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WARNING!

NEVER USE A TELESCOPE TO LOOK AT THE SUN!
Looking at or near the Sun will cause instant and irreversible damage to your eye.
Children should always have adult supervision while observing.
1. Introduction

1.1. CubePro Features

CubePro™ GOTO altazimuth (A/A) Mount is the ideal portable mount to go with your traveling OTAs, such as a 60mm or 80mm ED refractor, a 90mm or 100mm Maksutov-Cassegrain or a 114mm Newtonian reflector. It can also be used to mount solar scopes.

It features a SmartStar® computerized control system with 130,000 objects and 8-line backlit LCD screen. A 32 channel internal GPS, easy alignment procedure and accurate GoTo and auto-tracking minimize the setup time.

1” stainless steel tripod with metal platform and metal hinges makes the mount very sturdy. Compact design of the tripod and the mount makes it easy to carry around in a travel case. The mount assembling takes less than 5 minutes.

Standard dovetail makes this mount compatible with many different OTAs.

CubePro™ is compatible with all ASCOM compliant planetarium programs and many other programs such as Sky X, Starry Night and Voyager.

Package Contents

The CubePro™ mount comes with the tripod in the same shipping box, which includes:

- Telescope Mount (with built-in GPS)
- AC Adaptor with cord
- 8401 Hand Controller
- Controller Cable
- USB cable
- Tripod
- Tripod bolt (with black shaft) and Tray Lock
- Tripod Tray
- 1.5 kg Counterweight and shaft

1 US market only. Actual contents may vary from time to time.
1.2. **CubePro™ Assembly Terms**

1. Telescope (not included)
2. Dovetail Lock
3. Hand Controller
4. Altitude Lock
5. Mount
6. Tripod
7. Inner support/Tripod bolt
8. Tray
9. Tray lock
10. Counterweight (not shown)

**Figure 1. CubePro mount and tripod**
## 2. CubePro Assembly

<table>
<thead>
<tr>
<th>Step 1.</th>
<th>Extend tripod legs to full extension.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2.</td>
<td>Attach mount to tripod using the long bolt (#7). Slide tray on bottom of shaft. Then screw on round black knob (#9).</td>
</tr>
<tr>
<td>Step 3. Installing Batteries</td>
<td>Pull the batteries compartment cover (shown) open. Gently pull the batteries holder out of the compartment to avoid breaking the attached wires.</td>
</tr>
</tbody>
</table>
| Step 3a. | Insert 8 AA batteries (not included) according to the diagrams on the holder.* Replace the holder back into the batteries compartment and replace the cover.  
*Note:* fit the batteries holder back into the compartment with the attached wires at the bottom right corner (see arrow in the photo).  
*Use only fresh batteries; do not mix fresh and old batteries; insufficient battery power may cause error messages. |
| Step 4. Attaching Telescope | Attach telescope to mount using the dovetail lock knob (#2). |
Step 6. Connecting Hand Controller

Plug hand controller into any one of the HBX (handbox) ports on the mount. Plug in power plug if a AC adaptor is used.

Turn on power. Now you are ready to observe. Use the 4 Arrow keys (▲▼◄►) to rotate the scope Up, Down, Left, and Right. Use the Number key to change the slew speed from the slowest (1 - 1X) to the fastest (9 - MAX).

The other HBX is reserved for accessories, such as electronic focuser, laser pointer and autoguider adapter. **DO NOT plug non-iOptron accessories into the unit to avoid damaging the mount or accessories**

7. This step allows you to attach the counterweight to the mount. *(note: if you have a scope less than 7 lbs., attaching a counterweight is optional).*

Unlock and remove the altitude lock (#4). Screw on the counterweight shaft and tighten it.

8. Slide the counterweight onto the counterbalance shaft. Next, insert the brass pin into the hole on the counterweight.

9. Secure the counterweight by tightening the lock knob.

⚠️ **Counter weight is heavy. Please handle with care to avoid injury!**
3. GOTONOVA™ 8401 Hand Controller

GOTONOVA™ 8401 hand controller (HC) is the standard controller for a CubePro, as shown in Figure 2.

3.1. Key Description

- **MENU**: Press “MENU” to enter the Main Menu.
- **BACK**: Move back to the previous screen, or end/cancel current operation, such as slewing.
- **ENTER**: Confirm an input, go to the next menu, select a choice, or slew the telescope to a selected object.
- **Arrow (▲▼►◄)**: Press ▲▼ buttons to move a telescope along the DEC direction, ►◄ to move a telescope along the RA direction. Brows the menu or move the cursor in operating menu.
- **Number Keys**: Input numerical values. Also used to adjust speeds (1: 1X; 2: 2X; 3: 8X; 4: 16X; 5: 64X; 6: 128X; 7: 256X; 8: 512X; 9: MAX)
- **Light Key(☼)**: Turns on/off the red LED reading light on the back of the controller.
- **? Key**: For help or extra information.
- **STOP/0 Key**: Stop/Start tracking.
- **HBX (Handbox) port**: connect the HC to CubePro mount using a 6-wire RJ11 cable.
- **USB port**: connect the HC to a Computer via a USB cable.
3.2. The LCD Screen

The 8401 HC is designed to use for both iOptron’s equatorial (EQ) mount, such as the SmartStar®-PR GOTO German Equatorial Mount and the GOTONOVA™ Equatorial Kit, and AltAzimuth (A/A) mount, which includes all SmartStar® GOTO mounts and telescopes. It consists of a large 8-line LCD screen, which displays all the information as shown in Figure 3. The user interface is simple and easy to learn.

- **GPS status**: When the power is turned on, it shows “GPS ON”, which means a GPS receiver is connected. When the GPS receiver finds the satellite and receives GPS signal, it shows “GPS OK”. The “GPS OK” may turn off after few minutes.
- **Slew speed**: It has 9 speeds: 1X, 2X, 8X, 16X, 64X, 128X, 256X(1°/sec), 512X(2°/sec), MAX(4°/sec).
- **Tracking speed**: It has 4 speeds: Cel (celestial), Sol (Solar), Lun (Lunar), Def (user defined)
- **Mount Type**: EQ is equatorial and A/A altazimuth.

3.3. Connection to a Computer

The GOTONOVA hand controller has a USB port which can be connected to a computer. This will allow Firmware Upgrading, Database Updating, or Planetarium application. A USB2COM driver is needed to simulate the USB port to a RS-232 serial port. (see Appendix D)

The CubePro™ can be controlled by a number of popular astronomy software programs. For astronomy software that does not have an embedded iOptron mount driver, an ASCOM driver and related platform are needed. Please refer to Appendix F for more information.

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. Level and Align the Mount

Each time the Mount is turned on, the default position is Parking Position, i.e., Alt. 90°0’0” and Azi. 180°0’0”, which means the Mount is leveled, facing south and the telescope pointing up at the Zenith. The procedures are:
• Level the Mount. Adjust the leg length to make sure the bubble on the side of the mount is centered. Turn the Mount around to make sure it is always leveled. It is also recommended to use additional levels to assure very precise leveling. **Leveling is critical for a good GOTO and tracking accuracy.**

• Face the South. Align the Mount to south by turning the South mark facing south. An additional compass may be needed. There are two ways to do so. One is loosen the AZI lock (7) a little and manually turn the Mount to face south. Then tighten the AZI lock again. The other is turn on the Mount. Turn the Mount facing south using hand control. Then turn off the power.

• Point to Zenith. Unlock the ALT Lock and turn the telescope to point up directed at the Zenith.

4.2. Setting Up the Mount

A CubePro is equipped with a GPS receiver, which will receive the local time, longitude and latitude information from a satellite after the link is established. However, manual input is still needed for time zone and Daylight Saving setting.

A clear sky outside is needed for GPS to communicate well with the satellites.

4.2.1. Set Up Time Zone

Press MENU button, from the main menu, scroll down and select “Set up controller” Press ENTER. Scroll down and select “Set up site” Press ENTER. The longitude and latitude coordinates will be updated when the GPS picks up satellite signals. “W/E” means west/east hemisphere; “N/S” means north/south hemisphere; “d” means degree; “m” means minute; and “s” means second.

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 internet, such as GPSVisualizer (http://www.gpsvisualizer.com/geocode), by entering the city name or address. In case you only find the site information in decimal format you can convert them into d:m:s format by multiplying the decimal numbers by 60. For example, N47.53 can be
changed to N47º31'48": 47.53º = 47º + 0.53º, 0.53º=0.53x60'=31.8', 0.8'=0.8x60"=48".
Therefore, 47.53º=47º31'48" or 47d31m48s.
Same as N47º31.8": 31.8'=31'+0.8', 0.8'=0.8x60"=48".

Press ◄ or ► key, move the cursor to the
bottom of the screen to set the time zone
information (add or subtract 60 minutes per
time zone). Enter minutes “ahead of” or
“behind” UT (universal time).
• New York City is 300 minutes “behind”
UT
• Los Angeles is 480 minutes “behind” UT
• Rome is 60 minutes “ahead of” UT
• Beijing is 480 minutes “ahead of” UT
• Sydney is 600 minutes “ahead of” UT

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

For other parts of the world, you can find out
your “time zone” information from internet,
such as
DO NOT COUNT DAYLIGHT SAVING
TIME.

4.2.2. Set Up Daylight Saving Time

Scroll up and select “Set up local Time”

<table>
<thead>
<tr>
<th>Time Zone</th>
<th>Hours behind UT</th>
<th>Enter Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hawaii</td>
<td>-10</td>
<td>600</td>
</tr>
<tr>
<td>Alaska</td>
<td>-9</td>
<td>540</td>
</tr>
<tr>
<td>Pacific</td>
<td>-8</td>
<td>480</td>
</tr>
<tr>
<td>Mountain</td>
<td>-7</td>
<td>420</td>
</tr>
<tr>
<td>Central</td>
<td>-6</td>
<td>360</td>
</tr>
<tr>
<td>Eastern</td>
<td>-5</td>
<td>300</td>
</tr>
</tbody>
</table>

Use the ◄ or ► key to move the cursor to the
bottom of the screen, use the ▲ or ▼ button to toggle between “Y” and “N”. Press
ENTER to go back the previous screen. The
local time also can be manually entered in
case of GPS malfunction or testing the
mount inside.

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

4.2.3. Set Mount Type

The 8401 hand controller that comes with
the CubePro can function in both EQ and
AltAz. For the CubePro you will need to set
the hand controller to function in AltAz.
Scroll down and select “Set Mount Type”,

To adjust minutes, move the cursor to each
digit and use the number keys to input
number directly. To change the “behind” or
“ahead” of UT, move the cursor to “ahead”
and using ▲ or ▼ key to toggle between
“behind” and “ahead”. When the number is
correct, press ENTER and go back to the
previous screen.
Press Enter.

Select Alt/Azi mount and press ENTER to go back the previous screen.

4.2.4. Set Anti-backlash

For an Alt/Azi operation, both R.A. and DEC anti-backlash should be set to 0 step (factory default setting). Scroll down and select “Set anti-backlash”

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

<table>
<thead>
<tr>
<th>R.A. anti-backlash:</th>
<th>0150 steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>One steps equal to</td>
<td>1.5 arc second.</td>
</tr>
</tbody>
</table>

To adjust steps, move the cursor to each digit and use the number keys to input number directly. Press ENTER, a DEC anti-backlash will display:

<table>
<thead>
<tr>
<th>DEC anti-backlash:</th>
<th>0150 steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>One steps equal to</td>
<td>1.5 arc second.</td>
</tr>
</tbody>
</table>

Move the cursor to each digit and use the number keys to set the anti-backlash to 0. Press ENTER to go back the previous screen.

Press BACK button to go back to main menu.

4.2.5. Go to the Moon

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

To slew to the Moon, press MENU button, select “Select and slew” by pressing the ENTER button. Select “Planets, Sun, Moon”, and use the ▲ or ▼ buttons to select Moon. Press ENTER. The telescope will automatically slew to the Moon and lock on. It will automatically begin to track once it locks on. Use the arrow keys to center the Moon in your eyepiece if it is not centered. Or for better performance use Sync to Target (see instructions later).

4.2.6. Initial Star Alignment

A simple star alignment/synchronization can be performed to improve the GOTO and tracking accuracy. To do so, after slew the mount to an object, such as Moon, press MENU button, scroll down to “Sync. To Target”, follow the on-screen instruction and press ENTER.

An alternate way is to perform an “Easy One Star Align”. To do so, press MENU button, scroll down to “Align”, select “Easy One Star Align” and press ENTER. The screen will list three bright objects for you to select from (ex. Moon, Jupiter, Venus).
Select an object using ▲ or ▼ key. Then press ENTER. Next use the arrow keys to slew to the object until it is centered in your eyepiece. Then press ENTER.

You may need using number keys to change the slewing speed to make the centering procedure easier.

4.3. Turn Off the Mount

When you are finished observing it is recommended to return the mount to Park Position. If the mount is not moved then no initial set up is needed when you turn on the mount next time. To park the telescope press the MENU button, scroll down to “Park Telescope” and press ENTER. Once the telescope returns to Park Position turn the power off.

5. Use the CubePro

5.1. Manual Operation of a Telescope

You may observe land and astronomical objects using GOTONOVA’s arrow keys.

After the telescope was assembled (referring to Section 2. Telescope Assembly), flip the I/O switch on the telescope mount to turn on the mount. Use ►,◄,▼ or ▲ buttons to point the telescope to the desired object. You may need to use the number keys to change the slewing speed. Simply press a number while slewing to change the slew speed.

5.2. Slew to an Object

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

The GOTONOVA™ 8401 hand controller has a database of about 130,000 objects. Use the ► or ◄ buttons to move the cursor and the ▼▲ buttons to change the individual number. The check mark (✓) indicates the object is above the horizon, and a cross mark (X) means it is below the horizon. In some catalogs those stars below the horizon will not display on the hand controller.

5.2.1. Planets, Sun, Moon

There are 10 objects in the Solar system catalog.

5.2.2. Deep sky objects

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

- Named Deepsky Objects: consists of 60 deep sky objects with their common names. A list of named deep sky objects is attached in Appendix C.
- Messier Catalog: consists of all 110 objects.
- NGC IC Catalog: consists of 7840 objects in NGC catalog and 5386 objects in IC catalog. To select an object from NGC or IC catalog, move the cursor to NGC, using ▲ or ▼ button to toggle between NGC and IC. Then move the cursor to numerical position and use the number button to select the object.
- UGC Catalog: consists of 12939 objects.
- MCG Catalog: consists of 29004 objects. They are listed numerically from MCG+15 to MCG-05.
- Caldwell Catalog: consists of 109 objects.
- Abell Catalog: consists of 2712 objects.
- Herschel Catalog: consists of 400 objects.

5.2.3. Comets

This catalog contains up to 190 comets. This database is customer upgradeable.
5.2.4. Asteroids
This catalog contains up to 4096 asteroids. This database is customer upgradeable.

5.2.5. Stars
• Named Stars: consists of 191 stars with their common names. They are listed alphabetically. A list is attached in Appendix C.
• Double Stars: consists of 40 double stars. A list is attached in Appendix C.
• GCVS Variable Stars: consists of 38624 GCVS variable stars. They are listed numerically.
• SAO Catalog: consists of 26584 SAO catalog objects. They are listed numerically.

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

5.2.7. User Objects
This catalog can consist up to 256 user predefined objects. These objects need to be entered before they can be selected for slewing.

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

5.3. Sync to Target
This operation will match the telescope’s current coordinates to Target Right Ascension and Declination. After slew to an object, press MENU—then scroll to “Sync to Target” and press ENTER. Follow the screen to do the sync. Using this function will re-calibrate the computer to the selected object. Multiple syncs can be performed if needed.

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

“Sync to Target” does the same thing as one star alignment except that you choose the object to “sync” to. One star alignment chooses the star/object for you.

5.4. Electric Focuser
If you have an electric focuser in your system and it is supported by GOTONOVA, use this option to adjust the focuser. Use ◀► for coarse tuning and ▼▲ for fine tuning.

Refer to your Electric Focuser operation manual for detailed instruction.

5.5. Set Up Controller
5.5.1. Set Up Local Time
Refer to 4.2.2.

5.5.2. Set Up Site
Refer to 4.2.1.

5.5.3. Set N/S Hemisphere
Set north or south hemisphere.

5.5.4. Set Display Contrast
Use arrow keys to adjust LCD display contrast.
5.5.5. Set Eyepiece Light
If you have an illuminated-reticule eyepiece or illuminated polar scope, and it is supported by GOTO NOVA hand controller—use this option to adjust the light intensity.

5.5.6. Set Backlight
Adjust LCD and keypad backlight.

5.5.7. Set Anti-backlash
Use Array Keys to move the cursor and Number Keys to change the number. 0 is suggested for Alt/Azi mount. For an EQ mount, the default setting is 150 for both DEC and R.A.

5.5.8. Set Key Beep
Turn the key beep on/off.

5.5.9. Set Mount Type
Although CubePro is an Alt/Azi mount the controller can be used for either Equatorial Mount or Alt/Azi Mount. This command changes between the two positions (EQ and AltAz).

5.5.10. Reset All
Reset all settings to factory default data.

5.5.11. Update Firmware
Firmware updating using iOptron Downloader through USB port on hand controller. (Refer to Appendix E.)

5.5.12. Set gear ratio
Reserved for future products.

5.5.13. Set Language
Select hand controller language.

5.6. Align
This function is used for aligning the telescope. In addition to “Easy One Star Align,” the system also provides “One Star Align” and “Two Star Align” for Alt/Azi mount. “Three Star Align” is only supported by EQ mode.

5.6.1. One Star Align
From the main menu select “Align”. Select “One Star Align”. Use ▲ and ▼ buttons to select a star and press ENTER. A list of align planets or stars that are above the horizon is computed based on your local time and location. Use arrow buttons to move the telescope and center the star in your eyepiece. You can use the number buttons to change the slew speed.

Press ENTER when finished. If your setup is leveled well, one star alignment should be sufficient for good GOTO accuracy. To increase the accuracy you may choose to do two star alignment.

5.6.2. Two Star Align
Two star alignment will increase the GOTO accuracy of the mount. It is suggested to do two star alignment after one star alignment. Two star alignment requires a wider view of the sky, since the two align stars need to be far apart. Select “Two Star Align” in the Align menu. When you finish the first star, the system will prompt you to choose the second star. If the star you choose is too close to the first one, the system will let you choose another one. When you are aligned with the second star, two star alignment is finished. You can reject the suggested star if it is blocked by the tree or behind the house.

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

It will increase the accuracy even higher and requires an even wider view of the sky. This basically asks you to choose a third star to align after two-star align. Three star alignment is not available for Alt/Azi mode.

5.6.4. Dis R.A axis error

This only works for EQ mode. This displays the celestial pole point error. Point error is zero when you power on the mount (unless you “Park Telescope” before powering off.

5.6.5. Test Anti-backlash

This command tests the backlashes in both R.A. and DEC. The saved numbers will show in “Set Anti-backlash” menu. However, if no high accuracy is needed or your equatorial mount is not a high accuracy unit (i.e. the worm gear has different clearance in different positions) you can omit this procedure.

This command only works for EQ mode.

5.6.6. Polaris Position

This shows Polaris position.

5.7. PEC Option

Periodic Error Correction (PEC) is not supported in Alt/Azi mode.

5.8. Set Up Tracking

A user can set up tracking in the main menu by selecting “Set up tracking”. Then the user can select “Sidereal speed”, “Solar speed”, “Lunar speed”, and “User defined speed”. For “User defined speed” this can be adjusted from 91% to 109% of sidereal speed by pressing the ▲ or ▼ buttons.

5.9. User Objects

Besides various star lists available in the hand controller—you can add, edit or delete your own user-defined objects. All data you enter is supposedly J2000.0 epoch.

5.10. Auto Guide

This is an advanced function for autoguiding when a guiding scopes and a camera are equipped. The GOTO NOVA supports autoguiding through ASCOM protocol, such as PHD Guiding or Guidedog, or an ST-4 guiding camera (an extra ST-4 to HBX adapter is needed). Please follow the guiding software for detailed instructions.

This function is not supported in Alt/Azi mode.

5.11. Park Scope

This procedure only needs to be done if you do not move your telescope mount after you power off the GOTO NOVA. Celestial pole pointing error will be stored to flash memory and recalled when you power on again.

5.12. To Park Position

This moves your telescope to park position. When power is turned on—the mount assumes the physical position is the park position. This is its reference point for all other objects.
6. Maintenance and Servicing

6.1. Maintenance

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

If your mount is not to be used for an extended period, dismount the OTAs and counterweight. Remove the batteries from the battery holder if they were installed.

6.2. Troubleshooting

The following suggestions may be helpful for the operation of the CubePro. More information can be found in our online FAQ section (www.iOptron.com then click on “support”).

1. **Error Message “Warning! DEC. (or R.A.) driver motor over current. Please check balance.”**
   1. Check if the mount or OTA is blocked by any obstructions.
   2. Try to operate the mount without an OTA.
   3. Check the power supply. This is a common reason for this message and unexpected slew behavior or movement, which include:
      - **Batteries**: Are the batteries fresh? How long have they been used? (frequent slewing and GOTO will deplete battery power very quickly)
      - **AC or DC adapter**: Check the plugs to the mount and to the power outlet.
      - **Extension cord**: Make sure the cord is in good condition. Power drop along the extension cord has been known to cause this error message.

2. **Error Message “Warning! Can not communicate with DEC motor controller.”**
   1. Check the hand controller cord. Unplug it and re-plug into another HBX port.
   2. Check the power supply, which include:
      - Using the battery? Is the battery fresh? How long it has been used? (frequent slew and GOTO will deplete battery power very quickly)
      - Using AC or DC adapter? Check the plugs to the mount and to the power outlet.
      - Using extension cord? Make sure the cord is in good condition. Power drop along the extension cord was known to cause the problem. Also check all the plugs and connections.

3. **The object is jumping up and down in the eyepiece or over-slewed, and other unexpected slew behavior or movement.**
   1. Use most updated firmware.
   2. Set backlash to 0 in both DEC and RA.
   3. Check the power supply, which include:
      - Using the battery? Is the battery fresh? How long it has been used? (frequent slew and GOTO will deplete battery power very quickly)
      - Using AC or DC adapter? Check the plugs to the mount and to the power outlet.
      - Using extension cord? Make sure the cord is in good condition. Power drop along the extension cord was known to cause the problem. Also check all the plugs and connections.
   4. System balancing.

Also check all the plugs and connections.

4. Check the hand controller cord. Unplug it and re-plug into the other HBX port.
4. **Star Alignment accuracy; GOTO accuracy**

1. Leveling (very important).
2. Site information (minutes ahead or behind UT, DST).
4. Use most updated firmware.
5. Select right mount type (A/A).
6. Set backlash to 0 in both DEC and RA.
7. Check the power supply, which include:
   - Using the battery? Is the battery fresh? How long it has been used? (frequent slew and GOTO will deplete battery power very quickly)
   - Using AC or DC adapter? Check the plugs to the mount and to the power outlet.
   - Using extension cord? Make sure the cord is in good condition. Power drop along the extension cord was known to cause the problem. Also check all the plugs and connections.

6.3. **iOptron Customer Service**

If you have a question concerning your CubePror contact the iOptron Customer Service Department. Customer Service hours are 9:00 AM to 5:00 PM, Eastern Time, Monday through Friday. In the unlikely event that the CubePro requires factory servicing or repairs, write or call the iOptron Customer Service Department first to receive an RMA# before returning the telescope to the factory. Please provide details as to the nature of the problem as well as your name, address, and daytime telephone number. We have found that most problems can be resolved by telephone. So please call first to avoid returning the telescope for repair. Call toll free in the U.S. 1.866.399.4587 or 1.781.569.0200. It is also strongly suggested to send technical questions to support@ioptron.com.
# Appendix A. Technical Specifications

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Appendix B. GOTONOVA™ 8401 HC MENU STRUCTURE

- **MENU**
  - **Select and Slew**
    - **Planets, Sun, Moon**
      - **Mercury**
      - **Venus**
      - **Mars**
      - **Jupiter**
      - **Saturn**
      - **Uranus**
      - **Neptune**
      - **Pluto**
      - **Sun**
      - **Moon**
    - **Deep Sky Objects**
      - **Named Deepsky Object**
      - **Messier Catalog**
      - **NGC IC Catalog**
      - **UGC Catalog**
      - **MCG Catalog**
      - **Caldwell Catalog**
      - **Abell Catalog**
      - **Herschel Catalog**
    - **Comets**
    - **Asteroids**
    - **Stars**
      - **Named Stars**
      - **Double Stars**
      - **GCVS Variable Stars**
      - **SAO Catalog**
  - **Constellations**
  - **User Objects**
  - **Enter R.A. and DEC**
  - **Sync. To Target**
  - **Electric Focuser**
    - **Focus**
    - **Set Anti-backlash**
## Appendix C. GOTO NOVA™ Star List

### GotoNova Deep Sky Object List

for 8401

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# GOTONOVA Named Star List

for 8401

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Appendix D. Set Up USB-PC Connection

1. Download USB2COM driver (cp2102.zip file for 8401) from iOptron Website

2. Install cp2101(usb2com) driver

Choose the appropriate driver for your OS. In this case is a Windows XP operation system. Double click on it, and you will see:

Click “Next”.
Select “I accept the terms of license agreement”, and click “Next”.

Using the default installation path, c:\SiLabs\MCU\CP210x, or specify your own path by click “Change”. Click “Next”. Then click “Install”.
When finished installation, click “Finish”

3. Plug the USB cable to the USB port on your PC, plug the other end of the USB cable to hand controller. Turn on the power on the mount.

4. Install the Hardware
The computer will find a new hardware and show the following screen

Select “No, not this time” and click “Next”.

29
Select “Install from a list or specific location” and click “Next”.

Select “Search for the best driver in these locations,” and check “Include this location in the search.”

Click on “Browse” and select the cp210x driver from directory c:\SiLabs\MCU\CP210x\Win2K_XP, click OK.
Click “Next”. The computer will start to install the driver for the USB2COM. When the installation is done, click “Finish”.

If the computer shows “find a new hardware” screen again, just repeat the steps in this section again.
Now you computer should be ready for Firmware Upgrading, computer communication with the mount via ASCOM platform and planetarium software applications. However, you need to find assigned COM port number for the USB connection. To do so, right click “My Computer”, and click “Properties”.

Click “Hardware”, click “Device Manager”
Double click on “Ports(COM & LPT)”, find out the COM number and write it down (in the following figure, it is COM4)
Appendix E. Firmware Upgrade

1. Download and install Firmware Downloader from iOptron Website

2. Double click and open “iOptron Downloader”

On the interface, select appropriate port using pull-down menu (in this case, COM4):
Click “Open Data File”, and select appropriate “.bin” file that matches your hand controller.

![Image showing the software interface with an open file selection dialog]

and click “Open”. Select “Main Program” in Update Type.

![Image showing the software interface with the update type selection]

Click “Start Download”.
It shows “Please reset GOTO NOVA[GOSTAR], waiting for connection…”

Now the upgrade is finished.

**Typical Errors:**
1. Invalid Port Number: in Device Manager, make sure you have the correct COM port number for CP210x.
2. Wrong ".bin" file: make sure you have the correct ".bin" file for firmware upgrade.
3. Wrong downloader, you should use iOptron Downloader instead of the Flash Downloader.
4. Use cp210x driver provided by iOptron. The newest version from SiLab may not work properly for iOptron’s hand controller.
Appendix F. Use a PC to Control an iOptron Mount

In general you need the followings to use a PC to control the mount,

1. Download USB2COM driver (cp2102, zip file for 8401 and 8402A)
   http://www.ioptron.com/manuals/USB_2COM_Driver.zip;
2. Install USB2COM and establish the connection between the mount and the PC (see
   instruction);
3. ASCOM platform (download from http://ascom-standards.org/);
4. iOptron ASCOM drive (download it from iOptron website
   http://www.ioptron.com/Files/File/iOptronAscomSetupV1.02.rar); and
5. Planetarium software.

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

Some other ASCOM drivers, such as LX200 Generic ASCOM driver and AstroPhysics
GTO driver, are also compatible to SmartStar® mount.
Appendix G. RS-232 Command Set

Abbreviations used:
- DD or DDD degrees or day of the month depending on the context
- HH hours
- MM minutes or month depending on the context
- MM.M minutes and tenths of minutes
- s + or – sign, assumed to be + if omitted
- SS seconds
- SS.S seconds and tenths of seconds
- YY last two digits of the year

General Telescope Information:

Command: :SG sHH#
Response: “1”
Set the offset from Greenwich mean time. The offset can be entered in signed format (-12 to +12) hours.

Command: :Sg sDDD*MM:SS#
Response: “1”
Set the current longitude. The east is positive while the west is negative.

Command: :St sDD*MM:SS
Response: “1”
Set the current latitude.

Command: :SL HH:MM:SS#
Response: “1”
Set the current local time.

Command: :SC MM/DD/YY#
Response: 32 spaces followed by “#”, followed by 32 spaces, followed by “#”
Set the current date.

Command: :GG#
Response:
East Longitude E HH:00#
West Longitude W HH:00#
Get the offset from Greenwich mean time.

Command: :Gg#
Response: sDDD*MM:SS#
Get the current longitude.

Command: :Gt#
Response: sDD*MM:SS#
Get the current latitude.

**Command:** :GL#
**Response:** HH:MM:SS.S#
Get the current local time in 24 hour format. Overflows from 23:59:59 to 00:00:00.

**Command:** :GS#
**Response:** HH:MM:SS.S#
Get the current local sidereal time in 24 hr. format.

**Command:** :GR#
**Response:** HH:MM:SS.S#
Get the current Right Ascension of mount.

**Command:** :GD#
**Response:** sDD*MM:SS#
Get the current Declination.

**Command:** :GA#
**Response:** sDD*MM:SS#
Get the current Altitude.

**Command:** :GZ#
**Response:** sDD*MM:SS#
Get the current Azimuth.

**Command:** :GC#
**Response:** MM:DD:YY#
Get the current calendar day.

**Telescope Motion**
**Command:** :MS#
**Response:** “0” if command accepted, "1Object is below horizon #" the desired object is below 0 degrees altitude. (8 trailing spaces before “#”, 32 total characters plus “#”)
Target command: Slew to the most recently defined RA and DEC coordinates in RA-DEC mode,

**Command:** :Mn# :Ms# :Me# :Mw#
**Response:** (none)
Command motion in the direction specified (n=north, s=south, e=east, w=west) at the currently selected guide or centering rate. Motion will continue until a quit command is issued.

**Command:** :Qn# :Qs# :Qe# :Qw#
**Response:** (none)
Stop motion in the specified axis. Note that :Qn# is identical to :Qs#, and :Qe# is identical to :Qw#. Motion is terminated only if it was not started by a slew (:MS#) command.

Command: :Q#
Response: (none)
Motion in both axes is stopped, regardless of how the motion was invoked.

Command: :RG#
Response: (none)
Selects guide. If tracking is stopped, turns tracking on.

Command: :RC#
Response: (none)
This command sets to quit guide mode.

Command: :RCn#
Response: (none)
:RC0 # Set moving speed by N-S-E-W Keys to 16x
:RC1 # Set moving speed by N-S-E-W Keys to 64x
:RC2 # Set moving speed by N-S-E-W Keys to 256x
:RC3 # Set moving speed by N-S-E-W Keys to 512x

Command: :pS#
Response: “East#” or “West#”
This command returns the side of the pier on which the telescope is currently positioned.

Position
Command: :CM#
Response: “Coordinates matched. #”
(position are 5 spaces between “Coordinates” and “matched”, and 8 trailing spaces before the “#”, the total response length is 32 character plus the “#”).
Calibrate mount. Current Right Ascension and Declination become the commanded Right Ascension and Declination. This command does the same thing as synchronize to target. This command should be used after a “:MS#” command has been finished. This means a GOTO must be done first.

Command: :CMR#
Response: “Coordinates matched. #”
(position are 5 spaces between “Coordinates” and “matched”, and 8 trailing spaces before the “#”, the total response length is 32 character plus the “#”).
Calibrate mount. Current Right Ascension and Declination become the commanded Right Ascension and Declination. This command synchronizes HC coordinate to commanded coordinate. No GOTO needs to be done first.
Command: :Sr HH:MM:SS.S#
Response: “1”
Define the commanded Right Ascension, RA.

Command: :Sd sDD*MM:SS#
Response: “1”
Define the commanded Declination.

**Miscellaneous**

Command: :F+# :F-# :FF# :FS# :FQ#
Response: (none)
Advances (F+) or retracts (F-) focus adjust motor on the eyepiece. F+ or F- commands commence adjustment and :FQ# stops it. If :FS# has been issued previously, then the focus adjustment will be slow. If the :FF# command has been issued, then the adjustment will be fast. If neither FF nor FS is specified, the power up default of FS is assumed.

Command: :F1# :F2# :F3# :F4#
Response: (none)
Set the focus speed to 1,2,3,4, from slow to fast.

Command: :V#
Response: (current servo controller software RS232 command language version number)
This command returns the current servo controller software RS232 command language version.

Command: :Vs#
Response: (current servo controller software information)
This command returns the current servo controller software information.

Command: :STR0#,:STR1#,:STR2#
Response: ‘1’
This command sets the track rate.
0 - sidereal
1- solar
2- lunar

Command: :GTR#
Response: ‘0’,’1’,’2’
This command gets the current tracking rate.
0 - sidereal
1 – solar
2 - lunar

Command: :SGS0#,:SGS1#,:SGS2#,:SGS3#,
Response: (none)
This command sets the guide rate.
0 – 1.0X of sidereal
1 – 0.8X of sidereal
2 – 0.6X of sidereal
3 – 0.4X of sidereal

Command: :GGS#
This command gets the current guide rate.
0 – 1.0X of sidereal
1 – 0.8X of sidereal
2 – 0.6X of sidereal
3 – 0.4X of sidereal

Command: :SE?#
Response: ‘0’, ‘1’,
This command gets the slewing status.
‘1’ in slewing
‘0’ not in slewing

Command: :GAM#
Response: ‘0’, ‘1’, ‘2’
This command gets the current mount type.
0 – Altitude/Azimuth type
1 – fork mount
2 – Germany equator mount

Command: :PK#"
Response: ‘1’
This command parks the telescope.

Command: :STPKP0#, :STPKP1#, :STPKP2#, :STPKP3#, :STPKP4#
Response: ‘1’
These command sets the mount park position.
0 – original to north pole
1 - Left and vertical
2 - Left and horizon
3 - Right and vertical
4 - Right and horizon