SmartStar® iEQ75-GT™

Instruction Manual

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. iEQ75-GT™ Overview

The iEQ75-GT™ is a one-of-a-kind premium CNC-machined astro-imaging mount from iOptron. The iEQ75-GT™ offers the next generation GoTo technology from iOptron. With a Renishaw high resolution encoder-enabled double closed-loop tracking, the system is able to tracking the target with a tracking error less that ±1 arcsec. The iEQ75-GT™ has a payload of 75 lb (34 kg) and includes a calibrated dark field illumination polar scope. Its unique base design makes it easy for just one person to carry to location.

Features:

- Premium CNC-machined astrophotography mount suited for advanced imaging
- Heavy duty German equatorial mount
- Maximum payload: 75 lb (34 kg) (excluding counterweight)
- Mount weight: 52 lb (23.6 kg)
- Angular contact ball bearings for R.A and DEC axles, as well as worm gear shafts
- Precision DC servo motor-driven and double closed-loop tracking with Renishaw high resolution encoder feedback
- 32-bit ARM system for ultra-accurate tracking with temperature-compensated crystal oscillator (TCXO)
- Maximum tracking error: ± 1 arc second
- Advanced GOTONOVA® technology for accurate GOTO and tracking
- Built-in 32-channel Global Positioning System (GPS)
- Integrated ST-4 autoguiding port capable of reverse guiding with auto-protection
- Hand Box (HBX) port for hand controller connection
- iOptron port for electronic focuser, laser pointer, planetary dome control
- RS232 port for firmware upgrading and computer control via ASCOM platform
- Calibrated polar scope with dark-field illumination and easy polar alignment procedure, allowing for fast and accurate polar alignment
- Heated hand controller for low temperature operation as low as -20ºC
- Comes standard with:
    - a mounting plate for Vixen or Losmandy-D saddles
    - a Vixen dovetail saddle
    - stainless steel counterweight shaft with safety lock
    - 2 x 16.5 lb (7.5 kg) stainless steel counterweights
    - 12V DC car plug adaptor
    - USB cable
    - RS232 Cable
- Optional tripod or pier

2. iEQ75-GT™ Assembly

2.1. Parts List[1]

The parts comes with the iEQ75-GT™ order include an EQ mount (Figure 1), one mounting plate (Figure 2), 2 counterweights and an CW shaft (Figure 1). Other parts are, as shown in Figure 4, an 8406 hand controller, coiled hand controller cable, a Vixen dovetail saddle, R.A. and DEC cables, a dark field illuminating LED with cable, a 12V DC adapter cable with car lighter plug, a USB Cable, a RS232 cable, GPS antenna, a hex key set, 4 base mounting screws, and 8 M6X20 hex head screws

Figure 1. iEQ75-GT mount

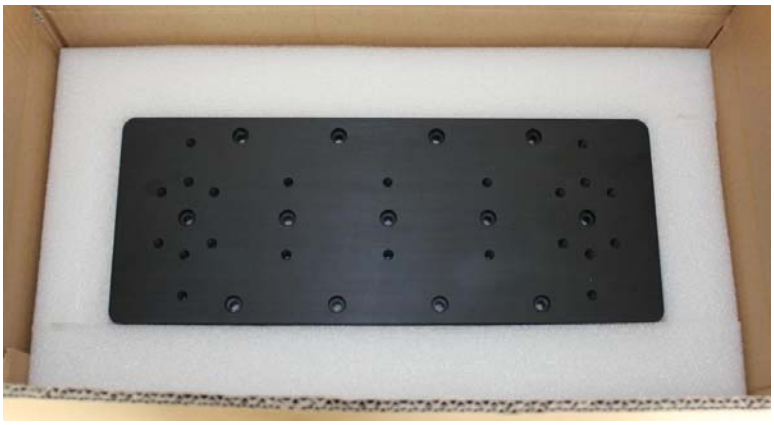


Figure 2. Mounting plate

[1] Actual contents may vary from time to time.

Figure 3. Counterweights and CW shaft

Figure 4. Included accessories

2.2. Assembly terms

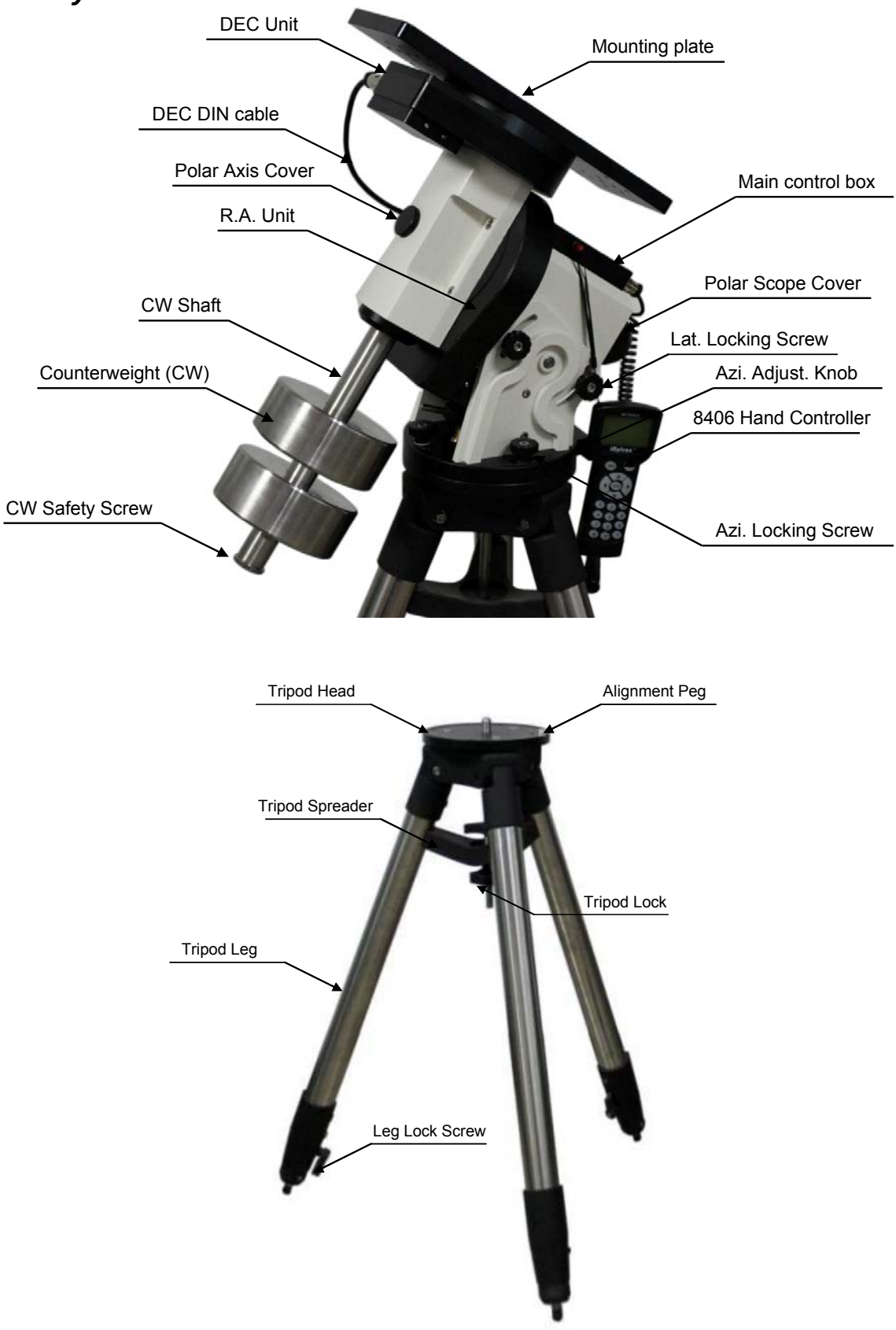


Figure 5. iEQ75-GT assembly terms (mount and optional tripod)

2.3. iEQ75-GT™ Ports

Figure 6. Ports on iEQ75-GT™ control box

- R.A. and DEC motor: For connecting to R.A. and DEC driver unit
- Power: Power switch
- DC 12V: 12 volts DC power plug (center positive)
- HBX (Hand Box): For connecting to the 8406 Hand Controller
- iOptron port: For connecting to other iOptron accessories, such as an electronic focuser, a laser pointer, or a planetary dome control
- RS232: Series port for ASCOM control and main board firmware upgrade
- Autoguide: Autoguiding port for ST-4 compatible guiding cameras
- GPS: GPS antenna connection
- Reticle: Power supply for the Polar Scope dark field illumination LED

2.4. Introduction

You have just purchased a telescope mount that is capable of taking you to a new level of astronomy. No matter which telescope or optical tube assembly (OTA) you select to install on the mount, the overall performance will be greatly enhanced. In order for you to get the optimum performance from the mount and OTA combination, you must assemble and adjust the mount correctly. The following fundamentals of telescope mounts are included to help you understand the big picture before you get into the specific details of the iEQ75-GT mount.

Telescope mounts are either equatorial mounts or altitude-azimuth (Alt-Az) mounts. Both types of mounts rotate the OTA around two perpendicular axes to point to a desired object in the night sky. An equatorial mount has the right ascension (R.A.) axis aligned with the celestial North Pole (CNP), or celestial South Pole (CSP), to provide rotation matching the celestial sphere rotation around the Earth and the declination axis (DEC) to provide elevation relative to the celestial equator. Since all celestial objects appear to rotate around the CNP, the R.A. axis allows the OTA to rotate with the celestial sphere and provide accurate tracking for visual observations and astrophotography. R.A. is the celestial equivalent of longitude. Like longitude, R.A. measures an angle that increases toward the East as measured from a zero reference point on the celestial equator. An Alt-Az mount has a horizontal axis to provide vertical (altitude) OTA movement from the local horizon and a vertical axis to provide horizontal (azimuth) OTA movement, similar to compass headings. An Alt-Az mount can provide tracking that is good enough for visual observing

and short exposure photos, but not good enough for serious astrophotography. Alt-Az mounts require star alignments for the OTA to track stars and they do not have adjustment components on the mount. Equatorial mounts require alignment of the mount components as well as star alignments for accurate OTA tracking.

In order to provide the required Polar Axis alignment, equatorial mounts use a combination of both mount types described above. The adjustable part of the mount moves in the Alt-Az mode in order to align the R.A. axis, also known as the mount's Polar Axis, with the CNP. These Polar Axis adjustments do not involve any rotations of the OTA about the R.A. or DEC axes and can be performed without the OTA installed. The first step is to make an approximate azimuth alignment of the Polar Axis by aligning the specified tripod leg or reference point toward True North using a compass for reference (you must allow for the variation between True and Magnetic North at your location). Precise horizontal alignment of the Polar Axis is accomplished with azimuth adjustments on the mount. The second step is to adjust the Polar Axis vertically (altitude) above the North horizon by setting the observer's latitude on the provided latitude scale. This procedure is based on the fundamental geometry of the Earth's coordinate system in conjunction with the concept of the celestial sphere. You can verify this by visualizing yourself at the North Pole (latitude N90°) and Polaris will be 90° from the horizon, or directly overhead. These steps will place the Polar Axis very close to the CNP. Both of the above adjustments can be enhanced by the use of an opening along the R.A. axis that allows direct viewing of the North Star and the use of a polar scope to view through this opening. If you are going to get the most out of your equatorial mount it is essential to understand the concept of the Polar Axis and how the equatorial mount helps you establish and maintain a true Polar Axis alignment. Now, you are ready to perform star alignments using the equatorial mount's electronic controller and enjoy the night sky.

The iEQ75-GT is a next-generation equatorial mount that provides the precision alignment capabilities required for today's complete astronomy solution. The following sections of this manual provide the detailed steps required to successfully set up and operate the iEQ75-GT.

2.5. iEQ75-GT Assembly

NOTE: The iEQ75-GT 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 and install the Tripod Support using the Tripod Lock as shown in Figure 7. Tightening the Tripod Lock will expand the tripod legs fully and provide maximum support for the mount and the Optical Tube Assembly (OTA). Adjust the tripod height by unlocking the tripod Leg Lock Screws, sliding the lower tripod leg to the desired length, and relocking the tripod Leg Lock Screws. It is recommended that you extend the legs fully during the first assembly and modify the length as required in subsequent adjustments. After the legs are adjusted and locked, stand the tripod with the Alignment Peg facing True South. If you are located in the southern hemisphere, face the Alignment Peg True North.

STEP 2. Attach the iEQ75-GT Mount

Locate the Azimuth Adjustment Knobs and retract them to allow enough clearance for the mount to fit on the tripod head. Unscrew the four (4) Azimuth Locking Screws shown in Figure 8. Place the mount onto the Tripod Head with the alignment notch on top of the Alignment Peg. Place the four (4) Azimuth Locking Screws back and tighten the screws. Level the tripod base by adjusting the individual legs. You need a level to check leveling.

Figure 7. Tripod

Figure 8. Attaching the mount

STEP 3. Connect Cables

Figure 9. Cable connections

There are two DIN 6 cables that have C091 connectors on both ends of the cable. Insert one end of the DIN 6 cable into the R.A. socket on the control box, and the other end into the socket located on R.A. driver unit, as shown in Figure 9. Secure both ends of the DIN 6 cable. Connect another DIN 6 cable between the DEC socket on the control box and the DEC socket on DEC driver unit. Attach the DIN 6 end of a DIN-RJ-11 cable into the HBX socket on the control box and the RJ-11 end into the hand controller. Connect the GPS antenna into the GPS socket on the control box. Plug the 12V DC power supply (center positive) into the Power socket on the control box. The back light of the hand controller will illuminate when the power switch is turned on.

STEP 4. Set the Location Latitude

This step requires you to know the latitude of your current location. This can be found from your 8406 hand controller after the embedded GPS receives the signal from the satellites. It also 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.

Figure 10. Adjust latitude

Unscrew the Latitude Adjustment Lever from the Latitude Adjustment Knob as shown in Figure 10. Turn the Latitude Adjustment Knob to set your current latitude, using the Latitude Adjustment Lever for a fine adjustment, if needed. At this point, with the mount level and pointed North, and the latitude set, the Polar Axis (R.A. axis) should be pointing very close to the NCP and Polaris.

CAUTION: For safety reasons, always adjust the latitude without an OTA and/or counterweights installed. Also, it is much easier to make this precise adjustment without a load on the axis being adjusted.

STEP 5. Polar Alignment

As explained in the introduction, an equatorial mount must have an accurate polar axis alignment in order to track properly. With the iOptron innovative Polar Scope and Quick Polar Alignment procedure, you can do a fast and accurate polar axis alignment.

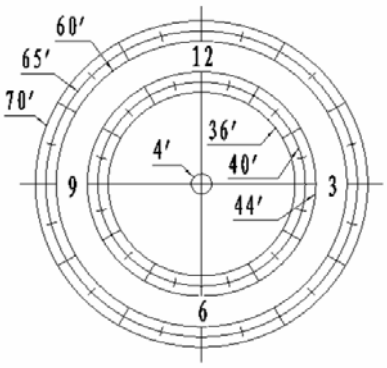


Figure 11. Polar Scope Dial

As indicated in Figure 11, the Polar Scope Dial has been divided into 12 hours along the angular direction with half-hour tics. There are 2 groups, 6 concentric circles marked from 36’ to 44’ and 60’ to 70’, respectively. The 36’ to 44’ concentric circles are used for polar alignment in northern hemisphere using Polaris. While the 60’ to 70’ circles are used for polar alignment in southern hemisphere using Sigma Octantis.

Polar axis adjustments

Whenever polar axis adjustments are required, loosen the four Azimuth Locking Screws and adjust the Azimuth Adjustment Knobs to do a fine adjustment of the mount in the azimuth direction. Tighten

the locking screws to secure the mount. Loosen four Latitude Locking Screws on the side of the mount, turning the Latitude Adjustment Knob to adjust the latitude (altitude). Use the Lever for a fine latitude adjustment. Re-tighten the lock screws.

Initializing the polar scope

During initial setup of the iEQ mount, it is likely that the viewing hole on the DEC axis of the polar scope may be blocked by the DEC axle. The Polar Scope Dial in the polar scope should be set at the normal clock position with 12 o'clock located at the top, as shown in Figure 11. Before doing the Quick Polar Axis Alignment, complete the following steps:

(1) Take off both the Polar Axis Cover and the Polar Scope Cover from the mount.

(2) Thread the dark field illuminating LED end into the threaded hole and plug the other end into the Reticle socket located on the control box (Figure 12). The illumination intensity can be adjusted using the hand controller (HC) via the "**Set Eyepiece Light**" function under the "**Set Up Controller**" menu.

(3) Use the **UP** or **DOWN** button to turn the DEC axle if it blocks the Polar Scope view, press number buttons to change the slew speed.

(4) If the 12 o'clock of the Polar Scope dial is not at the top, as shown in Figure 11, rotate it using HC's **LEFT** or **RIGHT** button.

Figure 12. Connect the illumination LED to Polar Scope

NOTE: Do not disassemble the Polar Scope to rotate it. It is adjusted at the factory and can be misaligned if you disassemble it. A good Polar alignment is the basis for good GOTO and tracking performance.

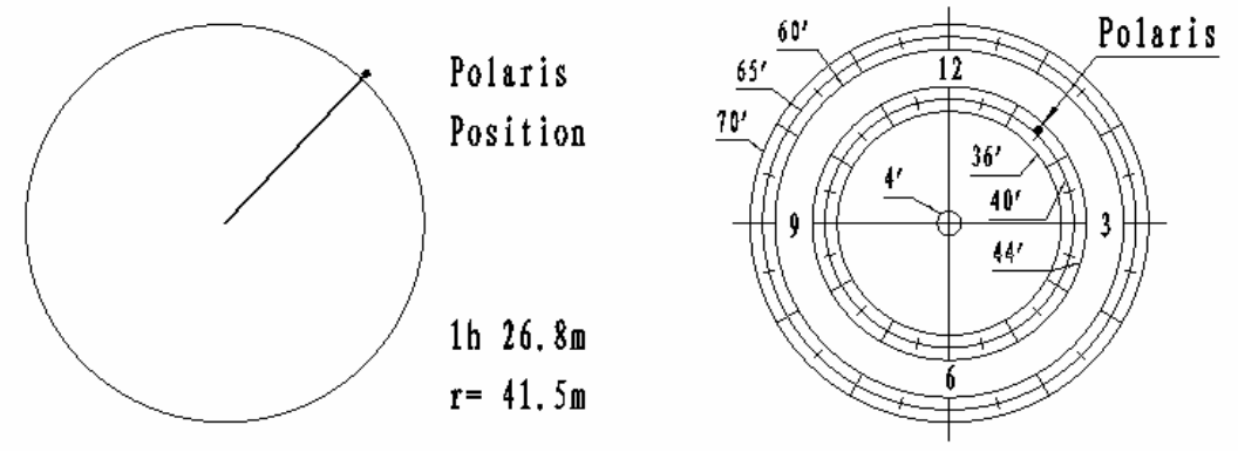
Quick polar axis alignment

(1) Turn on the mount power by pressing the **On/Off** switch on the R.A. unit. After "**GPS OK**" is shown in the upper right corner of the HC, the LCD will display the Polaris Position as shown in Figure 13 (a). If you are practicing inside or when there is no GPS signal, you can view this chart by pressing the **MENU** button, then select "**Align**" and "**Polaris Position**". For example, on May 30, 2010, 20:00:00 in Boston, US (Lat N42º30'32" and Long W71º08'50"), 300 min behind UT, the Polaris Position is 1hr 26.8m and r= 41.5m, as shown in Figure 13 (a).

(2) Look through the polar scope; make sure the polar scope is not blocked by the DEC axle. The 12 o'clock indicator of the Polar Scope Dial must be positioned on top.

(3) Follow the ***Polar axis adjustment*** procedure **(not the hand controller)** to adjust the mount in altitude (latitude) and azimuth (heading) direction and place 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 41.5' and an angle of 1 hour 26.8 minute, as shown in Figure 13 (b).



(a) (b)

Figure 13. Polaris displayed on 8406 hand controller (a) and Polaris located on Polar scope dial

STEP 4. Attach Dovetail Adapter

Install the Mounting Plate onto the iEQ75-GT mount. Both Vixen (included) and Losmandy-D dovetail saddles can be used. The mounting-hole distribution on the Mount Plate is shown in Figure 14.

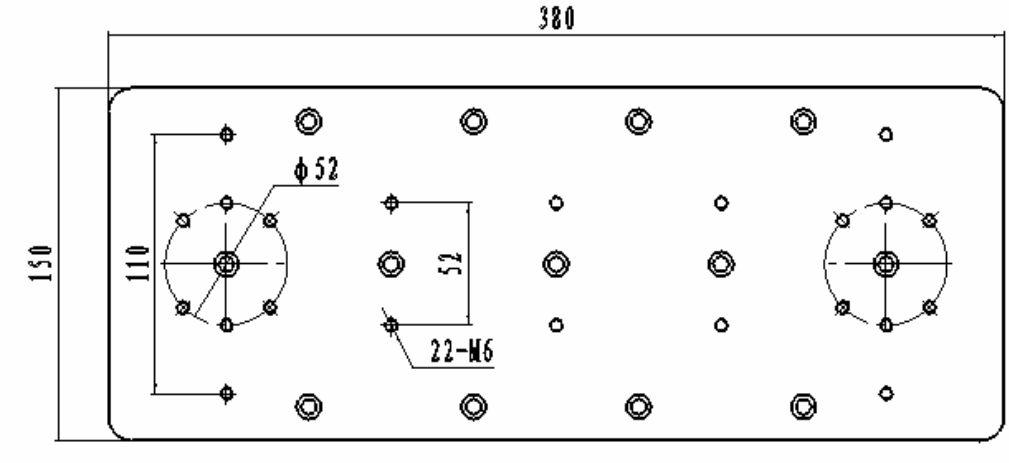


Figure 14. The mounting-hole distribution on the Mount Plate

STEP 7. Install Counterweight(s)

iEQ75-GT comes with two 16.5 lb (7.5 kg) stainless steel counterweights (CWs). Use one or both CWs as required for your particular OTA. Additional CW(s) may be needed to balance a heavier OTA (Optional CWs are available from iOptron).

CSUTION: The mount must be at the zero position when the counterweights are being installed. The Zero Position is the position with the CW shaft pointing toward the ground, as shown in Figure 15. Use your hand controller to move the mount.

Figure 15. Zero position

Remove the CW Safety Screw on the end of the CW shaft. Loosen the CW Locking Screw on the side of the CW (there is a CW pin inside) and slide the CW into the shaft. Tighten the CW Locking Screw to hold the CW in place. Tighten the CW Safety Screw.

CAUTION: For safety reasons, the CW Safety Screw must be installed and tightened to prevent the CW from dropping off the end of the CW shaft. This can cause serious personal injury.

STEP 8. Attach and Balance an OTA on the Mount

After attaching an OTA and accessories to the mount, the mount must be balanced to ensure minimum stress on the mount's gears and motors. There are no clutch screws on either R.A. or DEC axes. The balancing is performed using iOptron Electronic Balance technology.

Set the mount at Zero Position first. If it is not, turn the mount on, press the arrow key on the hand controller to adjust the mount position. Press number key on the hand controller to select appropriate speed. After the Zero Position is adjusted, turn the power off.

Balance the mount in R.A. and DEC axes

When the mount is rest at Zero Position, turn the mount power on. Press the **MENU** button, scroll down to "***Balance Test***", and press **ENTER**. The mount will start to slew and stop at the balance test position, as shown in Figure 16.

Figure 16. Balance test position

A “Testing R.A. Balance” screen will be displayed. Press the **ENTER** key to start the test. After few swings, a test results will be displayed on the hand controller LCD screen:

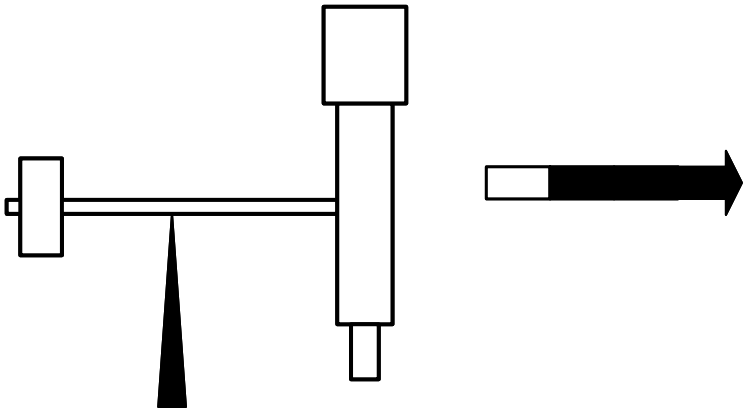


Figure 17. R.A. Balance Test

Follow the arrow indicator to move the CW left or right. The more the arrow is shaded, the more the CW needs to be moved. Press the **ENTER** key to test it again, until the **OK** sign is displayed or ¼ or less of the arrow key is shaded.

Press ◄ ► ▲ or ▼ button on the hand controller to toggle between R.A. and DEC testing. Press **ENTER** to start the DEC balance test. Move the telescope back and forth to balance the OTA around the DEC axis.

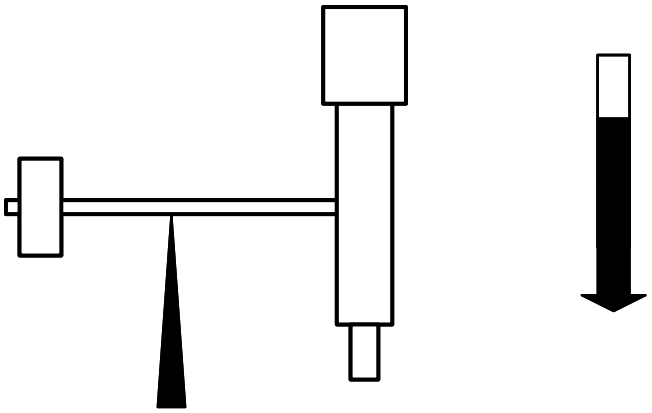


Figure 18. DEC Balance Test

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.

3. GoToNova® 8406 Hand Controller

Figure 19. GoToNova 8406 hand controller

The GoToNova® 8406 hand controller (HC) shown in Figure 19 is the standard controller for the iEQ75-GT mount. It has an integrated temperature controller that ensures it can be operated below 20ºC (-4ºF).

3.1. 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.
- Number Keys: Input numerical values. Also used to adjust speeds (1: 1X; 2: 2X; 3: 8X; 4: 16X; 5: 64X; 6: 128X; 7: 256X; 8: 512X; 9: MAX)
- Light Key(☼): Turns on/off the red LED reading light on the back of the controller.
- ? Key: For help or extra information.
- STOP/0 Key: Stop/Start tracking.
- HBX (Handbox) port: connect the HC to the iEQ75-GT mount using a 6-wire RJ11 cable.
- USB port: connect the HC to a Computer via a USB cable.

3.2. The LCD Screen

The 8406 HC has a large 8-line, 21 character LCD screen, which displays all the information as shown in Figure 20. The user interface is simple and easy to learn.

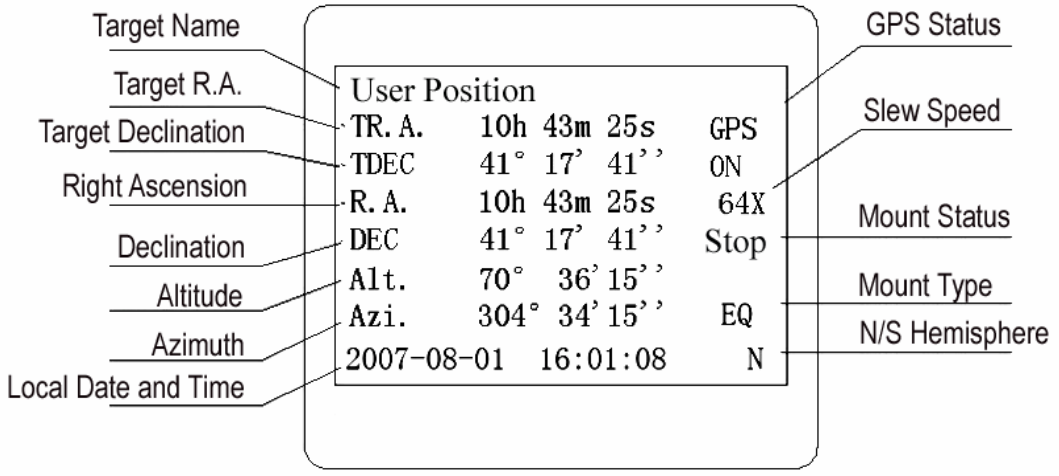


Figure 20. 8406 HC LCD Information Screen

1. Target Name/Mount Position: displays the name of the target that telescope is currently pointed to or the current mount position.
   - User Position: When the mount is turned on.
   - 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 R.A. DEC. Now: The mount is slewed to a target with manually entered R.A. and DEC numbers;
   - Zero Position: The mount is moved to Zero Position using ***“To Zero Position”*** command;
   - Park Position: Display one of six scope parking position, such as “Up North” after using ***“Park Scope”*** command.
2. Target R.A.: Right Ascension of the target object.
3. Target Declination: Declination of the target object.
4. Right Ascension: Right Ascension of the telescope, or R.A.
5. Declination: Declination of the telescope, or DEC.
6. Altitude: Altitude of the telescope (degrees vertical from the local horizon - zenith is 90º).
7. Azimuth: Azimuth of the telescope (north is 0º, east 90º, south 180º, and west 270º).
8. Local Date and Time: display local time in a format of YYYY-MM-DD.
9. Mount Status: Display the current operation or tracking status of the mount.
   - Stop: mount is stop moving;
   - Slew: mount is slewing to a target;
   - Cel: mount is tracking at a celestial speed;
   - Sol: mount is tracking at a solar speed;
   - Lun: mount is tracking at a lunar speed;
   - King: mount is tracking at a user defined tracking speed.
10. Slew speed: It has 9 speeds: 1X, 2X, 8X, 16X, 64X, 128X, 256X(1º/sec), 512X(2º/sec), MAX(~ 4º/sec).
11. GPS status: When the power is turned on, it shows “GPS ON”, which means a GPS receiver is properly connected. When the GPS receiver finds the satellites and receives the GPS signal, it shows “GPS OK”. The “GPS OK” may turn off after few minutes to save power.

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

Setup and polar alignment your iEQ75-GT mount according to Section 2.5. The default position for the mount is the Zero Position, as shown in Figure 15, when the mount is powered on: the counterweight shaft is pointing to ground, telescope is at the highest position with its axis parallel to the polar axis and the telescope is pointing to the North Celestial Pole.

4.2. Manual Operation of the Mount

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

Flip the I/O switch on the telescope mount to turn on the mount. Use ►,◄,▼ or ▲ buttons to point the telescope to the desired object. Use the number keys to change the slewing speed. Then press **STOP/0** button to start tracking.

4.3. Setting Up the Hand Controller

The iEQ75-GT is equipped with a GPS receiver, which will receive the local time, longitude and latitude information from satellites after the link is established. A clear sky outside is needed for the GPS to establish its link with the satellites.

4.3.1. Set Up Local Time

Press MENU button, from the main menu, scroll down and select "*Set up controller*"

```
Select and slew
Sync. to target
Electronic focuser
Set up controller
Align
PEC option
Set up Tracking
User objects
```

Press ENTER and select "Set up local Time"

```
Set up Local Time
Set up Observ. site
Set N/S hemisphere
Set display contrast
Set Eyepiece light
Set Backlight
Set Backlash Value
Set Key Beep
```

Press ENTER.

```
Set local time:

2008-06-01 11:55:09
Daylight Saving Time Y
```

The time will be updated automatically when the GPS has picked up a signal. You also can manually input the time information in case GPS does not function. Use the ◄ or ► key to move the cursor and use

number keys to change the numbers. Use the ▲ or ▼ button to toggle between “Y” and “N” for Daylight Saving Time. Press ENTER to go back the previous screen.

4.3.2. Set Up Observation Site

Scroll down and select “*Set up Observ. site*”

```
Set up Local Time
Set up Observ. site
Set N/S hemisphere
Set display contrast
Set Eyepiece light
Set Backlight
Set anti-backlash
Set Key Beep
```

Press ENTER. The longitude and latitude coordinates will be updated when the GPS picks up satellite signals. “W/E” means west/east hemisphere; “N/S” means north/south hemisphere; “d” means degree; “m” means minute; and “s” means second.

```
Set up site info:
Longitude:
      W071d27m47s
Latitude:
      N42d15m40s
300  Min.  behind    UT
```

If for any reason your GPS can’t pick up a signal you can manually enter the GPS coordinates. 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 *Support* section in iOptron website, under *Controller Set-up* (http://www.ioptron.com/support.cfm?module=faq#).By entering the city name or address, you can find its latitude and longitude. In case you only find the site information in decimal format you can convert them 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.

Press ◄ or ► key, move the cursor to the bottom of the screen to set the time zone information (add or subtract 60 minutes per time zone). Enter minutes “ahead of” or “behind” UT (universal time).

- Boston is 300 minutes “behind” UT
- Los Angeles is 480 minutes “behind” UT
- Rome is 60 minutes “ahead of” UT
- Beijing is 480 minutes “ahead of” UT
- Sydney is 600 minutes “ahead of” UT

All the time zones in North America are *behind* UT, as shown in the following table. So make sure it shows “behind” instead of “ahead of” UT.

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

To adjust minutes, move the cursor to each digit and use the number keys to input number directly. To change the “behind” or “ahead of” UT, move the cursor to “ahead” and using ▲ or ▼ key to toggle

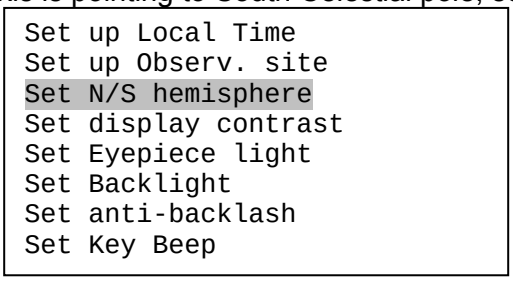
between “behind” and “ahead”. When the number is correct, press ENTER and go back to the previous screen.

For other parts of the world you can find your “time zone” information from iOptron website (http://www.ioptron.com/support.cfm?module=faq#). **DO NOT COUNT DAYLIGHT SAVING TIME.**

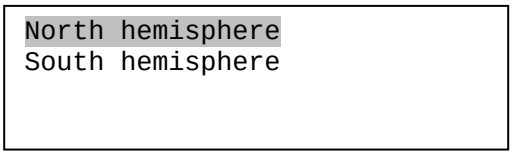
The time and site information will be stored inside the HC memory chip. If you are not traveling to another observation site, they do not need to be changed.

4.3.3. Set N/S Hemisphere

If the polar axis is aligned to North Celestial Pole, then set the mount to Northern Hemisphere. If the polar axis is pointing to South Celestial pole, set the mount to Southern Hemisphere.



Press Enter.



Select North Hemisphere if you are located in US and press ENTER to go back to the previous screen.

4.3.4. Initial Star Alignment

A simple star alignment/synchronization can be performed to improve the GOTO accuracy.

To perform “***One Star Align***,” press MENU button, scroll down to “***Align***”, select “***One Star Align***” and press 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 5.6)

An alternate way is to perform “***Sync to Target***.” Press the MENU button, select “***Select and Slew***” and press ENTER. Browse over the catalogs and select an object, such as “***Stars***” →“***Named stars***” →***140 (Polaris)***, and press ENTER. After the mount slews to Polaris, press the MENU button, scroll down to “***Sync. To Target***”, follow the on-screen instruction to center Polaris and press ENTER. You may need to use the number keys to change the slewing speed to make the centering procedure easier.

4.3.5. Go to the Moon

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 the MENU button. Select “***Select and Slew***” by pressing the ENTER button. Select “***Planets, Sun, Moon***”, and use the ▲ or ▼ buttons to select Moon. Press 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. Or for better performance use “***Sync to Target***.”

4.4. Turn Off the Mount

When you have finished your observation, it is recommended that you return the mount to Zero Position before powering down. This will ensure that there is no need for you to perform the initial setup again when you power up the mount subsequently, if the mount is not moved. To return the mount to its Zero Position, press the MENU button, scroll down to “To Zero Position” and press ENTER. Once the telescope returns to Zero Position turn the power off.

5. Complete Functions of GoToNova® Hand Controller

5.1. Slew to an Object

Press the MENU button. From the main menu select "***Select and Slew***." Select an object that you would like to observe and press the ENTER key.

The GoToNova 8406 hand controller has a database of about 580,000 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. 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. Planets, Sun, Moon

There are 10 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 deepsky 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 IC Catalog: consists of 7,840 objects in NGC catalog and 5,386 objects in IC catalog. To select an object from NGC or IC catalog, move the cursor to NGC, using▲ or ▼ button to toggle between NGC and IC. Then move the cursor to a numerical position and use the number button to select the object.
- UGC Catalog: consists of 12,939 objects.
- MCG Catalog: consists of 29,004 objects.
- Caldwell Catalog: consists of 109 objects.
- Abell Catalog: consists of 2,712 objects.
- Herschel Catalog: consists of 400 objects.

5.1.3. Comets

This catalog contains 233 comets.

5.1.4. Asteroids

This catalog contains 231,665 asteroids.

5.1.5. Stars:

- Named Stars: consists of 191 stars with their common names. They are listed alphabetically. A list is included in Appendix E.
- Double Stars: consists of 211 double stars. A list is attached in Appendix E.
- GCVS Variable Stars: consists of 38,624 GCVS variable stars. They are listed numerically.
- SAO Catalog: consists of 258,997 SAO catalog objects. They are listed numerically.

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. Enter 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. After slewing to an object, press MENU—then scroll to "***Sync to Target***" and press ENTER. Follow the screen to do the sync. Using this function will re-calibrate the computer to the selected object. Multiple syncs can be performed if needed. This operation is most useful to find a faint star or nebula near a bright star.

"***Sync to Target***" will only work after "***Select and Slew***" is performed. Otherwise, the system may perform incorrectly. You can change the slewing speed to make the centering procedure easier. Simply press a number (1 through 9) to change the speed. The default slew speed is 64X.

"***Sync to Target***" does the same thing as one star alignment except that you choose the object to "sync" to. "***One star align***" chooses the star/object for you. "***Sync to Target***" operation will override any previously performed "***Two Star Align***" operation.

5.3. Electric Focuser

For future iOptron electric focuser use.

5.4. Set Up Controller

5.4.1. Set Up Local Time

Refer to 4.3.1.

5.4.2. Set Up Observation Site

Refer to 4.3.2.

5.4.3. Set N/S Hemisphere

Refer to 4.3.3.

5.4.4. Set Display Contrast

Use arrow keys to adjust LCD display contrast.

5.4.5. Set Eyepiece Light

If you have an illuminated-reticule eyepiece or illuminated polar scope, and it is supported by GoToNova hand controller, use this option to adjust the light intensity.

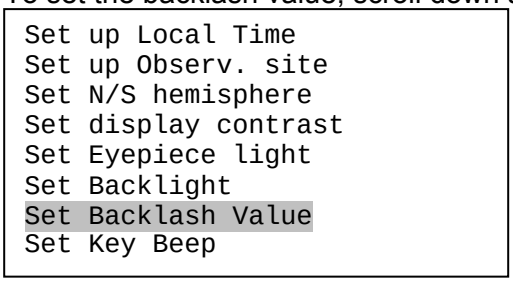
5.4.6. Set Backlight

Adjust LCD and keypad backlight.

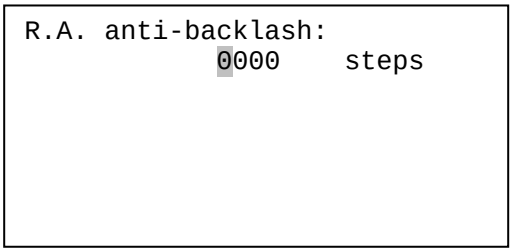
5.4.7. Set Backlash Value

Set the backlash of R.A axis and DEC axis. Although both R.A. and DEC worms have gap-free structure, there still might be backlash or play between the reducing gears of a R.A. or DEC motor.

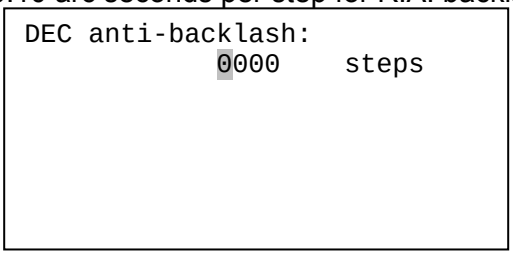
To set the backlash value, scroll down and select “Set Backlash Value”



Press ENTER. A R.A. anti-backlash screen will display:



To adjust steps move the cursor to each digit and use the number keys to input number directly. It is about 0.10 arc seconds per step for R.A. backlash. Press ENTER – “DEC anti-backlash” will display:



Move the cursor to each digit and use the number keys to set the anti-backlash. It is about 0.12 arc seconds per step for DEC backlash. Press ENTER to go back the previous screen. Press BACK button to go back to main menu.

While viewing an object in the eyepiece, observe the responsiveness of each of the four arrow buttons. Note which directions you see a pause in the star movement after the button has been pressed. Working one axis at a time, adjust the backlash settings high enough to cause immediate movement without resulting in a pronounced jump when pressing or releasing the button. The hand controller will remember these values and use them each time it is turned on until they are changed.

5.4.8. Set Key Beep

Turn the key beep on/off.

5.4.9. Reset All

Reset all settings to factory default data.

5.4.10. Meridian Protection

The Meridian Flip can be turn on or off. If the Meridian Flip is turned off, there are two more options: Meridian Protection ON or OFF.

If the Meridian Protection is turned on, the mount will stop tracking when it passes the meridian. If it is turned off, the mount will keeping tracking and the OTA could hit the tripod leg if the mount is not monitored.

5.4.11. Set Language

Select hand controller language from English or French.

5.4.12. Heating Controller

Turn on/off the controller internal heater.

5.4.13. Upgrade Firmware

Use this operation to upgrade 8406 hand controller firmware and iEQ75-GT main control board firmware. Please refer to Appendix C. Firmware Upgrade for details.

5.4.14. Firmware Version

Will display hand controller firmware version.

5.4.15. Set Speed Limit

You can select the GOTO speed to be 128X, 256X, 512X, or MAX. The slower the speed, the quieter the motors run.

5.5. Align

This function is used for aligning the telescope. The system provides two alignment methods: “One Star Align” and “Two Star Align” The mount has to be at Zero Position before any star alignment.

5.5.1. One-Star Align

Press MENU button and select “***Align***”. Select “***One Star Align***” and press ENTER. 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 ▲ and ▼ buttons to select a star and press ENTER. Center the target in your eyepiece using arrow key. Press ENTER when finished. If your mount is well set up and polar aligned, one star alignment should be sufficient for good GOTO accuracy. To increase the accuracy you may choose to do two star alignment.

5.5.2. Two-Star Align

Two star alignment will increase the GOTO accuracy of the mount. Two star alignment requires a wider view of the sky, since the two align stars need to be far apart. Press MENU button and select “***Align***”. Select “***Two Star Align***” in the align menu. A list of alignment stars that are above the horizon is computed based on your local time and location. With the mount is at the “Zero Position,” use ▲ and ▼ buttons to select first alignment star and press ENTER. Center the target in your eyepiece using arrow key. Press ENTER when finished. The hand controller will prompt you to choose the second star. If the star you choose is too close to the first one, the system will let you choose another one. When you are aligned with the second star, the two star alignment is finished. You can reject the suggested star if it is blocked by a tree or other obstruction.

After the two-star alignment, a pointing error between the R.A. axis and the polar axis will be recorded. This number can be used to fine tune the R.A. axis.

“***Two Star Align***” results will be overridden if “***One Star Align***” or “***Sync. to Target***” is performed after “***Two Star Align.***”

5.5.3. Dis R.A axis error

This displays the celestial pole pointing error after two star or three star alignment. When the HC shows for example:

7.5" lower

4.3" east,

it means the polar axis of the mount is pointing lower and to the east. Pointing error is zero when the mount is powered on (unless you “Park Telescope” before powering off).

5.5.4. Polaris Position

This shows Polaris position in the polar scope and is used for Quick Polar Alignment.

5.6. PEC Option

iEQ75-GT uses automatic real time periodic error correction technique with a Renishaw high resolution optical encoder.

5.7. Set Up Tracking

You can set up tracking in the main menu by selecting “***Set up tracking***”. Then the user can select “***Solar speed***”, “***Lunar speed***”, “***Sidereal speed***” and “***User defined speed***”. For “User defined speed,” it can be adjusted from 0.9900X to 1.0100X of sidereal speed by pressing the ▲or ▼ button or number buttons.

5.8. Auto Guide

5.8.1. Set Guider Rate

This is an advanced function for autoguiding when a guiding camera is equipped either via an ST-4 guiding port or an ASCOM protocol. Before autoguiding, align the polar axis carefully. Press **MENU** and select Auto Guide and press **ENTER**. Select a proper guiding speed. The suppositional guiding speed can be selected from 0.10X to 1.00X. Follow the autoguiding software for detailed operation.

5.8.2. Set Guider Direction

The Guide Port iEQ75-GT equipped is capable to handle an ST-4 autoguiding camera with both straight and a reverse wired RJ-11 guiding cable. Select “***Reverse***” option in the “***Auto Guide***” function for an ST-4 camera with a reversed RJ-11 guiding cable, as shown in Figure 21.

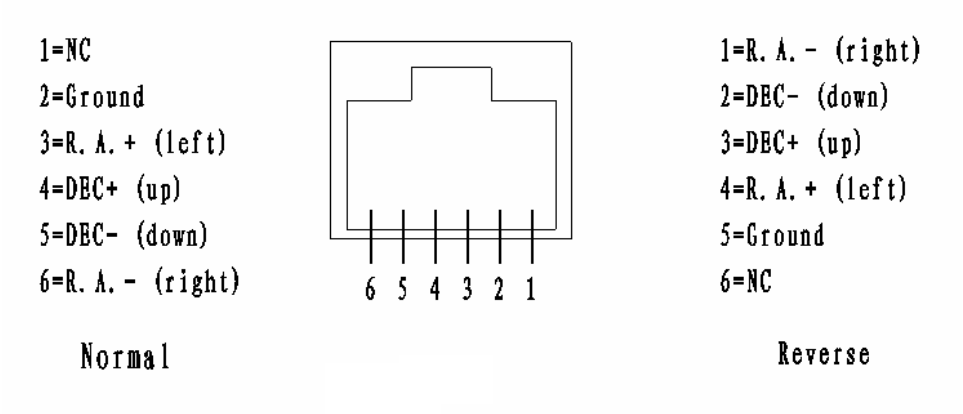


Figure 21

5.9. Park Scope

5.9.1. Park Scope

Park the mount to a preset parking position.

5.9.2. Set Park Position

There are 6 park positions to be chosen from, namely “Up north,” “Left zenith,” “Left horizontal,” “Right zenith,” “Right horizontal,” and “Position now.” Different OTA may have different requirement for parking. When the mount is powered off, the park position will be remembered. *If you selected the park position other than “Up north,” make sure you do a “**One Star Align**” before using GOTO for any object.*

This procedure only needs to be done if you do not move your telescope mount after you power off the mount. R.A. axis pointing error will be stored in flash memory and recalled when you power on again. If the power is turned off before performing “**Park Scope**” operation, all the reference information will be lost.

5.10. To Zero Position

This moves your telescope to its Zero Position. When the power is turned on, the mount assumes the Zero Position. This is its reference point for all other objects being tracked.

6. Maintenance and Servicing

6.1. Maintenance

The iEQ75-GT 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 iEQ75-GT 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 iEQ75-GT 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 us first to avoid returning the mount for repair. It is strongly suggested that to send technical questions to support@ioptron.com. Call in the U.S. 1.781.569.0200.

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

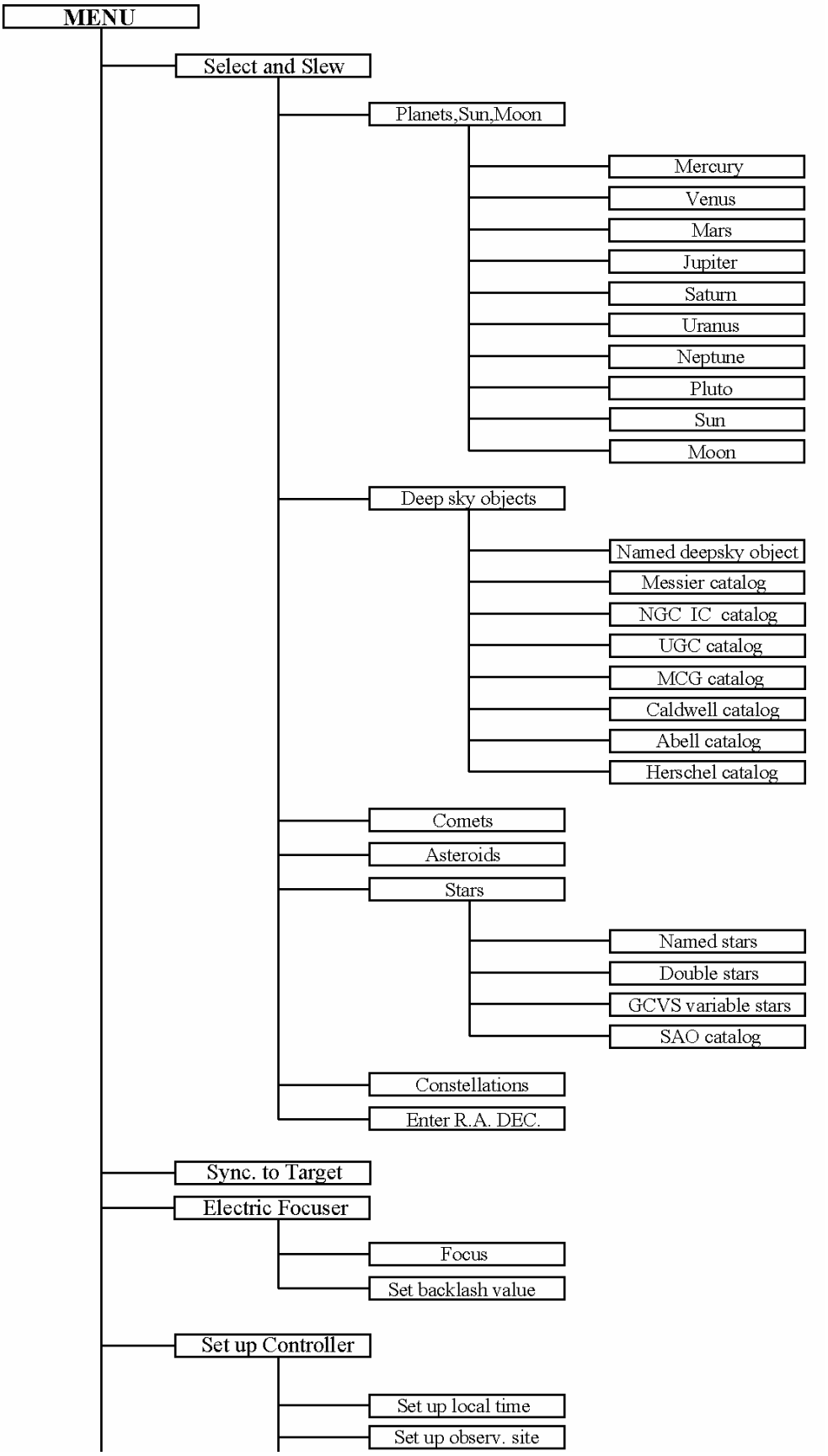
Battery Disposal- Batteries contain chemicals that, if released, may affect the environment and human health. Batteries should be collected separately for recycling, and recycled at a local hazardous material disposal location adhering to your country and local government regulations. To find out where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

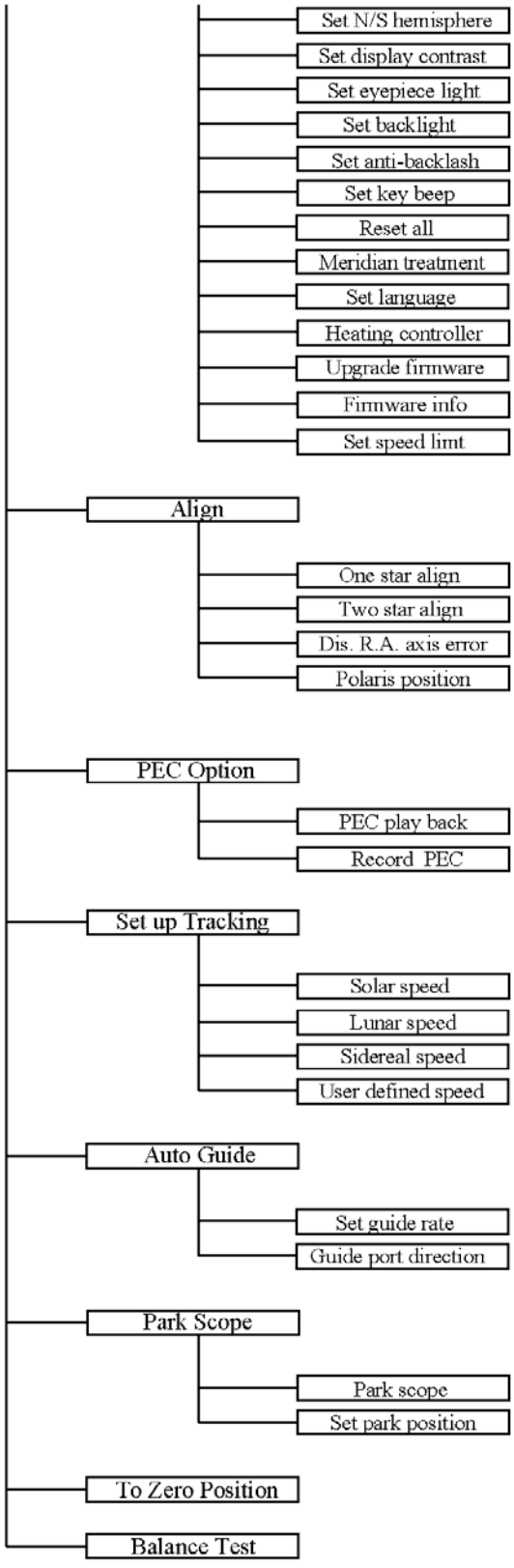
May 2011 V1.0

Appendix A. Technical Specifications

Mount	German Equatorial Mount
Payload	75 lb (34kg)
Mount weight	52 lb (23.6kg)
Right Ascension worm wheel	Φ182mm, 228 teeth bronze
Declination worm wheel	Φ154mm, 192 teeth bronze
Right Ascension axis shaft	Φ60mm steel
Declination axis shaft	Φ45mm steel
Right Ascension bearing	Φ90mm angular contact ball bearing
Declination bearing	Φ68mm angular contact ball bearing
Worm gears	Φ15.6mm steel
Motor drive	Planetary Gear Reducer DC servo with encoder
Resolution	0.1 arc seconds
Latitude adjustment range	15º ~ 70º
Azimuth adjustment range	± 7.5º
GPS	Internal 32-channel GPS
Polar Scope	Yes. (with dark field illumination)
Accuracy	2 arc minutes
Hand Controller	GoToNova® 8406 with 580,000 objects database
Tracking controller	Double closed-loop tracking with Renishaw high resolution encoder feedback
Tracking error	± 1 arc second max
PEC	Real-time automatic
Speed	1×,2×,8×,16×,64×,128×,256×,512×,MAX(~4°/sec)
Counterweight shaft	Φ31.8 mm (included)
Counterweight	16.5 lb (7.5kg) X 2 stainless steel (Φ150X52 mm, included)
Base diameter	Φ200 mm
Mounting plate	Black anodized aluminum (150X380mm, included)
Dovetail	3.5"VIXEN Saddles included
Power consumption	0.4A(Tracking), 1.2A(Slew)
Power requirement	12V DC(11 ~ 15V), 3Amp, center positive
USB port	Yes (on hand controller)
RS232 port	Yes (on control box)
Autoguide port	Yes (ST-4 compatible)
Firmware upgrade	Yes (main board and hand controller)
PC computer control	Yes (ASCOM)
Operation temperature	-20ºC ~ 40ºC

Appendix B. GoToNova® 8406 HC MENU STRUCTURE




Set N/S hemisphere
Set display contrast
Set eyepiece light
Set backlight
Set anti-backlash
Set key beep
Reset all
Meridian treatment
Set language
Heating controller
Upgrade firmware
Firmware info
Set speed limt
Align
One star align
Two star align
Dis. R.A. axis error
Polaris position
PEC Option
PEC play back
Record PEC
Set up Tracking
Solar speed
Lunar speed
Sidereal speed
User defined speed
Auto Guide
Set guide rate
Guide port direction
Park Scope
Park scope
Set park position
To Zero Position
Balance Test

Appendix C. Firmware Upgrade

The firmware in the 8406 hand controller and/or main control board can be upgraded by the customer. Please check iOptron's website, www.iOptron.com, under Support Directory, for the most up to date firmware.

To upgrade i8406 hand controller firmware:

(1) Download the newest version of the 8406 hand controller firmware (i8406.iop) from iOptron's website, save it on your desktop;

(2) Connect 8406 hand controller to your computer's USB port using included USB cable;

(3) Turn on the mount;

(4) Press MENU and select "***Set Up Controller***," scroll down to "***Upgrade Firmware***." A new storage drive with a drive number, *e.g.* "IOPTRON(E:)", will be shown under "My Computer." If it is the first time you have connected the hand controller to the computer, it may take few minutes to install the driver.

(5) Copy the downloaded firmware, i8406.iop, into "sys" folder under IOPTRON(E:) drive to replace the original one;

(6) Restart iEQ75-GT mount to finish the hand controller firmware upgrade.

To upgrade iEQ75-GT main control board firmware:

(1) Download iOptron Downloader Setup from iOptron's website and save it on your desktop;

(2) Double click on iOptron Downloader Setup to install it;

(3) Download the newest version of iEQ75-GT main control board firmware (iEQ75-GT_main_VX.XX.bin) from iOptron website, save it on your desktop;

(4) Connect iEQ75-GT RS232 port to your computer's serial port using supplied RS-232 cable. A USB to COM adapter is needed if you computer does not have a serial port, like most of the laptops today;

(5) Turn on the mount;

(6) Find your COM port number by click on windows ***start***, select ***Properties*** on ***My Computer***, click on ***Hardware*** and select ***Device Manager***, double click on "***Ports (COM & LPT)***." In most cases, it will be COM1. (If you are using a USB to RS-232 converting cable, the COM port number will be different.)

(7) Double click on "iOptron Download" icon to start the program;

(8) Select the Serial Port, here is COM1. Open the data file, here is iEQ75-GT_main_VX.XX.bin. Click on Start Download. After the program prompts that "Download successfully finished," restart the mount to finish main control board firmware upgrade.

Note: Only use the iEQ75-GT bin file. Sending a wrong file into the main control board will cause the mount stop working.

Appendix D. Use a PC to Control an iEQ75-GT Mount

The iEQ75-GT mount can be connected to a computer using supplied RS232 cable, if your PC is equipped with a serial port. A RS232 to USB adapter is needed 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.

When the communication between the mount and computer has been established, the mount can be controlled via either ASCOM or RS485 protocol.

To control the mount via ASCOM protocol, you need:

1. Download and install ASCOM Platform from http://www.ascom-standards.org/. Make sure you PC meet the software requirement, such as Microsoft .NET Framework 3.5 Service Pack 1 is installed. Refer to the ascom-standards website for details.

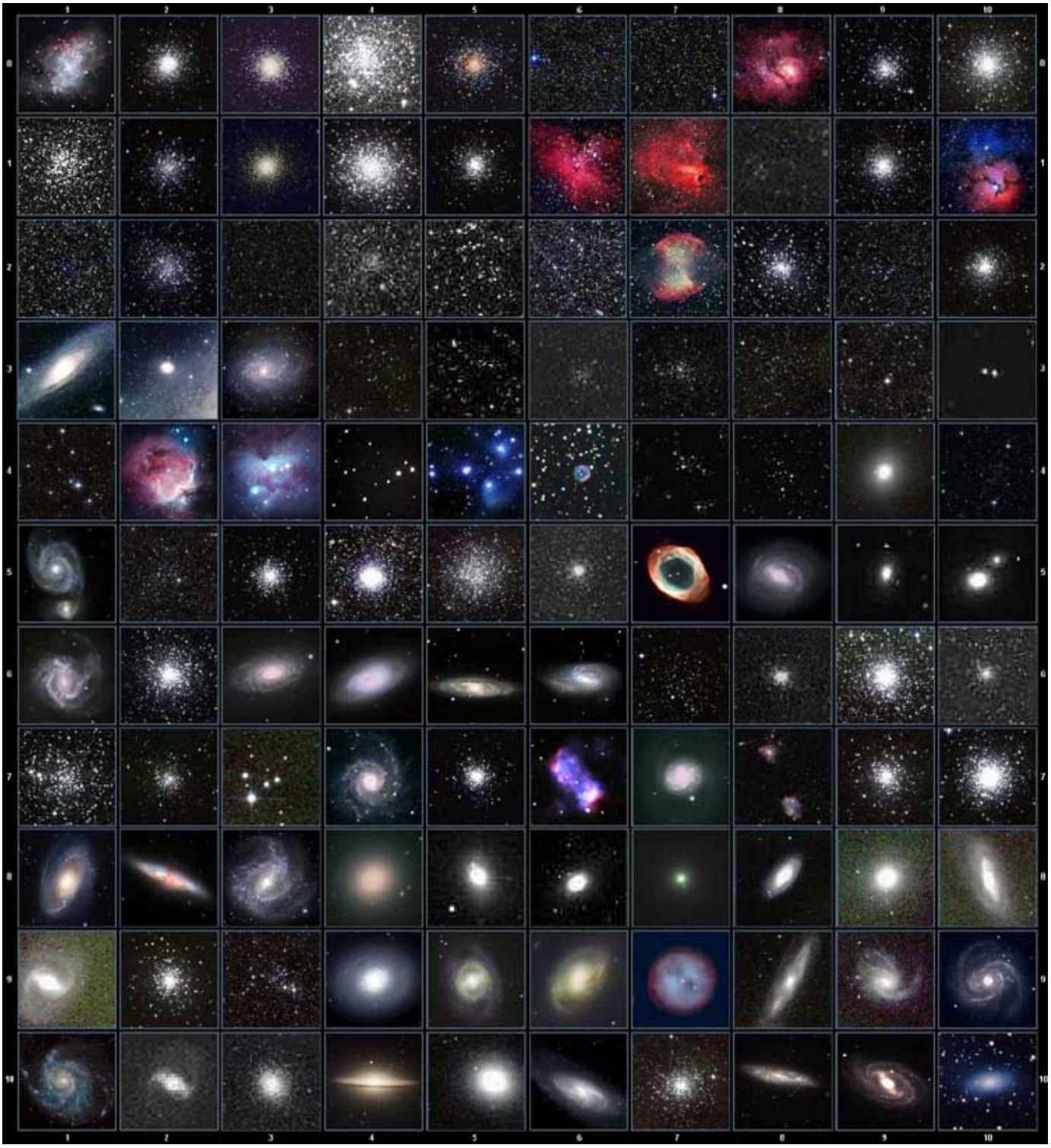
2. Download and install latest iOptron Telescope ASCOM drive from iOptron website, click on **Support**, select **ASCOM Driver**.

3. Planetarium software support ASCOM protocol. Follow software instructions to select the iOptron Telescope.

Some companies have integrated iOptron's products into their planetarium software, such as Voyage and The Sky X Pro. Therefore, an ASCOM plug-in will not be needed. Most planetarium software can be used to control iOptron's product via ASCOM.

Appendix E. GoToNova® Star List

Messier Catalog



GoToNova Named Star List

for 8406

001 Acamar	049 Ascella	097 Kaus Australis	145 Rassalas
002 Achernar	050 Asellus Australis	098 Kaus Borealis	146 Rasagethi
003 Acrux	051 Asellus Borealis	099 Kaus Media	147 Rasalhague
004 Acubens	052 Aspidiske	100 Keid	148 Rastaba
005 Adhafera	053 Atik	101 Kitalpha	149 Regulus
006 Adhara	054 Atlas	102 Kochab	150 Rigel
007 Al Na'ir	055 Atria	103 Kornephoros	151 Rigel Kentaurus
008 Albali	056 Avoir	104 Kurhah	152 Ruchbah
009 Alberio	057 Azha	105 Lesath	153 Rukbat
010 Alchibar	058 Baten Kaitos	106 Maia	154 Sabik
011 Alcor	059 Beid	107 Marfik	155 Sadachbia
012 Alcyone	060 Bellatrix	108 Markab	156 Sadalbari
013 Aldebaran	061 Betelgeuse	109 Matar	157 Sadalmelik
014 Alderamin	062 Biham	110 Mebsuta	158 Sadalsuud
015 Alfirk	063 Canopus	111 Megrez	159 Sadr
016 Algedi	064 Capella	112 Meissa	160 Saiph
017 Algenib	065 Caph	113 Mekbuda	161 Scheat
018 Algiebra	066 Castor	114 Menkalinan	162 Schedar
019 Algol	067 Celabrai	115 Menkar	163 Seginus
020 Algorab	068 Celaeno	116 Menkent	164 Shaula
021 Alhena	069 Chara	117 Menkib	165 Sheiak
022 Alioth	070 Chertan	118 Merak	166 Sheratan
023 Alkaid	071 Cor Caroli	119 Merope	167 Sirius
024 Alkalurops	072 Cursa	120 Mesartim	168 Skat
025 Alkes	073 Dabih	121 Miaplacidus	169 Spica
026 Almach	074 Deneb	122 Mintaka	170 Sterope
027 Alnasl	075 Deneb Algedi	123 Mira	171 Sulafat
028 Alnilam	076 Deneb Kaitos	124 Mirach	172 Syrma
029 Alnitak	077 Denebola	125 Mirfak	173 Talitha
030 Alphard	078 Dubhe	126 Mirzam	174 Tania Australis
031 Alphecca	079 Edasich	127 Mizar	175 Tania Borealis
032 Alpheratz	080 Electra	128 Muphrid	176 Tarazed
033 Alrakis	081 Elnath	129 Muscida	177 Taygeta
034 Alrescha	082 Eltanin	130 Nashira	178 Thuban
035 Alshain	083 Enif	131 Nekkar	179 Unukalhai
036 Altair	084 Errai	132 Nihal	180 Vega
037 Altais	085 Fomalhaut	133 Nunki	181 Vindemiatrix
038 Alterf	086 Furud	134 Nusakan	182 Wasat
039 Aludra	087 Gacrux	135 Peacock	183 Wazn
040 Alula Australis	088 Giausar	136 Phact	184 Yed Posterior
041 Alula Borealis	089 Gienah	137 Phecda	185 Yed Prior
042 Alya	090 Gomeisa	138 Pherkad	186 Zaniah
043 Ancha	091 Graffias	139 Pleione	187 Zaurak
044 Ankaa	092 Groombridge 1830	140 Polaris	188 Zavijava
045 Antares	093 Grumium	141 Pollux	189 Zosma
046 Arcturus	094 Hamal	142 Porrima	190 Zubenelgenubi
047 Arkab	095 Homan	143 Procyon	191 Zubeneschamali
048 Arneb	096 Izar	144 Propus	

Modern Constellations

for 8406

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

GoToNova Deep Sky Object List

for 8406

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			

GoToNova Double Star List

For 8406

No.	Object	Const	Sep.	Magitude	SAO	Comm. Name
1	Gam	And	9.8	2.3 / 5.1	37734	Almaak
2	Pi	And	35.9	4.4 / 8.6	54033	
3	Bet	Aql	12.8	3.7 / 11	125235	Alshain
4	11	Aql	17.5	5.2 / 8.7	104308	
5	15	Aql	34	5.5 / 7.2	142996	
6	E2489	Aql	8.2	5.6 / 8.6	104668	
7	57	Aql	36	5.8 / 6.5	143898	
8	Zet	Aqr	2.1	4.3 / 4.5	146108	
9	94	Aqr	12.7	5.3 / 7.3	165625	
10	41	Aqr	5.1	5.6 / 7.1	190986	
11	107	Aqr	6.6	5.7 / 6.7	165867	
12	12	Aqr	2.5	5.8 / 7.3	145065	
13	Tau	Aqr	23.7	5.8 / 9.0	165321	
14	Gam	Ari	7.8	4.8 / 4.8	92681	Mesartim
15	Lam	Ari	37.8	4.8 / 6.7	75051	
16	The	Aur	3.6	2.6 / 7.1	58636	
17	Nu	Aur	55	4.0 / 9.5	58502	
18	Ome	Aur	5.4	5.0 / 8.0	57548	
19	Eps	Boo	2.8	2.5 / 4.9	83500	Izar
20	Del	Boo	105	3.5 / 7.5	64589	
21	Mu 1	Boo	108	4.3 / 6.5	64686	Alkalurops
22	Tau	Boo	4.8	4.5 / 11	100706	
23	Kap	Boo	13.4	4.6 / 6.6	29046	
24	Xi	Boo	6.6	4.7 / 6.9	101250	
25	Pi	Boo	5.6	4.9 / 5.8	101139	
26	Iot	Boo	38	4.9/7.5/13	29071	
27	E1835	Boo	6.2	5.1 / 6.9	120426	
28	44	Boo	2.2	5.3 / 6.2	45357	
29		Cam	2.4	4.2 / 8.5	24054	
30	32	Cam	21.6	5.3 / 5.8	2102	
31	Alp 2	Cap	6.6	3.6 / 10	163427	Secunda giedi
32	Alp 1	Cap	45	4.2 / 9.2	163422	Prima giedi
33	Pi	Cap	3.4	5.2 / 8.8	163592	
34	Omi	Cap	21	5.9 / 6.7	163625	
35	Alp	Cas	64.4	2.2 / 8.9	21609	Shedir
36	Eta	Cas	12.9	3.5 / 7.5	21732	Achird

No.	Object	Const	Sep.	Magitude	SAO	Comm. Name
37	Iot	Cas	2.3	4.7/7.0/8.2	12298	
38	Psi	Cas	25	4.7 / 8.9	11751	
39	Sig	Cas	3.1	5.0 / 7.1	35947	
40	E3053	Cas	15.2	5.9 / 7.3	10937	
41	3	Cen	7.9	4.5 / 6.0	204916	
42	Bet	Cep	13.6	3.2 / 7.9	10057	Alfirk
43	Del	Cep	41	3.5 / 7.5	34508	
44	Xi	Cep	7.6	4.3 / 6.2	19827	Al kurhah
45	Kap	Cep	7.4	4.4 / 8.4	9665	
46	Omi	Cep	2.8	4.9 / 7.1	20554	
47	E2840	Cep	18.3	5.5 / 7.3	33819	
48	E2883	Cep	14.6	5.6 / 7.6	19922	
49	Gam	Cet	2.8	5.0 / 7.7	110707	Kaffaljidhma
50	37	Cet	50	5.2 / 8.7	129193	
51	66	Cet	16.5	5.7 / 7.5	129752	
52	Eps	CMa	7.5	1.5 / 7.4	172676	Adhara
53	Tau	CMa	8.2	4.4/10/11	173446	
54	145	CMa	25.8	4.8 / 6.8	173349	
55	Mu	CMa	2.8	5.0 / 7.0	152123	
56	Nu 1	CMa	17.5	5.8 / 8.5	151694	
57	Iot	Cnc	30.5	4.2 / 6.6	80416	
58	Alp	Cnc	11	4.3 / 12	98267	Acubens
59	Zet	Cnc	6	5.1 / 6.2	97646	
60	24	Com	20.6	5.0 / 6.6	100160	
61	35	Com	1.2	5.1/7.2/9.1	82550	
62	2	Com	3.7	5.9 / 7.4	82123	
63	Zet	CrB	6.1	5.0 / 6.0	64833	
64	Gam	Crt	5.2	4.1 / 9.6	156661	
65	Del	Crv	24.2	3.0 / 9.2	157323	Algorab
66	Alp	CVn	19.4	2.9 / 5.5	63257	Cor caroli
67	25	CVn	1.8	5.0 / 6.9	63648	
68	2	CVn	11.4	5.8 / 8.1	44097	
69	Gam	Cyg	41	2.2 / 9.5	49528	Sadr
70	Del	Cyg	2.5	2.9 / 6.3	48796	
71	Bet	Cyg	34.4	3.1 / 5.1	87301	Albireo
72	Omi 1	Cyg	107	3.8 / 6.7	49337	

No.	Object	Const	Sep.	Magitude	SAO	Comm. Name
73	52	Cyg	6.1	4.2 / 9.4	70467	
74	Ups	Cyg	15.1	4.4 / 10	71173	
75	Mu	Cyg	1.9	4.7 / 6.1	89940	
76	Psi	Cyg	3.2	4.9 / 7.4	32114	
77	17	Cyg	26	5.0 / 9.2	68827	
78	61	Cyg	30.3	5.2 / 6.0	70919	
79	49	Cyg	2.7	5.7 / 7.8	70362	
80	E2762	Cyg	3.4	5.8 / 7.8	70968	
81	E2741	Cyg	1.9	5.9 / 7.2	33034	
82	Gam	Del	9.6	4.5 / 5.5	106476	
83	Eta	Dra	5.3	2.7 / 8.7	17074	
84	Eps	Dra	3.1	3.8 / 7.4	9540	Tyl
85	47	Dra	34	4.8 / 7.8	31219	
86	Nu	Dra	61.9	4.9 / 4.9	30450	
87	Psi	Dra	30.3	4.9 / 6.1	8890	
88	26	Dra	1.7	5.3 / 8.0	17546	
89	16&17	Dra	90	5.4/5.5/6.4	30012	
90	Mu	Dra	1.9	5.7 / 5.7	30239	
91	40/41	Dra	19.3	5.7 / 6.1	8994	
92	1	Equ	10.7	5.2 / 7.3	126428	
93	The	Eri	4.5	3.4 / 4.5	216114	Acamar
94	Tau 4	Eri	5.7	3.7 / 10	168460	
95	Omi 2	Eri	8.3	4.4/9.5/11	131063	Keid
96	32	Eri	6.8	4.8 / 6.1	130806	
97	39	Eri	6.4	5.0 / 8.0	149478	
98	Alp	For	5.1	4.0 / 6.6	168373	Fornacis
99	Ome	For	10.8	5.0 / 7.7	167882	
100	Alp	Gem	3.9	1.9 / 2.9	60198	Castor
101	Del	Gem	5.8	3.5 / 8.2	79294	Wasat
102	Lam	Gem	9.6	3.6 / 11	96746	
103	Kap	Gem	7.1	3.6 / 8.1	79653	
104	Zet	Gem	87	3.8/10/8.0	79031	Mekbuda
105	38	Gem	7.1	4.7 / 7.7	96265	
106	Del	Her	8.9	3.1 / 8.2	84951	Sarin
107	Mu	Her	34	3.4 / 9.8	85397	
108	Alp	Her	4.6	3.5 / 5.4	102680	Rasalgethi
109	Gam	Her	42	3.8 / 9.8	102107	
110	Rho	Her	4.1	4.6 / 5.6	66001	

No.	Object	Const	Sep.	Magitude	SAO	Comm. Name
111	95	Her	6.3	5.0 / 5.2	85647	
112	Kap	Her	27	5.0 / 6.2	101951	
113	E2063	Her	16.4	5.7 / 8.2	46147	
114	100	Her	14.3	5.9 / 5.9	85753	
115	54	Hya	8.6	5.1 / 7.1	182855	
116	HN69	Hya	10.1	5.9 / 6.8	181790	
117	Eps	Hyd	2.7	3.4 / 6.8	117112	
118	The	Hyd	29.4	3.9 / 10	117527	
119	N	Hyd	9.4	5.6 / 5.8	179968	
120		Lac	28.4	4.5 / 10	72155	
121	8	Lac	22	5.7/6.5/10	72509	
122	Gam 1	Leo	4.4	2.2 / 3.5	81298	Algieba
123	Iot	Leo	1.7	4.0 / 6.7	99587	
124	54	Leo	6.6	4.3 / 6.3	81583	
125	Gam	Lep	96	3.7 / 6.3	170757	
126	Iot	Lep	12.8	4.4 / 10	150223	
127	Kap	Lep	2.6	4.5 / 7.4	150239	
128	h3752	Lep	3.2	5.4 / 6.6	170352	
129	Iot	Lib	57.8	4.5 / 9.4	159090	
130		Lib	23	5.7 / 8.0	183040	
131	Mu	Lib	1.8	5.8 / 6.7	158821	
132	Eta	Lup	15	3.6 / 7.8	207208	
133	Xi	Lup	10.4	5.3 / 5.8	207144	
134	38	Lyn	2.7	3.9 / 6.6	61391	
135	12	Lyn	1.7	5.4/6.0/7.3	25939	
136	19	Lyn	14.8	5.8 / 6.9	26312	
137	Bet	Lyr	46	3.4 / 8.6	67451	Sheliak
138	Zet	Lyr	44	4.3 / 5.9	67321	
139	Eta	Lyr	28.1	4.4 / 9.1	68010	Aldafar
140	Eps	Lyr	208	5.0 / 5.2	67310	Double dbl
141	Eps 1	Lyr	2.6	5.0 / 6.1	67309	Double dbl1
142	Eps 2	Lyr	2.3	5.2 / 5.5	67315	Double dbl2
143	Alp	Mic	20.5	5.0 / 10	212472	
144	Zet	Mon	32	4.3 / 10	135551	
145	Eps	Mon	13.4	4.5 / 6.5	113810	
146	Bet	Mon	7.3	4.7/4.8/6.1	133316	
147	15	Mon	2.8	4.7 / 7.5	114258	
148	70	Oph	4.5	4.0 / 5.9	123107	

No.	Object	Const	Sep.	Magitude	SAO	Comm. Name
149	67	Oph	55	4.0 / 8.6	123013	
150	Lam	Oph	1.5	4.2 / 5.2	121658	Marfic
151	Xi	Oph	3.7	4.4 / 9.0	185296	
152	36	Oph	4.9	5.1 / 5.1	185198	
153	Tau	Oph	1.7	5.2 / 5.9	142050	
154	Rho	Oph	3.1	5.3 / 6.0	184382	
155	39	Oph	10.3	5.4 / 6.9	185238	
156	Bet	Ori	9.5	0.1 / 6.8	131907	Rigel
157	Del	Ori	53	2.2 / 6.3	132220	Mintaka
158	Iot	Ori	11.3	2.8 / 6.9	132323	Nair al saif
159	Lam	Ori	4.4	3.6 / 5.5	112921	Meissa
160	Sig	Ori	13	3.8/7.2/6.5	132406	
161	Rho	Ori	7.1	4.5 / 8.3	112528	
162	E747	Ori	36	4.8 / 5.7	132298	
163	1	Peg	36.3	4.1 / 8.2	107073	
164	Eps	Per	8.8	2.9 / 8.1	56840	
165	Zet	Per	12.9	2.9 / 9.5	56799	Atik
166	Eta	Per	28.3	3.3 / 8.5	23655	Miram in becvar
167	The	Per	18.3	4.1 / 10	38288	
168	E331	Per	12.1	5.3 / 6.7	23765	
169	Del	PsA	5.1	4.2 / 9.2	214189	
170	Iot	PsA	20	4.3 / 11	213258	
171	Bet	PsA	30.3	4.4 / 7.9	213883	
172	Gam	PsA	4.2	4.5 / 8.0	214153	
173	Eta	PsA	1.7	5.8 / 6.8	190822	
174	Alp	Psc	1.8	4.2 / 5.2	110291	Alrisha
175	55	Psc	6.5	5.4 / 8.7	74182	
176	Psi	Psc	30	5.6 / 5.8	74483	
177	Zet	Psc	23	5.6 / 6.5	109739	
178	Kap	Pup	9.9	4.5 / 4.7	174199	
179	Eta	Pup	9.6	5.8 / 5.9	174019	
180	Eps	Scl	4.7	5.4 / 8.6	167275	

No.	Object	Const	Sep.	Magitude	SAO	Comm. Name
181	Bet	Sco	13.6	2.6 / 4.9	159682	Graffias
182	Sig	Sco	20	2.9 / 8.5	184336	Alniyat
183	Nu	Sco	41	4.2 / 6.1	159764	Jabbah
184	2	Sco	2.5	4.7 / 7.4	183896	
185		Sco	23	5.4 / 6.9	207558	
186	Hn39	Sco	5.4	5.9 / 6.9	184369	
187	12	Sco	3.9	5.9 / 7.9	184217	
188	Bet	Ser	31	3.7 / 9.0	101725	
189	Del	Ser	4.4	4.2 / 5.2	101624	
190	Nu	Ser	46	4.3 / 8.5	160479	
191	The	Ser	22.3	4.5 / 5.4	124070	Alya
192	59	Ser	3.8	5.3 / 7.6	123497	
193	Zet	Sge	8.5	5.0 / 8.8	105298	
194	Eta	Sgr	3.6	3.2 / 7.8	209957	
195		Sgr	5.5	5.2 / 6.9	209553	
196	Phi	Tau	52	5.0 / 8.4	76558	
197	Chi	Tau	19.4	5.7 / 7.6	76573	
198	118	Tau	4.8	5.8 / 6.6	77201	
199	6	Tri	3.9	5.3 / 6.9	55347	
200	Zet	UMa	14	2.4 / 4.0	28737	Mizar
201	Nu	UMa	7.2	3.5 / 9.9	62486	Alula borealis
202	23	UMa	23	3.6 / 8.9	14908	
203	Ups	UMa	11.6	3.8 / 11	27401	
204	Xi	UMa	1.8	4.3 / 4.8	62484	Alula australia
205	Sig 2	UMa	3.9	4.8 / 8.2	14788	
206	57	UMa	5.4	5.4 / 5.4	62572	
207	Alp	UMi	18.4	2.0 / 9.0	308	Polaris
208	Gam	Vir	1.4	3.5 / 3.5	138917	Porrima
209	The	Vir	7.1	4.4 / 9.4	139189	
210	Phi	Vir	4.8	4.8 / 9.3	139951	
211	84	Vir	2.9	5.7 / 7.9	120082	

IOPTRON TWO YEAR TELESCOPE, MOUNT, AND CONTROLLER WARRANTY

A. iOptron warrants your telescope, mount, or controller to be free from defects in materials and workmanship for two years. iOptron will repair or replace such product or part which, upon inspection by iOptron, is found to be defective in materials or workmanship. As a condition to the obligation of iOptron to repair or replace such product, the product must be returned to iOptron together with proof-of-purchase satisfactory to iOptron.

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.
All returns must be accompanied by a written statement stating the name, address, and daytime telephone number of the owner, together with a brief description of any claimed defects. Parts or product for which replacement is made shall become the property of iOptron.

The customer shall be responsible for all costs of transportation and insurance, both to and from the factory of iOptron, and shall be required to prepay such costs.

iOptron shall use reasonable efforts to repair or replace any telescope, mount, or controller covered by this warranty within thirty days of receipt. In the event repair or replacement shall require more than thirty days, iOptron shall notify the customer accordingly. iOptron reserves the right to replace any product which has been discontinued from its product line with a new product of comparable value and function.

This warranty shall be void and of no force of effect in the event a covered product has been modified in design or function, or

subjected to abuse, misuse, mishandling or unauthorized repair. Further, product malfunction or deterioration due to normal wear is

not covered by this warranty.

IOPTRON DISCLAIMS ANY WARRANTIES, EXPRESS OR IMPLIED, WHETHER OF MERCHANTABILITY OF FITNESS FOR A PARTICULAR USE, EXCEPT AS EXPRESSLY SET FORTH HERE. THE SOLE OBLIGATION OF IOPTRON UNDER THIS LIMITED WARRANTY SHALL BE TO REPAIR OR REPLACE THE COVERED PRODUCT, IN ACCORDANCE WITH THE TERMS SET FORTH HERE. IOPTRON EXPRESSLY DISCLAIMS ANY LOST PROFITS, GENERAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM BREACH OF ANY WARRANTY, OR ARISING OUT OF THE USE OR INABILITY TO USE ANY IOPTRON PRODUCT. ANY WARRANTIES WHICH ARE IMPLIED AND WHICH CANNOT BE DISCLAIMED SHALL BE LIMITED IN DURATION TO A TERM OF TWO YEARS FROM THE DATE OF ORIGINAL RETAIL PURCHASE.

Some states do not allow the exclusion or limitation of incidental or consequential damages or limitation on how long an implied warranty lasts, so the above limitations and exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

iOptron reserves the right to modify or discontinue, without prior notice to you, any model or style telescope.

If warranty problems arise, or if you need assistance in using your telescope, mount, or controller contact:

iOptron Corporation
Customer Service Department
6E Gill Street
Woburn, MA 01801
www.ioptron.com
support@ioptron.com
Tel. (781)569-0200
Fax. (781)935-2860
Monday-Friday 9AM-5PM EST

NOTE: This warranty is valid to U.S.A. and Canadian customers who have purchased this product from an authorized iOptron dealer in the U.S.A. or Canada or directly from iOptron. Warranty outside the U.S.A. and Canada is valid only to customers who purchased from an iOptron Distributor or Authorized iOptron Dealer in the specific country. Please contact them for any warranty