INSTRUCTION MANUAL

Orion StarSeeker™ II 102mm GoTo Refractor

#8991

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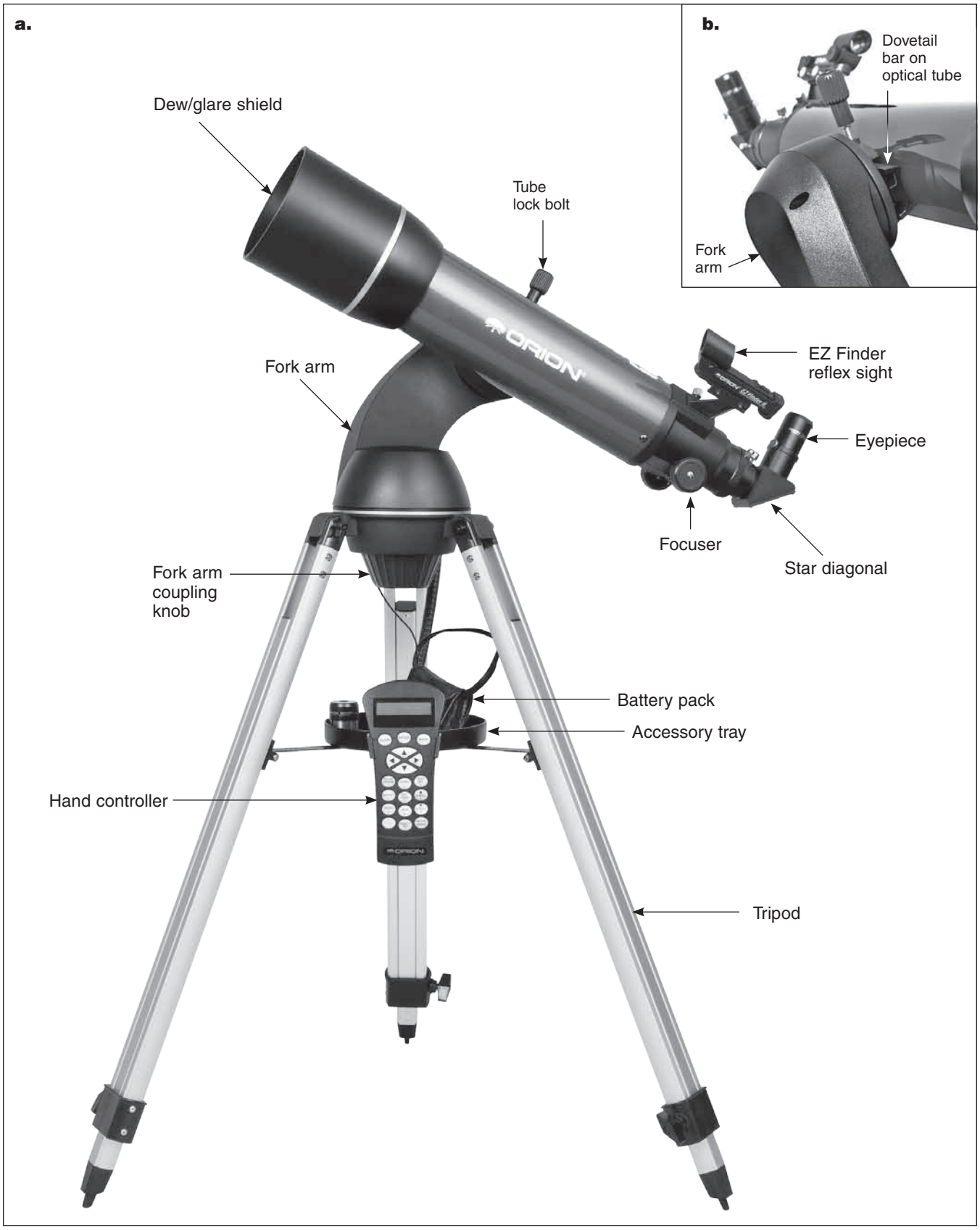

Figure 1. The StarSeeker II 102 GoTo Refractor

Introduction

Congratulations on your purchase of the Orion StarSeeker II 102 GoTo telescope! Simple and friendly to use, the StarSeeker combines state-of-the-art GoTo pointing technology with sharp, wide-field achromatic refractor optics in a package that makes observing the night sky both remarkably easy and wonderfully rewarding. It's the perfect combination of power and portability. Using the built-in SkyAlign technology, you initialize the scope for GoTo object location by simply pointing it to any three bright objects in the sky. If you are new to astronomy, you may wish to start off by using the StarSeeker's built-in Sky Tour feature, which commands the StarSeeker to find the most interesting objects and automatically slews to each one. Or if you are a more experienced amateur, you will appreciate the comprehensive database of 4,033 objects, including customized lists of all the best deep-sky objects, bright double stars, and variable stars. Regardless of your astronomy experience, the StarSeeker will reveal to you, your family, and your friends countless wonders of the universe.

Take time to read through this manual before embarking on your journey through the heavens. It may take a few observing sessions to become familiar with all of the StarSeeker's features, so you should keep this manual handy until you have fully mastered your telescope's operation. The StarSeeker hand controller displays step-by-step instructions to guide you through the alignment procedures needed to get the telescope up and running in minutes. Use this manual in conjunction with the on-screen instructions provided by the hand controller. The manual gives detailed information regarding each step as well as needed reference material and helpful hints guaranteed to make your observing experience as easy and pleasurable as possible.

WARNING: ***Never look directly at the Sun with the naked eye or with a telescope – unless you have a proper solar filter installed over the front of the telescope! Otherwise, permanent, irreversible eye damage may result.***

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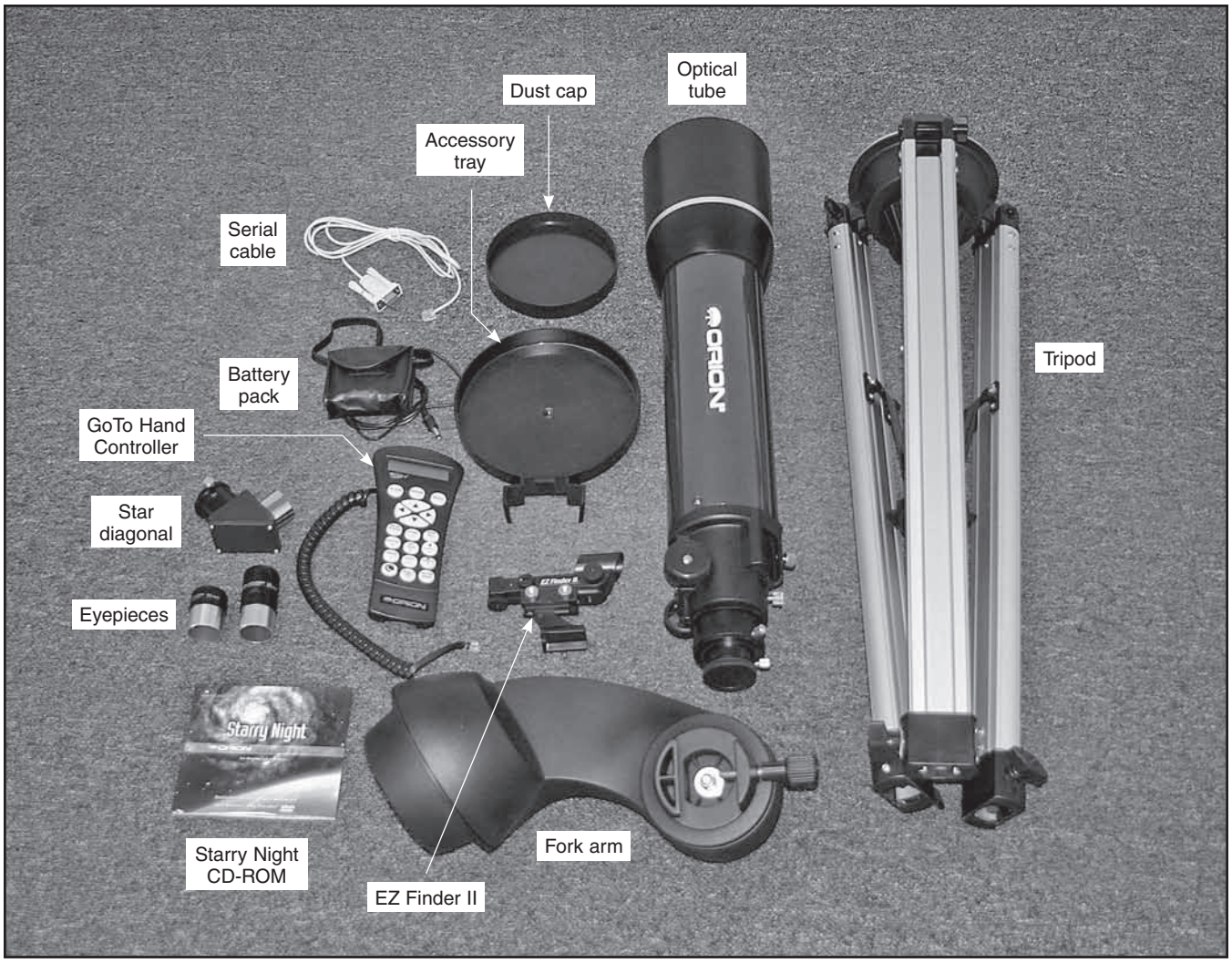


Figure 2. In the box: Parts of the StarSeeker II 102

Parts List

Qty.	*Description*
1	Optical Tube Assembly
1	Fork Arm
1	Tripod
1	Accessory Tray (with hand controller bracket)
1	GoTo Hand Controller
1	EZ Finder II Reflex Sight (with bracket)
1	25mm Explorer II Eyepiece
1	10mm Explorer II Eyepiece
1	Star Diagonal, 1.25"
1	Battery Pack (batteries not included)
1	Dust Cap
1	Serial RS-232 cable
1	Starry Night CD-ROM

Open the shipping box and, referring to the above Parts List and **Figure 2**, check that all the parts are present. Remove all of the accessories from their individual boxes. Remember to save all of the original packaging in case the scope needs to be returned to Orion for warranty repair, or should you wish to return the scope under the 30-day return policy. Especially in the latter case, the original packaging is required. If anything is missing, call Orion Customer Service at (800) 676-1343, or support@telescope.com.

Assembly

Your StarSeeker comes in three major sections: the optical tube, fork arm and the tripod. The assembly process entails first installing the fork arm on the tripod, then attaching the telescope tube to the fork arm. After that, you will attach the accessories. It's all very easy to do!

First, install the accessory tray onto the tripod:

1. Remove the tripod from the box and spread the legs apart until the center leg brace is fully extended.
2. Locate the accessory tray, and place it on top of the tripod center support brace in between the tripod legs (see **Figure 3**).
3. Insert the locking bolt from underneath the tripod support brace and thread it into the hole in the center of the accessory tray. Do not over tighten.

The accessory tray has a hand controller bracket protruding from the edge. The back of the hand controller has an opening that slides over the clip on the inside of the bracket.

It is a good idea to adjust the height of the tripod before attaching the fork arm and optical tube. Minor adjustments can be made later. To adjust the height of the tripod legs:

1. Loosen the tripod leg lock knob located on the side of each leg.
2. Slide the inner portion of each leg down to the desired length.
3. Tighten the tripod lock knobs to secure each leg in place.

Also, be sure to tighten the lock knobs at the top of each leg, where it attaches to the tripod mounting platform.

Attaching the Fork Arm to the Tripod

With the tripod properly assembled, the fork arm can now be attached using the quick-release coupling knob located under the tripod mounting platform:

1. Place the fork arm base inside the tripod mounting platform. See **Figure 4**.
2. Thread the coupling screw into the hole at the bottom of the fork arm base and tighten with the large coupling knob.

Attaching the Telescope Tube to the Fork Arm

1. Unthread the tube lock bolt until the bolt tip is not protruding into the saddle slot.
2. Slide the tube dovetail bar into the saddle on the fork arm as shown in **Figure 5**, and secure it by tightening the tube lock bolt.

Your StarSeeker is now assembled and is ready for attachment of the accessories!

NEVER ATTEMPT TO MOVE THE TELESCOPE BY HAND! Otherwise, the gears and motors may be damaged. Move the telescope only electronically with the hand controller.

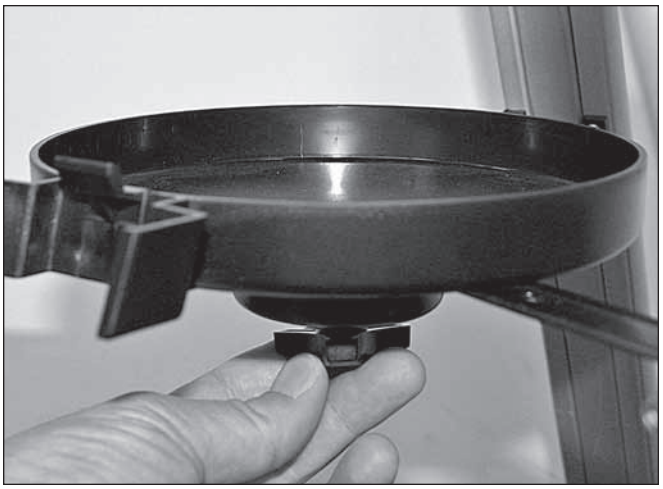


Figure 3. The round accessory tray attaches to the tripod leg brace with the captive screw on the brace.

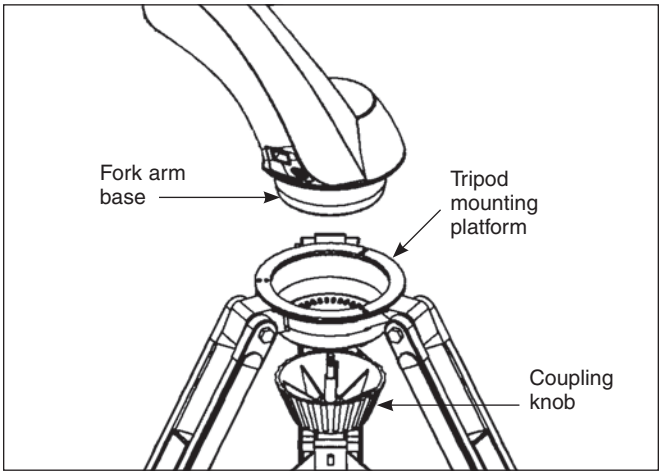


Figure 4. The fork arm attaches to the tripod mounting platform with the large coupling knob.

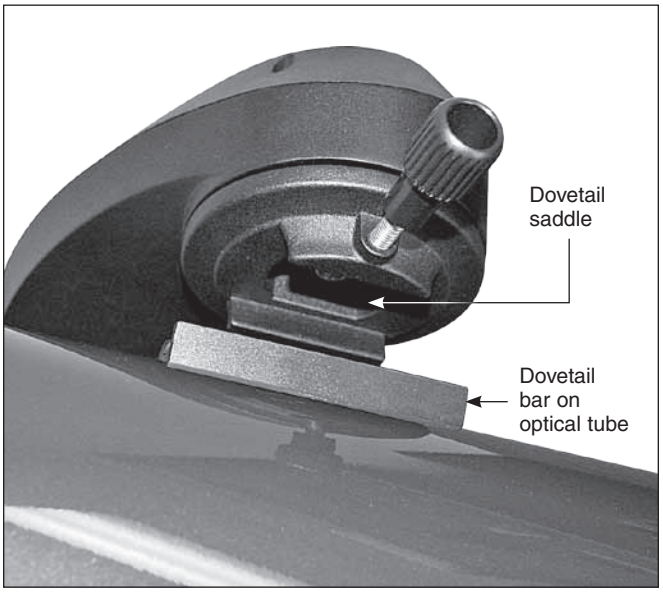


Figure 5. Mount the tube on the fork arm via the dovetail bar and saddle.

Inserting the Star Diagonal and Eyepiece

The star diagonal diverts the light at a right angle from the light path of the telescope. For astronomical observing with a refractor, the star diagonal allows you to observe in positions that are more comfortable than if you were to look straight through. To attach the star diagonal:

1. Remove the protective dust cap from the 1.25" accessory adapter (see **Figure 6**).
2. Loosen the thumbscrew on the 1.25" adapter and slide the chrome portion of the star diagonal into the adapter.
3. Tighten the thumbscrew on the adapter to hold the star diagonal in place.

If you wish to change the orientation of the star diagonal to a more convenient viewing angle, loosen the thumbscrew on the 1.25" adapter and rotate the diagonal to the desired position, then retighten the thumbscrew.

The eyepiece, or ocular, is the optical element that magnifies the image focused by the telescope. The eyepiece fits directly into the focuser. The supplied 1.25" eyepieces fit in the 1.25" star diagonal (**Figure 6**). Optional 2" eyepieces could be used, but would require a 2" star diagonal to be inserted in the 2" accessory collar with the 1.25" adapter removed. The 12.5" and 2" designations refer to the barrel diameter of the eyepieces. To install one of the included eyepieces:

1. Loosen the thumbscrew on the eyepiece adapter at the end of the focuser drawtube and remove the protective dust cap.
2. Slide the chrome barrel of the eyepiece into the eyepiece adapter **(Figure 7)**.
3. Tighten the thumbscrews to hold the eyepiece in place.
4. To remove the eyepiece, loosen the thumbscrews on the eyepiece adapter and slide the eyepiece out.
5. Eyepieces are commonly referred to by their focal length and barrel diameter. The focal length of each eyepiece is typically printed on the eyepiece body. For example this telescope ships with two 1.25" diameter eyepieces; a 25mm and a 10mm. The longer the focal length (i.e., the larger the number), the lower the eyepiece power or magnification; and the shorter the focal length (i.e., the smaller the number), the higher the magnification. Generally, low or moderate power will produce the sharpest images when viewing. For more information on how to determine power, see the section “Calculating Magnification.”

Focusing

To focus your telescope, simply turn either of the focus wheels on the focuser (see **Figure 6**) until the image looks sharp.

Installing the EZ Finder II

Before installing the EZ Finder II on the telescope, you’ll need to insert the included 3-volt lithium battery.

1. Insert a small, flat-blade screwdriver into the notch in the battery casing and gently pry it off (**Figure 8**).

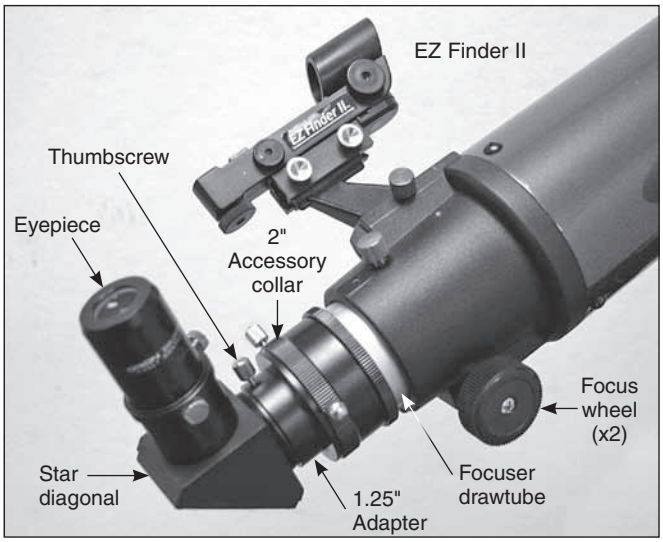


Figure 6. The focuser and installed accessories.

Figure 7. Insert the chrome barrel of the eyepiece into the diagonal and secure with the two thumbscrews.

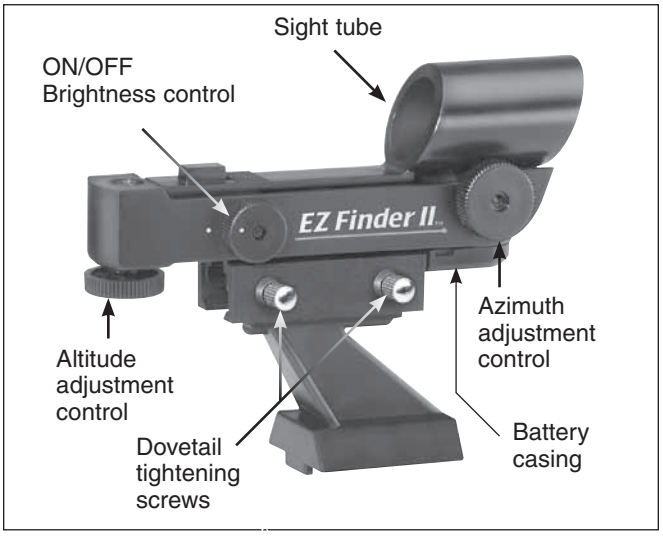


Figure 8. The EZ Finder II’s On/Off and adjustment knobs.

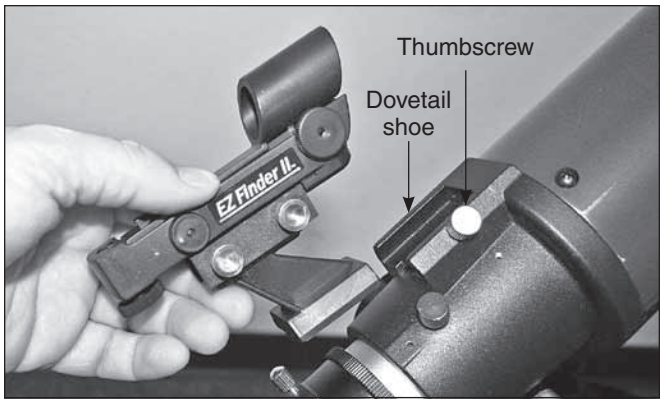


Figure 9. Insert the EZ Finder II into its dovetail shoe in the orientation shown and secure it with the thumbscrew.

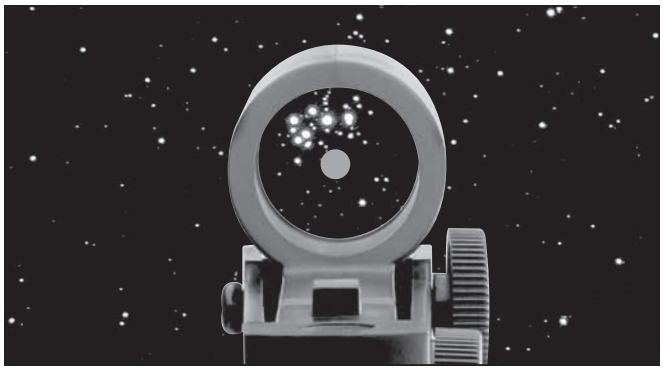


Figure 10. The EZ Finder II superimposes a tiny red dot on the sky, showing right where the telescope is aimed.

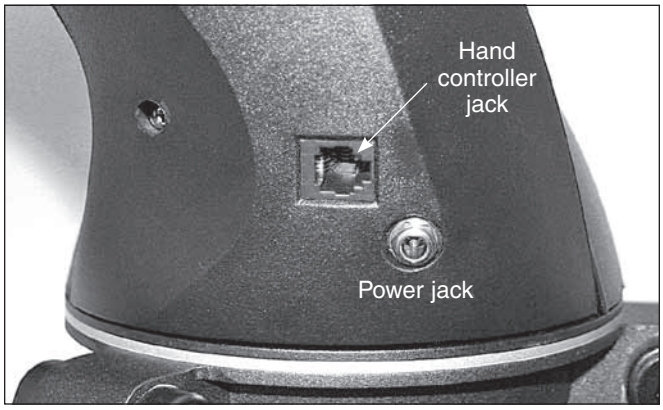


Figure 11. Jacks for the power cable and hand controller cable are located at the bottom of the fork arm.

2. Slide the CR2032 3V lithium battery under the retaining clip with the positive (+) side facing down (touching the clip).
3. Then press the battery casing cover back on.

Should the battery die, replacement CR2032 batteries are available at many stores where small batteries are sold.

To attach the dovetail mounting bracket to the EZ Finder II, loosen the two thumbscrews on the bottom rail of the EZ Finder II. Slide the EZ Finder II onto the bracket and tighten the two thumbscrews (See **Figure 8**). Then simply slide the dovetail mounting bracket into the telescope's dovetail mounting shoe as shown and tighten the thumbscrew on the shoe to secure the mounting bracket.

Slide the base of the EZ Finder II bracket into the dovetail shoe on the optical tube (**Figure 9**). The EZ Finder II should be oriented so that the sight tube is facing the *front* of the telescope, as shown. Tighten the thumbscrew on the dovetail shoe to secure the EZ Finder II in place.

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 (**Figure 10**). 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 ON/OFF knob (see **Figure 8**) 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 ON/OFF 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

For the EZ Finder II to work properly, it has to be aligned with the telescope. When the two are aligned, a celestial object that is centered on the EZ Finder II's red dot should also appear in the center 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 turn on the EZ Finder II and look though it. Without moving the main telescope, use the EZ Finder II's azimuth (left/right) and altitude (up/down) adjustment knobs (see **Figure 8**) 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 eyepiece. If it isn't, 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, 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 off the ON/OFF knob on the EZ Finder II.

Attaching the Hand Controller

The StarSeeker hand controller has a phone jack type connector at the end of its cord. Plug the phone jack connector into the outlet at the base of the telescope's fork arm (**Figure 11**). Push the connector into the outlet until it clicks into place and place the hand controller into its holder as described previously in the Assembly section of the manual.

Powering the StarSeeker

The StarSeeker II 102 can be powered by the supplied battery pack, or an optional AC-to-DC adapter or Dynamo Pro 12V field battery. The battery pack requires 8 user-supplied AA alkaline batteries. To power the StarSeeker, insert the plug of your desired power supply into the 12V jack located on the side of the fork arm (**Figure 11**). Once the power supply is plugged in, the LCD on the StarSeeker's hand controller will light up and display the opening message. To turn the StarSeeker off, simply disconnect the power supply from the jack on the mount. (There is no On/Off switch.)

The GoTo Hand Controller

This section describes the basic hand controller procedures needed to operate the StarSeeker.

Refer to **Figure 12** to familiarize yourself with the hand controller's features and keypad.

1. **Liquid Crystal Display (LCD) Window:** Has a dual-line, 16 character display screen that is backlit for comfortable viewing of telescope information and scrolling text.
2. **Align:** Instructs the StarSeeker to use a selected star or object as an alignment position.
3. **Enter:** Pressing Enter allows you to select any of the StarSeeker functions, accept entered parameters, and slew the telescope to displayed objects.
4. **Back:** Will take you out of the current menu and display the previous level of the menu path. Press Back repeatedly to get back to a main menu or use it to erase data entered by mistake.
5. **Directional (Arrow) Buttons:** Allow the StarSeeker to be moved in altitude (up and down) and azimuth (left and right). Use the direction buttons to move the telescope or center objects in the EZ Finder II and eyepiece. You can press just one button at a time or you can press two adjacent buttons simultaneously to move the scope in both altitude and azimuth simultaneously. These buttons only move the telescope. They cannot be used to scroll through menu features.
6. **Object Type Buttons:** Three separate buttons for accessing lists of Solar System objects; Stars, including variable and double stars; and Deep Sky objects.
7. **Identify:** Allows search of any of the StarSeeker database catalogs or lists and display the name and offset distances to the nearest matching objects.
8. **Sky Tour:** Activates the tour mode, which lists the best objects currently visible. Scroll through the selections and press Enter to slew the telescope to any of the objects.
9. **Scroll Buttons:** Pair of angled buttons used to scroll up and down within any of the menu lists. The angled face of the buttons makes them literally stand out from the other buttons on the keypad. A double arrow symbol on the right side of the LCD indicates that the scroll buttons can be used to view additional information.

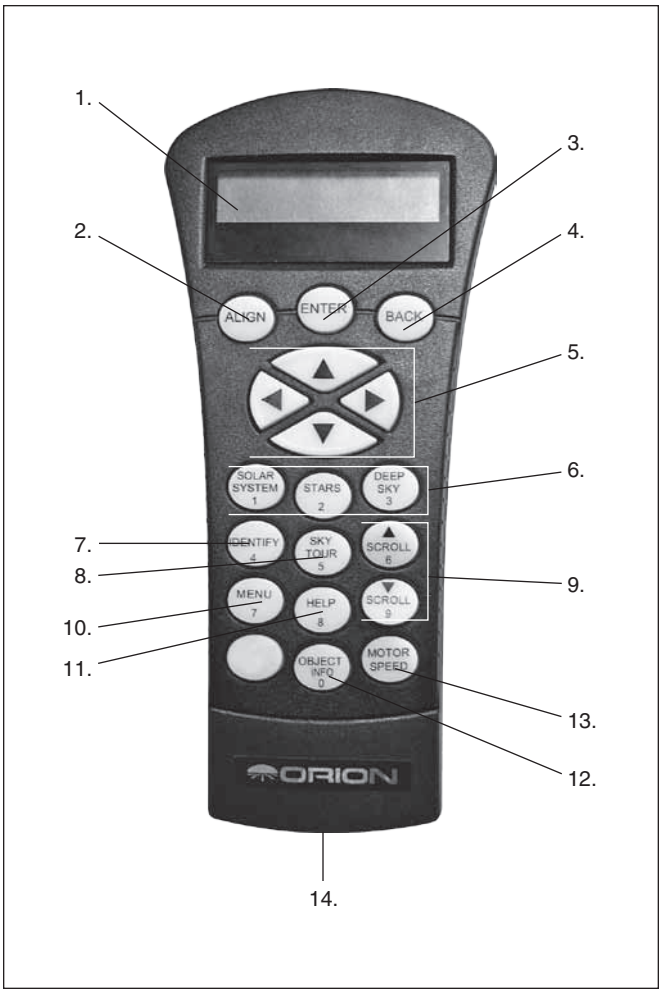


Figure 12. The StarSeeker GoTo hand controller

10. **Menu:** Displays the many setup and utilities functions such as tracking rate, user-defined objects, and many others. See below for detailed review of Menu options.
11. **Help:** Will be used in future revisions to the firmware to provide tutorials on using the more advanced features of the hand controller.
12. **Object Info:** Displays coordinates, magnitude, a description, and other useful information about the object currently selected. Use the scroll buttons to toggle through the various pieces of information. Object information can be obtained without having to do a star alignment. After the telescope is powered on, pressing any of the object type buttons allows you to scroll through object lists or enter catalog numbers and view the information about the object by then pressing the Object Info button.
13. **Motor Speed:** Instantly changes the rate of speed of the motors when the direction buttons are pressed. (0 = slower, 9 = faster)
14. **RS-232 Port:** This port, on the bottom end of the controller, allows connection with a computer running

astronomy software programs for controlling the telescope using the software interface.

Motor Speed Button

The telescope can be controlled at nine different speed rates when using the directional buttons. In the table below, the "x" in the first five speeds refers to sidereal tracking rate. Pressing the MOTOR SPEED button allows you to instantly change the speed rate of the motors from high speed slew rate to precise guiding rate or anywhere in between. Each rate corresponds to a number on the hand controller keypad. The number 9 is the fastest rate (approximately 4° per second, depending on power source) and is used for slewing between objects and locating alignment stars. The number 1 on the hand control is the slowest rate (2x sidereal) and can be used for accurate centering of objects in the eyepiece. To change the speed rate of the motors:

- Press the MOTOR SPEED button on the hand controller. The LCD will display the current speed rate in the upper right corner.
- Press the number on the hand controller that corresponds to the desired speed. (You do not need to press ENTER to activate the change.)
- The hand controller has a "double button" feature that allows you to instantly speed up the motors without having to choose a speed rate. To use this feature, simply press the arrow button that corresponds to the direction that you want to move the telescope. While holding that button down, press the opposite directional button. This will increase the speed to the maximum slew rate.

1 = 2x	*4 = 16x*	*7 = 1° / sec*
2 = 4x	*5 = 32x*	*8 = 2° / sec*
3 = 8x	*6 = .5° / sec*	*9 = 4° / sec*

Choose from nine available slew speeds.

Alignment Procedure

In order for the StarSeeker to accurately point to objects in the sky, it must first be aligned to known positions in the sky. With this information, the telescope can create a model of the sky, which it uses to locate any object with known coordinates. There are many ways to align the StarSeeker with the sky depending on what information the user is able to provide. All methods require you to enter your current date, time, and city to create an accurate model of the sky. With **SkyAlign** simply point the telescope to any three bright celestial objects to accurately align the telescope with the sky. **Auto Two-Star Align** will ask the user to choose and center the first alignment star, then the StarSeeker will automatically select and slew to a second star for alignment. **Two-Star Alignment** requires the user to identify and manually slew the telescope to the two alignment stars. **One-Star Align** requires you to align to just one known star. Although not as accurate as the other alignment methods, One-Star Align is the quickest way to find and track bright planets and objects in Altazimuth mode. Finally, **Solar System Align** will display a list of visible daytime objects (planets and the Moon) available to align the telescope. Each alignment method is discussed in detail below.

Note: Before performing an alignment, be sure that the EZ Finder II is properly aligned with the telescope.

Initial Set-Up

1. Power on the StarSeeker by plugging the power supply into the jack on the base of the fork arm (**Figure 11**).
2. Press ENTER to choose SkyAlign. You will be able to choose a different alignment method in the future. Pressing the ALIGN button will bypass the other alignment options and the scrolling text and automatically begins SkyAlign.
3. The hand controller display will then ask for the following time/site information:

   Location – The StarSeeker will display a list of cities to choose from. Choose the city from the database that is closest to your current observing site. The city you choose will be remembered in the hand controller's memory so that it will be automatically displayed the next time an alignment is done. Alternatively, if you know the exact longitude and latitude of your observing site, it can be entered directly into the hand controller and remembered for future use as well. To choose a location city:

   - Use the Up and Down scroll buttons to choose between City Database and Custom Site. City Database will allow you to select the closest city to your observing site from a list of either international or U.S. location. Custom Site allows you to enter the exact longitude and latitude of your observing site. Select City Database and press ENTER.
   - The hand controller will allow you to choose from either U.S. or international locations. For a listing of U.S. locations by state and then by city, press ENTER while United States is displayed. For international locations, use the Up or Down scroll button to select International and press ENTER.
   - Use the Up and Down Scroll buttons to choose your current state (or country if International locations was selected) from the alphabetical listing and press ENTER.
   - Use the Up and Down Scroll buttons to choose the closest city to your location from the displayed list and press ENTER.

   If you choose to enter the latitudinal and longitudinal position, use the numeric keypad and scroll buttons. This method can provide greater accuracy when targeting objects in the night sky. First enter the longitudinal coordinate and hemisphere (W or E), followed by the latitudinal coordinate and hemisphere (N or S). Press ENTER to confirm your coordinates.

   Note: Latitude and longitude coordinates must be entered in degrees and arcminutes. If your map or atlas gives coordinates in decimal values (i.e., latitude = 36.95 N) you must convert into degrees and arcminutes. To do this simply multiply the decimal value by 60. If your viewing location is at lati-

tude 36.95 N you would enter a latitude of 36°57' N [.95x60=57].

Time – Enter the current time for your area. You can enter either the local time (i.e., 8:00), or you can enter military time (i.e., 20:00).

- Select PM or AM. If military time was entered, the hand control will bypass this step.
- Choose between Standard time or Daylight Saving time. Use the Up and Down scroll buttons to toggle between options.
- Select the time zone that you are observing from. Again, use the Up and Down buttons to scroll through the choices. For time zone information, refer to the Time Zone map in the appendices of this manual.

Date – Enter the month, day and year of your observing session. The display will read: mm/dd/yy.

- If the wrong information has been input into the hand controller, the BACK button will act as a backspace allowing the user to re-enter information.
- The next time that your StarSeeker is aligned, the hand controller will automatically display the last location (either a city or longitude/latitude) that was entered. Press ENTER to accept these parameters if they still apply. Pressing the BACK button will allow you to go back and select a new city location or longitude/latitude.

SkyAlign

SkyAlign is the easiest way to get your StarSeeker aligned and ready to observe. Even if you do not know a single star in the sky, the StarSeeker will have you aligned in minutes by asking for basic information like the date, time and location. Then you simply need to aim the telescope to any three bright celestial objects in the sky. Since SkyAlign requires no knowledge of the night sky it is not necessary to know the name of the objects at which you are aiming. You may even select a planet or the Moon. The StarSeeker is then ready to start finding and tracking any of the objects in its 4,033 object database. Before the telescope is ready to be aligned, it should be set up in an outside location with all accessories (eyepiece, diagonal, and finder scope) attached and lens cover removed as described in the Assembly section of the manual. To begin SkyAlign:

1. Choose your first target and use the arrow buttons on the hand controller to slew (move) the telescope toward the selected object in the sky. Align the object with the red dot of the finder scope and press ENTER.
2. If the finder scope has been properly aligned with the telescope tube, the alignment star should now be visible inside the field of view of the eyepiece. The hand controller will ask that you center the bright alignment star in the center of the eyepiece and press the ALIGN button. This will accept the star as the first alignment position. (There is no need to adjust the slewing rate of the motors after each alignment step. The StarSeeker automatically selects the best slewing rate for aligning objects in both the finder scope and the eyepiece).
3. For the second alignment object, choose a bright star or planet as far as possible from the first alignment object. Use the directional buttons on the hand controller to move the scope to it. Then use the buttons to center the object in the finder scope and press ENTER. Then once centered in the eyepiece press the ALIGN button.
4. Repeat the process for the third alignment star. When the telescope has been aligned to the final star, the display will read Match Confirmed! Press BACK to display the names of the three bright objects you aligned to, or press ENTER to accept these three objects for alignment. You are now ready to find your first object.

Note: If the message "Alignment Failed" appears on the display it means the computer was unable to identify the three objects chosen and you will need to re-do the alignment procedure. One common cause is inaccurate time/site information input into the hand controller. Confirm that you have all the correct information before proceeding. It could also be that the objects chosen were not accurately centered in the eyepiece before pressing the ALIGN button. It can be helpful to use an illuminated reticle eyepiece (see orionteleskopes.com for more details) or switch to a higher power eyepiece after centering the object in a low power eyepiece. This will help you achieve greater accuracy.

Tips for Using SkyAlign

Remember the following alignment guidelines to make using SkyAlign as simple and accurate as possible.

- Be sure to level the tripod before you begin alignment. Accurate time/site information along with a level tripod will help the telescope better predict the available bright stars and planets that are above the horizon.
- Remember to select alignment stars that are as far apart in the sky as possible. For best results make sure that the third alignment star does not lie in a straight line between the first two stars. This may result in a failed alignment.
- Don't worry about confusing planets for stars when selecting alignment objects. SkyAlign works with the four brightest planets (Venus, Jupiter, Saturn, and Mars) as well as the Moon. In addition to the planets, the hand controller has over 80 bright alignment stars to choose from (down to magnitude 2.5).
- On rare occasions SkyAlign will not be able to determine what three alignment objects were centered. This sometime happens when a bright planet or the Moon passes near one of the brighter stars. In situations like these it is best to try to avoid aligning to either object if possible.
- Be sure to center the objects with the same final movements as the direction of the GoTo approach. For example, if the scope normally finishes a GoTo with the front of the scope moving right and up, you should center all three alignment objects in the eyepiece using the right

and up arrow buttons (the up/down arrows reverse at slew rates of 6 or lower). Approaching the star from this direction when looking through the eyepiece will eliminate much of the backlash between the gears and assure the most accurate alignment possible.

Auto Two-Star Align

As with SkyAlign, Auto Two-Star Align requires you to enter all the necessary time/site information as referenced in the section entitled Initial Setup. Once this information is entered and confirmed, StarSeeker will prompt you to select and point the telescope at one known star. In other words, you will need to input the chosen star's name into the hand controller. You cannot simply choose a bright object. The StarSeeker now has all the information it needs to automatically choose a second star that will assure the best possible alignment. Once selected, the telescope will automatically slew to that second alignment star to complete the alignment. With the StarSeeker set up outside with all accessories attached and the tripod leveled, follow the steps below to align the telescope:

1. Once the StarSeeker is powered on, Press ENTER to begin alignment.
2. Use the Up and Down scroll buttons to select Auto Two-Star Align and press ENTER.
3. The hand controller will display the last time and location information that was entered into the hand controller. Use the Up and Down scroll buttons to confirm the information or make any necessary revisions. Press ENTER to accept the current information, or press BACK to manually edit the information (see SkyAlign section for detailed instruction on entering time/site information).
4. The display will now prompt you to select a bright star from the displayed list on the hand controller. Use the scroll buttons to scroll to the desired star and then press ENTER.
5. Use the directional arrow buttons to slew the telescope to the star you selected. Center the star in the EZ Finder II and press ENTER. Finally, center the star in the eyepiece and press ALIGN.
6. Based on this information, the StarSeeker will automatically display the most suitable second alignment star that is above the horizon. Press ENTER to automatically slew the telescope to the displayed star. If for some reason you do not wish to select this star (perhaps it is behind a tree or building), you can either:
   - Press the BACK button to display the next most suitable star for alignment.
   - Use the UP and DOWN scroll buttons to manually select any star you wish from the entire list of available stars.

Once the scope has finished slewing, the display will ask you to use the arrow buttons to align the selected star with the red dot of the EZ Finder II. Once centered in the finder, press ENTER. The display will then instruct you to center the star in the field of view of the eyepiece. When the star is centered, press ALIGN to accept this star as your second alignment star. When the telescope has been aligned to both stars the display will read **Align Success**, and you are now ready to find your first object.

Two-Star Alignment

With the two-star alignment method, the StarSeeker requires the user to know the names and positions of two bright stars in order to accurately align the telescope with the sky and begin finding objects. Here is an overview of the two-star alignment procedure:

1. Once the StarSeeker is powered on, use the Up and Down scroll buttons to select Two-Star Align, and press ENTER.
2. Press ENTER to accept the time/site information displayed on the display, or press BACK to enter new information.
3. The SELECT STAR 1 message will appear in the top row of the display. Use the Up and Down scroll buttons to select the star you wish to use for the first alignment star. Press ENTER.
4. StarSeeker then asks you to center in the eyepiece the alignment star you selected. Use the directional arrow buttons to slew the telescope to the alignment star and carefully center it in the finder scope. Press ENTER when centered.
5. Then, center the star in the eyepiece and press ALIGN.

HELPFUL HINT: In order to accurately center the alignment star in the eyepiece, you may wish to decrease the slew rate of the motors for fine centering. This is done by pressing the RATE button on the hand controller then selecting the number that corresponds to the speed you desire. (9 = fastest, 1 = slowest).

6. StarSeeker will then ask you to select and center a second alignment star and press the ALIGN button. It is best to choose alignment stars that are a good distance away from one another. Stars that are at least 40° to 60° apart from each other will give you a more accurate alignment than stars that are close to each other. For reference, your fist held at arm's length spans about 10° of sky.

Once the second star alignment is completed properly, the display will read Align Successful, and you should hear the tracking motors turn on and begin to track.

One-Star Align

One-Star Align requires you to input all the same information as you would for the Two-Star Align procedure. However, instead of slewing to two alignment stars for centering and alignment, the StarSeeker uses only one star to model the sky based on the information given. This will allow you to roughly slew to the coordinates of bright objects like the Moon and planets and gives the StarSeeker the information needed to track objects in altazimuth in any part of the sky. One-Star Align is not meant to be used to accurately locate small or faint deep-sky objects or to track objects accurately for photography.

To use One-Star Align:

1. Select One-Star Align from the alignment options.
2. Press ENTER to accept the time/site information displayed on the display, or press BACK to enter new information.
3. The SELECT STAR 1 message will appear in the top row of the display. Use the Up and Down scroll buttons to select the star you wish to use for the first alignment star. Press ENTER.
4. StarSeeker then asks you to center in the eyepiece the alignment star you selected. Use the directional arrow buttons to slew the telescope to the alignment star and carefully center it in the finder scope. Press ENTER when centered.
5. Then, center the star in the eyepiece and press ALIGN.
6. Once in position, the StarSeeker will model the sky based on this information and display Align Successful.

Note: Once a One-Star Alignment has been done, you can use the Re-alignment feature (later in this section) to improve your telescope's pointing accuracy.

Solar System Align

Solar System Align is designed to provide excellent tracking and GoTo performance by using solar system objects (Sun, Moon and planets) to align the telescope with the sky. Solar System Align is a great way to align your telescope for daytime viewing as well as a quick way to align the telescope for night time observing.

Never look directly at the Sun with the naked eye or with a telescope unless it is equipped with a proper solar filter on the front of the tube. Otherwise, permanent eye damage may result.

1. Select Solar System Align from the alignment options.
2. Press ENTER to accept the time/site information displayed on the display, or press BACK to enter new information.
3. The SELECT OBJECT message will appear in the top row of the display. Use the Up and Down scroll buttons to select the daytime object (planet, Moon, or Sun) you wish to align. Press ENTER.
4. StarSeeker then asks you to center in the eyepiece the alignment object you selected. Use the directional buttons to slew the telescope to the alignment object and carefully center it in the finder scope. Press ENTER when centered.
5. Then, center the object in the eyepiece and press ALIGN.

Once in position, the StarSeeker will model the sky based on this information and display **Align Successful**.

Tips for Using Solar System Align

For safety purposes, the Sun will not be displayed in any of the hand controller's customer object lists unless it is enabled from the Utilties Menu. To allow the Sun to be displayed on the hand controller, do the following:

1. Press the BACK button until the display reads StarSeeker Ready.
2. Press the MENU button and use the scroll buttons to select the Utilities menu. Press ENTER.
3. Use the scroll buttons to select Sun Menu and press ENTER.
4. Press ENTER again to allow the Sun to appear on the hand controller display.

The Sun can be removed from the display by using the same procedure as above.

To improve the telescope pointing accuracy, you can use the Re-Align feature as described below.

StarSeeker Re-Alignment

The StarSeeker has a re-alignment feature which allows you to replace either of the original alignment stars with a new star or celestial object. This can be useful in several situations:

- If you are observing over a period of a few hours, you may notice that your original two alignment stars have drifted towards the west considerably. (Remember that the stars are moving at a rate of 15° every hour.) Aligning on a new star that is in the eastern part of the sky will improve your pointing accuracy, especially on objects in that part of the sky.
- If you have aligned your telescope using the One-star align method, you can use re-align to align to an additional object in the sky. This will improve the pointing accuracy of your telescope without having to re-enter location information.

To replace an existing alignment star with a new alignment star:

1. Select the desired star (or object) from the database and slew to it.
2. Carefully center the object in the eyepiece.
3. Once centered, press the BACK button until you are at the main menu.
4. With StarSeeker Ready displayed, press the ALIGN button on the hand controller.
5. The display will then ask you which alignment star you want to replace.
6. Use the UP and Down scroll buttons to select the alignment star to be replaced, and press ENTER. It is usually best to replace the star closest to the new object. This will space out your alignment stars across the sky. If you have used one of the single object alignment methods then it is always best to replace the object that is "unassigned" with an actual object.
7. Press ALIGN to make the change.

Selecting an Object

Now that the telescope is properly aligned, you can choose an object from any of the catalogs in the StarSeeker's 4,033 object database. The hand controller has individual buttons designated for the object groups Solar System, Stars, and

Deep Sky. Pressing the button will call up that particular list or catalog, or a submenu of catalogs.

The object catalogs and lists included in the StarSeeker's database are:

Solar System

All 8 planets in our solar system (including Pluto!), plus the Moon. Shows only those that are above the horizon for the current date/time.

Stars

Asterisms: A unique list of some of the most recognizable star patterns in the sky.

Constellations: All 88 standard constellations

Double Stars: Alphabetical listing of the most visually stunning double, triple, and quadruple stars in the sky.

Named Stars: Common names of bright stars in the sky.

SAO Stars: When entering the number for a SAO star, you are only required to enter the first four digits of the star's six digit SAO number. Once the first four digits are entered, the hand controller will automatically list all the available SAO objects beginning with those numbers. This allows you to scroll through only the SAO stars in the database. For example, in searching for the SAO star 40186 (Capella), the first four digits would be "0401". Entering this number will display the closest match from the SAO stars available in the database. From there you can scroll down the list and select the desired object.

Variable Stars: Select list of the brightest variable stars with the shortest period of changing magnitude.

Deep Sky

Messier: Complete list of all 109 objects catalogued by French comet hunter Charles Messier

Caldwell: 109 of the best NGC and IC objects not included in the Messier catalog

NGC: Many of the brightest deep sky objects from the Revised New General Catalog

IC: Selections from the Index Catalog of nebulae, clusters, and galaxies

Abell: Catalog of approximately 4,000 galaxy clusters

CCD Objects: A list of 26 notable galaxy pairs, groups, and clusters such as the Virgo cluster, Bodes's Galaxies (M81 & M82), and Stephan's Quintet.

Named Objects: Alphabetical listing of over 50 of the most popular deep-sky objects.

There are two ways to select objects from the database:

- For some of the catalogs/lists, selecting them will display an alpha-numeric listing of the objects. Such catalogs are Named Stars, Named Objects, Asterisms, Constellations, Double Stars, and Variable Stars. Pressing the Up and Down scroll buttons allows you to scroll through the catalog to the desired object.

  Pressing the SOLAR SYSTEM button will allow you to use the scroll buttons to select any of the eight planets as well as the Moon.
- Selecting any of the other object catalogs will display a blinking cursor below the name of the catalog chosen. Use the numeric keypad to enter the number of any object within these standardized catalogs. For example, to find the Orion Nebula (M42), press the "M" button and enter "042".

When scrolling through a long list of objects, holding down either the up or down scroll buttons will allow you to scroll through the catalog at a rapid speed.

Slewing to an Object

Once the desired object is displayed on the hand controller screen, you have two options:

- Press the OBJECT INFO button. This will give you useful information about the selected object such as magnitude, constellation, and for many, fascinating facts.
- Press the ENTER button. This will automatically slew the telescope to the coordinates of the object. While the telescope is slewing to the object, the user can still access many of the hand controller functions, such as displaying information about the object.

If you slew to an object that is below the horizon, StarSeeker will notify you by displaying a message reminding you that you have selected an object outside of your slew limits (see Slew Limits in the Scope Setup section of the manual). Press BACK to go back and select a new object. Press ENTER to ignore the message and continue the slew. The StarSeeker hand controller will only display objects that are below the horizon if the Filter Limits are set below 0° in altitude. See Filter Limits in the Utility Feature section of the manual for more information on setting the filter limits.

Caution: Never slew the telescope when someone is looking into the eyepiece. The telescope can move at fast speeds and the impact may cause injury.

NEVER ATTEMPT TO MOVE THE TELESCOPE BY HAND! Otherwise, the gears and motors may be damaged. Move the telescope only electronically with the hand controller.

Sky Tour

The StarSeeker includes a tour feature that allows the user to choose from a list of interesting objects based on the date and time in which you are observing. The automatic tour will display only those objects that are within your set filter limits. To activate the tour mode, press the SKY TOUR button on the hand controller. The StarSeeker will display the best objects currently in the sky.

- To see information and data about the displayed object, press the OBJECT INFO button.
- To slew to the object displayed, press ENTER.
- To see the next tour object, press the downward scroll button.

Constellation Tour

In addition to the Sky Tour, the StarSeeker telescope has a Constellation Tour that allows the user to take a tour of all the best objects within a particular constellation. Selecting Constellations from the STAR menu will display all the constellation names that are above the user defined horizon (filter limits). Once a constellation is selected by pressing ENTER, you can choose from any of the database object catalogs to produce a list of all the available objects in that constellation.

- To see information and data about the displayed object, press the OBJECT INFO button.
- To slew to the object displayed, press ENTER.
- To see the next tour object, press the Up OR Down scroll button.

Menu Button

The MENU button on the keypad contains many user defined setup functions and utilities designed to give the user control over the telescope's many advanced features.

Tracking Once the StarSeeker is aligned the tracking motors will automatically turn on and begin tracking the sky. However, the tracking can be turned off for terrestrial use. *(We don't recommend using the StarSeeker 130 II reflector for terrestrial use, as the view will be rotated from normal in the eyepiece.)*

Mode

Alt-Az – This is the default tracking mode and is used when the StarSeeker has been properly aligned.

EQ North – Used to track the sky when the telescope is polar aligned using an equatorial wedge in the Northern Hemisphere. This option is not used with the StarSeeker telescope.

EQ South – Used to track the sky when the telescope is polar aligned using an equatorial wedge in the Southern Hemisphere. This option is not used with the StarSeeker telescope.

Off – When using the telescope for terrestrial (land) observation the tracking can be turned off so that the telescope never moves.

Note: The EQ North and EQ South tracking modes are only needed with telescopes that can be polar aligned. The StarSeeker is an Alt-Az mounted telescope and does not require equatorial tracking.

Rate – In addition to being able to move the telescope with the hand controller buttons, the StarSeeker will continually track a celestial object as it moves across the night sky. The tracking rate can be changed depending on what type of object is being observed:

Sidereal – This rate compensates for the rotation of the Earth by moving the telescope at the same rate as the rotation of the earth, but in the opposite direction. When tracking in Alt-Az mode, the telescope must make corrections in both altitude and azimuth.

Lunar – Used for tracking the Moon when observing the lunar landscape.

Solar – Used for tracking the Sun when solar observing using a proper solar filter.

View Time-Site View Time-Site will display the last saved time and longitude/latitude entered in the hand controller.

Hand Control

Set Contrast – In Set Contrast screen, use the scroll buttons to vary the contrast from 1 (lowest) to 20 (highest).

Set Language – Choose from the different language options using the scroll buttons.

Lights Control – This feature allows you to set the intensity of the red-illuminated keypad and the LCD screen to the desired level. Keeping them as dim as possible will help conserve battery power and preserve your night vision.

Scrolling Menu – Allows you to change the speed that the text scrolls across the hand controller display.

- Press the Up scroll button to increase the speed of the text.
- Press the Down scroll button to decrease the speed of the text.

Toggle Bold Font – Pressing the ENTER button toggles between the bold and regular fonts.

Scope Setup

Setup Time-Site – Allows the user to customize the StarSeeker display by changing time and location parameters (such as time zone and daylight savings).

Anti-backlash – All mechanical gears have a certain amount of backlash or play between the gears. This play is evident by how long it takes for a star to move in the eyepiece when the hand controller arrow buttons are pressed (especially when changing directions). The StarSeeker's anti-backlash feature allows the user to compensate for backlash by inputting a value that quickly rewinds the motors just enough to eliminate the play between gears. The amount of compensation needed depends on the slewing rate selected; the slower the slewing rate the longer it will take for the star to appear to move in the eyepiece. Therefore, the anti-backlash compensation will have to be set higher. You will need to experiment with different values; a value between 20 and 50 is usually best for most visual observing, whereas a higher value may be necessary for photographic guiding. Positive backlash compensation is applied when the mount changes its direction of movement from backwards to forwards. Similarly, negative backlash compensation is applied when the mount changes its direction of movement from forwards to backwards. When tracking is enabled, the mount will be moving in one or both axes in either the positive or negative direction, so backlash compensation will always be applied when a direction button

is released and the direction moved is opposite to the direction of travel.

To set the anti-backlash value, scroll down to the anti-backlash option and press ENTER. Enter a value from 0-100 for both azimuth and altitude directions and press ENTER after each one to save these values. StarSeeker will remember these values and use them each time it is turned on until they are changed.

Slew Limits – Sets the limits in altitude that the telescope can slew without displaying a warning message. The slew limits prevent the telescope tube from slewing to an object below the horizon or slewing to an object that is high enough that the tube might hit one of the tripod legs. However, the slew limits can be customized depending on your needs. For example, if you would like to slew to an object that is close to the zenith and are certain that the tube will not hit the tripod legs, you can set the slew limits to 90° in altitude. This will allow the telescope to slew to any object above the horizon without warning.

Filter Limits – When an alignment is complete, the StarSeeker automatically knows which celestial objects are above the horizon. As a result, when scrolling through the database lists (or selecting the Tour function), the StarSeeker hand controller will display only those objects that are known to be above the horizon when you are observing. You can customize the object database by selecting altitude limits that are appropriate for your location and situation. For example, if you are observing from a mountainous location where the horizon is partially obscured, you can set your minimum altitude limit to read +20°. This will make sure that the hand controller only displays objects that are higher in altitude than 20°.

If you want to explore the entire object database, set the maximum altitude limit to 90° and the minimum limit to -90°. This will display every object in the database lists regardless of whether it is visible in the sky from your location or not.

Direction Buttons – The direction a star moves in the eyepiece varies depending on the accessories being used (see Image Orientation, page 18). This can create confusion when guiding on a star using an off-axis guider versus a straight through guide scope. To compensate for this, the direction of the drive control buttons (the four large arrow buttons) can be changed. To reverse the button logic of the hand controller, use the scroll buttons to select either the Azimuth buttons (left and right) or Altitude buttons (up and down) and press ENTER. Pressing ENTER again will reverse the direction of the hand controller buttons from their current state. Direction Buttons will only change the eyepiece rates (rate 1-6) and will not affect the slew rates (rate 7-9).

GoTo Approach – lets the user define the direction that the telescope will approach when slewing to an object. This allows the user the ability to minimize the effects of backlash. For example, if your telescope is front heavy from using heavy optical or photographic accessories attached to the back, you would want to set your altitude approach to the negative direction. This would ensure that the telescope always approaches an object from the opposite direction as the load pulling on the scope.

To change the GoTo approach direction, simply choose GoTo Approach from the Scope Setup menu, select either Altitude or Azimuth approach, choose positive or negative and press Enter.

AutoGuide rates – Allows you to set the RA and Dec autoguiding rates for 0 to 99% of sidereal rate.

Cordwrap – Cord wrap safeguards against the telescope slewing more than 360º in azimuth and wrapping the power cable around the telescope mount. This could damage the cable itself or, worse, the telescope's drive motors. In this mode it could take longer to reach an object as the mount may not take the shortest route to it in an effort to minimize cord wrap. By default, the cord wrap feature is turned off when the telescope is aligned in altazimuth mode. We highly recommend turning it on!

Utilities

Factory Setting: Returns the StarSeeker hand controller to its original factory settings. Parameters such as backlash compensation values, initial date and time, longitude/latitude along with slew and filter limits will be reset. However, stored parameters such as PEC and user defined objects will remain saved even when Factory Settings is selected. The hand controller will ask you to press the "0" button before returning to the factory default setting.

Version: Selecting this option will allow you to see the version number of the hand controller and motor controller software.

Get Axis Position: Displays the current altitude and aximuth coordinates of the telescope.

GoTo Axis Position: Allows input of altitude and azimuth coordinates for slewing to a specific location.

Hibernate: Hibernate allows the StarSeeker to be completely powered down and still retain its alignment when turned back on. This not only saves power, but is ideal for those that have their telescopes permanently mounted or leave their telescope in one location for long periods of time. To place your telescope in Hibernate mode:

1. Select Hibernate from the Utility Menu.
2. Move the telescope to a desire position and press ENTER.
3. Power off the telescope. Remember to never move your telescope manually while in Hibernate mode.

Once the telescope is powered on again the display will read Wake Up. After pressing Enter you have the option of scrolling through the time/site information to confirm the current setting. Press ENTER to wake up the telescope.

Pressing BACK at the Wake Up screen allows you to explore many of the features of the hand controller without waking the telescope up from hibernate mode. To wake up the telescope after BACK has been pressed, select Hibernate from the Utility menu and press ENTER. Do not use the direction buttons to move the telescope while in hibernate mode.

Sun Menu: For safety purposes the Sun will not be displayed as a database object unless it is first enabled. To enable the Sun, go to the Sun Menu and press ENTER. The Sun will now be displayed in the SOLAR SYSTEM catalog as can be used as an alignment object when using the Solar System Alignment method. To remove the Sun from displaying on the hand controller, once again select the Sun Menu from the Utilities Menu and press ENTER.

Calibrate GoTo: A useful tool when attaching heavy visual or photographic accessories to the telescope. GoTo Calibration calculates the amount of distance and time it takes for the mount to complete its final slow GoTo when slewing to an object. Changing the balance of the telescope can prolong the time it takes to complete the final slew. GoTo Calibration takes into account any slight imbalances and changes the final GoTo distance to compensate.

Set Mount Position: The Set Mount Position menu can be used to maintain your alignment in cases where you wish to disengage the clutches or similar situations. For instance, you might use this feature if you needed to rebalance the mount after having completed an alignment. To set the mount position simply slew to a bright star in the named star list then select Set Mount Position. The hand control will sync on the star by asking you to center the star in the eyepiece and pressing the Align button. Once synced on the star, you are free to manually move the mount in both axes in order to rebalance. When you are ready to slew the telescope to your next object, just remember to manually return the tube to the same bright star and carefully center it in the eyepiece. Using this tool will invalidate the PEC index.

GPS On/Off: Allows you to turn on\off the GPS module when using the optional GPS accessory. When aligning the telescope, the scope still receives information, such as current time, from the optional GPS accessory. If you want to use the hand controller database to find the coordinates of a celestial object for a future date, you would need to turn the GPS module off to manually enter a date and time other than the present.

User Objects – The StarSeeker can store up to 50 different user-defined objects in its memory. The objects can be daytime land objects or an interesting celestial object that you discover is not included in the regular database. There are several ways to save an object to memory depending on what type of object it is:

GoTo Object: To go to any of the user-defined objects stored in the database, scroll down to either GoTo Sky Obj or Goto Land Obj and enter the number of the object you wish to select, then press ENTER. StarSeeker will automatically retrieve and display the coordinates before slewing to the object.

Save Sky Object: The StarSeeker stores celestial an objects in its database by saving its right ascension and declination coordinates in the sky. This way the same object can be found each time the telescope is aligned. Once a desired object is centered in the eyepiece, simply scroll to the Save Sky Obj command and press ENTER. The display will ask you to enter a number between 1-25 to identify the object. Press ENTER again to save this object to the database.

Save Land Object: Fixed land objects can be stored by saving their altitude and azimuth relative to the location of the telescope at the time of observing. Since these objects are relative to the location of the telescope, they are only valid for that exact location. To save land objects, once again center the desired object in the eyepiece. Scroll down to the Save Land Obj command and press ENTER. The display will ask you to enter a number between 1-25 to identify the object. Press ENTER again to save this object to the database.

Save Database (Db) Object: This feature allows you to create your own custom tour of database objects by allowing you to record the current position of the telescope and save the name of the object by selecting it from any one of the database catalogs. These objects then can be accessed by selecting GoTo Sky Object.

Enter RA & Dec: You can also store a specific set of coordinates for an object just by entering the right ascension and declination for that object. Scroll to the Enter RA-DEC command and press ENTER. The display will then ask you to enter first the R.A. and then the declination of the desired object.

To replace the contents of any of the user-defined objects, simply save a new object using one of the existing identification numbers; StarSeeker will replace the previous user-defined object with the current one.

Get RA-Dec – Displays the right ascension and declination for the current position of the telescope.

Goto RA-Dec – Allows you to input a specific R.A. and declination and slew to it.

Identify – Identify Mode will search any of the StarSeeker database catalogs or lists and display the name and offset

Figure 13. The StarSeeker II 102's 4-inch achromatic objective lens delivers sharp, high-resolution views of the Moon, planets, and brighter deep-sky objects.

distances to the nearest matching objects. This feature can serve two purposes. First, it can be used to identify an unknown object in the field of view of your eyepiece. Additionally, Identify Mode can be used to find other celestial objects that are close to the objects you are currently observing. For example, if your telescope is pointed at the brightest star in the constellation Lyra, choosing Identify and then searching the Named Star catalog will no doubt return the star Vega as the star you are observing. However, by selecting Identify and searching by the Named Object or Messier catalogs, the hand controller will let you know that the Ring Nebula (M57) is approximately 6° from your current position. Searching the Double Star catalog will reveal that Epsilon Lyrae is only 1° away from Vega. To use the Identify feature:

- Press the Menu button and select the Identify option.
- Use the Up/Down scroll buttons to select the catalog that you would like to search.
- Press ENTER to begin the search.

Note: Some of the databases contain thousands of objects, and can therefore take a minute or two to return the closest object.

Precise GoTo – The Precise GoTo function assists in finding extremely faint objects and centering objects closer to the center of the field of view for astrophotography and CCD imaging. Precise GoTo automatically searches out the closest bright star to the desired object and asks the user to carefully center it in the eyepiece. The hand control then calculates the small difference between its GoTo position and its centered position. Using this offset, the telescope will then slew to the desired object with enhanced accuracy. To use Precise GoTo:

1. Press the MENU button and use the UP/DOWN keys to select Precise GoTo.
2. Choose Database to select the object that you want to observe from any of the database catalogs listed
3. Choose RA/DEC to enter a set of celestial coordinates that you wish to slew to.
4. Once the desired object is selected, the hand controller will search out and display the closest bright star to your desired object. Press ENTER to slew to the bright alignment star.
5. Use the directional buttons to carefully center the alignment star in the eyepiece. Press ENTER to slew to the desired object.

Telescope Basics

A telescope is an instrument that collects and focuses light. The nature of the optical design determines how the light is focused. Some telescopes, known as refractors, use lenses. Other telescopes, known as reflectors, use mirrors. The StarSeeker II 102 is a refracting telescope that uses an objective lens to gather and focus light (**Figure 13**).

Focusing

Once you have found an object in the telescope, turn the focusing knob until the image is sharp. To achieve a truly sharp focus, never look through glass windows or across objects that produce heat waves, such as asphalt parking lots.

For astronomical viewing, out of focus star images are very diffuse, making them difficult to see. If you turn the focus knob too quickly, you can go right through focus without seeing the image. To avoid this problem, your first astronomical target should be a bright object (like the Moon or a planet) so that the image is visible even when out of focus. It can even be helpful to practice during the day on an object at least a mile away, i.e., at "infinity."

Image Orientation

The image orientation of any telescope changes depending on its optical design and how the eyepiece is inserted into the telescope. A refractor used with a star diagonal, for astronomical viewing, will show an image that is right side up, but left-right reversed. An optional "correct-image" diagonal can be used to yield a correctly oriented image, which is recommended for daytime terrestrial viewing.

Calculating Magnification

You can change the power of your telescope just by changing the eyepiece (ocular). To determine the magnification of your telescope, simply divide the focal length of the telescope by the focal length of the eyepiece used. In equation format, the formula looks like this:

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

Let's say, for example, you are using the 25mm eyepiece. To determine the magnification you simply divide the focal length of the StarSeeker II 102, which is 660mm, by the focal length of the eyepiece, 25mm. Dividing 660 by 25 yields a magnification of about 26 power. For the included 10mm eyepiece, the magnification is 660/10 = 66x.

Although the power is variable, each instrument under average skies has a limit to the highest useful magnification. The general rule is 2x per millimeter of aperture. For example, the StarSeeker II 102 is so named for its objective lens, which has a diameter of 102mm. So 102mm x 2 = 204. Thus, 204x is the highest practical magnification one can normally achieve under ideal seeing conditions. Although this is the maximum useful magnification, most observing will yield best results at lower powers.

Determining Field of View

Determining the field of view is important if you want to get an idea of the angular size of the object you are observing. To calculate the actual field of view, divide the apparent field of the eyepiece (supplied by the eyepiece manufacturer) by the magnification. In equation format, the formula looks like this:

$$\frac{\text{Apparent Field of Eyepiece}}{\text{Magnification}} = \text{True Field}$$

As you can see, before determining the field of view, you must calculate the magnification. Using the example in the previous section, we can determine the field of view using the same 25mm eyepiece. The 25mm eyepiece has an apparent field of view of 56°. Divide 56° by the magnification, which is 26 power. This yields an actual field of view of 2.2°.

To convert degrees to feet at 1,000 yards, which is more useful for terrestrial observing, simply multiply by 52.5. Continuing with our example, multiply the angular field 2.2° by 52.5. This produces a linear field width of 115.5 feet at a distance of one thousand yards.

General Observing Hints

When working with any optical instrument, there are a few things to remember to ensure you get the best possible image:

- Never look through window glass. Glass found in household windows is optically imperfect, and as a result, may vary in thickness from one part of a window to the next. This inconsistency can and will affect the ability to focus your telescope. In most cases you will not be able to achieve a truly sharp image, while in some cases, you may actually see a double image.
- Never look across or over objects that are radiating heat waves. This includes asphalt parking lots on hot summer days or building rooftops.
- Hazy skies, fog, and mist can also make it difficult to focus. The amount of detail seen under these conditions is greatly reduced.
- If you wear corrective lenses (specifically, glasses), you may want to remove them when observing with an eyepiece attached to the telescope. When using a camera, however, you should always wear corrective lenses to ensure the sharpest possible focus. If you have astigmatism, corrective lenses must be worn at all times.

Celestial Observing

With your telescope set up, you are ready to use it for observing. This section covers visual observing hints for both solar system and deep-sky objects as well as general observing conditions that will affect your ability to observe.

Observing the Moon

The Moon is the ideal target for all amateur astronomers. It is bright and large enough to show amazing surface detail, regardless of the type or size of telescopic used, and can be viewed just as successfully from the center of a city as from the rural countryside.

Its broad plains, rugged mountain ranges, deep valleys, and countless craters provide amazing views on almost any clear night.

Lunar Observing Hints

- Observe during partial phases. Often, it is tempting to look at the Moon when it is full. At this time, the face we see is fully illuminated and its light can be overpowering. In addition, little or no contrast can be seen during this phase. The best times to observe the Moon are during its partial phases, when long shadows cast by the Sun highlight surface details. Due to the sunlight's changing angle, the Moon presents a slightly different perspective every night as it passes from phase to phase.
- Look along the terminator. The greatest amount of detail is visible along the Moon's terminator, the boundary separating the lighted area of the lunar disk from the darkened portion. It is here that the Sun's light strikes the Moon as the narrowest angle. This casts the longest shadows, increasing contrast of lunar features and showing the greatest three-dimensional relief. Sometimes you will notice a bright "island" surrounded by darkness on the dark side of the terminator. That's a high peak, tall enough to still catch the light of the setting Sun, while the lower terrain around it does not.
- Use a Moon filter. No matter what the phase of the Moon is, the view is almost always better through a Moon filter. It screws into the barrel of a telescope eyepiece and cuts the bright glare, making for more comfortable observing and bringing out more surface detail. Some lunar filters,

called variable polarizing filters, act something like a dimmer switch, permitting adjustment of the brightness to your liking.

Observing the Planets

Other fascinating targets include the five naked eye planets. You can see Venus go through its lunar-like phases. Mars can reveal a host of surface detail and one, if not both, of its polar caps. You will be able to see the cloud belts of Jupiter and the Great Red Spot (if it is visible at the time you are observing). In addition, you will also be able to see the moons of Jupiter as they orbit the giant planet. Saturn, with its beautiful rings, is easily visible at moderate power.

Planetary Observing Hints

- Remember that atmospheric conditions are usually the limiting factor on how much planetary detail will be visible. So, avoid observing the planets when they are low on the horizon or when they are directly over a source of radiating heat, such as a rooftop or chimney. See the "Seeing" section later in this section.
- To increase contrast and bring out detail on the planetary surface, try using color eyepiece filters.

Observing the Sun

Although overlooked by many amateur astronomers, solar observation is both rewarding and fun. However, because the Sun is so bright, special precautions must be taken when observing our star so as not to damage your eyes or your telescope.

- Never project an image of the Sun through the telescope! Tremendous heat build-up may result inside the optical tube. This can damage the telescope and/or any accessories attached to the telescope.
- For safe solar viewing, use a solar filter that reduces the intensity of the Sun's light, making it safe to view. With a filter you can see sunspots as they move across the solar disk and faculae, which are bright patches seen near the Sun's edge.

Solar Observing Hints

- The best time to observe the Sun is in the early morning or late afternoon when the air is cooler.
- To center the Sun without looking into the eyepiece, watch the shadow of the telescope tube until it forms a circular shadow. There are also special "solar viewing" finder devices available that are designed for aligning a telescope with the Sun.
- To ensure accurate tracking, be sure to select solar tracking rate.

Observing Deep-Sky Objects

Deep-sky objects are simply those objects outside the boundaries of our solar system. They include star clusters, planetary nebulae, diffuse nebulae, double stars and other galaxies outside our Milky Way galaxy. Most deep-sky objects have a large angular size. Therefore, low-to-moderate power is all you need to see them. Visually, they are too faint to reveal any of the color seen in long exposure photographs. Instead, they appear grayish. And, because of their low surface brightness, they should be observed from a dark sky location whenever possible. Light pollution around large urban areas washes out most nebulae making them difficult, if not impossible, to observe. Light Pollution Reduction filters help reduce the background sky brightness, thus increasing contrast.

Viewing Conditions

Viewing conditions affect what you can see through your telescope during an observing session. Conditions include transparency, sky illumination, and seeing. Understanding viewing conditions and the effect they have on observing will help you get the most out of your telescope.

Transparency

Transparency is the clarity of the atmosphere, which is affected by clouds, moisture, and other airborne particles. Thick cumulus clouds are completely opaque while cirrus can be thin, allowing the light from the brightest stars through. Hazy skies absorb more light than clear skies, making fainter objects harder to see and reducing contrast on brighter objects. Aerosols ejected into the upper atmosphere from volcanic eruptions also affect transparency. Ideal conditions are when the night sky is inky black.

Sky Illumination

General sky brightening caused by the Moon, aurorae, natural airglow, and light pollution greatly affect transparency. While not a problem for the brighter stars and planets, bright skies reduce the contrast of extended nebulae making them difficult, if not impossible, to see. To maximize your observing, limit deep-sky viewing to moonless nights far from the light polluted skies found around major urban areas. LPR filters enhance deep-sky viewing from light polluted areas by blocking unwanted light while transmitting light from certain deep-sky objects. You can, on the other hand, observe planets and stars from light polluted areas or when the Moon is out, due to their strong brightness.

Seeing

Seeing conditions refer to the stability of the atmosphere. "Seeing" directly affects the amount of fine detail seen in extended objects. The air in our atmosphere acts as a lens that bends and distorts incoming light rays. The amount of bending depends on air density. Varying temperature layers have different densities and, therefore, bend light differently. Light rays from the same object arrive slightly displaced creating an imperfect or smeared image. These atmospheric disturbances vary from time-to-time and place-to-place. The size of the air parcels compared to your aperture determines the "seeing" quality. Under good seeing conditions, fine detail is visible on the brighter planets like Jupiter and Mars, and stars are pinpoint images. Under poor seeing conditions, images are blurred and stars appear as blobs.

The conditions described here apply to both visual and photographic observations.

Telescope Maintenance

While your StarSeeker telescope requires little maintenance, there are a few things to remember that will ensure your telescope performs at its best.

Care and Cleaning of the Optics

In general, your telescope's objective lens will only need to be cleaned very infrequently, if ever. Covering the front opening of the telescope with the dust cap when it is not in use will prevent dust from accumulating on the lens surface. Keeping the dust cap on the focuser's 1.25" opening is also a good idea. Improper cleaning can scratch the lens coatings, so the fewer times you have to clean the lens, the better. A little dust or small specks of paint from the scope's interior have virtually no effect on the visual or imaging performance of the telescope. So avoid the urge to clean the optics unless it is absolutely necessary!

If dust has built up on the lens surface, remove the dust with a brush made of camel's hair or a can of pressurized air. Spray at an angle to the lens for approximately two to four seconds. Then, use an optical cleaning solution and optical cleaning tissue to remove any remaining debris. Apply the solution to the tissue and then apply the tissue paper to the lens. Low pressure strokes should go from the center of the lens to the outer portion. Do NOT rub in circles! You can use a commercially made lens cleaner or mix your own. A good cleaning solution is isopropyl alcohol mixed with distilled water. The solution should be 60% isopropyl alcohol and 40% distilled water. Or, liquid dish soap diluted with water (a couple of drops per one quart of water) can be used.

Collimation

For the sharpest images, the optics of your telescope should be precisely aligned, or collimated. Your StarSeeker II 102 refractor's optics were aligned at the factory and should never need adjustment. If you believe the scope is out of collimation, contact Orion Customer Service at (800) 676-1343, or support@telescope.com

Specifications

Objective Lens:	102mm diameter doublet
Focal Length:	660mm
Focal Ratio:	f/6.5
Focuser:	2" Rack-and-Pinion, with 1.25" adapter
Lens Coatings:	Multi-coated
Eyepieces:	25mm & 10mm Explorer II
Magnification with supplied Eyepieces:	26.4x, 66x
Tube Length:	24.5"
Tube Material:	Aluminum
Weight, assembled:	15 lbs.
Input Voltage:	12V DC
Power Supply Requirements:	12V DC~750 mA (Tip positive)
Motor Type:	DC Servo
Slew Speeds:	4°/sec., 2°/sec., 1°/sec., 5°/sec., 32x, 16x, 8x, 4x, 2x sidereal
Tracking Rates:	Sidereal, Lunar, Solar
Tracking Modes:	Alt-Az, EQ North, EQ South
Hand controller:	Double line, 16-character LCD; 19 fiber optic backlit buttons
Ports:	RS-232 on Hand Controller
Object Database:	4,033 objects

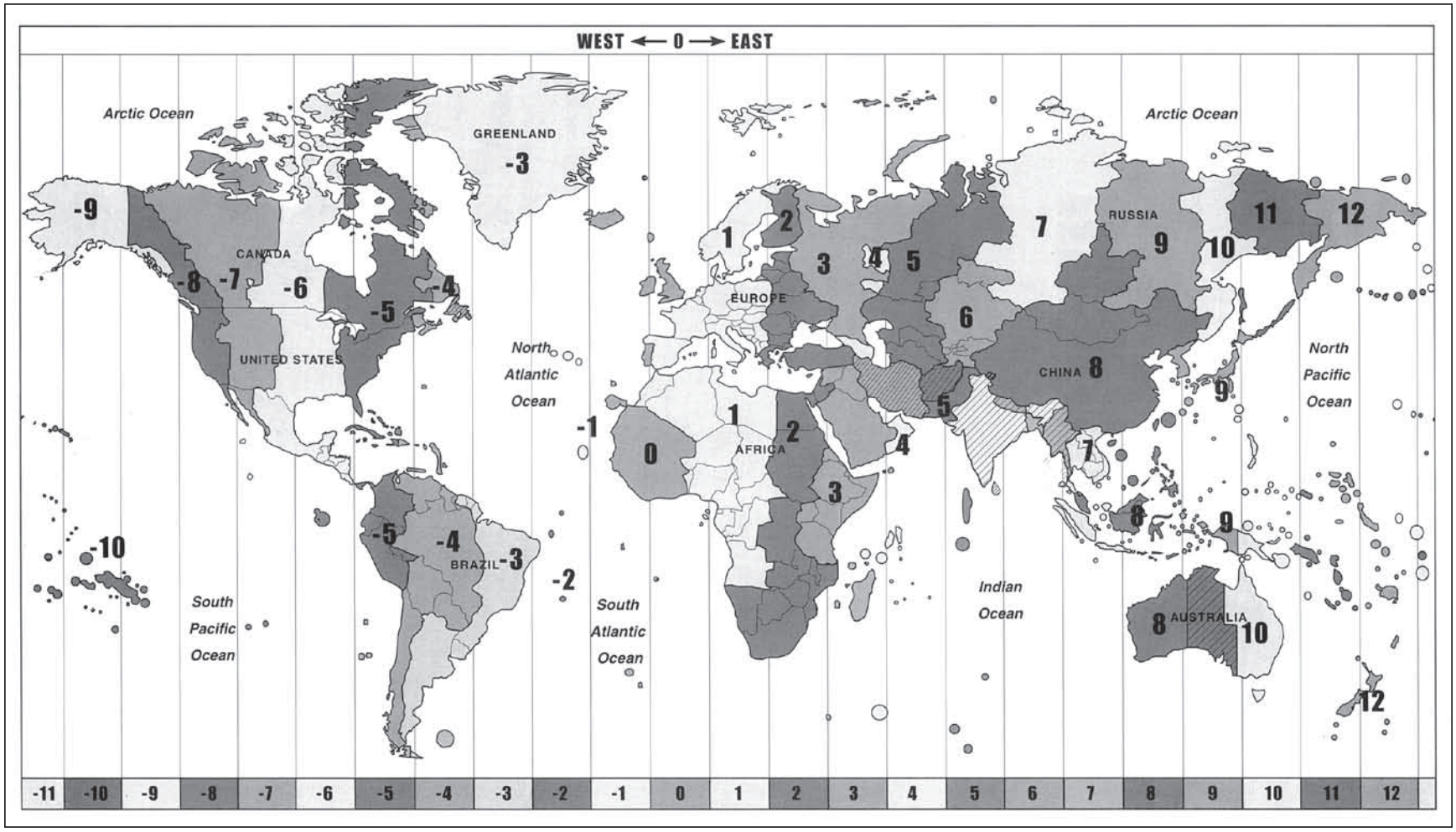
Appendix A – RS-232 Connection

You can control your StarSeeker telescope with a computer via the RS-232 port located on the computerized hand controller using the included RS-232 serial cable. If your computer does not have a serial port (which many do not these days), you will also need to purchase a serial-to-USB adapter, available from Orion. The telescope can be controlled using popular astronomy software programs such as Starry Night.

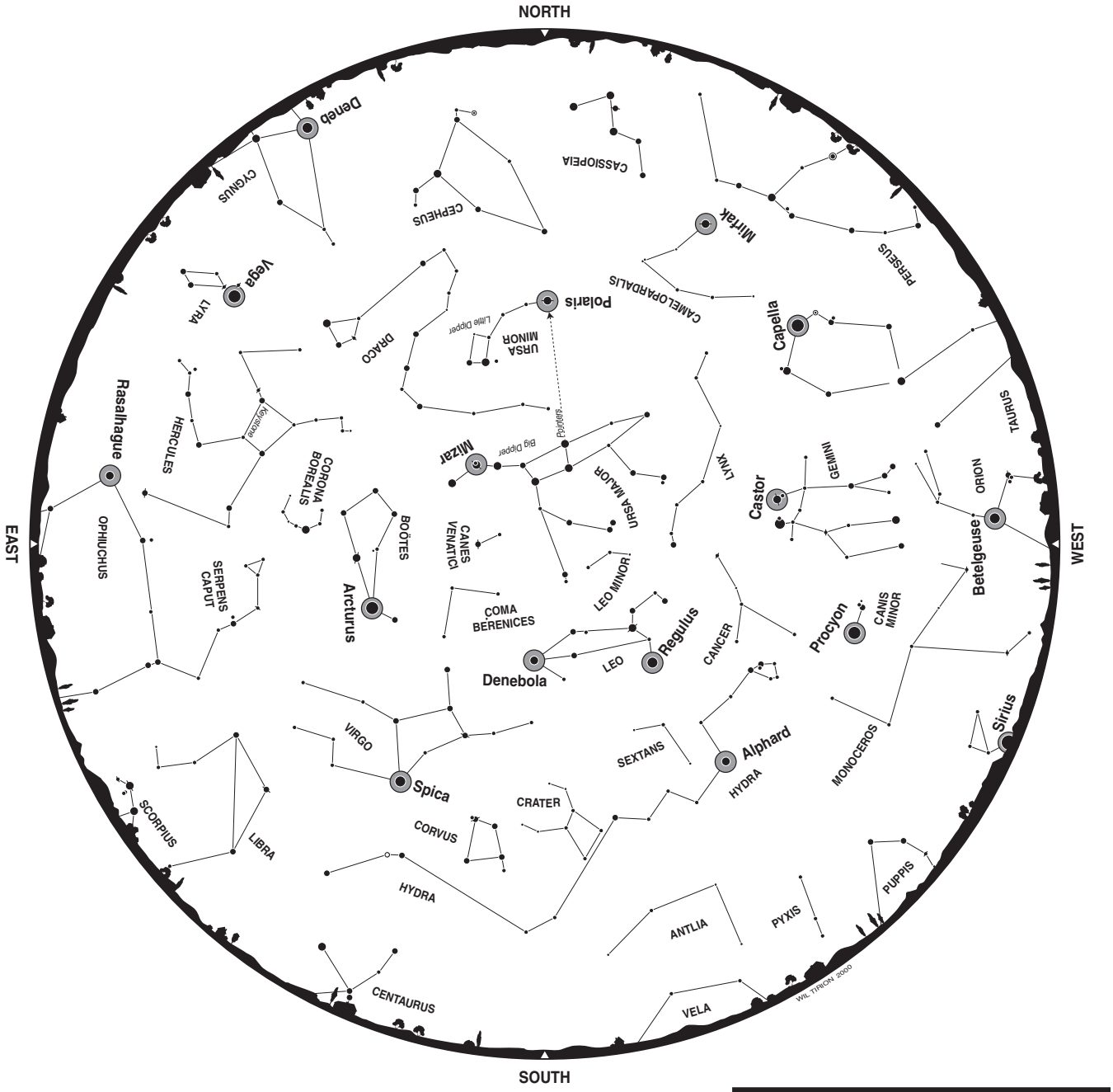
The RS-232 port and cable are also used for updating the firmware of the hand controller, when firmware updates are available. See Oriontelescopes.com for the firmware update procedure.

This device complies with Part 15 of the FCC Rule. Operation is subject to the following two conditions: 1) This device may not cause harmful interference, and 2) This device must accept any interference received, including interference that may cause undesired operations.

Appendix B – Time Zones

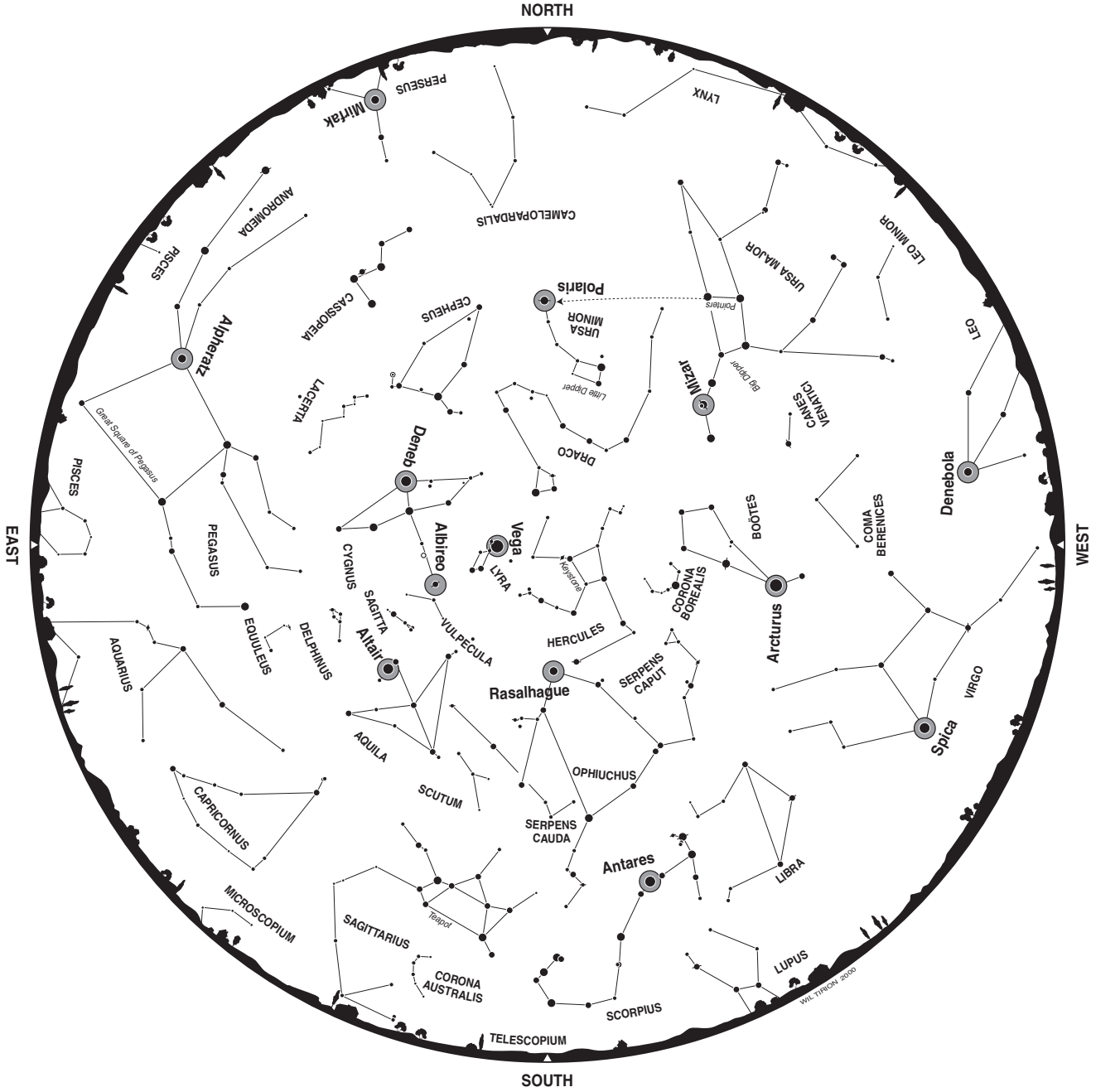


Sky Maps



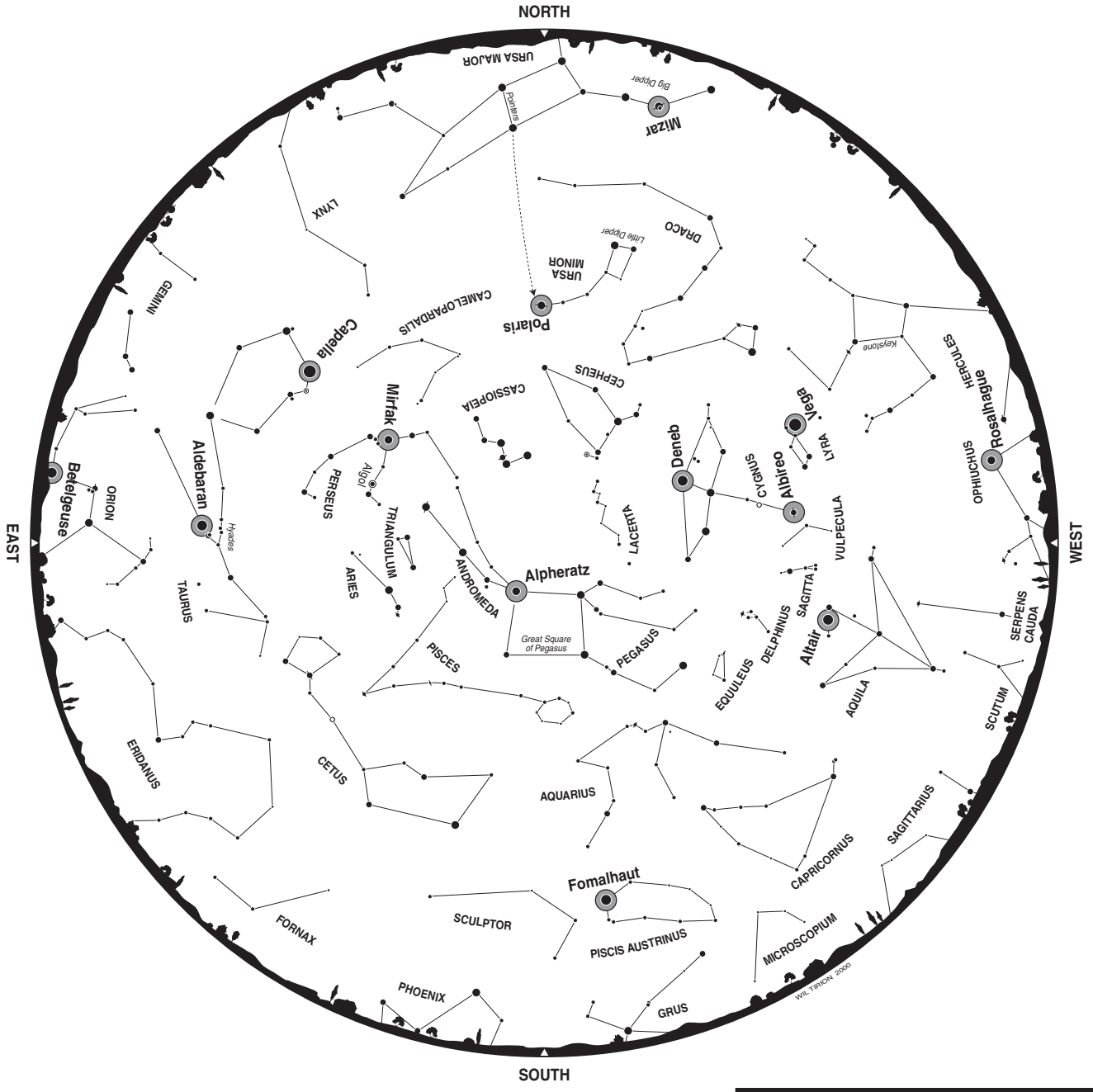
SPRING	
Early March	1:00 AM
Late March	12:00 AM
Early April	12:00 AM*
Late April	11:00 PM*
Early May	10:00 PM*
Late May	9:00 PM*
Early June	8:00 PM (dusk)*

***Daylight saving time**



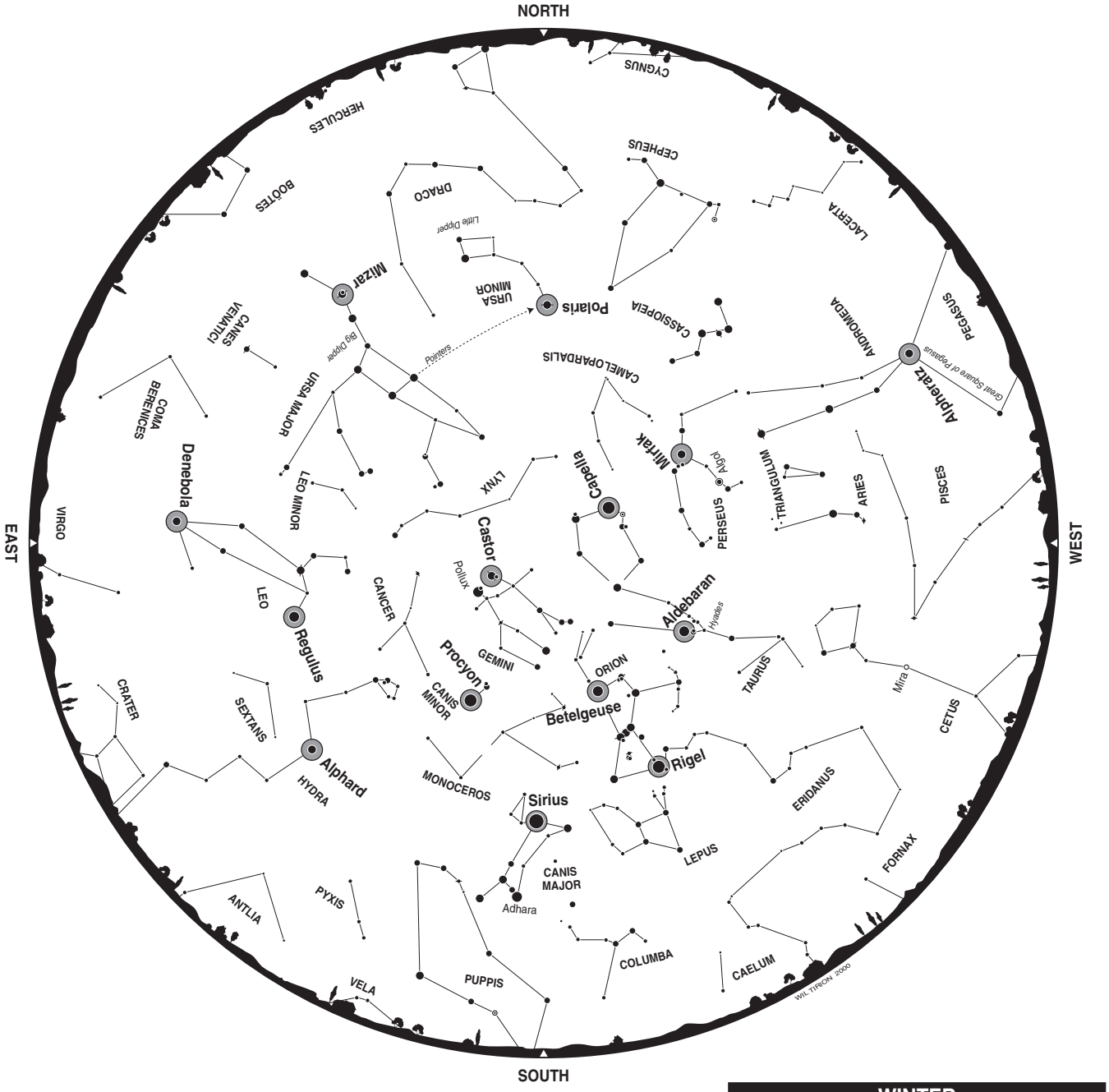
SUMMER	
Early June	2:00 AM*
Late June	1:00 AM*
Early July	12:00 AM*
Late July	11:00 PM*
Early August	10:00 PM*
Late August	9:00 PM*
Early September	8:00 PM (dusk)*

***Daylight saving time**



AUTUMN	
Early September	2:00 AM*
Late September	1:00 AM*
Early October	12:00 AM*
Late October	11:00 PM*
Early November	9:00 PM
Late November	8:00 PM
Early December	7:00 PM

***Daylight saving time**



WINTER	
Early December	2:00 AM
Late December	1:00 AM
Early January	12:00 AM
Late January	11:00 PM
Early February	10:00 PM
Late February	9:00 PM
Early March	8:00 PM

Two-Year Limited Warranty

This Orion product is warranted against defects in materials or workmanship for a period of two years 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. Proof of purchase (such as a copy of the original receipt) is required. This warranty is only valid in the country of purchase.

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. It is not intended to remove or restrict your other legal rights under applicable local consumer law; your state or national statutory consumer rights governing the sale of consumer goods remain fully applicable.

For further warranty information, please visit **www.OrionTelescopes.com/warranty**.

Orion Telescopes & Binoculars

89 Hangar Way, Watsonville CA 95076

Customer Support Help Line (800) 676-1343 • Day or Evening