![iOptron logo]

iOptron®CEM60 Center-Balanced Equatorial Mount

Instruction Manual

Product #7200 and#7201

Please read the included CEM60 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

WARNING!

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

Table of Contents

1. CEM60 Introduction

Welcome to a new type of equatorial mount – the iOptron® Center-Balanced Equatorial Mount, or CEM! Its unique design puts the payload at the center of gravity providing greater natural stability. This means the mount is extremely light compared to its maximum payload – resulting in an observatory class mount that is portable enough for easy transportation and set-up at a remote site. The adjustable counterweight bar prevents the counterweight from getting in the way of the tripod or pier when operating at a low latitude location. Polar aligning is quick and accessible all the time since the polar scope is not blocked by the declination shaft.

The CEM60™ mount is equipped with the most advanced GOTONOVA® GOTO technology, making it one of the most powerful and accurate GOTO mounts available. TheGo2Nova® 8407 hand controller has a database of over 212,000 objects making it easy to locate even the faintest celestial objects. Other features include a magnetically loaded gear system to dramatically reduce backlash, gear switches on both R.A. and DEC axes, a screw/worm type latitude adjuster for precision polar alignment and a built-in cable management system which can be customized by the user.

Features:
- A new design, center-balanced equatorial mount (CEM) for maximum payload capacity and minimum mount weight
- High precision tracking mount ideal for both visual observers and astrophotographers
- Patent pending non-contact magnetically loaded gear system
- Payload of 60 lbs (27.2 kg) with mount-only weight of 27 lbs (12.3 kg)
- Gear switches on both R.A. and DEC axes for easy balancing
- Adjustable counterweight shaft for low latitude operation
- Screw/worm type latitude adjuster for precision adjustments when polar aligning
- Milling machine tooling vise type latitude bearing and lock system for rock solid positioning
- Azimuth fine adjusters for easy azimuth adjustment
- Precision stepper motor with 0.06 arcsec accuracy for precise GOTO and accurate tracking
- Permanent periodic error correction (PPEC) (#7200) or Real-time periodic error correction (RPEC) (#7201)
- iOptron AccuAlign™ calibrated polar scope with illuminated reticle and easy polar alignment procedure for fast and accurate polar alignment
- Polar alignment routine for those who can't see the Pole Star
- AutoZero™ technology for mount remote operation
- Power-down memorization of GOTO and tracking position
- Go2Nova® 8407+ controller with advanced GOTONOVA® GOTO Technology, built-in heater, and red LED reading light
- Integrated ST-4 compatible autoguiding port
- Built-in 32-channel Global Positioning System (GPS)
- Built-in cable management system which can be user customized
- Spring loaded dual saddle compatible with Vixen/Losmandy style dovetail bars
- 150mm base size to match optional 2 inch heavy-duty stainless steel tripod (8kg), pier or tri-pier
- Optional PowerWeight™ rechargeable battery pack

2. CEM60 Overview

2.1. Parts List[1]

SHIPPING CONTENTS

Your new CEM60 mount comes in two shipping boxes. One box contains either a CEM60 (#7200) or CEM60-EC (#7201) mount head, hand controller, counterweight shaft, and accessories enclosed in a sturdy aluminum carry case. The other box contains a 21lb (9.5kg) counterweight. The contents are:

- iOptron® CEM60 telescope mount (#7200, with silver adjustment knobs) or iOptron® CEM60-EC mount (#7201, high precision model with red adjustment knobs)
- Go2Nova® 8407 Hand Controller
- One 21lb (9.5 kg) counterweight
- Stainless steel counterweight shaft
- Polar scope with LED illuminated reticle and reticle power cable
- AC adapter (100V-240V)
- Hand Controller Cable (6P6C RJ11 to RJ11, straight wired)
- Serial cable (RS232 to RJ9)
- DC power cable for standard 12V car power socket
- Aluminum carrying case
- Quick Start Guide

OPTIONAL PARTS

- 2" tripod (#8021ACC)
- 42 inch pier (#8033) /48 inch pier (#8030)
- Tri-Pier (#8034)
- MiniPier (#8032)
- StarFi wireless adapter (#8434)
- USB to RS232 Converter with FTDI chipset (#8435)
- PowerWeight™ rechargeable counterweight battery (#8128)

ONLINE RESOURCES *(click on the "Support" menu at* **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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[1] US market only. Actual contents, design and function may vary.

2.2. Identification of Parts
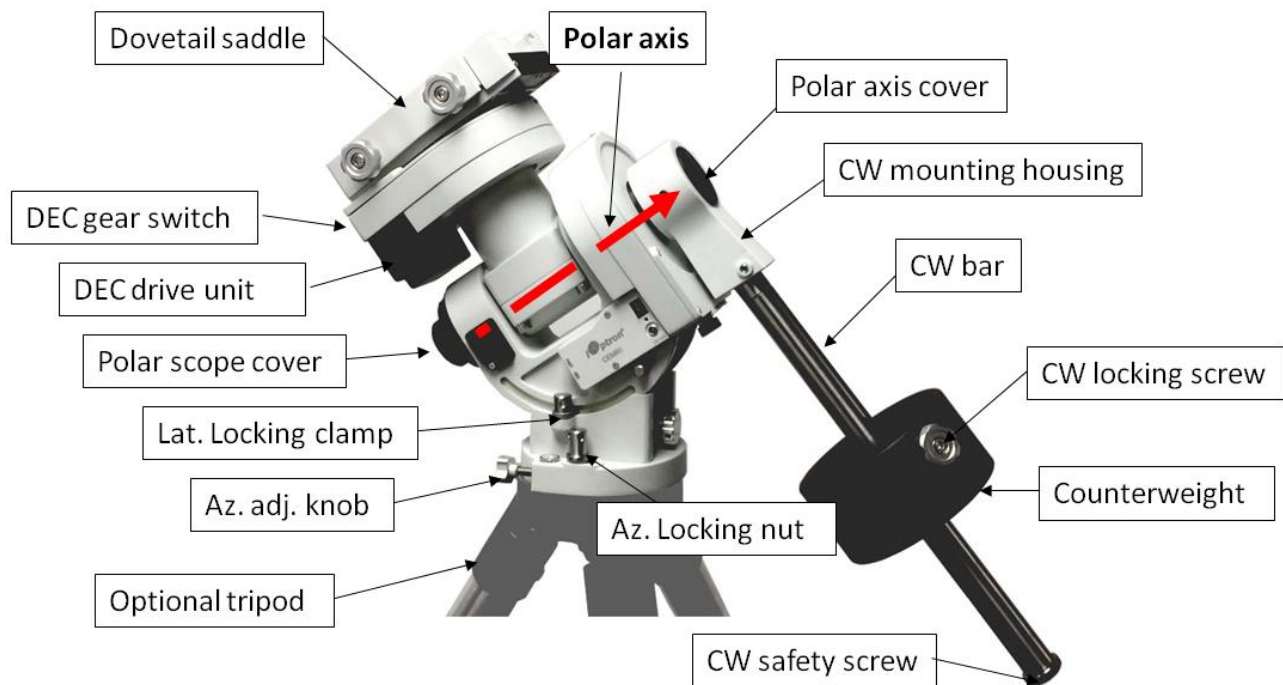
Figure 1.CEM60 mount assembly

2.3. CEM60 Mount Ports

Ports on the mount

Figure 2. Ports on a CEM60 mount

- I/O: Power Switch
- DC 12V: DC power socket to power the mount (2.1mmX5.5mm, center positive)
- PORT: Auxiliary port for connecting to other iOptron accessories, such as an electronic focuser or for observatory dome control. **DO NOT** plug your ST-4 guiding camera cable into this port as it may damage the mount or guide camera electronics.
- HBX (Hand Box): For connecting to an 8407 Hand Controller
- GUIDE: ST-4 compatible autoguiding port
- RS232: Serial port for mount-computer control and firmware upgrade

On DEC unit:

- Reticle: Power supply for the polar scope illuminated reticle LED, or illuminated eyepiece (1.3mmX3.5mm, center positive)

Figure 3. Polar scope reticle power socket on DEC unit

2.4. CEM60 Gear Switches

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

⚠️ **WARNING: Never disengage or adjust the Gear Switches without holding the mount firmly! Otherwise personal injury and/or equipment damage may occur.**

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

2.5. CEM60 Cable Management

The CEM60 mount has a pre-wired Cable Management Panel that allows the user to connect their accessories and imaging equipment without cables tangling or snagging when the mount is slewing or tracking. As shown in Figure 5, the Cable Management Panel has the following connections:

Figure 5.Cable management panel

- 2X 12V power outlets (2.1mmX5.5mm, center positive) for powering accessories such as CCD cameras, filter wheels, or electric focusers
- 4X USB 2.0 ports with standard type A connectors for connecting accessories
- 1X 6P6C port which can be used to bridge the guiding port or accessories with a 6P6C/6P4C plug

The USB hub is non-powered and will draw power from the source USB port (for example computer USB port). Therefore, the number of usable USB ports might be limited, depending on the power consumption of the accessories.

The ports on the Cable Management Panel are connected to the Input Panel located next to the polar scope, as shown in Figure 6.

Figure 6. Input panel

- 1X 12V power input (**2.5mmX5.5mm**, 5A max., such as #8417-50)
- 1x USB 2.0 port with a standard type B connector
- 1X 6P6C port

Owners that would like to wire their own cables can remove the dovetail saddle, remove the polar scope and run cables through the polar scope aperture, soldering the cables onto the cable management panel. When reinstalling the dovetail saddle, make sure that the Stop Post and the arrow is pointed to the front of the mount as shown in Figure 7.

Figure 7. Stop Post on dovetail saddle

2.6. Go2Nova® 8407+ Hand Controller

Figure 8. Go2Nova® 8407+ hand controller

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

2.6.1. Key Description
- MENU Key: Press "MENU" to enter the Main Menu.
- BACK Key: Move back to the previous screen, or end/cancel current operation, such as slewing.
- ENTER Key: Confirm an input, go to the next menu, select a choice, or slew the telescope to a selected object.
- Arrow (▲▼◄►) Keys: The arrow keys are used to control the movement of DEC and R.A. axes. Press and hold ▲(DEC+),▼(DEC-) buttons to move a telescope along the DEC direction, ◄(R.A.+), ►(R.A.-) to move a telescope along the R.A. direction. They are also used to browse the menu or move the cursor while in the menu. Press and 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)
- Light Key(☼): Turns on/off the red LED reading light on the back of the controller.
- Help (?) Key: Identify and display bright stars or objects that the telescope is pointing to.
- STOP/0 Key: Stop the mount during GOTO. Also toggling between starting and stopping tracking.
- HBX (Handbox) port: connect the HC to the CEM60 mount using a 6P6C RJ11 cable.

- Serial port: connect the HC to a computer via a RS232 to 4P4C RJ9 cable. The pin-out of the serial port is shown in Figure 9.
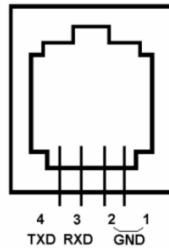
Figure 9. Serial port pin-out on an 8407+ hand controller

2.6.2. The LCD Screen

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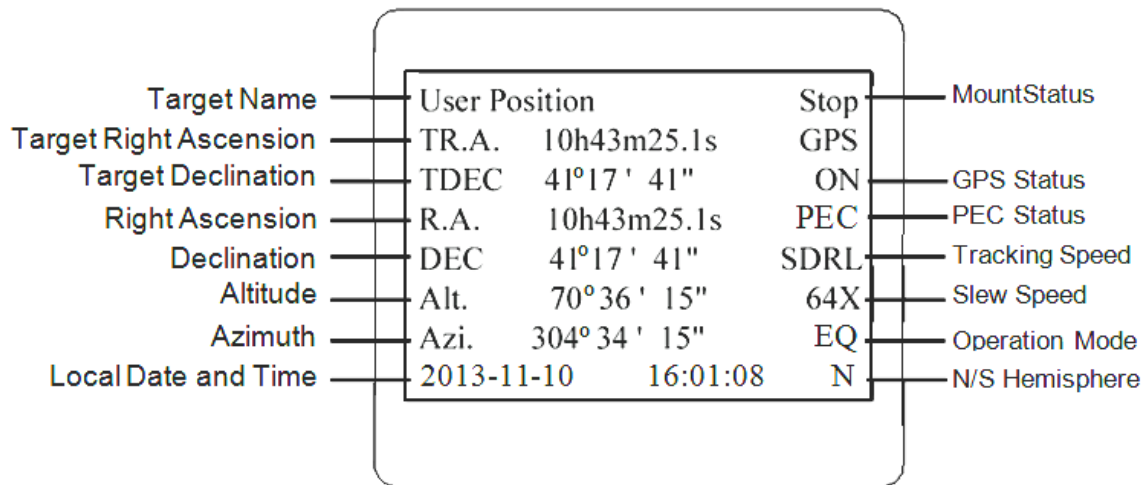
Figure 10. 8407+ HC LCD Information Screen

1. Target Name/Mount Position: displays the name of the target that telescope is currently pointed to or the current mount position.
   - Zero Position: The reference position for GOTO. The mount can move to Zero Position using "**Goto Zero Position**" or **"Search Zero Position"** command;
   - User Position: The mount is pointed to a user defined position, which could be a particular celestial object or simply a position determined by pressing an arrow key;
   - An object name, such as "Mercury" or "Andromeda Galaxy": Name of the star or celestial object that the mount is currently slewing to or tracking.

2. Target R.A.: Right Ascension (R.A.) of the target object.

3. Target Declination: Declination (DEC) of the target object.

4. Right Ascension: Current R.A. of the telescope.

5. Declination: Current DEC of the telescope.

6. Altitude: Altitude of the telescope (degrees vertical from the local horizon - zenith is 90º).

7. Azimuth: Azimuth of the telescope (north is 0º, east is 90º, south is 180º, and west is 270º).

8. Local Date and Time: displays the local time in a format of YY-MM-DD HH:MM:SS.

9. Mount Status: Displays the current operational status of the mount.
   - Stop: mount is not moving;

- Slew: mount is moving with an arrow key is pressed or a GOTO command, such as "**Select and Slew**" or "**Goto Zero Position**";
- Tracking: mount is at a tracking status.

10. GPS status: When the power is turned on, the initial GPS status will be "GPS ON", which means that the mount is connected to its GPS receiver and is seeking a satellite signal. When the GPS receiver finds the satellites and receives the GPS signal the status will change to "GPS OK".

11. PEC status: Display of "PEC" here Indicates the Periodic Error Correction playback is turned on. Default is off.

12. Tracking speed: Displays the current tracking rate of the mount.
- SDRL: mount is tracking at sidereal speed;
- Solar: mount is tracking at solar speed;
- Lunar: mount is tracking at lunar speed;
- King: mount is tracking at king speed;
- CSTM: mount is tracking at a custom, user-defined speed.

13. Slew speed: The mount has 9 slew speeds: 1X, 2X, 8X, 16X, 64X, 128X, 256X, 512X, MAX (~3.75⁰/sec).

14. Operation Mode: EQ indicates that the mount is operating in an equatorial mode.

2.7. 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, as shown in Figure 11.

Figure 11. Setup for initial mount testing

Slewing the mount without the CW shaft installed, as shown in the image on the left of Figure 12, *is not recommended*.

NEVER operate the mount with only the counterweight or OTA on it, as shown in the image on the right of Figure 12. It will damage the precision engineering of the mount drive system.

Figure 12.**Do not** operate the mount with an unbalanced load, for instance with a counterweight installed without an OTA, as shown above, or vice versa

3. CEM60 Mount Assembly

3.1. Introduction

Congratulations! You have just purchased a new design of telescope mount that has a class leading payload capacity for its weight and is capable of high precision tracking. This makes the CEM60 a superb choice for observational astronomy and astrophotography whether permanently mounted on a pier, in an observatory, or as part of a portable setup for use in your backyard, at dark sky sites, and at star parties.

In order for you to get the optimum performance from the mount and your optical tube assembly (OTA) combination, you must assemble and set up the mount correctly.

The following basic principles are included to help you understand the fundamental concepts of telescope mounts before the specific details of the CEM60 mount are covered.

Telescope mounts are either equatorial or altitude-azimuth (Alt-Az). Both types of mount rotate the OTA around two perpendicular axes to point to a desired object in the night sky.

An Alt-Az is a simple mount that has a horizontal axis to provide vertical (altitude) OTA movement from the local horizon and a vertical axis to provide horizontal (azimuth) OTA movement and is therefore able to point at any part of the sky. In order to track an object across the sky, an Alt-Az mount has to continually move the OTA in both axes. This can provide tracking that is good enough for visual observing and short exposure photography. However, the mechanics of this system are such that an OTA carried by an Alt-Az mount will suffer from field rotation where stars will appear to rotate about the point being tracked forming arcs. As such Alt-Az mounts are not suitable for long exposure astrophotography which is needed to capture faint deep sky objects.

An equatorial mount has an axis, called the right ascension (R.A.) axis, aligned with the celestial North Pole (CNP) in northern latitudes, or the celestial South Pole (CSP) in the Southern Hemisphere. Equatorial mounts counteract the rotation of the Earth by driving the R.A. axis in the opposite direction thus tracking celestial objects as they appear to move across the sky. Once the mount has been accurately aligned to the celestial pole, only movement of the R.A. axis is required for accurate tracking and this design does not suffer from field rotation .R.A. is the celestial equivalent of longitude and is the angular distance measured eastward along the celestial equator as measured from a zero reference point (the vernal equinox). A second axis perpendicular to the R.A., the declination axis (DEC), provides elevation relative to the celestial equator.

As mentioned above, in order to track celestial objects the R.A. axis of an equatorial mount must be accurately aligned with the celestial pole. Your new iOptron mount comes equipped with features that make accurate alignment quick and easy. The CEM60 includes mechanical adjusters that move the mount in altitude and azimuth in order to align the R.A. axis, also known as the mount's Polar Axis, with the celestial pole. These adjustments do not involve any rotation of the mount's R.A. or DEC axes and can be performed without the OTA installed. The first step is to make an approximate azimuth alignment of the mount's Polar Axis by roughly aligning the R.A. axis to a reference point toward True North (or True South if in the Southern Hemisphere). A compass can be used for this initial azimuth alignment but you must allow for the variation between True and Magnetic North/South at your location. Precise horizontal alignment of the Polar Axis is accomplished with the azimuth adjustment bolts on the mount. The second step is to adjust the Polar Axis vertically (altitude) above the horizon by setting the observer's latitude on the provided latitude scale. This procedure is based on the fundamental geometry of the Earth's coordinate system in conjunction with the concept of the celestial sphere. You can verify this by visualizing yourself at the North Pole (latitude N90°) in which case Polaris will be 90° from the horizon, or directly overhead. These steps will place the Polar Axis very close to the celestial pole. The accuracy of both of the above adjustments can be enhanced by the use of the incorporated polar scope, which sits in an opening along the R.A. axis and allows direct viewing of the pole. In order to get the most out of your equatorial mount it is essential to understand the concept of polar alignment and how the equatorial mount helps you establish and maintain a true Polar Axis alignment. Now you are ready to set up the GOTO functionality of the CEM60 – which gives access to more than 300,000

celestial objects – by performing star alignments using the equatorial mount's electronic controller, and enjoy the night sky.

The CEM60 mount is a next-generation equatorial mount that provides the precision alignment capabilities required for today's complete astronomy solution. The following sections of this manual provide the detailed steps required to successfully set up and operate the CEM60 mount.

3.2. CEM60 Mount Assembly

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

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

STEP 1. Removing the Mount from the Carrying Case

The mount is shipped with the R.A. Gear Switch disengaged. The R.A. axis is locked with a stainless steel lever. Just pull the mount out from the carrying case. (**Error! Reference source not found.**).
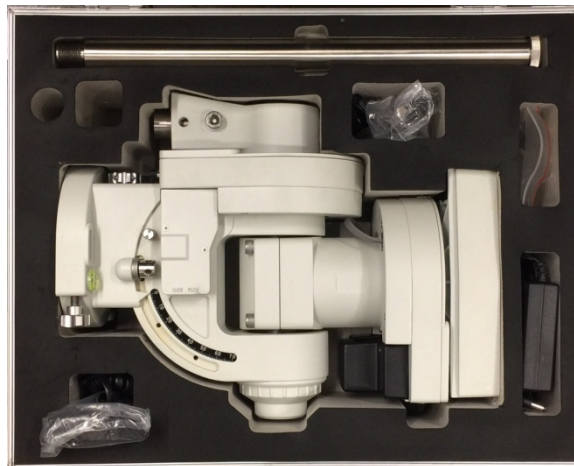
Figure 13. Mount in a hard case

STEP 2. Attaching the Mount

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

There are two sets of mounting studs and azimuth locking nuts. Thread the two studs onto an iOptron tripod or pier (if you are using one). Remove the alignment peg from the tripod/pier if it comes with one. Use the pair of mounting holes that are closest to the edge and thread on the studs. Use the stainless steel lever to tighten the mounting studs. Make sure that the two studs are aligned east-west by rotating the tripod or pier.
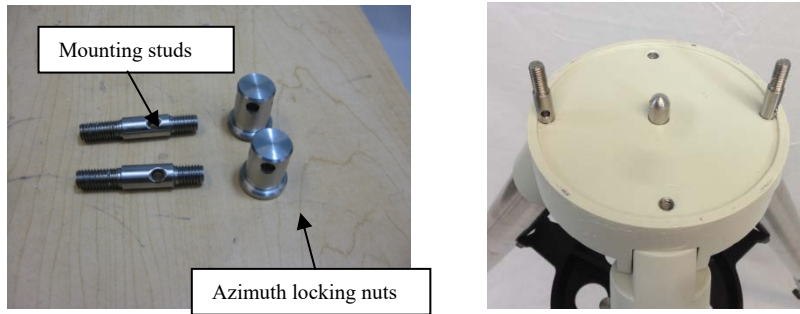
Figure 14.Mounting studs and locking nuts

Back out the azimuth adjustment knobs to make enough room to prevent them from blocking the mounting studs. Put the mount head onto the tripod, making sure that the mount head is facing north (or south if operating in the Southern Hemisphere). Install the washer (optional) and thread the azimuth locking nuts onto the mounting studs, hand tightening them. Adjust the tripod/pier to level the mount.
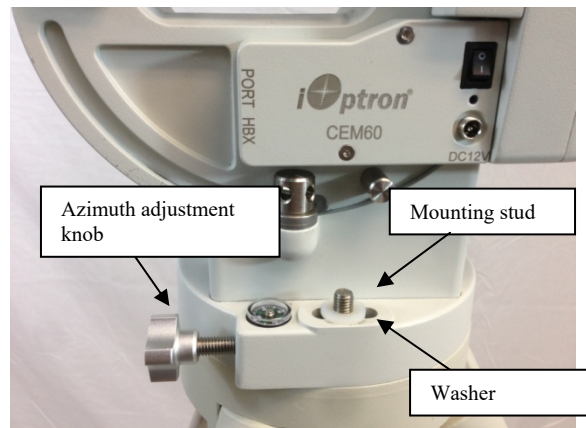
Figure 15. Attaching the mount

There is a stainless steel (SS) lever which is used to lock the RA axis during shipping on later version mount, as shown in Figure 16.

Remove it from the RA yoke to allow the mount slew freely in RA axis. **Make sure the RA gear switch is engaged before remove the SS lever**. Use it to tighten all the screws/nuts. Thread it into the hole under the main board (Figure 17).
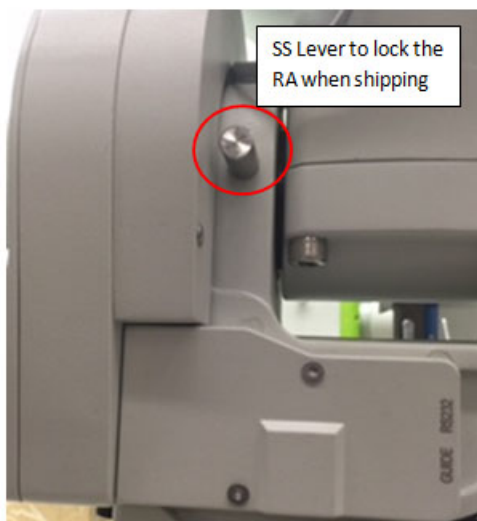
Figure 16. SS lever used t lock the RA axis

Figure 17. Storing SS lever

STEP 3. Setting the Latitude

This step requires you to know the latitude of your current location. This can be found from your 8407+ hand controller after the mount GPS receives the signal from satellites. It can also be easily found on the Internet, a GPS satellite-navigation system, or a GPS capable cell phone. You will have to change this latitude setting every time you significantly change your night sky viewing location. Note that this setting directly affects the mount's GOTO accuracy.
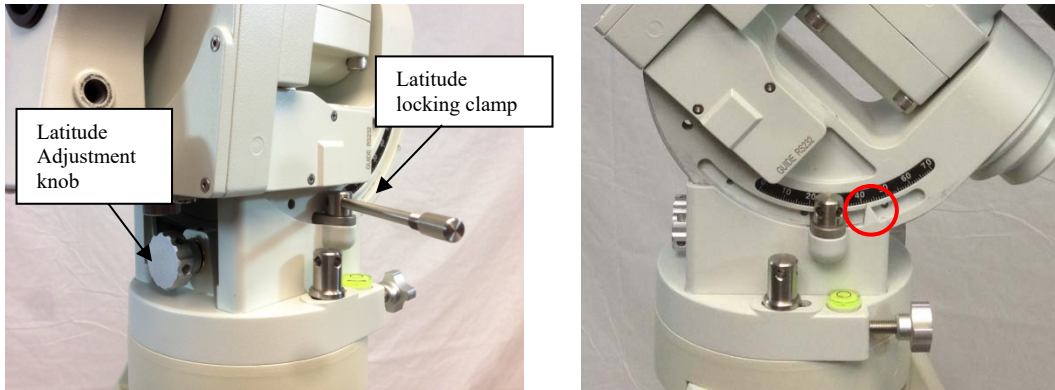
Figure 18. Setting the latitude

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

At this point, with the mount leveled and pointed north (or south in the Southern Hemisphere), and the latitude set, the Polar Axis (R.A. axis) should be pointing very close to the celestial pole. This alignment accuracy will be sufficient for visual tracking and short exposure, short focal length astrophotography (for example piggy-back mounting a camera on top of the OTA).

STEP 4. Installing the Counterweight (CW) Shaft

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

The CW shaft system is a two-part configuration. It comes with preinstalled top part of the shaft. Just simply thread the CW shaft onto it.
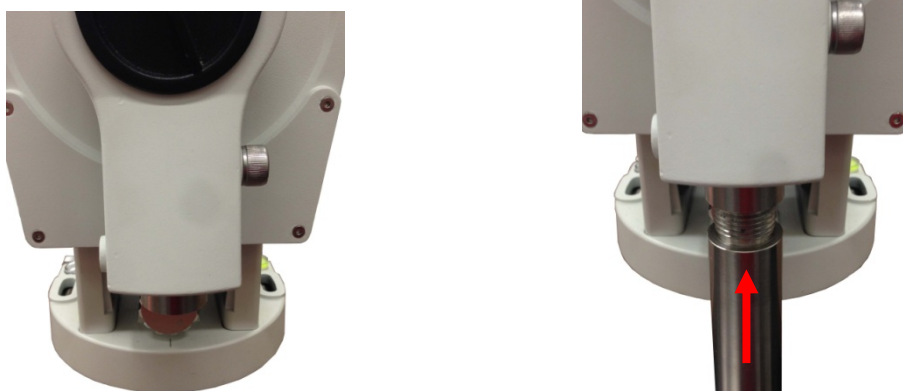
Figure 19. Install counterweight shaft for a two part configuration

There are three screws on CEM60 CW Mounting Housing: A Shaft Locking Screw, a Shaft Position Screw on the other side, and a Low-Latitude Set Screw, as shown in Figure 20.

At very low-latitudes (<10°), loosen the Shaft Position Screw first. Then loosen Shaft Locking Screw. Turn the Low Latitude Position Screw into the CW Mounting Housing to tilt the CW shaft so that the CW does not foul your tripod/pier (Figure 21). Then tighten the CW Shaft Positioning Screw and Shaft Locking Screw.
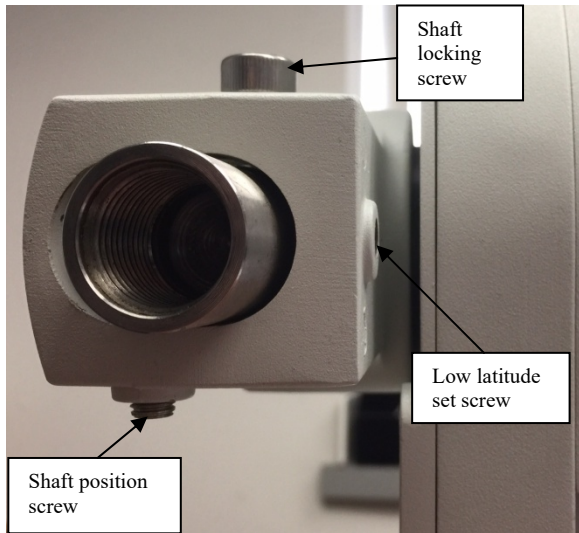
Figure 20. Adjustment screws for CW shaft tilting
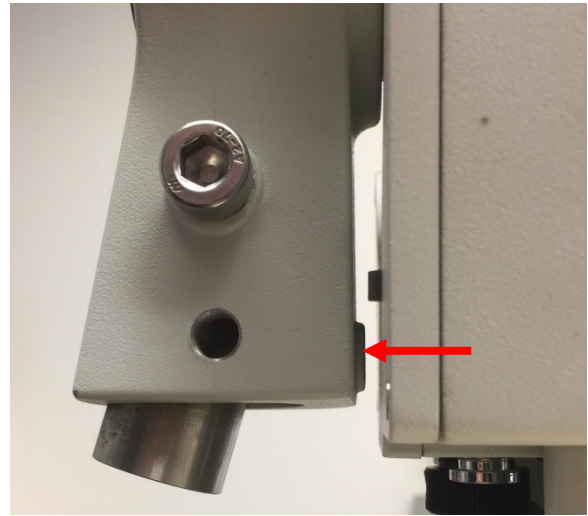
Figure 21. Tilt the counterweight shaft for low altitude

STEP 5. Installing the Counterweight(s)

Before installing the counterweight, make sure that both R.A. and DEC Gear Switches are fully engaged to avoid sudden mount movements which could cause injury and/or damage the mount gear system and your equipment.

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

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 the CW Shaft. Guide the CW over the shaft and tighten the CW Locking Screw to hold the CW in place. Always place the Safety Cap back onto the shaft prior to use to prevent personal injury and/or equipment damage**.** Engage the R.A. Gear Switch again.

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

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

You may need more CW for heavier payload, or smaller size CW for lighter scope.

STEP 6. Balancing the Payload

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

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

The CEM gear system utilizes a magnetic force system for optimal gear meshing. Fully turn the Gear Switch *clockwise* to disengage the worm from the worm wheel. Turn the Gear Switch *counterclockwise* to engage the worm to worm wheel, as indicated on the mount. You may feel a "click" when the gear meshed.

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

Figure 22. Gear switches

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

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

Return the mount to the Zero Position after balancing, i.e. with the CW Shaft pointing to the ground and the telescope front side at its highest position.

STEP 7. Connecting Cables

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

Figure 23. Connecting the cables

STEP 8. Setting Gear Switch Position

Set both Gear Switches to engaged positions after balancing the mount. To make sure the gears are meshed properly, gently turn the Gear Switch *counterclockwise (CCW)* until you just feel a soft stop, but never over tightening. Then turn the Gear Switch *Clockwise (CW)* 1/8 turn. More adjustment may be needed as described below.

Turn the mount power on. Press 9 button on hand controller to change the slew speed to MAX. Press the arrow button to check the gear meshing. If the mount motor has "grinding" sound (which is not harmful) while slewing, the gear switch is too tight. Release 1/16 to 1/8 turn *(Clockwise)* and check it again. If there is excess play in either RA or DEC axis, the gear and worm is not properly meshed. Turn the Gear Switch more *Counterclockwise*. You may need to readjust the Gear Switch for different payload.

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STEP 9. Setting up the Hand Controller

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

A clear sky and open space outside is needed for the GPS to establish a link with the satellites. The GPS is installed on the side of the mount and is protected with a black plastic cover. If the GPS module has difficulty receiving the satellite signal, you may rotate the R.A. axis to one side so that the GPS module is not obscured from the satellites by the mount head or OTA.

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

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

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

```
Set Time and Site
Set Beep
Set Display
Set Guiding Rate
Set Tracking Rate
Set Parking Position
Meridian Treatment
Set Altitude Limit
```

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

```
Daylight Saving Time    Y
UTC -300 Minute(s)
2014-03-09 10:19:18

Longitude:W071d08m50s
Latitude:  N42d30m32s

Northern Hemisphere
```

Set Local Time

The time will be updated automatically when the GPS receiver has established its link with the GPS satellites. 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 +**".

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

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

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

Set Observation Site Coordinates

The fifth and sixth lines display the longitude and latitude coordinates, respectively. The longitude and latitude coordinates will be automatically updated when the GPS picks up a satellite signal. "W/E" means Western/Eastern Hemisphere; "N/S" means Northern/Southern Hemisphere; "d" means degree; "m" means minute; and "s" means second.

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

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

Select N/S Hemisphere

The northern/southern hemisphere will be determined by your latitude coordinate, with one exception. If your are near the equator (within +/- 10°), you can choose your own N/S setting.

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".

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 (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 required. The battery is a 3V, CR1220 button battery.

STEP 10. Set the Zero Position

Press **MENU** => "**Zero Position**" => "**Search Zero Position**" to let the mount search the Zero Position. Or press **MENU** => "**Zero Position**" => "**Set Zero Position**", to manually set the mount to Zero

Position. Loosen the DEC and R.A. Gear Switches in turn to adjust the mount to the Zero Position. Engage the clutches after each adjustment.

STEP 11. Performing Polar Alignment

One of the CEM60'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.

In order for an equatorial mount to track properly, it has to be accurately polar aligned.
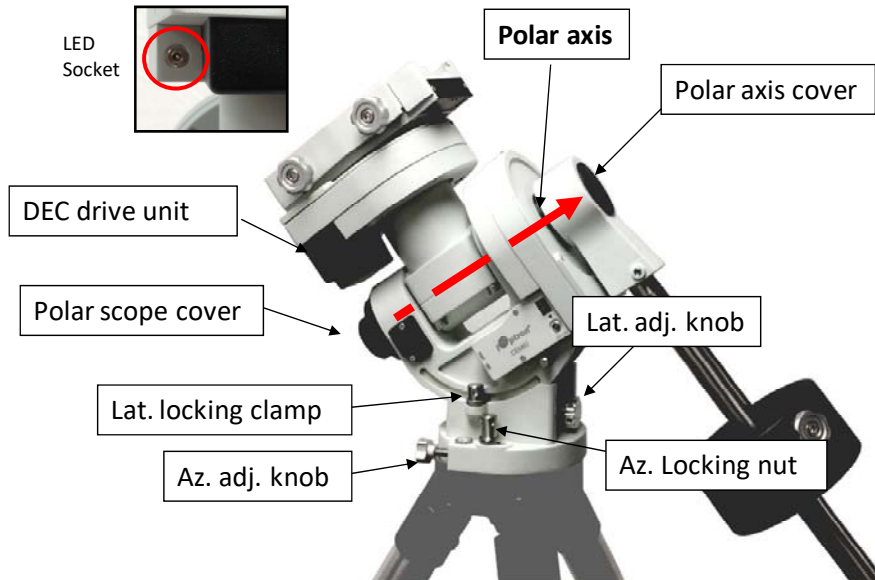
Figure 24. Polar alignment

As indicated in Figure 25, the Polar Scope reticle has been divided into 12 hours along the angular direction with 20-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.
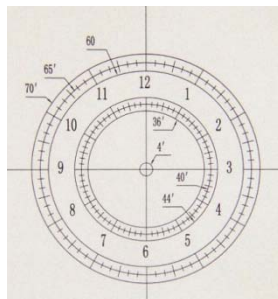
Figure 25. Polar Scope

Figure 26. Polar Scope LED

Quick Polar Alignment

(1) Level the CEM60 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. Remove both the Polar Axis Cover and Polar Scope Cover.

(2) Connect one end of the polar scope power cable to the illumination LED (Figure 26) and the other end to the Reticle socket located next to DEC motor unit (Figure 3). Turn the mount power on. Use the Hand Controller ("**Settings**" => "**Polar Scope Brightness**") to set the illumination intensity.

(3) Adjust the polar scope dial to rotate the 12 o'clock at the top. You may also refer to the bubble level indicator.

(4) 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.

(a)   (b)
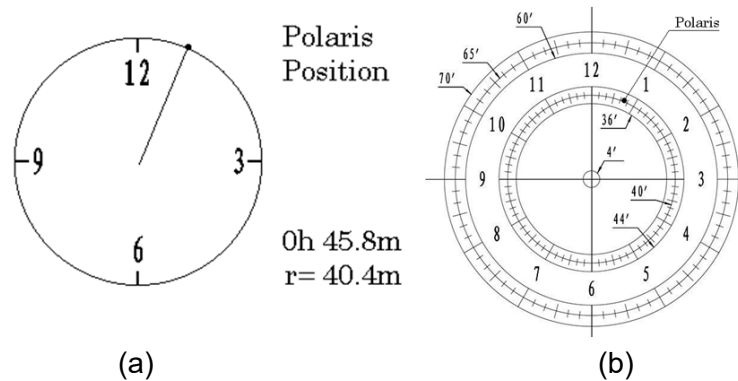
Figure 27. Polaris Position shown on HC (a) and where to put on polar scope reticle (b)

(5) Look through the polar scope to find the Polaris. Use the Azimuth and Latitude Adjustment Knobs to adjust the mount in both directions and put the Polaris in the same position on the Polar Scope reticle as indicated on the HC display screen. In this case, Polaris will be located at a radius of 41.5 minutes and an angle of 1 hour 26.8 minutes, as shown In Figure 27 (b).

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

BrightStar Polar Alignment

When 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 12. Returning the Mount to Zero Position

After polar alignment and balancing OTA, return the mount to the Zero Position, as shown in Figure 28. Please set the zero position if it is the first time using the mount, or the firmware just being updated.

Figure 28. Zero Position

4. Getting Started

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

4.1. Setting the Mount and Performing Polar Alignment

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

After the mount is powered on, perform **MENU** => "**Zero Position**" => "**Goto Zero Position**" to check the Zero Position, 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. If the mount is not at the Zero Position, release the Gear Switches to adjust the mount to approximately the Zero Position.

The exception is when the mount is switched on after it was parked before powering off (**MENU** => "**Telescope Motion**" => "**Park Scope**")

4.2. Manual Operation of the Mount

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

4.3. One Star Alignment

After the mount set up, perform a "**One Star Align**" to correct the Zero Position discrepancy, or linear error.

Press **MENU** => "**Alignment**" => "**One Star Align**" to perform "**One Star Align.**" The hand controller will display a alignment star. Select a different star using the ▲ or ▼ keys. Then press **ENTER**. After the mount slews to the target, use the arrow keys to center it in your eyepiece. Then press **ENTER**. (More details on the alignment function are given in section 5.3)

4.4. GOTO the Moon and Other Objects

Now the mount is ready for GOTO operation which, using advanced GOTONOVA® technology, will automatically slew to, and track, a huge range of celestial targets. We will use the Moon as an example.

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

4.5. Star Identification Function

The 8407+ hand controller has a star identification function. After setting the correct local time and location and completing polar alignment, slew the telescope to a bright star manually or using the

GOTO function. Press the Help(**?**) key to identify the star that the telescope is pointing to, as well as nearby bright stars if there is any.

4.6. Power-Down Memorization

The CEM60 mount can memorize its R.A. and DEC positions if the mount loses its power by accident, 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. Turning 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 Carrying Case

It is recommended to return the mount to Zero Position at the end of the observing session. Insert the SS lever into the RA locking hole on the yoke to lock the RA axis. Disengage the gear system for transportation. Lay the mount into the carrying case.

5. Complete Functions of Go2Nova® 8407+ Hand Controller

The function described here is for an 8407 V2 hand controller. If you have an 8407 V1 hand controller, you may refer to iOptron website under Support directory for a CEM60 w/8407 V1 hand controller. All the functions are the same. The only difference is the star catalog.

5.1. Select and Slew

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

The Go2Nova® 8407+ hand controller has a database of around 212,000 objects. Use the ► or ◄ buttons to move the cursor. Use the number buttons to enter a number, or the ▼ or ▲ buttons to change a number. Hold a button to fast scroll through the list. The "☉"symbol indicates that the object is above the horizon, and the "◇" symbol means it is below the horizon. In some catalogs the stars below the horizon will not be displayed on the hand controller.

5.1.1. Solar System

There are 9 objects in the Solar System catalog.

5.1.2. Deep Sky Objects

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

- Named Objects: consists of 92 popular deep sky objects with their common names. A list of named deep sky objects is included in Appendix E.

- Messier Catalog: consists of all 110 Messier objects.

- NGC Catalog: consists of 7,840 objects.

- IC Catalog: consists of 5,386 objects.

- PGC Catalog: consists of 73,197 objects..

- Caldwell Catalog: consists of 109 objects.

- Abell Catalog: consists of 4,076 objects.

- Herschel Catalog: consists of 400 objects.

5.1.3. Stars

- Named Stars: consists of 259 stars with their common names. They are listed alphabetically; a list is included in Appendix E.

- Double/Multi Stars:: consists of 208 double/multi stars; a list is attached in Appendix E.

- Hipparcos Catalog: the new HIP catalog consists of 120,404 records (2008).

5.1.4. Comets

This catalog contains 15 comets.

5.1.5. Asteroids

This catalog contains 116 asteroids.

5.1.6. Constellations

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

5.1.7. Custom Objects

This allows the storage of up to 60 user-defined objects, including comets.

5.1.8. Customer R.A. and DEC

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

5.2. Sync to Target

This operation will match the telescope's current coordinates to the Target Right Ascension and Declination. It can be used to correct GOTO pointing error. After slewing to an object, press **MENU** - then scroll to "**Sync to Target**" and press **ENTER**. Follow the screen to perform the sync. Using this function will re-align the telescope to the selected object. Multiple syncs can be performed if needed. This operation is 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 slew rate to make the centering procedure easier. Simply press a number (1 through 9) key to change the speed. The default slew rate is 64x.

"**Sync to Target**" will improve the local GOTO accuracy near by the synced star, which is useful for finding a faint object nearby.

5.3. Alignment

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

The hand controller provides two polar alignment methods. "**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 "**Two Star Polar Align**" is used to refine the polar alignment using the AccuAlign™ polar scope.

The system provides four alignment methods to calibrate the mount's GOTO function: "**Solar System Align**", "**One Star Alignment**", "**Two Star Alignment**" and "**Three Star Alignment**". The "**Two Star Alignment**" may be used to refine the polar alignment.

The mount has to be set to Zero Position before performing any alignment.

5.3.1. Position of Polaris/SigmaOct

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

5.3.2. One Star Alignment

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

5.3.3. Two Star Alignment

Two Star Align can improve the accuracy of the mount's polar alignment. Press **MENU** => "**Alignment**" => "**Two Star Alignment**" 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 **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 lower than 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 Alignment,**" 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. 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.

5.3.6. Polar Iterate Align

This alignment method allows you to polar align the mount even if you cannot view the Celestial Pole. Press the **MENU** button, then select "**Alignment**" and "**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.

5.3.7. View 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 star alignment process. If you are controlling the mount using planetarium software via ASCOM, and the software has its own alignment function, ***please clear the alignment data***.

5.4. Settings

5.4.1. Set Time and Site

Refer to STEP 9 in Section 3.2.

5.4.2. Set Beep

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

```
Set Up Time and Site
Set Beep
Set Display
Set Guiding Rates
Set Tracking Rate
Set Parking Position
Meridian Treatment
Set Altitude Limit
```

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 Rates
Set Tracking Rate
Set Parking Position
Meridian Treatment
Set Altitude Limit
```

Use the arrow keys to adjust LCD display contrast, LCD backlight intensity, and keypad's backlight intensity.

5.4.4. Set Guiding Rate

Press **MENU => "*Settings*" => "*Set Guiding Rates*"**,

```
Set Up Time and Site
Set Beep
Set Display
Set Guiding Rates
Set Tracking Rate
Set Parking Position
Meridian Treatment
Set Altitude Limit
```

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 ±0.01X to ±0.90X sidereal rate. The DEC guiding speed can be set between ±0.10X to ±0.99X sidereal rate. Follow the instructions of your autoguiding software for detailed guiding operation.


```
1= NC
2= Ground
3= +RA (left)
4= +DEC (up)
5= -DEC (down)
6= -RA (right)
```
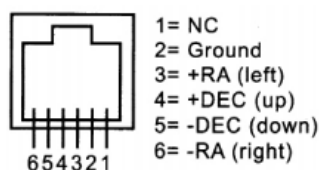
Figure 29. Guide port pin-out

The guide port wiring is shown in Figure 29, which has same pin-out as that from Celestron / Starlight Xpress / Orion Mount / Orion Autoguider/ QHY5 autoguider.

If you have an autoguider which has the same pin-out 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.**

5.4.5. Set Tracking Rate

You can set up the mount tracking rate by selecting "*Set Tracking Rate*".

```
Set Up Time and Site
Set Beep
Set Display
Set Guiding Rates
Set Tracking Rate
Set Parking Position
Meridian Treatment
Set Altitude Limit
```

Then the user can select "*Sidereal Rate*", "*Lunar Rate*", "*Solar Rate*", "*King Rate*", and "*User Defined Speed*". The "User defined speed" can be adjusted from 0.9900X to 1.0100X of sidereal.

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

5.4.6. 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 six 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. Alternatively, you can enter any altitude and azimuth combination for "**Custom Parking Pos**.". When the mount is turned on, it will use the last parking position setting as the default setting.

5.4.7. Meridian Treatment

This function tells the mount what to do when it tracks past the meridian. 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 15° (1 hour) pass meridian for Northern Hemisphere and 0° to 10° for Southern Hemisphere.

- "**Set Behavior**" will tell the mount if a meridian flip will be performed.

5.4.8. 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.

5.4.9. Polar Scope Bright.

Use this function to adjust the light intensity of the CEM60 illuminated polar scope.

5.4.10. Set Heating OFF/ON

Turn on/off the controller LCD back heater. When "**Heating Controller**" is set to **ON**, the heater will automatically be turned on when the ambient temperature reaches 0°C (32°F) and shut off at 10°C.

5.4.11. Set RA Guiding

The function is for the EC version of the CEM60 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 guiding software.

5.4.12. Language

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

5.5. Electric Focuser

This function controls an iOptron electric focuser.

5.6. PEC Option

This function only works for the standard CEM60 mount.

5.6.1. PEC Playback

You can turn "**PEC Playback On**" to improve tracking accuracy which is especially useful for long exposure astrophotography. The default status is "**PEC Playback Off**" when the mount is turned on.

5.6.2. Record PEC

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

In order to use the PEC function, the Go2Nova® hand controller first needs to record the periodic error. The periodic error of the worm gear drive will be used to correct periodic error.

We recommend using a guiding camera to record the PE with autoguiding. Here's how to use the PEC function:

      1. Setup the mount with a telescope in autoguiding configuration by connecting a guiding camera via the mount's Guide Port or using the ASCOM protocol;

      2. Select "**MENU**=>**Settings** => **Set Guiding Rate**s". Set a guiding speed from 0.10X to 0.90X. The default setting is 0.50X;

      3. Then press the **BACK** button and select "**PEC Option**" from the menu. Use the ▲ and ▼ scroll buttons to display the "**Record PEC**" option and press **ENTER** to start recording the periodic error.

      4. It takes the worm gear 300 seconds to make one complete revolution. After 300 seconds PEC will automatically stop recording. The PEC value will be permanently stored inside PEC chip on R.A. motor drive until a new data are recorded.

      5. If you want to re-record the periodic error, select "**Record PEC**" and repeat the recording processes again. The previously recorded information will be replaced with the current information.

5.6.3. PEC Data Integrity

This function will check the recorded PEC data integrity.

5.7. Park Telescope

This function parks the scope to one of four preset park positions.

5.8. Edit User Objects

Besides various star lists available in the hand controller, you can add, edit or delete your own user-defined objects. 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.

5.8.1. Enter a New Comet

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

```
User Defined Comet
Other Objects


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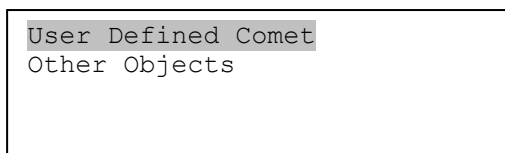
Select "**User Defined Comet**" to add/browse/delete the user-defined comet list. Find the orbit parameters of a comet in the SkyMap format. For example, the C/2012 ISON has an orbit parameter:

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

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

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

The hand controller will display the parameter entry screen:

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

Enter the 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.

5.8.2. Enter Other Objects or Observation List

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

```
User Defined Comet
Other Objects

```

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

```
Add a New Object
Browse Objects
Delete One Object
Delete 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**."

5.9. Firmware Information

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

5.10. Zero Position

5.10.1. Goto Zero Position

This moves your telescope to its Zero Position.

5.10.2. Set Zero Position

This set the Zero Position for the firmware.

The Zero Position reference will be an undefined value after firmware upgrade, or it may lost during power outage 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.

5.10.3. Search Zero Pos.

In the event of power failure, the mount will lose all its alignment information. This can be very troublesome if the mount is being operated from a remote observation site and is controlled via the internet. To counter this, the CEM60 has been equipped with a function that can find the Zero Position for an initial mount set up.

Select "**Search Zero Pos.**" and the mount will start to slew slowly and find the R.A. and DEC position to set the mount to the Zero Position. When the mount has found the Zero Position, the HC will ask if you want to calibrate the Zero Position. Press **ENTER** to confirm. The mount will then provide a list of bright stars for you to perform alignment. This will correct any discrepancy in the Zero Position. Alternatively, press **BACK** to cancel.

6. Maintenance and Servicing

6.1. Maintenance

The CEM60 mount is designed to be maintenance free. Do not overload the mount. Do not drop the mount 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.

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

6.2. iOptron Customer Service

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

It is strongly suggested that to send technical questions to support@ioptron.com. Call in the U.S. 1.781.569.0200.

6.3. Product End of Life Disposal Instructions

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

6.4. Battery Replacement and Disposal Instructions

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

Appendix A. Technical Specifications

Mount	Center-balanced Equatorial Mount (CEM)
Payload	60 lb (27.2kg), exclude counterweight
Mount weight	27 lb (12.3kg)
Payload/Mount weight ratio	2.22:1
Material	All metal (except GPS cover)
Latitude adjustment range	0°~ 70°
Azimuth adjustment range	± 8°
Right Ascension worm wheel	Φ146mm, 288 tooth aluminum
Declination worm wheel	Φ146mm, 288 teeth aluminum
PEC	PPEC/Real time PEC
PE	~±5 arcsec p-p (#7200) or <0.3 arcsec RMS for 5 min (#7201)
Counterweight shaft	Φ28x 450 mm Stainless Steel
Counterweight	21 lb (9.5 kg)
Mount base size	Φ150 mm
Motor drive	Stepper motor
Resolution	0.06 arc seconds
Slew speed	1×,2×,8×,16×,64×,128×,256×,512×,MAX(~3.75°/sec)
Power consumption	0.6A(Tracking), 1.1A(GOTO)
Power requirement	12V DC 2A
AC adapter	100V ~ 240V (included)
Polar Scope	AccuAlign^{TM} dark field illuminated, 2 arc min
Level indicator	Level bubble
Dovetail saddle	8" Losmandy/Vixen dual saddle
Hand Controller	Go2Nova® 8407+,212,000 objects database, star recognition
Meridian treatment	Stop (0-15° pass), auto flip
GPS	Internal 32-channel GPS
Autoguide port	ST-4
Communication port	Serial Port
PC computer control	Yes (ASCOM)
Cable management	4X USB, 2X DC12V (MAX 5A), 6P6C
Operation temperature	-20°C ~ +45°C
Tripod	Optional 2 "tripod Stainless Steel(8kg)/Pier (10kg)
Warranty	Two year limited

Appendix B. Go2Nova® 8407+ HC MENU STRUCTURE

MENU
- Select and Slew
  - Solar System
    - Mercury
    - Venus
    - Mars
    - Jupiter
    - Saturn
    - Uranus
    - Neptune
    - Sun
    - Moon
  - Deep Sky Objects
    - Named Object
    - Messier Catalog
    - NGC
    - IC
    - PGC
    - Caldwell Catalog
    - Abell Catalog
    - Herschel Catalog
  - Stars
    - Named Stars
    - Double/Multi Stars
    - Hipparcors Catalog
  - Comets
  - Asteroids
  - Constellations
  - Custom Objects
    - User Defined Comets
    - Other Objects
  - Custom R.A. and DEC
- Sync. To Target

```
Alignment
              ├─ Position of Pole Star
              ├─ One Star Alignment
              ├─ Two Star Alignment
              ├─ Three Star Alignment
              ├─ Solar System Align
              ├─ Polar Interate Align
              ├─ View Model Error
              └─ Clear Alignment Data

Settings
              ├─ Set Time and Site
              ├─ Set Beep
              ├─ Set Display
              ├─ Set Guiding Rate
              ├─ Set Tracking Rate
              │           ├─ Sidereal Rate
              │           ├─ Lunar Rate
              │           ├─ SolarRate
              │           ├─ King Rate
              │           └─ User Defined Speed
              ├─ Set Parking Position
              │           ├─ Horizon Position 1
              │           ├─ Zenith Position 1
              │           ├─ Horizon Position 2
              │           ├─ Zenith Position 2
              │           ├─ Current Position
              │           └─ Custom Parking Pos.
              ├─ Meridian Treatment
              │           ├─ Set Position Limit
              │           └─ Set Behavior
              ├─ Set Altitude Limit
              ├─ Polar Scope Bright.
              ├─ Set Heating ON/OFF
              ├─ Set RA Guiding
              └─ Language
```

```
├── Electric Focuser
├── PEC Options
│       ├── PEC Playback
│       ├── Record PEC
│       └── PEC Data Integrity
├── Park Telescope
├── Edit User Objects
│       ├── User Defined Comet
│       │       ├── Add a New Comet
│       │       ├── Browse Comets
│       │       ├── Delete a Comet
│       │       └── Clear All Comets
│       └── Other Objects
│               ├── Add a New Object
│               ├── Browse Objects
│               ├── Delete an Object
│               └── Clear All Objects
├── Firmware Information
└── Zero Position
        ├── Goto Zero Position
        ├── Set Zero Position
        └── Set Zero Position
```

Appendix C. Firmware Upgrade

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

Appendix D. Computer Control a CEM60 Mount

The CEM60 mount can be controlled by a SmartPhone, a Pad or a computer. It is supported by two types of computer connections:

- Connect to a computer via RS232 serial port. An optional RS232 to USB adapter (iOptron part #8435) is needed if your computer does not have a serial port, like most of the laptops on the market today. Follow the adapter instructions to install the adapter driver. The mount can be controlled via ASCOM protocol (Windows OS), or directly by some software, such as Sky Safari (Mac OS)

- Connect wirelessly with iOptron StarFi adapter (#8434) or some other third party adapter (may with limited function). The mount can be controlled via ASCOM protocol (Windows OS), SmartPhone/Pad and Mac OS wirelessly. See StarFi Instruction Manual for detailed information.

To control the mount via ASCOM protocol, you need:
1. Download and install the latest ASCOM Platform, currently 6.1 SP1, from http://www.ascom-standards.org/. Make sure your PC meets the software requirement. For 6.1 SP1, Windows XP users should install .NET Framework 4 (not the Client Profile). Windows Vista and Windows 7 users should install .NET Framework 4.5.2. Windows 8 and 8.1 users do not need install any additional components.
2. Download and install the latest iOptron Telescope ASCOM drive for CEM60 from iOptron website.
3. Planetarium software that supports ASCOM protocol. Follow software instructions to select the iOptron Telescope.

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

Appendix E. Go2Nova®Star List

Named Deep Sky Object

ID No.	OBJECT	NGC #	Messier#	IC#	A(Abell)	U(UGC)
1	Andromeda Galaxy	224	31			
2	Barnards Galaxy	6822				
3	Beehive Cluster	2632	44			
4	Blackeye Galaxy	4926	64			
5	Blinking Planetary Nebula	6826				
6	Blue Flash Nebula	6905				
7	Blue Planetary	3918				
8	Blue Snowball Nebula	7662				
9	Box Nebula	6309				
10	Bubble Nebula	7635				
11	Bipolar Nebula	6302				
12	Butterfly Cluster	6405	6			
13	California Nebula	1499				
14	Cat's Eye Nebula	6543				
15	Cocoon Nebula			5146		
16	Cone Nebula	2264				
17	Cork Nebula	650-51	76			
18	Crab Nebula	1952	1			
19	Crescent Nebula	6888				
20	Draco Dwarf					10822
21	Duck Nebula	2359				
22	Dumbbell Nebula	6853	27			
23	Eagle Nebula		16			
24	Eight-Burst Nebula	3132				
25	Eskimo Nebula	2392				
26	Flaming Star Nebula			405		
27	Ghost of Jupiter	3242				
28	Great Cluster	6205	13			
29	Helix Nebula	7293				
30	Hercules Galaxy Cluster			2151		
31	Hind's Variable Nebula	1555				
32	Hubble's Variable Nebula	2261				
33	Integral Sign Galaxy					3697
34	Jewel Box Cluster	4755				
35	Keyhole Nebula	3372				
36	Lagoon Nebula	6523	8			
37	Little Gem	6445				
38	Little Gem Nebula	6818				
39	Little Ghost Nebula	6369				
40	North American Nebula	7000				
41	Omega Nebula	6618	17			
42	Orion Nebula	1976	42			
43	Owl Nebula	3587	97			
44	Pelican Nebula			5070		
45	Phantom Streak Nebula	6741				
46	Pinwheel Galaxy	598	33			
47	Pleiades		45			
48	Ring Nebula	6720	57			
49	Ring Tail Galaxy	4038				
50	Rosette Nebula	2237				
51	Saturn Nebula	7009				
52	Sextans B Dwarf					5373
53	Small Magellanic Cloud	292				
54	Sombrero Galaxy	4594	104			
55	Spindle Galaxy	3115				
56	Tank Track Nebula	2024				
57	Trifid Nebula	6514	20			
58	Ursa Minor Dwarf					9749
59	Whirlpool Galaxy	5194	51			
60	Wild Duck Cluster	6705	11			

Messier Catalog
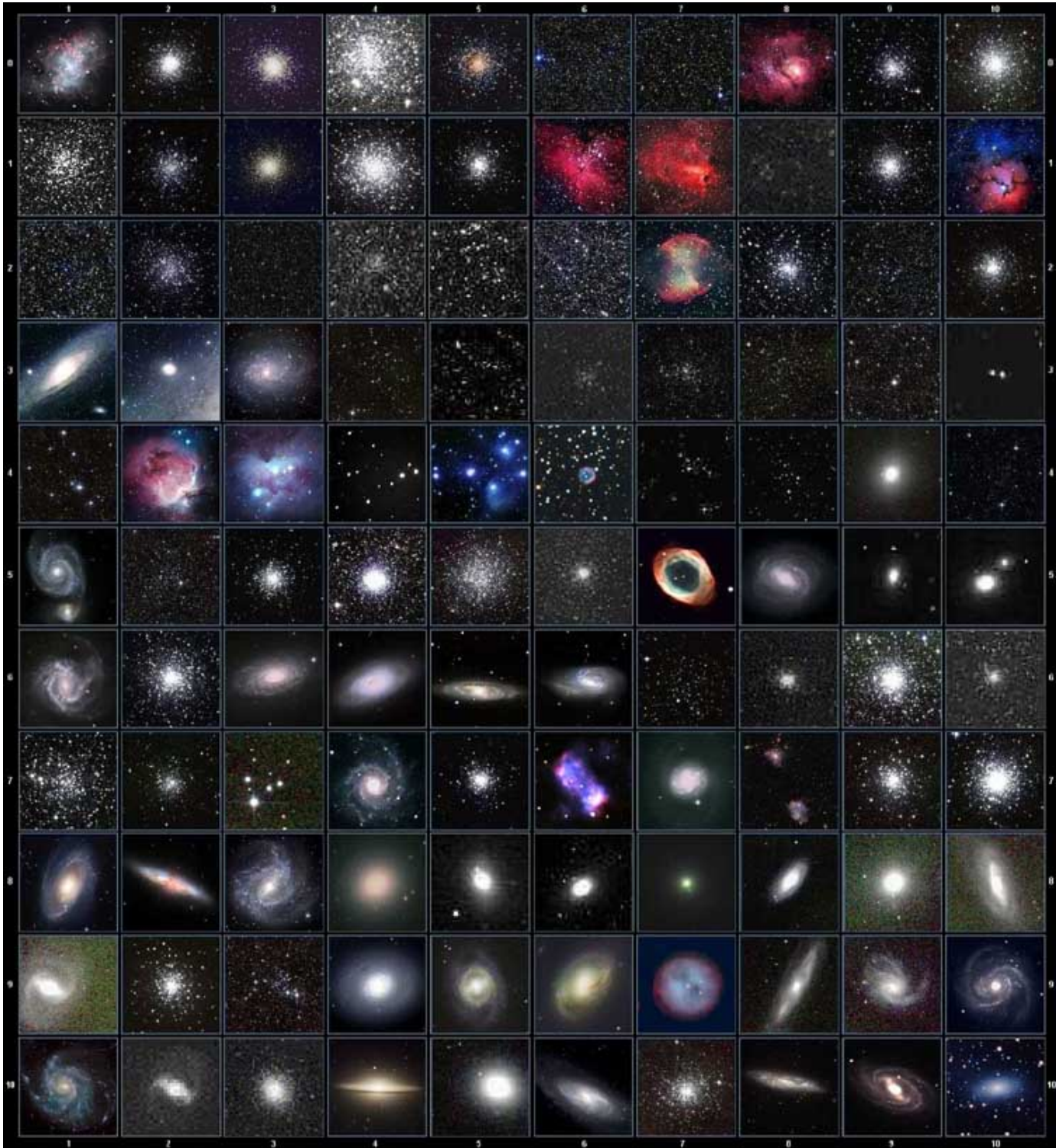
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Named Stars

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

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

Modern Constellations

No.	Constellation	Abbreviation	No.	Constellation	Abbreviation
1	Andromeda	And	45	Lacerta	Lac
2	Antlia	Ant	46	Leo	Leo
3	Apus	Aps	47	Leo Minor	LMi
4	Aquarius	Aqr	48	Lepus	Lep
5	Aquila	Aql	49	Libra	Lib
6	Ara	Ara	50	Lupus	Lup
7	Aries	Ari	51	Lynx	Lyn
8	Auriga	Aur	52	Lyra	Lyr
9	Boötes	Boo	53	Mensa	Men
10	Caelum	Cae	54	Microscopium	Mic
11	Camelopardalis	Cam	55	Monoceros	Mon
12	Cancer	Cnc	56	Musca	Mus
13	Canes Venatici	CVn	57	Norma	Nor
14	Canis Major	CMa	58	Octans	Oct
15	Canis Minor	CMi	59	Ophiuchus	Oph
16	Capricornus	Cap	60	Orion	Ori
17	Carina	Car	61	Pavo	Pav
18	Cassiopeia	Cas	62	Pegasus	Peg
19	Centaurus	Cen	63	Perseus	Per
20	Cepheus	Cep	64	Phoenix	Phe
21	Cetus	Cet	65	Pictor	Pic
22	Chamaeleon	Cha	66	Pisces	Psc
23	Circinus	Cir	67	Piscis Austrinus	PsA
24	Columba	Col	68	Puppis	Pup
25	Coma Berenices	Com	69	Pyxis	Pyx
26	Corona Australis	CrA	70	Reticulum	Ret
27	Corona Borealis	CrB	71	Sagitta	Sge
28	Corvus	Crv	72	Sagittarius	Sgr
29	Crater	Crt	73	Scorpius	Sco
30	Crux	Cru	74	Sculptor	Scl
31	Cygnus	Cyg	75	Scutum	Sct
32	Delphinus	Del	76	Serpens	Ser
33	Dorado	Dor	77	Sextans	Sex
34	Draco	Dra	78	Taurus	Tau
35	Equuleus	Equ	79	Telescopium	Tel
36	Eridanus	Eri	80	Triangulum	Tri
37	Fornax	For	81	Triangulum Australe	TrA
38	Gemini	Gem	82	Tucana	Tuc
39	Grus	Gru	83	Ursa Major	UMa
40	Hercules	Her	84	Ursa Minor	UMi
41	Horologium	Hor	85	Vela	Vel
42	Hydra	Hya	86	Virgo	Vir
43	Hydrus	Hyi	87	Volans	Vol
44	Indus	Ind	88	Vulpecula	Vul

Double/Multi Stars

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

IOPTRON TWO YEAR TELESCOPE, MOUNT, AND CONTROLLER WARRANTY

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

B. The Proper Return Merchant Authorization Number must be obtained from iOptron in advance of return. Call iOptron at 1.781.569.0200 to receive the RMA number to be displayed on the outside of your shipping container.
All returns must be accompanied by a written statement stating the name, address, and daytime telephone number of the owner, together with a brief description of any claimed defects. Parts or product for which replacement is made shall become the property of iOptron.

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

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

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

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

not covered by this warranty.

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

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

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

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

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

iOptron Corporation
Customer Service Department
6E Gill Street
Woburn, MA01801
www.ioptron.com
support@ioptron.com
Tel. (781)569-0200
Fax. (781)935-2860
Monday-Friday 9AM-5PM EST

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