INSTRUCTION MANUAL

Orion SkyQuest™ XX12g, XX14g GoTo Truss Tube Dobsonians

#8953 XX12g, #8954 XX14g

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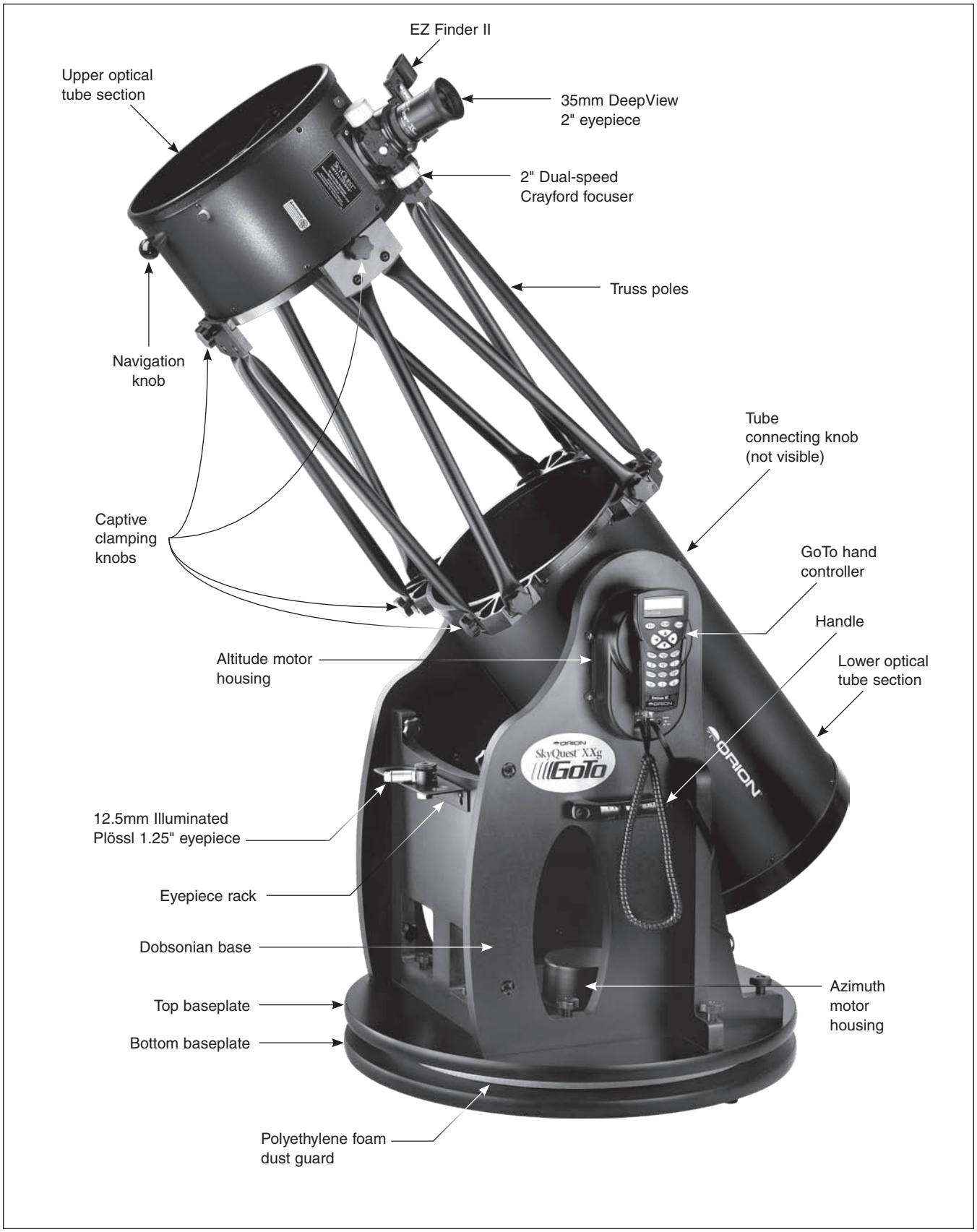

Figure 1. Overview of SkyQuest XXg Dobsonian (XX12g shown)

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WARNING: Never look directly at the Sun through your telescope or its finder scope – even for an instant – without a professionally made solar filter that completely covers the front of the instrument, or permanent eye damage could result. Young children should use this telescope only with adult supervision.

Congratulations on your purchase of an Orion SkyQuest XXg GoTo Dobsonian. XXg GoTo Dobs combine large-aperture optical performance with state-of-the-art computerized GoTo pointing capability. Moreover, these big telescopes were designed by Orion to be remarkably transportable – both their base and optical tube break down into easily manageable components that can fit into any standard size vehicle. Setup for an observing session takes just minutes, and the views are spectacular! We know you will enjoy many years of rewarding observations with your SkyQuest XXg GoTo Truss Dobsonian.

Please read these instructions thoroughly before beginning assembly and subsequent use of the telescope.

NOTE: The XX12g and XX14g are similar telescopes, but do have some differences (in addition to their apertures). For the purposes of this manual, the XX12g will be referenced primarily. References to the XX14g's assembly and use will be made as needed to highlight any differences from the XX12g.

1. Unpacking

The SkyQuest XX12g is packed in three boxes, one containing the optical tube assembly (OTA) and accessories, a second containing the unassembled Dobsonian base, and third containing the primary mirror and mirror cell. The XX14g model has a fourth box containing the truss poles (which for the XX12g are included in the OTA box).

Before beginning assembly, unpack each box and confirm that all of the parts in the Parts List below are present. The parts are listed by the box they should arrive in, but some of the parts may be in different boxes than indicated below. Be sure to check all boxes carefully, as some parts are small. If anything appears to be missing or broken, immediately call Orion Customer Support (800-676-1343) or email support@telescope.com for assistance.

Parts List

Box #1: Optical Tube Assembly and Accessories (Figure 2)

Qty.	*Description*
1	Lower optical tube section
1	Upper optical tube section
2	Optical tube dust covers (one for each tube section)
4	Truss pole pairs (XX12g only; poles for XX14g come in separate box)
1	DeepView 35mm eyepiece, 2" barrel diameter
1	Illuminated 12.5mm Plössl eyepiece, 1.25" barrel diameter
1	EZ Finder (with bracket)
1	Collimation cap
1	Eyepiece rack
2	Eyepiece rack wood screws (20mm long, color black)
3	Hex keys (2mm, 2.5mm, 4mm)
1	Tube connecting knob
1	Hand controller bracket (with 2 assembly screws)
3	Counterweight mounting bolts (XX14g only)
6	Counterweights, 2.2 lbs. ea. (XX14g only)
1	Cooling accelerator fan with battery holder (XX12g only)
1	Instruction manual (not shown)
1	Starry Night CD-ROM

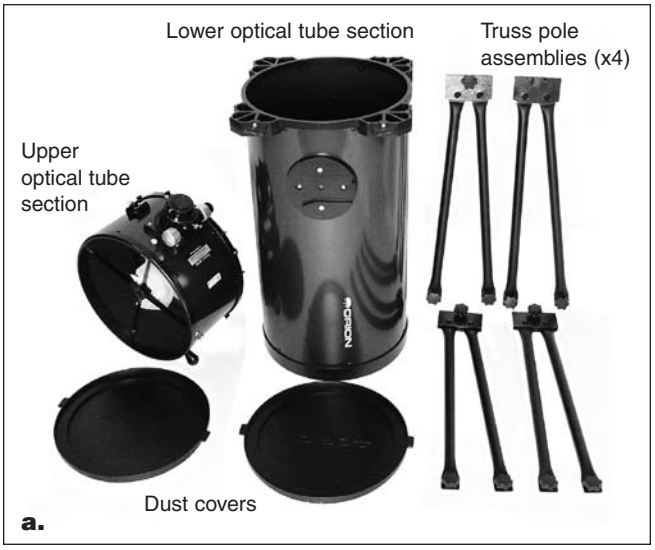
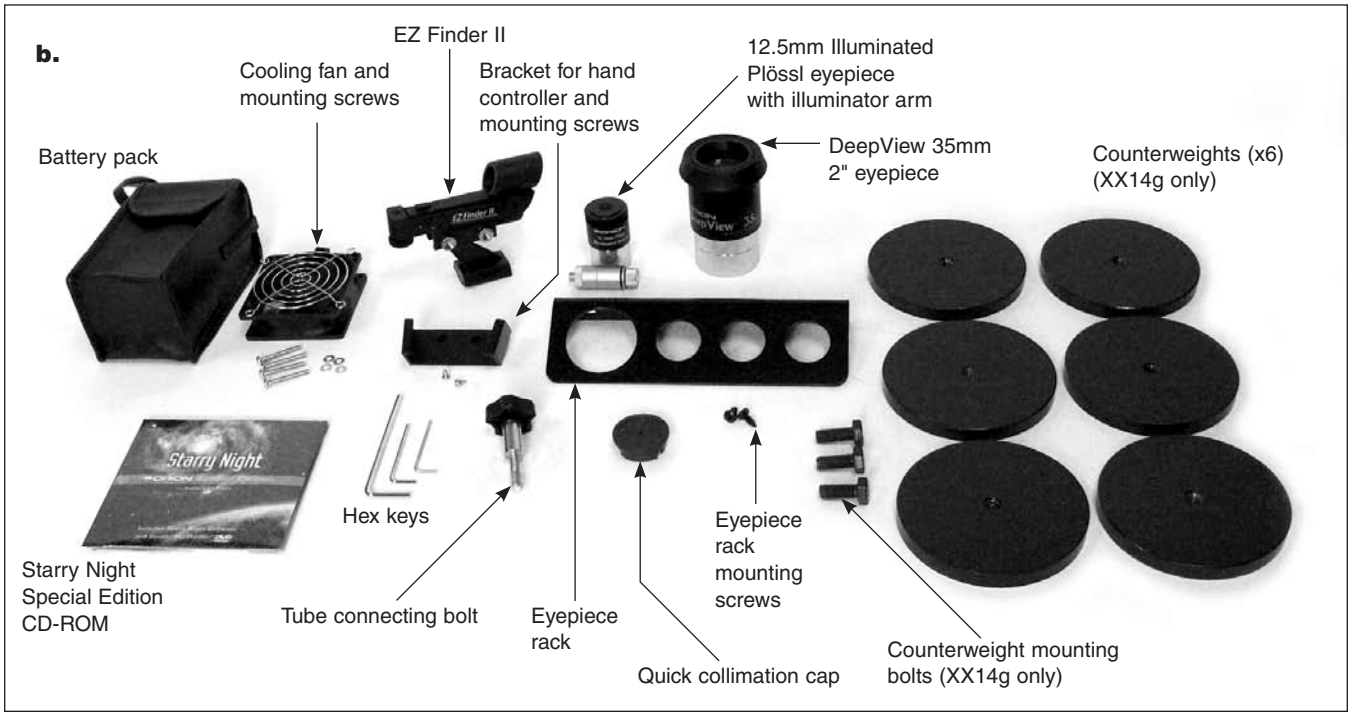


Figure 2. Contents of the optical tube box. **a)** The larger components. **b)** Accessories and hardware.



Box #2: Dobsonian Base (Figure 3)

Qty.	*Description*
1	Left side panel (with altitude motor and encoders pre-installed)
1	Right side panel
1	Front panel
2	Side braces
1	Baseplate assembly (with azimuth motor and encoders pre-installed)
6	Base assembly wood screws (coarse thread, 47mm long)
12	Base connecting bolts with hand knobs
12	Rubber retaining washers
12	Spacers for connecting bolts (10mm long, 15mm dia.)
1	Insertion tube for rubber retaining washers (~3" long)
2	Carrying handles
4	Handle mounting bolts (socket head cap screws)
3	Hex keys (2mm, 4mm, 6mm)
3	Plastic feet (XX12g only; feet are pre-installed on XX14g)
3	Feet wood screws (1" long; XX12g only)
1	SynScan AZ hand controller
1	Hand controller cable (coiled)
1	Azimuth motor connection cable
1	RS-232 computer cable
1	DC power cable

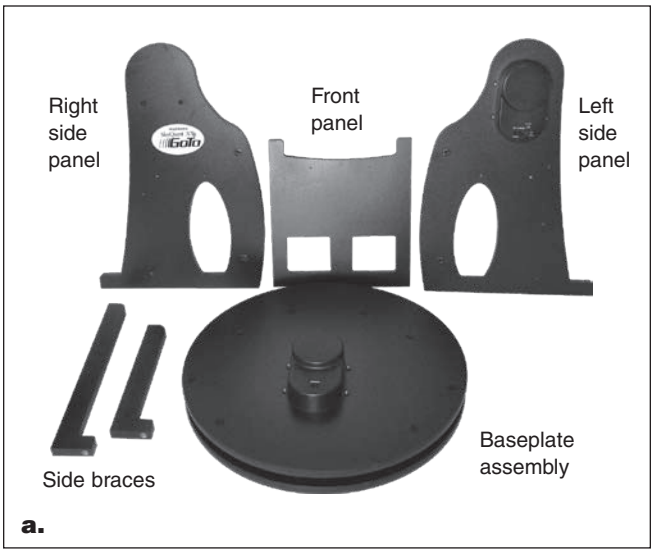
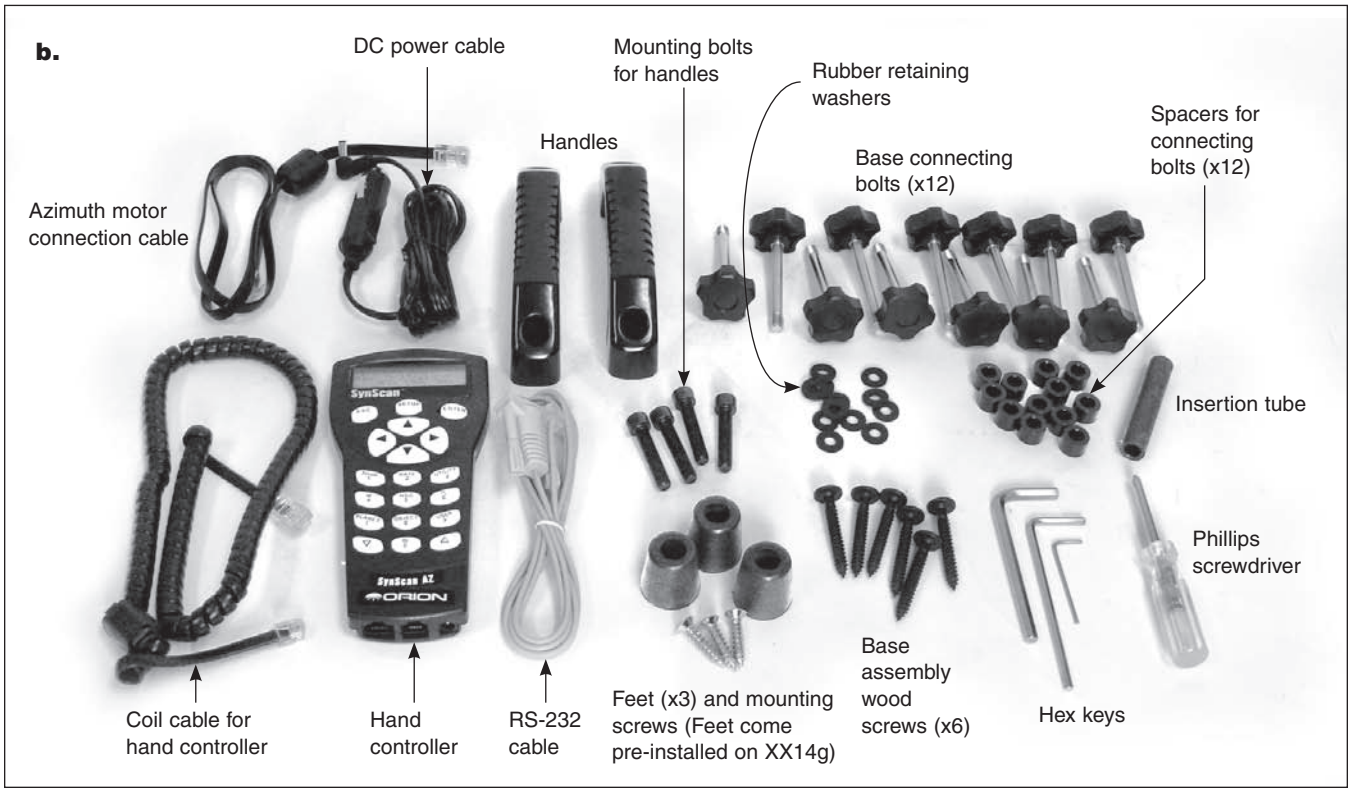


Figure 3. Contents of the base box. **a)** The larger components. **b)** The hand controller, cables, and other hardware.



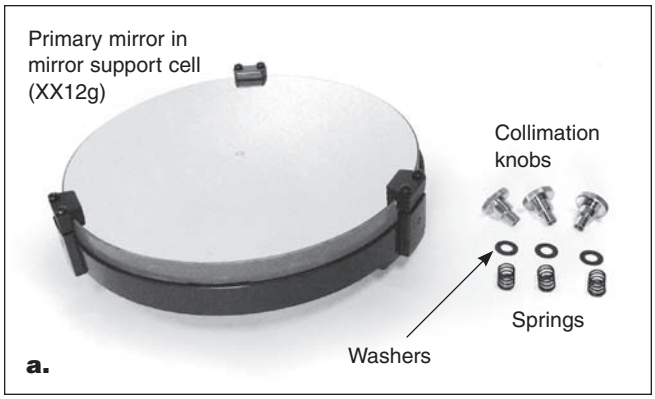


Figure 4. Contents of the primary mirror box. **a)** The primary mirror, mirror cell, and collimation hardware for the XX12g. **b)** The primary mirrors and mirror support cells for the XX12g (top) and XX14g are quite different.

Box #3: Primary Mirror and Cell (Figure 4)

Qty.	*Description*
1	Parabolic primary mirror (XX12g, flat back; XX14g, convex back) in mirror support cell
3	Collimation knobs
3	Nylon washers (3/4" outer diameter)
3	Springs

Box #4: Truss Pole Assemblies (XX14g only)

4	Truss pole pairs

2. Assembly

Now that you have unpacked the boxes and familiarized yourself with all the parts in front of you, it is time to begin assembly.

Initial Assembly of the GoTo Dobsonian Base

The GoTo bases of the SkyQuest XX12g and XX14g are shipped partially assembled for your convenience. All the motors, optical encoders, and gears are pre-installed at the factory. The two round baseplates are preassembled and should not be taken apart. Note that there is a protective ring of white polyethylene foam material between the two baseplates **(Figure 5)**. **Do not attempt to remove this material; it is glued in place. It is designed to keep dust out of the azimuth motor assembly and gears.**

When fully assembled, the SkyQuest XXg GoTo Truss Tube Dobsonians are big telescopes. But we designed them to break down into easily manageable components, none of which is too big or too heavy for a reasonably fit individual to lift and carry. In fact, both the base and the optical tube can be quickly disassembled into smaller components for transport and/or storage, then reassembled – all without tools! We'll get to the tube later, but for the base you'll see that it has four main components: the baseplate assembly (top and bottom baseplates and installed azimuth motor housing), the left side panel with installed altitude motor housing, the right side panel, and the front panel.

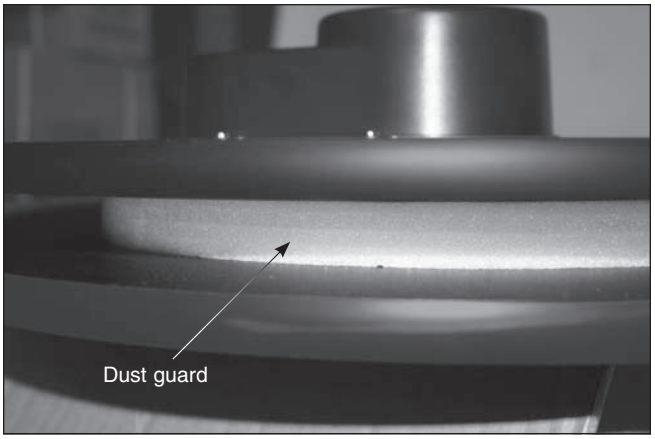


Figure 5. Polyethylene foam dust guard between top and bottom baseplates. DO NOT REMOVE!

For the initial assembly of the base, you will need a Philips screwdriver.

To install the feet (XX12g only; feet are pre-installed at the factory on the XX14g), turn the baseplate assembly upside-down and *gently* rest it on the azimuth motor housing on a clean, flat surface. Carpet is good, or you may want to place a cloth under the azimuth motor housing to avoid scratching it. Locate the three starter holes on the perimeter of the bottom baseplate **(Figure 6a).** Insert the screws through the feet and thread them into the predrilled starter holes **(Figure 6b)** with a Phillips screwdriver until tight.

1. Connect the side braces to the side panels using three base assembly screws for each panel **(Figure 7).** The brace should be attached to the outside surface of the side panel – the outside of the left side panel has the altitude motor housing attached; the outside of the right side panel bears the SkyQuest XXg label. The screws go through the holes in the side panels and thread into the starter holes in the side braces. Use the included 4mm hex key to firmly tighten the screws, but *be careful not to strip the holes by over-tightening!*
2. Now you will install the captive connecting bolts, each of which is already fitted with a black hand knob. There are 12 connecting bolts altogether; refer to **Figure 8** for loca-

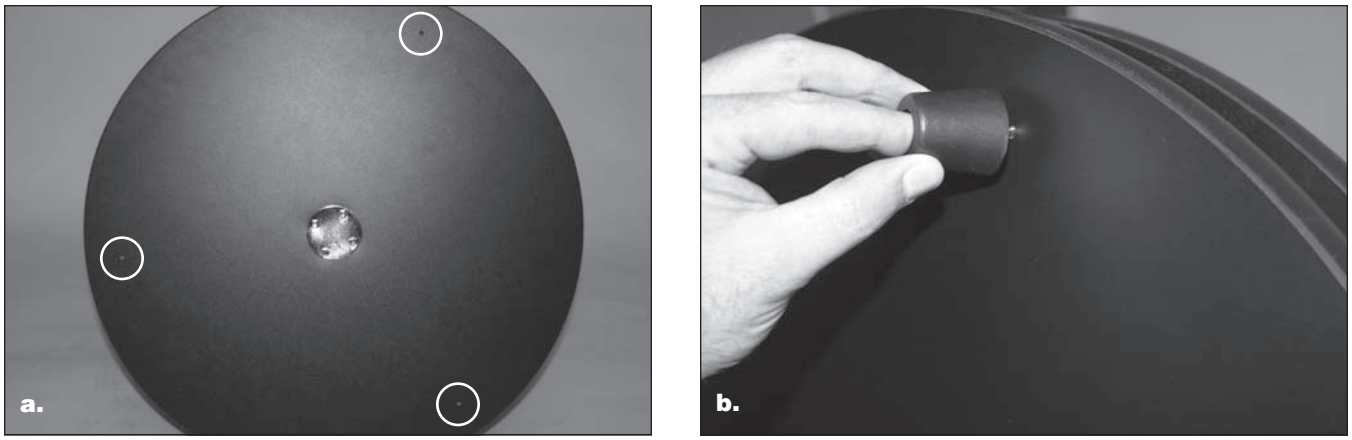


Figure 6. a) Starter holes for feet on bottom baseplate. **b)** Attaching the base feet.

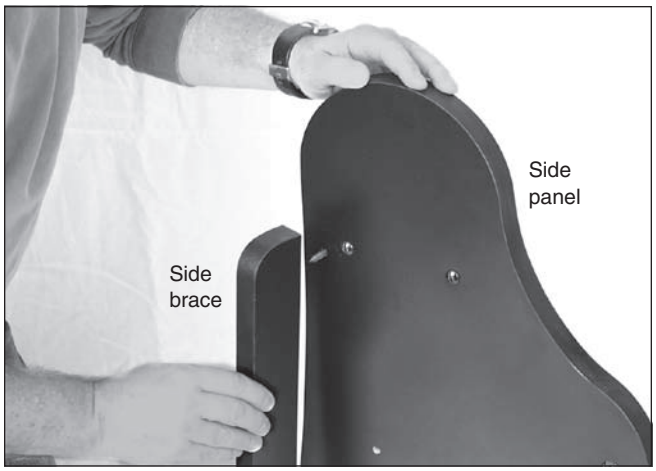


Figure 7. Attach a side brace to the outside of each side panel using three base assembly wood screws and the 4mm hex key. On the XX12g, the left side brace is shorter than the right side brace. On the XX14g, the side braces are the same length.

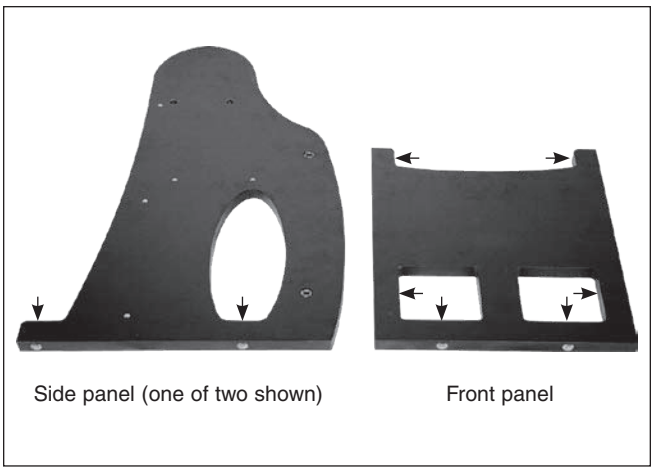


Figure 8. Locations for insertion of connecting bolts in the front and side panels (one side panel and side braces not shown). Connecting bolts should be inserted in the predrilled holes in the direction indicated by the arrows.

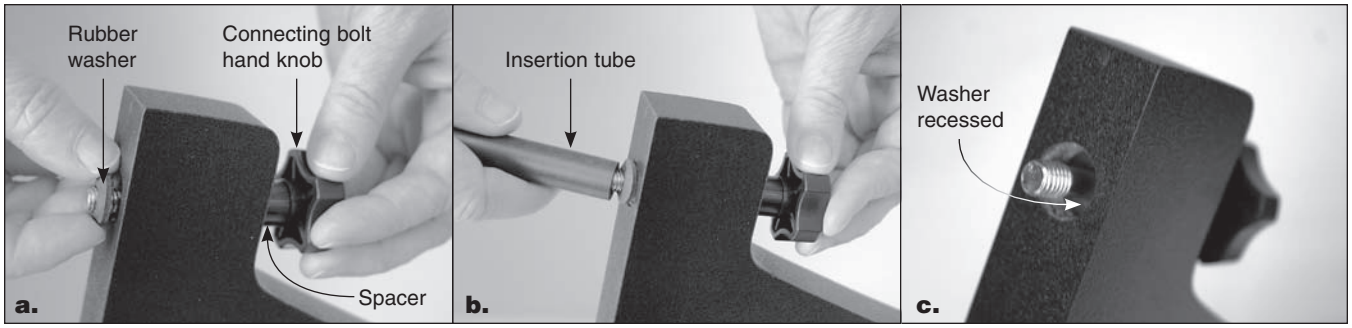


Figure 9. (a) Place a rubber washer on the threaded end of the connecting bolt and push it on as far as you can with your fingers. **(b)** Then use the included insertion tube to push the washer past the threads on the bolt and up into the counterbored hole in the wood. **(c)** The recessed washer will keep the bolt captive in the hole.

tions. Start with the front panel, which has through holes for six connecting bolts.

3. First, slide a spacer onto a collecting bolt. Then insert the connecting bolt into the through hole, in the direction indicated in **Figure 8**. Holding the knob with one hand, use your other hand to press a rubber washer over the threaded (protruding) end of the bolt. It will be a tight fit; you may have to work the washer a bit to get it on. Push the washer up on the bolt as far as you can with your fingers **(Figure 9a).** Then place the insertion tube on the bolt **(Figure 9b)** and use it to push the washer farther up on the bolt, into the counterbored hole in the wood

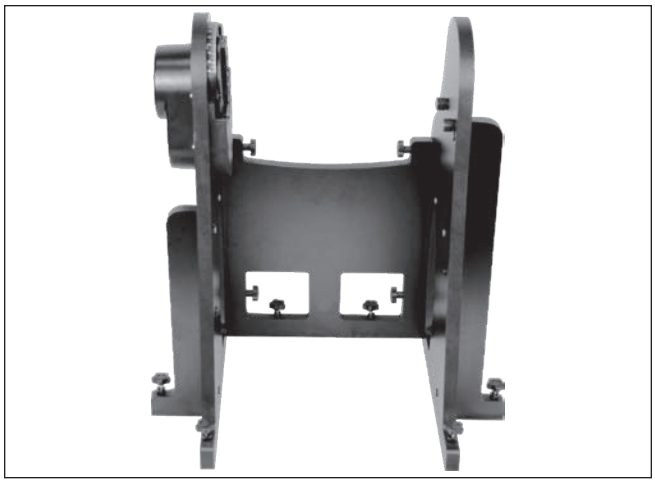


Figure 10. The completed side panel and front panel assembly

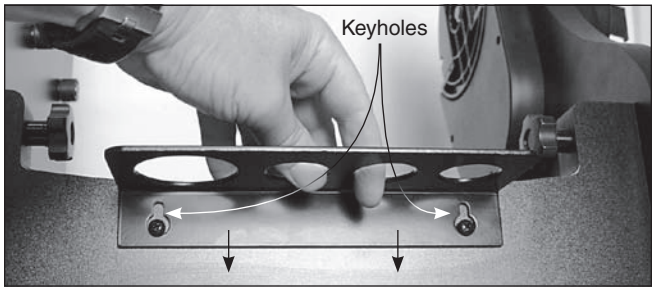


Figure 11. Place the large opening of the "keyhole" slots in the eyepiece rack over the mounting screw heads, then push the rack downward. To do this, leave about 1/8" gap between the heads of the mounting screws and the panel surface. After the rack is installed, you can tighten the screws to secure it in place.

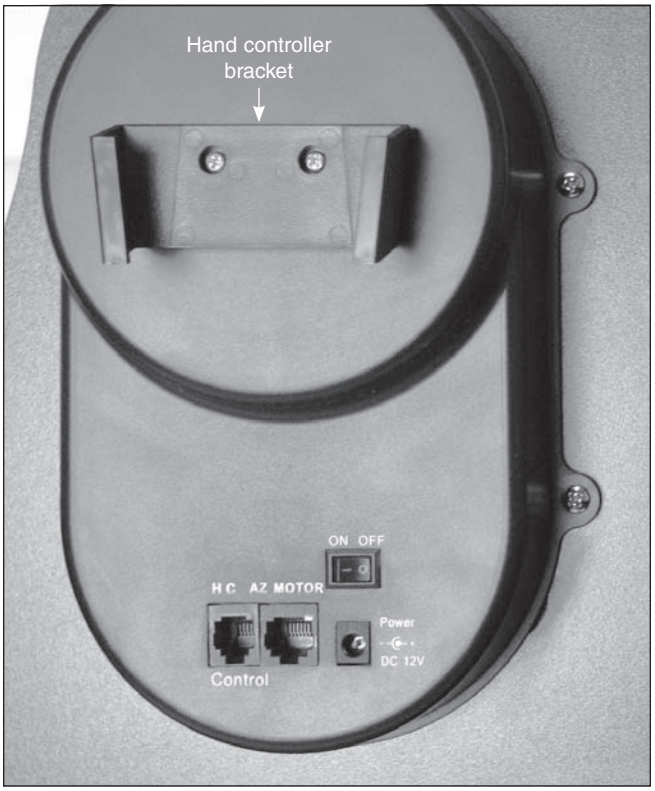


Figure 12. Altitude motor housing with hand controller bracket installed

(Figure 9c). The washer will keep the bolt captive when it is fully disengaged from the mating part of the base. Repeat this procedure for the other five connecting bolts to be installed in the front panel, and for the six additional connecting bolts that attach the side panels and side braces to the top baseplate.

4. Now attach the front brace to the two side panels with four captive connecting bolts. Use the hand knob to screw each bolt into the threaded metal receptacle recessed in the side panel. The side panels should be oriented so the side braces are facing outward. The front panel should be oriented so that the two pilot holes for the eyepiece rack face outward. Do not completely tighten the connecting bolts yet. The completed assembly should look like **Figure 10.**

5. Place the assembled side panel/front panel structure on the top baseplate, aligning the protruding connecting bolts with the threaded inserts in the baseplate. Turn the connecting bolt hand knobs to fasten the side panel/front panel structure to the baseplate. Firmly tighten all 12 connecting bolts installed in steps 3 and 4. To avoid stripping the threads, do not overtighten.

6. Attach a handle on each of the two side panels. Insert a large socket head cap screw through the holes in the handle and into the predrilled hole in the side panel. The hole has a flanged threaded metal insert in it. Use the 6mm hex key to thread the screw into the insert until tight. Refer to **Figure 1** for handle placement.

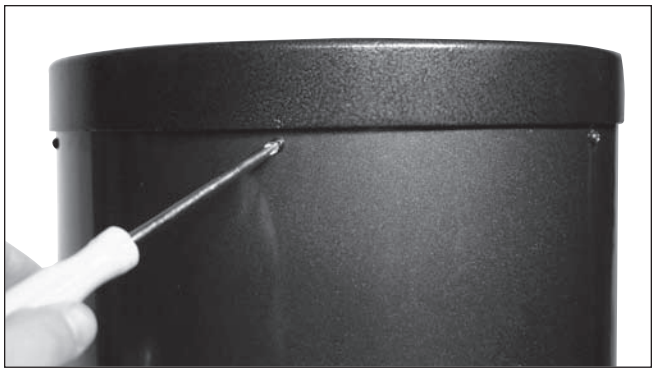


Figure 13. To remove the rear end ring, unthread the Phillips screws that attach it to the tube.

Figure 14. Thread the three hex-head counterweight mounting bolts (XX14g only) into the holes in counterweight support plates as shown. Tighten using an adjustable or 16mm crescent wrench.

7. The aluminum eyepiece rack holds three 1.25" eyepieces and one 2" eyepiece in a convenient place on the base, within easy reach while you are observing. To attach the eyepiece rack, locate the two small pilot holes on the front panel. Thread the small Phillips-head screws into the holes until the screw head is about 1/8" from the panel's surface. Now place the wide part of the "keyhole" on the eyepiece rack over the screw heads and slide it downward so the narrow portion of the keyhole is under the screws. Tighten the screws to secure the rack in place. See **Figure 11**.
8. The XXg base includes a bracket that holds the hand controller when it's not in use. The bracket mounts on the altitude motor housing **(Figure 12).** Locate the two small pilot holes and attach the bracket using the small screws included with the bracket until just barely tight. *Do not over-tighten these screws or you'll strip the holes!*
9. Now install the azimuth motor connection cable. It is a flat cable that has an 8-pin RJ-45 plug on both ends. Plug one end into the jack on the azimuth motor housing on the top baseplate; plug the other end into the jack labeled AZ MOTOR on the altitude motor housing **(Figure 12).**
10. Finally, connect the GoTo hand controller. Plug the wide RJ-45 connector on the coiled hand controller cable into the corresponding port on the hand controller. Plug the smaller RJ-12 connector into the port labeled HC on the altitude motor housing **(Figure 12).**

Initial Assembly of the Optical Tube

The primary mirror is shipped in its metal support cell separately from the optical tube, to prevent possible damage to both the mirror and the optical tube. Once the primary mirror is installed, there will be no need to remove it except if cleaning is necessary (see Section 11, "Care & Maintenance"). First, the mirror will be installed in the tube, then the upper and lower sections of the tube will be assembled with the truss poles.

The primary mirror of the XX12g has the typical flat back side, whereas the thinner primary of the XX14g has a molded, convex back with raised "spokes" radiating from the center for added strength. The reduced-mass design of the XX14g's mirror allows more-efficient equilibration to outdoor ambient temperature. Both mirrors have a small adhesive ring placed in the exact center; it aids in achieving a precise collimation, which will be covered later. The ring should not be removed.

1. To install the mirror cell in the optical tube, the rear end ring attached to the lower section of the optical tube must first be removed. This is done by unthreading and removing the six Phillips-head screws (eight on the XX14g) that attach the end ring to the tube **(Figure 13),** and then pulling the end ring off of the tube.

Warning: Once the rear end ring is removed from the tube, the raw edge of the tube itself will be exposed. Be careful not to cut or otherwise hurt yourself on the tube's edge. Also, be careful not to pinch your fingers when attaching the assembled mirror cell onto the tube.

2. For the XX14g (only), thread the three counterweight mounting bolts into their respective holes in the rear end ring, as shown in **Figure 14.** Use an adjustable wrench or a 16mm crescent wrench to tighten the bolts. Do not install the counterweights yet.

3. Next, assemble the telescope's rear end ring to the primary mirror cell. Find a clean, flat surface, and turn the mirror cell over so that the mirror is facing downward. For the XX14g, we recommend placing a soft towel on a flat surface and placing the mirror face down on the towel, because the aluminized outer edge of the mirror *will* contact the surface. With the XX12g mirror, on the other hand, the aluminized mirror itself will not make contact with the surface; only the mirror retaining clips will.

   Place the three springs onto the three exposed threaded shafts **(Figure 15a).** Lower the end ring onto the mirror cell so the threaded shafts pass through it, and the end ring rests on the springs **(Figure 15b).** Add a nylon washer to each collimation knob and thread the collimation knobs through the end ring and onto the threaded shafts (**Figure 15c**). Make sure the knobs have at least three full turns of engagement on the shafts. The mirror cell is now almost ready to be installed onto the lower tube section.

4. Check to make sure that the three mirror retaining clips are properly tensioned (XX12g only). If they are too tight, the pinching of the mirror's edge will distort the images you see through the telescope. But if they are too loose, the mirror could shift or even fall out if it is tilted severely. With the mirror in its cell facing up, use a Phillips screwdriver to loosen the two screws on one of the clips until you can easily move the small metal plate underneath the screw heads. Then gradually tighten both screws just until the metal plate is no longer loose. Repeat this with the other two retaining clips. Now the clips are properly tensioned.

5. Assembling the end ring (and mirror assembly) back onto the tube can be a bit tricky. This is because the large diameter and thin metal of the tube will cause the tube to become somewhat out of round once the end ring is removed. To assemble the rear end ring (with mirror and mirror cell now connected) to the tube, stand the lower section of the tube up vertically so the raw edge of the tube is up. Line up the threaded holes in the edge of the end ring with the holes in the end of the tube. Then, lower the entire assembly onto the tube. (Be careful to avoid finger pinching during this step!) There may be a bulge in the perimeter of the tube that prevents the end ring from fully seating onto the tube **(Figure 16).** Press against this bulge, and the entire mirror cell assembly should seat onto the tube. Now, replace the eight Phillips screws that connect the rear end ring to the tube.

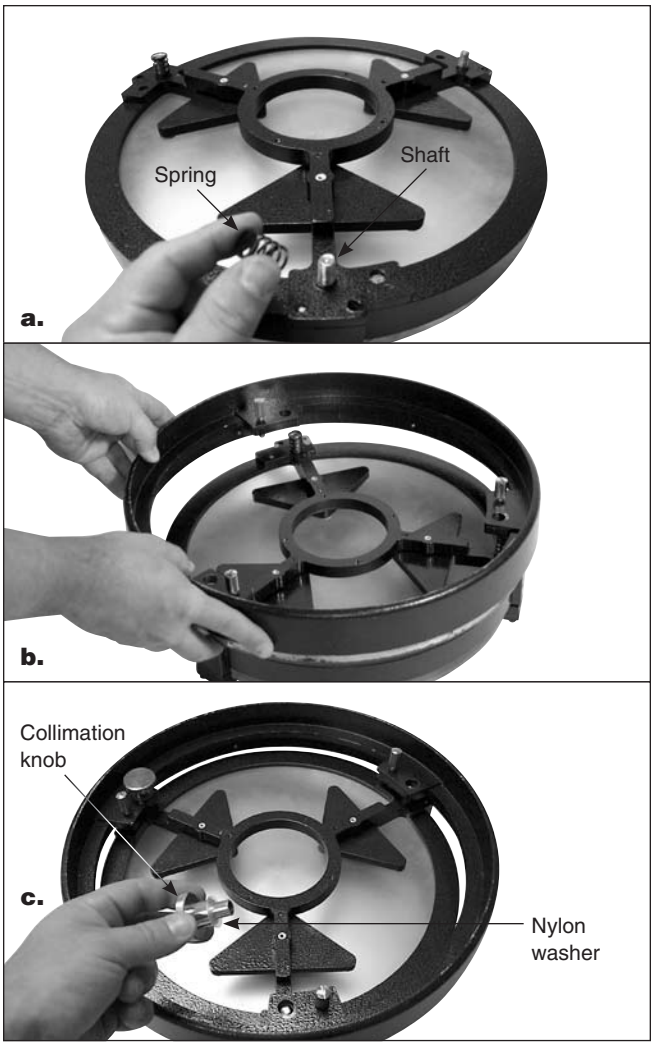


Figure 15. a) Place the three springs on the exposed threaded shafts of the mirror cell. **b)** Lower the rear end ring onto the mirror cell so that the threaded shafts pass through the end ring, and the end ring rests on the springs. **c)** Thread the collimation knobs, with nylon washers attached, through the rear end ring and onto the threaded shafts.

Figure 16. Locate the area of tube that is bulging out and preventing the end ring from fully seating. Press on this bulge to allow the mirror cell to seat properly on the tube. Be careful not to pinch fingers!

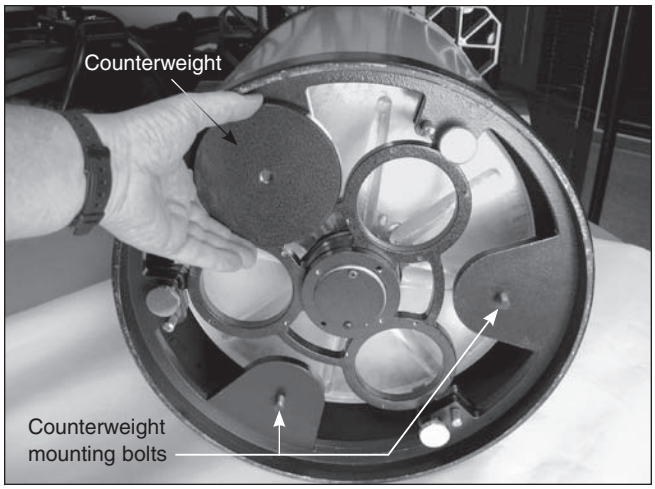


Figure 17. Installing counterweights (XX14g only). Thread two 2.2-lb. counterweights onto each counterweight mounting bolt for proper tube balance.

Before assembling the rest of the optical tube, you should consider how – or rather, when – you want to mount the optical tube on the base. You can mount just the lower tube section on the base – minus the poles and upper tube section – THEN finish the assembly of the tube with the lower section already in place on the base. Alternatively, you could complete the assembly of the optical tube first, then hoist the whole thing onto the base. You may find it easier to lift the lower tube section only and guide it onto its resting place on the base's altitude trunnion than hoisting and mounting the fully assembled optical tube, especially for the heavier XX14g.

If you want to mount the lower tube section only on the base, skip to the next section, "Mounting the Optical Tube on the Dobsonian Base" now. If you want to complete the assembly of the tube before mounting it on the base, continue to step 6.

6. Now, the upper and lower sections of the tube will be connected with the four truss pole assemblies. This is a procedure that will be done whenever the telescope has been disassembled for transport or storage. It is very easy to do, and should only take a couple of minutes. For the XX14g (only), start by installing at least three of the six counterweights onto the rear cell of the lower tube section. (The XX12g does not utilize counterweights.) Installing the counterweights now will make the tube heavier to lift, but they will ensure that the tube isn't too front-heavy when mounted onto the base, which could damage components of the optical tube or base if it were to swing downward rapidly. Three counterweights will be sufficient; the other three can be installed after the tube is mounted on the base. To install the counterweights, gently lay the lower section of the optical tube on its side, then thread one counterweight onto each of the three counterweight mounting bolts **(Figure 17).** Then return the lower tube section to the vertical position.

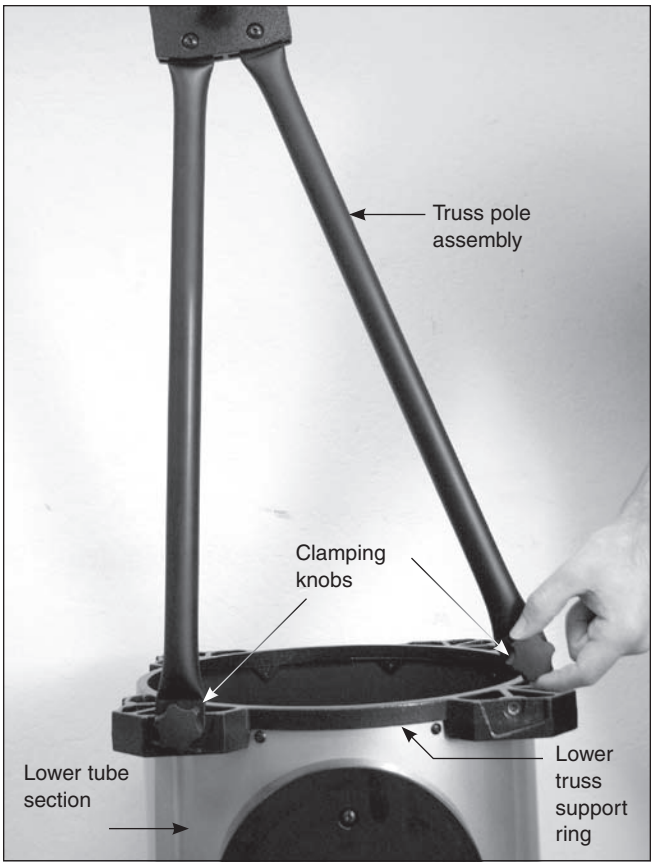


Figure 18. The clamping knobs on the ends of the truss pole assemblies thread into the holes in the lower truss support ring on the lower tube section.

7. Now, connect the eight captive clamping knobs on the ends of the pole assemblies to the lower truss support ring on the lower optical tube section **(Figure 18).** This is done by simply threading the knobs into the holes in the ring. Do not completely tighten the knobs just yet.

8. Attach the upper tube section to the four truss connectors at the top of the poles. Orient the upper tube section as shown in **Figure 19.** Hold the upper tube section with one hand while threading the knobs in the truss connectors into the holes in the upper truss support ring. If necessary, you can slightly adjust the position of the truss connector with respect to the pole ends in order to have the knobs and holes line up **(Figure 20).** When tightened, the knob will clamp the truss connector against the registration flats on the upper truss support ring **(Figure 21).** Repeat this for the other three truss connectors. Firmly tighten the knobs.
9. Now go back and firmly tighten the eight clamping knobs on the lower truss support ring.

If, after assembling, the truss poles are loose within the truss connectors, use the supplied 4mm hex key to tighten the button head cap screws that connect the poles to the truss connectors (see **Figure 20**). This should rarely need to be done.

The telescope is now assembled and ready to be mounted on the Dobsonian base.

Mounting the Optical Tube on the Dobsonian Base

As mentioned in the section above, there are two ways you can mount the optical tube on the base: you can mount just the lower tube section before assembling the entire optical tube, or you can assemble the optical tube completely, then lift it onto the base.

Mounting the Lower Tube Section (Only) on the Base

1. The left altitude hub on the optical tube has a dovetail slot that slides into the altitude axis trunnion on the inside of the left side panel **(Figure 22).** We recommend orienting the trunnion such that the threaded hole for the tube connecting knob is facing upward. Then the telescope tube can be held horizontally and just lowered into the base by gently sliding the tube's altitude hub into the altitude trunnion on the base **(Figure 23).** If the altitude axis trunnion on the base is oriented differently, you'll have to adjust the angle of the telescope tube so the altitude hub slides into the altitude axis trunnion. (The altitude axis trunnion may be too difficult to rotate by hand to adjust its orientation.) Once seated in the base, the tube will freely rotate to a vertical position due to its bottom-heavy imbalance. That's OK. The tube should now be resting in a vertical position in the base **(Figure 24).**
2. Now insert and tighten the tube connecting knob to secure the tube in place **(Figure 25).**
3. For the XX14g, before assembling the rest of the optical tube, it is recommended that you install the counterweights on the rear cell so that the tube, when assembled, will be properly balanced rather than front-heavy. (The XX12g does not utilize counterweights.) There are six counterweight disks, each weighing 2.2 lbs. Tilt the lower tube section as needed to access the rear cell, and while holding it up, thread two counterweights onto each of the three counterweight mounting bolts.

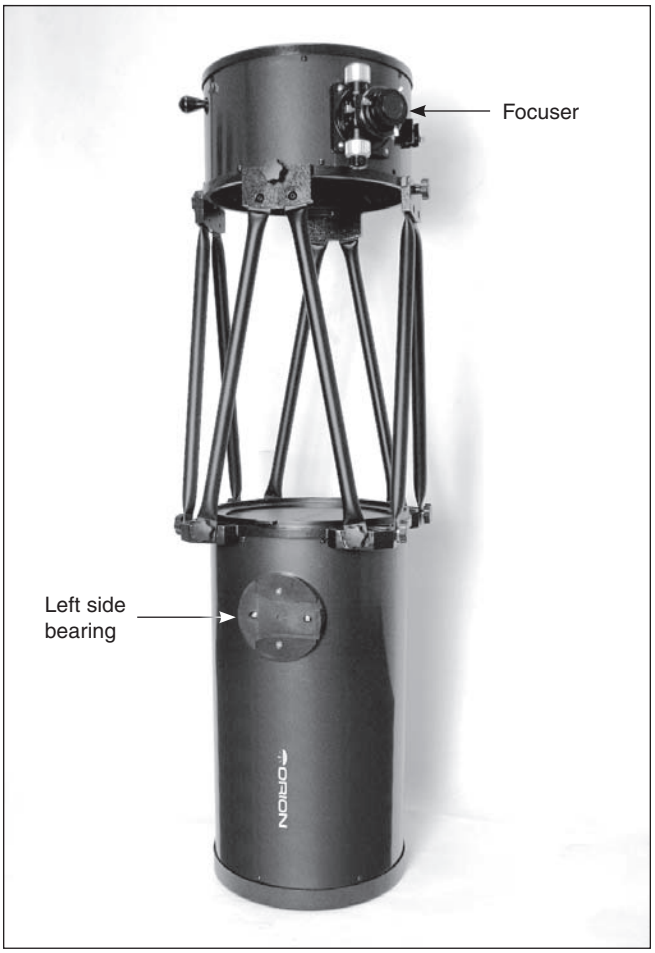


Figure 19. The upper tube section should be oriented relative to the lower tube section as shown. Note the orientation of the focuser on the upper tube section relative to the left side bearing on the lower tube section.

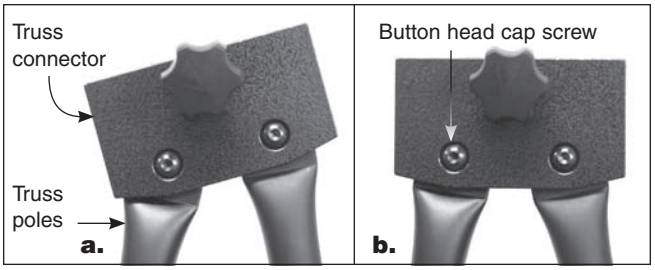


Figure 20. The position of the truss connectors relative to the pole ends can be adjusted to register the truss connectors with the upper truss support ring.

Now you're ready to assemble the rest of the optical tube. Refer to step 6 in the previous section, "Initial Assembly of the Optical Tube."

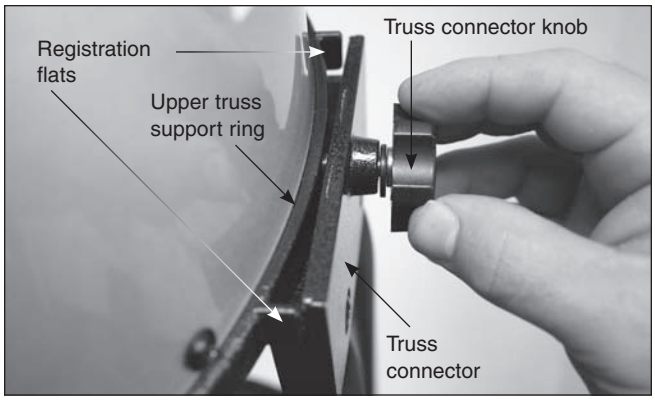


Figure 21. When the truss clamping knob is tightened, it will clamp the truss connector against the registration flats on the upper truss support ring.

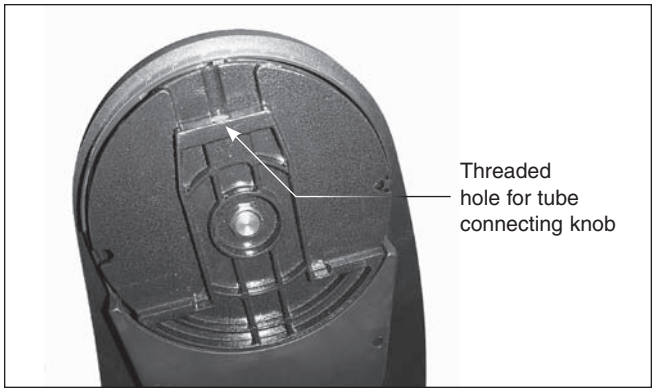


Figure 22. The cast-metal altitude axis trunnion on the left side panel of the base mates with the left side bearing on the telescope tube.

Mounting the Fully Assembled Optical Tube on the Base

The left altitude hub on the optical tube has a dovetail slot that slides into the altitude axis trunnion on the inside of the left side panel **(Figure 22).** We recommend orienting the trunnion such that the threaded hole for the tube connecting knob is facing upward. Then the telescope tube can be held horizontally and just lowered into the base by gently sliding the tube's altitude hub into the altitude trunnion on the base. If the altitude axis trunnion on the base is oriented differently, you'll have to adjust the angle of the telescope tube so you can slide it onto the altitude axis trunnion. (The altitude axis trunnion may be too difficult to rotate by hand to adjust its orientation.)

The tube assembly is heavy and bulky, especially for the XX14g. Get another person to help lift the tube in place if it is too heavy or unwieldy for you to do by yourself.

1. Grasp the rear end ring of the tube with one hand and one of the truss tubes with the other hand, as shown in **Figure 26**. Lift the optical tube and gently lower it down onto the base, sliding the tube's dovetail altitude hub into the mating receptacle of the altitude trunnion on the base.

Figure 23. Grasp both ends of the lower tube section to lift it, then lower it into the base, sliding the dovetail slot in the tube's left altitude hub onto the mating part of the metal trunnion on the base's left side panel.

Figure 24. bottom tube section resting vertically in base

2. Once the tube is seated in the base, insert and tighten the tube connecting knob to secure the tube in place **(Figure 25).**
3. Lastly, for the XX14g, install the remaining three counterweights on the rear cell of the lower tube section (if you only installed three in the "Initial Assembly of the Optical Tube" section). There should now be six counterweights installed on the rear cell – two on each of the three mounting bolts. These counterweights are not optional; they are needed on the XX14g to provide proper balance of the optical tube.

Accessory Installation

Now that the base is assembled and the optical tube installed, all that remains is to attach the EZ Finder II reflex sight and pop an eyepiece into the focuser.

EZ Finder II

Using the included dovetail mounting bracket, the EZ Finder II will slip neatly into the dovetail base pre-installed on the upper tube section adjacent to the focuser. The EZ Finder II arrives attached to the mounting bracket. Just slide the dovetail mounting bracket into the telescope's dovetail mounting base and tighten the thumbscrew on the base to secure the mounting bracket.

Operating the EZ Finder II

The EZ Finder II works by projecting a tiny red dot (it is not a laser beam) onto a lens mounted in the front of the unit. When you look through the EZ Finder II, the red dot will appear to float in space, helping you to pinpoint your target object. The red dot is produced by a light-emitting diode (LED) near the rear of the sight. A 3-volt lithium battery provides the power for the diode. Turn the power knob **(see Figure 27)** clockwise until you hear the "click" indicating that power has been turned on. Look through the back of the reflex sight with both eyes open to see the red dot. Position your eye at a comfortable distance from the back of the sight. In daylight you may need to cover the front of the sight with your hand to be able to see the dot, which is purposefully quite dim. The intensity of the dot is adjusted by turning the power knob. For best results when stargazing, use the dimmest possible setting that allows you to see the dot without difficulty. Typically a dimmer setting is used under dark skies and a brighter setting is needed under light-polluted skies or in daylight.

Aligning the EZ Finder II

When the EZ Finder II is properly aligned with the telescope, an object that is centered on the EZ Finder II's red dot should also appear in the center of the field of view of the telescope's eyepiece. Alignment of the EZ Finder II is easiest during daylight, before observing at night. Aim the telescope at a distant object such as a telephone pole or roof chimney and center it in the telescope's eyepiece. The object should be at least 1/4 mile away. Now, with the EZ Finder II turned on, look though the EZ Finder II. The object should appear in the field of view. Without moving the main telescope, use the EZ Finder II's azimuth (left/right) and altitude (up/down) adjustment knobs

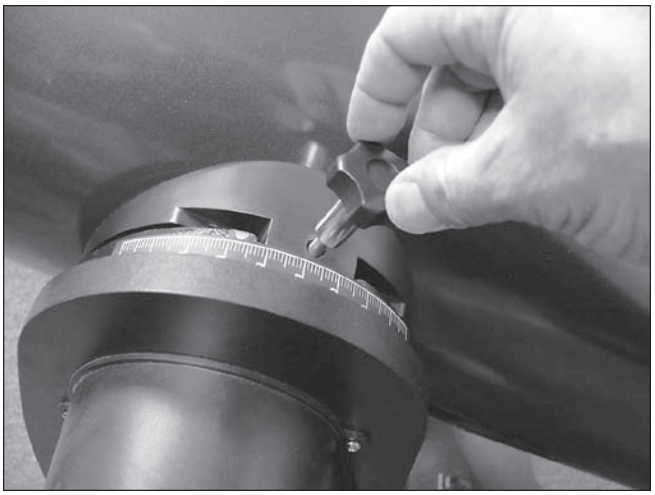


Figure 25. Secure the tube to the base with the tube connecting knob.

Figure 26. To mount the fully assembled tube assembly onto the base, grasp the rear of the scope with one hand and one of the truss poles with the other. Holding the telescope in a horizontal orientation, lower it into the base, sliding the dovetail slot in the tube's left altitude bearing onto the mating part of the metal trunnion on the left side panel.

(see Figure 27) to position the red dot on the object in the eyepiece. When the red dot is centered on the distant object, check to make sure that the object is still centered in the telescope's field of view. If not, re-center it and adjust the EZ Finder II's alignment again. When the object is centered in the eyepiece and on the EZ Finder's red dot, the EZ Finder II is properly aligned with the telescope. Once aligned, the EZ Finder II will usually hold its alignment even after being removed and remounted. Otherwise, only minimal realignment will be needed. At the end of your observing session, be sure to turn the power knob counterclockwise until it clicks off. When the white dots on the EZ Finder II's body and power knob are lined up, the EZ Finder II is turned off.

Replacing the Battery

Should the battery ever die, replacement 3-volt lithium batteries are available from many retail outlets. Remove the old battery by inserting a small flat-head screwdriver into the slot

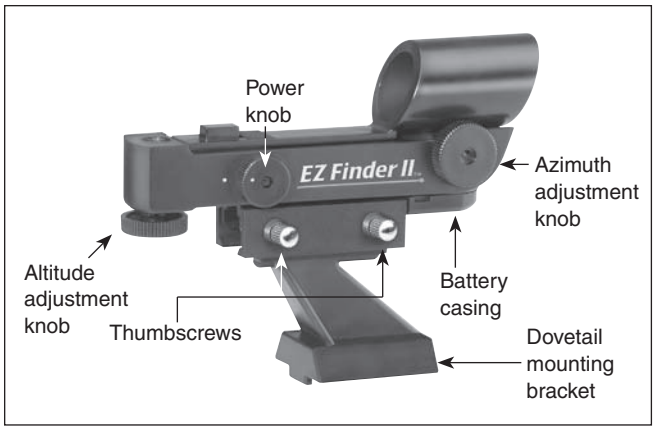


Figure 27. The EZ Finder II reflex sight.

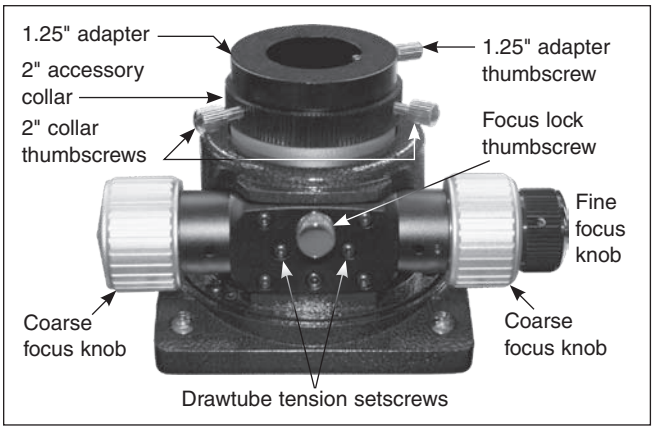


Figure 28. Detail of the dual-speed focuser.

on the battery casing **(Figure 27)** and gently prying open the case. Then carefully pull back on the retaining clip and remove the old battery. Do not over-bend the retaining clip. Then slide the new battery under the battery lead with the positive (+) end facing down and replace the battery casing.

Using Eyepieces

The final step in the assembly process is to insert an eyepiece into the telescope's focuser. First, take the cover cap off the focuser drawtube. To use the 2" DeepView eyepiece, loosen the two thumb screws on the 2" accessory collar (on the end of the focuser drawtube) and remove the 1.25" adapter. Then place the 2" eyepiece directly into the 2" accessory collar and secure it with the two thumb screws loosened previously **(Figure 28).** The other eyepiece and 1.25" adapter can be placed in the eyepiece rack until they are needed.

To install the 1.25" Illuminated Plössl eyepiece instead of the 2" DeepView eyepiece, keep the 1.25" adapter in the focuser, and make sure the two thumb screws on the 2" adapter are tightened. Now, loosen the thumb screw on the 1.25" adapter, do not loosen the two thumb screws on the 2" adapter. Insert the 1.25" eyepiece into the 1.25" eyepiece adapter, and secure it by retightening the thumb screw on the 1.25" eyepiece adapter **(Figure 28).** The other eyepiece can be placed in the eyepiece rack until it is needed.

The basic assembly of your SkyQuest XXg Dobsonian is now complete. It should appear as shown in **Figure 1.** Keep the dust cap in place on the bottom tube section when the telescope is not in use, to minimize the accumulation of dust on the primary mirror. It is also a good idea to store eyepieces in an eyepiece case and to replace the cover cap on the focuser when the telescope is idle.

3. Tips for Transporting Your XXg

The SkyQuest XX12g and XX14g GoTo Truss Dobsonians are big scopes, but they were designed with portability in mind. For both telescopes, the optical tube *and* the GoTo base break down *without tools* into easily manageable components for transporting to and from your favorite observing site in a standard-sized vehicle, or for more convenient storage in your home or garage.

A fit individual should have no trouble setting up, dismantling, or carrying the components of an XX12g or XX14g Dobsonian short distances *without assistance.* Of course, having a helper will facilitate these activities, but if or when you find yourself on your own for an evening observing session, you'll be just fine!

The truss tube disassembles into a small front tube section including the secondary mirror and focuser, rear tube section housing the primary mirror cell, and four truss-pole pairs. The base disassembles into four separate components: the baseplate assembly (top and bottom baseplates with azimuth motor and encoders installed), left side panel (with altitude motor and encoders installed), right side panel, and front panel. All the hardware has hand knobs for tool-free manipulation and is captive so that nothing will drop off and get dirty or lost in the dark.

Before transporting the telescope, remove the EZ Finder II (with bracket) and any eyepiece from the focuser. The eyepiece rack can also be removed from the base, if you wish. This will prevent these accessories from getting damaged during transport. These items can be placed in an optional accessory case.

To remove the optical tube from the base, first orient the tube so it is horizontal. Then unthread the tube connecting knob (see **Figure 25**) until it disengages from the metal dovetail trunnion on the base. You needn't unthread it completely from the telescope side bearing. Grasp the rear end ring of the tube with one hand and one of the truss poles with your other hand **(see Figure 26).** Then, using both hands, carefully lift the tube upward and off the base.

If possible, transport the bottom tube section containing the primary mirror in an upright position, i.e., with the rear end ring resting on the ground. Doing so will reduce stress on the mirror support system. We recommend transporting the tube assembly in the optional padded case set for proper protection.

Each time you assemble the optical tube for an observing session, you should check the optical collimation. It may not need any adjustment, but it could require a minor tweak to

dial it in precisely. See the section on collimation for details on how to collimate the optics.

4. The GoTo Hand Controller

The SkyQuest XXg features the SynScan AZ hand controller, which provides two different modes of operation:

AutoTracking Mode

The SkyQuest XXg base incorporates a quad-encoder design that records the position of the telescope relative to the sky. In the AutoTracking mode, after a quick initial alignment procedure, you can move the telescope manually, or electronically by using the directional buttons on the hand controller, to any position and the telescope will track the motion of the sky, keeping your viewing target in the eyepiece field of view indefinitely. Basically, this mode allows you to operate your Dobsonian in the traditional way, with the added bonus of automatic tracking.

GoTo Mode

GoTo mode provides automated, computerized object location, i.e., "GoTo" functionality to assist you in finding and enjoying thousands of night sky objects such as planets, nebulas, star clusters, galaxies, and more. You can slew the telescope automatically to any of 42,000 celestial objects, or take a preprogrammed tour the skies, with push-button simplicity. Once the scope has pinpointed your desired observing target, the telescope will track its motion, keeping it in the field of view. Even inexperienced astronomers will find themselves quickly mastering the variety of features the SynScan AZ GoTo system offers in just a few observing sessions.

Note also that after the initial alignment of the GoTo system, the SkyQuest XXg's closed-loop electronics allow you to move the telescope manually (by hand) without losing the alignment.

GoTo Hand Controller's Features and Functions

The GoTo hand controller **(Figure 29a)** allows direct access to all the motion controls of the telescope and a database with some 42,000 pre-set objects. The controller has a two-line, 16-character LCD screen that is backlit for comfortable viewing of the telescope information and scrolling text.

On the bottom end of the hand controller are three ports: a wide RJ-45 port for the cable that connects the hand controller to the GoTo base, an RJ-12 port that is used to connect the hand controller to a PC (with provided RS-232 cable) for firmware updates, and a DC power jack, which allows independent use of the hand controller for browsing the database or updating the firmware without connecting to the telescope **(Figure 29b)**.

***NOTE: The DC power port on the hand controller is for hand controller stand-alone applications only, such as updating the firmware without connecting to the telescope. For telescope operation, your 12V power source should be plugged into the 12V DC port on the Dobsonian base* (Figure 12).**

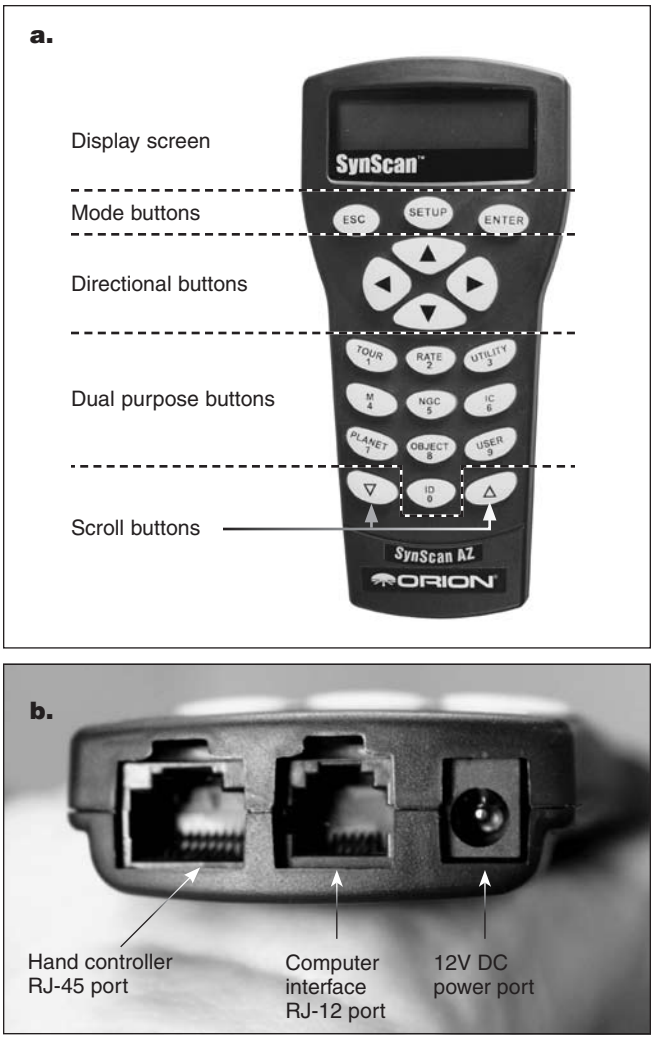


Figure 29. (a) The SynScan AZ hand controller's button layout. **(b)** The bottom end of the hand controller.

There are four main categories of control buttons on the GoTo hand controller **(Figure 29a)**:

1) Mode buttons

2) Directional buttons

3) Scroll buttons

4) Dual purpose buttons

Mode Buttons

The three mode buttons are located at the top of the controller, directly below the LCD display. They include the *ESC*, *ENTER*, and *SETUP* buttons:

The *ESC* button is used to escape from a certain command or to go back a level in the menu tree.

The *ENTER* button is used to select the functions and submenus in the menu tree, and to confirm certain functional operations.

The *SETUP* button is a quick hot key that takes you to the Setup submenu

Directional Buttons

The directional buttons allow the user to have complete control of the telescope at almost any step in the operation. These controls are locked out when the telescope is slewing to an object. The directional buttons are very helpful for the initial alignment of the GoTo system, for centering objects in the eyepiece field of view, and for manually slewing the telescope. The left and right directional buttons can also be used to move the text cursor when entering data on the hand controller.

Scroll Buttons

The up and down scroll buttons allow you to move up and down within the menu tree or selections displayed on the hand controller LCD.

Dual Purpose buttons

These buttons serve two distinct purposes: for data entry and as quick reference keys.

TOUR button: Takes you on a preset tour of the best night sky objects visible at the present time.

RATE button: Changes the speed of the motors when the directional buttons are pressed. There are 10 speeds to choose from, with 0 being the slowest and 9 being the fastest.

UTILITY button: "Hot key" access to the Utility Functions menu that provides useful tools in configuring your mount.

USER button: Gives access to up to 25 user-defined coordinates.

ID button: Identifies the object the telescope is currently pointing to.

NGC, IC, M, Planet, and Object buttons: Allow direct access to the database of objects in the most popular celestial catalogs and categories.

5. Setup for AutoTracking or GoTo Mode

Please review carefully the two setup methods outlined below. Once you have completed your initial setup you will need to perform an alignment procedure for GoTo pointing, or activate AutoTracking.

1. Place the telescope on a level surface. Having the telescope on level ground will aid tracking accuracy. However, you will still be able to take advantage of these features if you are on a slight incline.

2a. **[For AutoTracking Mode setup]** Locate the altitude scale on the inside of the left side panel. Position the optical tube horizontally so that the altitude scale is set to zero and aim the telescope North.

2b. **[For GoTo Mode setup]** Manually position the optical tube so it is pointing anywhere above the horizon.

[Steps 3 – 8 Apply to both AutoTracking and GoTo Mode setup]

3. Connect the hand controller to the base with the provided coil cable. Insert the RJ-12 connector of the cable into the jack labeled "HC" on the altitude motor housing **(see Figure 12)**. Plug the 12-volt DC power cable (connected to your 12-volt DC power source) into the Power jack on the altitude motor housing. Now flip the red power switch on the housing to the "ON" position.

4. The display will show the firmware version loaded on the device. Press *ENTER* to proceed. A warning will scroll across the screen about not viewing the Sun without proper equipment. After you have read this message press *ENTER*.

5. Enter the telescope's current latitudinal and longitudinal position using the numeric keypad and scroll buttons. First enter the longitudinal coordinate and hemisphere (W or E), followed by the latitudinal coordinate and hemisphere (N or S). If you do not know the latitude and longitude coordinate of your viewing location, do an online search or consult an atlas or geographical map of your area. Press *ENTER* to confirm your coordinates. The format you enter should look like this: 123° 04' W 49° 09'N.

NOTE: Latitude and longitude coordinates must be entered in degrees and arc-minutes. If your map or atlas gives coordinates in decimal values (i.e. latitude = 36.95 N) you must convert into degrees and arc-minutes. To do this simply multiply the decimal value by 60. If your viewing location is at latitude 36.95 N you would enter a latitude of 36°57' N [.95 x 60 = 57].

6. Enter the time zone in which you are observing in hours **(see Appendix A)**, using the scroll keys and numeric keypad (+ for east of Prime Meridian, – for west of Prime Meridian). Press *ENTER* to confirm your choice. The format you enter should look like this if you are in Pacific Standard Time (PST): -08:00.

7. Enter the date in the following format, mm/dd/yyyy, using the numeric keypad. Press *ENTER*.

8. Enter your current local time using the 24 hour time mode (example: 2:00PM = 14:00). Press *ENTER* to view the time you entered. If the time is incorrect, press *ESC* to go back to the previous screen. If the time is correct, press *ENTER* again to proceed to the next step.

9. After entering the current time, the hand controller will prompt "DAYLIGHT SAVING?". Use the scroll keys to make the selection and press ENTER to confirm.

10a. **[For AutoTracking Mode setup]** The LCD will now display "Begin Alignment?" Press "2 NO" (to bypass GoTo alignment) and follow the instructions in "Using the Telescope in AutoTracking Mode" below to turn on the automatic tracking.

10b. **[For GoTo Mode setup]** The LCD will now display "Begin Alignment?" Press "1 YES" and follow the instructions in Alignment for GoTo Operation to activate the computerized GoTo functionality.

NOTE: If a mistake was entered into the hand controller during the initial setup, press the ESC key to go back to the previous menu, and press ENTER to start again.

6. Using the Telescope in AutoTracking Mode

To activate AutoTracking, at the Choose Menu > Setup Mode prompt, press *ENTER*. At the Setup Menu prompt, scroll to Auto Tracking and press *ENTER* to activate automatic tracking.

The telescope is now tracking at the sidereal rate. The hand controller will display the coordinates corresponding to the direction the telescope is pointed. Use the scroll keys to switch between the following three coordinate formats: Celestial, Terrestrial, and Telescope mount coordinates. You may press *ESC* to exit from the AutoTracking mode at any time during tracking to browse or choose other functions provided by the hand controller. To return to the AutoTracking mode, choose "Auto Tracking " under *SETUP* menu and press *ENTER*.

NOTE: When the power is on, you may choose to adjust the telescope electronically by using the hand control or manually by pushing the tube with your hand. The telescope will calculate the coordinates for its position and display the information correctly on the hand controller.

NOTE: The hand controller's backlit display will become dimmer and the button Illumination will turn off if left idle for 30 seconds. Pressing any button will re-illuminate the display.

7. Alignment for GoTo Operation

Once the initial setup is complete, if you wish to take advantage of the GoTo functionality to accurately locate and point the telescope to objects in the sky, then the GoTo system must first be aligned on known positions (stars) in the sky. Use the supplied 12.5mm Illuminated Plössl Eyepiece to ensure accurate centering of the alignment stars. By performing the star alignment procedure, the mount can replicate a model of the sky to pinpoint and follow the movements of astronomical objects.

There are two methods for aligning the GoTo system, and they are very similar: Brightest Star Alignment and Two Star Alignment. Both actually involve identifying and pointing the telescope to two different bright stars in the night sky. The only difference is that for the Brightest Star Alignment, the hand controller will prompt you to select the first alignment star from a directional region of the sky and will provide a short list of the brightest stars in that region. With the Two Star alignment procedure the list of eligible stars is not grouped by region of sky.

For the novice stargazer unfamiliar with the night sky or the names of brighter stars, some might find the Brightest Star Alignment to be the easier of the two methods. To assist you in performing the alignment by either method, we have included in the back of this manual a set of star charts with the names of some bright stars indicated for easy reference.

The descriptions below will lead you through step-by-step procedures for both alignment methods.

NOTE: Before performing either of the alignment methods, be sure that the EZ Finder II is precisely aligned with the telescope tube. See "Aligning the EZ Finder II" in Section 2.

Brightest Star Alignment

This method helps you to find and identify the brightest star within a selected region of the sky. Even if you are not familiar with the names of stars in the sky, you simply choose the direction of a visible bright star and the hand controller will help you to identify it. This method can also be useful if your visibility is limited due to obstructions such as trees, hills, or buildings.

1. First, select "Brightest Star" as your Alignment Method. Press *ENTER*.
2. The hand controller will prompt you to "Select Region". Choose the direction that corresponds with where you see the brightest star in the night sky. It may be helpful to have a compass for reference during this process. There are eight regions to choose from, each covers a 90-degree span in azimuth **(Figure 30).** The direction you choose will only affect your alignment star selection; you will still be able to choose stars to view across the entire sky once the alignment is complete.
3. After you have selected the region of the sky containing the brightest star, the hand controller will generate a list of the brightest stars (magnitude 1.5 or brighter and between 10 and 75 degrees above the horizon only) in that region. (If there are no suitable stars in the direction you have chosen, the text "No Star Found in the Region" will display. If this occurs, press *ENTER* or *ESC* and select another region of sky.) Now, use the Scroll keys to scroll through the list of bright stars. There will only be a few stars, at most, on the list, and sometimes only one star will be on the list. The hand controller will display the name and magnitude of the bright star on the first line, and the approximate position of the star (based on the time and date entered during the initial setup) on the second line. The first coordinate on the second line is an E-W coordinate, and the second coordinate on the second line indicates degrees above the horizon. These coordinates provide a simple way to identify the bright star you have chosen. When you are confident the hand controller is displaying the name of the bright star you wish to align on, press *ENTER*.
4. The mount will *not* slew to the selected bright star automatically. Instead, the hand controller will direct you to slew the mount to the coordinates displayed on the LCD. It might be easier to refer to the appropriate seasonal star chart, find the selected star on it, and slew the telescope to its location in the sky. Slew the scope using the directional keys and center the star in the view of the EZ Finder II reflex sight. Press *ENTER*. The hand controller will now instruct you to center the star in the telescope eyepiece. Once again, use the directional keys to do this. You may change the slewing speed by pressing the RATE

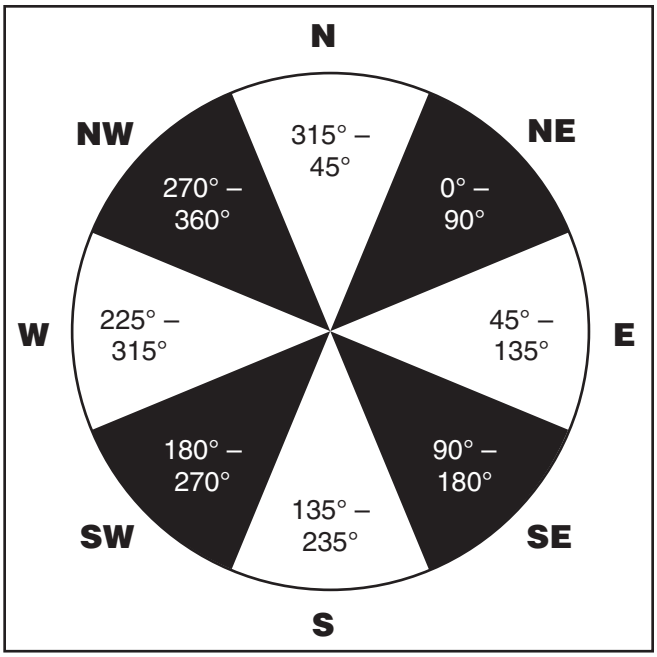


Figure 30. Pie chart of the eight directional regions referenced in the Brightest Star Alignment procedure.

button, and then choose a number between 0 (slowest) and 9 (fastest). You may find that Rate 4 is best for centering the object in the EZ Finder, while Rate 3 or less is best for centering in the eyepiece view. When the star is centered in the eyepiece, press *ENTER*.

5. The hand controller will now generate a list of bright stars to choose as your second alignment star. Scroll through the list using the Scroll keys and refer to the appropriate star chart in the back of this manual to choose a second alignment star*. Ideally, you want this star to be about 60 degrees (i.e., about six fist-widths held at arm's length) away from the first alignment star in azimuth, and preferably at roughly the same altitude. The more distance between the two alignment stars, the better accuracy the alignment will produce.* Once you've selected the second alignment star, press *ENTER*. The mount will now automatically slew to the selected star, which should land in or near the field of view of the EZ Finder II. When it stops slewing you'll hear a beep, then the hand controller will instruct you to use the directional buttons to center the star in the eyepiece. After you've done that, press *ENTER*.

The message "Alignment Successful" should display on the LCD. You may now use the hand controller to locate objects to view. At this time it is recommended that you switch to the low-power DeepView 2" eyepiece for acquiring targets using the GoTo system.

If the message "Alignment Failed" displays, it usually means the star positions do not correspond with the location and date/time information input during setup. Please check your user input settings before starting again.

NOTE: To ensure the accuracy of the star alignment, make sure to end the movement of the telescope with the UP or RIGHT directional button when centering the object in the eyepiece view.

NOTE: The hand controller will beep when the telescope has finished slewing to an object. Do not try to adjust the telescope position further before you hear the beep. The hand controller will only respond to the ESC key while slewing.

Two-Star Alignment

The standard two-star alignment is suggested if you have a star chart handy or are able to identify two bright stars visible in the night sky. To perform the two-star alignment, you follow the same steps described for the Brightest Star alignment, except that the hand controller will not prompt you to select a directional region for a bright star. Instead, you'll be presented with a list of stars available in your current sky to choose from, for each of the two alignment stars.

Use the supplied 12.5mm Illuminated Plössl to ensure accurate centering of your alignment objects. Refer to the appropriate star chart in the back of this manual for help in locating a specific star.

NOTE: When the power is on, you may choose to adjust the telescope electronically by using the hand control or manually by pushing the tube with your hand. The telescope will calculate the coordinates accordingly and display the information correctly on the hand controller.

NOTE: The hand control's backlit display will become dimmer and the button Illumination will turn off if left idle for 30 seconds. Pressing any button will re-illuminate the display.

NOTE: After doing a successful star alignment, the information is stored in the hand controller even after the power has been turned off. You will only need to perform the star alignment once as long as these two criteria are met: 1. The telescope is moved to its Home position, i.e., the telescope is "parked" (Choose Menu > Utility Func. > Park Scope > Home position) before turning off the power, and 2. The telescope setup, including the mount, has not been moved. Changing accessories shouldn't upset the alignment as long as it is done carefully. When the hand controller is turned on for the next session, make sure to choose YES when prompted whether to start from the Home position. The time entered during initial setup should be based on the same source as last time. For example, if you enter the time from your watch for this observing session, the time you enter next session should also be read from your watch.

8. Using the Telescope in GoTo Mode

Object Database in the Hand Controller

The SkyQuest XXg GoTo hand controller contains a database of over 42,900 celestial objects:

Solar System – The 8 other planets of our solar system (including Pluto), plus the Moon

Named Star – 212 of the best-known stars

NGC* – 7,840 of the brightest deep-sky objects from the Revised New General Catalog

IC – 5,386 standard stars and deep-sky objects from the Index Catalog

Messier – Complete list of 109 Messier objects

Caldwell – Complete list of 109 Caldwell objects

Double Stars – 55 well-known double stars

Variable Stars – 20 well-known variable stars

SAO – Includes 29,523 stars

** NGC 2000.0 database, edited by Roger Sinnott, copyright Sky Publishing corporation. Used with permission.*

Selecting an Object

Once the telescope has been aligned, you can access and view any object in the GoTo database. There are three methods for selecting an object to view:

1) Dual Purpose Buttons **(Figure 29a)**

TOUR – Takes you on a preset tour of your current sky. It will automatically choose from the database the best and brightest deep-sky objects. Use the scroll buttons to scroll through the selections, then press *ENTER to choose one. The coordinates of the selected object will be displayed. Other information such as constellation, magnitude, and size can be displayed by using the scroll buttons. Pressing ENTER a second time will prompt the telescope to slew to the object.*

M, NGC, IC – These shortcut buttons give you access to the most popular celestial catalogs: Messier Catalog, Revised New General Catalog, and Index Catalog. Use the numeric buttons to select an object by entering its number. Pressing *ENTER* will display its coordinates. Other Information such as constellation, magnitude, and size are accessed by pressing the scroll buttons. Pressing *ENTER* a second time will prompt the telescope to slew to the object.

PLANET – This button takes you to the Planets submenu in the database. Use the scroll buttons to scroll through the list of planets in our solar system. Press *ENTER to view its coordinates, and ENTER a second time to slew to the planet.*

USER – This button will take you to the database of objects that you have defined for yourself. You can enter a new location or recall the objects that have previously been saved (see Using the User Defined Database).

2) Object Button

The *OBJECT* button takes you to the Object Catalog, where you have complete access to over 42,000 celestial objects in the database.

3) Menu

In the Main Menu, scroll down to *OBJECT CATALOG* and press *ENTER*. Similar to the *OBJECT* button, this gives you access to all 42,900 celestial objects in the database.

Pointing Accuracy Enhancement (PAE)

Each of the two alignment methods described earlier will provide accurate alignment for most visual applications – accurate enough to land an object somewhere in the field of view of a low-power eyepiece such as the DeepView 35mm. If during an observing session you discover that the GoTo pointing is off a bit, the PAE function can be employed. PAE provides a quick way to "sync" or "true up" the GoTo alignment. Performing the PAE will correct the displacement error to improve the telescope pointing accuracy in a small region of the sky containing the object you're targeting. It will not affect the pointing accuracy in other regions in the sky and it will not affect the original star alignment calculation. With PAE you can "sync" on the target object or on a bright star close to the target object. After PAE correction, when you select and slew to the target object again in GoTo mode, it should be at or very close to the center of the eyepiece field of view.

The following provides a step-by-step procedure on how to perform PAE:

1. Choose a bright star or object that's visible in the same area of the sky as your object of interest. The reference object could be a bright named star, a planet, or an object from the Messier, NGC, or IC catalogs, but not a star from the SAO catalog.
2. Find the reference object in the hand controller database and command the telescope to "GoTo" the object.
3. Once the telescope has stopped slewing, press *ESC* to return to any submenu.
4. Press and hold down the *ESC* key for 2 seconds to enter the PAE mode. The hand control will display "Re-centering obj" and the name of the reference object will appear in a blinking mode (3 times). If the reference object is selected from a planetarium software program, instead of the name of the object, the hand control will display "Last goto object".
5. Use the directional buttons to center the reference object in the telescope eyepiece (the 12.5mm Illuminated Plossl eyepiece is recommended). Then press *ENTER*, or if you do not wish to record the result, press *ESC* to abort the operation. After pressing *ENTER*, the SynScan will determine the amount of the displacement and automatically correct the SynScan's pointing error for this small region of the sky. Now the pointing accuracy in this particular part of the sky should be greatly improved.

NOTE: The PAE correction is stored in the hand controller even after the power has been turned off. You will only need to perform the star alignment once as long as these two criteria are met: 1. The telescope Is moved to its Home position, i.e., the telescope is "parked" (Choose Menu > Utility Func. > Park Scope > Home position) before turning off the power, and 2. The telescope setup, including the mount, has not been moved. Changing accessories shouldn't upset the alignment as long as it is done carefully. When the hand controller is turned on for the next session, make sure to choose YES when prompted whether to start from the Home position. The time entered

during Initial setup should be based on the same source as last time. For example, if you enter the time from your watch for this observing session, the time you enter next session should also be read from your watch.

Other Functions

The GoTo hand controller is equipped with a variety of additional functions that allow you to optimize performance and access other features of the system. Some functions allow you to re-enter portions of data to improve or correct operational flaws. Other functions give users the chance to identify unknown objects, interface the mount with a computer, and to use other equipment in conjunction with the SkyQuest XXg. You can even customize your own catalog of celestial objects.

Utility Functions

To access the utility functions, press the *UTILITY* (3) button on the hand controller or scroll to Utility Func. on the Choose Menu screen using the scroll keys.

Show Position: This displays the coordinates of the location where the telescope is currently pointed. Use the scroll keys to toggle between Right Ascension/Declination, Altitude/Azimuth and Ax1/Ax2, where Ax1 and Ax2 stand for the +/- angular readings of the elevation and azimuth axes, respectively.

Show Information: This function displays setup information input by the user:

Time: Displays the current time and local sidereal time (LST).

Version: Displays the hardware, firmware, and database version of the GoTo hand controller. If the hand controller is connected to the mount, this will also display the firmware version of the motor control board. Use the scroll buttons to view the version numbers.

Temperature: Displays the temperature detected from the thermal sensor in the hand control in both Celsius and Fahrenheit degrees.

*Power Voltage***:** Displays the input voltage to the hand controller. This can be used to check the status of your power supply.

Park Scope: Moves the telescope to the Home position or parks the telescope at the current or previously stored park position. Allows user to use GoTo star alignment from previous viewing session. *(NOTE: If the scope is moved after It has been parked, the alignment procedure must be performed again.) There are three possible parking positions:*

HOME position – The HOME position is the initial position of the scope when it is powered on. Typically, the HOME position is defined as the position at which the telescope altitude and azimuth angles are both 0 degrees; that is, the telescope tube is positioned horizontally and north.

Current position – The Current position is where the telescope is currently pointed.

Custom position – The Custom position is the previously set parking position. The hand controller will remember the coordinates of a park position that you have specified.

PAE: Allows user to fine-tune star alignment based on region of the sky used during setup. Please see the information in previous Pointing Acccuracy Enhancement (PAE) section.

Clear PAE data – This function clears all PAE data stored in the hand controller. Doing the star alignment will also clear the PAE data.

GPS – This allows you to obtain information from the optional GPS receiver for Orion GoTo Mounts, if the GPS receiver is connected.

PC Direct Mode – This allows you to send commands to the GoTo base's motor control board from your PC via the hand controller. This is different from a PC link to the hand controller to control the base, because all the communication commands and data are sent to and received from the motor control board in the base directly. The PC Direct Mode is useful for doing motor control board firmware updates and for some applications that need to communicate with the motor control board directly.

Setup Functions

The Setup functions allow you to change any system variable or information regarding location, time, date, and alignment configurations. To access the Setup Functions, either press the *SETUP* button on the hand controller or browse to *SETUP* on the Choose Menu screen using the mode and scroll keys. The different types of functions available to you are listed below, along with their respective purposes.

Date: Allows you to change the date entered at the initial setup.

Time: Allows you to change the current time.

Observ. site: Allows you to change the current location setting.

Daylight Saving: Allows you to change the Daylight Saving option.

Alignment: Allows you to re-perform the star alignment.

Alignment Stars: Allows you to choose how alignment stars are displayed.

Auto Select: When selected the hand controller will filter out stars not available for selection.

Sort By: Generates a list of alignment stars sorted alphabetically or by magnitude.

Backlash: This function allows you to insert a value for each axis to compensate for slewing backlash experienced on that axis. Backlash is a delay in motorized motion of the mount due to slack between gears. Backlash is experienced when the slewing direction is reversed on one or both axes of motion. For improved pointing accuracy, it is important that the backlash value is set to be equal or greater than the actual amount of backlash between the gears. The default setting is 0° 00' 00" (degree, arcminute, arcsecond). Use the numeric keys to set the values and press the RIGHT directional key to proceed to the next digit. First set the value for R.A. backlash, then press *ENTER* to set the value for DEC.

NOTE: Backlash compensation is only active for computerized slewing, not for manual slewing with the directional buttons.

Tracking:

- Sidereal Rate: Activates tracking at sidereal rate. This is the default tracking rate.
- Lunar Rate: Activates tracking at lunar rate.
- Solar Rate: Activates tracking at solar rate.
- Stop Tracking: Stops the tracking motors.

Auto Tracking: Allows the telescope to automatically track a celestial object without star alignment. The hand controller will display the coordinates of the direction in which the telescope is pointed. You may press the scroll buttons to switch between the different coordinate options.

Set Slew Limits: Allows you to set slewing limits of the GoTo base's altitude axis, to prevent the optical tube from colliding with the base. When you press *ENTER* in the Set Slew Limits submenu, you may enable or disable the slew angular limitations in altitude. If you enable the slew limit setting, the hand control will prompt you to edit the upper and the lower altitudinal limitations in degrees. You may use the numeric keys to edit the number and use the RIGHT and LEFT keys to move the cursor. The slew limit range is dependent on the mount and the optical tube installed on the mount.

Re-align Encoder: The SkyQuest XXg GoTo base uses two encoders on each axis to track its position for GoTo and Autotracking functionality. One encoder is coupled to the axis shaft and the other is coupled to the motor shaft for each axis. This dual encoder design allows you to move the telescope by hand or electronically via the hand controller's directional buttons without losing its alignment. However, accuracy may be diminished when the telescope is moved by hand. The following procedure can be used to recover pointing accuracy.

1. Browse to the Re-align Encoder submenu under *SETUP* menu list, and then press *ENTER*. The hand control will display "Re-align Encoder, press *ENTER*".
2. Press *ENTER*, then the hand control will show the two alignment stars that were centered in the last star-alignment procedure.
3. Use the scroll keys to select one of the previous alignment stars or select another star to recalibrate the axis encoders. Then press *ENTER* to confirm.
4. After selecting the star as the reference star to recalibrate the axis encoders, the telescope will slew to the selected reference star. When the telescope stops slewing, it should be pointing somewhere close to the reference star. Use the directional keys to center the reference star in the field of view of the illuminated Plossl crosshair eyepiece, and then press *ENTER* to confirm.
5. The hand control will prompt "Re-align Encoder completed." on the LCD screen. Press *ENTER* to confirm and finish the Re-align Encoder procedure.

Handset Setting – This submenu allows adjustments of the brightness of the LCD backlight, the LCD contrast, the brightness of the LED button lights, and the beeper volume of the hand controller. Press the RIGHT or LEFT directional key to increase or decrease the values.

Factory Setting: Allows hand controller to be reset to the factory default setting. Note that this will not delete PAE settings or User Defined objects.

Using the User Defined Database

The GoTo system allows you to save up to 25 objects in the User Defined Database. You can save currently unknown objects, unidentifiable objects, current comet and/or asteroid positions, or you can make a custom list of your favorite objects to view for quick access.

Saving an object to the database

1. Press the **USER** button (number 9) on the hand controller, or select "User Objects" under the Object Catalog menu. Press *ENTER*.
2. The first available selection in the User Objects is Recall Object. This is where you select previously saved objects to view. Use the scroll buttons to call up "Edit Object" and press *ENTER*.
3. User-defined objects are stored in two formats: RA-Dec and AzAlt. Press 1 for the RA-Dec format or 2 for AzAlt. The LCD will display the coordinates at which the telescope is currently pointed. In the case of the RA-Dec format, the coordinate readout will be similar to this: "22h46.1m + 90°00' " , which means 22 hours and 46.1 minutes in R.A. (right ascension) and "+90°00'" in Dec (declination). Change the coordinates using the numeric keypad and scroll keys. Use the RIGHT or LEFT directional keys to move the cursor to the next or previous digit. Press *ENTER* to save.
4. Warning: If the RA-Dec coordinates entered do not exist, the hand controller will not respond when the *ENTER* key is pressed. Check the entry for a mistake and re-enter the correct coordinates.
5. To store an object/location in Altazimuth (AzAlt) format, first point the telescope to the desired location to obtain the Altazimuth value, and then press *ENTER* to save.
6. After the coordinates have been saved, the LCD will display a User Object number, such as # 03. Use the scroll keys to change to the number you wish to represent the coordinates and press *ENTER*.
7. The prompt "View Object?" and the User Object number you just entered will be displayed. Press *ENTER* to go to the object or ESC to return to the Edit Coordinates menu.

Warning: The User Object number displayed may not be an unassigned one. If you are unsure which numbers have already been assigned, it is recommended that you first check for the available numbers by recalling the saved user-defined objects.

Recalling a user-defined object

1. See Step 1-2 of "Saving an object to the database" for details on how to access to the User Objects menu. Select Recall Object and press *ENTER.*
2. Use the scroll buttons to browse through the User Object numbers until the number representing the object you wish to view is displayed. Press *ENTER* to show its coordinates. Press *ENTER* again and you'll see "View object?" Press *ENTER* to slew the telescope to the object. The hand control will not respond if an unassigned User Object number is selected. Use the scroll buttons to choose another number and try again.

Hint: If the recalled object is below the horizon, the hand controller will display "Below Horizon! Try another obj." and automatically return to the Recall Object menu.

Identifying an "Unknown" Object

The GoTo system has the ability to identify an unknown (to you) celestial object that the telescope it pointing at. Here's how:

Press the ID button or scroll to *IDENTIFY* in the main menu and press *ENTER* to identify the object.

3. The hand controller will display a list containing the closest known object in different catalogs and its distance to the exact location where the telescope is pointed. Use the scroll buttons to view these objects.
4. Press *ESC* to exit this function.

Linking with a Computer

The SkyQuest XXg can be connected to a computer via the supplied computer interface (serial) cable. Many commercially available planetarium software programs can be used to control the SkyQuest XXg. Look for software that is compatible with the Orion SkyQuest XXg Dobsonians, Celestron NexStar5i/8i, or NexStar GPS series. Starry Night Pro is one such astronomy software package. The description below will lead you through the procedure on how to connect and disconnect the SkyQuest XXg to a computer.

1. Align the base as described previously (see "Alignment for GoTo Operation").
2. Connect the supplied serial cable to the smaller of the two modular jacks (RJ-12) on the bottom end of the hand controller **(Figure 29b)**. Connect the other end of the cable to the serial port of your computer. (If your computer uses USB ports instead of serial ports, as most do these days, you will need the included USB-to-serial adapter cable.)
3. In the planetarium software of your choice, choose "Orion SkyQuest GoTo or Celestron NexStar5i/8i or Celestron 8/9/11 GPS (any of these will work) in the driver setup and follow the instructions provided by the program to connect the mount and computer. The SkyQuest XXg will be under the full control of your computer once the connection is successfully established.

Disconnecting from the Computer

Follow the instructions provided by the planetarium software to close the connection to the hand controller.

On the hand controller, press *ESC* to resume normal hand controller operations.

NOTE: Do NOT disengage the SkyQuest XXg unit before you close the connection in the planetarium program. Doing so may cause some programs to freeze.

Updating the GoTo Hand Controller's Firmware

From version 3.0 and up, the GoTo hand controller's firmware can be updated over the internet. The firmware loader and firmware updates are available for download on the Orion website, OrionTelescopes.com

System Requirements

- SynScan AZ GoTo hand controller version 3.0 or later
- Windows95 or later
- An available RS-232 COM port on the PC
- Computer interface cable (supplied)
- DC power supply (7.5V to 15V @ 100mA or greater output with 2.1mm tip positive plug)

Preparing the Computer for the Update

1. Create a folder where you will store the files necessary for the update.
2. On the OrionTelescopes.com website, go to the product page for your telescope. Look in the text description and you'll see the Download Firmware Loader link. Click on it and save the Firmware Loader program to the folder you have created on your computer. You will need to download this program only once; after it is saved on your computer, only the firmware data file is needed for future updates.
3. On the same web page, find the Download Firmware Files link and click on it. Download and save the firmware update data file to the folder you created. The file will be named OrionVxxxxAZ.ssf, where xxxx indicates the version number of the firmware.

Updating the GoTo Hand Controller

1. Plug the modular plug end of the computer interface cable into the middle jack in the hand controller. Plug the serial connector end of the cable to the COM port on your PC.
2. Press and hold down the 0 and 8 numerical buttons simultaneously, then plug the power supply into the hand controller's DC power jack. The hand controller will beep and display "SynScan Update Ver. x.x" on the LCD screen.
3. Run the Firmware Loader program on your computer.
4. Click on the "Browse" box and select the OrionVxxxx. ssf file location where it was saved previously on your computer.
5. Click on the "Update" button, and the new firmware will begin loading into the hand controller. The Firmware Loader will show the progress of the update on your com-

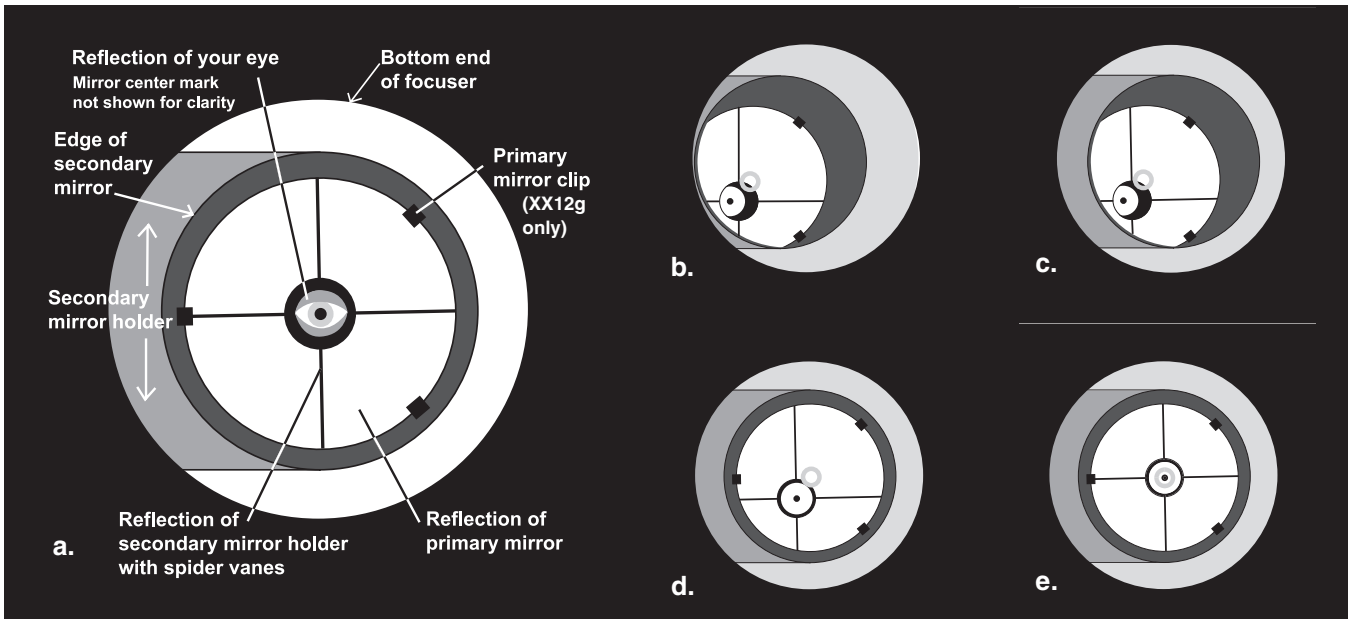


Figure 31. Collimating the optics. **(a)** When the mirrors are properly aligned, the view down the focuser drawtube should look like this. **(b)** With the collimation cap in place, if the optics are out of alignment, the view might look something like this. **(c)** Here, the secondary mirror is centered under the focuser, but it needs to be adjusted (tilted) so that the entire primary mirror is visible. **(d)** The secondary mirror is correctly aligned, but the primary mirror still needs adjustment. When the primary mirror is correctly aligned, the "dot" will be centered, as in **(e)**.

puter screen. It will usually take approximately 30 seconds for the new firmware to load into the hand controller. It may take significantly longer if a serial-to-USB adapter is employed on your computer.

6. When the download is complete, the Firmware Loader will display "Update Complete."

The firmware in the computerized GoTo hand controller has now been updated. You can click on the "HC Version" button to confirm the new version number of the firmware (and possibly the database, but the hardware version will not change with internet updates).

NOTE: If the error message "Can not connect to a SynScan hand control" appears on your computer, check all cable connections. Also, try closing all other computer programs that might be attempting to use the COM port.

NOTE: If the error message "Firmware update failed..." appears on your computer, remove the power plug from the hand controller, and then reconnect it. Now, repeat the firmware update procedure.

By default, the data communication rate between the GoTo hand controller and the computer is 115kbps. The RS-232 port on some PCs may not support this high data transfer rate. If the firmware update procedure fails after a few tries, try reducing the data transfer rate by pressing the *SETUP* button on the hand controller. This will reduce the data transfer rate to 9.6kbps. The controller's LCD screen will show "Lo" in the lower right hand corner to indicate the lower transfer rate setting. The firmware update procedure remains the same except it will take much longer for the firmware to load into the hand controller.

9. Collimating the Optical System

To get the sharpest images, your telescope's optical system must be in precise alignment. The process of aligning the primary and secondary mirrors with each other and with the mechanical axis of the telescope is called collimating. Collimating is relatively easy to do and can be done in daylight or at night.

Because the primary mirror is shipped separately from the optical tube, the telescope's optics must be collimated before it can be used. Most of the adjustments will be to the tilt of the primary mirror, as the secondary mirror has been pre-aligned at the factory. It is also good idea to check the collimation (optical alignment) of your telescope before each observing session and make any necessary adjustments.

To check collimation, remove the eyepiece and look down the focuser drawtube. You should see the secondary mirror centered in the drawtube, as well as the reflection of the primary mirror centered in the secondary mirror, and the reflection of the secondary mirror (and your eye) centered in the reflection of the primary mirror, as depicted in **Figure 31a**. If anything is off-center, as in **Figure 31b**, proceed with the following collimation procedure.

The Collimation Cap and Mirror Center Mark

Your XXg comes with a collimation cap. This is a simple cap that fits on the focuser drawtube like a dust cap, but has a hole in the center and a reflective inner surface. The cap helps center your eye so that collimating is easier to perform. **Figures 31b-e** assume you have the collimation cap in place.

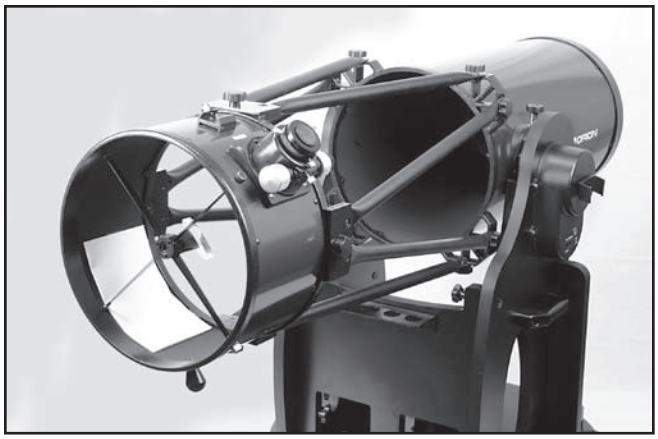


Figure 32. The SkyQuest XX12g optical tube properly set up for collimation.

As an additional aid in collimating, the primary mirror of the XXg has a tiny adhesive ring marking its exact center. This center ring will not affect the images you see when observing with the telescope in any way (since it lies directly in the shadow of the secondary mirror), but it will greatly facilitate collimating when using the supplied collimation cap or other, more sophisticated collimation devices, such as the Orion LaserMate Laser Collimator.

Preparing the Telescope for Collimation

Once you get the hang of collimating, you will be able to do it quickly even in the dark. For now, it is best to collimate in daylight, preferably in a brightly lit room and aimed at a white wall. It is recommended that the telescope tube be oriented horizontally. This will prevent any parts from the secondary mirror from falling down onto the primary mirror and causing damage if something comes loose when you are making adjustments. Place a sheet of white paper inside the optical tube directly opposite the focuser. This will provide a bright "background" when viewing into the focuser. When properly set up for collimation, your telescope should resemble **Figure 32.**

Aligning the Secondary Mirror

With the collimation cap in place, look through the hole in the cap at the secondary (diagonal) mirror. Ignore the reflections for the time being. The secondary mirror itself should be centered in the focuser drawtube. If it isn't, as in **Figure 31b**, its position must be adjusted. This positional adjustment of the secondary mirror will rarely, if ever, need to be done.

To adjust the secondary mirror left-to-right in the focuser drawtube, use the included 2mm hex key to loosen the three small alignment setscrews in the center hub of the 4-vaned spider several turns. Now, grasp the mirror to prevent it from rotating (be careful not to touch the surface of the mirror), while turning the center screw with a Phillips screwdriver **(Figure 33).** Turning the screw clockwise will move the secondary mirror toward the front opening of the optical tube, while turning the screw counter-clockwise will move the secondary mirror toward the primary mirror. When the secondary mirror is centered left-to-right in the focuser drawtube, rotate the secondary mirror holder until the reflection of the primary mirror is as centered in the secondary mirror as possible. It may not be perfectly centered, but that is OK for now. Tighten the three small alignment setscrews equally to secure the secondary mirror in that position.

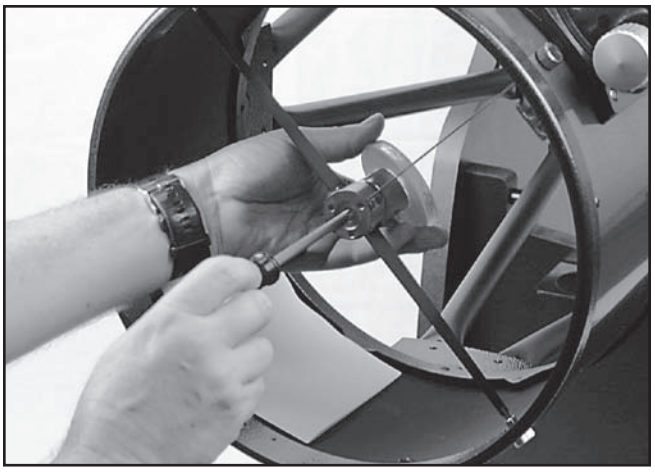


Figure 33. To center the secondary mirror under the focuser, hold the mirror holder in place with one hand while adjusting the center bolt with a Phillips screwdriver.

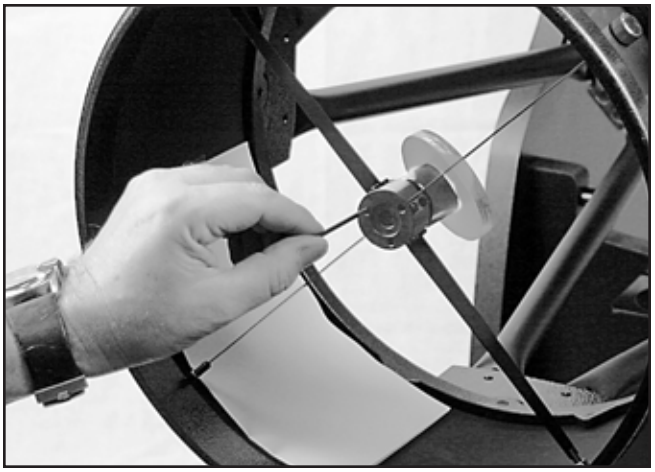


Figure 34. Adjust the tilt of the secondary mirror by loosening or tightening the three alignment set screws with the supplied 2mm hex key.

NOTE: When making these adjustments, be careful not to stress the spider vanes or they may bend.

The secondary mirror should now be centered in the focuser drawtube. Now we will shift our attention to the reflections within the secondary mirror in order to properly adjust the tilt of the secondary mirror. Adjusting the tilt of the secondary mirror and the tilt of the primary mirror are the two collimation adjustments that will be done most often.

If the entire primary mirror reflection is not visible in the secondary mirror, as in **Figure 31c,** you will need to adjust the tilt of the secondary mirror. This is done by alternately loosening one of the three secondary mirror alignment set screws while tightening the other two **(Figure 34).** Do not make excessive

turns of these set screws or force them past their normal travel. A simple 1/2 turn of the screw can dramatically change the tilt of the secondary mirror. The goal is to center the primary mirror reflection in the secondary mirror, as in **Figure 31d**. Don't worry that the reflection of the secondary mirror (the smallest circle, with the collimation cap "dot" in the center) is off-center. You will fix that in the next step.

Aligning the Primary Mirror

The final adjustment is made to the tilt of the primary mirror. It will need adjustment if, as in **Figure 31d,** the secondary mirror is centered under the focuser and the reflection of the primary mirror is centered in the secondary mirror, but the small reflection of the secondary mirror (with the "dot" of the collimation cap) is off-center.

The tilt of the primary mirror is adjusted with the three large spring-loaded collimation knobs on the rear end of the optical tube **(Figure 35).** The three smaller thumb screws lock the mirror's position in place. These thumb screws must be loosened before any collimation adjustments can be made to the primary mirror.

To start, turn the smaller thumb screws counterclockwise a few turns each. Use a screwdriver in the slots, if necessary.

Now, try tightening or loosening one of the collimation knobs Look into the focuser and see if the secondary mirror reflection has moved closer to the center of the primary mirror. You can easily determine this with the collimation cap and mirror center mark by simply watching to see if the "dot" of the collimation cap is moving closer or further away from the "ring" on the center of the primary mirror. If turning the one knob does not seem to bring the dot closer to the ring, try using one of the other collimation knobs. It will take some trial-and-error using all three knobs to properly align the primary mirror. Over time you will get the feel for which collimation screws to turn to move the image in a given direction.

When you have the dot centered as much as is possible in the ring, your primary mirror is collimated. The view through the collimation cap should resemble **Figure 31e.** Re-tighten the locking thumb screws in the bottom of the mirror cell.

A simple star test will tell you whether the optics are accurately collimated.

Star-Testing the Telescope

When it is dark, point the telescope at a bright star high in the sky and center it in the eyepiece's field of view. Slowly defocus the image with the focusing knob. If the telescope is correctly collimated, the expanding disk should be a perfect circle **(Figure 36)**. If the image is unsymmetrical, the telescope is out of collimation. The dark shadow cast by the secondary mirror should appear in the very center of the out-of-focus circle, like the hole in a doughnut. If the "hole" appears off center, the telescope is out of collimation.

If you try the star test and the bright star you have selected is not accurately centered in the eyepiece, then the optics will always appear out of collimation, even though they may be perfectly aligned. It is critical to keep the star centered, so over time you will need to make slight corrections to the telescope's position in order to account for the sky's apparent motion.

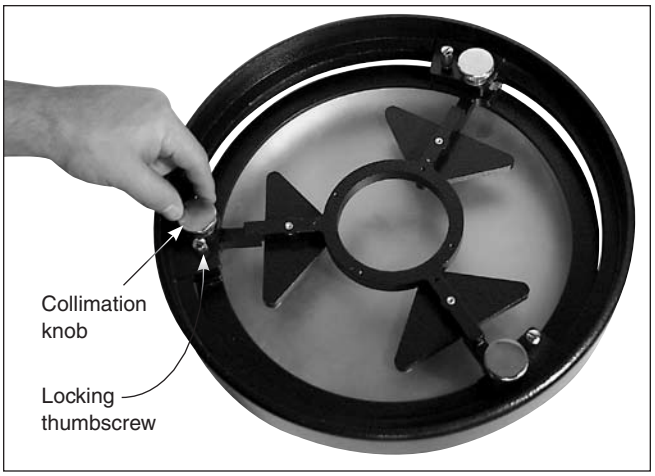


Figure 35. The tilt of the primary mirror is adjusted by turning one or more of the three collimation (large) knobs.

10. Using Your Telescope

Focusing the Telescope

The SkyQuest XXg Dobsonians come standard with a 2" dual-speed (11:1) Crayford focuser **(Figure 28)**. The large 2" format focuser allows use of 2" or 1.25" eyepieces and the Crayford design prevents imaging shifting while focusing. The focuser has coarse focus knobs and a fine focus knob for very precise focusing.

With the 35mm DeepView eyepiece in the focuser and secured with the thumb screws, move the telescope so the front end is pointing in the general direction of an object at least 1/4-mile away. Now, with your fingers, slowly rotate one of the coarse focus knobs until the object comes into sharp focus. Go a little bit beyond sharp focus until the image just starts to blur again, then reverse the rotation of the knob, just to make sure you're close to the focus point.

Now, use the fine focus knob to achieve precise focus. Eleven turns of the fine focus knob is equivalent to one turn of the coarse focus knobs, so much finer adjustment is possible than with just the coarse focus knobs alone. You'll find this is a great convenience, especially when attempting to focus at high magnifications.

If you have trouble focusing, rotate the coarse focusing knob so the drawtube is inward as far as it will go. Now look through the eyepiece while slowly rotating the focusing knob in the opposite direction. You should soon see the point at which focus is reached.

The thumb screw on the bottom of the body of the focuser **(Figure 28)** will lock the focuser drawtube in place once the telescope is properly focused. Before focusing, remember to first loosen this thumb screw.

If you find the drawtube tension when focusing is either too tight (i.e., focus knob is difficult to turn) or too loose (i.e., draw-

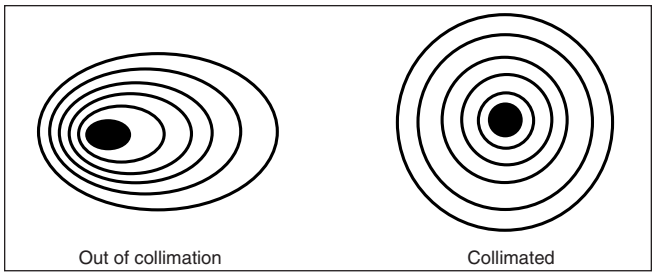


Figure 36. A star test will determine if a telescope's optics are properly collimated. An unfocused view of a bright star through the eyepiece should appear as illustrated on the right if the optics are perfectly collimated. If the circle is unsymmetrical, as in the illustration on the left, the scope needs collimation.

tube moves by itself under the weight of the eyepiece), you can adjust it by tightening or loosening the drawtube tensioning set screw on the focuser, which is located just below the focus lock thumb screw. Adjust this set screw with the included 2.5mm hex key. Do not loosen the set screw too much as there must be some tension to keep the drawtube secure within the focuser. The other set screw below the drawtube tensioning set screw does not affect drawtube tension and should not be adjusted.

Viewing with Eyeglasses

If you wear eyeglasses, you may be able to keep them on while you observe, if your eyepieces have enough eye relief to allow you to see the whole field of view. You can try this by looking through the eyepiece first with your glasses on and then with them off, and see if the glasses restrict the view to only a portion of the full field. If they do, you can easily observe with your glasses off by just refocusing the telescope as needed. If you suffer from severe astigmatism, however, you may find images noticeably sharper with your glasses on.

Aiming/Pointing the Telescope

Finding objects in GoTo mode is covered in sections 7 and 8. If you're using AutoTracking mode, you'll need to use the EZ Finder II aiming device to help in putting objects in the field of view of the telescope's eyepiece for viewing. When the EZ Finder II is properly aligned, the telescope can be pointed at anything you wish to observe and it will then be centered, or nearly so, in the telescope's field of view as well.

Start by moving the telescope by hand or using the hand controller's directional buttons until it is pointed in the general direction of the object you want to see. Some observers find it convenient to sight along the tube to do this.

Now, look in the EZ Finder II. If your general aim is accurate, the object should appear somewhere in the EZ Finder II's field of view. Make small adjustments to the telescope's position until the EZ Finder II's red dot is centered on the object. Now, look in the telescope's eyepiece and enjoy the view!

Magnification

Magnification, or power, is determined by the focal length of the telescope and the focal length of the eyepiece. Therefore, by using eyepieces of different focal lengths, the resultant magnification can be varied.

Magnification is calculated as follows:

$$\frac{\textbf{Telescope Focal Length (mm)}}{\textbf{Eyepiece Focal Length (mm)}} = \textbf{Magnification}$$

The XX12g, for example, has a focal length of 1500mm. So, the magnification with the supplied 35mm 2" eyepiece is:

$$\frac{\textbf{1500 mm}}{\textbf{35mm}} = \textbf{43x}$$

The magnification provided by the 12.5mm illuminated eyepiece is:

$$\frac{\textbf{1500 mm}}{\textbf{12.5mm}} = \textbf{120x}$$

The maximum attainable magnification for a telescope is directly related to how much light its optics can collect. A telescope with more light-collecting area, or aperture, can yield higher magnifications than a smaller-aperture telescope. The maximum practical magnification for any telescope, regardless of optical design, is about 50x per inch of aperture. This translates to about 600x for the XX12g. Of course, such high magnification will only yield acceptable images if atmospheric conditions are extremely favorable.

More typically, useful magnifications will be limited to 200x or less, regardless of aperture. This is because the Earth's atmosphere distorts light as it passes through. On nights of good "seeing," the atmosphere will be still and will yield the least amount of distortion. On nights of poor seeing, the atmosphere will be turbulent, which means different densities of air are rapidly mixing. This causes significant distortion of the incoming light, which prevents sharp views at high magnifications.

Keep in mind that as magnification is increased, the brightness of the object being viewed will decrease; this is an inherent principle of the physics of optics and cannot be avoided. If magnification is doubled, an image appears four times dimmer. If magnification is tripled, image brightness is reduced by a factor of nine!

The SkyQuest XXg Dobs are designed to accept eyepieces with a barrel diameter of either 1.25" or 2". At low magnifications, 2" eyepieces can provide a wider field of view than standard 1.25" eyepieces. A wider field can be desirable for viewing extended deep-sky objects that are too large to fit within a narrower field of view.

11. Care and Maintenance

If you give your telescope reasonable care, it will last a lifetime. Store it in a clean, dry, dust-free place, safe from rapid changes in temperature and humidity. Do not store the telescope outdoors, although storage in a garage or shed is OK. Be sure to keep the dust cover on the telescope when not in use.

Your SkyQuest XXg requires very little mechanical maintenance. The optical tube is steel and has painted finish that is fairly scratch-resistant. If a scratch does appear on the tube, it

will not harm the telescope. Smudges on the tube or base can be wiped off with a soft cloth and household cleaning fluid.

Cleaning Eyepiece Lenses

Any quality optical lens cleaning tissue and optical lens cleaning fluid specifically designed for multi-coated optics can be used to clean the exposed lenses of your eyepieces or finder scope. Never use regular glass cleaner or cleaning fluid designed for eyeglasses. Before cleaning with fluid and tissue, however, blow any loose particles off the lens with a blower bulb or compressed air. Then apply some cleaning fluid to a tissue, never directly on the optics. Wipe the lens gently in a circular motion, then remove any excess fluid with a fresh lens tissue. Oily fingerprints and smudges may be removed using this method. Use caution; rubbing too hard may scratch the lens. On larger lenses, clean only a small area at a time, using a fresh lens tissue on each area. Never reuse tissues.

Cleaning the Telescope's Mirrors

You should not have to clean the telescope's mirrors very often; normally once every few years or so. Covering the telescope with the dust cover when it is not in use will prevent dust from accumulating on the mirrors. Improper cleaning can scratch mirror coatings, so the fewer times you have to clean the mirrors, the better. Small specks of dust or flecks of paint have virtually no adverse effect on the visual performance of the telescope. The large primary mirror and the elliptical secondary mirror of your telescope are front-surface aluminized and over-coated with hard silicon dioxide, which prevents the aluminum from oxidizing. These coatings normally last through many years of use before requiring re-coating (which is easily done).

To clean the secondary mirror, you will need to remove it from the telescope. Before doing so, remove the upper tube section from the assembled telescope. Hold the secondary mirror stationary while loosening the center Phillips-head screw. Handle the mirror by its edge; avoid touching the mirror surface itself. Once the mirror (still in its holder) is removed from the tube, follow the same procedure described below for cleaning the primary mirror. You do not need to remove the secondary mirror from its holder when cleaning.

To clean the mirrors, you'll need the following:

- A sink or tub big enough to hold the mirror
- Distilled water, 1 gallon
- Squeeze bottle (for XX14g mirror only)
- A little dishwashing liquid
- 100% isopropyl alcohol (optional)
- Cotton balls
- Soft towel

To clean the primary mirror, you must carefully remove the end ring and mirror support assembly from the telescope. To do this remove the screws on the side of the tube near the rear end ring. You do not need to remove the collimation screws on the bottom of the mirror cell. Remove the entire end ring and mirror cell assembly (including mirror) from the tube.

The primary mirrors and mirror support cells for the XX12g and XX14g are quite different. The XX12g uses a flat-back primary mirror and a 9-point floatation mirror cell, whereas the XX14g uses a low mass, convex-back primary mirror and a mirror cell that holds the mirror only in the center area.

Cleaning the XX12g Primary Mirror

1. The primary mirror is held down with clips, each one fastened by two screws. Loosen the screws and remove the clips. Then carefully remove the mirror from the mirror cell. Do not touch the surface of the mirror with your fingers; lift it carefully by the uncoated sides.
2. Set the mirror, aluminized face up, on a clean, soft towel.
3. Fill a *clean* sink or tub – not a bath tub but rather a smaller plastic tub or bin – with room-temperature water, a few drops of liquid dishwashing detergent, and if possible a capful of 100% isopropyl alcohol.

4. Submerge the mirror, aluminized face up, in the water; you want about 1-2 inches of water above the mirror face. Let the mirror soak for 10 minutes or more while swishing the water over the mirror with your hand, by moving you hand back and forth. Be careful not to touch the mirror surface while doing this!
5. Then, with the mirror still submerged, wipe the aluminized surface with clean cotton balls, using extremely light pressure and stroking in a straight line across the mirror. Use a different cotton ball for each wipe across the mirror.
6. Now drain the water from the sink or tub and rinse the mirror with room-temperature *distilled* water; a gallon should suffice.
7. Set the rinsed mirror on a soft towel face up and let it air dry in a warm place. Water will run off a clean surface, so keep the mirror slightly tilted while drying. You can remove any random drops of water with the corner of a paper towel. When it is completely dry your mirror should be clean and spot free, ready to be re-installed in the mirror cell.

Cleaning the XX14g Primary Mirror

The XX14g's primary mirror should not be removed from its support cell, so we must use a different method for cleaning the mirror from that outlined for the XX12g.

1. Fill a *clean* sink or tub – not a bath tub but rather a smaller plastic tub or bin – with room-temperature water, a few drops of liquid dishwashing detergent, and if possible a capful of 100% isopropyl alcohol.
2. With the mirror still in its support cell but with the rear end ring removed, grasp the mirror cell and hold the mirror upside-down. Submerge the aluminized face of the mirror in the solution and gently swish it around for a minute or so.
3. Now remove the mirror from the water and keep it tilted for a few seconds to allow the water to drain off.
4. For the next steps you might want to prop the mirror at a slight angle on your work surface so that water will run off and not collect in the middle.
5. To help dislodge any remaining particulate matter, use a squeeze bottle filled with water to spray a "jet" of water across the mirror surface.
6. Now you're going to use *wet* cotton balls to clean the mirror. Dump out the solution used in the above steps, rinse the tub, then refill it (or a smaller container, since we won't be immersing the mirror in it this time) with new solution following the same recipe. This will ensure that no particles that came off the mirror in the previous steps are picked up on the cotton balls and rubbed across the mirror in the next steps.
7. Completely submerge a cotton ball in the solution. Starting on one side of the mirror and using extremely light pressure, wipe the cotton ball across the aluminized surface in a straight line. Wipe just once, then discard the cotton ball. Submerge another cotton ball and wipe it across the mirror in a straight line right next to the first wipe, then discard this cotton ball.
8. Repeat this procedure using wet, clean cotton balls for each swipe until you'd cleaned the entire surface of the mirror.
9. Now rinse the aluminized surface of the mirror with room-temperature *distilled* water; a gallon should suffice.
10. Let the mirror air dry in a warm place. Water will run off a clean surface, so keep the mirror slightly tilted while drying. You can remove any random drops of water with the corner of a paper towel. When it is completely dry your mirror should be clean and spot free.

12. Specifications

SkyQuest XX12g GoTo

Primary mirror: 305mm diameter, parabolic, center-marked

Focal length: 1500mm

Focal ratio: f/4.9

Focuser: Dual-speed Crayford (11:1), accepts 2" and 1.25" eyepieces with included adapter

Optical tube material: Rolled steel

Azimuth bearing: Thrust needle bearing

Altitude bearing: Ball bearing

Eyepieces: 35mm DeepView, 2" barrel; 12.5mm Illuminated Plössl, 1.25" barrel

Eyepiece magnifications: 43x and 120x

Finder scope: EZ Finder II Reflex Sight

Eyepiece rack: Holds three 1.25" eyepieces and one 2" eyepiece

Mirror coatings: Enhanced aluminum (94% reflectivity) with SiO_2 overcoat

Minor axis of secondary mirror: 70mm

Optical tube weight: 47 lbs.

Base weight: 71 lbs.

Tube length: 58.3”

Operation: Northern or Southern hemisphere

Power requirement: 12V DC 2.1 Amp (tip positive)

Motor type: DC servo with optical encoders for altitude and azimuth axes

Slew speeds:
Rate 0 = 1.0X
Rate 1 = 2X
Rate 2 = 16X
Rate 3 = 32X
Rate 4 = 50X
Rate 5 = 200X
Rate 6 = 400X
Rate 7 = 600X
Rate 8 = 800X
Rate 9 = 1000X

Tracking rates: Sidereal (default), Lunar, Solar.

Alignment method: Brightest Star, Two Star

Database: Over 42,900 objects including:
Complete Messier & Caldwell catalogs, 7840 NGC objects, 5386 IC objects, 29523 SAO stars, 8 planets, moon, 212 named stars, 55 well-known double stars, 20 well-known variable stars, 25 user-defined objects.

SkyQuest XX14g GoTo

Primary mirror: 356mm diameter, parabolic, center-marked

Focal length: 1650mm

Focal ratio: f/4.6

Focuser: Dual-speed Crayford (11:1), accepts 2" and 1.25" eyepieces with included adapter

Optical tube material: Rolled steel

Azimuth bearing: Thrust needle bearing

Altitude bearing: Ball bearing

Eyepieces: 35mm DeepView, 2" barrel; 12.5mm Illuminated Plössl, 1.25" barrel

Eyepiece magnifications: 47x and 132x

Finder scope: EZ Finder II Reflex Sight

Eyepiece rack: Holds three 1.25" eyepieces and one 2" eyepiece

Mirror coatings: Enhanced aluminum (94% reflectivity) with SiO_2 overcoat

Minor axis of secondary mirror: 80mm

Optical tube weight: 64 lbs.

Base weight: 76 lbs.

Tube length: 61”

Operation: Northern or Southern hemisphere

Power requirement: 12V DC 2.1 Amp (tip positive)

Motor type: DC servo with optical encoders for altitude and azimuth axes

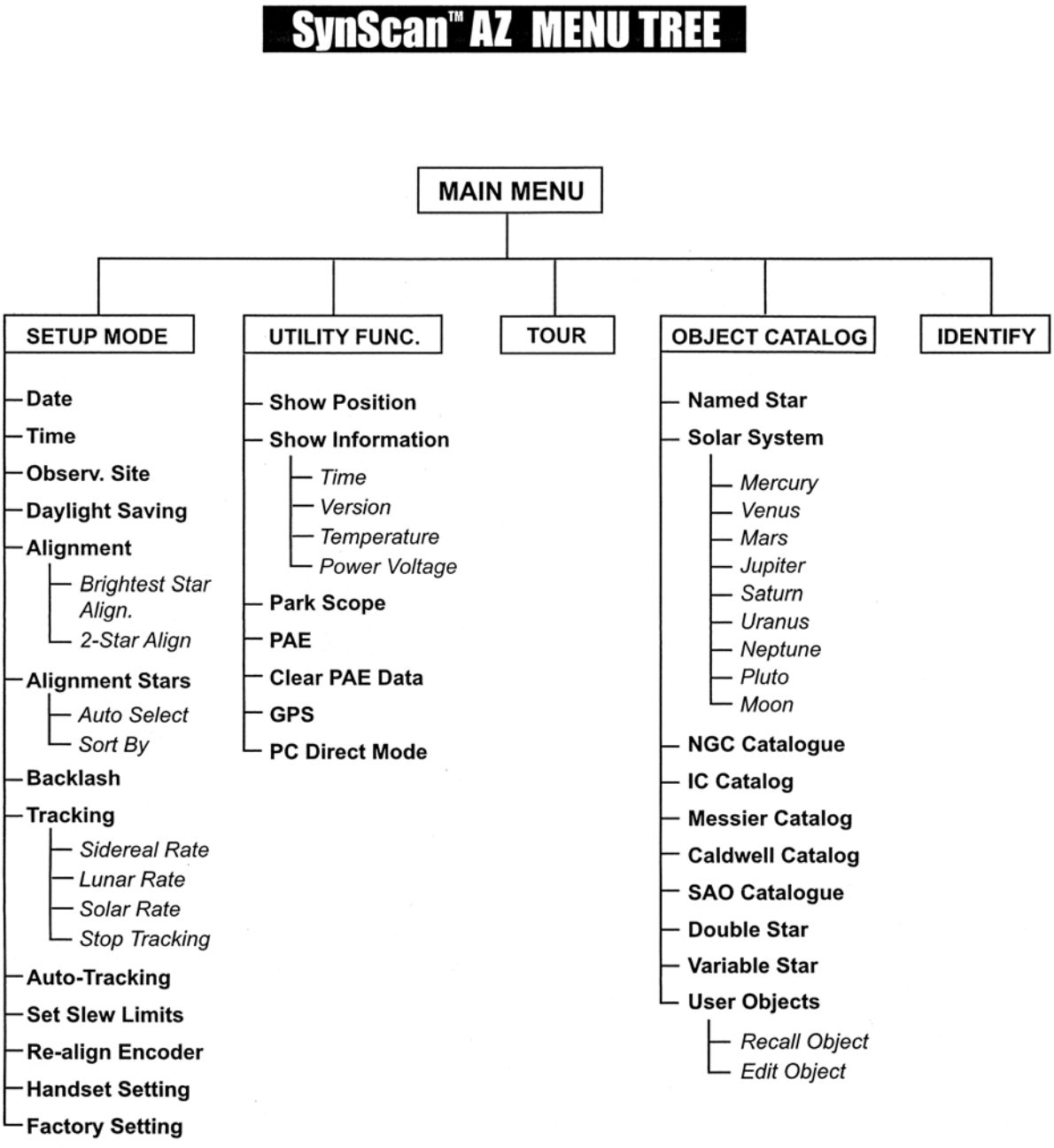
Slew speeds:
Rate 0 = 1.0X
Rate 1 = 2X
Rate 2 = 16X
Rate 3 = 32X
Rate 4 = 50X
Rate 5 = 200X
Rate 6 = 400X
Rate 7 = 600X
Rate 8 = 800X
Rate 9 = 1000X

Tracking rates: Sidereal (default), Lunar, Solar.

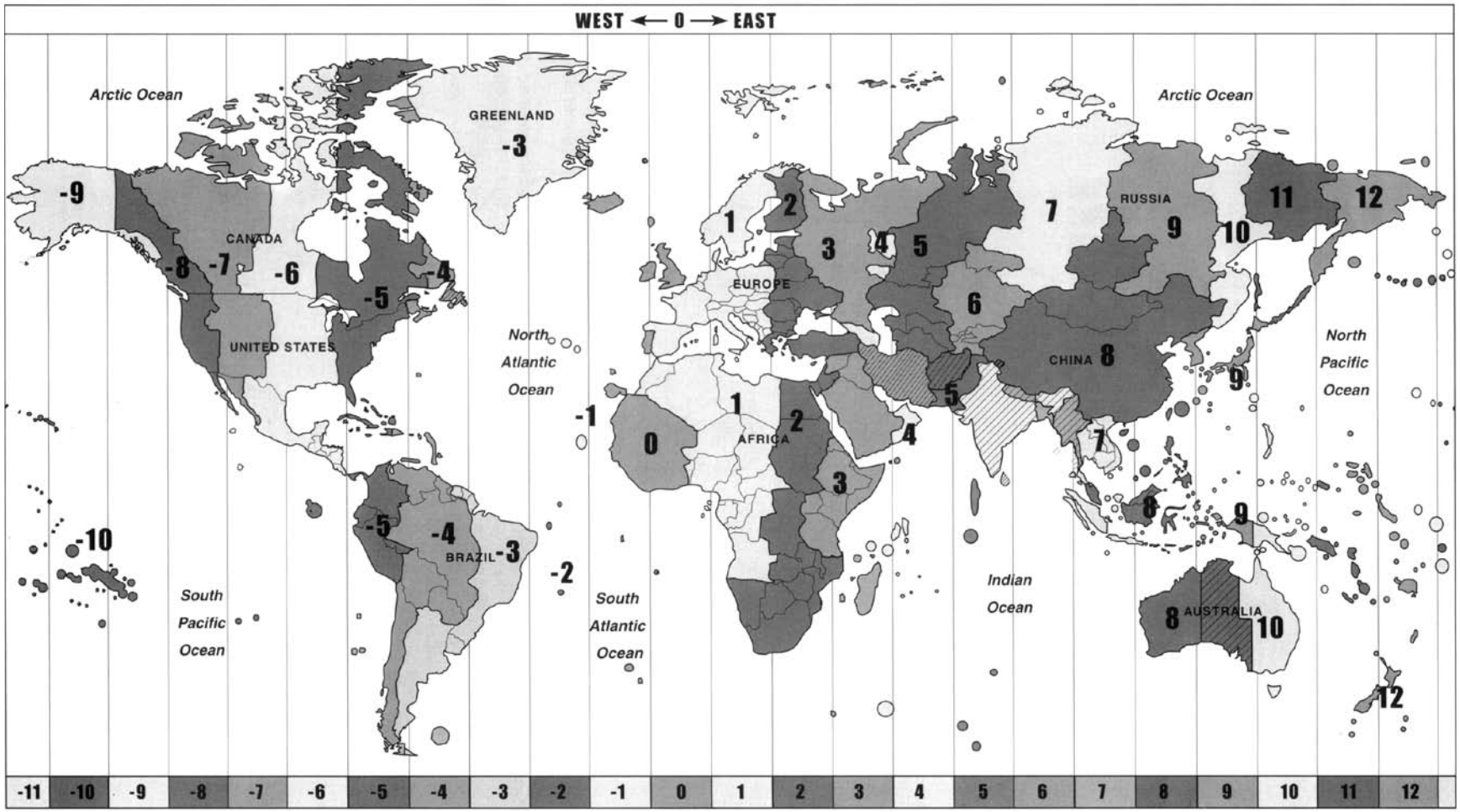
Alignment method: Brightest Star, Two Star

Database: Over 42,900 objects including:
Complete Messier & Caldwell catalogs, 7840 NGC objects, 5386 IC objects, 29523 SAO stars, 8 planets, moon, 212 named stars, 55 well-known double stars, 20 well-known variable stars, 25 user-defined objects.

Menu Tree


SynScan™ AZ MENU TREE
MAIN MENU
SETUP MODE
Date
Time
Observ. Site
Daylight Saving
Alignment
Brightest Star Align.
2-Star Align
Alignment Stars
Auto Select
Sort By
Backlash
Tracking
Sidereal Rate
Lunar Rate
Solar Rate
Stop Tracking
Auto-Tracking
Set Slew Limits
Re-align Encoder
Handset Setting
Factory Setting
UTILITY FUNC.
Show Position
Show Information
Time
Version
Temperature
Power Voltage
Park Scope
PAE
Clear PAE Data
GPS
PC Direct Mode
TOUR
OBJECT CATALOG
Named Star
Solar System
Mercury
Venus
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto
Moon
NGC Catalogue
IC Catalog
Messier Catalog
Caldwell Catalog
SAO Catalogue
Double Star
Variable Star
User Objects
Recall Object
Edit Object
IDENTIFY

Appendix A: Time Zones of the World



Appendix B: RS-232 Connection

The SkyQuest XTg Mount is designed to receive commands sent from a computer's RS-232 COM port (via the computer interface cable). The hand controller will communicate with the computer at 9600 bits/sec, no parity, no stop bit. All angles are communicated with 16 bits and communicated using ASCII hexadecimal. The chart below shows the ASCII commands from the PC, and what the hand controller's response will be.

Description	PC Command ASCII	Hand Control Response	Notes
Echo	Kx	X#	Useful to check communication
Goto Azm-Alt	B12AB, 4000	#	10 characters sent. B=Command, 12AB=Azm, comma, 4000=Alt. If command conflicts with slew limits, there will be no action.
Goto Ra-Dec	R34B, 12CE	#	Scope must be aligned. If command conflicts with slew limits, there will be no action.
Get Azm-Alt	Z	12AB, 4000#	10 characters returned, 12AB=Azm, comma, 4000=Alt, #
Get RA-Dec	E	34AB, 12CE#	Scope must be aligned.
Cancel Goto	M	#	
Is Goto in Progress	L	0# or 1#	0=No, 1=Yes: "0" is ASCII character zero
Is Alignment Complete	J	0# or 1#	0=No, 1=Yes
HC version	V	22	Two bytes representing V2.2
Stop/Start Tracking	Tx x= 0 (Tracking off) x= 1 (Alt-Az on) x= 2 (EQ-N) x= 3 (EQ-S)	#	Alt-Az tracking requires alignment
32-bit goto RA-Dec	r34AB0500,12CE0500	#	
32-bit get RA-Dec	e	34AB0500, 12CE0500#	The last two characters will always be zero.
32-bit goto Azm-Alt	b34AB0500,12CE0500	#	
32-bit get Azm-Alt	z	34AB0500, 12CE0500#	The last two characters will always be zero.

Additional RS-232 Commands

Sending a Tracking Rate

1. 1. Multiply the desired tracking rate (arcseconds / second) by 4. For example: if the desired track rate is 120 arcseconds/second (approximately 8 times sidereal rate), then the TRACKRATE = 480.
2. 2. Separate TRACKRATE into two bytes, such that (TRACKRATE = TrackRateHighByte*256 + TrackRateLowByte). For example, if TRACKRATE = 480, then TrackRateHighByte = 1 and TrackRateLowByte = 224.
3. 3. To send a tracking rate, send the following 8 bytes:
4. a. Positive Azm tracking: 80, 3, 16, 6, TrackRateHighByte, TrackRateLowByte, 0, 0
5. b. Negative Azm tracking: 80, 3, 16, 7, TrackRateHighByte, TrackRateLowByte, 0, 0
6. c. Positive Alt tracking: 80, 3, 17, 6, TrackRateHighByte, TrackRateLowByte, 0, 0
7. d. Negative Alt tracking: 80, 3, 17, 7, TrackRateHighByte, TrackRateLowByte, 0, 0
8. 4. The number 35 is returned from the hand controller.

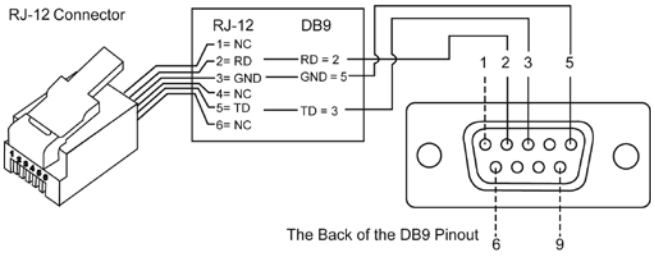
Sending a Slow-GoTo Command

9. 1. Convert the angle position to a 24 bit number. Example: if the desired position is 220, then POSITION_24BIT = (220/360)*224 = 10,252,743
10. 2. Separate POSITION_24BIT into three bytes such that (POSITION_24BIT = PosHighByte * 65536 + PosMedByte * 256 + PosLowByte). Example: PosHighByte = 156, PosMedByte = 113, PosLowByte = 199
11. 3. Send the following 8 bytes:
12. a. Azm Slow Goto: 80, 4, 16, 23, PosHighByte, PosMedByte, PosLowByte, 0
13. b. Alt Slow Goto: 80, 4, 17, 23, PosHighByte, PosMedByte, PosLowByte, 0
14. 4. The number 35 is returned from the hand controller.

Resetting the Position of Azimuth or Altitude

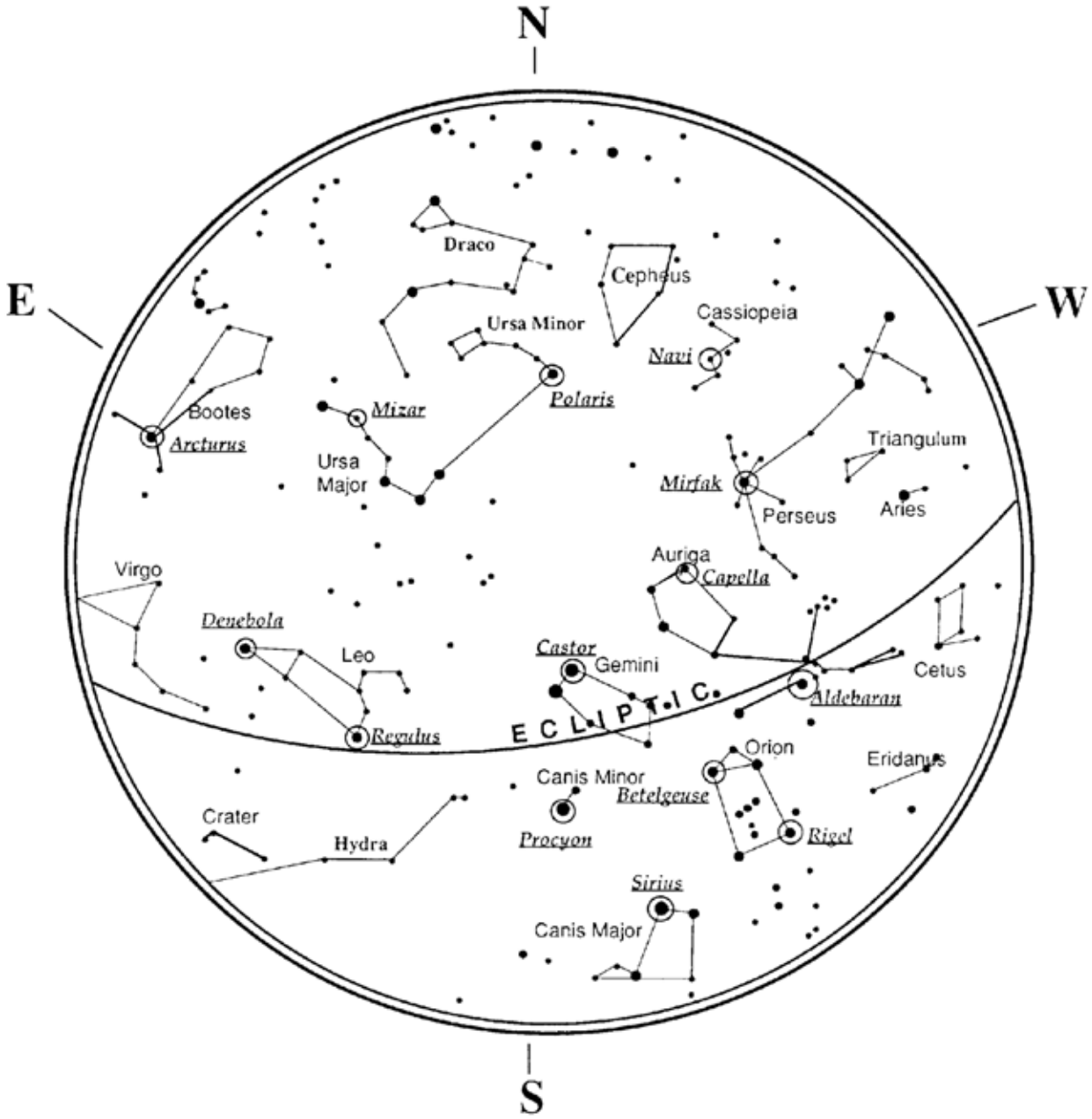
15. 1. Convert the angle position to a 24bit number, same as Slow-Goto example.
16. 2. Send the following 8 bytes:
17. a. Azm Set Position: 80, 4, 16, 4, PosHighByte, PosMedByte, PosLowByte, 0
18. b. Alt Set Position: 80, 4, 17, 4, PosHighByte, PosMedByte, PosLowByte, 0
19. 3. The number 35 is returned from the hand controller.

Physical Connection Diagram

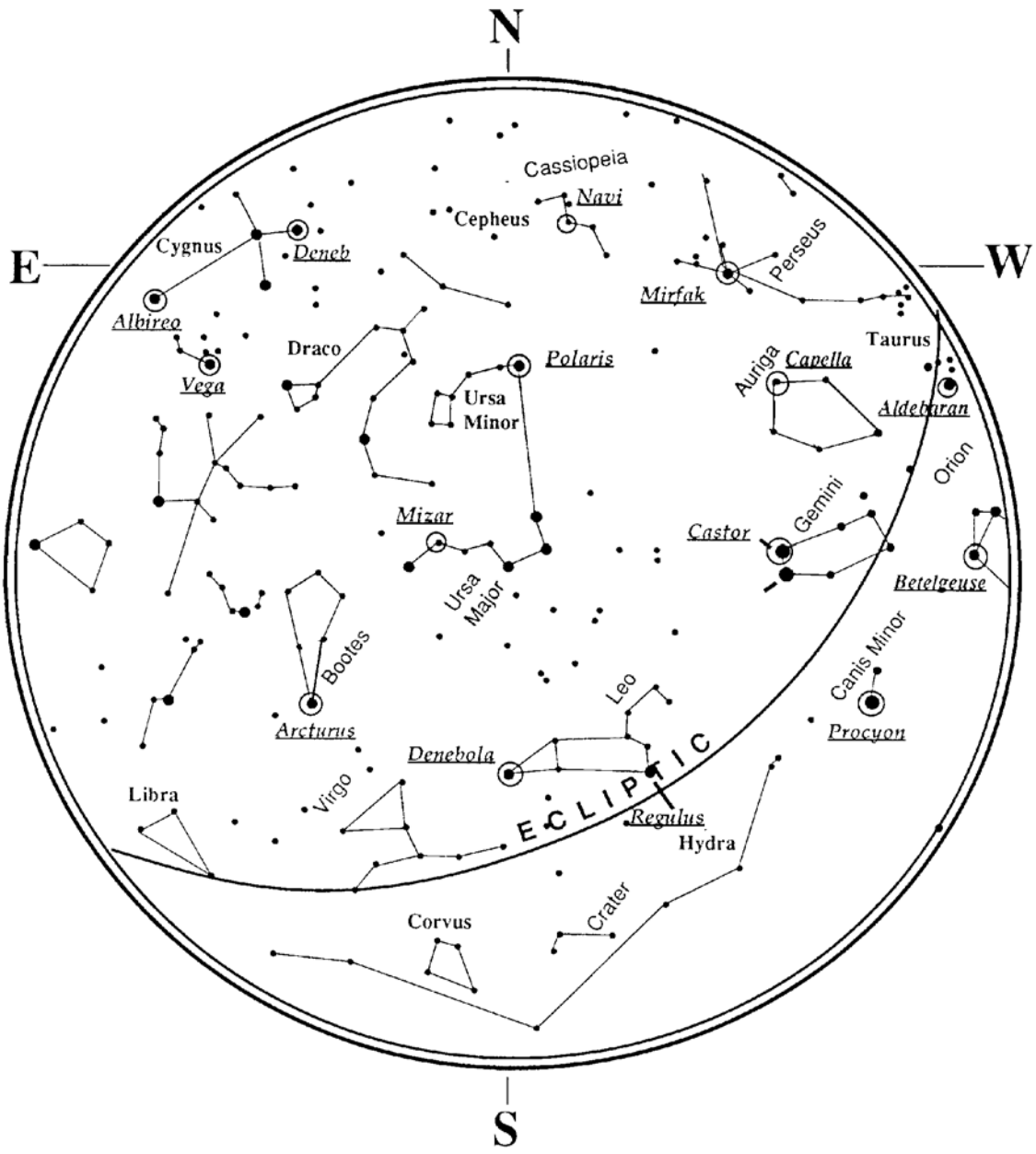


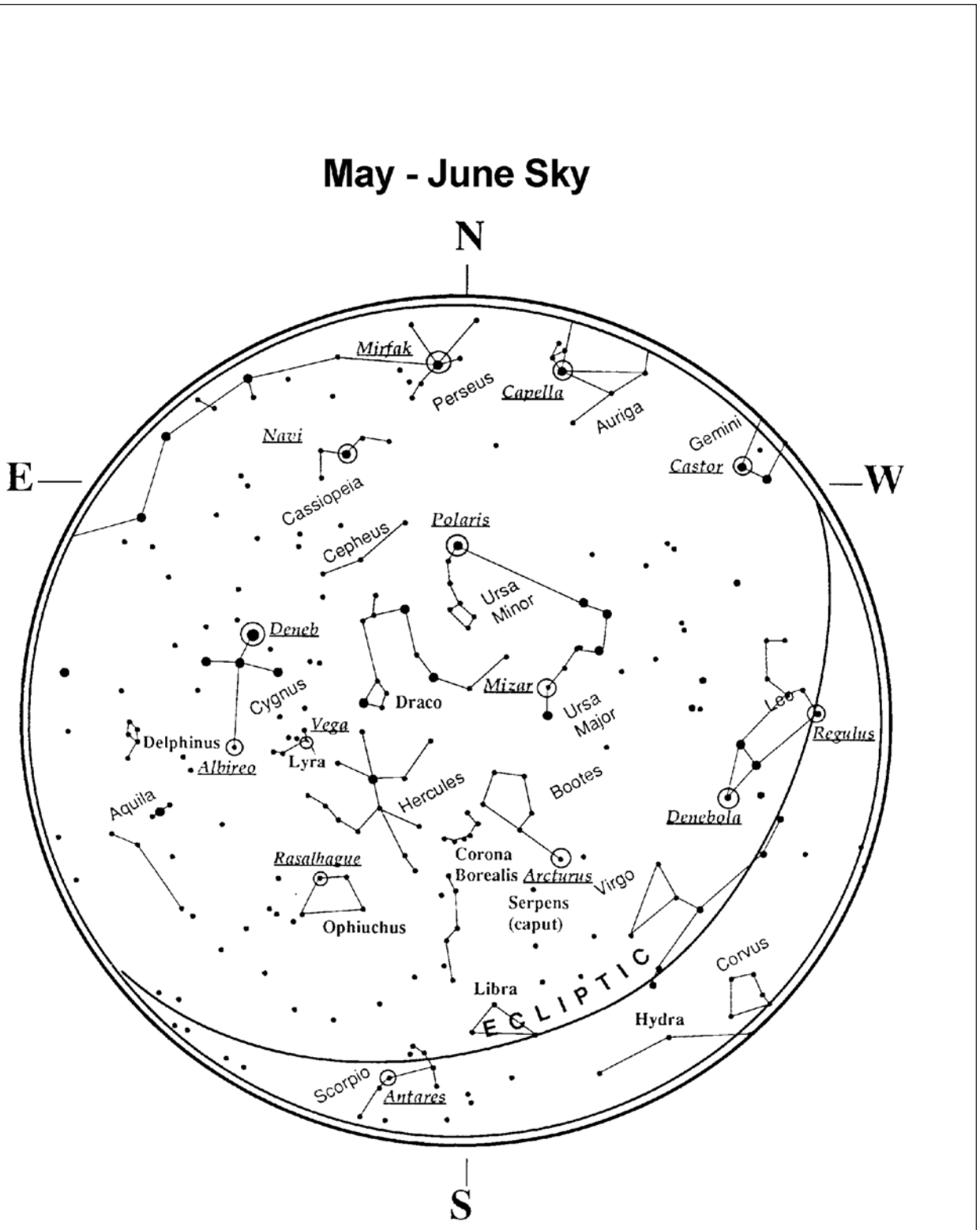
Star Charts

January - February Sky

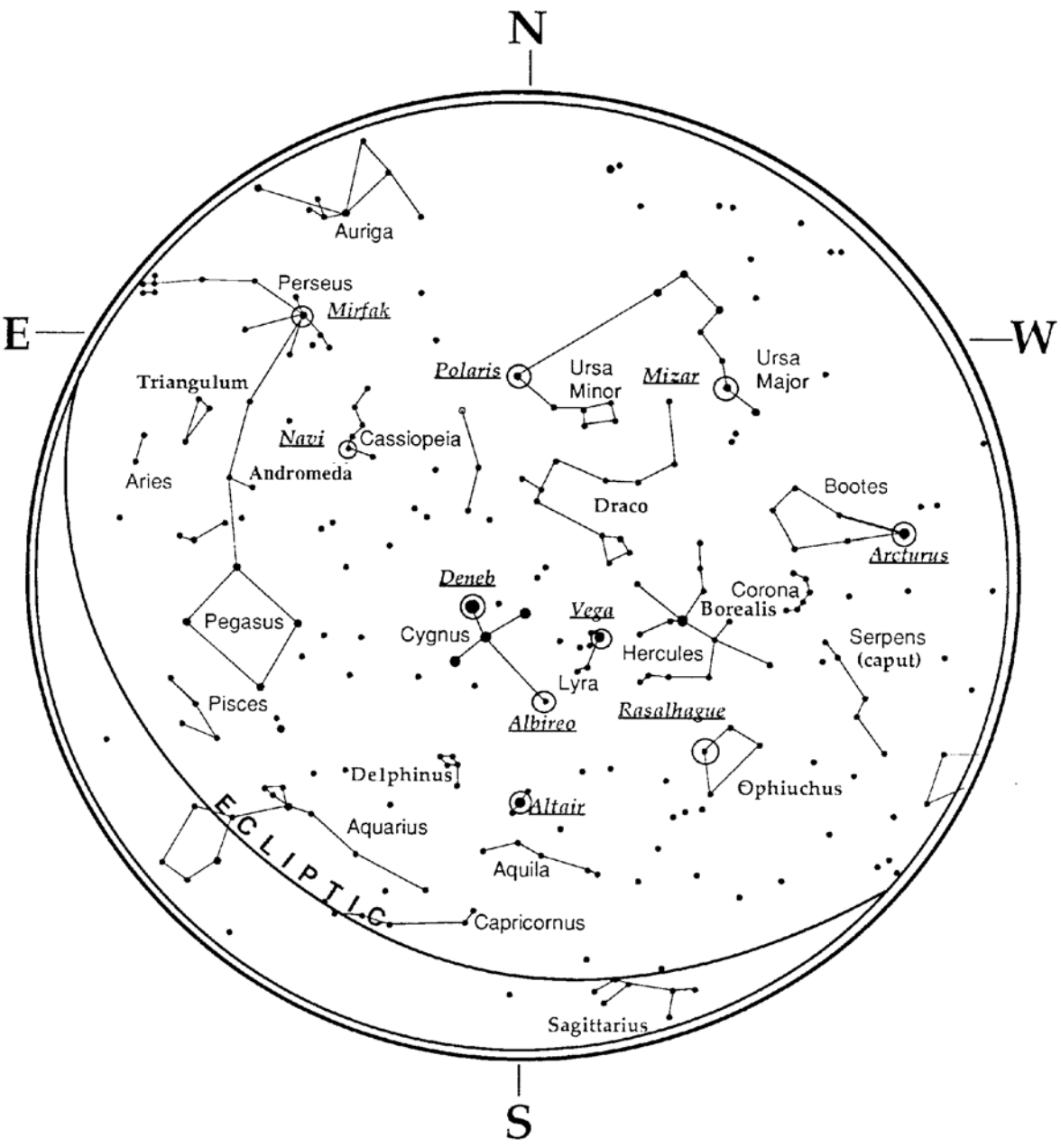


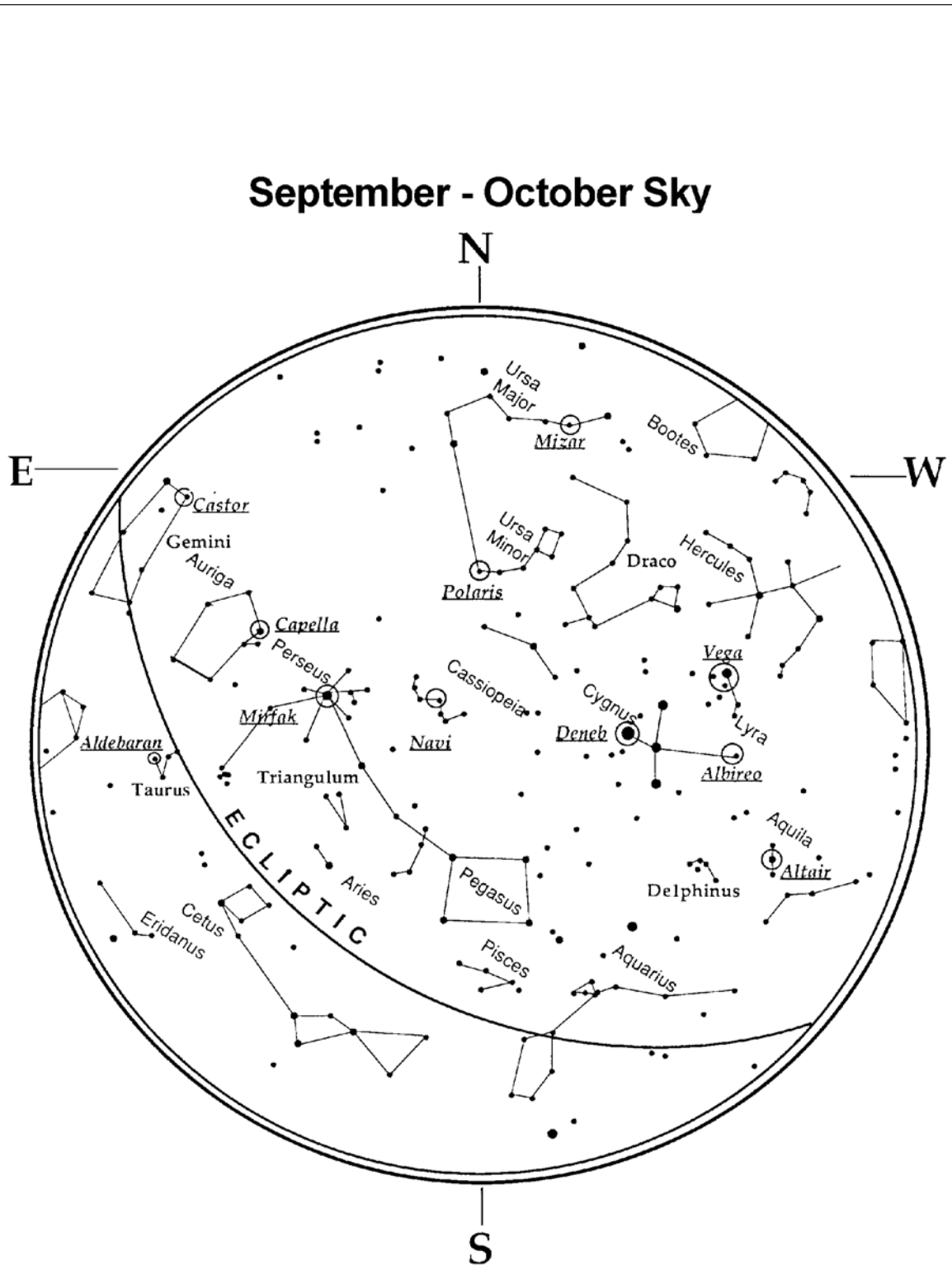
March - April Sky



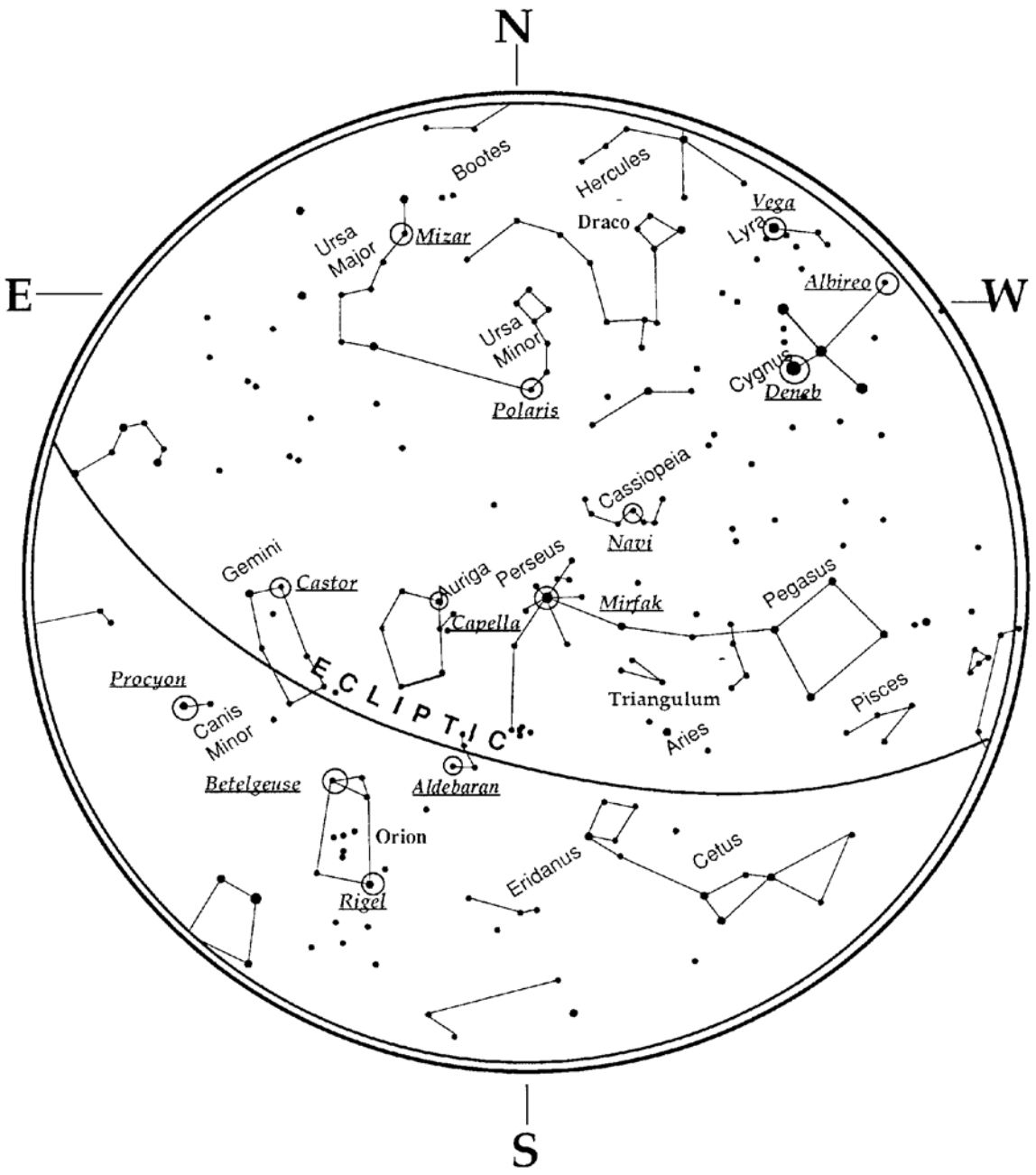

May - June Sky
N
E
W
S
Mirfak
Perseus
Capella
Auriga
Navi
Cassiopeia
Gemini
Castor
Cepheus
Polaris
Ursa Minor
Deneb
Cygnus
Draco
Mizar
Ursa Major
Leo
Regulus
Vega
Delphinus
Albireo
Lyra
Hercules
Bootes
Aquila
Denebola
Rasalhague
Corona Borealis
Arcturus
Virgo
Ophiuchus
Serpens (caput)
Corvus
Libra
ECLIPTIC
Hydra
Scorpio
Antares

July - August Sky




September - October Sky
N
E
W
S
Ursa Major
Mizar
Bootes
Castor
Gemini
Auriga
Ursa Minor
Polaris
Draco
Hercules
Capella
Perseus
Cassiopeia
Vega
Cygnus
Deneb
Lyra
Albireo
Mirfak
Navi
Aldebaran
Taurus
Triangulum
ECLIPTIC
Aquila
Altair
Aries
Pegasus
Delphinus
Cetus
Eridanus
Pisces
Aquarius

November - December Sky



One-Year Limited Warranty

The Orion XXg Truss Tube GoTo Dobsonians are warranted against defects in materials or workmanship for a period of one year from the date of purchase. This warranty is for the benefit of the original retail purchaser only. During this warranty period Orion Telescopes & Binoculars will repair or replace, at Orion's option, any warranted instrument that proves to be defective, provided it is returned postage paid to: Orion Warranty Repair, 89 Hangar Way, Watsonville, CA 95076. Proof of purchase (such as a copy of the original receipt) is required.

This warranty does not apply if, in Orion's judgment, the instrument has been abused, mishandled, or modified, nor does it apply to normal wear and tear. This warranty gives you specific legal rights, and you may also have other rights, which vary from state to state. For further warranty service information, contact: Orion Customer Service (800) 676-1343; support@telescope.com.

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OrionTelescopes.com
89 Hangar Way, Watsonville CA 95076
Customer Support Help Line (800) 676-1343 • Day or Evening