



# **iOptron<sup>®</sup> CEM26 Center Balanced Equatorial Mount**

## **Instruction Manual**

Product CEM26 and CEM26EC



Read the included Quick Setup Guide (QSG) 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's limited warranty.

If you have any questions please contact us at [support@ioptron.com](mailto: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 observing.***

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# 1. CEM26 Overview

The iOptron® CEM26 and CEM26EC mount is the next-generation compact center-balance equatorial mounts. Like their predecessors, the CEM26 is designed with portability in mind, weighing in at only 10 lbs, it can support up to a 26lb payload an incredible 2.6 mount weight to payload ratio. The key to enable such ratios is the CEM design focuses the mount and payload weight directly on the center of the tripod rendering “natural stability”.

Building on the legacy of earlier CEM models, we have added features for convenience and functionality. A positive lock gear engagement system (easy to use even when wearing gloves), Built-in Wi-Fi enabling unparallel connectivity and recordable permanent periodic error correction (PPEC) to repeat optimal PEC training sessions (real time PEC on the CEM26EC). Regarding functionality the CEM26 and CEM26EC delivers precise pointing and accurate tracking (PE <0.3 arcsec rms on the EC model). The 212,000 object library ensures you'll never run out of targets to see or image. The CEM26 and CEM26EC set the new standard for compact equatorial mounts.

The mount has an integrated electronic polar finder scope known as the iPolar, or an AccuAlign™ optical polar scope. The iPolar ensures the accurate alignment of a telescope, even when the pole star is obscured.

The iOptron CEM26 mount uses the new Go2Nova® 8409 hand controller to navigate the night sky. This incredible technology helps observers find celestial objects with the aid of the mount's 212,000+ object database! For those looking for a telescope that has the capability of tracking and finding beautiful night sky objects, this mount is a must have tool.

## Features:

- Unique design, center-balanced equatorial mount (CEM)for maximum payload and minimum mount weight
- Ideal for both visual observation and astrophotography
- Low periodic error (< ± 10 arcsec for CEM26 and <0.3 arcsec for CEM26EC)
- Payload of 12 kg (26 lbs) with the mount-only weight of 4.5 kg (10 lbs)
- Spring loaded gear system
- Large easy to use quick-lock gear clutches
- Adjustable counterweight shaft for 0° latitude operation
- Stepper motor with low power consumption
- Integrated iOptron iPolar™ electronic polar scope or AccuAlign™ dark field polar scope
- Polar alignment routine for those who can't see the Pole Star
- Go2Nova® 8409 controller with Advanced GOTO TECHNOLOGY® GOTO Technology
- Integrated ST-4 autoguiding port
- Built-in Wi-Fi
- USB port for firmware upgrade and computer control
- Standard 1.5 inch heavy-duty stainless steel tripod (5kg), optional LiteRoc™ tripod (7.5kg)
- Die-cast metal tripod spreader with accessory tray
- Optional external 32-channel Global Positioning System (GPS)
- Optional hard carrying case (standard for EC model)
- Optional iGuider™ autoguiding system #3360

## 2. CEM26 Terms

### 2.1. Parts List<sup>1</sup>

#### SHIPPING CONTENTS

Your new CEM26 mount comes in two shipping boxes. One box contains a CEM26/CEM26EC mount, hand controller, one 10.4 lbs (4.7kg) counterweight, counterweight shaft, tripod spreader and accessories. The other box contains a tripod.

- iOptron® CEM26 mount head with iPolar (#C26xAx), or iOptron® CEM26 mount head with AccuAlign™ optical polar scope (#C26xBx), or iOptron® CEM26EC mount with iPolar (#C264Ax, with red gear switch)
- Go2Nova® 8409 Hand Controller with USB port
- One 10lbs (4.5 kg) counterweight
- Stainless steel counterweight shaft
- Internal iPolar™ electronic polar scope or AccuAlign™ optical polar scope
- AC adapter (100V-240V)
- 2X coiled control Cable (6P6C RJ11 to RJ11, straight wired)
- USB cable for mount
- USB cable for iPolar or LED and cable for optical polar scope
- Aluminum carrying case (for CEM26EC and mount w/case)
- 1.5" tripod or LiteRoc™ tripod
- Quick Start Guide

#### OPTIONAL PARTS

- External GPS module (#8438)
- iGuider 1 mini autoguiding system (#3360)
- Hard case (#C268)

#### ONLINE RESOURCES *(click on the "Support" menu at [www.iOptron.com](http://www.iOptron.com))*

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

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<sup>1</sup> US market only. Actual contents, design and function may vary.

## 2.2. Identification of Parts



Figure 1.CEM26 mount assembly

## 2.3. CEM26 Port

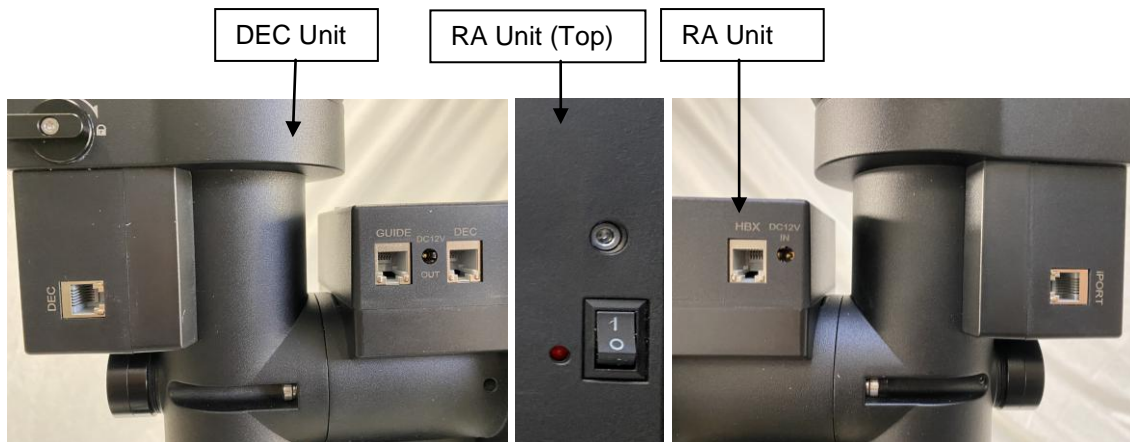


Figure 2. Ports on a CEM26 mount

### On RA Unit:

- I/O Switch: Power switch
- LED: Power indicator
- DC 12V IN: DC power socket to power the mount (2.1mmX5.5mm, center positive)
- HBX (Hand Box): For connecting to an 8409 Hand Controller
- GUIDE: ST-4 compatible autoguiding port. The wiring is shown in Figure 3

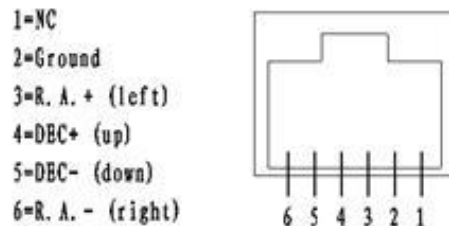


Figure 3. ST-4 Compatible Guiding Port Wiring

- DC 12V OUT: DC power socket for optical polar scope LED
- DEC: For connecting to DEC drive unit

### On DEC unit:

- DEC: Connect the DEC drive unit to RA unit via RJ11 cable
- iPORT: Auxiliary port for connecting to other iOptron accessories, such as a GPS receiver or an electronic focuser. **DO NOT** plug ST-4 guiding camera cable into this port, It will damage the guide camera electronics.

## 2.4. Go2Nova<sup>®</sup> 8409 Hand Controller

The Go2Nova<sup>®</sup> 8409 hand controller (HC) shown in Figure 4 is the standard controller used on the CEM26 mount. It has a large LCD screen, function, direction, and number keys on the front; and an HBX (6-pin) and a USB port at the bottom.





Figure 4. Go2Nova® 8409 hand controller

### 2.4.1. 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 ( $\blacktriangle$   $\blacktriangledown$   $\blacktriangleleft$   $\blacktriangleright$ ) Keys: The arrow keys are used to control the movement of DEC and R.A. axes. Press and hold  $\blacktriangle$  (DEC+),  $\blacktriangledown$  (DEC-) buttons to move a telescope along the DEC direction,  $\blacktriangleleft$  (R.A.+),  $\blacktriangleright$  (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 holding 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)
- Help (?) Key: Identify and display bright stars or objects that the telescope is pointing to.
- 0 Key: Stop the mount during GOTO. Also toggling between starting and stopping tracking.
- HBX (Handbox) port: connect the HC to the CEM26 mount using a 6P6C RJ11 cable.
- USB port: connect the HC to a computer for firmware upgrade and computer control.

### 2.4.2. The LCD Screen

The 8409 HC has a large 4-line, 21-character per line LCD screen. The user interface is simple and easy to learn. When the mount first turned on, an initial information screen will be displayed as shown in Figure 5, after company logo displayed. It displays the Zero Position, current date and time.

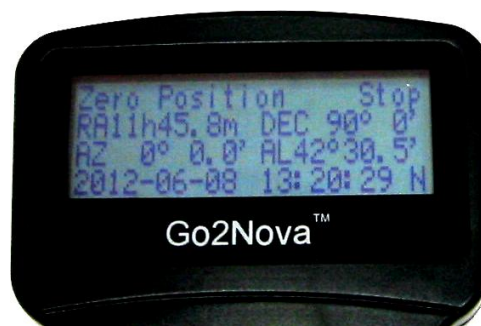


Figure 5. 8409 Initial Information Screen

The LCD screen will switch to the information screen, as indicated in Figure 6, with pressing any button.

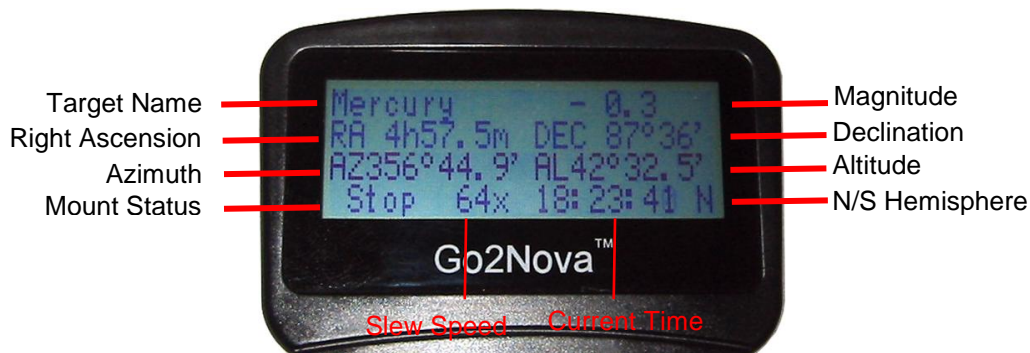


Figure 6. 8409 HC LCD Information Screen

1. Target Name/Mount Position: displays the name of the target that telescope is currently pointed to or the current mount position.
  - An object name, such as “Mercury” or “Andromeda Galaxy”: Name of the Star or celestial object that the mount is currently slewing to, GOTO or tracking;
  - User Position: The mount is point to a user defined position, which could be a real sky object or just simply due to press an arrow key.
2. Magnitude: the magnitude of the current celestial object
3. Right Ascension: Right Ascension of the telescope, or R.A.
4. Declination: Declination of the telescope, or DEC.
5. Azimuth: Azimuth of the telescope (north is 0°, east 90°, south 180°, and west 270°).
6. Altitude: Altitude of the telescope (degrees vertical from the local horizon - zenith is 90°).
7. Mount Status: Display current operation status of the mount.
  - Stop: mount is not moving;
  - Slew: mount is moving with an arrow key is pressed;
  - GoTo: mount is slewing to a celestial object using “Select and Slew”;
8. Slew speed: It has 9 speeds: 1X, 2X, 8X, 16X, 64X, 128X, 256X, 512X, MAX(1440X, or 6°/sec).
9. Current Time: display local time in a format of HH:MM:SS.

## 2.5. Check the Battery



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

## 2.6. Bench Testing the Mount

The counterweight shaft is designed to counter balance the mount’s own weight. It is recommended that the CW shaft is installed when testing the mount’s function.

**NEVER** operate the mount with only the counterweight or OTA on it. It may cause gear slippery and cause the worm and gear damage.

### 3. CEM26 Mount Assembly

#### 3.1. CEM26 Mount Assembly

**NOTE:** The CEM26 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. This may damage the worm/drive gear system and such damage will not be covered by warranty.

#### Step 1. Remove mount head from package

The RA axle is locked by an Allen wrench (blue circle). Make sure it is inserted all the way in. Check the R.A. and DEC Gear Switches and make sure they are at the unlock position before removing it from the box.



Figure 7. CEM26 mount in a case

#### Step 2. Set up tripod

The mount has a 102mm base. Thread the **Alignment Peg** onto the tripod head, on top of a tripod leg or between two legs depending on the latitude. Insert the Accessory Tray through the center rod and secure the setup by tightening Locking Knob from underneath.



Figure 8. CEM26 tripod top

#### Step 3. Attach mount head

**Before put the mount onto the tripod, make sure the RA gear switch is at lock position to prevent mount head free swing by accident!** Retract the 2x Azimuth (Azi) Adjustment Screws from both sides to leave ample

space for the alignment peg to be fitted in between the 2x Azi Adjustment Screws. Remove the 2x Azi Locking Screws from the mount base and insert them into the opening next. Secure the mount head by tightening the Azi Locking Screws into the M6 holes on the tripod.

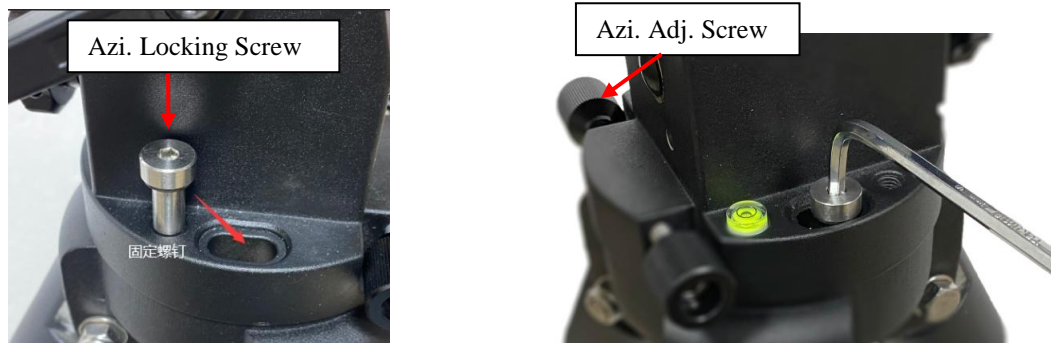


Figure 9. Attach the mount

Level the mount by adjusting the tripod legs. Use the build-in Bubble Level Indicator or an external leveler for this purpose.

#### **Step 4. Adjust latitude**

Loosen the Latitude Locking Lever. Turn Latitude Adj. Knob to adjust the latitude until the arrow points to the current latitude on the Latitude Scale. You may use the Allen wrench for easy adjustment. Tighten the Latitude Locking Lever.

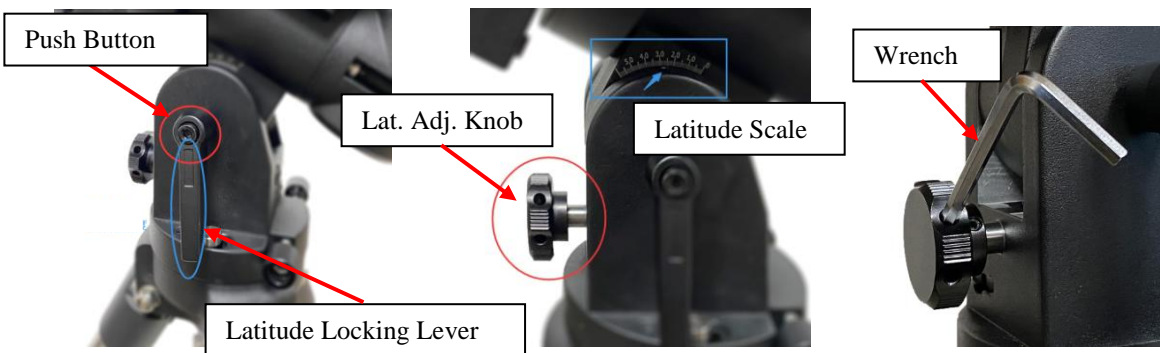


Figure 10. Adjust latitude

You may lift the Latitude Locking Lever handle by push the Push Button on this ratchet lever to disengage gear teeth and rotate freely for quick adjustment.

Before pulling the Allen wrench out from the RA axle, make sure the RA gear switch is locked, as shown in Figure 11. There are three RA axle locking positions for the CEM26 mount: Zero Position, East and West position.



Figure 11. Allen wrench to lock the RA axle and storage

The Allen wrench can be stored on the bottom of the mount, as show in Figure 11.

### **Step 5. Install counterweight (CW) shaft**

- (1) Remove CW Shaft Locking Screw.
- (2) Insert CW Shaft into the CW Mounting House.
- (3) Thread in the CW Shaft Locking Screw from **the other side**.
- (4) Tighten the Front CW Position Screw.

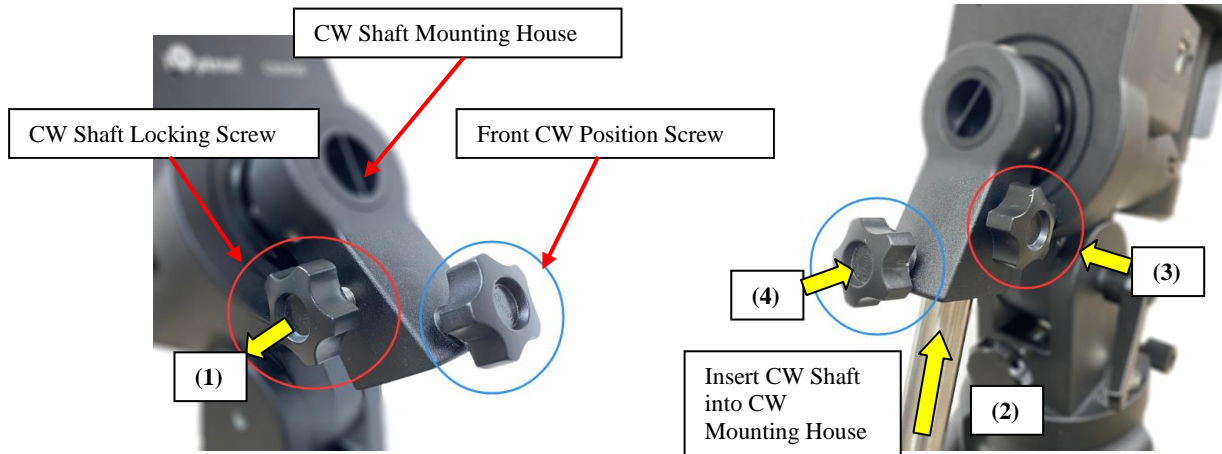


Figure 12. Install counterweight shaft

At very low latitudes ( $<10^\circ$ ), to avoid CW bumping into tripod leg, retreat the Front CW Positioning Screw while turn the Rear CW Position Screw (a hex head set screw) to tilt the CW shaft outwards.

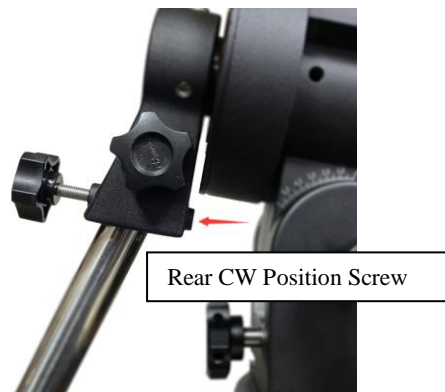


Figure 13. Counterweight shaft at low latitude

### **Step 6. Install counterweight**

Before putting on CW, make sure the mount is at its zero position, *i.e.*, CW shaft points to the ground. **Insert Allen wrench to lock the RA axle** and disengage the R.A. Gear Switch to set the R.A. axis free before loading the CW. Remove the CW Safety Cap at the end of CW Shaft. Glide the CW over the shaft with the larger opening facing down. Tighten the CW Locking Screw to hold the CW in place. Place the Safety Cap back onto the shaft. Move the CW to the bottom of the shaft and tighten the CW locking Screw.

CEM26 comes with a 10.4 lbs (4.7 kg) CW, which should be sufficient for an 6" scope with total payloads up to about 13 lbs (6kg). Use extra CW or CW Extension Bar to balance higher payloads.





Figure 14. Install counterweight

### **Step 7. Install telescope**

CEM26 has a 3.5" Vixen dovetail saddle, with a Center Adjusting Block. This can be used to accommodate dovetail bars with different width and keep the OTA centered. Release the locking screws (blue circled) on the Center Adjusting Bar first. Adjust the setting screws (red circled) to move the center block in or out. Then tighten the locking screws. Tighten the set screws at last.

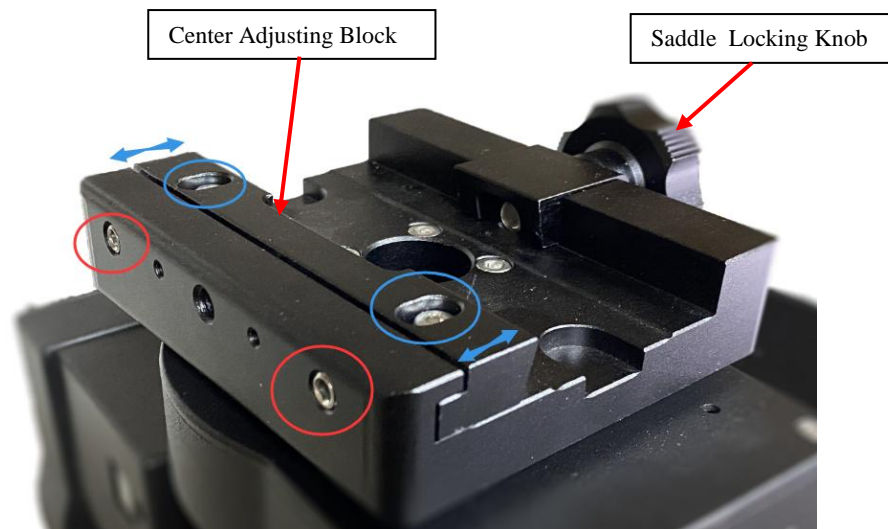


Figure 15. CEM26 Vixen dovetail saddle with Center Adjusting Block

To mount a telescope on to the mount, release the dovetail Saddle Locking Knob and slide the telescope dovetail plate into the saddle. Tighten the Saddle Locking Knob.

There are two threaded holes on the side of the dovetail saddle for mounting an iOptron mini autoguiding system, iGuider.



Figure 16. iGuider mini-autoguiding system

### **Step 8. Balance payload**

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

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

Set the mount at Zero Position. Disengage both RA and DEC gear switches and move the mount to horizontal position to check balance. Return to Zero Position for balance adjustment. Balance the DEC axis by moving the scope with accessories back and forth in the mount saddle or within the scope mounting rings. Balance the assembly in R.A. axis by moving CW along its shaft. Repeat the process until both DEC and RA axes are balanced.

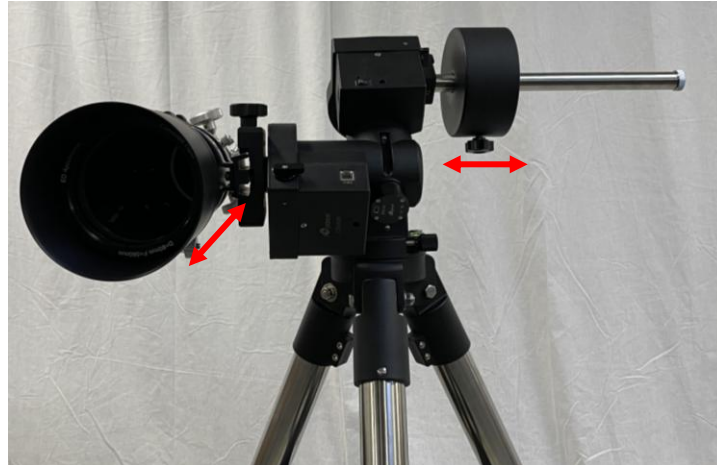


Figure 17. Balance a telescope

**CAUTION: The balancing process MUST be done with Gear Switch at the total disengaged position! Otherwise it might damage the worm system.**

Return the mount to Zero Position after balancing and engage gear switches.

### **Step 9. Connect cables**

Use the short RJ11 cable to connect the DEC control unit to the **DEC** port of the RA control unit.



Figure 18. Connect DEC cable

Connect the Go2Nova<sup>®</sup> 8409 Hand Controller to the **HBX** port on the RA unit. Plug in a 12V DC power supply to the **DC12V IN** socket next to the **HBX** port. **NOT the 12V DC OUT on the other side!**



Figure 19. Ports for cables

Plug optional GPS module into the **iPORT** with a coiled cable. When powering on, GPS ON sign should be displayed at the upper right corner of the hand controller. You may disconnect the GPS module after it picks up satellites signals and displays GPS OK (It takes a few minutes in normal conditions).

### **STEP 10. Set hand controller**

If a CEM26 is equipped with a GPS receiver, it will receive the time, longitude and latitude information from satellites after the link is established. However, there are still some parameters need to be entered to reflect your location, such as time zone info (**UTC offset**) and daylight saving time (**DST**). 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 top of the R.A. motor control board. **Do not leave the hand controller on GPS Status submenu waiting for GPS ON tuning into GPS OK.**

To set up the controller, turn the mount power ON. Press **MENU**=> "**Settings**":

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

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

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

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

```
2020-10-01 12:01:36
UTC -300 Minute(s)
W071d08m50s      DST: (N) ← Daylight Saving Time
N42d30m32s      Northern
```

### **Set Local Time**

The time will be updated automatically when the GPS receiver has established its link with the GPS satellites. In the event that the GPS module is unable to establish a link to the satellites, local time can be entered manually. 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, or "+" and "-" for UTC (Coordinated Universal Time) setting. 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 “UTC -300 Minute(s)” to set the time zone information (add or subtract 60 minutes per time zone). For example:

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

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

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

To adjust minutes, move the cursor to each digit and use the number keys to input the number directly. Use ▲ or ▼ key to toggle between “+” and “-”. When the time information entered is correct, press ENTER and go back to the previous screen. **Note that fractional time zones can be entered.**

Do not manually add or subtract an hour from displayed time to reflect Daylight Saving Time (DST). Instead please select “Y” for DST when daylight saving time begins.

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

### **Set Observation Site Coordinate**

The third and fourth lines display the longitude and latitude coordinates, respectively. 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 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 your smart phone, GPS receiver or via the internet. Site information in decimal format can be converted into d:m:s format by multiplying the decimal numbers by 60. For example, N47.53 can be changed to 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.

### **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 use 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 hand controller’s memory chip. If you are not traveling to another observation site, they do not need to be changed.

### **Check the Hand Controller Battery**

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

## **STEP 11. Perform polar alignment**

A CEM26 mount may be equipped with an iPolar™ electronic polar scope or an AccuAlign™ optical polar scope.

### ***iPolar Polar Alignment***

For a CEM26 with an iPolar, refer to iPolar Operation Manual from iOptron's website to perform the polar alignment, or steps briefly outlined below:

- Download and install iPolar Software (first time use);
- Connect a mini USB cable between the iPolar and a computer USB port;



Figure 20. USB port on an iPolar electronic polar scope

- Click Connect and start polar alignment by following on screen instructions.

### ***Quick Polar Alignment***

If the mount equipped with an AccuAlign™ optical polar scope, you can use the Quick Polar Alignment procedure to perform the polar alignment. One of the CEM26's unique features is that the polar scope can be used at anytime as it is not blocked by DEC axle as is the case in a German Equatorial Mount. This makes it possible to adjust the polar alignment while the mount is tracking.

As indicated in Figure 21, the Polar Scope reticle has been divided into 12 hours along the angular direction with 10-minute tics. There are 6 concentric circles in 2 groups of 3 marked from 36' to 44' and 60' to 70', respectively. The 36' to 44' concentric circles are used for polar alignment in the Northern Hemisphere using Polaris, while the 60' to 70' circles are used for polar alignment in Southern Hemisphere using Sigma Octantis.

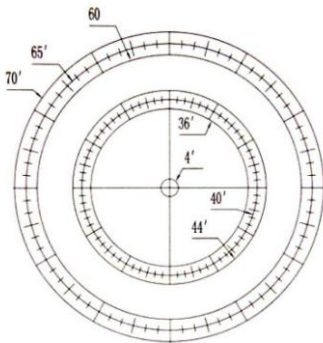


Figure 21. Polar Scope

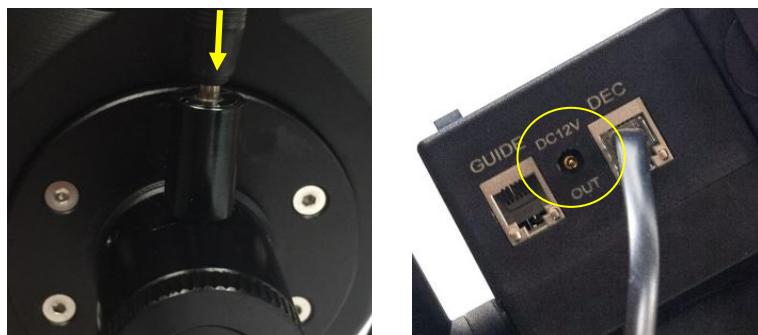


Figure 22. Connect polar scope LED

To perform the polar alignment:

- (1) Level the CEM26 mount and set it to the Zero Position. Make sure the telescope optical axis is parallel to the polar axis (R.A. axis) of the mount. If using a finder scope, adjust it to be parallel to the telescope optical axis.

- (2) Remove both the polar axis cover. Thread the polar scope LED to the Polar Scope. Connect one end of the polar scope power cable to the illumination LED and the other end to the DC12V output located on RA Unit (Figure 22).
- (3) Turn the mount power on.
- (4) Adjust the polar scope dial to rotate one of the major ticks at the top.
- (5) Use the Hand Controller (**MENU** => "**Alignment**" => "**Position of Polaris/SigmaOct**") to display the current position of Polaris on the LCD screen, as indicated in the left side of the figure below. For example, June 22, 2014, 20:19:42 in Boston, US (long. W71°08'50" and lat. N42°30'32", UTC - 300 min,) the Polaris Position is 0h45.8m and 40.4m.

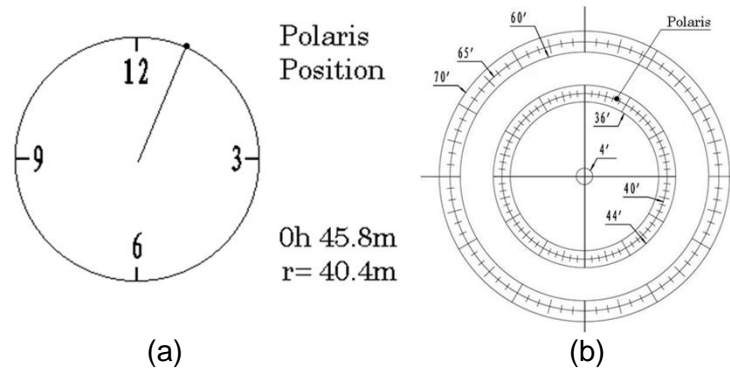


Figure 23. Polaris position shown on HC (a) and where to put on polar scope reticle (b)

- (6) Look through the polar scope to find the Polaris. Use the Azimuth and Latitude Adj. Knobs to adjust the mount in both directions and put the Polaris in the location on the Polar Scope Dial (same as indicated on the HC LCD), as shown in In **Error! Reference source not found.** (b).

**NOTE: If you are located in the Southern Hemisphere, Sigma Octantis will be chosen for Polar Alignment.**

### **BrightStar Polar Alignment**

If your mount does not have an iPolar installed, or the pole star is not in sight, you may use two bright stars with **Polar Iterate Align** to do the polar alignment.

- (1) Level the mount and set it to the 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** => "**Alignment**" => "**Polar Iterate Align**") to display the azimuth and altitude position of several bright stars near the meridian. Select one that is visible at a high altitude as Alignment Star A. Follow the HC instruction to move Alignment Star A to the center of the eyepiece using a combination of the Latitude Adjustment Knob and the "**◀**" or "**▶**" buttons. Press **ENTER** to confirm when the star is centered. Next, select a bright star that is close to the horizon as 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 Alignment Star A. Repeat the steps above. 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 an illuminated crosshair for accurate centering.

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

## **STEP 11. Return Mount to Zero Position**

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

To set the mount to Zero Position, press **MENU=>"Zero Position"=>"Set Zero Position"**. Release the Gear Switch to manually return the mount to Zero Position, or use the hand controller to slew the mount to Zero Position. Press **ENTER** to confirm the zero position.

Set the Zero Position or check the Zero Position by using **MENU=>"Zero Position"=>"Goto Zero Position"** before each session.

## 4. Getting Started

In order to experience the full GOTO capability of GOTO<sup>NOVA</sup>® technology it is very important to set up the mount correctly before observation.

### 4.1. Setup the Mount and Polar Alignment

Assemble your CEM26 mount according to Section 3.1. Mount an OTA and accessories, and carefully balance the mount around the polar axis. Turn the mount power switch on. Check the date and site info. Perform polar alignment.

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

### 4.2. Manual Operation of the Mount

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

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

### 4.3. Initial Star Alignment

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

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

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

### 4.4. Go to the Moon and Other Stars

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

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

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

#### **4.5. Star Identifying Function**

The 8409 hand controller has a star identifying function. After **Polar Alignment** and **Set Up Time and Site**, slew the telescope to an bright star, manually or using GOTO. Press ? button to identify the star name telescope is pointing to, as well as nearby bright stars if there are any.

#### **4.6. Power-Down Memorization**

The CEM26 mount can memorize its R.A. and DEC positions if the mount power is lost during operation, even during high speed slewing. After the power is back, just do a **Select and Slew** to the same star when the power is lost. The mount will continue to track the star.

#### **4.7. Turn Off the Mount**

When you have finished your observation, 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 the 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 so long as the mount has not been moved from the parked position.

#### **4.8. Putting the Mount Back into the Package**

Lock the RA axle with the Allen wrench. Disengage the gear system for transportation.

## 5. Complete Functions of Go2Nova® 8409 Hand Controller

### 5.1. Slew to an Object

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

The Go2Nova® 8409 hand controller for CEM26 mount has a database of over 212,000 objects. Use the ► or ◀ buttons to move the cursor. Use the number buttons to enter the number, or the ▼ or ▲ buttons to change the individual number. Hold on a button to fast scroll through the list. The “☉” indicates the object is above the horizon, and a cross mark “☼” means it is below the horizon. In some catalogs those stars below the horizon will not display on the hand controller.

#### 5.1.1. Solar System

There are 9 objects in the Solar system catalog.

#### 5.1.2. Deep Sky Objects

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

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

#### 5.1.3. Stars:

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

#### 5.1.4. Constellations

This catalog consists of 88 modern constellations with their names. They are listed alphabetically.

#### 5.1.5. Comets

This catalog contains 15 comets.

#### 5.1.6. Asteroids

This catalog contains 116 asteroids.

#### 5.1.7. User Objects

It can store up to 60 used entered 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. After slewing to an object, press **MENU** => "**Sync to Target**" => **ENTER**. Follow the screen to perform 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. 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**" will improve the local goto accuracy around the synced star.

## 5.3. Alignment

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

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

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

**The alignment data is only stored in the mount. It won't be synced/used to a computer when planetarium software is used to control the mount.**

### 5.3.1. Pole Star Position

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

### 5.3.2. One Star Alignment

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

### 5.3.3. Two Star Polar Align

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



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

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

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

#### 5.3.4. Three Star Align

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

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

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

#### 5.3.5. Polar Iterate Align

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

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

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

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

#### 5.3.6. Solar System Align

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

#### 5.3.7. Display Model Error

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

#### 5.3.8. Clear Alignment Data

This will clear all alignment data created during one star, two star or three star alignment process.

## 5.4. Settings

### 5.4.1. Set Time and Site

Refer to STEP 10 in Section 3.1.

### 5.4.2. Set Beep

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

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

Select one of three available modes:

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

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

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

### 5.4.3. Set Display

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

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

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

### 5.4.4. Set Maximum Slew Rate

This function will help the mount to slew properly under low temperature or extreme payload condition (extra long or large diameter scope). Press **MENU** => "**Settings**" => "**Set Maximum Slew Rate**,". You can select one of three slew rates. The default is MAX.

### 5.4.5. Set Guiding Rate

This is an advanced function for autoguiding when a guiding camera is utilized either via a Guide Port or using the ASCOM protocol. Before autoguiding, align the polar axis carefully. Select an appropriate guiding speed. The latest firmware allow you to set the R.A. and DEC guiding speed differently. The R.A. guiding speed can be set between  $\pm 0.01X$  to  $\pm 0.90X$  sidereal rate. The DEC guiding speed can be set between  $\pm 0.10X$  to  $\pm 0.99X$  sidereal rate. Follow the instructions of your autoguiding software for detailed guiding operation. The default number is 0.5X.

The guide port wiring is shown in **Figure 3**, which has the same pin-out as that from Celestron / Starlight Xpress / Orion Mount / Orion/ QHY/ZWO autoguider camera.

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

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

### 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 five parking positions. Two positions that park the scope horizontally (**Horizon Position**). Two positions that park the scope vertically (**Zenith Position**). "**Current Position**" will park the scope at its current position. When the mount is turned on, it will use the last parking position setting as the default setting.

### 5.4.7. Set Tracking Rate

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

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

### 5.4.8. Meridian Treatment

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

- "**Set Position Limit**" will tell the mount when to stop tracking or to do a meridian flip. The limit can be set at from 0° to 20° (80 minutes) pass meridian.
- "**Set Behavior**" will determine if the mount will stop tracking or perform a meridian flip at the set position limit.

### 5.4.9. Set Altitude Limit

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

### 5.4.10. Wi-Fi Option

This function will display WI-FI module functions. It is useful when connect the mount via wireless connection.

```
Wireless Status
Restart
Restore to factory
```

Click on **Wireless Status**: displays will show:

- **SSID**: HBX8409\_XXXXXX
- **IP**: 010.010.100.254
- **Port**: 08899
- **MAC**: XX-XX-XX-XX-XX-XX

Click on **Restart** will restart the Wi-Fi adapter and **Restore to Factory** to restore the factory settings.

### 5.4.11. GPS Status

Display if the GPS connection status. GPS ON indicates that the mount is still acquiring the satellite data. GPS OK indicates the link has been established. GPS OFF indicates there is no GPS or the GPS is malfunctioning. Do not leave the hand controller at this submenu.

### 5.4.12. Language

Select one of supported menu languages. Currently it has English and Chinese.

### 5.4.13. Set RA Guiding (CEM26EC Only)

You can turn off R.A. guiding by selecting “**Filter R.A. Guiding**” to allow the high precision encoder to correct the tracking error, or turn the R.A. guiding on by selecting “**Allow RA Guiding**” to allow the mount to receive guiding corrections from the autoguiding software.

## 5.5. Electric Focuser

This function controls an iOptron electric focuser.

## 5.6. PEC Option

PEC for short is a system that improves the tracking accuracy of the drive by reducing the number of user corrections needed to keep a guide star centered in the eyepiece. PEC is designed to improve photographic quality by reducing the amplitude of the worm errors. Using the PEC function is a three-step process. First, the system needs to know the current position of its worm gear so that it has a reference when playing back the recorded error. Next, you must guide for at least 10 minutes during which time the system records the correction you make. (It takes the worm gear 10 minutes to make one complete revolution). This “teaches” the system the characteristics of the worm. The periodic error of the worm gear drive will be stored in the hand controller and used to correct periodic error. The last step is to play back the corrections you made during the recording phase. Keep in mind, the PEC only compensate the RA worm error.

### 5.6.1. 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.

### 5.6.2. Record PEC

Here’s how to record the PE curve manually:

1. Find a bright star relatively close to the object you want to photograph.
2. Insert a high power eyepiece with illuminated cross hairs into your telescope. Orient the guiding eyepiece cross hairs so that one is parallel to the declination while the other is parallel to the R.A. axis.
3. Center the guide star on the illuminated cross hairs, focus the telescope, and study the periodic movement.
4. Before actually recording the periodic error, take a few minutes to practice guiding. Set the hand control slew rate to an appropriate slew rate and practice centering the guide star in the cross hairs for several minutes. This will help you familiarize yourself with the periodic error of the drive and the operation of the hand control. Remember to ignore declination drift when programming the PEC.
5. To begin recording the drive's periodic error, press the **MENU** => “**PEC Option**” => “**Record PEC**”. Once ready to begin recording, press the **ENTER** button to begin. Use the arrow button to keep the guiding star staying at the center of the cross hairs. It takes the worm gear 600 seconds to make one complete revolution. After 600 seconds PEC will automatically stop recording.
6. 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.
7. The PE data needs be recorded again if the power is lost.

### 5.6.3. PEC Data Integrity

This function will check the recorded PEC data integrity.

## 5.7. Edit User Objects

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

### 5.7.1. 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         | $\omega$ | $\Omega$ | 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
Clear All Comets
```

The hand controller will display the parameter entry screen:

```
Date: 2000-01-00.0000
q: 0.000000 e: 0.000000
 $\omega$ : 000.0000  $\Omega$ : 000.0000
i: 000.0000
```

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

### 5.7.2. 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 Object
Browse Objects
Delete an Object
Clear All Objects
```

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

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

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

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

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

## 5.8. Firmware Information

This option will display the mount type, firmware version information for the hand controller (HC), R.A. board (RA), and DEC board (DEC).

## 5.9. Zero Position

### 5.9.1. 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.

### 5.9.2. Set Zero Position

This set the Zero Position for the firmware.

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

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

## 6. Maintenance and Servicing

### 6.1. Maintenance

Do not overload the mount. Do not drop the mount as this will damage the mount and / or permanently degrade GoTo performance and tracking accuracy. Use a wet cloth to clean the mount and hand controller. Do not use solvent.

The mount worm/gear meshing can be adjusted to accommodate payload or temperature changing. Please refer to the instruction in Appendix.

The real time clock battery in the hand controller needs be replaced if it can't keep the time after power off the mount.

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 mount, please contact iOptron Customer Service Department. It is strongly suggested to send technical questions to [support@ioptron.com](mailto:support@ioptron.com) for prompt response during off hour. Customer Service hours are 9:00 AM to 5:00 PM, Eastern Time, Monday through Friday. Call in the U.S. 1.781.569.0200.

In the unlikely event that the mount 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.

### 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

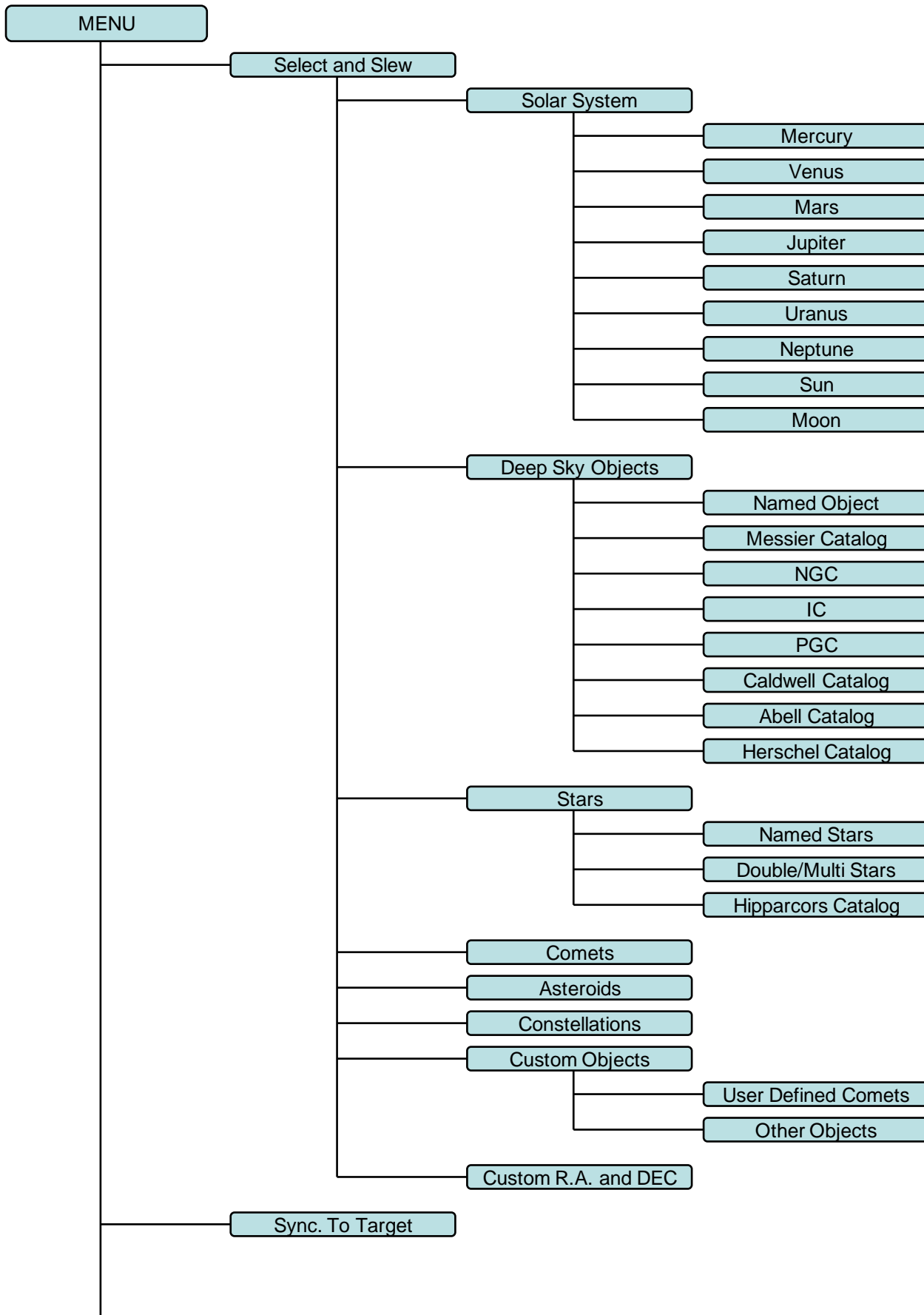
|                            |   |
|----------------------------|---|
| Mount                      | Center-Balanced Equatorial Mount (CEM)  |
| Payload*                   | Up to 26 lb (12kg), exclude counterweight   |
| Mount weight               | 10 lb (4.5kg)   |
| Payload/Mount weight       | 2.60  |
| Structure Material         | All metal, Casting + CNC machined   |
| Periodic Error (PE)**      | <±10 arcsec for CEM26<br><0.3 arcsec rms for CEM26EC                                    |
| PEC                        | Permanent PEC/Real-time PEC   |
| Right Ascension worm wheel | Φ88mm, 144 teeth aluminum   |
| Declination worm wheel     | Φ88mm, 144 teeth aluminum   |
| Right Ascension axis shaft | Φ35mm steel   |
| Declination axis shaft     | Φ35mm steel   |
| Right Ascension bearing    | Φ55mm ball bearing  |
| Declination bearing        | Φ55mm ball bearing  |
| Worm gears                 | Φ15.2mm, brass  |
| Motor drive                | 1.8° stepper motor, 128X microdivision  |
| Resolution                 | 0.17 arc seconds  |
| Transmission               | Synchronous belt  |
| Latitude adjustment range  | 0° ~ 60°  |
| Azimuth adjustment range   | ± 6°  |
| Polar Scope                | iPolar™ electronic polar scope or AccuAlign™ dark field illuminated optical polar scope |
| Level indicator            | Level bubble  |
| Hand Controller            | Go2Nova® 8409 with 212,000 objects database   |
| Tracking                   | Automatic   |
| Speed                      | 1x,2x,8x,16x,64x,128x,256x,512x,MAX(6°/sec)   |
| Power consumption          | 0.5A(Tracking), 0.8A(GOTO)  |
| Power requirement          | 12V, 5A   |
| AC adapter                 | 100V ~ 240V (included)  |
| Wi-Fi                      | Built-in  |
| Communication port         | Yes (USB and Wi-Fi)   |
| Autoguide port             | Yes (ST-4 compatible)   |
| Firmware upgrade           | Yes   |
| PC computer control        | Yes   |
| Dovetail saddle            | 3.8" spring loaded Vixen-style, center adjustable                                       |
| Counterweight shaft        | Φ20mm X306mm (M16)  |
| Counterweight              | 10 lb (4.5kg)   |
| Tripod                     | 1.5" Stainless Steel(5kg), or LiteRoc™ 1.75"(7.5kg)                                     |
| GPS                        | Optional external 32-channel GPS  |
| Autoguider                 | Optional external iGuider   |
| Operation temperature      | -10°C ~ 40°C  |
| Warranty                   | Two year limited  |

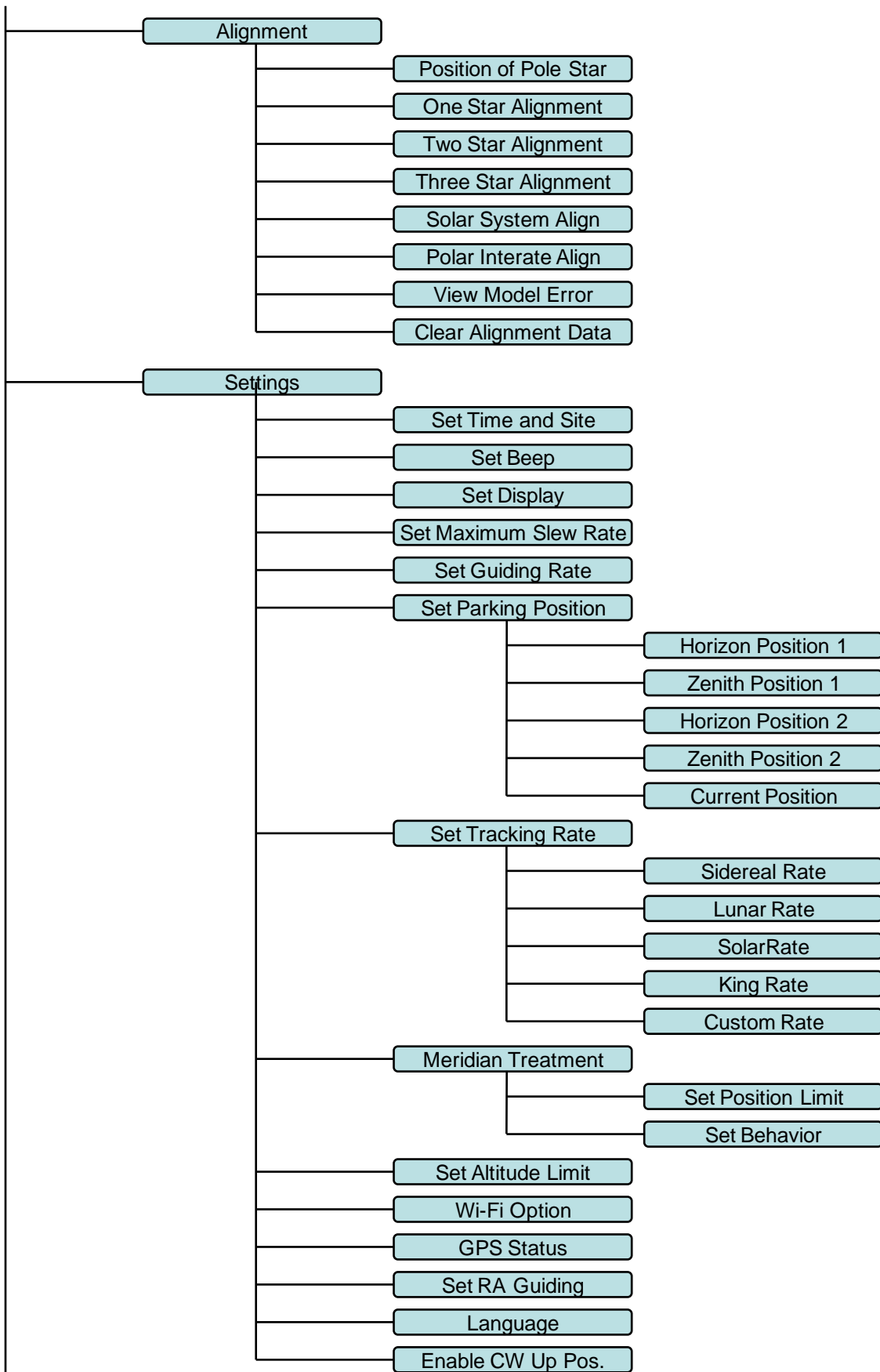
\* OTA size and length dependent, smaller than 6" in diameter recommended.

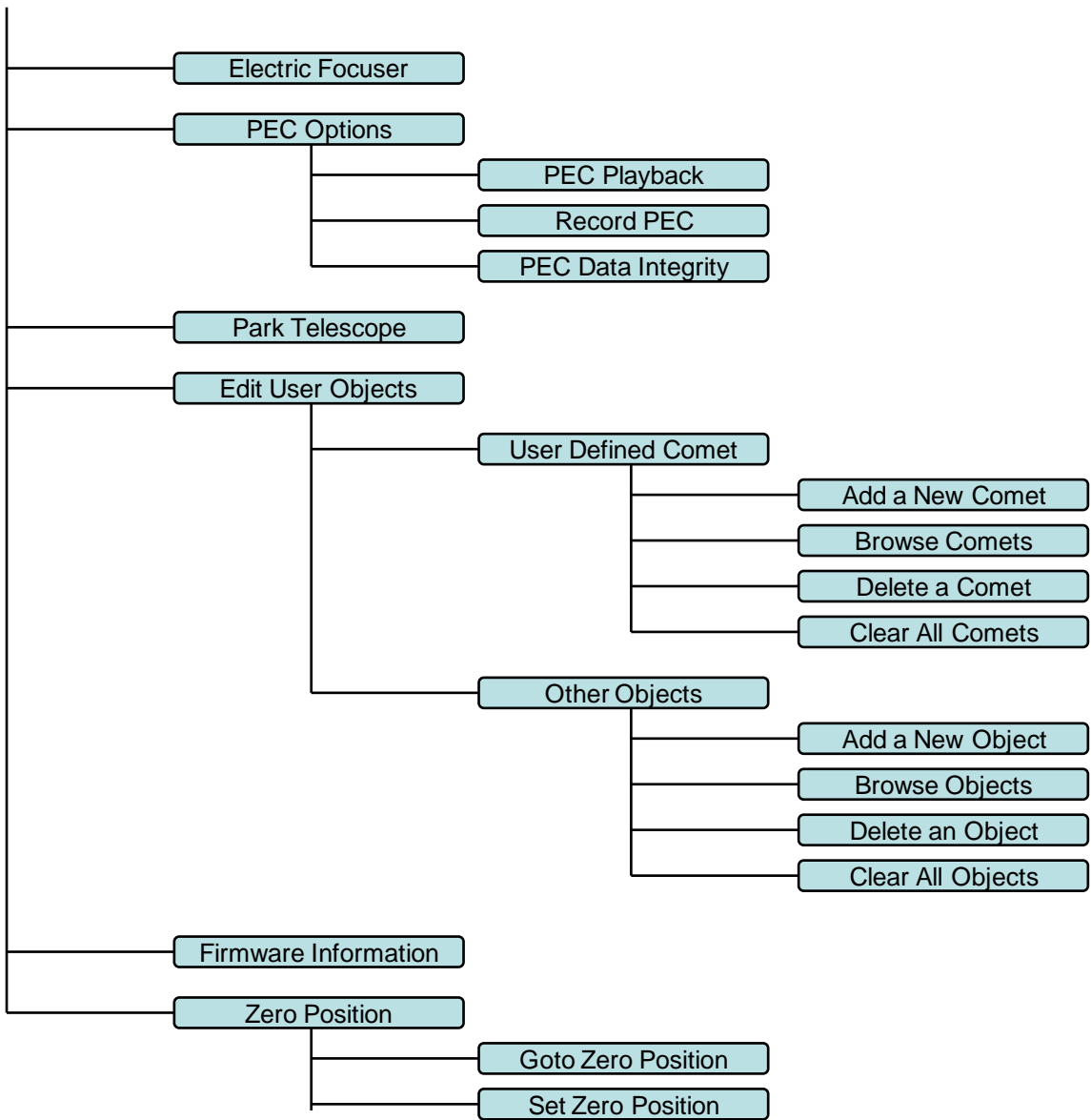
\*\* Measured with encoder on bench, 10 minutes



# Appendix B. Go2Nova<sup>®</sup> 8409 HC MENU STRUCTURE







Some functions are mount dependent.

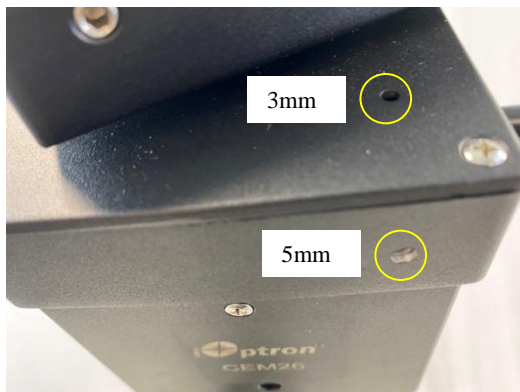
## Appendix C. Gear Meshing Adjustment

CEM26/GEM28 gear is designed adjustable by customer although in most cases not necessary. If you experienced DEC/RA motor stall occasionally, or there is free play between the worm and gear, follow this instruction to adjust the gear meshing.

**Tool needed:** 2mm and 3mm hex keys.

### To Adjust DEC Gear:

Disengage DEC gear switch. Rotate DEC saddle to exposure the small hole (3mm in diameter) that is blocked by the dovetail saddle. Another larger hole (5mm) is located on the side of the DEC gear housing. There is a **set screw** inside the 3mm hole to lock the **gear meshing adjustment plunger**, which is inside the larger hole.



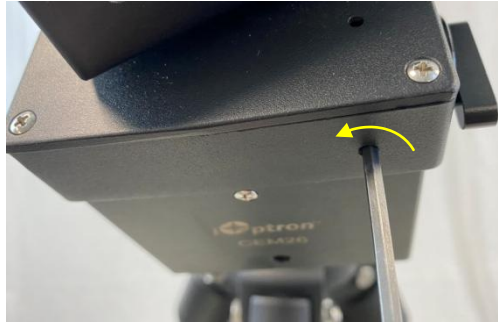
Engage the worm/gear by turn the gear switch to locking position.



Insert the 2mm hex key into the small hole on the top. Gently turn the hex key until you feel it is engaged to the set screw inside. You may turn the gear switch further in the lock position if the wrench can't engage the set screw. Turn the **set screw** half a turn counterclockwise to release it.



Adjust the **gear meshing adjustment plunger** on the side inside the large hole by using the 3mm hex key. Turn counterclockwise to loosen the meshing or turn clockwise to tighten the meshing.



If the motor stalls or the mount does not tracking smoothly, most likely the meshing is too tight. You may loosen it by about 1/8 turn (or less for tracking).

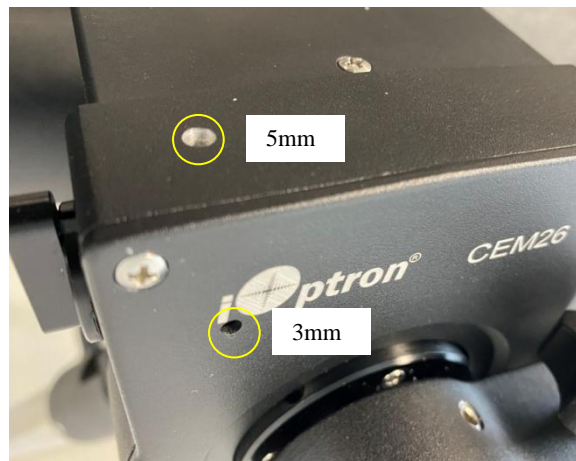
***Tighten the set screw in the small hole to LOCK the gear screw (important) before test the mount.***

Adjust again if needed, but no more than ¼ turn in total.

If you feel there is free play between the worm and gear, you may tighten the meshing adjustment plunger to eliminate it.

### **To Adjust RA Gear:**

The RA gear meshing adjustment plunger is located next to the RA Gear Switch. The adjustment is same as that for DEC gear/worm.



**DO NOT over tighten the gear meshing adjustment plunger to avoid damage it.**

## **Appendix D. Firmware Upgrade**

The firmware in the 8409 hand controller and motor control boards can be upgraded by the customer. Please check iOptron's website, [www.iOptron.com](http://www.iOptron.com), under the product page or Support Directory.

## Appendix E. Computer Control an CEM26 Mount

The CEM26 mount can be controlled by a SmartPhone, a Tablet or a computer. It is supported by two types of computer connections:

- Connect to a computer via USB port on hand controller. The mount can be controlled via ASCOM protocol (Windows OS), or directly by some software, such as Sky Safari (Mac OS)
- Connect wirelessly via built-in wireless connection. The mount can be controlled via ASCOM protocol (Windows OS), SmartPhone/Tablet and Mac OS wirelessly.

To control the mount via ASCOM protocol, you need:

1. Download and install the latest ASCOM Platform from <http://www.ascom-standards.org/>. Make sure your PC meets the software requirement.
2. Download and install the latest iOptron Commander/ASCOM drive for CEM26 from iOptron website. The CEM26 uses Commander for a CEM120/CEM70/CEM26/GEM28 mount.
3. Planetarium software that supports ASCOM protocol. Follow software instructions to select the iOptron Telescope.

Please refer to iOptron website, [www.iOptron.com](http://www.iOptron.com), under the product page, or Support Directory, iOptron ASCOM Driver for more detail.

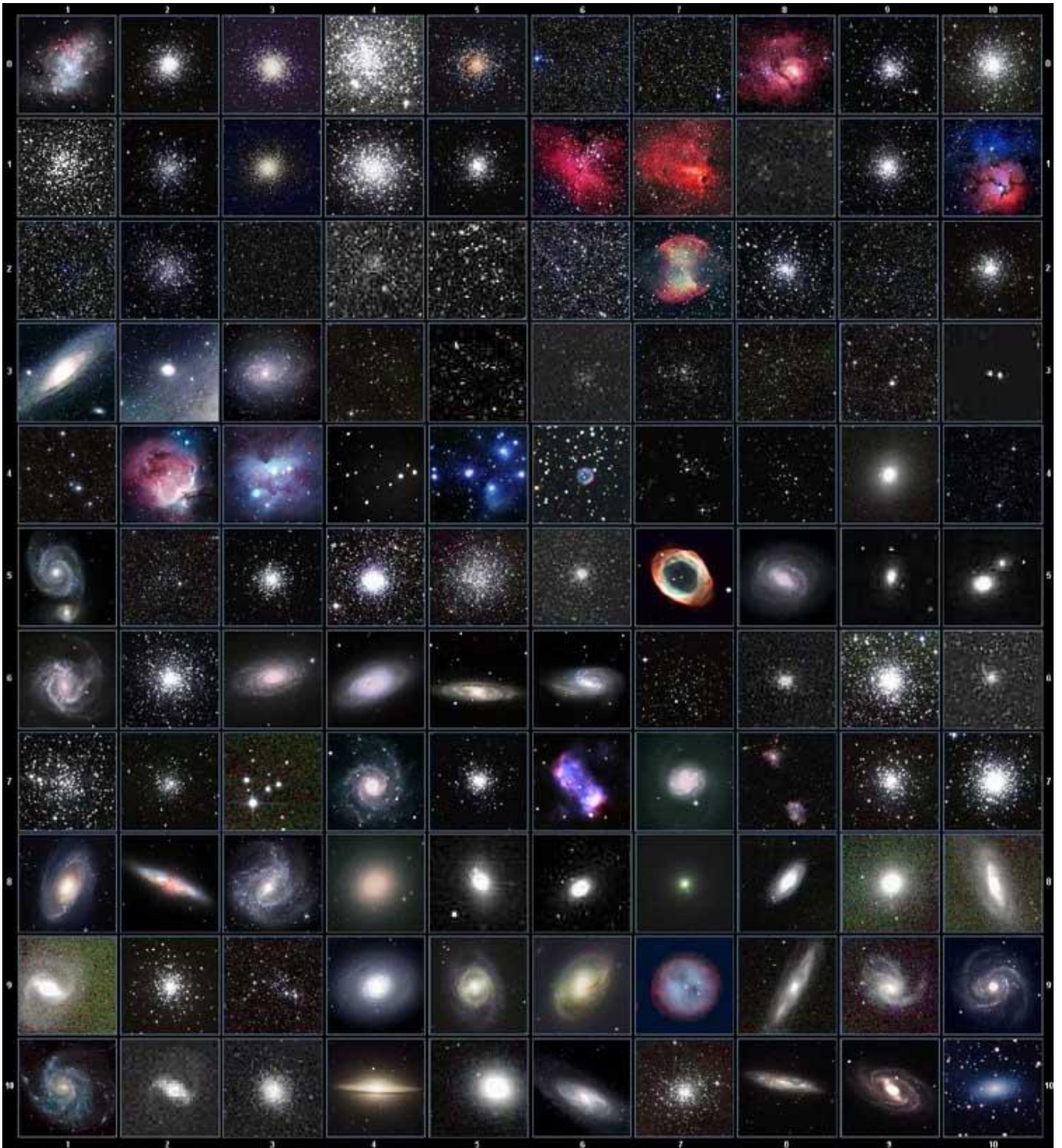
# Appendix F. Go2Nova<sup>®</sup> Star List

## Named Deep Sky Object

|    |                           |    |                          |
|----|---------------------------|----|--------------------------|
| 1  | 47 Tucanae                | 47 | Integral Sign Galaxy     |
| 2  | Andromeda Galaxy          | 48 | Iris Nebula              |
| 3  | Antennae Galaxies         | 49 | Jellyfish Nebula         |
| 4  | Barnard's Galaxy          | 50 | Jewel Box Cluster        |
| 5  | Bear-Paw Galaxy           | 51 | Lagoon Nebula            |
| 6  | Beehive Cluster           | 52 | Lambda Centauri Nebula   |
| 7  | Black Eye Galaxy          | 53 | Large Magellanic Cloud   |
| 8  | Blinking Planetary        | 54 | Leo Triplet              |
| 9  | Blue Flash Nebula         | 55 | Little Dumbbell Nebula   |
| 10 | Blue Planetary            | 56 | Little Gem Nebula        |
| 11 | Blue Snowball Nebula      | 57 | Little Ghost Nebula      |
| 12 | Bode's Galaxy             | 58 | Mice Galaxies            |
| 13 | Box Nebula                | 59 | Monkey Head Nebula       |
| 14 | Bubble Nebula             | 60 | North America Nebula     |
| 15 | Bug Nebula                | 61 | Northern Jewel Box       |
| 16 | Butterfly Cluster         | 62 | Omega Nebula             |
| 17 | Butterfly Galaxies        | 63 | Orion Nebula             |
| 18 | California Nebula         | 64 | Owl Nebula               |
| 19 | Carina Nebula             | 65 | Pacman Nebula            |
| 20 | Cat's Eye Nebula          | 66 | Pelican Nebula           |
| 21 | Cave Nebula               | 67 | Phantom Streak Nebula    |
| 22 | Christmas Tree Cluster    | 68 | Pinwheel Galaxy          |
| 23 | Cigar Galaxy              | 69 | Pleiades                 |
| 24 | Cocoon Nebula             | 70 | Ring Nebula              |
| 25 | Coma Pinwheel             | 71 | Rosette Nebula           |
| 26 | Copeland Septet           | 72 | Saturn Nebula            |
| 27 | Crab Nebula               | 73 | Sextans B                |
| 28 | Crescent Nebula           | 74 | Small Magellanic Cloud   |
| 29 | Draco Dwarf Galaxy        | 75 | Sombrero Galaxy          |
| 30 | Dumbbell Nebula           | 76 | Soul Nebula              |
| 31 | Eagle Nebula              | 77 | Southern Pinwheel Galaxy |
| 32 | Eight-Burst Nebula        | 78 | Spindle Galaxy(3115)     |
| 33 | Elephant Trunk Nebula     | 79 | Spindle Galaxy(5866)     |
| 34 | Eskimo Nebula             | 80 | Stephan's Quintet        |
| 35 | Eyes Galaxies             | 81 | Sunflower Galaxy         |
| 36 | Flame Nebula              | 82 | Tarantula Nebula         |
| 37 | Flaming Star Nebula       | 83 | The Witch Head Nebula    |
| 38 | Ghost of Jupiter          | 84 | The Wizard Nebula        |
| 39 | Heart Nebula              | 85 | Thor's Helmet            |
| 40 | Helix Nebula              | 86 | Triangulum Galaxy        |
| 41 | Hercules Globular Cluster | 87 | Trifid Nebula            |
| 42 | Hind's Variable Nebula    | 88 | Ursa Minor Dwarf Galaxy  |
| 43 | Hockey Stick Galaxies     | 89 | Veil Nebula              |
| 44 | Horsehead Nebula          | 90 | Whale Galaxy             |
| 45 | Hubble's Variable Nebula  | 91 | Whirlpool Galaxy         |
| 46 | Hyades Cluster            | 92 | Wild Duck Cluster        |



# Messier Catalog



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## Named Star

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

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

## Modern Constellations

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

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

## Double/Multi Stars

| No. | HC Item           |                         | Constellation  | Name            | HIP   | WDS        | SAO    |
|-----|-------------------|-------------------------|----------------|-----------------|-------|------------|--------|
| 1   | Rigel Kentaurus A | Alpha Centauri          | Centaurus      |                 | 71683 | 14396-6050 | 252838 |
| 2   | Rigel             | Beta Orionis            | Orion          |                 | 24436 | 05145-0812 | 131907 |
| 3   | Gacrux            | Gamma Crucis            | Crux           |                 | 61084 | 12312-5707 | 240019 |
| 4   | Sargas            | Theta Scorpii           | Scorpius       |                 | 86228 | 17373-4300 | 228201 |
| 5   | Castor A          | Alpha Geminorum         | Gemini         |                 | 36850 | 07346+3153 | 60198  |
| 6   | Mizar             | Zeta Ursae Majoris      | Ursa Major     |                 | 65378 | 13239+5456 | 28737  |
| 7   | Almach            | Gamma Andromedae        | Andromeda      |                 | 9640  | 02039+4220 | 37735  |
| 8   | Algieba           | Gamma Leonis            | Leo            |                 | 50583 | 10200+1950 | 81298  |
| 9   | Aludra            | Eta Canis Majoris       | Canis Major    |                 | 35904 | 07241-2918 | 173651 |
| 10  | Iritjinga (Cen)   | Gamma Centauri          | Centaurus      | Muhlifain       | 61932 | 12415-4858 | 223603 |
| 11  | Zubenelgenubi     | Alpha Librae            | Libra          |                 | 72603 | 14509-1603 | 158836 |
| 12  | Alcyone           | Eta Tauri               | Taurus         |                 | 17702 | 03475+2406 | 76199  |
| 13  | Cor Caroli        | Alpha Canum Venaticorum | Canes Venatici |                 | 63125 | 12560+3819 | 63257  |
| 14  | Acamar            | Theta Eridani           | Eridanus       |                 | 13847 | 02583-4018 | 216113 |
| 15  | Adhafera          | Zeta Leonis             | Leo            |                 | 50335 | 10167+2325 | 81265  |
| 16  | Rasalgethi        | Alpha Herculis          | Hercules       |                 | 84345 | 17146+1423 | 102680 |
| 17  | Meissa            | Lambda Orionis          | Orion          |                 | 26207 | 05351+0956 | 112921 |
| 18  | Graffias          | Beta1 Scorpii           | Scorpius       |                 | 78820 | 16054-1948 | 159682 |
| 19  | Alya              | Theta Serpentis         | Serpens        |                 | 92946 | 18562+0412 | 124068 |
| 20  | HIP 48002         | Upsilon Carinae         | Carina         | Vathorz Prior   |       | 09471-6504 | 250695 |
| 21  | HIP 95947         | Beta1 Cygni             | Cygnus         | Albireo         |       | 19307+2758 | 87301  |
| 22  | HIP 20894         | Theta2 Tauri            | Taurus         |                 |       | 04287+1552 | 93957  |
| 23  | HIP 74395         | Zeta Lupi               | Lupus          |                 |       | 15123-5206 | 242304 |
| 24  | HIP 27072         | Gamma Leporis           | Lupus          |                 |       | 05445-2227 | 170759 |
| 25  | HIP 26549         | Sigma Orionis           | Orion          |                 |       | 05387-0236 | 132406 |
| 26  | HIP 85667         | HD 158614               | Ophiuchus      |                 |       | 17304-0104 | 141702 |
| 27  | HIP 74376         | Kappa1 Lupi             | Lupus          |                 |       | 15119-4844 | 225525 |
| 28  | HIP 34481         | Gamma2 Volantis         | Carina         |                 |       | 07087-7030 | 256374 |
| 29  | HIP 53253         | Upsilon Carinae         | Carina         |                 |       | 10535-5851 | 238574 |
| 30  | HIP 99675         | Omicron1 Cygni          | Cygnus         | 31 Cyg          |       | 20136+4644 | 49337  |
| 31  | HIP 63003         | Mu1 Crucis              | Crux           |                 |       | 12546-5711 | 240366 |
| 32  | HIP 43103         | Iota Cancri             | Cancer         | 48 Cnc          |       | 08467+2846 | 80416  |
| 33  | HIP 110991        | Delta Cephei            | Cepheus        | 27 Cep          |       | 22292+5825 | 34508  |
| 34  | HIP 20635         | Kappa1 Tauri            | Taurus         | 65 Tau          |       | 04254+2218 | 76601  |
| 35  | HIP 88601         | 70 Ophiuchi             | Orion          |                 |       | 18055+0230 | 123107 |
| 36  | HIP 2484          | Beta1 Tucanae           | Horologium     |                 |       | 00315-6257 | 248201 |
| 37  | HIP 91971         | Zeta1 Lyrae             | Cygnus         | 6 Lyr           |       | 18448+3736 | 67321  |
| 38  | HIP 79374         | Nu Scorpii              | Scorpius       | Jabbah          |       | 16120-1928 | 159764 |
| 39  | HIP 102532        | Gamma2 Delphini         | Pegasus        | 12 Del          |       | 20467+1607 | 106476 |
| 40  | HIP 52154         | Xi Velorum              | Vela           |                 |       | 10393-5536 | 238309 |
| 41  | HIP 37229         | HD 61555                | Canis Major    |                 |       | 07388-2648 | 174198 |
| 42  | HIP 30419         | Epsilon Monocerotis     | Orion          | 8 Mon           |       | 06238+0436 | 113810 |
| 43  | HIP 108917        | Xi Cephei               | Cepheus        | Al kurhah       |       | 22038+6438 | 19827  |
| 44  | HIP 53417         | 54 Leonis               | Leo            |                 |       | 10556+2445 | 81584  |
| 45  | HIP 65271         | J Centauri              | Centaurus      |                 |       | 13226-6059 | 252284 |
| 46  | HIP 67669         | 3 Centauri              | Centaurus      |                 |       | 13518-3300 | 204916 |
| 47  | HIP 105319        | Theta Indi              | Indus          |                 |       | 21199-5327 | 246965 |
| 48  | HIP 80582         | Epsilon Normae          | Norma          |                 |       | 16272-4733 | 226773 |
| 49  | HIP 8832          | Gamma Arietis           | Aries          |                 |       | 01535+1918 | 92680  |
| 50  | HIP 69483         | Kappa Boötis            | Boötes         | Asellus Tertius |       | 14135+5147 | 29045  |
| 51  | HIP 92946         | Theta Serpentis         | Serpens        |                 |       | 18562+0412 | 124068 |
| 52  | HIP 86614         | Psi1 Draconis           | Draco          | 31 Draconis     |       | 17419+7209 | 8890   |



| No. | HC Item    |                       | Constellation   | Name                | HIP | WDS        | SAO    |
|-----|------------|-----------------------|-----------------|---------------------|-----|------------|--------|
| 53  | HIP 95771  | Alpha Vulpeculae      | Vulpecula       | Anser               |     | 19287+2440 | 87261  |
| 54  | HIP 30867  | Beta Monocerotis      | Monoceros       |                     |     | 06288-0702 | 133316 |
| 55  | HIP 35363  | NV Puppis             | Puppis          |                     |     | 07183-3644 | 197824 |
| 56  | HIP 94761  | Gliese 752            | Aquila          | Wolf 1055, Ross 652 |     | 19169+0510 |        |
| 57  | HIP 21683  | Sigma2 Tauri          | Taurus          |                     |     | 04393+1555 | 94054  |
| 58  | HIP 8497   | Chi Ceti              | Cetus           | 53 Cet              |     | 01496-1041 | 148036 |
| 59  | HIP 26199  | HD 36960              | Orion           |                     |     | 05350-0600 | 132301 |
| 60  | HIP 104521 | Gamma Equulei         | Equuleus        | 5 Equ               |     | 21103+1008 | 126593 |
| 61  | HIP 116389 | Iota Phoenicis        | Phoenix         |                     |     | 23351-4237 | 231675 |
| 62  | HIP 17797  | HD 24071              | Eridanus        |                     |     | 03486-3737 | 194550 |
| 63  | HIP 21036  | 83 Tauri              | Taurus          |                     |     | 04306+1343 | 93979  |
| 64  | HIP 107310 | Mu1 Cygni             | Cygnus          | 78 Cyg              |     | 21441+2845 | 89940  |
| 65  | HIP 72659  | Xi Boötis             | Boötes          | 37 Boo              |     | 14514+1906 | 101250 |
| 66  | HIP 21029  | HD 28527              | Taurus          |                     |     | 04306+1612 | 93975  |
| 67  | HIP 42726  | HY Velorum            | Vela            |                     |     | 08424-5307 | 236205 |
| 68  | HIP 18255  | 32 Eridani            | Eridanus        |                     |     | 03543-0257 | 130806 |
| 69  | HIP 9153   | Lambda Arietis        | Aries           |                     |     | 01580+2336 | 75051  |
| 70  | HIP 88267  | 95 Herculis           | Hercules        |                     |     | 18015+2136 | 85648  |
| 71  | HIP 85829  | Nu2 Draconis          | Draco           | 25 Dra              |     | 17322+5511 | 30450  |
| 72  | HIP 43937  | V376 Carinae          | Carina          | b1 Carinae          |     | 08570-5914 | 236436 |
| 73  | HIP 71762  | Pi2 Boötis            | Boötes          | 29 Boo              |     | 14407+1625 | 101139 |
| 74  | HIP 80047  | Delta1 Apodis         | Apus            |                     |     | 16203-7842 | 257380 |
| 75  | HIP 58484  | Epsilon Chamaeleontis | Chamaeleon      |                     |     | 11596-7813 | 256894 |
| 76  | HIP 25142  | 23 Orionis            | Orion           |                     |     | 05228+0333 | 112697 |
| 77  | HIP 54204  | Chi1 Hydrae           | Hydra           |                     |     | 11053-2718 | 179514 |
| 78  | HIP 76669  | Zeta Coronae Borealis | Corona Borealis | 7 CrB               |     | 15394+3638 | 64833  |
| 79  | HIP 99770  | b3 Cygni              | Cygnus          | 29 Cyg              |     | 20145+3648 | 69678  |
| 80  | HIP 101027 | Rho Capricorni        | Capricornus     | 11 Cap              |     | 20289-1749 | 163614 |
| 81  | HIP 74911  | Nu Lupi               | Lupus           |                     |     | 15185-4753 | 225638 |
| 82  | HIP 35210  | HD 56577              | Canis Major     |                     |     | 07166-2319 | 173349 |
| 83  | HIP 26235  | Theta2 Orionis        | Orion           | 43 Ori              |     | 05354-0525 | 132321 |
| 84  | HIP 40321  | OS Puppis             | Puppis          |                     |     | 08140-3619 | 198969 |
| 85  | HIP 70327  | HD 126129             | Boötes          |                     |     | 14234+0827 | 120426 |
| 86  | HIP 26221  | Theta1 Orionis        | Orion           | Trapezium           |     | 05353-0523 | 132314 |
| 87  | HIP 80473  | Rho Ophiuchi          | Ophiuchus       | 5 Oph               |     | 16256-2327 | 184381 |
| 88  | HIP 78105  | Xi1 Lupi              | Lupus           |                     |     | 15569-3358 | 207144 |
| 89  | HIP 79043  | Kappa Herculis        | Hercules        | 7 Her               |     | 16081+1703 | 101951 |
| 90  | HIP 61418  | 24 Comae Berenices    | Coma Berenices  |                     |     | 12351+1823 | 100160 |
| 91  | HIP 91919  | Epsilon Lyrae         | Lyra            | 4 Lyr               |     | 18443+3940 | 67309  |
| 92  | HIP 41639  | HD 72127              | Vela            |                     |     | 08295-4443 | 219996 |
| 93  | HIP 104214 | 61 Cygni              | Cygnus          |                     |     | 21069+3845 | 70919  |
| 94  | HIP 23734  | 11 Camelopardalis     | Camelopardalis  |                     |     | 05061+5858 | 25001  |
| 95  | HIP 60189  | Zeta Corvi            | Corvus          | 5 Crv               |     | 12206-2213 | 180700 |
| 96  | HIP 66821  | Q Centauri            | Centaurus       |                     |     | 13417-5434 | 241076 |
| 97  | HIP 14043  | HD 18537              | Perseus         |                     |     | 03009+5221 | 23763  |
| 98  | HIP 5737   | Zeta Piscium          | Pisces          | 86 Psc              |     | 01137+0735 | 109739 |
| 99  | HIP 84626  | Omicron Ophiuchi      | Ophiuchus       | 39 Oph              |     | 17180-2417 | 185238 |
| 100 | HIP 60904  | 17 Comae Berenices    | Coma Berenices  |                     |     | 12289+2555 | 82330  |
| 101 | HIP 58684  | 67 Ursae Majoris      | Ursa Major      |                     |     | 12021+4303 | 44002  |
| 102 | HIP 5131   | Psi1 Piscium          | Pisces          | 74 Psc              |     | 01057+2128 | 74482  |
| 103 | HIP 115126 | 94 Aquarii            | Aquarius        |                     |     | 23191-1328 | 165625 |
| 104 | HIP 62572  | HD 112028             | Camelopardalis  |                     |     | 12492+8325 | 2102   |

| No. | HC Item    |                         | Constellation    | Name     | HIP | WDS        | SAO    |
|-----|------------|-------------------------|------------------|----------|-----|------------|--------|
| 105 | HIP 40167  | Zeta1 Cancri            | Cancer           | Tegmen   |     | 08122+1739 | 97645  |
| 106 | HIP 40817  | Kappa Volantis          | Volans           |          |     | 08198-7131 | 256497 |
| 107 | HIP 81292  | 17 Draconis             | Draco            |          |     | 16362+5255 | 30013  |
| 108 | HIP 80197  | Nu1 Coronae Borealis    | Corona Borealis  |          |     | 16224+3348 | 65257  |
| 109 | HIP 88060  | HD 163756               | Sagittarius      |          |     | 17591-3015 | 209553 |
| 110 | HIP 42637  | Eta Chamaeleontis       | Chamaeleon       |          |     | 08413-7858 | 256543 |
| 111 | HIP 21039  | 81 Tauri                | Taurus           |          |     | 04306+1542 | 93978  |
| 112 | HIP 100965 | 75 Draconis             | Draco            |          |     | 20282+8125 | 3408   |
| 113 | HIP 25768  | HD 36553                | Pictor           |          |     | 05302-4705 | 217368 |
| 114 | HIP 93717  | 15 Aquilae              | Aquila           |          |     | 19050-0402 | 142996 |
| 115 | HIP 79980  | HD 148836               | Scorpius         |          |     | 16195-3054 | 207558 |
| 116 | HIP 12086  | 15 Trianguli            | Triangulum       |          |     | 02358+3441 | 55687  |
| 117 | HIP 90968  | Kappa2 Coronae Australe | Corona Australis |          |     | 18334-3844 | 210295 |
| 118 | HIP 22531  | Iota Pictoris           | Pictor           |          |     | 04509-5328 | 233709 |
| 119 | HIP 34065  | HD 53705                | Puppis           |          |     | 07040-4337 | 218421 |
| 120 | HIP 79607  | Sigma Coronae Borealis  | Corona Borealis  |          |     | 16147+3352 | 65165  |
| 121 | HIP 109786 | 41 Aquarii              | Aquarius         |          |     | 22143-2104 | 190986 |
| 122 | HIP 56280  | 17 Crateris             | Hydra            |          |     | 11323-2916 | 179968 |
| 123 | HIP 51561  | HD 91355                | Vela             |          |     | 10320-4504 | 222126 |
| 124 | HIP 107930 | HD 208095               | Cepheus          |          |     | 21520+5548 | 33819  |
| 125 | HIP 97966  | 57 Aquilae              | Aquila           |          |     | 19546-0814 | 143898 |
| 126 | HIP 117218 | 107 Aquarii             | Aquarius.        |          |     | 23460-1841 | 165867 |
| 127 | HIP 82676  | HD 152234               | Scorpius         |          |     | 16540-4148 | 227377 |
| 128 | HIP 111546 | 8 Lacertae              | Lacerta          |          |     | 22359+3938 | 72509  |
| 129 | HIP 29151  | HD 42111                | Orion            |          |     | 06090+0230 | 113507 |
| 130 | HIP 107253 | 79 Cygni                | Cygnus           |          |     | 21434+3817 | 71643  |
| 131 | HIP 88136  | 41 Draconis             | Draco            |          |     | 18002+8000 | 8996   |
| 132 | HIP 81702  | HD 150136               | Ara              |          |     | 16413-4846 | 227049 |
| 133 | HIP 97423  | HD 186984               | Sagittarius      |          |     | 19480-1342 | 162998 |
| 134 | HIP 30444  | HD 45145                | Columba          |          |     | 06240-3642 | 196774 |
| 135 | HIP 66400  | HD 118349               | Hydra            |          |     | 13368-2630 | 181790 |
| 136 | HIP 17579  | 21 Tauri                | Taurus           | Asterope |     | 03459+2433 | 76159  |
| 137 | HIP 35785  | 19 Lyncis               | Lynx             |          |     | 07229+5517 | 26312  |
| 138 | HIP 81641  | 37 Herculis             | Hercules         |          |     | 16406+0413 | 121776 |
| 139 | HIP 7751   | p Eridani               | Eridanus         |          |     | 01398-5612 | 232490 |
| 140 | HIP 21148  | 1 Camelopardalis        | Camelopardalis   |          |     | 04320+5355 | 24672  |
| 141 | HIP 9021   | 56 Andromedae           | Andromeda        |          |     | 01562+3715 | 55107  |
| 142 | HIP 97816  | HD 187420               | Telescopium      |          |     | 19526-5458 | 246311 |
| 143 | HIP 88818  | 100 Herculis            | Hercules         |          |     | 18078+2606 | 85753  |
| 144 | HIP 36817  | HD 60584                | Puppis           |          |     | 07343-2328 | 174019 |
| 145 | HIP 25695  | HD 35943                | Taurus           |          |     | 05293+2509 | 77200  |
| 146 | HIP 98819  | 15 Sagittae             | Sagitta          |          |     | 20041+1704 | 105635 |
| 147 | HIP 61910  | VV Corvi                | Corvus           |          |     | 12413-1301 | 157447 |
| 148 | HIP 111643 | Sigma2 Gruis            | Grus             |          |     | 22370-4035 | 231217 |
| 149 | HIP 80399  | HD 147722               | Scorpius         |          |     | 16247-2942 | 184368 |
| 150 | HIP 83478  | HD 154228               | Hercules         |          |     | 17037+1336 | 102564 |
| 151 | HIP 101123 | Omicron Capricorni      | Capricornus      |          |     | 20299-1835 | 163626 |
| 152 | HIP 28271  | 59 Orionis              | Orion            |          |     | 05584+0150 | 113315 |
| 153 | HIP 64246  | 17 Canum Venaticorum    | Canes Venatici   |          |     | 13101+3830 | 63380  |
| 154 | HIP 96895  | 16 Cygni                | Cygnus           |          |     | 19418+5032 | 31898  |
| 155 | HIP 35564  | HD 57852                | Carina           |          |     | 07204-5219 | 235110 |
| 156 | HIP 37843  | 2 Puppis                | Puppis           |          |     | 07455-1441 | 153363 |

| No. | HC Item          |                    | Constellation  | Name | HIP | WDS        | SAO    |
|-----|------------------|--------------------|----------------|------|-----|------------|--------|
| 157 | HIP 28790        | HD 41742           | Puppis         |      |     | 06047-4505 | 217706 |
| 158 | HIP 4675         | HD 5788            | Andromeda      |      |     | 01001+4443 | 36832  |
| 159 | HIP 31676        | 8 Lyncis           | Lynx           |      |     | 06377+6129 | 13897  |
| 160 | HIP 10176        | 59 Andromedae      | Andromeda      |      |     | 02109+3902 | 55330  |
| 161 | HIP 25950        | HD 36408           | Taurus         |      |     | 05322+1703 | 94630  |
| 162 | HIP 117931       | AL Sculptoris      | Sculptor       |      |     | 23553-3155 | 214860 |
| 163 | HIP 81914        | HD 150591          | Scorpius       |      |     | 16439-4107 | 227123 |
| 164 | HIP 21242        | m Persei           | Perseus        |      |     | 04334+4304 | 39604  |
| 165 | HIP 86831        | 61 Ophiuchi        | Ophiuchus      |      |     | 17446+0235 | 122690 |
| 166 | HIP 115272       | HD 220003          | Grus           |      |     | 23208-5018 | 247838 |
| 167 | HIP 46657        | Zeta1 Antliae      | Antlia         |      |     | 09308-3153 | 200444 |
| 168 | HIP 41404        | Phi2 Cancri        | Cancer         |      |     | 08268+2656 | 80188  |
| 169 | HIP 29388        | 41 Aurigae         | Auriga         |      |     | 06116+4843 | 40925  |
| 170 | HIP 49321        | HD 87344           | Hydra          |      |     | 10040-1806 | 155704 |
| 171 | HIP 84054        | 63 Herculis        | Hercules       |      |     | 17111+2414 | 84896  |
| 172 | HIP 39035        | HD 66005           | Puppis         |      |     | 07592-4959 | 219249 |
| 173 | HIP 25303        | Theta Pictoris     | Pictor         |      |     | 05248-5219 | 233965 |
| 174 | HIP 52520        | HD 93344           | Carina         |      |     | 10443-7052 | 256750 |
| 175 | HIP 95398        | 2 Sagittae         | Sagitta        |      |     | 19244+1656 | 104797 |
| 176 | UCAC4 277-135548 |                    |                |      |     |            |        |
| 177 | HIP 32609        | HD 48766           | Lynx           |      |     | 06482+5542 | 25963  |
| 178 | HIP 101765       | 48 Cygni           | Cygnus         |      |     | 20375+3134 | 70287  |
| 179 | HIP 24825        | YZ Leporis         | Lepus          |      |     | 05193-1831 | 150335 |
| 180 | HIP 31158        | 21 Geminorum       | Gemini         |      |     | 06323+1747 | 95795  |
| 181 | HIP 3885         | 65 Piscium         | Pisces         |      |     | 00499+2743 | 74295  |
| 182 | HIP 93371        | HD 176270          | Australis      |      |     | 19011-3704 | 210816 |
| 183 | HIP 36345        | HD 59499           | Puppis         |      |     | 07289-3151 | 198038 |
| 184 | HIP 108364       | HD 208947          | Cepheus        |      |     | 21572+6609 | 19760  |
| 185 | HIP 50939        | HD 90125           | Sextans        |      |     | 10242+0222 | 118278 |
| 186 | HIP 76603        | HD 139461          | Libra          |      |     | 15387-0847 | 140672 |
| 187 | HIP 32269        | HD 49219           | Carina         |      |     | 06442-5442 | 234683 |
| 188 | HIP 42516        | 39 Cancri          | Cancer         |      |     | 08401+2000 | 80333  |
| 189 | HIP 62807        | 32 Comae Berenices | Coma Berenices |      |     | 12522+1704 | 100309 |
| 190 | UCAC4 226-128246 |                    |                |      |     |            |        |
| 191 | HIP 94913        | 24 Aquilae         | Aquila         |      |     | 19188+0020 | 124492 |
| 192 | HIP 94336        | HD 179958          | Cygnus         |      |     | 19121+4951 | 48193  |
| 193 | HIP 107299       | HD 206429          | Indus          |      |     | 21440-5720 | 247151 |
| 194 | HIP 59984        | HD 106976          | Virgo          |      |     | 12182-0357 | 138704 |
| 195 | HIP 16411        | HD 21743           | Taurus         |      |     | 03313+2734 | 75970  |
| 196 | HIP 23287        | HD 32040           | Orion          |      |     | 05006+0337 | 112305 |
| 197 | HIP 105637       | HD 203857          | Cygnus         |      |     | 21238+3721 | 71280  |
| 198 | HIP 108925       | HD 209744          | Cepheus        |      |     | 22039+5949 | 34016  |
| 199 | HIP 103814       | HD 200011          | Microscopium   |      |     | 21022-4300 | 230492 |
| 200 | HIP 58112        | 65 Ursae Majoris   | Ursa Major     |      |     | 11551+4629 | 43945  |
| 201 | HIP 109354       | V402 Lacertae      | Lacerta        |      |     | 22093+4451 | 51698  |
| 202 | HIP 43822        | 17 Hydrae          | Hydra          |      |     | 08555-0758 | 136409 |
| 203 | HIP 21986        | 55 Eridani         | Eridanus       |      |     | 04436-0848 | 131442 |
| 204 | HIP 17470        | HD 23245           | Taurus         |      |     | 03446+2754 | 76122  |
| 205 | HIP 35960        | V368 Puppis        | Puppis         |      |     | 07248-3717 | 197974 |
| 206 | HIP 42936        | HD75086            | Carina         |      |     | 08451-5843 | 236241 |
| 207 | HIP 19272        | SZ Camelopardalis  | Camelopardalis |      |     | 04078+6220 | 13031  |
| 208 | HIP 76143        | HD 138488          | Libra          |      |     | 15332-2429 | 183565 |



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

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

This warranty shall be void and of no force of effect in the event a covered product has been modified in design or function, or subjected to abuse, misuse, mishandling or unauthorized repair. Further, product malfunction or deterioration due to normal wear is not covered by this warranty.

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

iOptron Corporation  
Customer Service Department  
6E Gill Street  
Woburn, MA 01801  
[www.ioptron.com](http://www.ioptron.com)  
support@ioptron.com  
Tel. (781)569-0200  
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