iOptron SmartEQ™ Pro+
Portable German Equatorial GOTO Mount

Instruction Manual

Product 3200

Table of Content

WARNING!

NEVER USE A TELESCOPE TO LOOK AT THE SUN WITHOUT A PROPER FILTER!
Looking at or near the Sun will cause instant and irreversible damage to your eye.
Children should always have adult supervision while observing.

1. SmartEQ™ Mount Overview

Born out of the popular iOptron Cube™ and iEQ™ mounts, the SmartEQ™ mount is the ultimate *Grab N' Go* German equatorial GOTO mount fitting into almost everyone's budget. It is ideal for visual observation and wide field astrophotography. The compact design and light weight make traveling with the mount easy.

SmartEQ™ mount is a fully computerized mount with a database of 150,000 objects. It offers the next generation GOTO technology from iOptron. The Go2Nova® Hand Controller is intuitive with a large LCD screen, with which you can easily set up your telescope and select where you want to navigate.

SmartEQ™ Pro+ mount has metal ring gears (aluminum alloy) and worm shafts (brass) to enhance the mount performance. It also equipped with an ST-4 compatible guiding port for those who wants to autoguide the mount. An iOptron AccuAligning™ Polar Scope is also equipped for better polar alignment. The mount can be controlled by most popular astronomical software.

SmartEQ™ Pro+ mount is universally compatible with any tubes using a Vixen-style dovetail connection, making it useful for beginners as well as hobbyists with multiple tubes.

Features:

- Specialized *Grab N' Go* mount ideal for visual observer and wide field astro-photographer
- Portable, compact, and sturdy German equatorial mount that is easy to travel with
- Payload: 11 lbs (5 kg) (excluding counterweight)
- Mount weight: 6.2 lbs (2.8 kg)
- Dual-axis servomotor with optical encoder
- Resolution: 0.5 arc second
- Go2Nova® 8408 controller with Advanced GOTONOVA® GoTo Technology
- Over 150,000 celestial objects for easy surfing
- Drive motor with 9-speed setting for precise slewing
- AccuAlign™ bright field polar scope
- Low power consumption (8 AA batteries for 16 hours consecutive tracking)
- Retractable counterweight shaft
- Vixen-type dovetail saddle
- Standard 1.25 inch heavy-duty stainless steel tripod
- Serial port on hand controller for firmware upgrade and computer controller (optional #8412 serial cable is needed)
- Metal worms and ring gears
- ST-4 guiding port
- BrightStar Polar Alignment procedure
- Optional 1.5A AC/DC adapter (#8417-15)
- Optional StarFi WI-FI adapter (#8434)

2. SmartEQ™ Pro+ Terms

2.1. Parts List[1]

A SmartEQ™ Pro+ mount contains:

- SmartEQ™ Pro+ telescope mount
- Go2Nova® 8408 hand controller
- 1.25-inch stainless steel tripod with accessory tray
- One 1 kg (2.2 lbs) counterweight
- One hand controller cable
- Installed polar scope

OPTIONAL PARTS

- AC/DC adapter (#8417-15, #8417)
- StarFi WI-FI adapter (#8434)
- RS232-RJ9 serial cable (#8412)
- Additional 1 kg (2.2 lbs) counterweight (#3106-02)
- Hard carrying case (#3280)

ONLINE CONTENTS (www.iOptron.com)

- Quick Start Guide
- This manual
- Accessories
- Firmware upgrade (check online for latest version)
- ASCOM driver
- Reviews and feedback from other customers

[1] US market only. Actual contents and accessories may change by time.

2.2. Go2Nova® 8408 Hand Controller

Figure 1. Go2Nova 8408 hand controller

The Go2Nova® 8408 hand controller (HC) shown in **Figure 1** is the standard controllers that used for the SmartEQ™ Pro+ mount. It has a 4 line, 21 character large LCD screen, function keys, direction keys and number keys on the front; and a HBX port (6-pin) and a serial port (4-pin) at the bottom.

2.2.1. Key Description

- MENU Key: Press "MENU" to enter the Main Menu.
- BACK Key: Move back to the previous screen, or end/cancel current operation, such as slewing.
- ENTER Key: Confirm an input, go to the next menu, select a choice, or slew the telescope to a selected object.
- Arrow (▲▼◄►) Keys: The arrow keys are used to control the movement of DEC and R.A. axes. Press and hold ▲(DEC+),▼(DEC-) buttons to move a telescope along the DEC direction, ◄(R.A.+), ►(R.A.-) to move a telescope along the RA direction. They are also used to browse the menu or move the cursor while in the menu. **Holding an arrow key for a fast scrolling.**
- Number Keys: Input numerical values. Also used to adjust slewing speeds (1: 1X; 2: 2X; 3: 8X; 4: 16X; 5: 64X; 6: 128X; 7: 256X; 8: 512X; 9: MAX)
- ? Key: **Identify and display nearby bright stars or objects where the telescope points to.**
- 0 Key: Stop the mount during GOTO. **Also toggling between start and stop tracking.**
- HBX (Handbox) port: connect the HC to the SmartEQ mount using 6 pin RJ11 plug.
- Serial port: connect the HC to a Computer via a RS232 to 4 pin 4 wire (4P4C) RJ-9 cable (iOptron item #8412). The pin out of the serial port is shown in **Figure 2**.

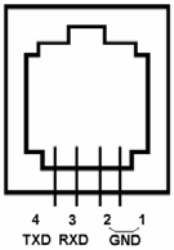


Figure 2. Serial port pin out on an 8408 hand controller

2.2.2. The LCD Screen

The 8408 HC has a large 4-line, 21-character per line LCD screen. The user interface is simple and easy to learn. When the mount first turned on, an initial information screen will be displayed as shown in **Figure 3**, after company logo and mount type are displayed. It will tell you if motors are at Zero Position, current date and time.

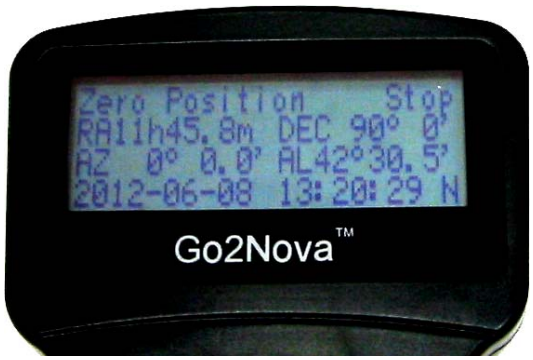


Figure 3. 8408 Initial Information Screen

The LCD screen will switch to the information screen, as indicated in **Figure 4**, during operation.

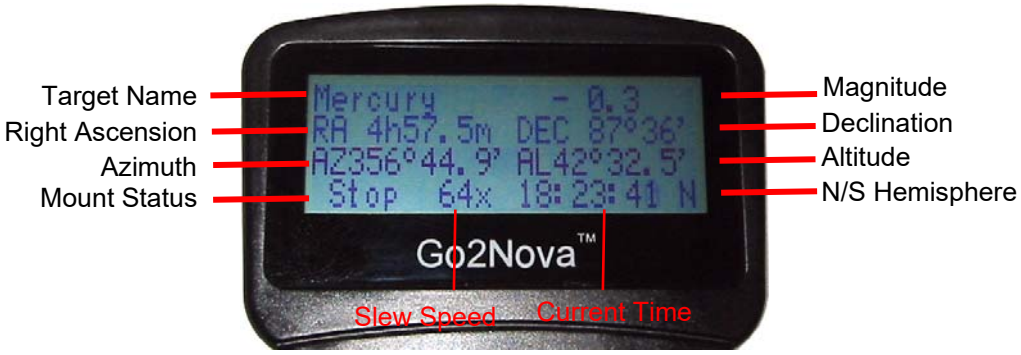


Figure 4. 8408 HC LCD Information Screen

1. Target Name/Mount Position: displays the name of the target that telescope is currently pointed to or the current mount position.
   - An object name, such as “Mercury” or “Andromeda Galaxy”: Name of the Star or celestial object that the mount is currently slewing to, GOTO or tracking;
   - User Position: The mount is point to a user defined position, which could be a real sky object or just simply due to press an arrow key.
2. Magnitude: the magnitude of the current celestial object
3. Right Ascension: Right Ascension of the telescope, or R.A.
4. Declination: Declination of the telescope, or DEC.
5. Azimuth: Azimuth of the telescope (north is 0º, east 90º, south 180º, and west 270º).
6. Altitude: Altitude of the telescope (degrees vertical from the local horizon - zenith is 90º).
7. Mount Status: Display current operation status of the mount.
   - Stop: mount is not moving;
   - Slew: mount is moving with an arrow key is pressed;
   - GoTo: mount is slewing to a celestial object using “Select and Slew”;
8. Slew speed: It has 9 speeds: 1X, 2X, 8X, 16X, 64X, 128X, 256X, 512X, MAX (~4º/sec, depends on power source).
9. Current Time: display local time in a format of HH:MM:SS.

2.2.3. Check the Battery

The hand controller has a real time clock (RTC) which should display the correct time every time the mount is turned on. If the time is incorrect, please check the battery inside the hand controller and replace it if needed. The battery is a 3V, CR1220 button battery.

3. SmartEQ™ Pro+ Mount Assembly

NOTE: The SmartEQ™ Pro+ mount is a precision astronomical instrument. It is highly recommended that you read the entire manual and become familiar with the nomenclature and function of all components before starting the assembly.

STEP 1. Setup Tripod

Expand the tripod legs. Put the Accessory Tray onto the Tripod Support Bracket. Slightly push down Accessory Tray while turn it, until the tray is locked into the Tripod Support Bracket. **(Figure 5)**. Adjust the tripod height by unlocking and re-locking the tripod leg screws (not shown) to a desired height. Position the tripod so that the Alignment Peg faces north, if you are in Northern Hemisphere **(Figure 6)**.

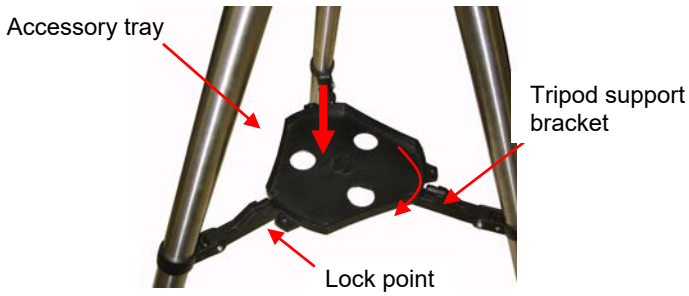


Figure 5. Install tripod support bracket

Figure 6. Alignment peg position

The Alignment Peg may be moved to the opposite position if used at latitude lower than 20º to avoid counterweights hit the tripod leg.

STEP 2. Attach the Mount Head

Remove the Latitude Adjustment Screw from its Storage Position (the bottom threaded hole) by unscrewing it all the way out **(Figure 7)**. Retract the Azimuth Adjustment Knobs to allow enough clearance for the Alignment Peg seating in the house. Tighten the Azimuth Lock to secure the mount **(Figure 8)**.

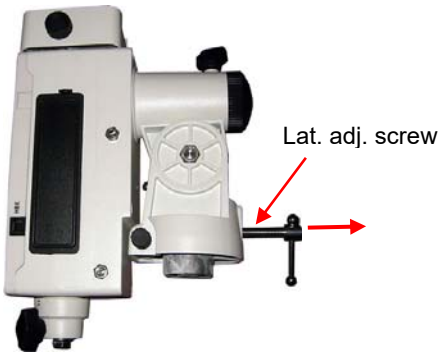


Figure 7. Remove Latitude Adjustment Screw

Figure 8. Install mount onto the tripod

STEP 3. Adjust Latitude

This step requires you to know the latitude of your current location. It can be easily found on the Internet, with your GPS navigator or a GPS capable cell phone. You will have to change this latitude setting every time you significantly change your night sky viewing location. This setting directly affects the mount's tracking and GOTO accuracy.

Thread in the Latitude Adjustment Screw into the Adjustment Position (the upper threaded hole), a threaded hole above the Storage Position **(Figure 9)**. Loosen the Latitude Clutch Screw and tune the Latitude Adjustment Screw to raise the mount altitude (latitude) to your current latitude as indicated on the Latitude Dial, as shown in **Figure 10**.

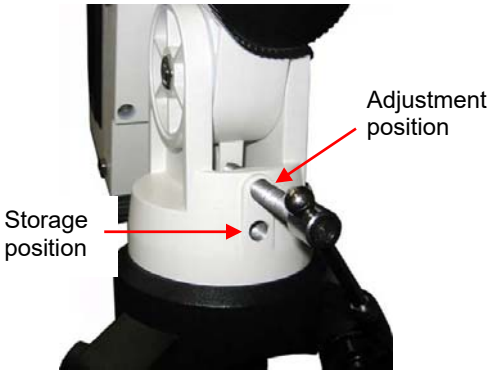


Figure 9. Move latitude adjustment screw

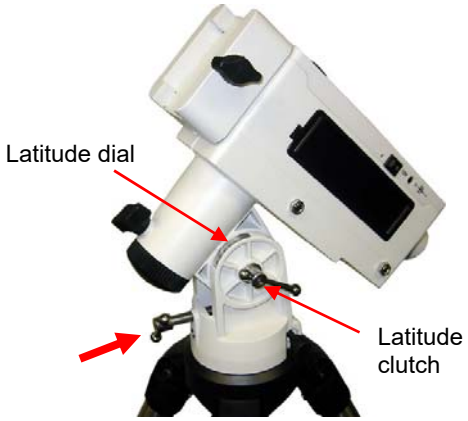


Figure 10. Adjust mount latitude

STEP 4. Install Counterweight (CW)

The mount comes with one 1 kg (2.2 lbs) counterweight. However, because of its unique design, no CW is needed if the payload is less than 4 lbs. ***The mount and installed batteries will provide balancing weight needed.*** If a payload is greater than 8.8 lbs (4 kg, this value may vary depends on the scope diameter), additional CW is needed. The Counterweight Shaft is stored inside the mount head. If a CW is needed, release the CW Shaft Locking Screw to pull out the shaft (**Figure 11**). Mount a CW onto the shaft and tighten the CW Locking Screw to hold the CW in place. Tighten the CW Safety Screw (**Figure 12**).

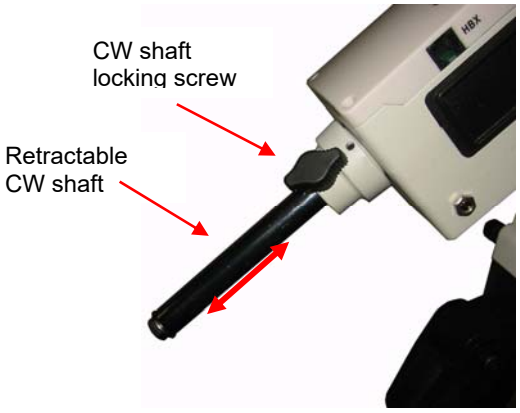


Figure 11. Release CW shaft

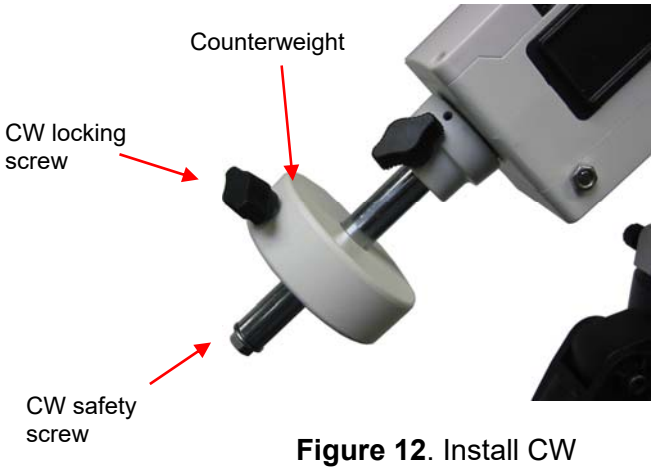


Figure 12. Install CW

STEP 5. Attach and Balance an OTA

After attaching an OTA and accessories to the mount, balance the mount in both R.A. and DEC to ensure minimum stress on the mount.

CAUTION: The telescope may swing when the R.A. or DEC clutch is released. Always hold on to the OTA before you release the clutch to prevent it from swinging. It can cause personal injury or damage to the equipment.

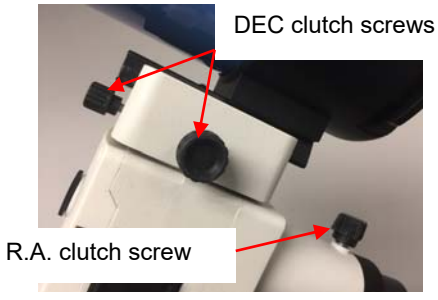


Figure 13. R.A. and DEC clutches

Balance the mount in R.A. axis

Release the R.A. Clutch and rotate the R.A. axis to place the DEC axis in the horizontal position. The OTA can be on either side. If the DEC axis stays in the horizontal position, it means the R.A. axis is balanced. Otherwise, you may adjust the length of CW shaft, or install and adjust CW position to balance the mount in R.A. axis. Remember to install the CW Safety Lock and tighten the CW Locking Screw, if a CW is installed.

Balance the mount in DEC. axis

While the mount is at horizontal position, release the DEC Clutch screws. If the OTA does not rotate along the DEC axis, it is OK. Otherwise move the scope back or forth to balance the OTA. Tighten the DEC Clutch again.

STEP 6. Install Batteries and Connect Cables

There are two battery compartments that each can hold 4 AA batteries **(Figure 14)**. Lift the battery cover. Carefully pull out the battery holder from the compartment. Be sure not to accidentally disconnect the wires. Insert 4 AA batteries into each holder. Replace the holder back into the battery compartment and replace the lid. Plug hand controller into the HBX port on the mount **(Figure 15)**. Turn on power and use four Arrow keys (▲▼◄►) to rotate the mount Up, Down, Left, and Right. Use the NUMBER key to change the slew rate from the slowest (1 for 1X) to the fastest (9 for MAX).

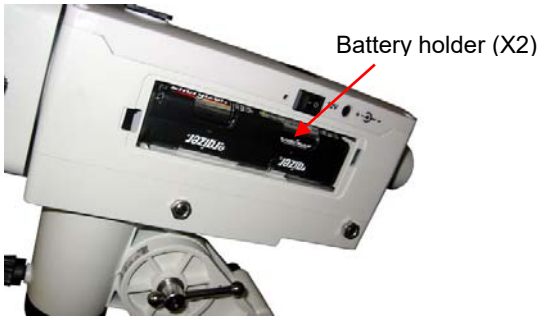


Figure 14. Battery holder

Figure 15. Connect control cable

STEP 7. Setup Hand Controller

You need manually enter the time and site information before the mount can precisely go to an object. To set up the controller, turn the mount power ON. Press **MENU**=> "***Settings***":

```
Select and Slew
Sync. to Target
Alignment
Settings
```

Press **ENTER** and select "***Set Time and Site***"

```
Set Time and Site
Set Beep
Set Display
Set Guiding Rate
```

Press ENTER. A time and site information screen will be displayed:

```
2013-04-01 12:01:36
UTC -300 Minute(s)
W071d08m50s       DST:  N
N42d30m32s        Northern
```

Daylight Saving Time

Set Local Time

Use the ◄ or ► key to move the cursor _ and use the number keys or ▲ or ▼ button to change the numbers of the date and time. The time is in 24 hour format.

In order to make the Hand Controller reflect your correct local time, ***time zone information, or UTC (Coordinated Universal Time), has to be entered.*** Press the ► key to move the cursor to the second line "**UTC -300 Minute(s)**" . Add or subtract 60 minutes per time zone). For example:

- Boston is "UTC -300 minutes"
- Los Angeles is "UTC -480 minutes"
- Rome is "UTC +60 minutes"
- Beijing is "UTC +480 minutes"
- Sydney is "UTC +600 minutes"

Use the number keys or ▲ or ▼ button to change the numbers. Use the ▲ or ▼ button to toggle between "+" and "-" for UTC offset.

All the time zones in North America are "UTC –", as shown in the following table, so ensure the display shows "**UTC -**" instead of "**UTC +**" if in North or South America.

Time Zone	Hawaii	Alaska	Pacific	Mountain	Central	Eastern
Hour behind UT	-10	-9	-8	-7	-6	-5
Enter UTC	-600	-540	-480	-420	-360	-300

When the time information entered is correct, press ENTER and go back to the previous screen. **Note that fractional time zones can be entered.**

Do not manually add or subtract an hour from displayed time to reflect Daylight Saving Time (DST). Only select "**Y**" after DST begins.

For other parts of the world you can find your "time zone" information from internet.

Set Observation Site Coordinate

The third and fourth lines display the longitude and latitude coordinates, respectively. "W/E" means western/eastern hemisphere; "N/S" means northern/southern hemisphere; "d" means degree; "m" means minute; and "s" means second.

Press ◄ or ► key to move the cursor and using ▲ or ▼ key to toggle between "W" and "E", "N" and "S", using number key to change the numbers. It is always a good idea to do your home work to get the GPS coordinates before traveling to a new observation site.

The site coordinates information can be found from your smart phone, GPS receiver or via the internet. Site information in decimal format can be converted into d:m:s format by multiplying the decimal numbers by 60. For example, N47.53 can be changed to N47º31'48": 47.53º = 47º +0.53º, 0.53º=0.53x60'=31.8', 0.8'=0.8x60"=48". Therefore, 47.53º=47º31'48" or 47d31m48s.

Set Daylight Saving Time

Keep moving the cursor by pressing ► key after setting the coordinate until it moves on DST section. Change the DST to "N" or "Y" accordingly.

Check the Hand Controller Battery

The hand controller has a real time clock (RTC) which keeps the correct time every time the mount is turned on. If the time is off too much, please check the battery inside the hand controller and replace it if required. The battery is a 3V, CR1220 button battery.

STEP 8. Polar Alignment

In order for an equatorial mount to track properly, it has to be accurately polar aligned. The SmartEQ™ Pro+ had a built-in AccuAlign™ polar scope. You can do a fast and accurate polar axis alignment with iOptron's **Quick Polar Alignment** procedure.

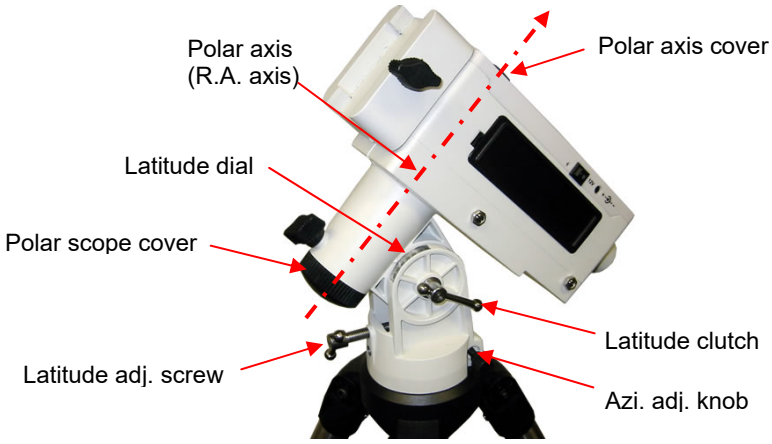


Figure 16. Align mount to the celestial pole

As indicated in **Figure 17**, the Polar Scope reticle has been divided into 12 hours along the angular direction with 10 minute tics. There are 6 concentric circles in 2 groups of 3 marked from 36' to 44' and 60' to 70', respectively. The 36' to 44' concentric circles are used for polar alignment in the Northern Hemisphere using Polaris, while the 60' to 70' circles are used for polar alignment in Southern Hemisphere using Sigma Octantis.

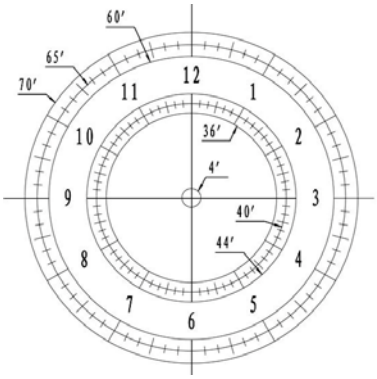


Figure 17. Polar Scope

Quick Polar Alignment

(1) Set the mount face North with your latitude. Connect the hand controller and power the mount on.

(2) Take off the Polar Axis Cover and Polar Scope Cover. Release CW shaft locking screw to release the CW shaft from the mount body, if no CW is used.

(3) Look through the polar scope to make sure that the DEC axle is not blocking the polar scope view. If you can't see through the polar scope, press the UP or DOWN button to rotate the DEC axle until the opening on the DEC axle is aligned with polar scope path. Press the number key to change the speed.

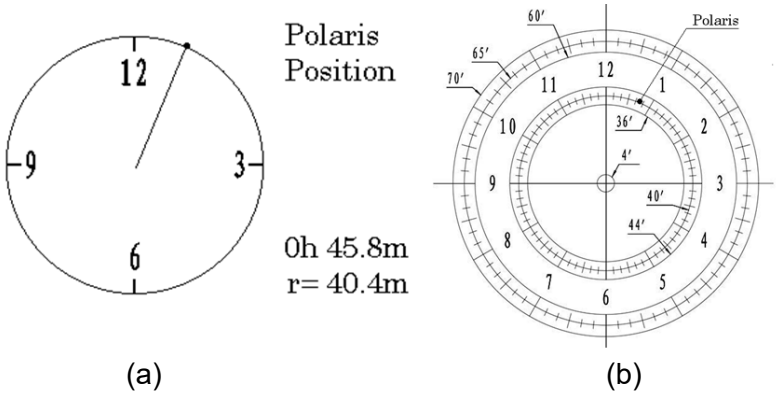
(4) Press **MENU**=> "***Settings"***=> "***Set Eyepiece Light"*** to adjust the LED brightness to a comfort level. Adjust polar scope eyepiece to bring the polar scope dial (**Figure 17**) in focus. The polar scope had been adjusted in factory for normal eye sight so when the polar scope dial is focused,

on should be able to see the star cleared as well. If one cannot have both focused at the same time, please see Appendix for Polar Scope adjustment.

(5) Slightly release R.A. Clutch Screw. Press the LFTT or RIGHT button on the hand controller to rotate the polar scope to align the 12 o'clock position of the dial on the top, as shown in **Figure 17**.

(6) Make sure that the time and site information of the hand controller is correct. Press **MENU** => "***Alignment"***=> "***Pole Star Position"*** to display the current Polaris position. For example, on June 22, 2014, 20:19:42 in Boston, US (alt N42º30'32" and long W71º08'50"), UTC -300 minutes, DST:Y, the Polaris Position is 0h45.8m and 40.4m,.as shown in **Figure 18a**.

(7) Look through the polar scope to find the Polaris. Using Azimuth Adjustment Knob and Latitude Adjustment Screw to adjust the mount in altitude and azimuth directions and put the Polaris in the same position on the Polar Scope Dial as indicated on the HC LCD. In this case, the Polaris will be located at a radius of 40.4' and an angle of 0 hour 45.8 minute, as shown in **Figure 18b**.



(a) (b)

Figure 18. Polaris Position shown on HC (a) and where to put on polar scope dial (b)

NOTE: If you are located in southern hemisphere, Sigma Octantis will be chosen for Polar Alignment. For example, on May 20, 2010, 20:00:00 in Sydney, Australia (Lat S33º51'36" and Long E151º12'40"), 600 min ahead of UT, the Sigma Octantis Position is 1hr21.8m and 64.4m.

BrightStar Polar Alignment/Polar Iterate Align

BrightStar Polar Alignment allows you to polar align the mount even if you cannot view the Celestial Pole.

(1) Level the SmartEQ pro+ mount and set it at Zero Position. Make sure the telescope is parallel to the pole axis (R.A. axis) of the mount. If a finder scope is used, adjust it to be parallel to the telescope optical axis. Turn the mount power on.

(2) Pressing **MENU**=>***Alignment***=>***Polar Iterate Align***. The HC will display the azimuth and altitude position of several bright stars near meridian. Select one that is visible with high altitude as Alignment Star A. Follow the HC instruction to move the Star A to the center of the eyepiece with the combination of Latitude Adjustment Knob and "◄" or "►" button. Press **ENTER** to confirm. Next, select a bright star that is close to the horizon as the Alignment Star B. Center it using the Azimuth Adjustment Knob and "◄" or "►" button *(The "▲" and "▼" buttons are not used here).* Press **ENTER** to confirm.

(3) The telescope will now slew back to Star A to repeat above steps. The iteration can be stopped when it is determined that the alignment error is at the minimum. Press **BACK** button to exit alignment procedure.

NOTE: The movement of the alignment star in your eyepiece may not be perpendicular but crossed, depends on its location in the sky.

STEP 9. Return Mount to Zero Position

After polar alignment and balancing OTA, return the mount to Zero Position before performing ***Star Alignment***. The Zero Position is the position with the CW shaft pointing toward the ground, OTA at the highest position with its axis parallel to the polar axis and the OTA pointing to the Celestial Pole.

Loosen the DEC and R.A. Clutches to adjust the mount to the Zero Position by align three marks located on DEC unit, R.A. unit and mount, respectively. Tighten the screws after adjustment.

Figure 19. Zero Position

Make sure the hand controller is also at the zero position by press **MENU**=> "***Zero Position"***=> "***Set Zero Position***." The mount has the capability to memorize the RA and DEC positions even the power is interrupted. Therefore, ***the power on position may not be the zero position in most cases***. Check the Zero Position by using **MENU**=> "***Zero Position"***=> "***Goto Zero Position"*** before each session.

4. Getting Started

In order to experience the full GOTO capability of GOTONOVA® technology it is very important to set up the mount correctly before observation.

4.1. Setup the Mount and Polar Alignment

Assemble your SmartEQ™ Pro+ mount. Mount an OTA and accessories, and carefully balance the mount around the polar axis. Polar align you mount using either ***Quick Polar Alignment*** or ***BrightStar Polar Alignment Procedure***. Power the mount on and double check the time and site information.

Always check if the mount is at the Zero Position when the mount is powered on, i.e. with the counterweight shaft pointing to ground, OTA at the highest position with its axis parallel to the polar axis and the telescope pointing to the Celestial Pole. Press **MENU** => "***Zero Position"*** => "***Goto Zero Position"*** to check it. If the mount is not at the Zero Position, press **MENU** => **"*Zero Position*"** => **"*Set Zero Position*."** Release the RA and DEC locking knobs to manually return the mount to Zero Position, or use the hand controller to slew the mount to Zero Position. Press **ENTER** to confirm the zero position.

4.2. Manual Operation of the Mount

You may observe astronomical objects using the arrow keys of a Go2Nova® hand controller.

Flip the I/O switch on the telescope mount to turn on the mount and the mount will start to tracking automatically. Use ►,◄,▼ or ▲ buttons to point the telescope to the desired object. Use the number keys to change the slewing speed. You may press **0** button to stop/start tracking when the hand controller is displaying the tracking object.

4.3. Initial Star Alignment

Perform a simple one star alignment/synchronization after set up the hand controller to correct any pointing discrepancy of the Zero Position and to improve the GOTO accuracy.

To perform ***One Star Align***, press **MENU**=>"***Alignment***"=>"***One Star Align***"=>**ENTER**. The screen will display a list of bright objects for you to select from. Select an object using ▲ or ▼ key. Then press **ENTER**. After the mount slews to the target, use the arrow keys to center it in your eyepiece. Then press **ENTER**. (More align details in 5.4)

An alternate way is to perform "***Sync to Target.***" Press **MENU**=>"***Select and Slew***"=>**ENTER**. Browse over the catalogs and select an object. Press **ENTER**. After the mount slews to the star, press **MENU**=>"***Sync. To Target***", follow the on-screen instruction to center the star and press **ENTER**. You may need to use the number keys to change the slewing speed to make the centering procedure easier.

4.4. Go to the Moon and Other Stars

After performing these set-ups the mount is ready to GOTO and track objects. One of the most common objects is the Moon.

To slew to the Moon press **MENU**=>"***Select and Slew***"=>"***Solar System***"=> "***Moon***"=>**ENTER**. The telescope will automatically slew to the Moon and lock on it. It will automatically begin to track once it locks on. If the Moon is not centered in your eyepiece, use the arrow keys to center the Moon. You may use "***Sync to Target***" to improve the tracking.

You may also select other bright celestial objects to start with, such as Jupiter or Saturn.

4.5. Star Identifying Function

The 8408 hand controller has a star identifying function. After ***Polar Alignment*** and ***Set Up Time and Site***, slew the telescope to an bright star, manually or using GOTO. Press **?** (Help) button to identify the star name telescope is pointing to, as well as nearby bright stars if there are any.

4.6. GOTO and Tracking Position Memorization

The SmartEQ Pro+ mount can memorize its R.A. and DEC positions if the mount loses its power by accident, even during high speed slewing. Just do a ***Select and Slew*** to the same star after the power is back. The mount will continue to track the star.

4.7. Turn Off the Mount

When you have finished your observation, just simply turn the mount power off and disassemble the mount and tripod.

5. Complete Functions of Go2Nova® 8408 Hand Controller

5.1. Slew to an Object

Press **MENU** => "***Select and Slew***." Select an object that you would like to observe and press the **ENTER** key.

The Go2Nova® 8408 hand controller for SmartEQ Pro+ mount has a database of over 150,000 objects. Use the ► or ◄ buttons to move the cursor. Use the number buttons to enter the number, or the ▼ or ▲ buttons to change the individual number. Hold on a button to fast scroll through the list. The "⌓" indicates the object is above the horizon, and a cross mark "⌔" means it is below the horizon. In some catalogs those stars below the horizon will not display on the hand controller.

5.1.1. Solar System

There are 9 objects in the Solar system catalog.

5.1.2. Deep Sky Objects

This menu includes objects outside our Solar system such as galaxies, star clusters, quasars, and nebulae.

- Named Objects: consists of 60 deep sky objects with their common names. A list of named deep sky objects is included in Appendix E.
- Messier Catalog: consists of all 110 Messier objects.
- NGC Catalog: consists of 7,840 objects in NGC catalog.
- IC Catalog: consists of 5,386 objects in IC catalog.
- UGC Catalog: consists of 12,921 objects.
- Caldwell Catalog: consists of 109 objects.
- Abell Catalog: consists of 4076 objects.
- Herschel Catalog: consists of 400 objects.

5.1.3. Stars:

- Named Stars: consists of 259 stars with their common names. They are listed alphabetically. A list is included in Appendix E.
- Double/Multi Stars: consists of 208 double/multi stars. A list is attached in Appendix E.
- Hipparcos Catalog: the new HIP catalog consists of 120,404 records (2008).

5.1.4. Comets

This catalog contains 15 comets.

5.1.5. Asteroids

This catalog contains 116 asteroids.

5.1.6. Constellations

This catalog consists of 88 modern constellations with their names. They are listed alphabetically. A list is attached in Appendix E.

5.1.7. Customer Objects

It can store up to 60 used entered objects, including comets.

5.1.8. Customer R.A. DEC

Here you can go to a target by entering its R.A. and DEC numbers.

5.2. Sync to Target

This operation will match the telescope's current coordinates to Target Right Ascension and Declination. Follow the screen to perform the sync. Using this function will re-calibrate the computer to the selected object. This operation is most useful to find a faint star or nebula near a bright star.

You can change the slewing speed to make the centering procedure easier. Simply press a number key (1 through 9) to change the speed. The default slew speed is 64X.

"***Sync to Target***" will improve the local goto accuracy around the synced star.

5.3. Alignment

This function is used for aligning the telescope to the celestial pole and to create a sky model to calibrate the mount's GOTONOVA® functionality.

The hand controller provides two polar alignment methods. The "***Two Star Polar Align***" is used to refine the polar alignment using the AccuAlign™ polar scope and **Quick Polar Alignment**. The "***Polar Iterate Align***" uses a set of 2 bright stars for polar alignment providing a viable polar alignment approach for those who can't see the pole.

The system provides three alignment methods to calibrate the mount's GOTO function: "***Solar System Align***", "***One Star Align***", and "***Three Star Align***". The mount has to be at Zero Position before performing any alignment.

5.3.1. Pole Star Position

This function displays the position of the Pole Star for **Quick Polar Alignment** using the iOptron® AccuAlign™ polar scope. In the Northern Hemisphere the position of Polaris is displayed, while in the Southern Hemisphere the position of Sigma Octantis is shown.

5.3.2. One Star Alignment

Press **MENU** => "***Alignment***" => "***One Star Align***". A list of alignment stars that are above the horizon is computed based on your local time and location. With the mount in the Zero Position, use the▲ and ▼ buttons to select a star and press **ENTER**. Center the target in your eyepiece using the arrow keys. Press **ENTER** when finished. If your mount is set up correctly and polar aligned, one star alignment should be sufficient for good GoTo accuracy. To increase the pointing accuracy over the sky, you may choose to do a three star alignment.

5.3.3. Two Star Polar Align

Two Star Polar Align can improve the accuracy of the mount's polar alignment. Press **MENU** => "***Alignment***" => "***Two Star Polar Align.***" A list of alignment stars that are above the horizon is computed based on your local time and location. With the mount at the Zero Position, use the ▲ and ▼ buttons to select the first alignment star and press **ENTER**. Center the target in your eyepiece using the arrow keys

after the mount slews to it. Press **ENTER** when finished. The hand controller will prompt you to choose a second star. After centering the second star, the two-star alignment is finished.

After the two-star alignment, the altitude and azimuth errors will be displayed. This number can be used to fine tune the Quick Polar Alignment.

For example, if the screen shows 7.5" low and 4.3" east, it means that THE MOUNT axis is pointing low and to the east of the Celestial Pole.

5.3.4. Three Star Align

The three-star alignment will further determine the cone error between the OTA and mount axis. The system will use these data to calculate the goto model. If the cone error is big enough, it is suggested to shim the OTA in DEC to minimize it.

Press **MENU** => "***Alignment***" => "***Three Star Align.***" A list of alignment stars that are above the horizon is computed based on your local time and location. With the mount at the Zero Position, use the▲ and ▼ buttons to select the first alignment star and press **ENTER**. Center the target in your eyepiece using the arrow keys. Press **ENTER** when finished. The hand controller will prompt you to choose a second star. Select third star after the mount aligned to the second star.

The system will display the pointing and cone errors after the three star alignment accepted. The system will update the pointing model accordingly.

5.3.5. Polar Iterate Align

This alignment method allows you to polar align the mount even if you cannot view the Celestial Pole. Press the **MENU** => "***Alignment***" => "***Polar Iterate Align***". The HC will display a list of bright alignment stars near the meridian as Alignment Star A. Follow the HC instructions to move Alignment Star A to the center of the eyepiece using a combination of the Latitude Adjustment Knob and the "◄" and "►" buttons. Press **ENTER** to confirm the settings. Next, select a bright star that is close to the horizon as Alignment Star B. Center it using the Azimuth Adjustment Knobs and the "◄" and "►" buttons (*the "◢" and "◤" buttons will not function*). Press **ENTER** to confirm the settings.

The telescope will now slew back to Alignment Star A to repeat the above steps. The iteration can be stopped when it is determined that the alignment error has been minimized. Press the **BACK** button to exit the alignment procedure.

NOTE: It is highly recommended to use an eyepiece with illuminated crosshairs for accurate centering.

NOTE: The movement of the alignment star in your eyepiece may not be perpendicular depending on its location in the sky.

5.3.6. Solar System Align

This function uses a planet or the moon as an alignment object. Press **MENU** => "***Alignment***" => "***Solar System Align***" for a list of available alignment objects.

5.3.7. Display Model Error

This will display linear RA error, linear DEC error, polar misalignment, non-perpendicular between OTA and DEC, and non-perpendicular between HA and DEC.

5.3.8. Clear Alignment Data

This will clear all alignment data created during one star, two star or three star alignment process. If you are control the mount using a planetarium software via ASCOM, and the software has its own alignment function, please clear the alignment data.

5.4. Settings

5.4.1. Set Time and Site

Refer to STEP 7 in Section 3.

5.4.2. Set Beep

The Hand Controller allows a user to turn off the beep partially, or even go to a silent mode. To change this setting press **MENU** => "***Settings*"** => "***Set Beep***",

```
Set Up Time and Site
Set Beep
Set Display
Set Guiding Rate
```

Select one of three available modes:

"**Always On**" – a beep will be heard on each button operation or mount movement;

"**On but Keyboard**" – a beep will be heard only when the mount is slewing to the object or there is a warning message;

"**Always Off**" – all sounds will be turned off, including the SUN warning message.

5.4.3. Set Display

Press **MENU** => "***Settings***" => "***Set Display***,"

```
Set Up Time and Site
Set Beep
Set Display
Set Guiding Rate
```

Use the arrow keys to adjust LCD display contrast (***LCD contrast***), LCD backlight intensity (***LCD light***), and keypad's backlight intensity (***Key light***).

5.4.4. Set Guiding Rate

This is an advanced function for autoguiding when a guiding camera is utilized via a Guide Port. Before autoguiding, align the polar axis carefully. Select an appropriate guiding speed. The latest firmware allows you to set the R.A. and DEC guiding speed differently. The R.A. guiding speed can be set between ±0.01X to ±0.90X sidereal rate. The DEC guiding speed can be set between ±0.10X to ±0.99X sidereal rate. Follow the instructions of your autoguiding software for detailed guiding operation.

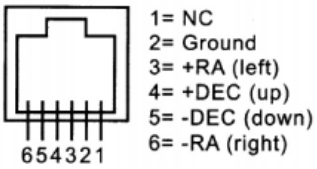


Figure 20. Guide port pin-out

The guide port wiring is shown in Figure 20, which has the same pin-out as that from Celestron / Starlight Xpress / Orion Mount / Orion Autoguider/ QHY5 autoguider.

If you have an autoguider which has a pin-out the same as the ST-I from SBIG, such as Meade/ Losmandy/ Takahashi/ Vixen, make sure a proper guiding cable is used. Refer to your guiding camera and guiding software for detailed operation.

WARNING: DO NOT plug your ST-4 guiding camera cable into the HBX port. It may damage the mount or guiding camera electronics.

5.4.5. Set Tracking Rate

You can set up the mount tracking rate by selecting "**Set Tracking Rate**". Then the user can select "**Sidereal Rate**", "**Lunar Rate**", "**Solar Rate**", "**King Rate**", and "**User Defined Speed**". The "User defined speed" can be adjusted from 0.9900X to 1.0100X of sidereal.

The "King Rate", developed by Edward S. King, corrects the tracking rate of a telescope to account for atmospheric refraction. This is more useful for unguided tracking.

5.4.6. Meridian Treatment

This function tells the mount what to do when it tracks past the meridian. You can tell the mount if it needs a meridian flip and when to do it.

- "**Set Position Limit**" will tell the mount when to stop tracking or to do a meridian flip. The limit can be set at from 0° to 10° (40 minutes) pass meridian.
- "**Set Behavior**" will determine if the mount will stop tracking or perform a meridian flip at the set position limit.

5.4.7. Set Altitude Limit

This function allows the mount to keep tracking an object even if it is below the horizon but can still be seen, for example from an elevated observation site, such as a hill. The range can be set from -89° to +89°. The default limit is 00°. ***Be careful when setting this limit.*** It may cause mount goto problems.

5.4.8. Set Eyepiece Light

Use this function to adjust polar scope LED brightness.

5.4.9. Language

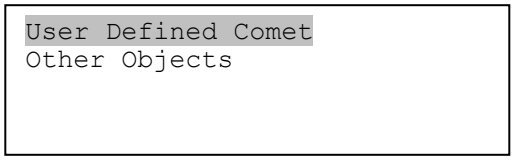
Select one of supported menu languages.

5.5. Edit User Objects

Besides various star lists available in the hand controller, you can add, edit or delete your own user-defined objects. This is especially useful for newly found comets. You can also add your favorite observation object into the user object list for easy sky surfing. Up to 60 comets and other user objects can be stored.

5.5.1. Enter a New Comet

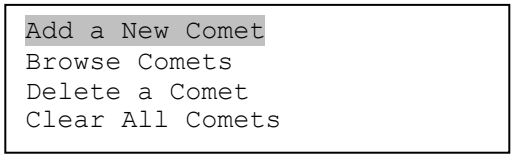
Press **MENU** => "***Edit User Objects***" to set user objects.



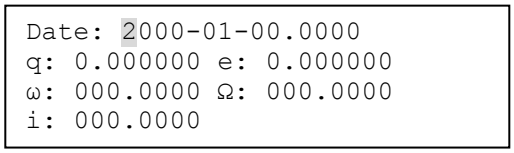
Select "***User Defined Comet***" to add/browse/delete the user-defined comet list. Find the orbit parameters of a comet in the SkyMap format. For example, the C/2012 ISON has an orbit parameter:

No.	Name	Year	M	Day	q	e	ω	Ω	I	H	G
C/2012	S1 ISON	2013	11	28.7960	0.0125050	1.0000030	345.5088	295.7379	61.8570	6.0	4.0

Select "***Add a New Comet***" to add a new one:



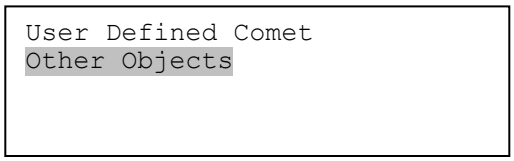
The hand controller will display the parameter entry screen:



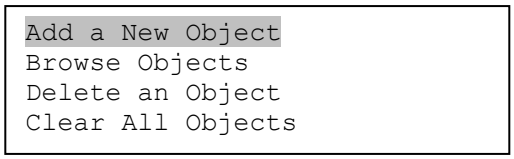
Enter the parameters using the arrow buttons and number keys. Press **ENTER** and a confirmation screen will be displayed. Press **ENTER** again to store the object under the assigned user object number, or press **BACK** button to cancel.

5.5.2. Enter Other Objects or Observation List

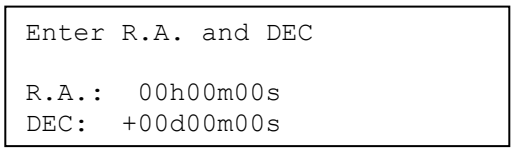
Press **MENU** => "***Edit User Objects"*** to set user objects.



Select "***Other Objects***" to enter you own object:



Select "***Add a New Object***". A screen will be displayed asking you to Enter R.A. and DEC coordinates:



You may enter the R.A. and DEC coordinates of the object you want to store, and press **ENTER** to confirm.

A more useful application of this function is to store your favorite viewing objects before heading to the field. When the "***Enter R.A. and DEC***" screen appears, press the **MENU** button. It brings up the catalogs that you can select the object from. Follow the screen instructions to add your favorite objects. Press **BACK** button to go back one level.

Press the **BACK** button to go back to the object entry submenu**.** You may review the records or delete those that are no longer wanted. Press the **BACK** button to finish the operation. Now you can slew to your favorite stars from "***Custom Objects***" catalog using "***Select and Slew***."

5.6. Firmware Information

This option will display the mount type, firmware version information for the hand controller (HC) and main board, *i.e.* RA and DEC board which should be the same.

5.7. Zero Position

5.7.1. Goto Zero Position

This moves your telescope to its Zero Position. This is the reference point for alignment and GoTo functions.

5.7.2. Set Zero Position

This set the Zero Position for the firmware.

The Zero Position reference will be an undefined value before the first time power on the mount, after firmware upgrade, or HC battery replacement. You can use this function to set the zero position reference.

Press the **ENTER** after moving the mount to Zero Position either manually or with the hand controller.

6. Maintenance and Servicing

6.1. Maintenance

The SmartEQ™ Pro+ mount is designed to be maintenance free. Do not overload the mount. Do not drop the mount, this will damage the mount or degrade the GOTO tracking accuracy permanently. Use a wet cloth to clean the mount and hand controller. Do not use solvent.

If your mount is not to be used for an extended period, dismount the OTAs and counterweight(s).

6.2. iOptron Customer Service

If you have any question concerning your SmartEQ™ Pro+ mount, contact iOptron Customer Service Department. Customer Service hours are 9:00 AM to 5:00 PM, Eastern Time, Monday through Friday. In the unlikely event that the mount requires factory servicing or repairing, write or call iOptron Customer Service Department first to receive an RMA# before returning the mount to the factory. Please provide details as to the nature of the problem as well as your name, address, e-mail address, purchase info and daytime telephone number. We have found that most problems can be resolved by e-mails or telephone calls. So please contact iOptron first to avoid returning the mount for repair.

It is strongly suggested that to send technical questions to support@ioptron.com. You may also call 1.781.569.0200 in the U.S.

6.3. Product End of Life Disposal Instructions

This electronic product is subject to disposal and recycling regulations that vary by country and region. It is your responsibility to recycle your electronic equipment per your local environmental laws and regulations to ensure that it will be recycled in a manner that protects human health and the environment. To find out where you can drop off your waste equipment for recycling, please contact your local waste recycle/disposal service or the product representative.

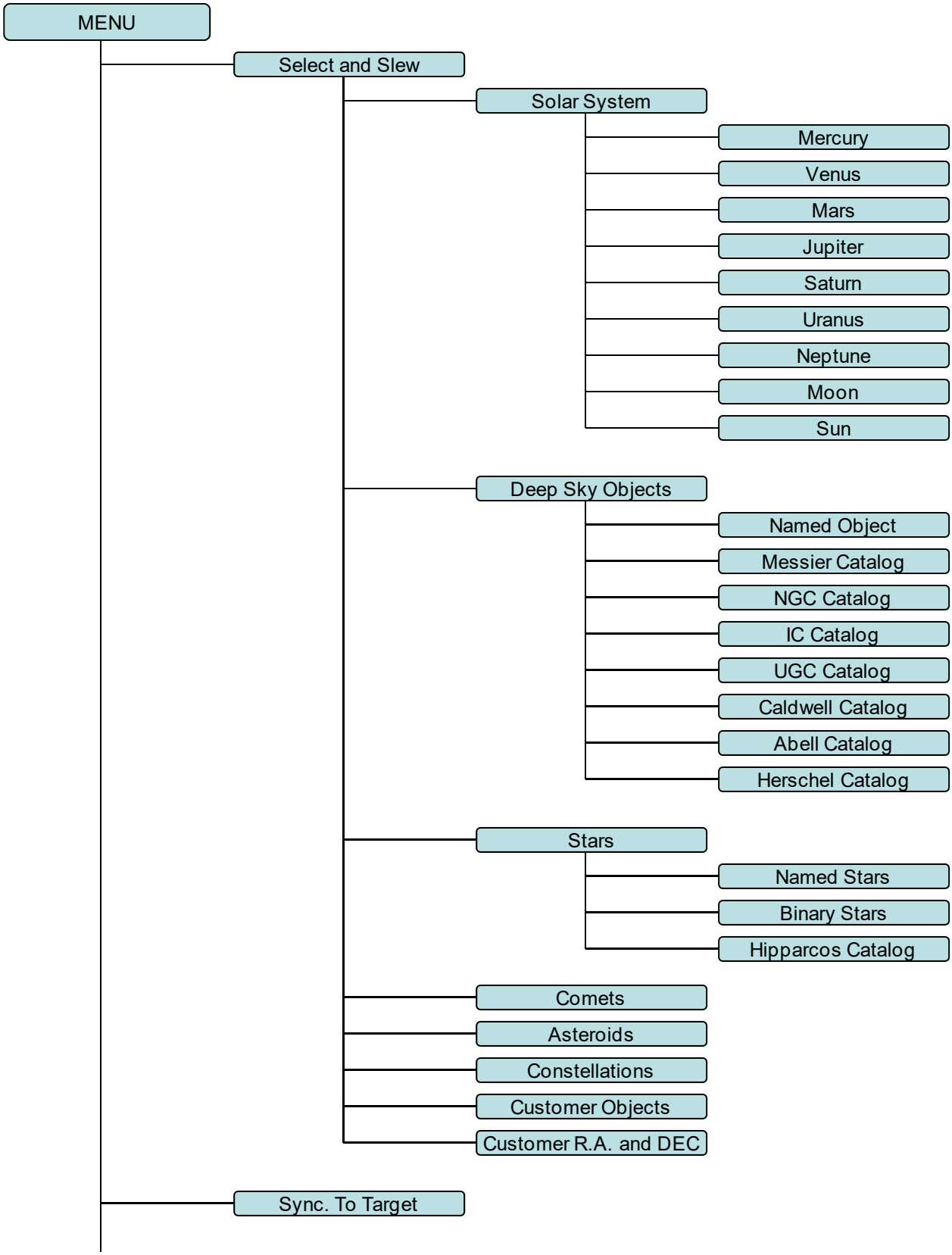
6.4. Battery Replacement and Disposal Instructions

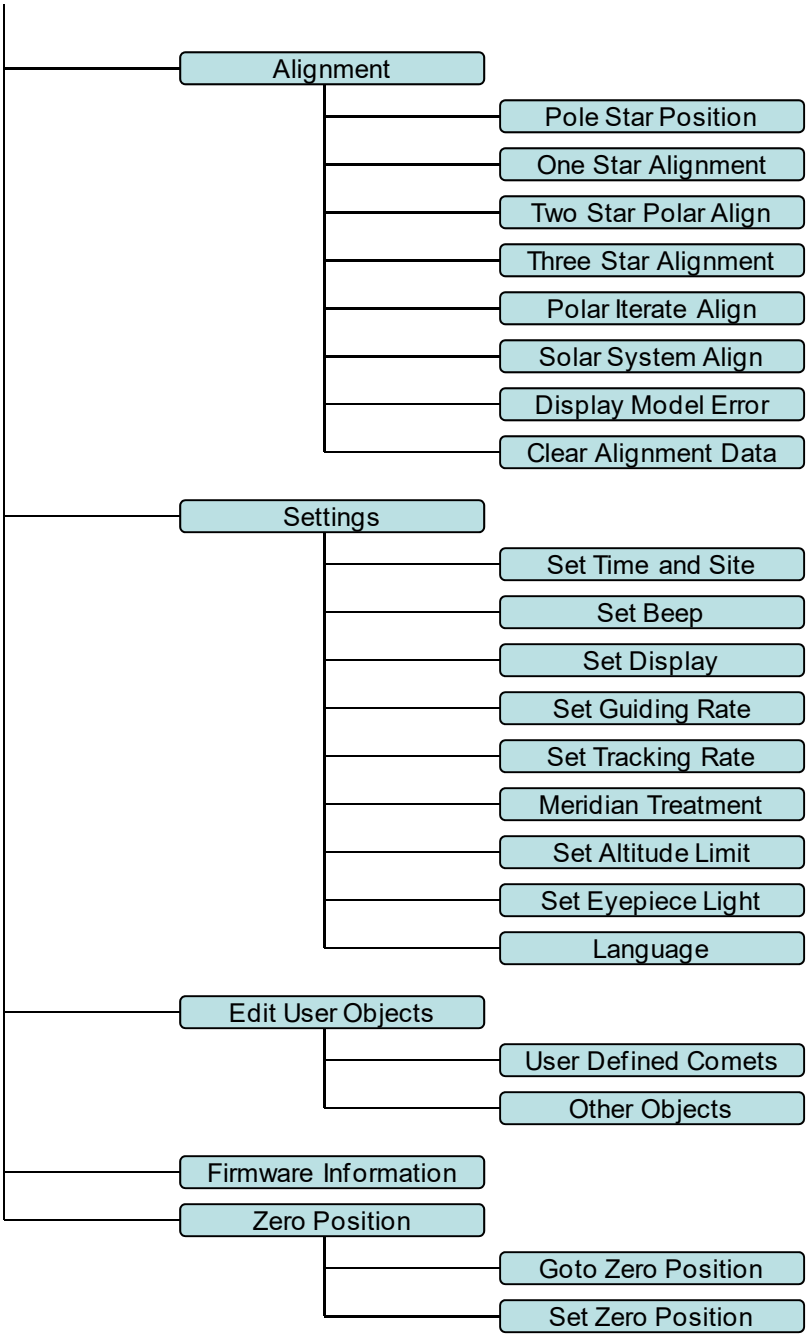
Battery Disposal- Batteries contain chemicals that, if released, may affect the environment and human health. Batteries should be collected separately for recycling, and recycled at a local hazardous material disposal location adhering to your country and local government regulations. To find out where you can drop off your waste battery for recycling, please contact your local waste disposal service or the product representative.

Appendix A. Technical Specifications

Mount	German Equatorial Mount
Payload	11 lbs (5kg), exclude counterweight
Mount weight	6.2 lbs (2.8kg)
Latitude adjustment range	0º ~ 65º
Azimuth adjustment range	± 10º
Right Ascension worm wheel	Φ60mm, 120 teeth
Declination worm wheel	Φ60mm, 120 teeth
Right Ascension axis shaft	Φ25mm steel
Declination axis shaft	Φ25mm steel
Right Ascension bearing	Φ42mm
Declination bearing	Φ42mm
Motor drive	DC servo with optical encoder
Resolution	0.5 arc seconds
Hand Controller	Go2Nova® 8408 with 150,000 objects database
Tracking	Automatic
Speed	1×,2×,8×,16×,64×,128×,256×,512×,MAX(~4°/sec)
Counterweight shaft	Φ16mm
Counterweight	1kg (2.2lbs)
Dovetail	VIXEN
Tripod	1.25” Stainless Steel (5.7lbs or 2.6kg)
Polar Scope	AccuAlign™ bright field illuminated Standard
Power consumption	0.1A(Tracking), 0.3A(GOTO)
Power requirement	DEC 9 ~12V, 1 amp
Battery	8AA (not included)
Serial port	Yes (on hand controller)
Autoguide port	ST-4 compatible
Firmware upgrade	Yes
PC computer control	Yes (ASCOM)
Warranty	One year limited

Appendix B. Go2Nova® 8408 HC MENU STRUCTURE




Alignment
Pole Star Position
One Star Alignment
Two Star Polar Align
Three Star Alignment
Polar Iterate Align
Solar System Align
Display Model Error
Clear Alignment Data
Settings
Set Time and Site
Set Beep
Set Display
Set Guiding Rate
Set Tracking Rate
Meridian Treatment
Set Altitude Limit
Set Eyepiece Light
Language
Edit User Objects
User Defined Comets
Other Objects
Firmware Information
Zero Position
Goto Zero Position
Set Zero Position

Appendix C. Firmware Upgrade

The firmware of a Go2Nova® 8408 hand controller and main control board can be upgraded by the customer. Please check iOptron's website, http://www.iOptron.com, under ***Support > Firmware/Software*** for details.

Appendix D. Computer Control an SmartEQ Pro+ Mount

The SmartEQ Pro+ mount can be controlled by a SmartPhone, a tablet or a computer. It is supported by two types of computer connections:

- Connect to a computer via RS232 serial port. A RS232-RJ9 cable (#8412) is needed. You may also need an optional RS232 to USB adapter (such as iOptron part #8435) if your computer does not have a serial port, like most of the laptops on the market today. Follow the adapter instructions to install the adapter driver.
- The mount can be controlled via ASCOM protocol (Windows OS). Please use iOptron ASCOM/Commander 5.4 or lateror.
- The mount can be controlled directly by some software in a Mac OS, such as Sky Safari. Please select a correct mount type, such as "***iOptron CEM/EQ Pro/AZ Mount Pro***".
- Connect wirelessly via StarFi™ Wi-Fi adapter. The mount can be controlled via ASCOM protocol (Windows OS), SmartPhone/tablet (iOS) and Mac OS wirelessly with supported software, such as Sky Safari. Please select Scope Type as "***iOptron CEM/EQ Pro/AZ Mount Pro***" in supported software.

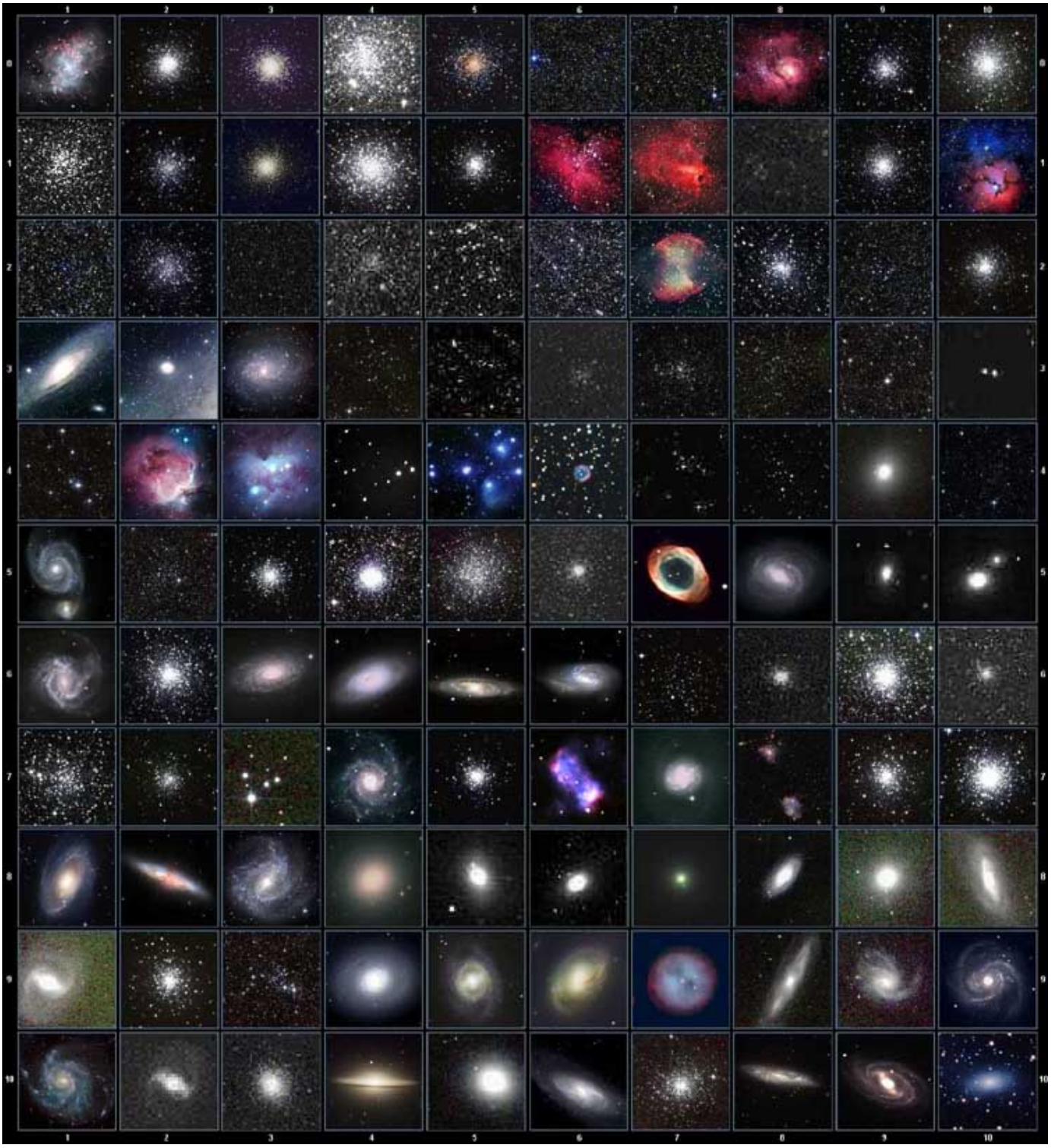
To control the mount via ASCOM protocol, you need:

1. Download and install the latest ASCOM Platform, from http://www.ascom-standards.org/. Make sure your PC meets the software requirement. For 6.1 SP1, Windows XP users should install .NET Framework 4 (not the Client Profile). Windows Vista and Windows 7 users should install .NET Framework 4.5.2. Windows 8 or users do not need install any additional components.
2. Download and install the latest iOptron Aommander/ASCOM drive for from iOptron website.
3. Planetarium software that supports ASCOM protocol. Follow software instructions to select the iOptron Telescope.

Please refer to iOptron website, www.iOptron.com, under ***Support > iOptron ASCOM Driver*** for more detail.

Appendix E. Go2Nova® Star List

Messier Catalog



Named Star List

1	Acamar	50	Alrescha	99	Deneb el Okab	148	Lalande 21185
2	Achernar	51	Alshain	100	Deneb Kaitos	149	Lesath
3	Achird	52	Altair	101	Denebakrab	150	Mahasim
4	Acrab	53	Altais	102	Denebola	151	Maia
5	Acrux A	54	Alterf	103	Dschubba	152	Marfik
6	Acrux B	55	Aludra	104	Dubhe	153	Marfikent
7	Acubens	56	Alula Australis	105	Edasich	154	Markab
8	Adhafera	57	Alula Borealis	106	El Rehla	155	Markeb
9	Adhara	58	Alya	107	Electra	156	Matar
10	Adid Australis	59	Ancha	108	Elnath	157	Mebsuta
11	Ahadi	60	Ankaa	109	Eltanin	158	Megrez
12	Al Dhanab	61	Antares	110	Enif	159	Meissa
13	Al Dhibain Prior	62	Apollyon	111	Errai	160	Mekbuda
14	Al Kab	63	Arcturus	112	Fomalhaut	161	Menkalinan
15	Al Nair	64	Arkab Prior	113	Furud	162	Menkar
16	Al Nair al Baten	65	Arneb	114	Gacrux	163	Menkent
17	Al Niyat(Sigma)	66	Ascella	115	Gatria	164	Menkib
18	Al Niyat(Tau)	67	Asellus Austral	116	Giausar	165	Merak
19	Albaldah	68	Asellus Boreali	117	Gienah Corvi	166	Merope
20	Albali	69	Aspidiske	118	Gienah Cygni	167	Mesartim
21	Albireo	70	Atik	119	Girtab	168	Miaplacidus
22	Alchiba	71	Atlas	120	Gliese 1	169	Mimosa
23	Alcor	72	Atria	121	Gomeisa	170	Mintaka
24	Alcyone	73	Avior	122	Graffias(Zeta)	171	Mira
25	Aldebaran	74	Azha	123	Groombridge 1830	172	Mirach
26	Alderamin	75	Barnard's Star	124	Gruid	173	Mirfak
27	Alfirk	76	Baten Kaitos	125	Grumium	174	Mirzam
28	Algenib	77	Beid	126	Hadar	175	Mizar
29	Algenubi	78	Bellatrix	127	Hamal	176	Mu Velorum
30	Algieba	79	Beta Hydri	128	Han	177	Muhlifain
31	Algiedi Secunda	80	Betelgeuse	129	Hatsya	178	Muphrid
32	Algol	81	Betria	130	Head of Hydrus	179	Muscida
33	Algorab	82	Biham	131	Homam	180	Naos
34	Alhakim	83	Birdun	132	Iritjinga(Cen)	181	Nashira
35	Alhena	84	Canopus	133	Izar	182	Navi
36	Alioth	85	Capella	134	Kakkab Su-gub Gud-Elim	183	Nekkar
37	Alkaid	86	Caph	135	Kapteyn's Star	184	Nihal
38	Alkalurops	87	Castor A	136	Kaus Australis	185	Nunki
39	Alkes	88	Castor B	137	Kaus Borealis	186	Nusakan
40	Almaaz	89	Cebalrai	138	Kaus Media	187	Palida
41	Almach	90	Chara	139	Keid	188	Peacock
42	Alnasl	91	Chertan	140	Kekouan	189	Phact
43	Alnilam	92	Choo	141	Kitalpha	190	Phecda
44	Alnitak	93	Cor Caroli	142	Kochab	191	Pherkad
45	Alpha Muscae	94	Cursa	143	Koo She	192	Polaris
46	Alpha Tucanae	95	Dabih	144	Kornephoros	193	Pollux
47	Alphard	96	Deltotum	145	Kraz	194	Porrima
48	Alphecca	97	Deneb	146	Kurhah	195	Procyon
49	Alpheratz	98	Deneb Algedi	147	Lacaille 9352	196	Propus

197	Proxima Centauri	213	Sadalbari	229	Sulafat	245	Vindemiatrix
198	Rasalas	214	Sadalmelik	230	Syrma	246	Vrischika
199	Rasalgethi	215	Sadalsuud	231	Talitha	247	Wasat
200	Rasalhague	216	Sadr	232	Tania Australis	248	Wazn
201	Rastaban	217	Saiph	233	Tania Borealis	249	Wei
202	Regor	218	Sargas	234	Tarazed	250	Wezen
203	Regulus	219	Scheat	235	Taygeta	251	Yed Posterior
204	Rigel	220	Schedar	236	Tejat Posterior	252	Yed Prior
205	Rigel Kentaurus A	221	Seginus	237	Thuban	253	Zaniah
206	Rigel Kentaurus B	222	Shaula	238	Thusia	254	Zaurak
207	Ruchbah	223	Sheliak	239	Tien Kwan	255	Zavijava
208	Rukbat	224	Sheratan	240	Turais	256	Zeta Persei
209	Rukh	225	Sirius	241	Unukalhai	257	Zosma
210	Rutilicus	226	Skat	242	Vasat-ul-cemre	258	Zubenelgenubi
211	Sabik	227	Spica	243	Vathorz Posterior	259	Zubeneschamali
212	Sadachbia	228	Suhail	244	Vega		

Modern Constellations

No.	Constellation	Abbreviation
1	Andromeda	And
2	Antlia	Ant
3	Apus	Aps
4	Aquarius	Aqr
5	Aquila	Aql
6	Ara	Ara
7	Aries	Ari
8	Auriga	Aur
9	Boötes	Boo
10	Caelum	Cae
11	Camelopardalis	Cam
12	Cancer	Cnc
13	Canes Venatici	CVn
14	Canis Major	CMa
15	Canis Minor	CMi
16	Capricornus	Cap
17	Carina	Car
18	Cassiopeia	Cas
19	Centaurus	Cen
20	Cepheus	Cep
21	Cetus	Cet
22	Chamaeleon	Cha
23	Circinus	Cir
24	Columba	Col
25	Coma Berenices	Com
26	Corona Australis	CrA
27	Corona Borealis	CrB
28	Corvus	Crv
29	Crater	Crt
30	Crux	Cru
31	Cygnus	Cyg
32	Delphinus	Del
33	Dorado	Dor
34	Draco	Dra
35	Equuleus	Equ
36	Eridanus	Eri
37	Fornax	For
38	Gemini	Gem
39	Grus	Gru
40	Hercules	Her
41	Horologium	Hor
42	Hydra	Hya
43	Hydrus	Hyi
44	Indus	Ind

No.	Constellation	Abbreviation
45	Lacerta	Lac
46	Leo	Leo
47	Leo Minor	LMi
48	Lepus	Lep
49	Libra	Lib
50	Lupus	Lup
51	Lynx	Lyn
52	Lyra	Lyr
53	Mensa	Men
54	Microscopium	Mic
55	Monoceros	Mon
56	Musca	Mus
57	Norma	Nor
58	Octans	Oct
59	Ophiuchus	Oph
60	Orion	Ori
61	Pavo	Pav
62	Pegasus	Peg
63	Perseus	Per
64	Phoenix	Phe
65	Pictor	Pic
66	Pisces	Psc
67	Piscis Austrinus	PsA
68	Puppis	Pup
69	Pyxis	Pyx
70	Reticulum	Ret
71	Sagitta	Sge
72	Sagittarius	Sgr
73	Scorpius	Sco
74	Sculptor	Scl
75	Scutum	Sct
76	Serpens	Ser
77	Sextans	Sex
78	Taurus	Tau
79	Telescopium	Tel
80	Triangulum	Tri
81	Triangulum Australe	TrA
82	Tucana	Tuc
83	Ursa Major	UMa
84	Ursa Minor	UMi
85	Vela	Vel
86	Virgo	Vir
87	Volans	Vol
88	Vulpecula	Vul

Deep Sky Object List

ID No.	OBJECT	NGC #	Messier#	IC#	A(Abell)	U(UGC)
1	Andromeda Galaxy	224	31			
2	Barnards Galaxy	6822				
3	Beehive Cluster	2632	44			
4	Blackeye Galaxy	4926	64			
5	Blinking Planetary Nebula	6826				
6	Blue Flash Nebula	6905				
7	Blue Planetary	3918				
8	Blue Snowball Nebula	7662				
9	Box Nebula	6309				
10	Bubble Nebula	7635				
11	Bipolar Nebula	6302				
12	Butterfly Cluster	6405	6			
13	California Nebula	1499				
14	Cat's Eye Nebula	6543				
15	Cocoon Nebula			5146		
16	Cone Nebula	2264				
17	Cork Nebula	650-51	76			
18	Crab Nebula	1952	1			
19	Crescent Nebula	6888				
20	Draco Dwarf					10822
21	Duck Nebula	2359				
22	Dumbbell Nebula	6853	27			
23	Eagle Nebula		16			
24	Eight-Burst Nebula	3132				
25	Eskimo Nebula	2392				
26	Flaming Star Nebula			405		
27	Ghost of Jupiter	3242				
28	Great Cluster	6205	13			
29	Helix Nebula	7293				
30	Hercules Galaxy Cluster				2151	

ID No.	OBJECT	NGC #	Messier#	IC#	A(Abell)	U(UGC)
31	Hind's Variable Nebula	1555				
32	Hubble's Variable Nebula	2261				
33	Integral Sign Galaxy					3697
34	Jewel Box Cluster	4755				
35	Keyhole Nebula	3372				
36	Lagoon Nebula	6523	8			
37	Little Gem	6445				
38	Little Gem Nebula	6818				
39	Little Ghost Nebula	6369				
40	North American Nebula	7000				
41	Omega Nebula	6618	17			
42	Orion Nebula	1976	42			
43	Owl Nebula	3587	97			
44	Pelican Nebula			5070		
45	Phantom Streak Nebula	6741				
46	Pinwheel Galaxy	598	33			
47	Pleiades		45			
48	Ring Nebula	6720	57			
49	Ring Tail Galaxy	4038				
50	Rosette Nebula	2237				
51	Saturn Nebula	7009				
52	Sextans B Dwarf					5373
53	Small Magellanic Cloud	292				
54	Sombrero Galaxy	4594	104			
55	Spindle Galaxy	3115				
56	Tank Track Nebula	2024				
57	Trifid Nebula	6514	20			
58	Ursa Minor Dwarf					9749
59	Whirlpool Galaxy	5194	51			
60	Wild Duck Cluster	6705	11			

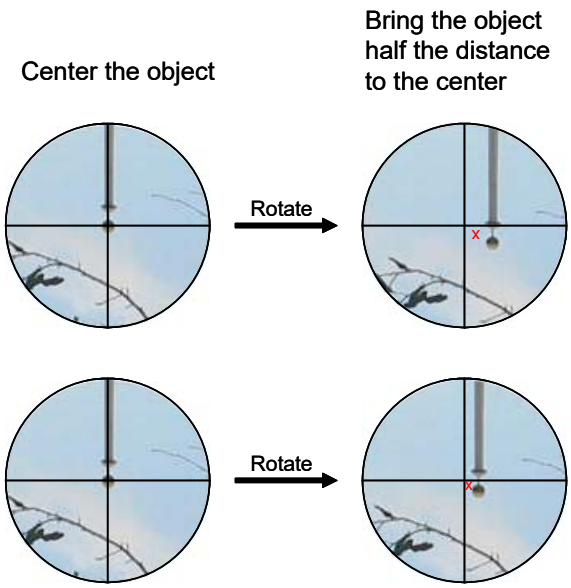
Double/MultiStar List

1	RigelKentaurus A	53	HIP 95771	105	HIP 40167	157	HIP 28790
2	Rigel	54	HIP 30867	106	HIP 40817	158	HIP 4675
3	Gacrux	55	HIP 35363	107	HIP 81292	159	HIP 31676
4	Sargas	56	HIP 94761	108	HIP 80197	160	HIP 10176
5	Castor A	57	HIP 21683	109	HIP 88060	161	HIP 25950
6	Mizar	58	HIP 8497	110	HIP 42637	162	HIP 117931
7	Almach	59	HIP 26199	111	HIP 21039	163	HIP 81914
8	Algieba	60	HIP 104521	112	HIP 100965	164	HIP 21242
9	Aludra	61	HIP 116389	113	HIP 25768	165	HIP 86831
10	Iritjinga(Cen)	62	HIP 17797	114	HIP 93717	166	HIP 115272
11	Zubenelgenubi	63	HIP 21036	115	HIP 79980	167	HIP 46657
12	Alcyone	64	HIP 107310	116	HIP 12086	168	HIP 41404
13	Cor Caroli	65	HIP 72659	117	HIP 90968	169	HIP 29388
14	Acamar	66	HIP 21029	118	HIP 22531	170	HIP 49321
15	Adhafera	67	HIP 42726	119	HIP 34065	171	HIP 84054
16	Rasalgethi	68	HIP 18255	120	HIP 79607	172	HIP 39035
17	Meissa	69	HIP 9153	121	HIP 109786	173	HIP 25303
18	Graffias(Zeta)	70	HIP 88267	122	HIP 56280	174	HIP 52520
19	Alya	71	HIP 85829	123	HIP 51561	175	HIP 95398
20	HIP 48002	72	HIP 43937	124	HIP 107930	176	UCAC4 277-135548
21	HIP 95947	73	HIP 71762	125	HIP 97966	177	HIP 32609
22	HIP 20894	74	HIP 80047	126	HIP 117218	178	HIP 101765
23	HIP 74395	75	HIP 58484	127	HIP 82676	179	HIP 24825
24	HIP 27072	76	HIP 25142	128	HIP 111546	180	HIP 31158
25	HIP 26549	77	HIP 54204	129	HIP 29151	181	HIP 3885
26	HIP 85667	78	HIP 76669	130	HIP 107253	182	HIP 93371
27	HIP 74376	79	HIP 99770	131	HIP 88136	183	HIP 36345
28	HIP 34481	80	HIP 101027	132	HIP 81702	184	HIP 108364
29	HIP 53253	81	HIP 74911	133	HIP 97423	185	HIP 50939
30	HIP 99675	82	HIP 35210	134	HIP 30444	186	HIP 76603
31	HIP 63003	83	HIP 26235	135	HIP 66400	187	HIP 32269
32	HIP 43103	84	HIP 40321	136	HIP 17579	188	HIP 42516
33	HIP 110991	85	HIP 70327	137	HIP 35785	189	HIP 62807
34	HIP 20635	86	HIP 26221	138	HIP 81641	190	UCAC4 226-128246
35	HIP 88601	87	HIP 80473	139	HIP 7751	191	HIP 94913
36	HIP 2484	88	HIP 78105	140	HIP 21148	192	HIP 94336
37	HIP 91971	89	HIP 79043	141	HIP 9021	193	HIP 107299
38	HIP 79374	90	HIP 61418	142	HIP 97816	194	HIP 59984
39	HIP 102532	91	HIP 91919	143	HIP 88818	195	HIP 16411
40	HIP 52154	92	HIP 41639	144	HIP 36817	196	HIP 23287
41	HIP 37229	93	HIP 104214	145	HIP 25695	197	HIP 105637
42	HIP 30419	94	HIP 23734	146	HIP 98819	198	HIP 108925
43	HIP 108917	95	HIP 60189	147	HIP 61910	199	HIP 103814
44	HIP 53417	96	HIP 66821	148	HIP 111643	200	HIP 58112
45	HIP 65271	97	HIP 14043	149	HIP 80399	201	HIP 109354
46	HIP 67669	98	HIP 5737	150	HIP 83478	202	HIP 43822
47	HIP 105319	99	HIP 84626	151	HIP 101123	203	HIP 21986
48	HIP 80582	100	HIP 60904	152	HIP 28271	204	HIP 17470
49	HIP 8832	101	HIP 58684	153	HIP 64246	205	HIP 35960
50	HIP 69483	102	HIP 5131	154	HIP 96895	206	HIP 42936
51	HIP 92946	103	HIP 115126	155	HIP 35564	207	HIP 19272
52	HIP 86614	104	HIP 62572	156	HIP 37843	208	HIP 76143

Appendix D. Polar Scope Adjustment

If you are suspecting that the polar scope may be misaligned to the mount R.A. axis, you may check it by putting a star in the center of the polar scope reticle cross hairs and rotating mount's R.A. axis. If the star stays in the center of cross hairs, the polar scope is aligned to the mount's R.A. axis.

In the event the polar scope optical axis needs to be adjusted, you can do this procedure at night while pointing at Polaris. However, it is probably easier to do it during the daytime using a distant point, such as a flag pole or top of a building a couple of hundreds away, as your target. Please remove the telescope and the counterweight. Release the counterweight shaft and adjust the DEC axle to unblock the polar scope view. Aim the mount to the object. Use the Latitude Adjustment Screw and Azimuth Adjustment Knob to center the object.



1. Release RA Clutch Screws. Rotate the mount along the RA axis to the balance position, dovetail saddle on the right side. Lock the RA clutch screws.
2. Loose latitude Locking Screws and Azimuth Locking Screws a little. Centering the object one the cross hairs by adjust Latitude Adjust. screw and Azi. Adjust. Knob.
3. Release the RA clutch again. Rotate the mount 180º to bring the dovetail to the left side. Retighten the RA clutch screw. Bring the object half the distance to the center by adjusting the reticle adjustment set screws using a hex key. Keep in mind that the image in the finder is inverted. Loose one screw first, then tighten the other screw(s). Only loose/tighten one screw at a time and a few turns each time to avoid the reticle totally lost its position. It may take a few minutes to familiarize yourself with the screws that move the polar scope in the appropriate direction. **PLEASE do not over tighten the setting screws.**
4. Release the RA clutch and rotate the mount 180º to bring the dovetail back to the right side. If you are lucky enough, the object will stay in center of the polar scope. Otherwise, repeat Steps 2 and 3 to further move the object to the center.
5. After few times, the object will stay in center when the mount is flipped from right to left.

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B. The Proper Return Merchant Authorization Number must be obtained from iOptron in advance of return. Call iOptron at 1.781.569.0200 to receive the RMA number to be displayed on the outside of your shipping container.
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