



SmartStar[®] iEQ45[™]

Instruction Manual

Table of Content

Table of Content	2
1. Introduction	4
2. iEQ45™ Assembly	5
2.1. Parts List	5
2.2. Assembly terms	6
2.3. iEQ45 Ports	7
2.4. iEQ45 Assembly	8
3. GoToNova™ 8406 Hand Controller	14
3.1. Key Description	14
3.2. The LCD Screen	15
4. Getting Started	17
4.1. Setup the Mount and Polar Alignment	17
4.2. Setting Up the Hand Controller	17
4.2.1. Set Up Local Time	17
4.2.2. Set Up Observation Site	18
4.2.3. Set N/S Hemisphere	19
4.2.4. Initial Star Alignment	19
4.2.5. Go to the Moon	19
4.3. Turn Off the Mount	20
5. Use the iEQ45	21
5.1. Manual Operation of a Telescope	21
5.2. Slew to an Object	21
5.2.1. Planets, Sun, Moon	21
5.2.2. Deep sky objects	21
5.2.3. Comets	21
5.2.4. Asteroids	21
5.2.5. Stars:	21
5.2.6. Constellations	22
5.2.7. Enter R.A. DEC	22
5.3. Sync to Target	22
5.4. Electric Focuser	22
5.4.1. Focus:	22
5.4.2. Set Backlash Value	22
5.5. Set Up Controller	22
5.5.1. Set Up Local Time	22
5.5.2. Set Up Observation Site	22
5.5.3. Set N/S Hemisphere	22
5.5.4. Set Display Contrast	23
5.5.5. Set Eyepiece Light	23
5.5.6. Set Backlight	23
5.5.7. Set Backlash Value	23
5.5.8. Set Key Beep	24
5.5.9. Reset All	24
5.5.10. Meridian Protection	24
5.5.11. Set Language	24
5.5.12. Heating Controller	24
5.5.13. Upgrade Firmware	24
5.5.14. Firmware Version	24

5.6. Align.....	24
5.6.1. One Star Align.....	24
5.6.2. Two Star Align.....	24
5.6.3. Dis R.A axis error.....	25
5.6.4. Polaris Position.....	25
5.7. PEC Option.....	25
5.7.1. PEC Playback.....	25
5.7.2. Record PEC.....	25
5.8. Set Up Tracking.....	25
5.9. Auto Guide.....	26
5.9.1. Set Guider Rate.....	26
5.9.2. Set Guider Direction.....	26
5.10. Park Scope.....	26
5.10.1. Park Scope.....	26
5.10.2. Set Park Position.....	26
5.11. To Zero Position.....	26
6. Maintenance and Servicing.....	27
6.1. Maintenance.....	27
6.2. iOptron Customer Service.....	27
Appendix A. Technical Specifications.....	28
Appendix B. GoToNova™ 8406 HC MENU STRUCTURE.....	29
Appendix C. Firmware Upgrade.....	31
Appendix D. Use a PC to Control an iEQ45 Mount.....	32
Appendix E. GoToNova™ Star List.....	33
IOPTRON TWO YEAR TELESCOPE, MOUNT, AND CONTROLLER WARRANTY.....	40



WARNING!

NEVER USE A TELESCOPE TO LOOK AT THE SUN!

Looking at or near the Sun will cause instant and irreversible damage to your eye. Children should always have adult supervision while observing.

1. Introduction

The iEQ45 is one of the new breed of premium astro-imaging equatorial mounts from iOptron. The iEQ45 offers the next generation GoTo technology from iOptron. The mount is made of the highest quality materials to ensure stability and durability. With a payload of 45 lbs. balanced – it comes standard with a calibrated dark field illumination polar scope and a sturdy 2-inch stainless steel tripod. It also fits both Vixen and Losmandy-type mounting plates. Its lighter weight (only 25 lbs.) makes it much easier to carry.

Features:

- Specialized astrophotography mount ideal for entry-level and intermediate astrophotographers
- Portable, compact, and sturdy German equatorial mount with the highest Payload/Mount ratio (1.7) in the category
- Payload: 45 lbs (exclude counterweight)
- Mount weight: 25 lbs
- Ultra-accurate tracking with temperature-compensated crystal oscillator (TCXO)
- FlexiTouch™ Gap-free structure for both R.A. and DEC worm gears
- Resolution: 0.09 arc second
- #8406 controller with Advanced GoToNova™ GoTo Technology and heating mechanism
- Permanent periodic error correction (PEC)
- Built-in 32-channel GPS
- Integrated ST-4 autoguiding port capable of reverse guiding with auto-protection
- Calibrated polar scope with dark-field illumination and easy polar alignment procedure, allowing for fast and accurate polar alignment
- iOptron Port for electronic focuser, laser pointer, dorm control
- RS232 port for computer control via ASCOM platform
- RS485 new command set completely open for user-defined control of the mount
- Heated hand controller for low temperature operation as low as -20°C
- Fits with both Vixen and Losmandy-type mounting plates
- 2 inch heavy-duty stainless steel tripod
- Optional pier
- Comes standard with: Vixen and Losmandy-D saddles, 2 x 5kg counterweight, AC adaptor (100~240V), 12V DC car plug adaptor, USB cable and RS232 Cable.

2. iEQ45™ Assembly

2.1. Parts List

There are two shipping boxes. One box contains an EQ mount, an 8406 hand controller, a Vixen-type dovetail saddle (attached to the mount) and a Losemandy-D dovetail saddle. One box contains a tripod and two 5kg counterweights.



Figure 1. EQ mount box

Other parts in the tripod box:

- 2 coiled controller cable
- Dark field illuminating LED with cable
- AC adapter (100V~240V)
- 12V DC adapter cable with car lighter plug
- USB Cable
- RS232 cable
- 6mm, 5mm and 2mm hex keys
- 4 M6 hex head screws



Figure 2. Included accessories

2.2. Assembly terms

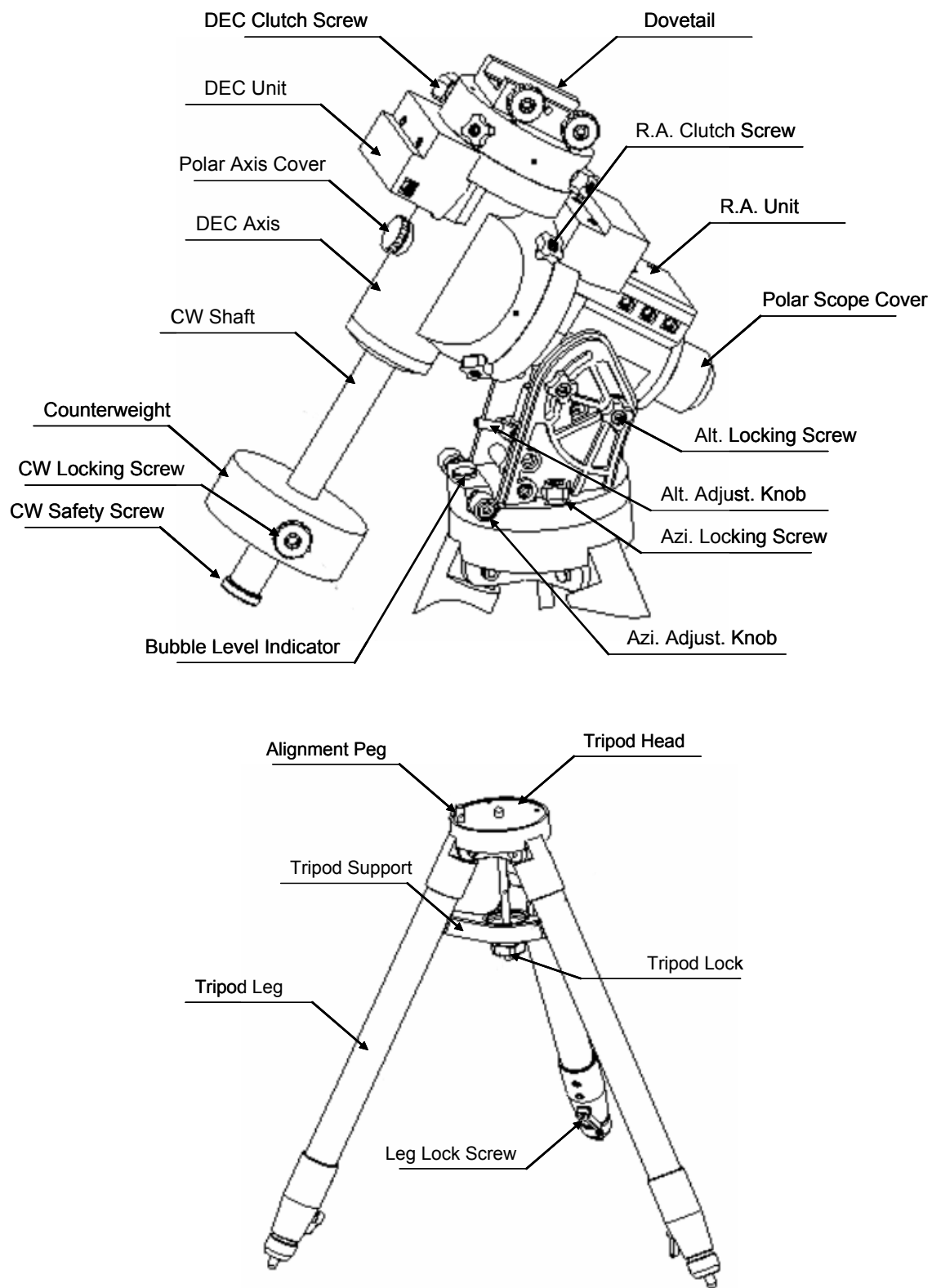


Figure 3. iEQ45 assembly terms (mount and tripod)

2.3. iEQ45 Ports

Ports on R.A. Unit



Figure 4. Ports on R.A. drive unit

- Dec: For connecting to DEC driver unit
- iOptron port: For connecting to other iOptron accessories, such as electronic focuser, laser pointer, dorm control
- HBX: For connecting to 8406 Hand Controller
- Reticle: Power supply for Polar Scope dark field illumination LED
- Power DC 12V: AC adapter power plug
- ON/OFF Switch: Power switch
- Guide: Autoguiding port for ST-4 compatible guiding cameras
- RS232: Series port for ASCOM control and main board firmware upgrade

Port on DEC Unit

The only port on DEC unit is used to connect to the Dec port on R.A. unit.

2.4. iEQ45 Assembly

STEP 1. Setup tripod:

Extend the tripod and lock the Tripod Support so that the tripod legs stay open (Figure 5). Adjust the tripod height by unlocking and re-locking the tripod Leg Lock Screws to desired lengths. Turn the tripod to make sure that the Alignment Peg faces North. If you are located in south hemisphere, please face the Alignment Peg South. **(To prevent counterweights hitting the tripod legs, you may move the Alignment Peg to the opposite position if used at latitude below 20°. If you are at below 10°, a pier would be recommended.)**

STEP 2. Attach the EQ mount:

Carefully take the EQ mount out of the shipping box. Retract the Azimuth Adjustment Knobs (next to the Bubble Level Indicator) to allow enough clearance for the mount to fit on the tripod head. Unscrew three Azimuth Locking Screws (Figure 6; don't lose the Teflon washers). Put the mount onto the Tripod Head with Bubble Level Indicator on top of the Alignment Peg (Figure 7). Put the Teflon washers and Azimuth Lock Screws back and tighten them. Level the tripod base by adjusting individual leg. You may use the build-in Bubble Level Indicator or an external torpedo level to check leveling.

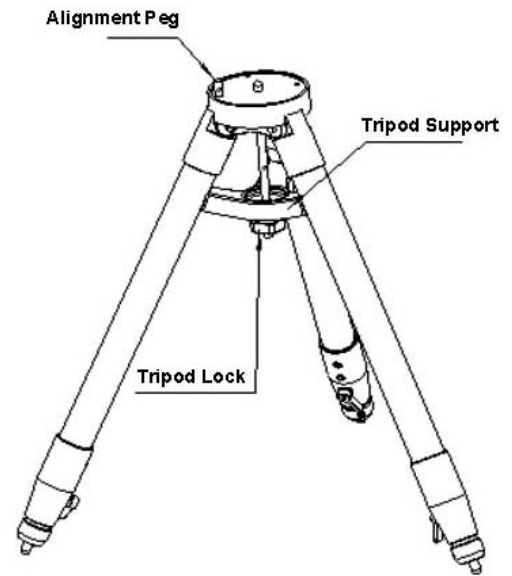


Figure 5

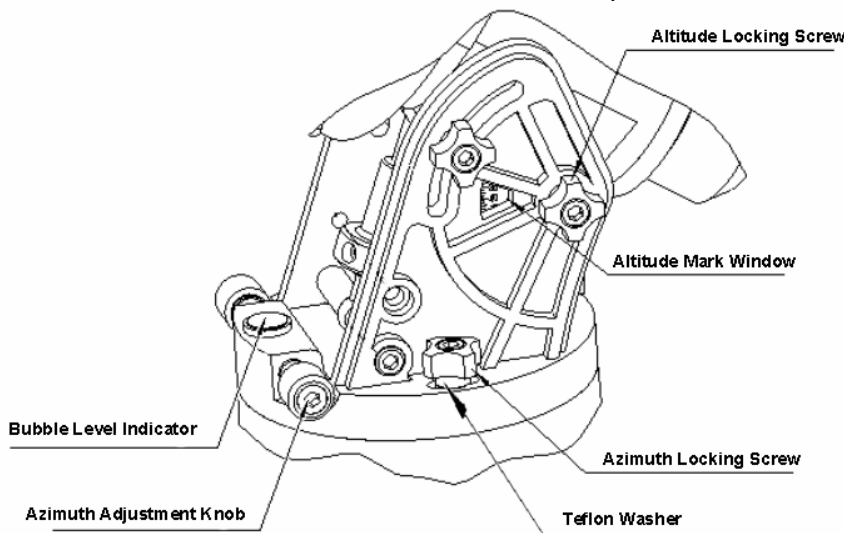


Figure 6

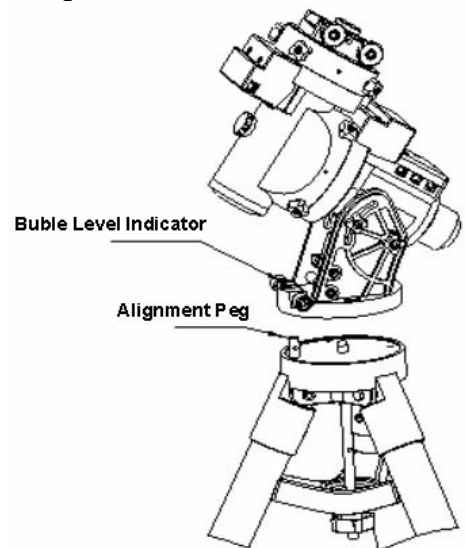


Figure 7

STEP 3. Set the altitude range:

Unlock four R.A. Clutch Screws and rotate the mount 180° around the R.A. axis (Figure 8) to move the dovetail saddle face upside. Tighten the R.A. Clutch Screws. Un-screw the Altitude Adjustment Lever from Altitude Adjustment Knob (Figure 9). Turn the Altitude Adjustment Knob to set your current altitude, which is displayed in Altitude Mark Window, using the Altitude Adjustment Lever for a fine adjustment if needed. Caution: For safety reasons, always adjust the altitude without load.

If your altitude is between 5° to 40°, set the Altitude Adjustment Knob to the lower position (factory default position, Figure 9). An Altitude Safety Block has to be installed (Figure 10. A hex key to release and secure the screw is included).

If your altitude is between 35° to 70°, take the Altitude Safety Block off. Set the Altitude Adjustment Knob to the upper position. *It is recommended to change the position before attaching the mount to the tripod head.*

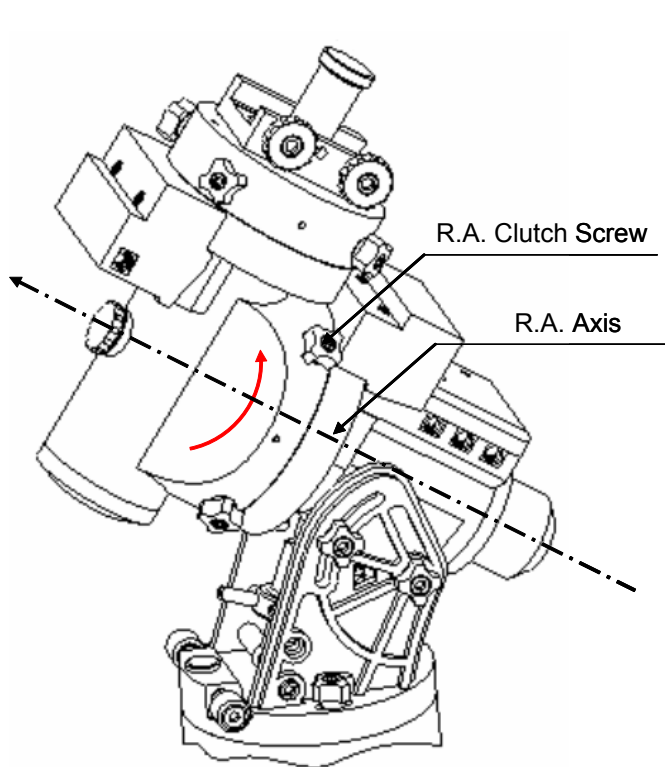


Figure 8

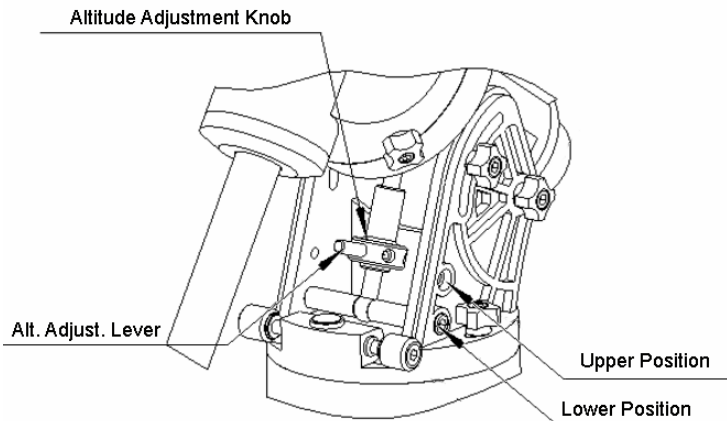


Figure 9

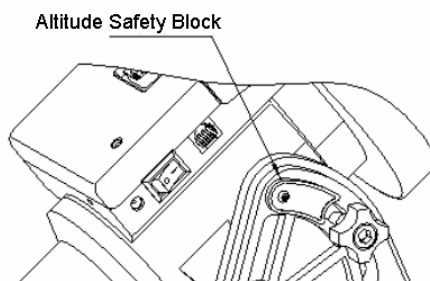


Figure 10

STEP 4. Attach counterweight (CW) shaft:

Unscrew the CW shaft from the top of the mount (Figure 11 left) and thread it into the opening of the DEC axis (Figure 11 right).

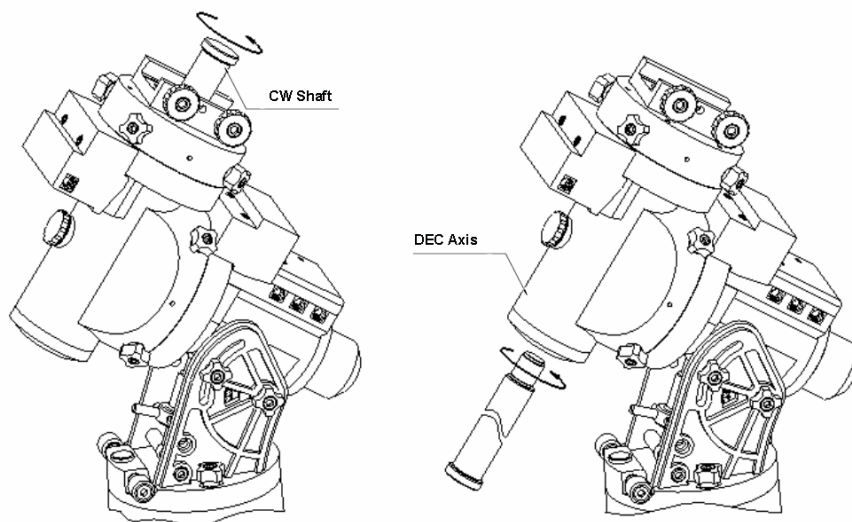


Figure 11

STEP 5. Attach dovetail adapter:

Both Vixen and Losmandy-D dovetail saddles have been included for your convenience. Two M6x14 hex head screws are used for the Vixen dovetail saddle. Additional four M6x14 screws are provided for Losmandy-D saddle installation. Customer-made large adapter can also be installed. Shown in Figure 12 is the mounting hole distribution on the mount.

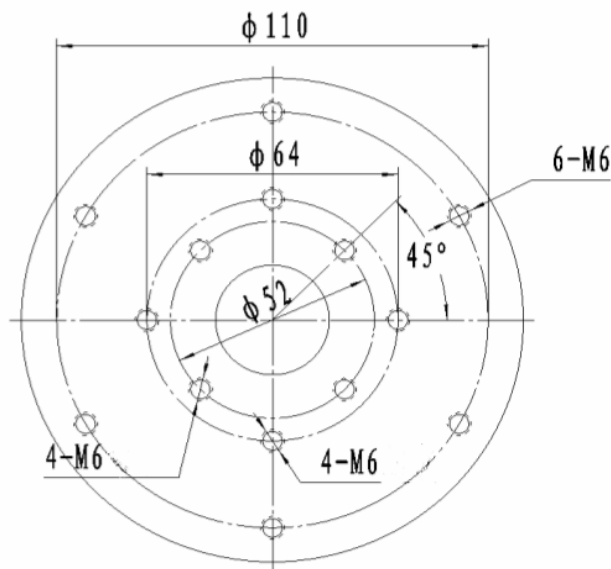


Figure 12

STEP 6. Install counterweight(s):

iEQ45 comes with two 5kg counterweights. Use just one or both of them for your particular OTA (Optical Tube Assembly).

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 onto the shaft (see Figure 13a). Tighten the locking screw on the CW to hold the CW in place. Tighten the CW Safety Screw. **Caution: For safety reasons, the CW Safety Screw must always be tightened to prevent the CW dropping off the CW shaft.** An optional CW shaft extension is available for purchase (Figure 13b).

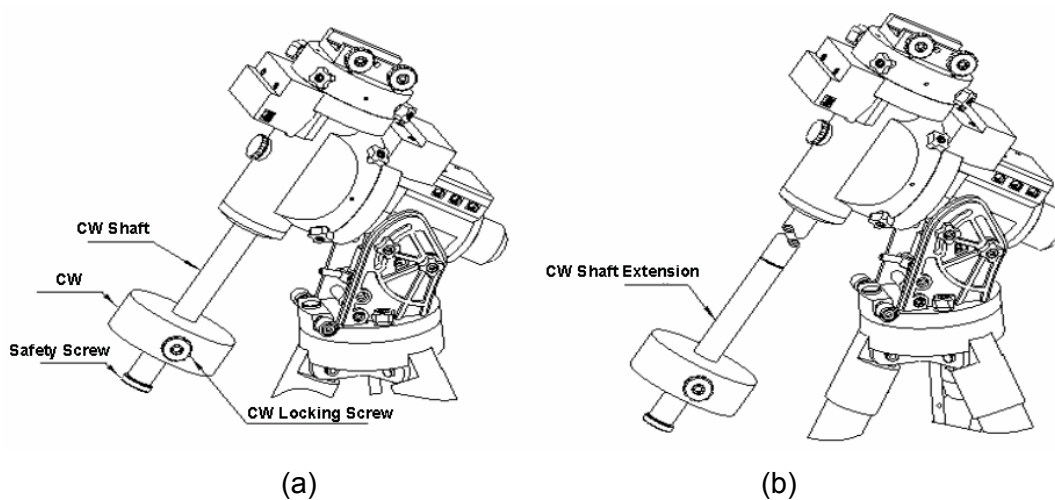


Figure 13

STEP 7. Attach an OTA to mount and balance:

After attaching an OTA and accessories to the mount, the mount must be balanced to ensure minimum stress on the mount (such as gears and motors inside). There are four (4) Clutch Screws on both R.A. and DEC axes. Each axis can rotate freely after the related clutch screws are released. The balance should be performed after the counterweight(s) and telescope, as well as any accessories, are installed. *Caution: The telescope may swing when the RA or DEC clutch screws are released (if the mount is not balanced). Hence you should hold onto the scope before you release the clutch screws to prevent it from swinging.*

Balance the mount in DEC

Release 4 R.A. Clutch Screws, rotate the R.A. axis to make the DEC axis in horizontal position, as shown in Figure 14a, with telescope on either side. Tighten the R.A. Clutch Screws. Then release 4 DEC Clutch Screws and put the telescope in horizontal position (Figure 14b). If the telescope has a tendency to rotate about the DEC axis, you may have to slide the telescope back and forth to make it balanced in level position. Retighten the DEC Clutch Screws.

Balance the mount in R.A.

Release 4 R.A. Clutch Screws. If the DEC axis can stay in the level position, it means the R.A. axis is well balanced. Otherwise, release the CW Locking Screw and move the CW back and forth to make the R.A. axis balanced. Re-secure the CW Locking Screw. Return the mount to the position with the counterweight bar points to the ground and telescope points to North Celestial Pole and tighten both R.A. and DEC Clutch Screws.

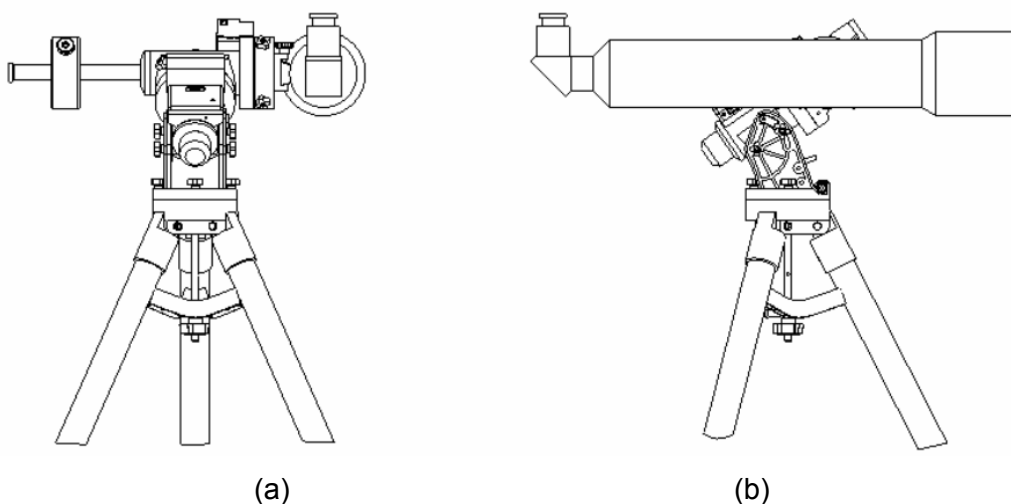


Figure 14

STEP 8. Connect cables:

Attach one end of an RJ-11 cable into the socket on the side of the DEC unit and the other end into the DEC socket located on R.A. unit. Using another RJ-11 cable to connect the hand controller and the HBX socket located on the R.A. unit. Plug 12V DC power supply into the POWER socket on R.A. unit. The red LED will be on when the power switch is turned on.

STEP 9. Polar alignment:

In order for an equatorial mount to track properly, it has to be accurately polar aligned. With the iOptron innovative Polar Scope and Quick Polar Alignment procedure, you can do a fast and accurate polar alignment.

Polar axis adjustment: Loosen three Azimuth Locking Screws, 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 Altitude Lock Screws on the side of the mount, turning the Altitude

Adjustment Knob so that the altitude reading from the Altitude Mark Window is set to your local altitude. Use the Lever for a fine altitude adjustment. Re-tighten the locking lock screws.

Quick Polar Alignment:

- (1) Turn the mount power on by pressing the On/OFF switch on R.A. unit. After GPS OK is shown at the upper right corner on the hand controller, the LCD will display the Polaris Position (as shown in Figure 16(a)). You also can show this chart by pressing MENU button, then select “**Align**” and “**Polaris Position**” if you are practicing inside or when there is no GPS signal. For example, on May 30, 2010, 20:00:00 in Boston, US (alt N42°30’32” and long W71°08’50”), 300 min behind UT, the Polaris Position are 1h26.8m and 41.5m.
- (2) Take off the Polar Axis Cover and Polar Scope Cover;
- (3) Remove the protection tape on the thread-in hole located on the Polar Scope. Then thread the dark field illuminating LED end into the thread-in hole and plug the other end into the Reticule socket located on the R.A. unit. The illumination intensity can be adjusted using the HC via “**Set Eyepiece Light**” function under “**Set Up Controller**” menu;
- (4) Using UP or DOWN button to turn the DEC axis to unblock the Polar Scope view (there is a hole on the DEC axis);
- (5) Using LEFT or RIGHT button to turn the RA axis to rotate the Polar Scope dial to a clock position where 12 is at the top, as shown in Figure 15;

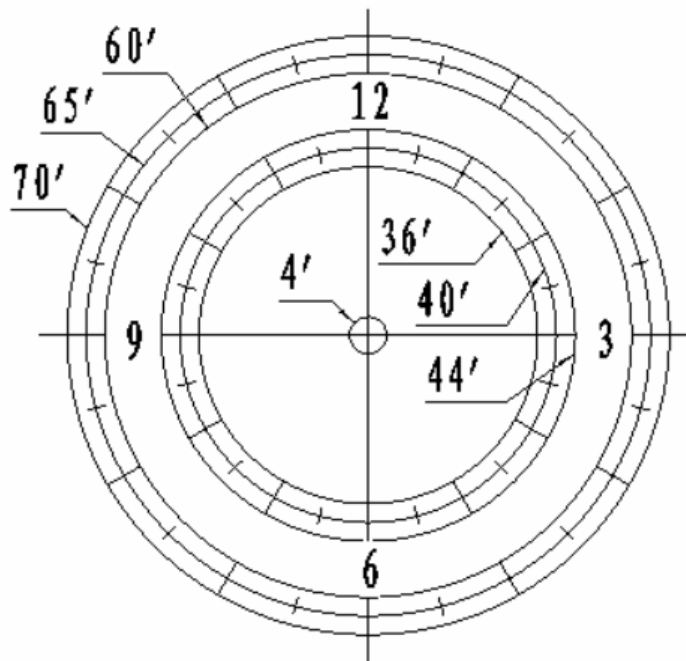
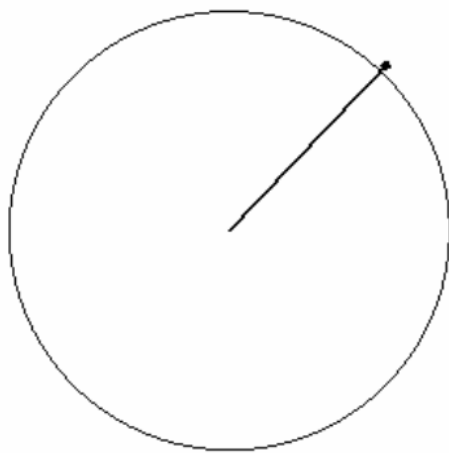


Figure 15

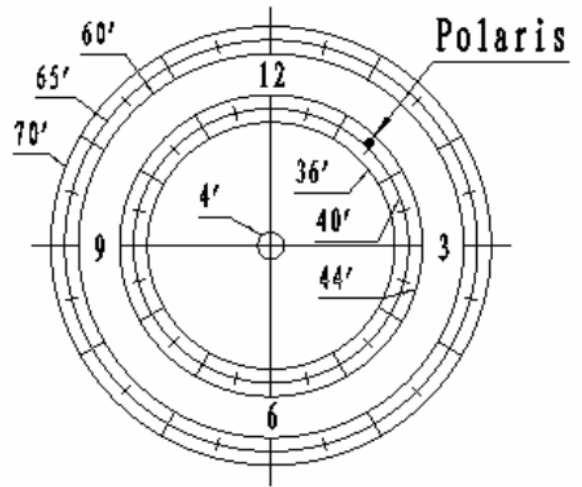
- (6) Follow Polar Axis Adjustment procedure (**not the hand controller**) to adjust the mount in altitude and azimuth direction and to put the Polaris in same position on the Polar Scope Dial as indicated on the HC LCD, as shown in Figure 16 (b).



Polaris
Position

1h 26.8m
r= 41.5m

(a)



(b)

Figure 16

Adjust the mount to Zero Position: The Zero Position is the position where the counterweight shaft pointing to ground, telescope at the highest position with its axis parallel to the polar axis and the telescope pointing to the North Celestial Pole. Loosen and re-tighten four (4) DEC Clutch Screws on DEC axis and four (4) R.A. Clutch Screws on R.A. axis to adjust the mount to the Zero Position.

3. GoToNova™ 8406 Hand Controller



Figure 17. GoToNova 8406 Hand Controller

GoToNova™ 8406 hand controller (HC) is the standard controller for an iEQ45 mount, as shown in Figure 17. It has integrated temperature controller that ensures it can be operated below 20°C (-4°F).

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 move 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 in operating 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 iEQ45 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 LCD screen, which displays all the information as shown in Figure 18. The user interface is simple and easy to learn.

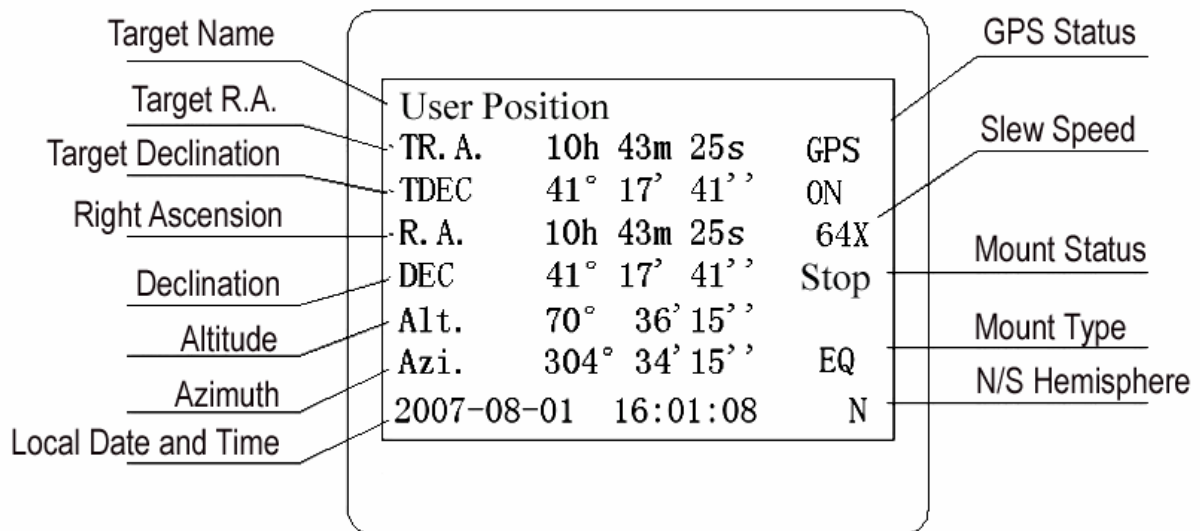


Figure 18. 8406 HC LCD Information Screen

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 is currently slewing, GOTO or tracking;
 - User R.A. DEC. Now: The mount is slew 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 (zenith is 90°).
7. Azimuth: Azimuth of the telescope (north is 0°, east 90°, south 180°, and west 270°).
8. Local Date and Time: display local time in a format of YY-MM-DD HH:MM:SS.
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(1°/sec), 512X(2°/sec), MAX(~ 4°/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 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

Assemble your iEQ45 mount according to 2.4: steps 1 ~ 6. Mount an OTA and accessories, and carefully balance the mount around the polar axis, as indicated in 2.4: steps 7. Turn the mount power switch on. After the GPS status change to GPS OK when the GPS receiver is connected to satellites, the LCD will display the Polaris Position chart. Follow Section 2.4: step 8 and 9 to do the Polar Alignment. If you already done so or the mount has not been moved from previous observation spot, press the BACK button to exit to the main menu.

The default mount position for the mount is the Zero Position 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. Setting Up the Hand Controller

An iEQ45 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.

4.2.1. 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 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.

4.2.2. 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 N47°31'48": $47.53^\circ = 47^\circ + 0.53^\circ$, $0.53^\circ = 0.53 \times 60' = 31.8'$, $0.8' = 0.8 \times 60'' = 48''$. Therefore, $47.53^\circ = 47^\circ 31' 48''$ 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 HC memory chip. If you are not traveling to other observation site, they do not need to be changed.

4.2.3. 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.

```
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.

```
North hemisphere
South hemisphere
```

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

4.2.4. 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 slew 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 the Polaris, press MENU button, scroll down to “**Sync. To Target**”, follow the on-screen instruction to center the Polaris and press ENTER. You may need to use the number keys to change the slewing speed to make the centering procedure easier.

4.2.5. 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 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. Use the arrow keys to center the Moon in your eyepiece if it is not centered. Or for better performance use “**Sync to Target**.”

4.3. 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 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. Use the iEQ45

5.1. Manual Operation of a Telescope

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

After the telescope was assembled (referring to Section 2. Telescope Assembly), 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. You may need to use the number keys to change the slewing speed. Simply press a number while slewing to change the slew speed.

5.2. 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.

5.2.1. Planets, Sun, Moon

There are 10 objects in the Solar system catalog.

5.2.2. 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 attached in Appendix E.
- Messier Catalog: consists of all 110 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 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.

5.2.3. Comets

This catalog contains 233 comets.

5.2.4. Asteroids

This catalog contains 231,665 asteroids.

5.2.5. Stars:

- Named Stars: consists of 191 stars with their common names. They are listed alphabetically. A list is attached 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.

5.2.6. Constellations

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

5.2.7. Enter R.A. DEC

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

5.3. Sync to Target

This operation will match the telescope's current coordinates to Target Right Ascension and Declination. After slew 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 previous performed “**Two Star Align**” operation.

5.4. Electric Focuser

If you have an electric focuser in your system and it is supported by GoToNova, use this option to adjust the focuser. Refer to your Electric Focuser operation manual for detailed instruction.

5.4.1. Focus:

Use ◀▶ for coarse tuning and ▼▲ for fine tuning.

5.4.2. Set Backlash Value

Set backlash value for the electric focuser. Move the cursor to each digit and use the number keys to input number directly to adjust the backlash.

5.5. Set Up Controller

5.5.1. Set Up Local Time

Refer to 4.2.1.

5.5.2. Set Up Observation Site

Refer to 4.2.2.

5.5.3. Set N/S Hemisphere

Refer to 4.2.3.

5.5.4. Set Display Contrast

Use arrow keys to adjust LCD display contrast.

5.5.5. 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.

5.5.6. Set Backlight

Adjust LCD and keypad backlight.

5.5.7. 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"

```
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. A R.A. anti-backlash screen will display:

```
R.A. anti-backlash:
    0000 steps
```

To adjust steps move the cursor to each digit and use the number keys to input number directly. It is about 0.09 arc seconds per step for R.A. backlash. Press ENTER – "DEC anti-backlash" will display:

```
DEC anti-backlash:
    0000 steps
```

Move the cursor to each digit and use the number keys to set the anti-backlash. It is about 0.1 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.

5.5.8. Set Key Beep

Turn the key beep on/off.

5.5.9. Reset All

Reset all settings to factory default data.

5.5.10. Meridian Protection

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 keep tracking and the OTA could hit the tripod leg if the mount is not monitored.

5.5.11. Set Language

Select hand controller language from English or French.

5.5.12. Heating Controller

Turn on/off the controller internal heater.

5.5.13. Upgrade Firmware

Use this operation to upgrade 8406 hand controller firmware and iEQ45 main control board firmware. Please refer to Appendix C. Firmware Upgrade for details.

5.5.14. Firmware Version

Will display hand controller firmware version.

5.6. 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.

5.6.1. 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. After confirm that the mount is at "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.

5.6.2. Two Star Align

Two star alignment will increase the GOTO accuracy of the mount. It has to be done after one star alignment. 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. After confirm that the mount is at "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, two star alignment is finished. You can reject the suggested star if it is blocked by a tree or behind the house.

After two star align, a pointing error between R.A. axis and 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**.”

5.6.3. Dis R.A axis error

This displays pointing error between R.A. axis and polar axis. Point error is zero when you power on the mount (unless you “Park Telescope” before powering off).

5.6.4. Polaris Position

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

5.7. PEC Option

5.7.1. PEC Playback

You can turn “**PEC Playback On**” while you do the tracking, especially for long time astrophotography. The default status is PEC Playback Off when the mount is turned on.

5.7.2. Record PEC

Any EQ mount that uses worm gears without install high precision optical encoders on the axis will have periodic error. Periodic Error Correction (PEC) is a system that improves the tracking accuracy of the drive by reducing the number of user corrections needed to keep an object centered in the eyepiece. PEC is designed to improve photographic quality by reducing the amplitude of the worm errors without autoguiding.

In order to use the PEC function, the GoToNova hand controller needs to record the PE first. The periodic error of the worm gear drive will be stored and used to correct periodic error. There is no need to record the PE value again unless it is necessary, such as wearing of worm gear after long time using.

Here’s how to use the PEC function.

1. Setup the mount with a telescope in autoguiding condition by connecting a guiding camera to a computer via ST-4 autoguidng port or ASCOM protocol;
2. Press MENU, select “**Auto Guide**” and press ENTER. Select a guiding speed from 0.10X to 1.00X;
3. Then press the BACK button and select “**PEC Option**” from the menu. Use the ▲ and ▼ scroll buttons to display the “**Record PEC**” option and press ENTER. Once ready to begin recording, press the ENTER button again to begin.
4. It takes the worm gear 400 seconds to make one complete revolution. After 400 seconds PEC will automatically stop recording. The PEC value will permanently stored inside PEC chip on R.A. motor drive until a new data are recorded.
5. If you want to re-record the periodic error, select “**Record PEC**” and repeat the recording processes again. The previously recorded information will be replaced with the current information.

5.8. Set Up Tracking

A user 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.

5.9. Auto Guide

5.9.1. 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.

5.9.2. Set Guider Direction

The Guide Port iEQ45 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 19.

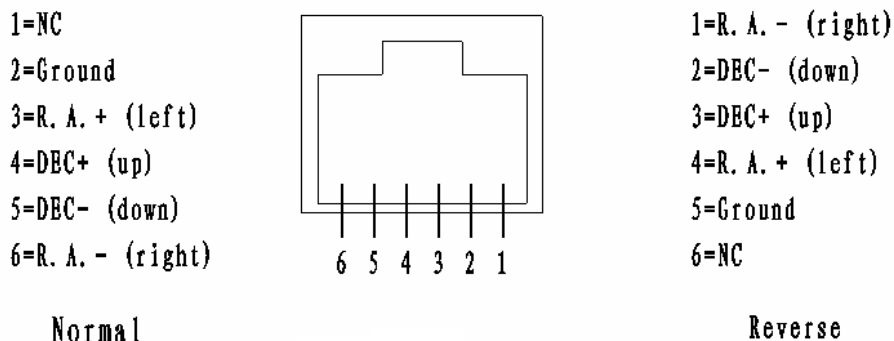


Figure 19

5.10. Park Scope

5.10.1. Park Scope

Park the mount to a preset parking position.

5.10.2. 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 do a "One Star Align" before GOTO 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 perform Park Scope operation, all the reference info will be lost.

5.11. To Zero Position

This moves your telescope to Zero Position. When power is turned on--the mount assumes the physical position is the Zero Position. This is its reference point for all other objects.

6. Maintenance and Servicing

6.1. Maintenance

The iEQ45 is designed to be maintenance free. Do not overload the mount. Do not drop the mount which will damage the mount or affect 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.

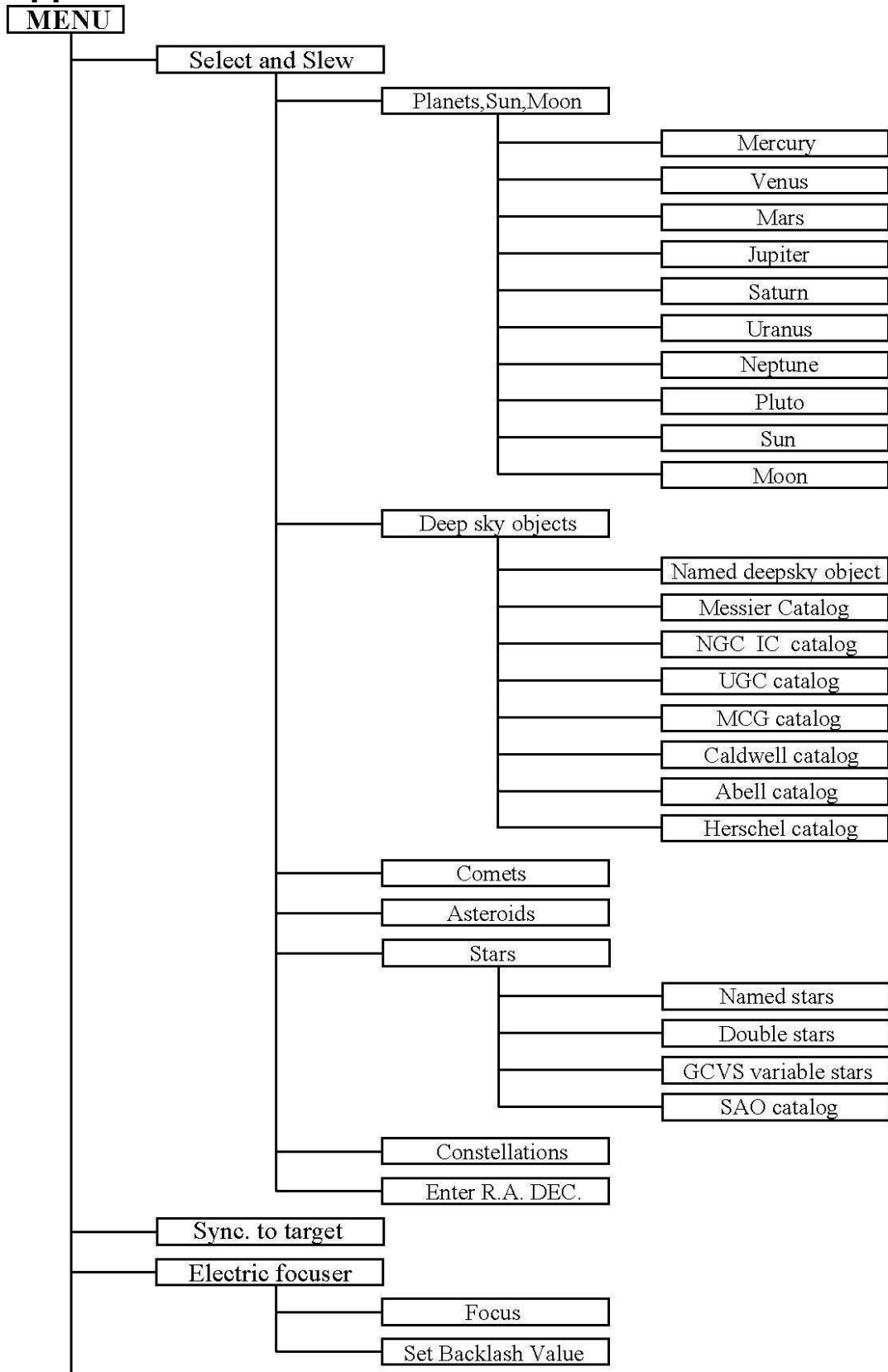
6.2. iOptron Customer Service

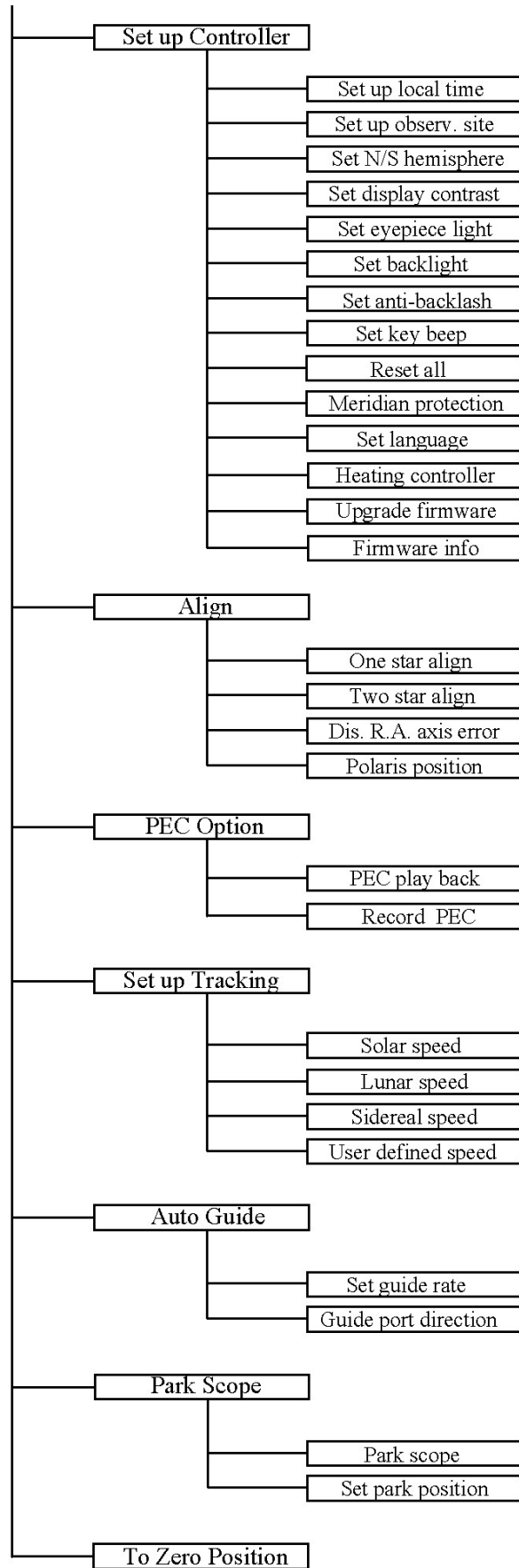
If you have any question concerning your iEQ45 contact iOptron Customer Service Department. Customer Service hours are 9:00 AM to 5:00 PM, Eastern Time, Monday through Friday. In the unlikely event that the iEQ45 requires factory servicing or repairing, write or call iOptron Customer Service Department 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.

Appendix A. Technical Specifications

Mount	German Equatorial Mount
Payload	45 lbs (20kg)
Mount weight	11.4kg
Payload/Mount weight	1.75
Ascension worm wheel	Φ130mm, 216 teeth aluminum
Declination worm wheel	Φ115mm, 192 teeth aluminum
Worm gears	Brass
Ascension axis shaft	Φ50mm
Declination axis shaft	Φ40mm
Motor drive	Planet reducer DC servo with encoder
Resolution	0.09 arc seconds
Transmission	Synchronous belt/Gear
Latitude adjustment range	5° ~ 70°
Azimuth adjustment range	± 6°
GPS	Internal 32-channel GPS
Polar Scope	Yes. (with dark field illumination)
Level indicator	Precision bubble
Hand Controller	GoToNova™ 8406 with 580,000 objects database
PEC	Permanent PEC
Tracking	Automatic
Speed	1×,2×,8×,16×,64×,128×,256×,512×,MAX(~4°/sec)
Counterweight bar	Φ28mm
Counterweight	5kg X 2 (included)
Tripod	2" Stainless Steel (7.5kg)
Dovetail	3.5"VIXEN and 8"LOSMANDY-D Saddles included
Power consumption	0.2A(Tracking), 1A(Slew)
Power requirement	12V DC(11 ~ 15V), 2Amp
AC adapter	100V ~ 240V (included)
USB port	Yes (on hand controller)
RS232 port	Yes (on mount)
Autoguide port	Yes
Firmware upgrade	Yes
PC computer control	Yes (ASCOT and RS485)
Operation temperature	-20°C ~ 40°C

Appendix B. GoToNova™ 8406 HC MENU STRUCTURE





Appendix C. Firmware Upgrade

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

To upgrade i8406 hand controller firmware:

- (1) Download the newest version of 8406 hand controller firmware (i8406.iop) from iOptron 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 connecting 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 iEQ45 mount to finish hand controller firmware upgrade.

To upgrade iEQ45 main control board firmware:

- (1) Download iOptron Downloader 2.01 from iOptron website and save it on your desktop;
- (2) Double click on iOptron Downloader 2.01 to install it;
- (3) Download the newest version of iEQ45 main control board firmware (iEQ45_main_VX.XX.bin) from iOptron website, save it on your desktop;
- (4) Connect iEQ45 RS232 port to your computer's serial port using supplied RS-232 cable;
- (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 an USB to RS-232 converting cable, the COM port number might be different.)
- (7) Double click on "iOptron Download 2.01" icon to start the program;
- (8) Select the Serial Port, here is COM1. Open the data file, here is iEQ45_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.

Appendix D. Use a PC to Control an iEQ45 Mount

The iEQ45 mount can be connected to a computer using supplied RS232 cable, if you PC equipped with a serial port. A RS232 to USB adapter is needed if you computer, like most of the laptops today. Follow the adapter instruction for detailed information.

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

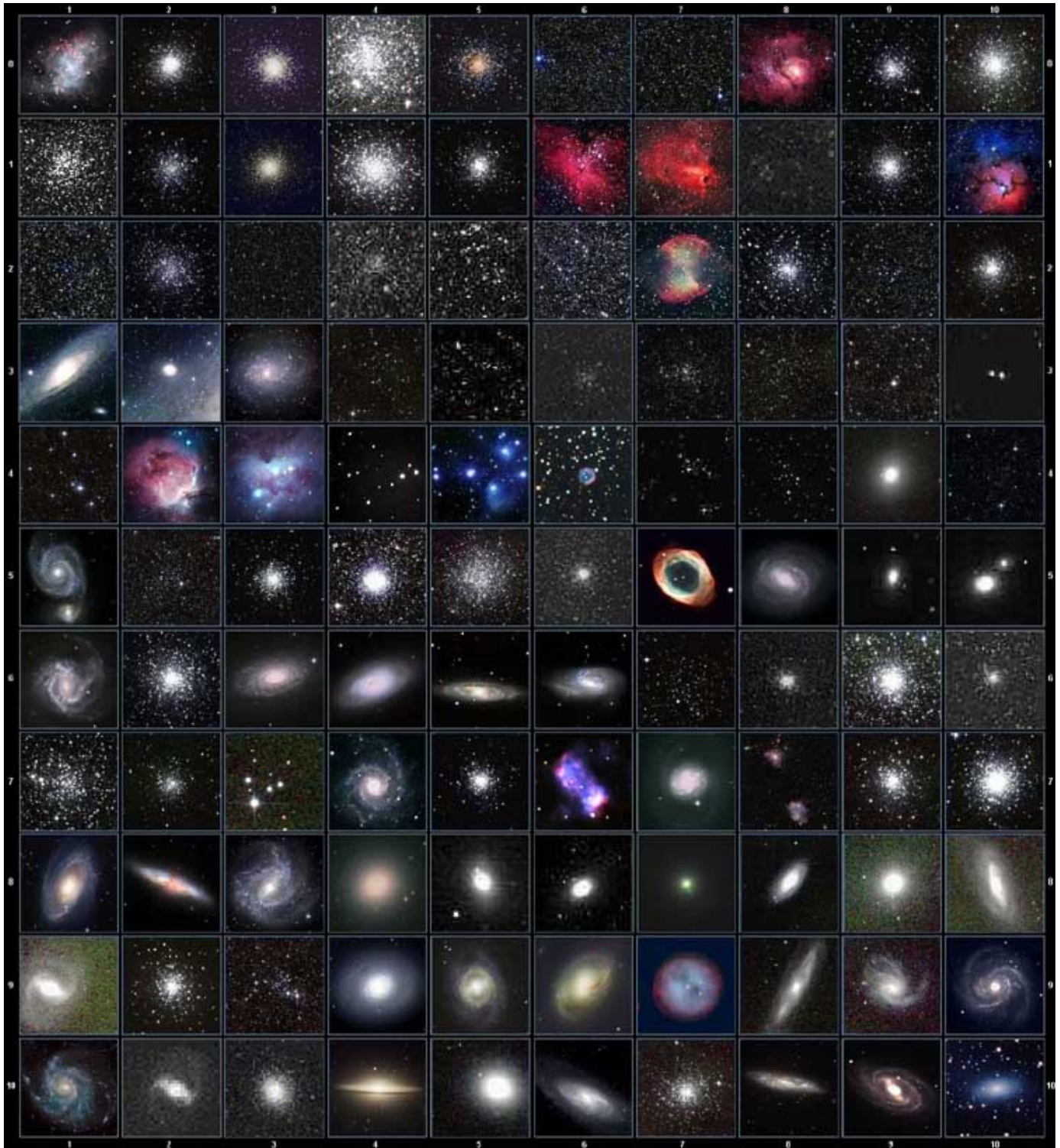
To control the mount via ASCOM protocol, you need:

1. Download and install ASCOMPlatform5b.msi from <http://www.ascom-standards.org/>
2. Download and install ASCOMPlatform5.5.1 Update from <http://www.ascom-standards.org/>.
3. Download and install iOptron Telescope ASCOM drive 1.03b from iOptron website, click on **Support**, select **ASCOM Driver**.
 - Please remove previous installed iOptron ASCOM driver before installation
 - If your computer does not have a Visual C++ 2008 SP1 Redistribute, which gave an error message during ASCOM installation, you need download and install one from http://download.microsoft.com/download/d/d/9/dd9a82d0-52ef-40db-8dab-795376989c03/vcredist_x86.exe.
4. Planetarium software support ASCOM protocol. Follow software instruction to select iOptron Telescope.

Some company has 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



This table is licensed under the [GNU Free Documentation License](#). It uses material from the [Wikipedia article List of Messier objects](#)

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 Mabsuta	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 Alkaluops	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 Giasar	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 Zubeneshamali
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)	ID No.	OBJECT	NGC #	Messier#	IC#	A(Abell)	U(UGC)
1	Andromeda Galaxy	224	31				31	Hind's Variable Nebula	1555				
2	Barnards Galaxy	6822					32	Hubble's Variable Nebula	2261				
3	Beehive Cluster	2632	44				33	Integral Sign Galaxy					3697
4	Blackeye Galaxy	4926	64				34	Jewel Box Cluster	4755				
5	Blinking Planetary Nebula	6826					35	Keyhole Nebula	3372				
6	Blue Flash Nebula	6905					36	Lagoon Nebula	6523	8			
7	Blue Planetary	3918					37	Little Gem	6445				
8	Blue Snowball Nebula	7662					38	Little Gem Nebula	6818				
9	Box Nebula	6309					39	Little Ghost Nebula	6369				
10	Bubble Nebula	7635					40	North American Nebula	7000				
11	Bipolar Nebula	6302					41	Omega Nebula	6618	17			
12	Butterfly Cluster	6405	6				42	Orion Nebula	1976	42			
13	California Nebula	1499					43	Owl Nebula	3587	97			
14	Cat's Eye Nebula	6543					44	Pelican Nebula			5070		
15	Cocoon Nebula			5146			45	Phantom Streak Nebula	6741				
16	Cone Nebula	2264					46	Pinwheel Galaxy	598	33			
17	Cork Nebula	650-51	76				47	Pleiades		45			
18	Crab Nebula	1952	1				48	Ring Nebula	6720	57			
19	Crescent Nebula	6888					49	Ring Tail Galaxy	4038				
20	Draco Dwarf					10822	50	Rosette Nebula	2237				
21	Duck Nebula	2359					51	Saturn Nebula	7009				
22	Dumbbell Nebula	6853	27				52	Sextans B Dwarf					5373
23	Eagle Nebula		16				53	Small Magellanic Cloud	292				
24	Eight-Burst Nebula	3132					54	Sombrero Galaxy	4594	104			
25	Eskimo Nebula	2392					55	Spindle Galaxy	3115				
26	Flaming Star Nebula			405			56	Tank Track Nebula	2024				
27	Ghost of Jupiter	3242					57	Trifid Nebula	6514	20			
28	Great Cluster	6205	13				58	Ursa Minor Dwarf					9749
29	Helix Nebula	7293					59	Whirlpool Galaxy	5194	51			
30	Hercules Galaxy Cluster				2151		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	lot	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	lot	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	lot	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	lot	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	lot	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	lot	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	lot	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	lot	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	

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Fax. (781)935-2860
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