iOptron® CEM60 Center-Balanced Equatorial Mount

Instruction Manual

Product #7200 and#7201

Read the included CEM60 Quick Setup Guide BEFORE taking the mount out of the case!

This product is a precision instrument and uses a magnetic gear meshing mechanism. Please read the included QSG before assembling the mount. Please read the entire Instruction Manual before operating the mount.

You must hold the mount firmly when disengaging or adjusting the gear switches. Otherwise personal injury and/or equipment damage may occur. Any worm system damage due to improper gear meshing/slippage will not be covered by iOptron limited warranty.

If you have any questions please contact us at support@ioptron.com

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 using a telescope.

Table of Content

Ver. 1.0

1. CEM60 Overview

Welcome to a new type of EQ mount- The iOptron® Center-Balanced Equatorial Mount, CEM! Its unique balance design puts the payload at the center of gravity allowing for greater natural stability. This also means the mount is extremely light compared to its payload—a nice benefit when setting up at a remote site. The adjustable counterweight bar prevents the counterweight from getting in the way of the tripod or pier when operating at a low latitude position. Polar aligning is quick and accessible all the time since the polar scope is not blocked by the declination shaft.

The CEM60™ mount is equipped with the most advanced GOTONOVA® GOTO technology, making it one of the most powerful and accurate GOTO mounts available. The database of a Go2Nova® 8407 hand controller has over 300,000 objects. The other features include a magnetically loaded gear system, gear switches on both R.A. and DEC axes, a screw/worm type latitude adjuster and a built-in or customized cable management system. The CEM60-- a new category (and payload capacity) of mounts for viewing and astrophotography!

Features:

- A new design, center-balanced equatorial mount (CEM) for maximum payload and minimum mount weight
- Specialized astrophotography mount ideal for both visual observers and astro-photographers
- Patent pending non-contact magnetically loaded gear system
- Payload of 60 lbs (27.2 kg) with the mount-only weight of 27 lbs (12.3 kg)
- Gear switches on both R.A. and DEC axes for easy balancing
- Adjustable counterweight shaft for low latitude operation
- Screw/worm type latitude adjuster for precision adjustments
- Milling machine tooling vise type latitude bearing and lock system for rock solid positioning
- Azimuth fine adjusters for easy azimuth adjustment
- Precision stepper motor with 0.06 arc-sec accuracy for precise GOTO and accurate tracking
- Permanent periodic error correction (PPEC) (#7200) or Real-time periodic error correction (RPEC) (#7201)
- iOptron AccuAligning™ calibrated polar scope with dark-field illumination and easy polar alignment procedure for fast and accurate polar alignment
- Polar alignment routine for those who can't see the Pole Star
- Go2Nova® 8407 controller with Advanced GOTONOVA® GOTO Technology an built-in heater
- Integrated ST-4 compatible autoguiding port
- Built-in 32-channel Global Positioning System (GPS)
- Built-in or customized cable management system
- Spring loaded Vixen/Losmandy dual saddle
- 150mm base size to match optional 2 inch heavy-duty stainless steel tripod (8kg) or 42/48 inch pier
- Optional PowerWeight™ rechargeable battery pack

2. CEM60 Terms

2.1. Parts List[1]

SHIPPING CONTENTS

There are two shipping boxes for a CEM60 mount. One box contains an aluminum carrying case with a mount, either CEM60 (#7200) or CEM60-EC (#7201) mount head, a hand controller, a counterweight shaft and accessories, including a counterweight pin and locking screws. The other box is for a 21lbs (9.5kg) counterweight. The contents are listed below:

- iOptron® CEM60 telescope mount (#7200, with silver adjustment knobs) or iOptron® CEM60-EC mount (high precision model #7201, with red adjustment knobs)
- Go2Nova® 8407+ Hand Controller
- One 21lbs (9.5 kg) counterweight
- Stainless steel counterweight shaft
- Dark field illuminating LED cable
- AC adapter (100V-240V)
- HC Controller Cable X 1
- Serial cable (RS232 toRJ9)
- 12V DC power cable with car charger
- Aluminum carrying case
- Quick Start Guide

OPTIONAL PARTS

- 2" tripod (#8021ACC)
- 42 inch pier (#8033) /48 inch pier (#8030)
- MiniPier (#8032)
- PowerWeight™ rechargeable counterweight battery (#8128)

ONLINE CONTENTS *(click under "Support" menu)* **www.iOptron.com**

- Quick Start Guide
- This manual
- Tips for set up
- Hand controller and mount firmware upgrades (check online for latest version)
- .NET ASCOM driver
- Reviews and feedback from other customers
- Accessories

[1] US market only. Actual contents may vary.

2.2. Assembly Terms

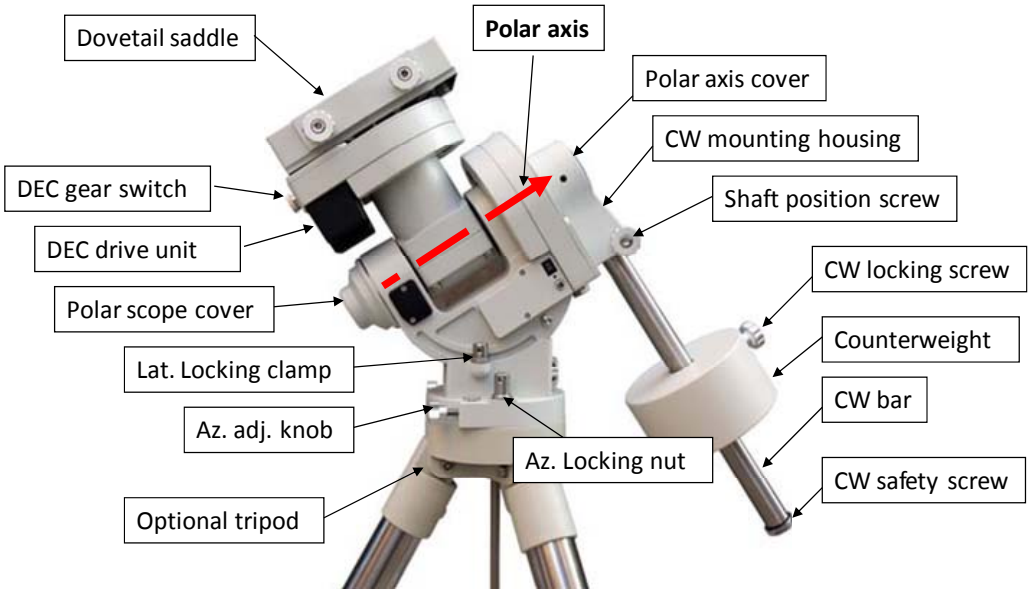


Figure 1.CEM60 assembly

2.3. CEM60 Mount Ports

Ports on the mount

Figure 2. Ports on a CEM60 mount

- I/O: Power Switch
- DC 12V: DC power socket for the mount
- PORT: iOptron port for connecting to other iOptron accessories, such as an electronic focuser or a planetary dome control. **DO NOT** plug your ST-4 guiding camera cable into it. It may damage the mount or guiding camera electronics.
- HBX (Hand Box): For connecting to an 8407 Hand Controller
- GUIDE: ST-4 compatible autoguiding port
- RS232: Serial port for mount-computer control and firmware upgrade

On DEC unit:

- Reticle: Power supply for the polar scope dark field illumination LED, or illuminated eyepiece

Figure 3. LED reticle on DEC unit

2.4. CEM60 Gear Switches

The CEM gear system utilizes a magnetic force system for optimal gear meshing. Fully turn the Gear Switch *clockwise* to disengage the worm from the worm wheel. Turn the Gear Switch *counterclockwise* to engage the worm to worm wheel, as indicated on the mount. The Gear Switch MUST NOT be left in a position that is in between the Engaged and Disengaged positions. Setting the Gear Switch in between states may damage the worm or worm wheel.

WARNING: Never disengage or adjust the Gear Switches without holding the mount firmly! Personal injury and/or equipment damage may happen.

Figure 4. CEM60 R.A. (left) and DEC (right) gear switches

2.5. CEM60 Cable Management

The CEM60 mount has a pre-wired instrument panel that allows the user to connect his imaging gears without having the wires/cables dragged all over the mount when the mount is slewing or tracking. As shown in Figure 5, the Instrument Panel has the following:

- 2X 12V power outlets for powering the CCD camera or electric focuser
- 4X USB 2.0 port with Type A connector for connecting to accessories.
- 1X 6P6C port which can be used to bridge the guiding port or accessories with a 6P6C/6P4C plug

Figure 5. Instrument panel

The USB hub is a non-powered one. It will draw power from a source, such a computer USB port. Therefore, the maximum usable USB ports might be limited, depending on the power consumption of the accessories.

The ports on the instrument panel are connected to the input panel located next to the polar scope, as shown in Figure 6.

- 1X 12V power input (5A max.)
- 1X USB 2.0 port with Type B connector
- 1X 6P6C port

Figure 6. Input panel

In the event where a user would like to wire his own cables, he can remove the dovetail saddle. Next he needs to remove the polar scope and run the cables through the polar scope opening. Solder the cables onto the instrument pane. When reinstalling the dovetail saddle, make sure that the STOPPER and the arrow is pointed to front, as shown in Figure 7.

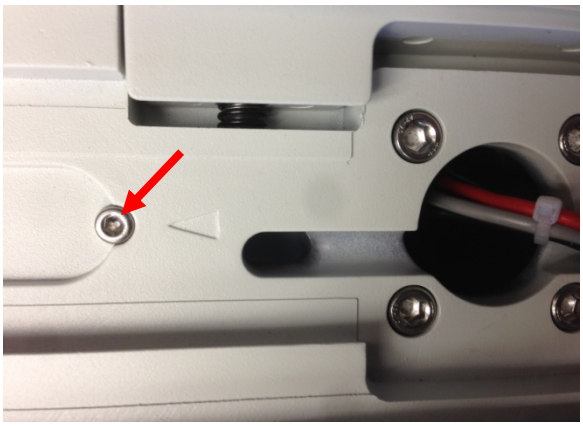


Figure 7. Stopper on a dovetail saddle

2.6. Go2Nova® 8407 Hand Controller

Figure 8. Go2Nova 8407 hand controller

The Go2Nova® 8407 hand controller (HC) shown in Figure 8 is the standard controllers that is used on the CEM60 mount. It has an integrated temperature controller that ensures it can be operated at -20ºC (-4ºF). It has a large LCD screen, function keys, direction keys and number keys on the front; a red LED reading light on the back; and a HBX port (6-pin) and a serial port (4-pin) at the bottom.

2.6.1. 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 R.A. direction. They are also used to browse the menu or move the cursor while in the menu. Press and **hold down an arrow key for a fast scrolling.**
- 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: Identify and display bright stars or objects where the telescope points to.
- STOP/0 Key: Stop the mount during GOTO. Also toggling between start and stop tracking.
- HBX (Handbox) port: connect the HC to the CEM60 mount using a 6-wire RJ11 cable.
- Serial port: connect the HC to a Computer via a RS232 to 4-wire RJ-9 cable. The pin out of the serial port is shown in Figure 9.

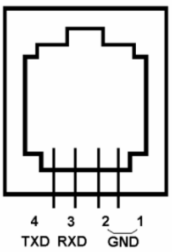


Figure 9. Serial port pin out on an 8407 hand controller

2.6.2. The LCD Screen

The 8407 HC has a large 8-line, 21-character per line LCD screen, which displays all the information as shown in Figure 10. The user interface is simple and easy to operate.

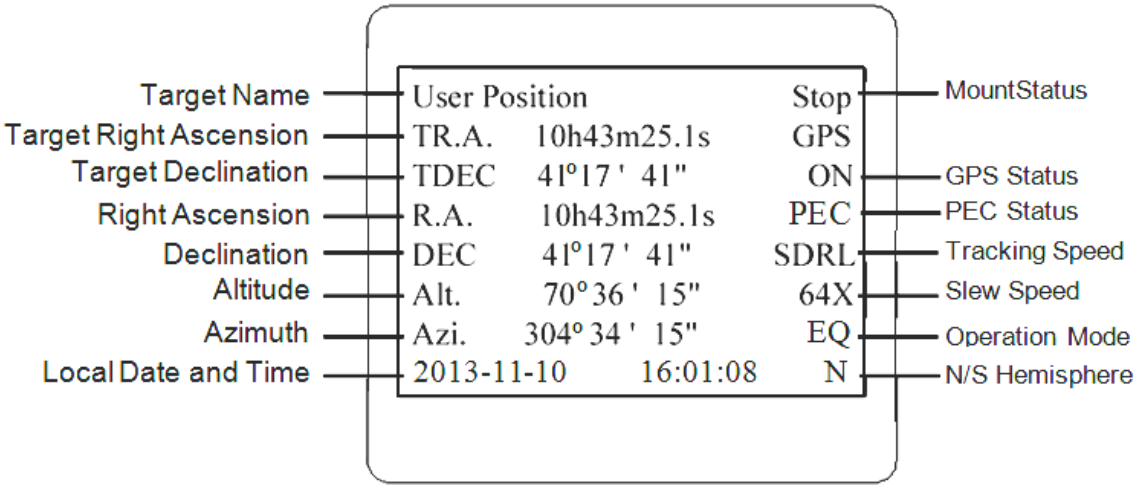


Figure 10. 8407 HC LCD Information Screen

1. Target Name/Mount Position: displays the name of the target that telescope is currently pointed to or the current mount position.
   - Zero Position: The position when the mount is turned on. Or when the mount is moved to Zero Position using "**Goto Zero Position**" command;
   - User Position: The mount is pointed to a user defined position, which could be a real sky object or just simply a position defined by pressing an arrow key.

- 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;

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 is 90º, south is 180º, and west is 270º).
8. Local Date and Time: display local time in a format of YY-MM-DD HH:MM:SS.
9. Mount Status: Display current operation status of the mount.
    - Stop: mount is not moving;
    - Slew: mount is moving with an arrow key pressed;
    - GoTo: mount is slewing to a celestial object using “Select and Slew”;
10. GPS status: When the power is turned on, it shows “GPS ON”, which means that the mount is connected to its GPS receiver. When the GPS receiver finds the satellites and receives the GPS signal, it shows “GPS OK”. The “GPS OK” may turn off after a few minutes to save power.
11. PEC status: Display of “PEC” here Indicates the PEC playback is turned on. Default is off.
12. Tracking speed: Display current tracking status of the mount
    - SDRL: mount is tracking at sidereal speed;
    - Solar: mount is tracking at solar speed;
    - Lunar: mount is tracking at lunar speed;
    - King: mount is tracking at king speed;
    - CSTM: mount is tracking at a customer-defined speed.
13. Slew speed: It has 9 speeds: 1X, 2X, 8X, 16X, 64X, 128X, 256X, 512X, MAX (~3.75º/sec).
14. Operation Mode: Indicate if the mount is working at the EQ mode

3. CEM60Mount Assembly

3.1. 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 set up 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 CEM60 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) in southern hemisphere, 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 CEM60 mount 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 CEM60 mount.

3.2. CEM60Mount Assembly

NOTE: The CEM60 mount is a precision astronomical instrument. It is highly recommended that you read the entire manual and become familiar with the nomenclature and function of all components before starting the assembly.

WARNING: DO NOT rock the counterweight shaft rigorously. Worm system damage due to improperly gear mesh/slippage will not be covered by warranty.

WARNING: The new Gear Switch will allow you to achieve the most precise weight balance. This also means the mount or OTA will swing FREELY when the Gear Switch is disengaged. Always hold the OTA or mount when releasing Gear Switch or adjusting gear tension.

STEP 1. Removing the Mount from the Carrying Case

The mount is shipped with both R.A. Gear Switch disengaged. ALWAYS turn the Gear Switch fully *counterclockwise* to fully engage the Gear Switch before removing the mount from the carrying case (Figure 11).

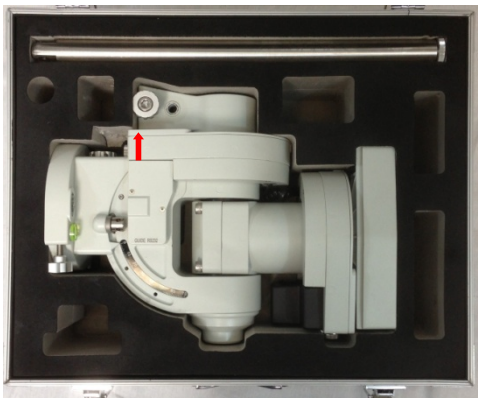


Figure 11. Engage the Gear Switches before removing the mount from the carrying case

Figure 12. Stainless steel lever

The CEM60 mount comes with a stainless steel (SS) lever which can be unthreaded from the mount. It can be used for tightening all the screws/nuts (Figure 12).

STEP 2. Attaching the Mount

The mount has a 150mm diameter base which can be mounted onto an optional iOptron 2" tripod or pier. If you have your own tripod/pier, make sure it has two M8 threaded holes separated by 130mm, with a Φ12mm X 15mm center stud.

There are two sets of mounting studs and azimuth locking nuts. Thread the two studs onto an iOptron tripod/or pier (if you are using one). Use the pair of mounting holes that are closest to the edge and thread the studs using the shorter thread side. Use the lever to tighten the mounting studs. Make sure that two studs are aligned eastern-western side by turning the tripod or pier.

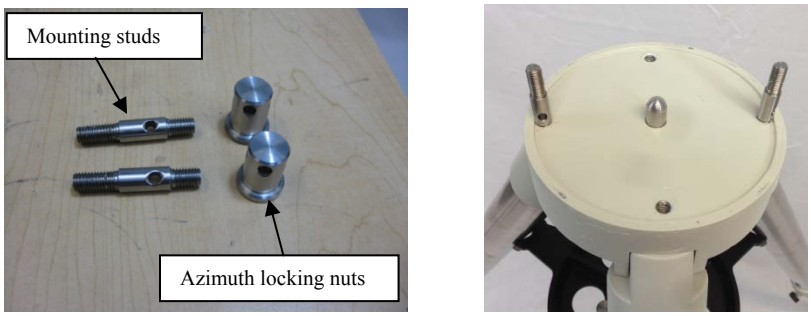


Figure 13. Mounting studs and locking nuts

Back out the azimuth adjustment knobs to make enough room to prevent them from blocking the mounting knobs. Put the mount head onto the tripod. Make sure that the mount head is facing north. Install

the Nylon washer. Put the azimuth locking nuts onto the mounting studs, hand tighten them. Adjust tripod/pier to level the mount.

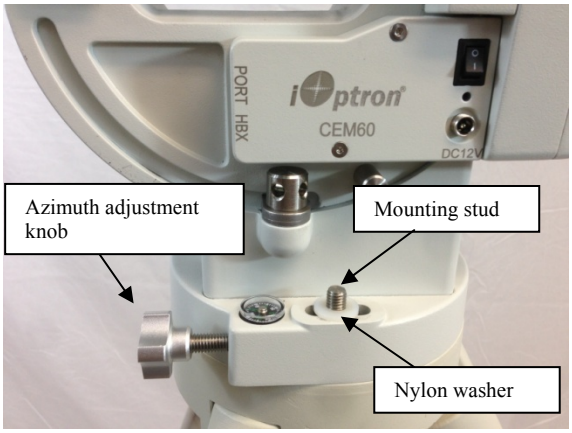


Figure 14. Attaching the mount

STEP 3. Setting the Latitude

This step requires you to know the latitude of your current location. This can be found from your 8407 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. This setting directly affects the mount's GOTO accuracy.

Slightly loosen the Latitude Locking Clamps. Turn the Latitude Adjustment Knob until the arrow points to your current latitude on the Latitude Scale. Tighten the Latitude Locking Clamps when done.

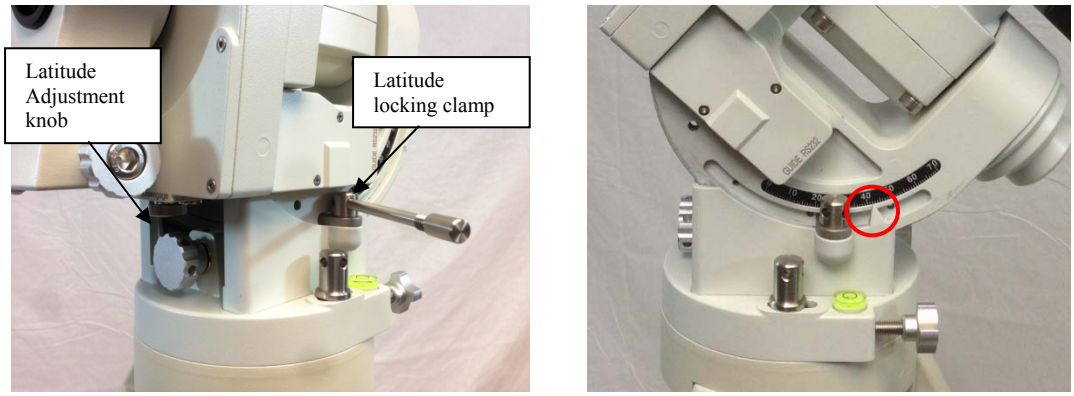


Figure 15. Setting the latitude

At this point, with the mount leveled and pointed north, and the latitude set, the Polar Axis (R.A. axis) should be pointing very close to the NCP and Polaris. This alignment accuracy will be sufficient for visual tracking and short duration piggy-back (camera mounted on top of the OTA) astrophotography.

STEP 4. Installing the Counterweight (CW) Shaft

There are three screws on CEM60 CW Mounting Housing: A Shaft Locking Screw, a Shaft Position Screw on the other side and a Low-Latitude Set Screw.

To install the CW shaft

(1) Remove CW Shaft Locking Screw from the CW Mounting Housing and back out the CW Shaft Position Screw to make room for the CW shaft;

(2) Insert CW Shaft into the CW Mounting Housing. Make sure the rounded top of the shaft is fully engaged in the slot;

(3) Insert the CW Shaft Locking Screw into the **TOP** hole and **thread it onto the CW shaft**;

(4) Tighten the CW Shaft Position Screw.

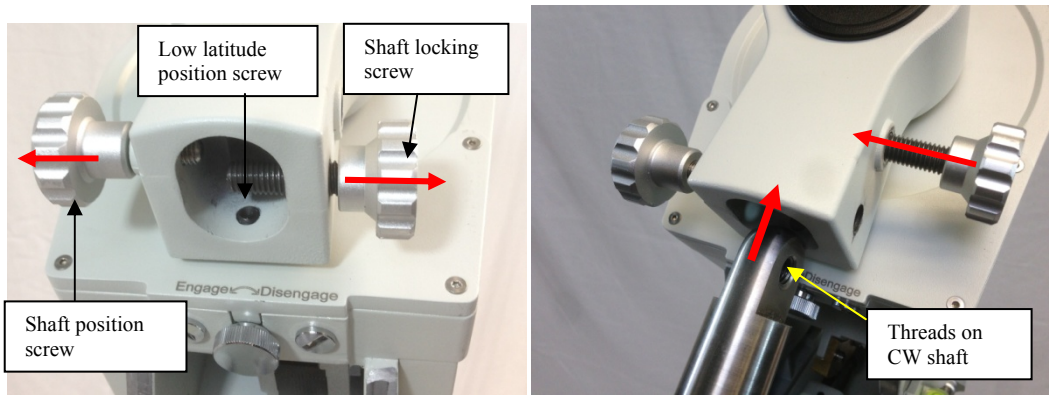


Figure 16. Install the counterweight shaft

At very low-latitudes (<10°), to avoid CW bumping into tripod leg, turn the rear Low Latitude Position Screw (a hex head set screw) further into CW Mounting Housing before tightening the CW Shaft Positioning Screw and Shaft Locking Screw.

DO NOT rock the counterweight shaft rigorously. It may damage the worm system.

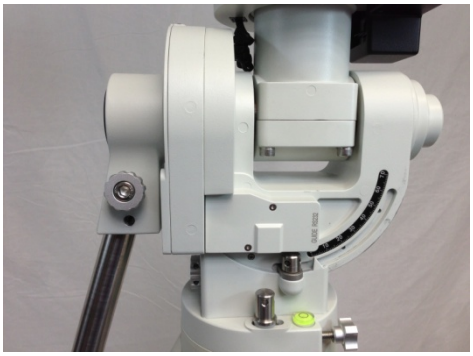


Figure 17. Tilt the counterweight shaft for low altitude

Figure 18. Install the counterweight

STEP 5. Installing the Counterweight(s)

Before installing the Counterweight, make sure that both R.A. and DEC Gear Switches are fully engaged to avoid sudden mount movements, which could injure yourself or damage the mount gear system.

Make sure the mount is at zero position (i.e. counterweight shaft is pointing to ground when the counterweight is installed.)

Remove the CW Safety Cap at the end of CW Shaft. Guide the CW over the shaft. Tighten the CW Locking Screw to hold the CW in place. **Always place the Safety Cap back onto the shaft prior to use to prevent personal injury and/or equipment damage.**

WARNING: The mount should always be kept in the zero position while it is being loaded with CWs and payload.

WARNING: The zero position is the only safe position the mount should stay in unless it is balanced.

STEP 6.Balancing the Payload

After attaching the scope and accessories, the mount head assembly must be balanced in both the R.A. and DEC axes to ensure minimum stress on the mount driving mechanism.

WARNING: The telescope may swing freely when the R.A. or DEC Gear Switch is disengaged. Always hold on to the telescope assembly before releasing the Gear Switches to prevent it from swinging, which can cause personal injury and/or equipment damage.

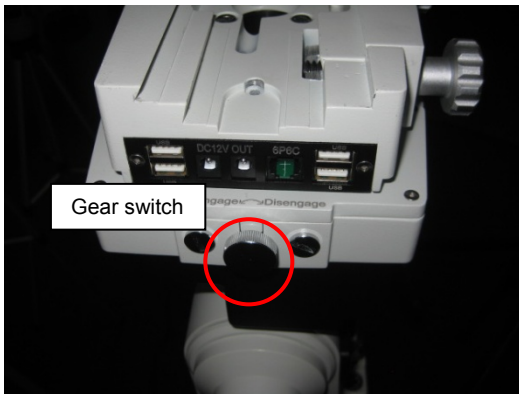


Figure 19. Gear switches

The CEM gear system utilizes a magnetic force system for optimal gear meshing. Fully turn the Gear Switch *clockwise* to disengage the worm from the worm wheel. Turn the Gear Switch *counterclockwise* to engage the worm to worm wheel, as indicated on the mount. **There is NO state between Engaged and Disengaged.** Setting the Gear Switch in between states may damage the worm or worm wheel.

WARNING: The balancing process MUST be done with Gear Switch at the Disengaged position! Otherwise it might damage the worm system.

With the corresponding Gear Switch disengaged, balance the assembly in R.A. axis by moving CW along its shaft. Balance in DEC axis by moving the scope with accessories back and forth in the mount saddle or within the scope mounting rings.

Only balance one axis at a time and start with the DEC axis first. Double check the mount to make sure both the R.A. and DEC axes are balanced.

Return the mount to the Zero Position after balancing; i.e., the CW Shaft points to ground, and the telescope tip is at its highest position.

Set both Gear Switches to engaged positions after balancing the mount**. To make sure the gears are meshed properly, gently turn the Gear Switch counterclockwise all the way until you feel the resistance, but not over tightening. You may back out 1//8 turn if the gear is not moving smoothly.**

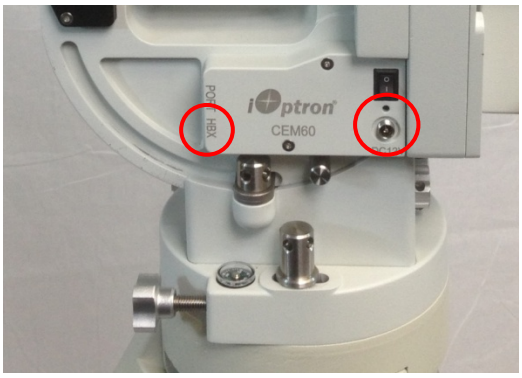


Figure 20. Connecting the cables

STEP 7. Connecting Cables

Plug in a 12V DC power supply to the DC12V POWER socket. Connect the Go2Nova® 8407 Hand Controller to the HBX port on the mount side panel.

STEP 8. Setting Hand Controller

The CEM60 mount is equipped with a GPS receiver, which will receive the time, longitude and latitude information from satellites after the link is established. However, there are still some parameters which need to be entered to reflect your location, such as time zone info and daylight saving time. The information will be stored inside the hand controller memory along with longitude and latitude coordinates until they need to be changed.

A clear sky and open space outside is needed for the GPS to establish its link with the satellites. The GPS is installed on the side of the mount with a black plastic cover. If it has difficulty to receive the GPS signal, you may turn the mount head to the side of the mount to clear the space on top of it.

To set up the controller, press **MENU** =>"**Settings**":

```
Select and Slew
Sync. to Target
Alignment
Settings
Electric Focuser
PEC Options
Telescope Motion
Edit User Objects
```

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

```
Set Time & Site
Set Display and Beep
Set Guiding Rate
Set Tracking Rate
Set Parking Position
Meridian Treatment
Tracking Below Horizon
Set Eyepiece Light
```

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

```
2014-03-09 10:19:18
Daylight Saving Time    Y
300 Min. behind   UT

Longitude:W071d08m50s
Latitude:  N42d30m32s

Northern Hemisphere
```

Set Local Time

The time will be updated automatically when the GPS receiver has established its link with the GPS satellites. You also can manually input the time information in case GPS does not function. Use the ◄ or ► key to move the cursor _ and use the number keys to change the numbers. Use the ▲ or ▼ button to toggle between "Y" and "N" for Daylight Saving Time. Hold the arrow key to fast forward or rewind the cursor.

In order to make the Hand Controller reflect your correct local time, **time zone information has to be entered.** Press the ◄ or ► key, move the cursor to the third line "**300 Min. behind UT**" to set the time zone information (add or subtract 60 minutes per time zone). Enter minutes "**ahead of**" or "**behind**" UT (universal time). For Example,

- 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 "**behind**" and using the ▲ or ▼ key to toggle between "**behind**" and "**ahead of**". When the number is correct, press ENTER and go back to the previous screen. **Fraction time zone can be entered.**

Do not manually add or subtract an hour from displayed time to reflect the DST. Only select "**Y**" after DST begins.

For other parts of the world you can find your "time zone" information from iOptron website (http://www.ioptron.com/support.cfm?module=faq#).

Set Observation Site Coordinates

The third and fourth lines display the longitude and latitude coordinates, respectively. The longitude and latitude coordinates will be automatically updated when the GPS picks up satellite signals. "W/E" means western/eastern hemisphere; "N/S" means northern/southern hemisphere; "d" means degree; "m" means minute; and "s" means second.

If, for any reason, your GPS does not pick up the signal, you can manually enter the GPS coordinates. Press the ◄ or ► key to move the cursor and using the ▲ or ▼ key to toggle between "W" and "E", "N" and "S", and using the number key to change the numbers. It is always a good idea to do your home work to get the GPS coordinates before traveling to a new observation site.

The site coordinates information can be found from your smart phone, GPS receiver or internet. 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.

Select N/S Hemisphere

If the polar axis is aligned to the North Celestial Pole, then set the mount to Northern Hemisphere. If the polar axis is pointing to the South Celestial Pole, set the mount to Southern Hemisphere. Press the ◄ or ► key to move the cursor and using the ▲ or ▼ key to toggle between "Northern Hemisphere" and "Southern Hemisphere".

As an example, select Northern Hemisphere if you are located in US and press **ENTER** to go back to the main menu.

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.

The hand controller has a real time clock. Every time the mount is turned on, it should display the correct time after initial set up. If the time is off too much, please check the clock battery inside the hand controller and replace it if required. The battery is a 3V, CR1220 button battery.

STEP 9. Performing Polar Alignment

One of the CEM60's unique features is that the polar scope can be accessed at anytime. It will not be blocked by DEC axle as in a German equatorial mount. This makes it possible to adjust the polar alignment during the tracking.

In order for an equatorial mount to track properly, it has to be accurately polar aligned.

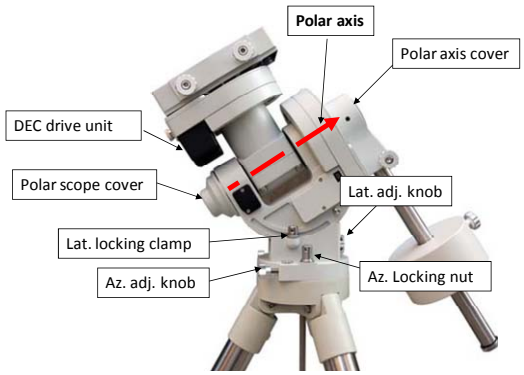


Figure 21. Polar alignment

As indicated in Figure 22, 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 the northern hemisphere using Polaris. While the 60' to 70' circles are used for polar alignment in southern hemisphere using Sigma Octantis.

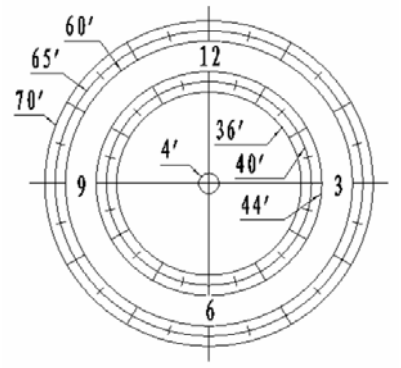


Figure 22. Polar Scope

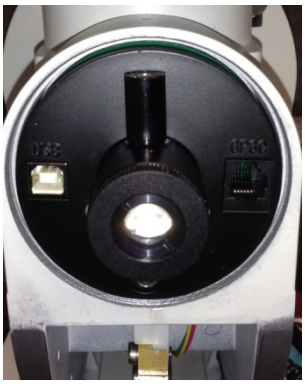


Figure 23. Polar Scope LED

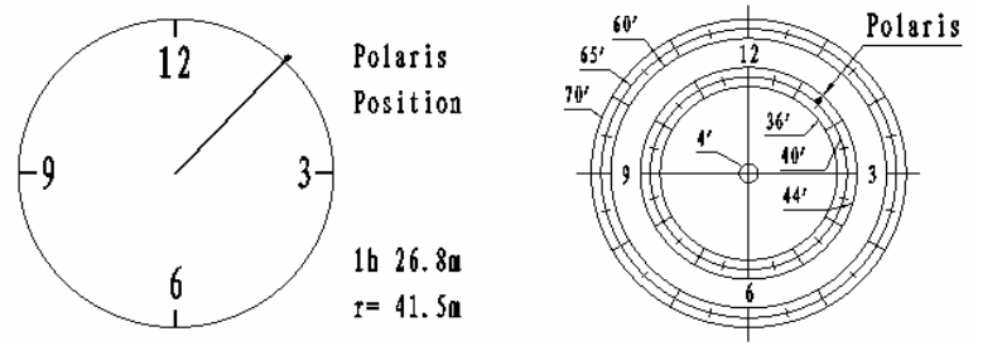
Quick Polar Alignment

(1) Level the CEM60 mount and set it at Zero Position. Make sure the telescope is parallel to the pole axis (R.A. axis) of the mount. If a finder scope is used, adjust it to be parallel to the telescope optical axis. Remove both the Polar Axis Cover and Polar Scope Cover.

(2) Connect the polar scope illumination LED (Figure 23) to the Reticle socket located next to DEC motor unit (Figure 3). Turn the mount power on. Use the Hand Controller ("**Settings**" => "**Set Eyepiece Light**") to set the illumination intensity.

(3) Use the Hand Controller (**MENU** => "**Align**" => "**Pole Star Position**") to display the Polaris Position on the LCD screen, as indicated in the left side of the figure below. For example, on May 30, 2010, 20:00:00 in Boston, United States (Lat N42º30'32" and Long W71º08'50", 300 min behind UT, DST set to Y), the Polaris Position is 1hr 26.8m and r = 41.5m.

(4) Look through the polar scope to find the Polaris. Use the Azimuth and Latitude Adjustment Knobs to adjust the mount in both directions and put the Polaris in the same position on the Polar Scope Dial as indicated on the HC LCD. In this case, the Polaris will be located at a radius of 41.5' and an angle of 1 hour 26.8 minute, as shown In Figure 24 (b).



(a) (b)

Figure 24. Polaris Position shown on HC (a) and where to put on polar scope dial (b)

NOTE: If you are located in the southern hemisphere, Sigma Octantis will be chosen for Polar Alignment. For example, on May 20, 2010, 20:00:00 in Sydney, Australia (LatS33º51'36" and Long E151º12'40"), 600 min ahead of UT, the Sigma Octantis Position is 1hr21.8m and 64.4m.

BrightStar Polar Alignment

When the pole star is not in sight:

(1) Level the mount and set it at Zero Position. Align the telescope to the R.A. axis of the mount. If a finder scope is used, adjust it to be parallel to the telescope optical axis.

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

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

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

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

STEP 10. Returning Mount to Zero Position

After polar alignment and balancing OTA, return the mount to Zero Position, as shown in Figure 25. The Zero Position is the position with the CW shaft pointing towards the ground, OTA/Dovetail is at the highest position with its axis parallel to the polar axis and the OTA pointing to the CP. Loosen the DEC and R.A. Gear Switches to adjust the mount to the Zero Position. Engage the clutches after each adjustment. **Remember, the hand controller needs to be at the Zero Position as well!** The simplest way is turn the mount power OFF and ON again to reset the hand controller. Alternatively you can use the hand controller (**MENU** => "**Goto Zero Position**") to set the mount to the Zero Position.

Figure 25. Zero position

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. Setting the Mount and Performing Polar Alignment

Assemble your CEM60 mount according to Section 3.2. Make sure the mount is leveled. Turn the mount power switch on. When the GPS receiver is connected to satellites, the hand controller LCD will display GPS OK. The mount will have correct time and site information. You can also enter them manually as described before. Mount an OTA and accessories, and carefully balance the mount on both R.A. and DEC axes. Polar align the mount using either the ***Quick Polar Alignment*** or ***BrightStar Polar Alignment Procedure***.

When the mount is powered on, the default position for the mount should be the Zero Position, i.e. 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, if you are located in northern hemisphere. If the mount is not at the zero position, release the gear switches to adjust the mount to approximately the zero position.

The exception for a mount to be not at the Zero Position is when the mount is switched on after it was parked before powering off (**MENU** => "**Telescope Motion**" => "**Park Scope**")

4.2. Manual Operation of the Mount

The mount can now be used to observe astronomical objects with the HC. Use arrow keys (►, ◄, ▼, and ▲) to point the telescope to the desired object. Use the number keys to change the slewing speed. Press the **STOP/0** button to start tracking.

4.3. One Star Alignment

Make sure the mount is at the ZERO position by pressing **MENU** => "**Goto Zero Position**". Release R.A. and DEC gear switches to manually adjust the mount to the zero position. Perform a "**One Star Align**" to correct the Zero Position discrepancy.

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

4.4. Go to the Moon and Other Stars

Now the mount is ready for GOTO and tracking targets. One of the most common objects is the Moon.

Press **MENU**, select and ENTER "**Select and Slew**". Select a category (for example, "**Solar System**"), then select an object of interest (for example, "**Moon**"). Press **ENTER** and the telescope will slew to the object and automatically start tracking. If the target is not centered in your eyepiece, use the arrow keys to center it. Then use **MENU** => "**Sync to Target**" for better performance.

4.5. Star Identification Function

The 8407 hand controller has a star identification function. After **Polar Alignment** and **Set Time & Site**, slew the telescope to a bright star manually or using the GOTO function. Press **?** (Help) button to identify the star that the telescope is pointing to, as well as nearby bright stars if there are any.

4.6. Turning Off the Mount

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

If the mount is set up on a pier or inside an observatory, it is recommended that you return the mount to Zero Position or park the telescope. This will ensure that there is no need for you to perform the initial setup again when you power on the mount subsequently with the mount not moved from the parked position.

4.7. Putting the Mount Back into the Carrying Case

Make sure that the Gear Switches are fully engaged before removing the mount from the tripod. Lay the mount into the carrying case. **Turn the R.A. Gear Switch *clockwise* all the way in to disengage the gear system for transportation.**

5. Complete Functions of Go2Nova® 8407Hand Controller

5.1. Select and Slew

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 Go2Nova® 8407 hand controller has a database of about 358,000 objects. Use the ► or ◄ buttons to move the cursor. Use the number buttons to enter the number, or the ▼ or ▲ buttons to change the individual number. Hold on a button to fast scroll through the list. The " ⏃ " indicates the object is above the horizon, and a " ⏀ " means it is below the horizon. In some catalogs those stars below the horizon will not be displayed on the hand controller.

5.1.1. Solar System

There are 9 objects in the Solar system catalog.

5.1.2. Deep Sky Objects

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

- Named Objects: consists of 60 deep sky objects with their common names. A list of named deep sky objects is included in Appendix E.
- Messier Catalog: consists of all 110 Messier objects.
- NGC IC Catalog: consists of 7,840 objects in the NGC catalog and 5,386 objects in the IC catalog. To select an object from the 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 12,921 objects.
- MCG Catalog: consists of 30,642 objects.
- Caldwell Catalog: consists of 109 objects.
- Abell Catalog: consists of 4,076 objects.
- Herschel Catalog: consists of 400 objects.

5.1.3. Stars

- Named Stars: consists of 195 stars with their common names. They are listed alphabetically. A list is included in Appendix E.
- Binary Stars: consists of 210binary stars. A list is attached in Appendix E.
- GCVS: consists of 38,528 variable stars in the catalog.
- SAO Catalog: consists of 258,997SAO catalog objects. They are listed numerically.

5.1.4. Comets

This catalog contains 15 comets.

5.1.5. Asteroids

This catalog contains 116 asteroids.

5.1.6. Constellations

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

5.1.7. Custom Objects

It can store up to 60 user-defined objects, including comets.

5.1.8. 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. It can be used to correct GOTO pointing error. 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-align the telescope 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. You can change the moving speed to make the centering procedure easier. Simply press a number (1 through 9) key to change the speed. The default moving speed is 64X.

"**Sync to Target**" is similar to "**One Star Align**", except that you choose the object to "sync" to. "**One Star Align**" chooses the star/object for you.

5.3. Align

This function is used for aligning the telescope. The hand controller provides two polar alignment methods. "**Polar Align**" uses a set of 2 bright stars for polar alignment. This provides a viable polar alignment approach for those who can't see the polar. The "**Two Star Polar Align**" is used to refine the polar alignment using the AccuAlign™ polar scope. The system also provides three star alignment methods: "**SolarSys Align**", "**One Star Align**", and "**Multi-Star Align**". The mount has to be at Zero Position before performing any star alignment.

5.3.1. Pole Star Position

This function displays the position of the Pole Star for ***Quick Polar Alignment*** using iOptron® AccuAlign™ polar scope. The position of Polaris is displayed in northern hemisphere or Sigma Octantis in southern hemisphere.

5.3.2. Polar Align

This ***BrightStar Polar Alignment*** allows you do a polar alignment without seeing the Pole Star. Press the **MENU** button, then select "**Align**" and "**Polar Align**". The HC will display a list of bright alignment stars near the meridian, with name, magnitude, azimuth and altitude position. Select one that is visible and high in altitude as the Alignment Star A. Follow the HC instruction to move the Star A to the center of the eyepiece with the combination of using Latitude Adjustment Knob and "◄" or "►" button. Press **ENTER** to confirm the settings. Next, select a bright star that is close to the horizon as the Alignment Star B. Center it using the Azimuth Adjustment Knob and "◄" or "►" button (*The "◢" and "◤" buttons are not used here*). Press **ENTER** to confirm the settings.

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

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

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

5.3.3. One Star Alignment

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 set up correctly and polar aligned, one star alignment should be sufficient for good GOTO accuracy. To increase the average pointing accuracy over the sky, you may choose to do multi-star alignment.

5.3.4. Solar System Align

This function uses a planet or the moon as an alignment object. Press **MENU** button and select "**Align**". Select "**Solar System Align**" and press ENTER for available alignment object.

5.3.5. Multi-Star Align

With iOptron's multi-star alignment, you can choose two, three, or as many stars as you want to reduce the mount average pointing offset across the sky. First, make sure you perform the "**One Star Align**" procedure.

Press **MENU** button and select "**Align**". Select "**Multi-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 the arrow keys. 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 the mount is 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.

When you are done with the two star alignment, press the **BACK** button to finish the alignment. Press **ENTER** key to select third star for further alignment.

5.3.6. Two Star Polar Align

This **Two Star Polar Align** may improve the polar alignment accuracy. It requires a wider view of the sky, since the two alignment stars need to be far apart. Press **MENU** button and select "**Align**". Select "**Two Star Polar 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 at the "Zero Position," use the ▲ and ▼ buttons to select first alignment star and press **ENTER**. Center the target in your eyepiece using the arrow keys after the mount slews to it. Press **ENTER** when finished. The hand controller will prompt you to choose the second star. After centering 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.

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

5.3.7. Display Axes Error

This displays the pointing error between the R.A. axis and the polar axis.

5.4. Settings

5.4.1. Set Time & Site

Refer to STEP 8 in Section 3.2.

5.4.2. Set Beep

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

```
Set Up Time and Site
Set Beep
Set Display
Set Guiding Rate
Set Tracking Rate
Set Parking Position
Meridian Treatment
Tracking Below Horizon
```

Select one of three available modes:

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

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

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

5.4.3. Set Display

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

```
Set Up Time and Site
Set Beep
Set Display
Set Guiding Rate
Set Tracking Rate
Set Parking Position
Meridian Treatment
Tracking Below Horizon
```

Use the arrow keys to adjust LCD display contrast, LCD backlight intensity and keypads backlight Intensity.

5.4.4. Set Guider Rate

This is an advanced function for autoguiding when a guiding camera is equipped either via a Guide Port or an ASCOM protocol. Before autoguiding, align the polar axis carefully. Select a proper guiding speed. The suppositional guiding speed can be selected from ±0.10X to ±0.80X. Follow the autoguiding software for detailed operation.

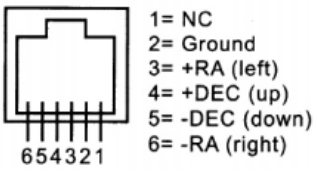


Figure 26. Guide port pinout

The guide port wiring is shown in Figure 26, which is same as that from Celestron / Starlight Xpress / Orion Mount / Orion Autoguider/ QHY5 autoguider pinout.

If you have an autoguider that has a pinout similar to ST-i of SBIG, such as Meade/ Losmandy/ Takahashi/ Vixen, make sure a proper guiding cable is used. Refer to your guiding camera and guiding software for detailed operation.

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

5.4.5. Set Tracking Rate

You can set up the mount tracking rate by selecting "**Set Tracking Rate**". Then the user can select "**Sidereal speed**", "**Lunar speed**", "**Solar speed**", "**King 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 the number buttons.

5.4.6. Set Parking Position

You may park the telescope before powering off the mount. This is very useful if the mount is on a permanent pier or the mount will not be moved in between observation sessions. The mount will keep all the alignment info and reference points.

There are four parking positions. "**Default Horizon Pos.**" will park the scope horizontally on the right side of the mount. "**Default Zenith Pos.**" will park the scope vertically on the right side of the mount. "**Current Position**" will park the scope at its current position. Or you can enter any altitude and azimuth combination for "**Custom Parking Pos**." When the mount is turned on, it will use last time parking position setting as the default setting.

5.4.7. Meridian Treatment

This function tells the mount what to do when it tracks past the meridian. There are two options. **Telescope Flip** will flip the telescope and continuously track the object. **Stop Tracking Pos.** will stop the mount when it passes the meridian. You can define how far the mount will track pass the meridian before it stops. The maximum traveling distance is 15°passing meridian, which equals to 1 hour.

5.4.8. Track Below Horizon

This function allows the mount to keep tracking an object even it is below the horizon but still can be seen from an elevated observation site, such as on a hill. The power on default is at OFF state. One can turn it on when needed.

5.4.9. Set Eyepiece Light

Use this function to adjust the light intensity of a CEM60 illuminated polar scope. If you have an illuminated-reticule eyepiece and has the same socket size, you may use this option to adjust its light intensity.

5.4.10. Heating Controller

Turn on/off the controller LCD back heater. When select **ON** for "**Heating Controller**", the heater would automatically be turned on when the ambient temperature reached 0°C (32°F) and shut off at 10°C.

5.5. Electric Focuser

This function controls iOptron electric focuser.

5.6. PEC Option

This function only works for a non-high precision encoder version of CEM60 mount.

5.6.1. PEC Playback

You can turn "**PEC Playback On**" while you do the tracking, especially for long time astro-photography. The default status is "**PEC Playback Off** when the mount is turned on.

5.6.2. Record PEC

All equatorial mounts have a small variation in the worm gears which can be corrected by using Period Error Correction or PEC. PEC is a system which improves the tracking accuracy of the mount by compensating for variations in the worm gear and is especially useful when doing astrophotography without autoguiding. Because the variations are regular, it is possible to record the corrections required to cancel out the worm gear variations and to play them back to correct the periodic error caused by the variations.

In order to use the PEC function, the Go2Nova hand controller needs to record the PE first. The periodic error of the worm gear drive will be used to correct periodic error. The data will be lost when the power is turned off.

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 mount's Guide Port or ASCOM protocol;

2. Select "**MENU**=>**Settings** => **Set Guiding Rate**s." Set a guiding speed from 0.10X to 0.80X. The default number is 0.25X;

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** to start record the PE.

4. It takes the worm gear 300 seconds to make one complete revolution. After 300 seconds PEC will automatically stop recording. The PEC value will be 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.

5.7. Telescope Motion

5.7.1. Park Scope

This function parks the scope to a preset position.

5.7.2. Search Zero Pos.

In the event of power failure, the mount will lose all its alignment info. It will be very troublesome for a remote observation site where the mount might be controlled via internet. The CEM60 has been equipped with a function that can find the zero position for an initial mount set up.

Select "**Search Zero Pos.**," the mount will starting slew slowly and find the R.A. and DEC position to set the mount to zero position. Do a "**One Star Align"** to correct any zero position discrepancy.

NOTE: This function is not intended for daily zero position setup.

5.8. Edit User Objects

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

5.8.1. Enter a New Comet

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

```
User Defined Comet
Other Objects
```

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

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

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

```
Add a New Comet
Browse Comets
Delete a Comet
Delete All Comets
```

The hand controller will display the parameter entry screen:

```
Enter Comet Parameter
Date: 0000-00-00.0000
   q: 0.000000
   e: 0.000000
   ω: 000.0000
   Ω: 000.0000
   i: 000.0000
```

Enter the parameter using the arrow button and number keys. Press **ENTER**. A confirmation screen will show. Press **ENTER** again to confirm storing your object under assigned user object number, or press **BACK** button to cancel it.

5.8.2. Enter Other Objects or Observation List

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

```
User Defined Comet
Other Objects
```

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

```
Add a New Record
Browse Records
Delete One Record
Delete All Records
```

Select “**Add a New Record**”. A screen will display asking to **Enter R.A. and DEC**:

```
Enter R.A. and DEC

R.A.:  00h00m00s
DEC:  +00d00m00s
```

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

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

Press the **BACK** button few times to go back to object entry submenu**.** You may review the records or delete the one you don’t want it anymore. Press **BACK** button to finish the operation. Now you can slew to your favorite stars from “**Custom Objects**” catalog using “**Select and Slew**.”

5.9. Firmware Information

This option will display firmware version information of Main board, R.A. board, DEC board and hand controller.

5.10. Goto Zero Position

This moves your telescope to its Zero Position. When the power is turned on, the mount assumes the Zero Position. This is the reference point for alignment and GOTO functions.

6. Maintenance and Servicing

6.1. Maintenance

The CEM60 mount is designed to be maintenance free. Do not overload the mount. Do not drop the mount, this will damage the mount or degrade the GOTO tracking accuracy permanently. Use a wet cloth to clean the mount and hand controller. Do not use solvent.

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

6.2. iOptron Customer Service

If you have any question concerning your CEM60 mount contact iOptron Customer Service Department. Customer Service hours are from 9:00 AM to 5:00 PM, Eastern Time, Monday through Friday. In the event that the CEM60 requires factory servicing or repairing, write or call iOptron Customer Service Department first to receive a RMA# before returning the mount to the factory. Please provide details as to the nature of the problem as well as your name, address, e-mail address, purchase info and daytime telephone number. We have found that most problems can be resolved by e-mails or telephone calls. So please contact iOptron first to avoid returning the mount for repair.

It is strongly suggested that to send technical questions to support@ioptron.com. 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.

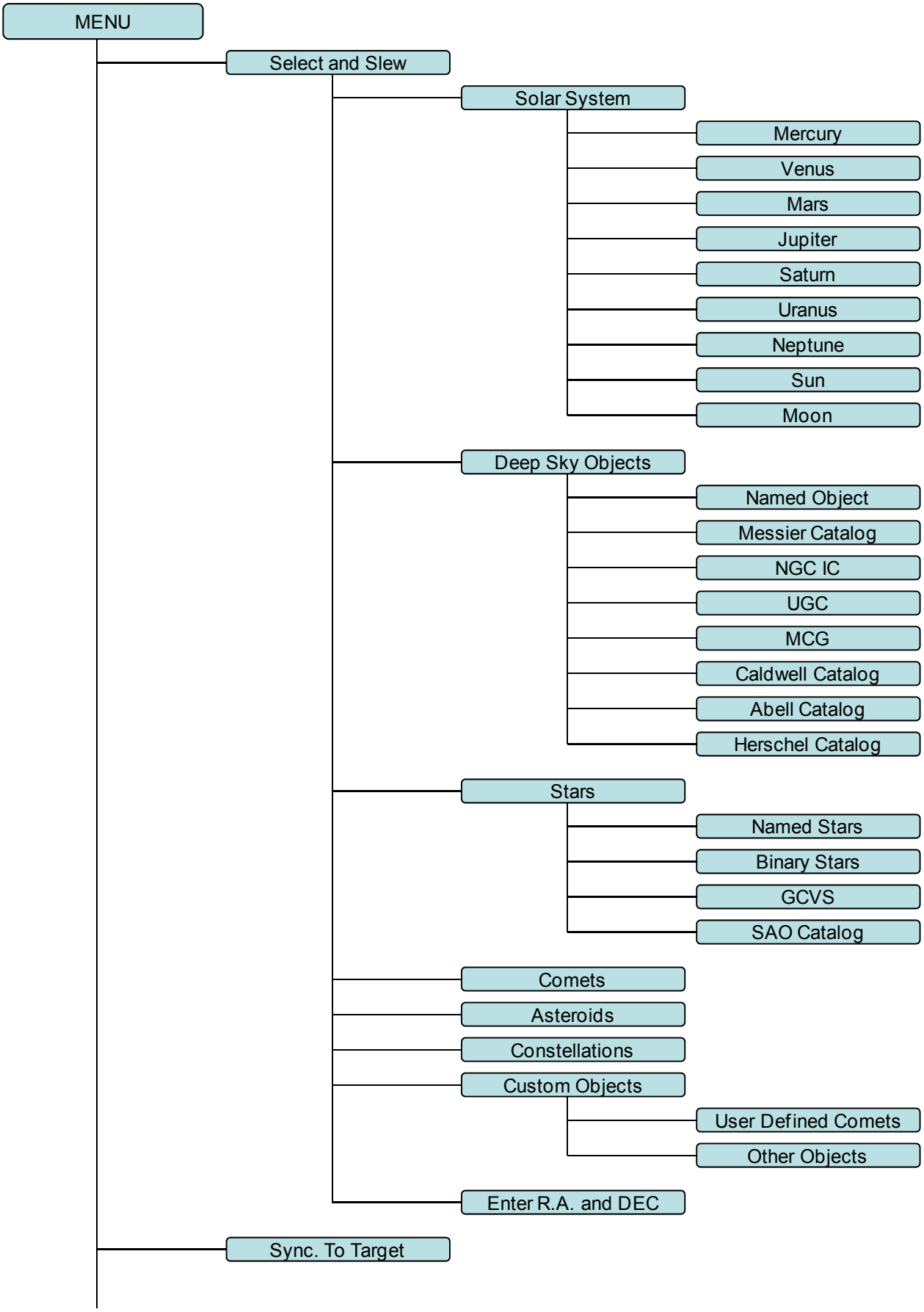
6.4. Battery Replacement and Disposal Instructions

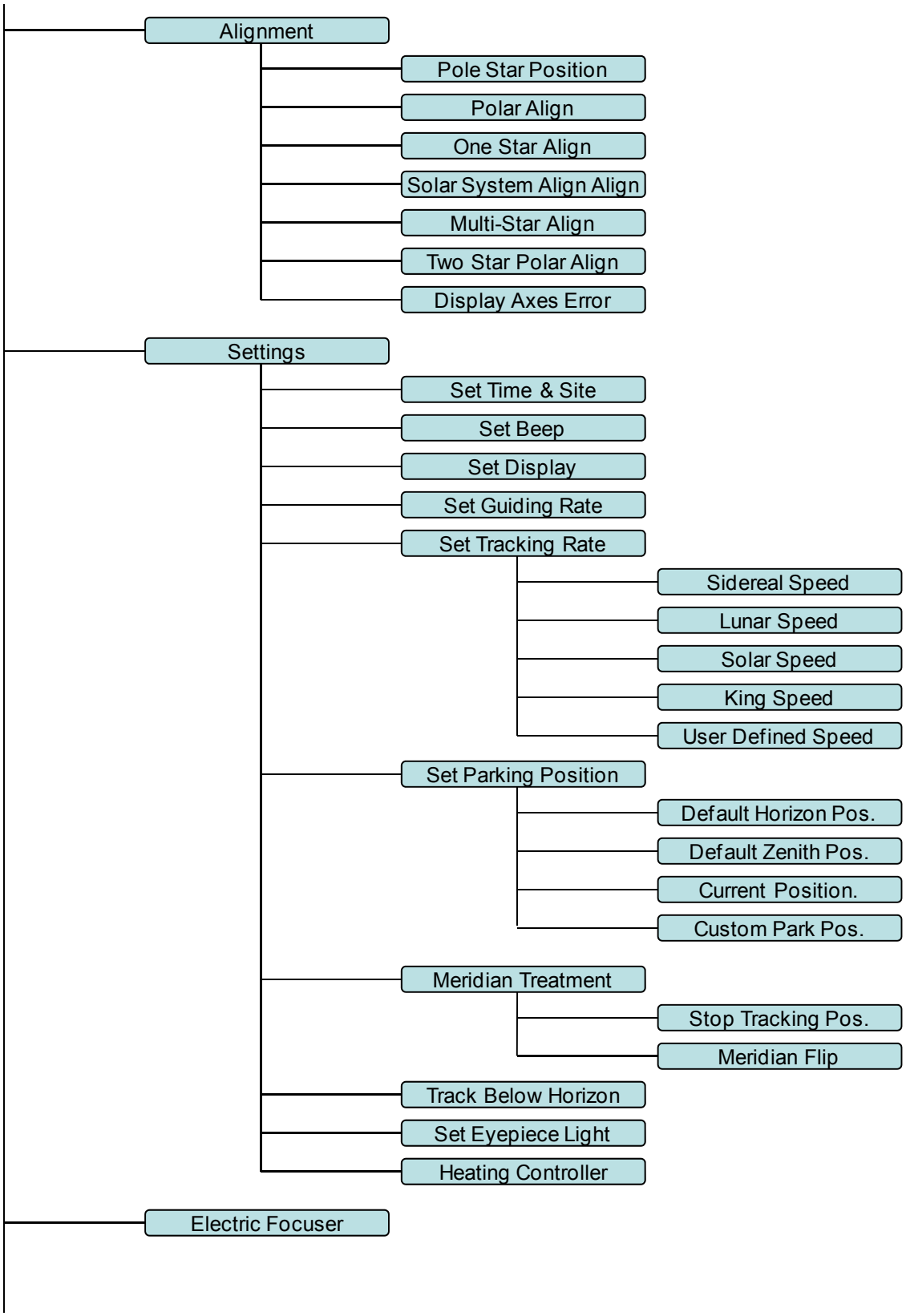
Battery Disposal- Batteries contain chemicals that, if released, may affect the environment and human health. Batteries should be collected separately for recycling, and recycled at a local hazardous material disposal location adhering to your country and local government regulations. To find out where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

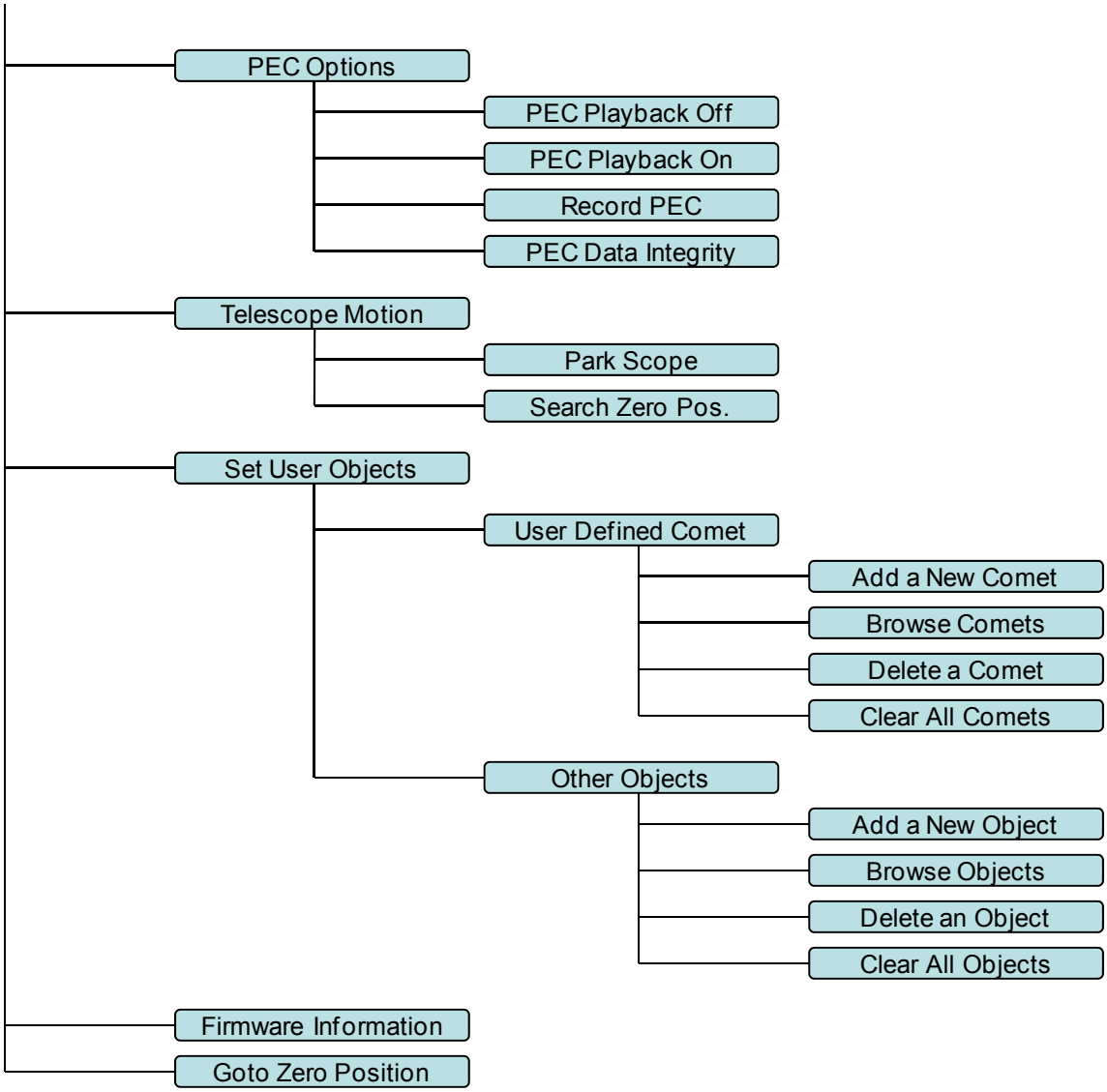
Appendix A. Technical Specifications

Mount	Center-balanced Equatorial Mount (CEM)
Payload	60 lb (27.2kg), exclude counterweight
Mount weight	27 lb (12.3kg)
Payload/Mount weight ratio	2.22:1
Material	All metal (except GPS cover)
Latitude adjustment range	0°~ 70°
Azimuth adjustment range	± 8°
Right Ascension worm wheel	Φ146mm, 288 tooth aluminum
Declination worm wheel	Φ146mm, 288 teeth aluminum
PEC	PPEC/Real time PEC
PE	~±5 arcsec p-p (#7200) or <0.5 arcsec RMS (#7201)
Counterweight shaft	Φ28x 450 mm Stainless steel
Counterweight	21 lb (9.5 kg)
Mount base size	Φ150 mm
Motor drive	Stepper motor
Resolution	0.06 arc seconds
Slew speed	1×,2×,8×,16×,64×,128×,256×,512×,MAX(~3.75°/sec)
Power consumption	0.6A(Tracking), 1.1A(GOTO)
Power requirement	12V DC 2A
AC adapter	100V ~ 240V (included)
Polar Scope	AccuAligning™ dark field illuminated, 2 arc min
Level indicator	Level bubble
Dovetail saddle	8” Losmandy/Vixen dual saddle
Hand Controller	Go2Nova® 8407,359,000 objects database, star recognition
Meridian treatment	Stop (0-15° pass), auto flip
GPS	Internal 32-channel GPS
Autoguide port	ST-4
Communication port	Serial Port
PC computer control	Yes (ASCOM)
Cable management	4X USB, 2X DC12V (MAX 5A), 6P6C
Operation temperature	-20°C ~ +45°C
Tripod	Optional 2 "tripod Stainless Steel(8kg)/Pier (10kg)
Warranty	Two year limited

Appendix B. Go2Nova® 8407HC MENU STRUCTURE







Appendix C. Firmware Upgrade

The firmware in the 8407Hand Controller and control boards can be upgraded by the customer. Please check iOptron's website, www.iOptron.com, under Support Directory/CEM Mounts, select CEM60 for details.

Appendix D. Computer Control a CEM60 Mount

The CEM60 mount can be connected to a computer using supplied serial cable. A RS232 to USB adapter (not supplied) 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 ASCOM protocol.

To control the mount via ASCOM protocol, you need:

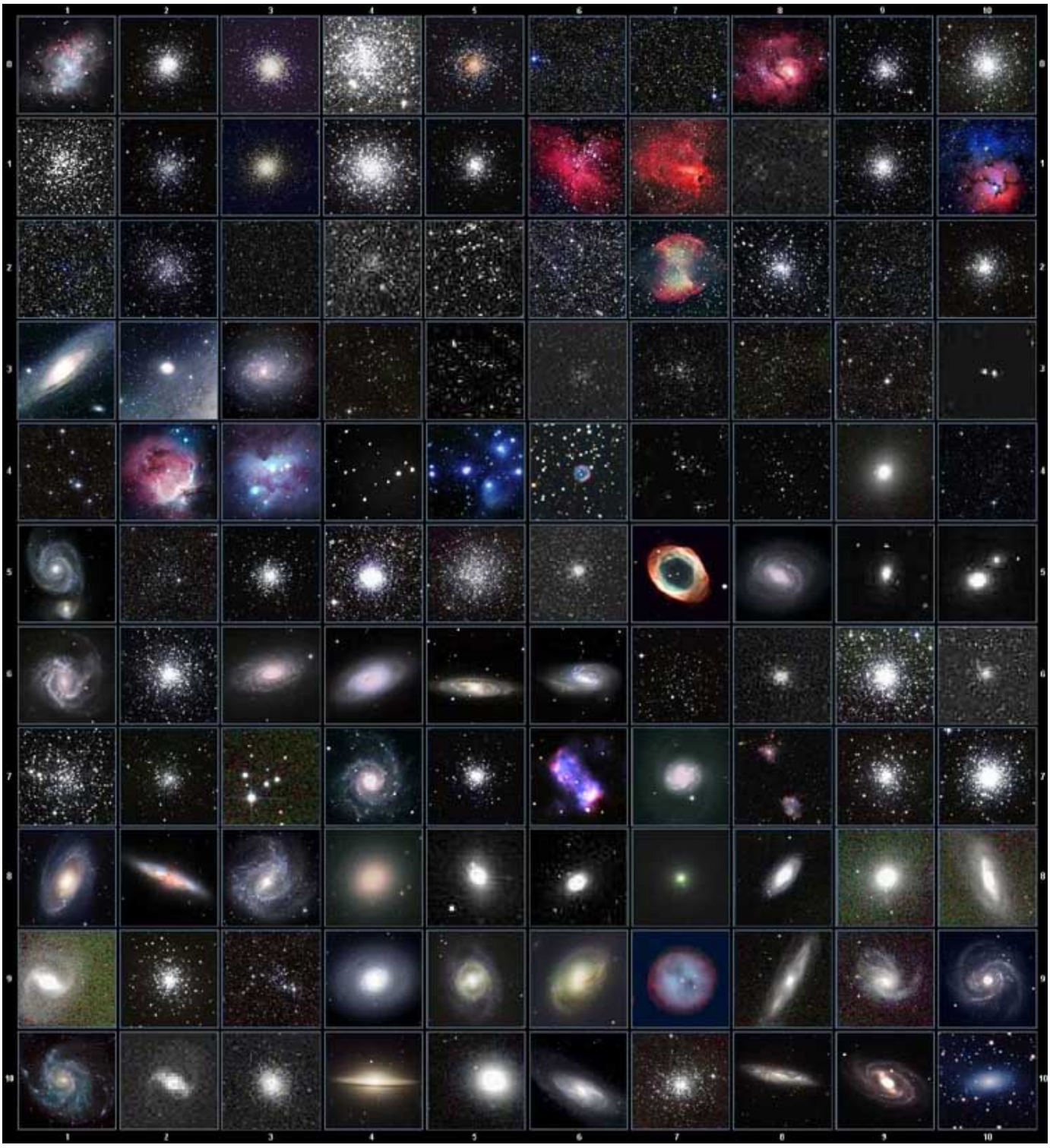
1. Download and install ASCOM Platform from http://www.ascom-standards.org/. Make sure your PC meets the software requirement. Refer to the ascom-standards website for details.
2. Download and install the latest iOptron Telescope .NET ASCOM drive from iOptron website.
3. Planetarium software that supports ASCOM protocol. Follow software instructions to select the iOptron Telescope.

Please refer to iOptron website, www.iOptron.com, under Support Directory/ASCOM Driver, iOptron Telescope .NET ASCOM Driver, for more detail.

CEM60 mount may also be directly controlled by other third party software and accessories. Please contact them for more information.

Appendix E. Go2Nova®Star List

Messier Catalog



Named Star List

001 Acamar	050 Asellus Australis	099 Kaus Media	148 Rastaba
002 Achernar	051 Asellus Borealis	100 Keid	149 Regulus
003 Acrux	052 Aspidiske	101 Kitalpha	150 Rigel
004 Acubens	053 Atik	102 Kochab	151 Rigel Kentaurus
005 Adhafera	054 Atlas	103 Kornephoros	152 Ruchbah
006 Adhara	055 Atria	104 Kurhah	153 Rukbat
007 Al Na'ir	056 Avoir	105 Lesath	154 Sabik
008 Albali	057 Azha	106 Maia	155 Sadachbia
009 Alberio	058 Baten Kaitos	107 Marfik	156 Sadalbari
010 Alchibar	059 Beid	108 Markab	157 Sadalmelik
011 Alcor	060 Bellatrix	109 Matar	158 Sadalsuud
012 Alcyone	061 Betelgeuse	110 Mebsuta	159 Sadr
013 Aldebaran	062 Biham	111 Megrez	160 Saiph
014 Alderamin	063 Canopus	112 Meissa	161 Scheat
015 Alfirk	064 Capella	113 Mekbuda	162 Schedar
016 Algedi	065 Caph	114 Menkalinan	163 Seginus
017 Algenib	066 Castor	115 Menkar	164 Shaula
018 Algiebra	067 Celabrai	116 Menkent	165 Sheiak
019 Algol	068 Celaeno	117 Menkib	166 Sheratan
020 Algorab	069 Chara	118 Merak	167 Sirius
021 Alhena	070 Chertan	119 Merope	168 Skat
022 Alioth	071 Cor Caroli	120 Mesartim	169 Spica
023 Alkaid	072 Cursa	121 Miaplacidus	170 Sterope
024 Alkalurops	073 Dabih	122 Mintaka	171 Sulafat
025 Alkes	074 Deneb	123 Mira	172 Syrma
026 Almach	075 Deneb Algedi	124 Mirach	173 Talitha
027 Alnasl	076 Deneb Kaitos	125 Mirfak	174 Tania Australis
028 Alnilam	077 Denebola	126 Mirzam	175 Tania Borealis
029 Alnitak	078 Dubhe	127 Mizar	176 Tarazed
030 Alphard	079 Edasich	128 Muphrid	177 Taygeta
031 Alphecca	080 Electra	129 Muscida	178 Thuban
032 Alpheratz	081 Elnath	130 Nashira	179 Unukalhai
033 Alrakis	082 Eltanin	131 Nekkar	180 Vega
034 Alrescha	083 Enif	132 Nihal	181 Vindemiatrix
035 Alshain	084 Errai	133 Nunki	182 Wasat
036 Altair	085 Fomalhaut	134 Nusakan	183 Wazn
037 Altais	086 Furud	135 Peacock	184 Yed Posterior
038 Alterf	087 Gacrux	136 Phact	185 Yed Prior
039 Aludra	088 Giausar	137 Phecda	186 Zaniah
040 Alula Australis	089 Gienah	138 Pherkad	187 Zaurak
041 Alula Borealis	090 Gomeisa	139 Pleione	188 Zavijava
042 Alya	091 Graffias	140 Polaris	189 Zosma
043 Ancha	092 Groombridge 1830	141 Pollux	190 Zubenelgenubi
044 Ankaa	093 Grumium	142 Porrima	191 Zubeneschamali
045 Antares	094 Hamal	143 Procyon	192 Barnard's Star
046 Arcturus	095 Homan	144 Propus	193 Kapteyn's Star
047 Arkab	096 Izar	145 Rassalas	194 Kruger 60
048 Arneb	097 Kaus Australis	146 Rasagethi	195 Luyten's Star
049 Ascella	098 Kaus Borealis	147 Rasalhague	

Modern Constellations

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

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

Deep Sky Object List

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

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

Double Star List

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

No.	Object	Const	Sep.	Magitude	SAO	Comm. Name
36	Eta	Cas	12.9	3.5 / 7.5	21732	Achird
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	

No.	Object	Const	Sep.	Magitude	SAO	Comm. Name
71	Bet	Cyg	34.4	3.1 / 5.1	87301	Albireo
72	Omi 1	Cyg	107	3.8 / 6.7	49337	
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	

No.	Object	Const	Sep.	Magitude	SAO	Comm. Name
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	
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 1	Lyr	2.6	5.0 / 6.1	67309	Double dbl1

No.	Object	Const	Sep.	Magitude	SAO	Comm. Name
141	Eps 2	Lyr	2.3	5.2 / 5.5	67315	Double dbl2
142	Alp	Mic	20.5	5.0 / 10	212472	
143	Zet	Mon	32	4.3 / 10	135551	
144	Eps	Mon	13.4	4.5 / 6.5	113810	
145	Bet	Mon	7.3	4.7/4.8/6.1	133316	
146	15	Mon	2.8	4.7 / 7.5	114258	
147	70	Oph	4.5	4.0 / 5.9	123107	
148	67	Oph	55	4.0 / 8.6	123013	
149	Lam	Oph	1.5	4.2 / 5.2	121658	Marfic
150	Xi	Oph	3.7	4.4 / 9.0	185296	
151	36	Oph	4.9	5.1 / 5.1	185198	
152	Tau	Oph	1.7	5.2 / 5.9	142050	
153	Rho	Oph	3.1	5.3 / 6.0	184382	
154	39	Oph	10.3	5.4 / 6.9	185238	
155	Bet	Ori	9.5	0.1 / 6.8	131907	Rigel
156	Del	Ori	53	2.2 / 6.3	132220	Mintaka
157	Iot	Ori	11.3	2.8 / 6.9	132323	Nair al saif
158	Lam	Ori	4.4	3.6 / 5.5	112921	Meissa
159	Sig	Ori	13	3.8/7.2/6.5	132406	
160	Rho	Ori	7.1	4.5 / 8.3	112528	
161	E747	Ori	36	4.8 / 5.7	132298	
162	1	Peg	36.3	4.1 / 8.2	107073	
163	Eps	Per	8.8	2.9 / 8.1	56840	
164	Zet	Per	12.9	2.9 / 9.5	56799	Atik
165	Eta	Per	28.3	3.3 / 8.5	23655	Miram in becvar
166	The	Per	18.3	4.1 / 10	38288	
167	E331	Per	12.1	5.3 / 6.7	23765	
168	Del	PsA	5.1	4.2 / 9.2	214189	
169	Iot	PsA	20	4.3 / 11	213258	
170	Bet	PsA	30.3	4.4 / 7.9	213883	
171	Gam	PsA	4.2	4.5 / 8.0	214153	
172	Eta	PsA	1.7	5.8 / 6.8	190822	
173	Alp	Psc	1.8	4.2 / 5.2	110291	Alrisha
174	55	Psc	6.5	5.4 / 8.7	74182	
175	Psi	Psc	30	5.6 / 5.8	74483	

No.	Object	Const	Sep.	Magitude	SAO	Comm. Name
176	Zet	Psc	23	5.6 / 6.5	109739	
177	Kap	Pup	9.9	4.5 / 4.7	174199	
178	Eta	Pup	9.6	5.8 / 5.9	174019	
179	Eps	Scl	4.7	5.4 / 8.6	167275	
180	Bet	Sco	13.6	2.6 / 4.9	159682	Graffias
181	Sig	Sco	20	2.9 / 8.5	184336	Alniyat
182	Nu	Sco	41	4.2 / 6.1	159764	Jabbah
183	2	Sco	2.5	4.7 / 7.4	183896	
184		Sco	23	5.4 / 6.9	207558	
185	Hn39	Sco	5.4	5.9 / 6.9	184369	
186	12	Sco	3.9	5.9 / 7.9	184217	
187	Bet	Ser	31	3.7 / 9.0	101725	
188	Del	Ser	4.4	4.2 / 5.2	101624	
189	Nu	Ser	46	4.3 / 8.5	160479	
190	The	Ser	22.3	4.5 / 5.4	124070	Alya
191	59	Ser	3.8	5.3 / 7.6	123497	
192	Zet	Sge	8.5	5.0 / 8.8	105298	
193	Eta	Sgr	3.6	3.2 / 7.8	209957	
194		Sgr	5.5	5.2 / 6.9	209553	
195	Phi	Tau	52	5.0 / 8.4	76558	
196	Chi	Tau	19.4	5.7 / 7.6	76573	
197	118	Tau	4.8	5.8 / 6.6	77201	
198	6	Tri	3.9	5.3 / 6.9	55347	
199	Zet	UMa	14	2.4 / 4.0	28737	Mizar
200	Nu	UMa	7.2	3.5 / 9.9	62486	Alula borealis
201	23	UMa	23	3.6 / 8.9	14908	
202	Ups	UMa	11.6	3.8 / 11	27401	
203	Xi	UMa	1.8	4.3 / 4.8	62484	Alula australia
204	Sig 2	UMa	3.9	4.8 / 8.2	14788	
205	57	UMa	5.4	5.4 / 5.4	62572	
206	Alp	UMi	18.4	2.0 / 9.0	308	Polaris
207	Gam	Vir	1.4	3.5 / 3.5	138917	Porrima
208	The	Vir	7.1	4.4 / 9.4	139189	
209	Phi	Vir	4.8	4.8 / 9.3	139951	
210	84	Vir	2.9	5.7 / 7.9	120082	

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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.
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