MANUAL

GOTONOVA™ 8401 HAND-HELD CONTROLLER

www.iOptron.com

WARNING!

NEVER USE A SMARTSTAR 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.

TIP:

For beginner users without a lot of knowledge in astronomy please refer to the Quick Start Reference. It contains enough information to get you started so you can enjoy the night sky without knowing all the jargon and math.

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For beginner users without a lot of knowledge in astronomy please refer to the Quick Start Menu. It contains enough information to get you started so you can enjoy the night sky without knowing all the jargon and math.

For more serious users we assume that you know some astronomy basics in reading this manual. Please refer to Appendix A for a more detailed menu structure.

Chapter 0 Quick Start Reference

0.1 GoToNova™ Features: (8401)

The 8401 GoToNova™ hand held controller operates the SmartStar™ A series telescopes. The user interface is simple and easy to learn. It can automatically reposition your telescope to any of the 130,000 objects stored in the database with the push of a button.

LCD Display: 8-line big screen, it displays all the information
Back Key: Move back to the previous screen.
Menu Key: Return to the Main Menu.
Enter Key: Confirms an input, goes to the next menu, selects a choice, slews the telescope to a selected object.
Arrow Keys: Moves the cursor, moves the telescope in a specific direction.
Number Keys: Adjusts numerical values.
Speed Key: Adjusts the speed.
Light Key: Adjusts the light.
Help Key: For help.

Useful Links

Sky and Telescope
http://www.skyandtelescope.com/

Astronomy
http://www.astronomy.com/asy/default.aspx

The Hubble Site
http://hubblesite.org/

0.2 Getting Started

For most beginner users who may not need a lot of astronomical detail this chapter gives just enough information to set up the controller. After the easy-to-follow setup you will be ready to point your telescope to wherever you want in the night sky.

After assembling the telescope [Refer to our Assembling Chart] turn on the power button located on the mount. You will see the iOptron logo displayed for a few seconds. Then you will see the zero position screen. By default, it works in Alt-Az mode:

TIP:
A GPS module makes life a lot easier. It automatically sets the time and location for you.

TR.A.	1h36m 2s	
TDEC	90° 0' 0"	
R.A.	19h52m 5s	
DEC	47° 31'16"	64X
Lgst	7h52m38s	Stop
Alt.	0° 0' 0"	
Azi.	0° 0' 0"	
2007-07-10 14:25:23		N

When the power is turned on you will see "G_ON" (GPS turned on) in the upper right corner of the screen. In about a minute, after the internal GPS communicate with the satellites, you will see "G_OK" on the screen. Both time and location are automatically set. If there is no GPS module connected you will need to set up time and location manually.

Press MENU button. Then you will see this screen:

Select and slew
Sync. To target
Electric Focuser
Set up controller
Align
PEC option
Set up tracking
User objects
Auto guide
Park scope
To park position

Select "Set up controller"

TIP:
The controller automatically skips those stars below the horizon of your current time and location.

Set up Local Time
Set up Site
Set N/S Hemisphere
Set Display contrast
Set Eyepiece light
Set Backlight
Set Anti-backlash
Set key Beep
Set Mount Type
Reset All
Upgrade Firmware
Set Gear Ratio
Set Language

TIP:
Spend some time familiarize yourself with those bright stars in the night sky

Press ENTER to select “Set up local time”, and you will see this screen:

Set Local Time: 2007-06-18 14.49.18 Daylight Time saving√

Use the LEFT and RIGHT keys to move the cursor, and use the number keys to adjust the numbers. When the correct local time has been entered, press ENTER. Then you will see this screen:

Set up site Info: Longi: W071d27m47s Latit: N42d15m40s 300 Min. behind UT

Again, use the LEFT and RIGHT keys to move the cursor, and use the number keys to adjust the values. You need the longitude and latitude values of your location. These values can be obtained from the internet (for example: http://www.lat-long.com/) or your GPS device. The last line is the time zone information. Check your time zone and enter properly. For example, Boston lags Universal Time (UT) by 5 hours, which means 300 Minutes *behind* UT. Use the UP or DOWN key to switch between “ahead of” and “behind”.
Press MENU button, then you will see this screen:

Select and slew Sync. To target Electric Focuser Set up GOTONOVA Align PEC option Set up tracking User objects Auto guide Park scope To park position

From the main menu, select “Align”. The system provides “one-star align”, “two-star align” and “Three Star Align”.
Select “one-star align”. You will see this screen:

Alphard A 39° 43.3′ Z 221° 20.0′ Center the target then press “ENTER” 2X

Use “UP” and “DOWN” arrow buttons to select a star and press ENTER. Use SPEED button to select a speed, and use arrow buttons to center the star in your telescope. Press ENTER when finished. Now your GoToNova™ is ready to direct you to any location in the night sky (provided that the object is in the database and above the horizon). Simply choose any object in the menu and press ENTER. Although not required, we strongly suggest that you double check your initial alignment with additional bright objects in the night sky, For example, in the menu, select “Venus” (if it is indeed in the sky) and press ENTER. When the motor stops check to see if

Venus is in the center of your eye piece. If your previous steps were correct, it should be.
You may need to make some minor adjustments to center the object. Otherwise, use “two-star align”.

What’s Next?

Most beginner users are now ready to explore the night sky without needing to refer to the manual any further. The function you will need most is “Select and slew” in the main menu. From there you can select and explore planets, stars, galaxies, nebulae, comets, asteroids, etc.-- virtually all of the most common celestial objects are included.

Chapter.1 Set Up And Alignment

Appendix:
Check Appendix D for a brief introduction of celestial coordinate systems

1.0 Basic Symbols

R	Right ascension
D	Declination
A	Altitude
Z	Azimuth
Cele	Sidereal speed
Sola	Solar speed
Moon	Lunar speed
Land	Land mode
nnX	Slewing speed

1.1 Set Up

By default, the mount works in Alt-az mode. Turn on the power button located on the mount. You will see the iOptron logo screen. Then you will see the zero position screen:

TR.A.	1h36m 2s	
TDEC	90° 0' 0"	
R.A.	19h52m 5s	
DEC	47° 31'16"	64X
Lgst	7h52m38s	Stop
Alt.	0° 0' 0"	
Azi.	0° 0' 0"	
2007-07-10 14:25:23		N

When the power is turned on you will see "G_ON" (GPS turned on) in the upper right corner of the screen. In about a minute, after the internal GPS communicate with the satellites, you will see "G_OK" on the screen. Both time and location are automatically set. Setup is finished in Alt-az mode.
If there is no GPS connected refer to *0.2 Getting Started* on how to manually set up time and location.
The mount can also work in equatorial mode. Tilt the mount to the appropriate angle and point it to the polar star. Go to "Set up GotoNova", select "Set Mount Type", and select Equatorial mode.

1.2 Align

1.2.1 One-Star Align

From the main menu, select "Align". The system provides for "one-star align" and "two-star align".
Select "one-star align". You will see this screen:

Alphard A 39° 43.3′ Z 221° 20.0′ Center the target then press “ENTER” 2X

Use “UP” and “DOWN” arrow buttons to select a star and press ENTER. Use SPEED button to select a speed, and use arrow buttons to center the star in your telescope. Press ENTER when finished.

1.2.2 Two-Star Align

If your mount is not horizontal one-star align is usually not accurate enough. You will need to do two-star align. Select “Two-star align” from the previous menu. Select one bright star from the menu. Use the arrow buttons to center it in the telescope and press ENTER. Select a second bright star and use the arrow keys to center the second star. Press ENTER. Two-star align is finished.

Chapter. 2 Select And Slew

After you have finished the set up and align steps in chapter 1 go to the main menu. Select "Select and slew." Now you can select any celestial objects in the database and GoToNova™ will take you there—whether it is a star, a planet, an asteroid, a comet or a galaxy.

Check astronomy books and magazines such as "Sky and Telescope." Familiarize yourself with the names in the night sky. Use the arrow buttons to move your cursor and press ENTER to select an object.

2.1 Planets, sun, moon
This menu includes the Sun, the Moon, Mercury, Venus, Mars, Jupiter, Saturn, Uranus, and Neptune.
WARNING: NEVER LOOK DIRECTLY AT THE SUN WITH THE NAKED EYES OR WITH A TELESCOPE (UNLESS YOU HAVE THE PROPER SOLAR FILTER). PERMANENT AND IRREVERSIBLE EYE DAMAGE MAY RESULT.

2.2 Deep Sky Objects
This menu includes objects outside our Solar system such as galaxies, star clusters, quasars, nebulae, etc.

2.2.1 Named Deep Sky Objects
This menu contains 60 named deep sky objects. If you know the names of the objects you can use this menu.

2.2.2 Messier Catalogue
Contains 110 objects from the Messier catalogue.

2.2.3 NGC-IC Catalogue
Contains 7840 objects from the NGC-IC catalogue.

2.2.4 UGC Catalogue
Contains 129,939 objects from the UGC catalogue.

2.2.5 MCG Catalogue
Contains 29,004 objects from the MCG catalogue.

2.2.6 CaldWell Catalogue
Contains 109 objects from the CaldWell catalogue.

2.2.4 Abel Catalogue
Contains 2712 objects from the Abel catalogue.

2.2.4 Herschel Catalogue
Contains 400 objects in Herschel catalogue.

2.3 Comets
Contains up to 256 comets.

2.4 Asteroids

Appendix:
Check Appendix B and Appendix C for names of galaxies and constellations

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TIP:
You can define and save new celestial objects in the database.

TIP:
By specifying R.A. and DEC numbers (or A and Z) , you can point your telescope to anywhere on the celestial sphere.

Contains up to 4096 asteroids.

2.5 Stars

2.5.1 Named Stars
Contains 191 stars.

2.5.2 Constellations
Contains 88 constellations.

2.5.3 Double Stars
Contains 40 double stars.

2.5.4 Variable Stars
Contains 38,624 variable stars.

2.5.5 SAO Bright Stars
Contains up to 26,584 SAO bright stars.

2.6 Constellations
Contains 88 constellations.

2.7 User Objects
User defined objects. User can define up to 128 objects

2.8 Enter R.A. DEC.
In Equatorial mode the user can target a location by specifying its RA (Right Ascension) and DEC (Declination). Use the arrow buttons to move the cursor and adjust the values. Press ENTER.

In Altazimuth mode the user can target a location by specifying its A (Altitude) and Z (Azimuth). Use the arrow buttons to move the cursor and adjust the values. Press ENTER.

Chapter. 3 Other Functions

Appendix:
Check Appendix A for complete menu structures

3.1 Sync To Target
Matches the telescope's current equatorial coordinates to Target Right Ascension and Declination.

3.2 Electric Focuser
If you have an electric focuser in your system use this option to adjust the focuser.

3.3 PEC option
If your telescope is equipped with Periodic Error Correction use this option to adjust Periodic Error Correction.

3.4 Set up tracking
Set up tracking speed.

3.5 User objects
Add, edit or delete user objects.

3.6 Auto guide
If your telescope is equipped with auto guide use this option.

3.7 Park Scope
Park your telescope.

3.8 To Park position
Move your telescope to park position.

3.9 The Equatorial Mode
For more advanced users you can set the mount to equatorial mode.

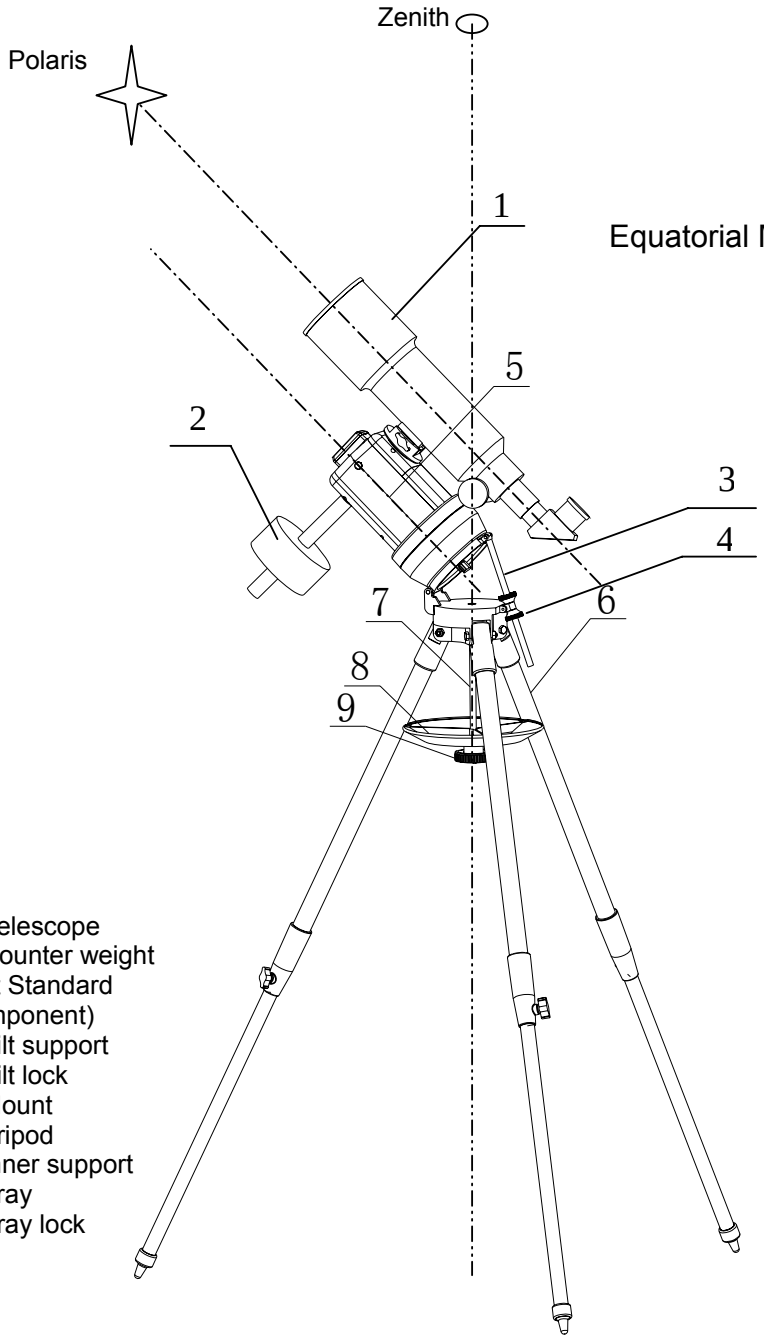
To change from alt-az mode to equatorial mode refer to FIG. 4. First, lock your telescope into vertical position. Make sure the optical axis of your telescope is parallel with the height of the mount. Put on appropriate counter weight. Loosen the tilt lock. Point your telescope to the north. Adjust the tilt. Find Polaris in your finder scope. Center it. Then center Polaris in your telescope. Lock the tilt into position.

In the main menu of your hand held controller, select “Set up GOTONOVA”, then select “Set Mount Type”, and select Equatorial mode.

TIP:
In Equatorial mode one axis of the motor is parallel with the earth’s axis of rotation.

TIP:

The earth's axis of rotation is tilted 23.5° from the vertical. This tilt changes throughout the year. In December the northern hemisphere is tilted 23.5° away from the sun. While in June the northern hemisphere is tilted 23.5° towards the sun.



1. Telescope
2. Counter weight (Not Standard Component)
3. Tilt support
4. Tilt lock
5. Mount
6. Tripod
7. Inner support
8. Tray
9. Tray lock

FIG.4

Chapter. 4 How to Observe

TIP:
People usually use alt-zi mode to observe land objects.

TIP:
People usually use optics that produce normal images (not reversed, or up-side-down images) to observe land objects.

TIP:
Use slower speed for fine tuning.

4.1 Observe manually

If you want to observe land objects, such as a mountain top or a bird you should use the **alt-az** mode. Simply point the telescope to your target and look through the eye piece. (For certain models, such as Newtonian and Maksutov-Cassagrein, the image you see in the eye piece is up-side down).

First, you need to loosen the telescope's tripod base lock knob and Altitude lock so that the telescope can move freely in both directions. Next, use the viewfinder to locate your target; Center the target in your eyepiece and tighten the base and Altitude locks. Then adjust focus.

You can also use this method to observe celestial objects in the night sky. However, you will notice that stars drift away slowly from your eyepiece field, and you have to keep adjusting your telescope to re-center your target. This drift is caused by the rotation of the Earth. This drift can be countered by using the automatic tracking feature of GoToNova™.

4.2 Observing using arrow keys

On our GoToNova™ controllers there are four arrow keys. You can use these keys to adjust and fine tune your telescope. To use this function make sure you tighten both the Altitude and base locks. Then turn on the power.
With the "User position" screen press the ENTER button to switch between "Land" and "Cele" mode (upper right corner). Use the SPEED button to adjust the speed (lower right corner). Use higher speed for initial adjustment. Use lower speed for fine tuning. Center your target in your eye piece then adjust the focus.

User position	Land
R：1h47.8m	D：32° 3.3'
A 89° 58.5'	Z 179° 11.8'
07-06-06	08:59:20 8X

4.3 The Moon

The Moon, when visible in the night sky, is most likely the first celestial object you want to watch with your new telescope. It is also the most convenient object in the sky to test some of the GoToNova™ functions.

There is a lot to explore on the surface of the Moon such as craters, mountain ranges, fault lines, etc. During a full moon, however, no shadows can be seen on the Moon's surface and it becomes too bright for any details to be seen. The best time to observe the Moon is during its crescent or half phase.

A neutral density Moon filter is recommended when observing the Moon. This filter cuts down on the bright glare and enhances contrast. You will be amazed by the dramatic difference.

TIP:
A full moon is not the best time to watch the Moon. There is too much glare and not enough shadow for details.

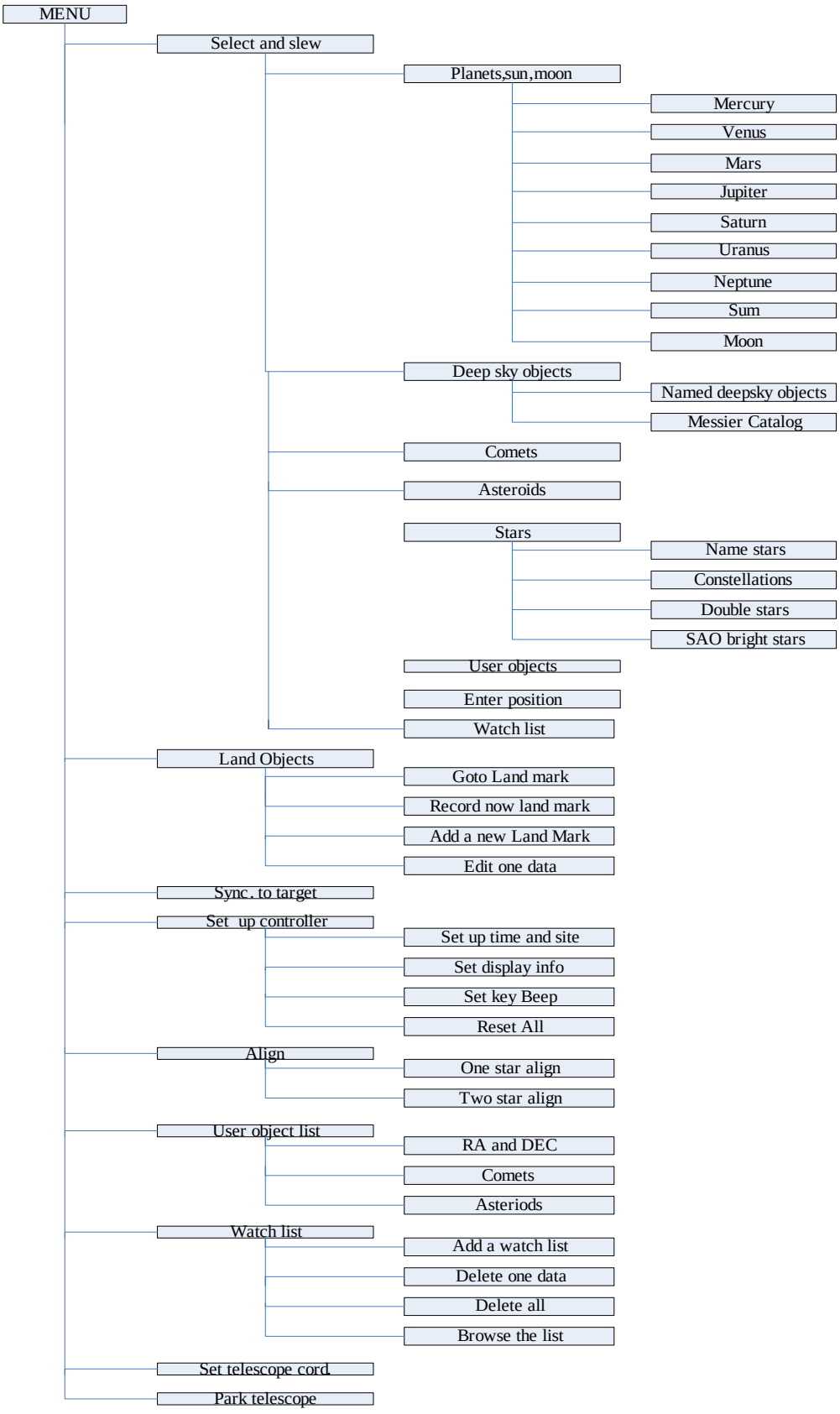
4.4 Tracking

The tracking function is used to counteract the rotation of the earth. When the telescope is in tracking mode, the celestial object will not drift away from your eye piece field. This function is essential for astrophotography.

When you switch to "Cele" mode the system is automatically in tracking mode. When you switch back to "Land" mode the tracking stops.

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", or user can define a speed using "User defined speed".

APPENDIX A
MENU STRUCTURE



APPENDIX B
Messier Catalog

- *Andromeda*
  - M31 **The Andromeda Galaxy** spiral galaxy (type Sb)
  - M32 **Satellite galaxy of M31** elliptical galaxy (type E2)
  - M110 **Satellite galaxy of M31** elliptical galaxy (type E6pec)
- *Aquarius*
  - M2 globular cluster
  - M72 globular cluster
  - M73 system or asterism of 4 stars
- *Auriga*
  - M36 open cluster
  - M37 open cluster
  - M38 open cluster
- *Cancer*
  - M44 **Praesepe, the Beehive Cluster** open cluster
  - M67 open cluster
- *Canes Venatici*
  - M3 globular cluster
  - M51 **The Whirlpool Galaxy** spiral galaxy
  - M63 **Sunflower galaxy** spiral galaxy
  - M94 spiral galaxy
  - M106 spiral galaxy
- *Canis Major*
  - M41 open cluster
- *Capricornus*
  - M30 globular cluster
- *Cassiopeia*
  - M52 open cluster
  - M103 open cluster
- *Cetus*
  - M77 spiral galaxy
- *Coma Berenices*
  - M53 globular cluster
  - M64 **Blackeye galaxy** spiral galaxy
  - M85 elliptical galaxy
  - M88 spiral galaxy
  - M91 spiral galaxy
  - M98 spiral galaxy
  - M99 spiral galaxy
  - M100 spiral galaxy
- *Cygnus*
  - M29 open cluster
  - M39 open cluster
- *Draco*
  - M102 may be NGC 5866 **Spindle Galaxy** , a lenticular galaxy (type S0_3)
- *Gemini*
  - M35 open cluster
- *Hercules*
  - M13 **Great Hercules Globular Cluster** globular cluster
  - M92 globular cluster
- *Hydra*
  - M48 open cluster

- M68 globular cluster
- M83 spiral galaxy

• *Leo*
- M65 spiral galaxy
- M66 spiral galaxy
- M95 spiral galaxy
- M96 spiral galaxy
- M105 elliptical galaxy

• *Lepus*
- M79 globular cluster

• *Lyra*
- M56 globular cluster
- M57 **The Ring Nebula** planetary nebula

• *Monoceros*
- M50 open cluster

• *Ophiuchus*
- M9 globular cluster
- M10 globular cluster
- M12 globular cluster
- M14 globular cluster
- M19 globular cluster
- M62 globular cluster
- M107 globular cluster

• *Orion*
- M42 **The Great Orion Nebula** diffuse nebula
- M43 **part of the Orion Nebula (de Mairan's Nebula)** diffuse nebula
- M78 diffuse nebula

• *Pegasus*
- M15 globular cluster

• *Perseus*
- M34 open cluster
- M76 **The Little Dumbell, Cork, or Butterfly** planetary nebula

• *Pisces*
- M74 spiral galaxy

• *Puppis*
- M46 open cluster
- M47 open cluster
- M93 open cluster

• *Sagitta*
- M71 globular cluster

• *Sagittarius*
- M8 **The Lagoon Nebula** diffuse nebula
- M17 **The Omega** or **Swan** or **Horseshoe Nebula** diffuse nebula
- M18 open cluster
- M20 **The Trifid Nebula** diffuse nebula
- M21 open cluster
- M22 globular cluster
- M23 open cluster
- M24 **Milky Way Patch** star cloud with open cluster (NGC 6603)
- M25 open cluster
- M28 globular cluster
- M54 globular cluster
- M55 globular cluster
- M69 globular cluster
- M70 globular cluster

- M75 globular cluster
- *Scorpius*
  - M4 globular cluster
  - M6 **The Butterfly Cluster** open cluster
  - M7 **Ptolemy's Cluster** open cluster
  - M80 globular cluster
- *Scutum*
  - M11 **The Wild Duck Cluster** open cluster
  - M26 open cluster
- *Serpens Caput*
  - M5 globular cluster
- *Serpens Cauda*
  - M16 open cluster associated with the **Eagle Nebula (IC 4703)**
- *Taurus*
  - M1 **The Crab Nebula** supernova remnant
  - M45 **Subaru, the Pleiades--the Seven Sisters** open cluster
- *Triangulum*
  - M33 **The Triangulum Galaxy** (also Pinwheel) spiral galaxy
- *Ursa Major*
  - M40 Double Star **Winecke 4 (WNC 4)**
  - M81 **Bode's Galaxy (nebula)** spiral galaxy (type Sb)
  - M82 **The Cigar Galaxy** irregular galaxy
  - M97 **The Owl Nebula** planetary nebula
  - M101 **The Pinwheel Galaxy** spiral galaxy (type Sc) (M102 may be a Duplication of M101)
  - M108 spiral galaxy (type Sc(s)III)
  - M109 spiral galaxy (type SBb(rs)I)
- *Virgo*
  - M49 elliptical galaxy (type E1 or S0_1(1))
  - M58 spiral galaxy (type Sab(s)II)
  - M59 elliptical galaxy (type E5)
  - M60 elliptical galaxy (type E2 or S0_1(2))
  - M61 spiral galaxy (type Sc(s)I.2)
  - M84 elliptical or lenticular galaxy (type SB0_2/3(r)(3))
  - M86 elliptical galaxy (type E3 or S0_1(3))
  - M87 **Virgo A** elliptical galaxy (type E0), with Smoking Gun
  - M89 elliptical galaxy (type E0)
  - M90 spiral galaxy (type Sab(s)I-II)
  - M104 **The Sombrero Galaxy** spiral galaxy (type Sa+/Sb-)
- *Vulpecula*
  - M27 **The Dumbbell Nebula** planetary nebula

APPENDIX C
Modern Constellations

constellation	abbreviation	genitive	origin
Andromeda	And	Andromedae	ancient (Ptolemy)
Antlia	Ant	Antliae	1763, Lacaille
Apus	Aps	Apodis	1603, *Uranometria*, created by Keyser and de Houtman
Aquarius	Aqr	Aquarii	ancient (Ptolemy)
Aquila	Aql	Aquilae	ancient (Ptolemy)
Ara	Ara	Arae	ancient (Ptolemy)
Aries	Ari	Arietis	ancient (Ptolemy)
Auriga	Aur	Aurigae	ancient (Ptolemy)
Boötes	Boo	Boötis	ancient (Ptolemy)
Caelum	Cae	Caeli	1763, Lacaille
Camelopardalis	Cam	Camelopardalis	1624, Bartsch[2]
Cancer	Cnc	Cancri	ancient (Ptolemy)
Canes Venatici	CVn	Canum Venaticorum	1690, *Firmamentum Sobiescianum*, Hevelius
Canis Major	CMa	Canis Majoris	ancient (Ptolemy)

Canis Minor	CMi	Canis Minoris	ancient (Ptolemy)
Capricornus	Cap	Capricorni	ancient (Ptolemy)
Carina	Car	Carinae	1763, Lacaille, split from Argo Navis
Cassiopeia	Cas	Cassiopeiae	ancient (Ptolemy)
Centaurus	Cen	Centauri	ancient (Ptolemy)
Cepheus	Cep	Cephei	ancient (Ptolemy)
Cetus	Cet	Ceti	ancient (Ptolemy)
Chamaeleon	Cha	Chamaeleontis	1603, *Uranometria*, created by Keyser and de Houtman
Circinus	Cir	Circini	1763, Lacaille
Columba	Col	Columbae	1679, Royer, split from Canis Major
Coma Berenices	Com	Comae Berenices	1603, *Uranometria*, split from Leo
Corona Australis[3]	CrA	Coronae Australis	ancient (Ptolemy)
Corona Borealis	CrB	Coronae Borealis	ancient (Ptolemy)
Corvus	Crv	Corvi	ancient (Ptolemy)
Crater	Crt	Crateris	ancient (Ptolemy)
Crux	Cru	Crucis	1603, *Uranometria*, split from Centaurus

Cygnus	Cyg	Cygni	ancient (Ptolemy)
Delphinus	Del	Delphini	ancient (Ptolemy)
Dorado	Dor	Doradus	1603, *Uranometria*, created by Keyser and de Houtman
Draco	Dra	Draconis	ancient (Ptolemy)
Equuleus	Equ	Equulei	ancient (Ptolemy)
Eridanus	Eri	Eridani	ancient (Ptolemy)
Fornax	For	Fornacis	1763, Lacaille
Gemini	Gem	Geminorum	ancient (Ptolemy)
Grus	Gru	Gruis	1603, *Uranometria*, created by Keyser and de Houtman
Hercules	Her	Herculis	ancient (Ptolemy)
Horologium	Hor	Horologii	1763, Lacaille
Hydra	Hya	Hydrae	ancient (Ptolemy)
Hydrus	Hyi	Hydri	1603, *Uranometria*, created by Keyser and de Houtman
Indus	Ind	Indi	1603, *Uranometria*, created by Keyser and de Houtman
Lacerta	Lac	Lacertae	1690, *Firmamentum Sobiescianum*, Hevelius
Leo	Leo	Leonis	ancient (Ptolemy)

Leo Minor	LMi	Leonis Minoris	1690, *Firmamentum Sobiescianum*, Hevelius
Lepus	Lep	Leporis	ancient (Ptolemy)
Libra	Lib	Librae	ancient (Ptolemy)
Lupus	Lup	Lupi	ancient (Ptolemy)
Lynx	Lyn	Lyncis	1690, *Firmamentum Sobiescianum*, Hevelius
Lyra	Lyr	Lyrae	ancient (Ptolemy)
Mensa	Men	Mensae	1763, Lacaille
Microscopium	Mic	Microscopii	1763, Lacaille
Monoceros	Mon	Monocerotis	1624, Bartsch
Musca	Mus	Muscae	1603, *Uranometria*, created by Keyser and de Houtman
Norma	Nor	Normae	1763, Lacaille
Octans	Oct	Octantis	1763, Lacaille
Ophiuchus	Oph	Ophiuchi	ancient (Ptolemy)
Orion	Ori	Orionis	ancient (Ptolemy)
Pavo	Pav	Pavonis	1603, *Uranometria*, created by Keyser and de Houtman
Pegasus	Peg	Pegasi	ancient (Ptolemy)

Perseus	Per	Persei	ancient (Ptolemy)
Phoenix	Phe	Phoenicis	1603, *Uranometria*, created by Keyser and de Houtman
Pictor	Pic	Pictoris	1763, Lacaille
Pisces	Psc	Piscium	ancient (Ptolemy)
Piscis Austrinus	PsA	Piscis Austrini	ancient (Ptolemy)
Puppis	Pup	Puppis	1763, Lacaille, split from Argo Navis
Pyxis	Pyx	Pyxidis	1763, Lacaille
Reticulum	Ret	Reticuli	1763, Lacaille
Sagitta	Sge	Sagittae	ancient (Ptolemy)
Sagittarius	Sgr	Sagittarii	ancient (Ptolemy)
Scorpius	Sco	Scorpii	ancient (Ptolemy)
Sculptor	Scl	Sculptoris	1763, Lacaille
Scutum	Sct	Scuti	1690, *Firmamentum Sobiescianum*, Hevelius
Serpens[4]	Ser	Serpentis	ancient (Ptolemy)
Sextans	Sex	Sextantis	1690, *Firmamentum Sobiescianum*, Hevelius
Taurus	Tau	Tauri	ancient (Ptolemy)
Telescopium	Tel	Telescopii	1763, Lacaille

Triangulum	Tri	Trianguli	ancient (Ptolemy)
Triangulum Australe	TrA	Trianguli Australis	1603 *Uranometria*, created by Keyser and de Houtman
Tucana	Tuc	Tucanae	1603 *Uranometria*, created by Keyser and de Houtman
Ursa Major	UMa	Ursae Majoris	ancient (Ptolemy)
Ursa Minor	UMi	Ursae Minoris	ancient (Ptolemy)
Vela	Vel	Velorum	1763, Lacaille, split from Argo Navis
Virgo	Vir	Virginis	ancient (Ptolemy)
Volans	Vol	Volantis	1603, *Uranometria*, created by Keyser and de Houtman
Vulpecula	Vul	Vulpeculae	1690, *Firmamentum Sobiescianum*, Hevelius

APPENDIX D
Celestial Coordinates

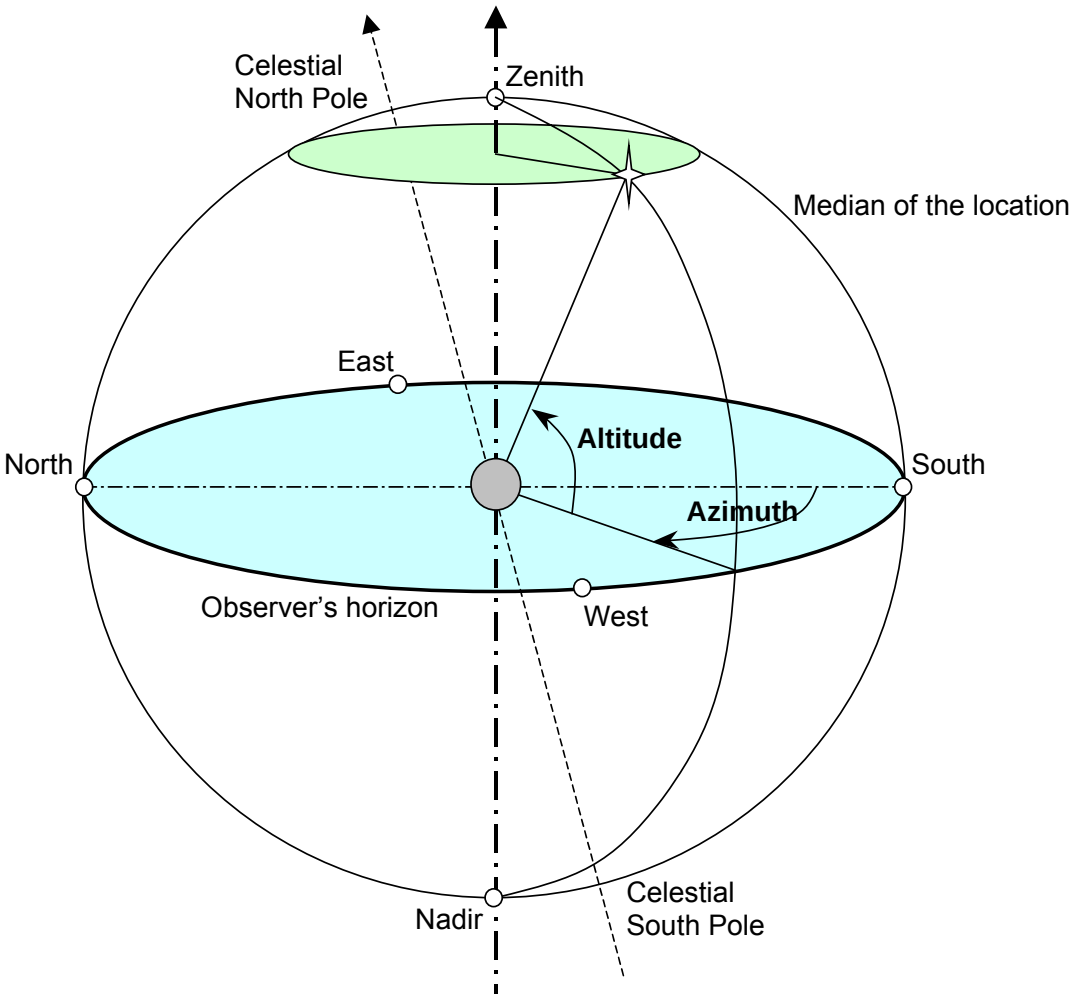


FIG.D1

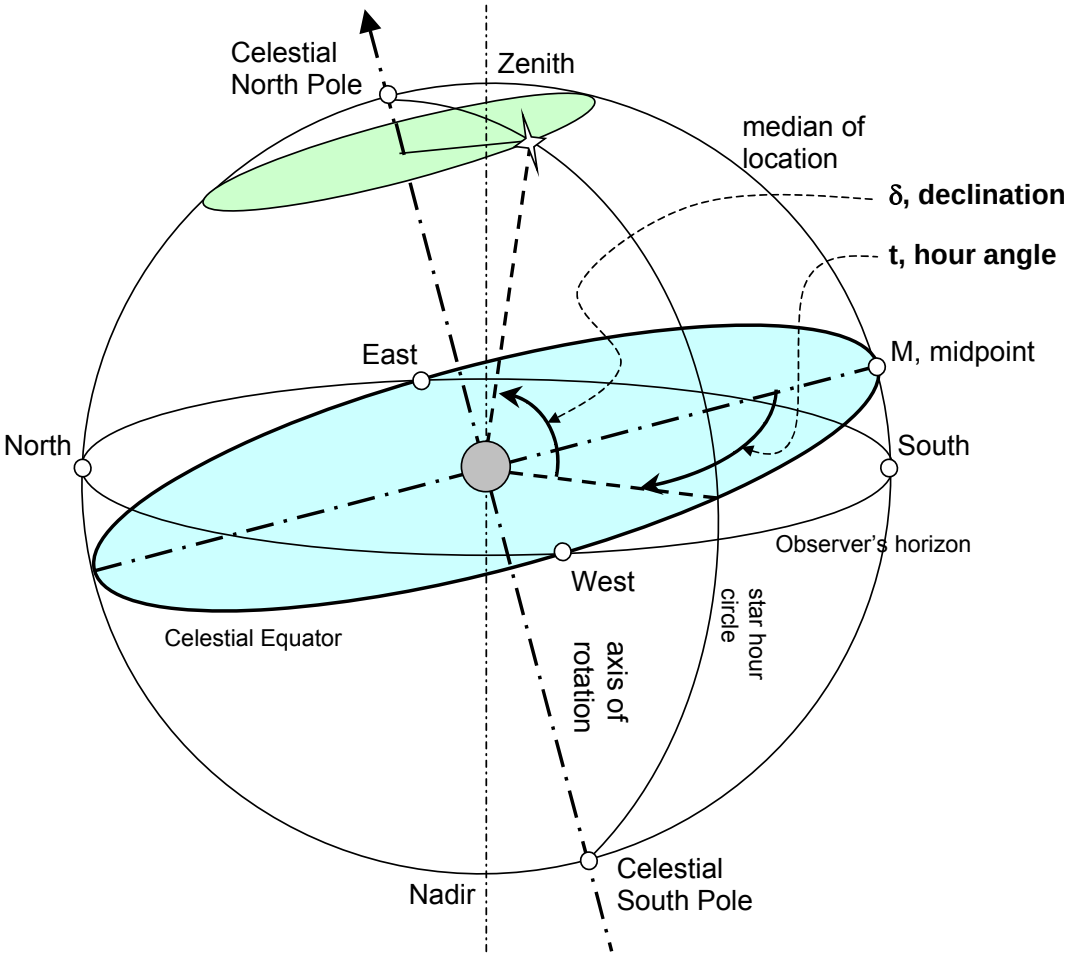

Celestial
North Pole
Zenith
median of
location
δ, declination
t, hour angle
East
M, midpoint
North
South
Observer's horizon
West
Celestial Equator
star hour
circle
axis of
rotation
Nadir
Celestial
South Pole

FIG.D2

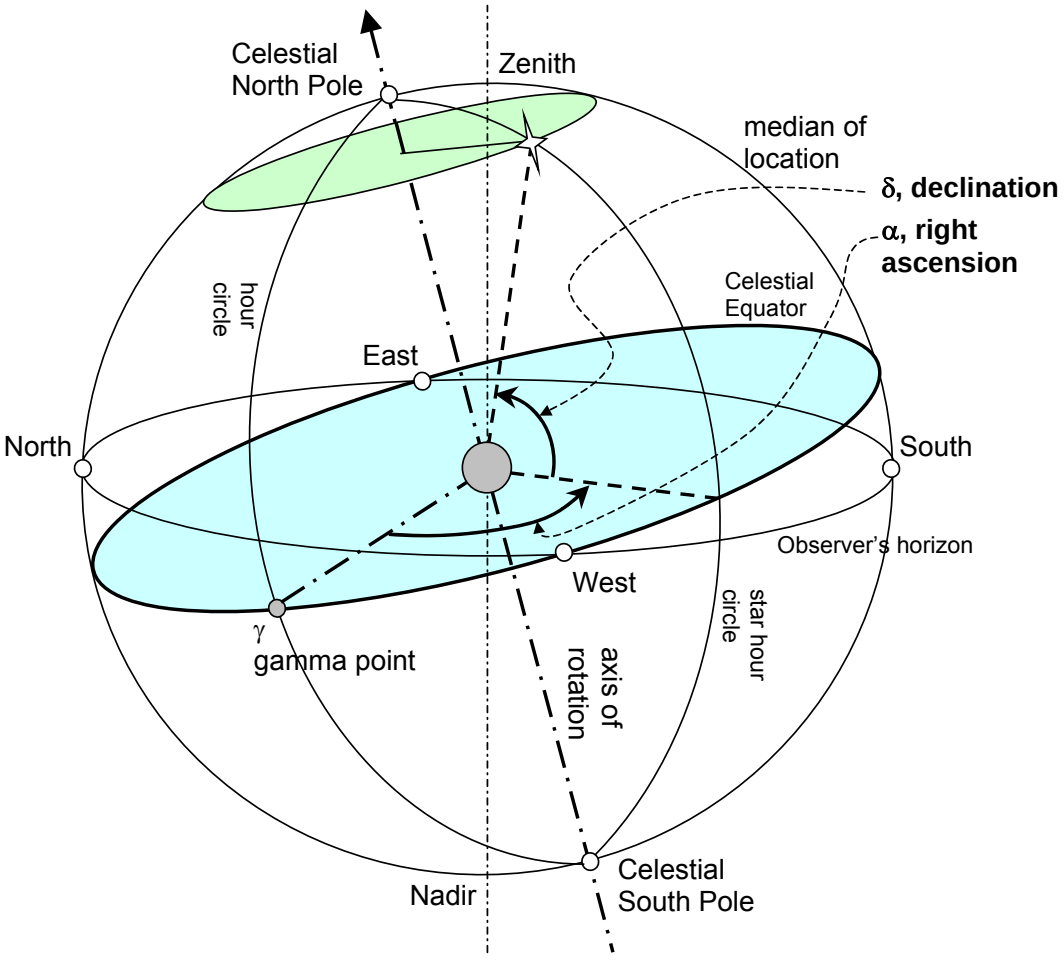

Celestial
North Pole
Zenith
median of
location
δ, declination
α, right
ascension
hour
circle
Celestial
Equator
East
North
South
Observer's horizon
West
γ
gamma point
axis of
rotation
star hour
circle
Nadir
Celestial
South Pole

FIG. D3

TIP:
Celestial sphere is an imaginary sphere of infinite radius.

To understand the celestial coordinate systems there are several concepts that should be clarified.

The **Celestial sphere** is an imaginary sphere of infinite radius concentric with the earth on which all celestial bodies are assumed to be projected. **Celestial coordinates** are used to define a point on the celestial sphere. A **great circle**, a.k.a., orthodrome, is the intersection of a sphere and a plane through its center. For the celestial sphere, a great circle is the intersection of a plane through the observer (on the earth) and the celestial sphere. **Celestial pole** is either of the two points of intersection of the celestial sphere and the extended axis of the earth. There are two celestial poles--the **north celestial pole** and the **south celestial pole**. The **Zenith** is the point of the celestial sphere vertically overhead. The **Nadir** is the point on the celestial sphere vertically below the observer, or 180 degrees from the zenith. A **horizon** is a great circle on the celestial sphere midway between the zenith and nadir. **Celestial meridian** is a great circle of the celestial sphere through the celestial poles and the zenith. **Celestial equator** is the intersection of the extended plane of the equator and the celestial sphere. It is the primary great circle of the celestial sphere in the equatorial system, everywhere 90-degree from the celestial poles.

We will talk about two different kinds of celestial coordinate systems. One is the **altazimuth** system. And the other is the **equatorial** system. The major difference between them is the referencing great circle. In **altazimuth** it is the celestial horizon, while in **equatorial** it is the celestial equator.

NOTE:
You need two numbers to define a position on the celestial sphere.

To define a position on the celestial sphere, we need two angles. In the **altazimuth** system (FIG. D1) these two angles are **altitude (A)** and **azimuth (Z).** Imagine a vertical plane perpendicular to the observer's horizon that passes through the observer and the star. The intersection of the vertical plane and the observer's plane of horizon defines the **azimuth**. It is measured from the south (or the north) to the intersection (in the direction of motion of the star, in degrees, 0°~360°). In GoToNova™ azimuth is measured from the north. On the vertical plane, **altitude** is measured from the intersection to the direction of the star (also in degrees, -90°~90°).

In the **equatorial** system (FIG. D2 and D3), **hour angle (t)** is measured on the equator from the point of intersection of the celestial equator and the local meridian in the direction of motion of the star. The value of hour angle is measured in hours, minutes and seconds instead of degrees.

TIP:
Don't be intimidated by the geometry. Hands-on experience will help you understand the concepts better.

Since the celestial sphere completes a full rotation in 24 hours, it follows that: 24 h = 360°, 1 h = 15°, 1 min = 15', and 1 sec = 15". The **declination (δ, DEC, or D)** is measured along the hour circle (perpendicular to the equator, passing through the celestial poles) passing through the star from the point it intersects the equator, it is in degrees. The **right ascension (α, RA or R)** is measured on the equator from the **gamma point** in the direction opposite to the direction of the motion of the star. It is in hours, minutes and seconds. Gamma point is the intersection of the hour circle and the celestial equator.

Appendix E
SPECIFICATIONS

GoToNova™ 8401 Specifications

LCD Display……8-line
Alignment……Altazimuth/Equatorial
GPS……Compatible
CPU……32 bit
USB Port……Yes
RS232 Port……Yes
Slewing Speeds……9-Speed (1x, 2x, 8x, 16x, 64x, 128x, 256x, 512x, MAX)
GoToNova™ Version……8401
Objects in database……130,000+

Appendix F
Products List

Item #	Product	Product Description	Components
SmartStar™-E Series			
#8500	SmartStar™-E GOTO	Mount AltAzi Mount,	#1403, #1501
#8502	SmartStar™-E-R80	Automatic Refractor GOTO Telescope	#8500, #8701
#8503	SmartStar™-E-N114	Automatic Newtonian GOTO Telescope	#8500, #8732
#8504	SmartStar™-E-MC90	Automatic Maksutov GOTO Telescope	#8500, #8740
#8501	1"Stainless Steel Tripod	For SmartStar™-E 26	.
SmartStar™-A Series			
#8600	SmartStar™-A	Fully Automatic AltAzi/EQ GOTO Mount with GPS	#8411, #8402, #8601
#8602	SmartStar™-A-R80	Fully Automatic Refractor GOTO Telescope	#8600, #8701
#8603	SmartStar™-A-N114	Fully Automatic Newtonian GOTO Telescope	#8600, #8734
#8604	SmartStar™-A-MC90	Fully Automatic Maksutov-Cassegrain GOTO Telescope	#8600, #8740
#8605	SmartStar™-A-MC100	Fully Automatic Maksutov-Cassegrain GOTO Telescope	#8600, #8741
#8601		1" AltAzi/EQ Stainless Steel Tripod For SmartStar™-A	
#8606	1.5kg Counter Weight		.
#8419	SmartStar™-PR	GOTO Equatorial Mount	#8400, #8413, #8414
#8400	GOTONova™ Dual-Axis Motor Kit	For EQ、CG5、GPD、LX75 Mounts	#8401 Dual-Axis Motor
GOTONova™ Controllers			
#8401	GOTONova™ Controller	AltAzi/EQ Controller with 130,000 objects in database	
#8402	GOTONova™ Controller	AltAzi/EQ Controller with 50,000 objects in database	
#8403	GOTONova™ Controller	AltAzi/EQ Controller with 5,000 objects in database (for SmartStar™-E)	
Accessories			
#8411	GPS Module	Compatible with all GOTONova™ Models	
#8412	Electronic Focuser Module		
#8413	2" Stainless Steel tripod	For EQ、CG5、GPD、LX75 Mounts	
#8414	EQ5 Equatorial Mount		
#8415	Controller Cable	Compatible with all GOTONova™ Models	
#8416	USB Cable	For #8401, #8402 Controllers	
#8417	AC Adaptor	Compatible with all GOTONova™ Models	
#8418	12V Car Recharger and Cable		

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 Authorization Number must be obtained from iOptron in advance of return. Call iOptron at 1.866.399.4587 to receive the 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 prepay such costs.

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

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

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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
6X Gill Street
Woburn, MA 01801
www.ioptron.com
Tel. (866)399-4597
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 service.