# MANUAL

## SMARTSTAR™-G SERIES

## REFRACTOR, NEWTONIAN AND MAKSUTOV-CASSEGRAIN TELESCOPES

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.***

# CONTENTS

**TIP:**
***Learn some astronomy basics***

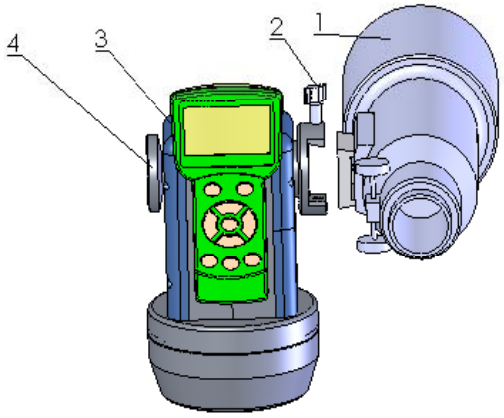
For beginner users without a lot of knowledge in astronomy please refer to the Quick Start Menu. It contains enough information to get you started so you can enjoy the night sky without knowing all the jargon and math.

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 Assembly

**NOTE:**
***Make sure that your telescope is not too heavy for your mount***




1. Telescope tube
2. Dovetail lock
3. Hand held controller
4. Altitude lock

FIG. 1

1. Unpack the package, take out all the parts.
2. Set up the tripod(6).
3. Put the mount(5) on the top of tripod(6), hold the mount with one hand, put the supporting rod(7) through the hole on the top of tripod with the other hand, screw and tighten the mount on the top of tripod(6).
4. Tighten the telescope tube(1) on the dovetail with lock (2), point the tube upward vertically and tighten the altitude lock (4).

**TIP:**
***Alt-Az mode is easier to set up, and easier to operate. Adjust the tripod and the mount, check the bubble on the mount, make sure it is horizontal.***

**NOTE:**
***A-series can also work in equatorial mode***

**TIP:**
***If you are not using the AC adaptor, you need eight AA batteries.***


5. Mount
6. Tripod
7. Inner support
8. Tray
9. Tray lock

FIG.2

5. Fit the tray (8) to the lower end of the rod (7), also fit the three indents to the three legs of tripod, tighten the tray lock (9). To avoid any damage to the tray or tripod, please do not use excessive strength.
6. Open the cover of battery box on the side of the mount (below dovetail), install 8 AA batteries (not included) appropriately. If you are using 12V AC adapter, plug the connector to the socket on the other side of the mount (below altitude lock). Connect hand controller(3) and mount(5) with retractable cable (provided). You can pick any one of the two sockets below altitude lock to plug in.
7. Always adjust the tripod to center the bubble in the circle on the mount. It is important that the tripod stay horizontal.

**0.2 GoToNova™ Features: (8402)**


FIG.3

The 8402 GoToNova™ hand held controller controls SmartStar™ G series telescopes. Its user interface is simple and easy-to-learn, it can automatically move to any of the 50,000 objects stored in the database with the push of a button.

**LCD Display:** 8-line big screen, it displays all the information
**Back Key:** Moves back to the previous screen.
**Menu Key:** Gets 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, adjusts numerical values, moves the telescope in a specific direction.
**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/

**0.3 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], you need to level the mount. This is done by centering the bubble in the circle on the mount. 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:

| | | |
|---|---|---|
| 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) on 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.

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" 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. Now your GoToNova™ is ready to

**TIP:**
***GPS module makes life a lot easier, it automatically sets the time and location for you.***

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

**TIP:**
***Spend some time familiarizing yourself with these bright stars in the night sky***

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.

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<br>A 39° 43.3′ Z 221° 20.0′<br>Center the target then<br>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.

**2.3 Comets**
Contains up to 256 comets.

**2.4 Asteroids**
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 SAO Bright Stars**
Contains up to 26,584 SAO bright stars.

**2.6 Constellations**

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

**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.***

**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.***

**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 you 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.

# Chapter. 4 How to Observe

## 4.1 Land Objects

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

If you don't want to turn on power and use hand controller, then 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 the hand controller to observe land objects. Turn on the power and from the main menu choose "Land Objects". If you already have land marks saved in your system and you want to go to one of those land marks (this is assuming that the tripod is not moved since you recorded those land marks), select "GoTo Land Mark" and pick the land mark you want to observe. If you want to record new land marks, select "Record New Land Mark", on the next screen, use "SPEED" button to choose an appropriate speed, then use arrow keys to move your telescope to your target. When the target is centered, press "ENTER", then give it a name(with "UP" and "DOWN" arrows you can input alphabets, with "LEFT" and "RIGHT" to move the cursor). Push "ENTER" to confirm you input. Next time, you can go to this land mark by selecting its name in the list under "GoTo Land Mark" menu.

If you use "Land" mode to observe celestial objects in the night sky, 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™.

**TIP:**
***The earth's axis of rotation is tipped over about 23.5° from the vertical.***

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

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

## 4.2 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 ENTER button to switch between "Land" and "Cele" mode (upper right corner). Use 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.

**TIP:**
***Use slower speed for fine tuning.***

| | | |
|---|---|---|
| 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 |

**TIP:**
***A Full Moon is not the best time to watch the Moon.***

**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. You can even use the Moon to align your telescope.

There are a lot to explore on the surface of the Moon, such as craters, mountain ranges and fault lines, etc. During full Moon, however, no shadows are seen on the Moon surface and it becomes too bright for the 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 image.

**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 setup tracking in the main menu by selecting “Set up tracking”. Then user can select “sidereal speed”, “Solar speed”, “Lunar speed”, or user can define a speed using “User defined speed”.

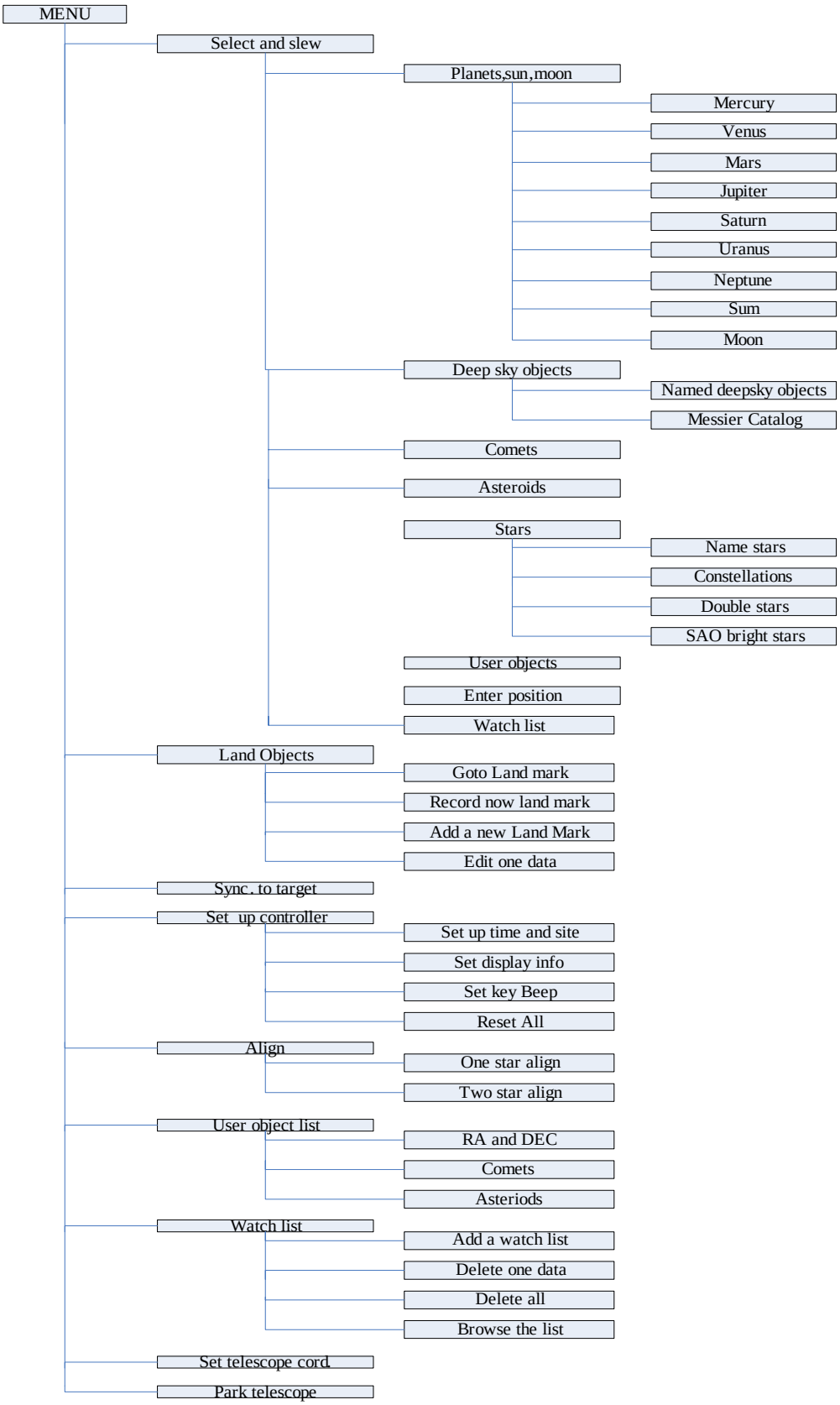
**4.5 The First Night**

With the convenience of SmartStar™, star hunting is made much easier. But this does not mean that you don’t need to do any homework before you actually spend the night watching the night sky, especially if you have never tried this before.

You should play with SmartStar™ and familiarize yourself with the components and functions during day time, check the altitude and latitude of your location (where you are going to use the SmartStar™ at night).

Spend sometime to study the current night sky, know what to expect when you are out there. It will be extremely helpful if you are able to identify some of the bright stars in the night sky.

# 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

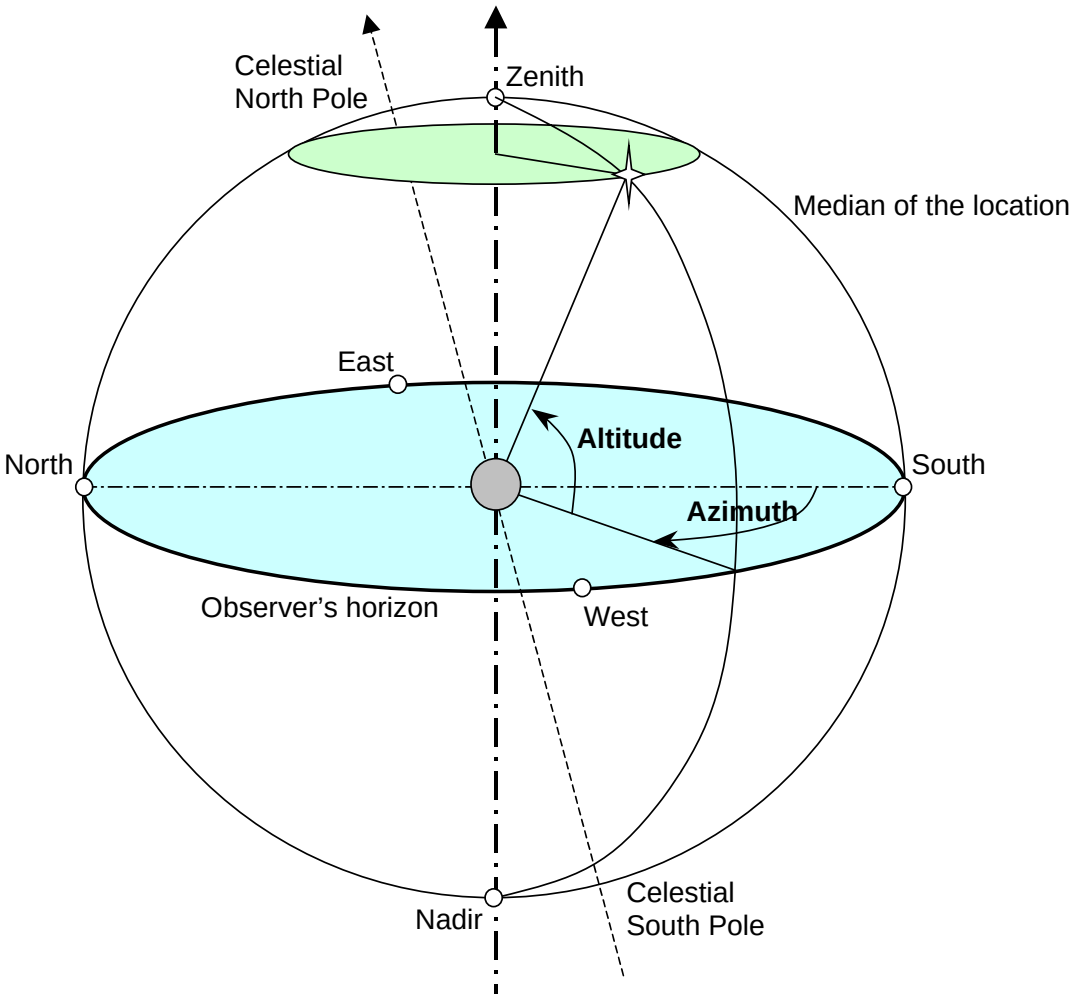



FIG.D1

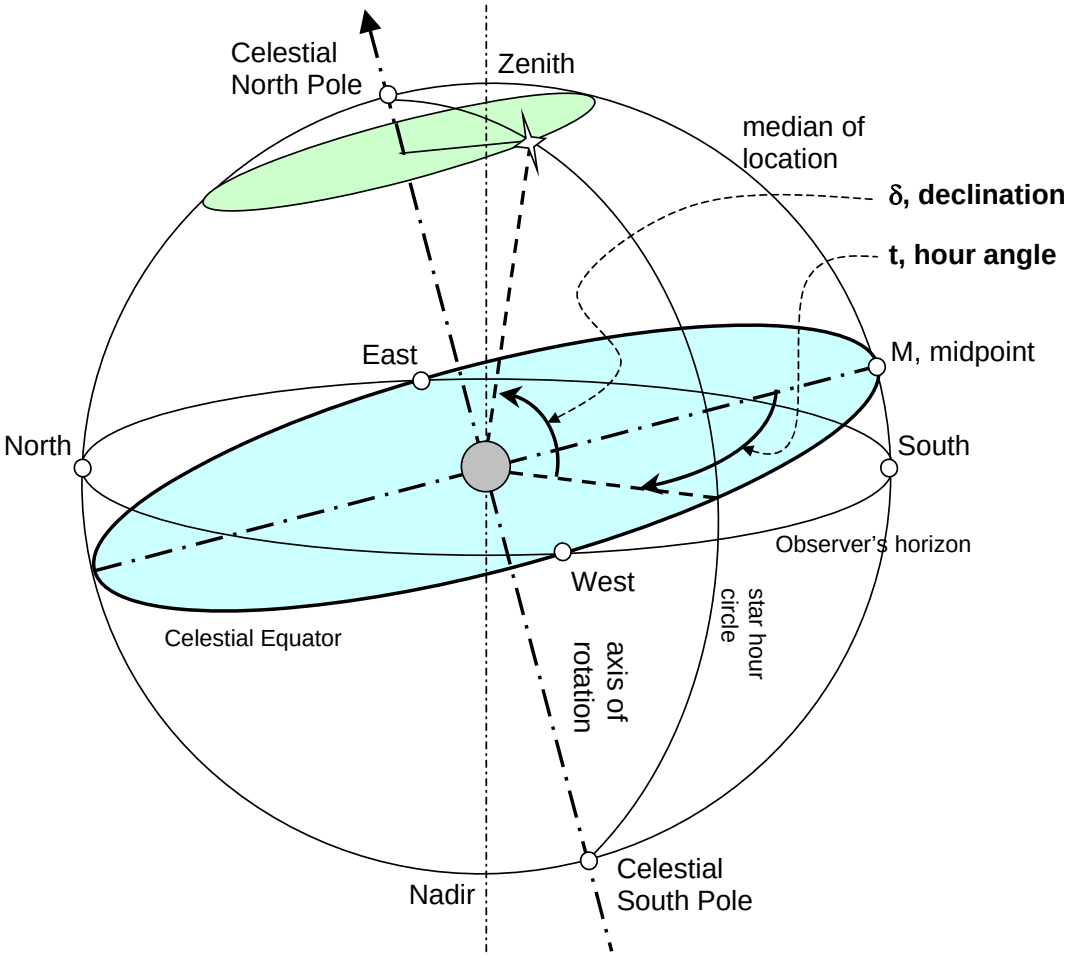



FIG.D2

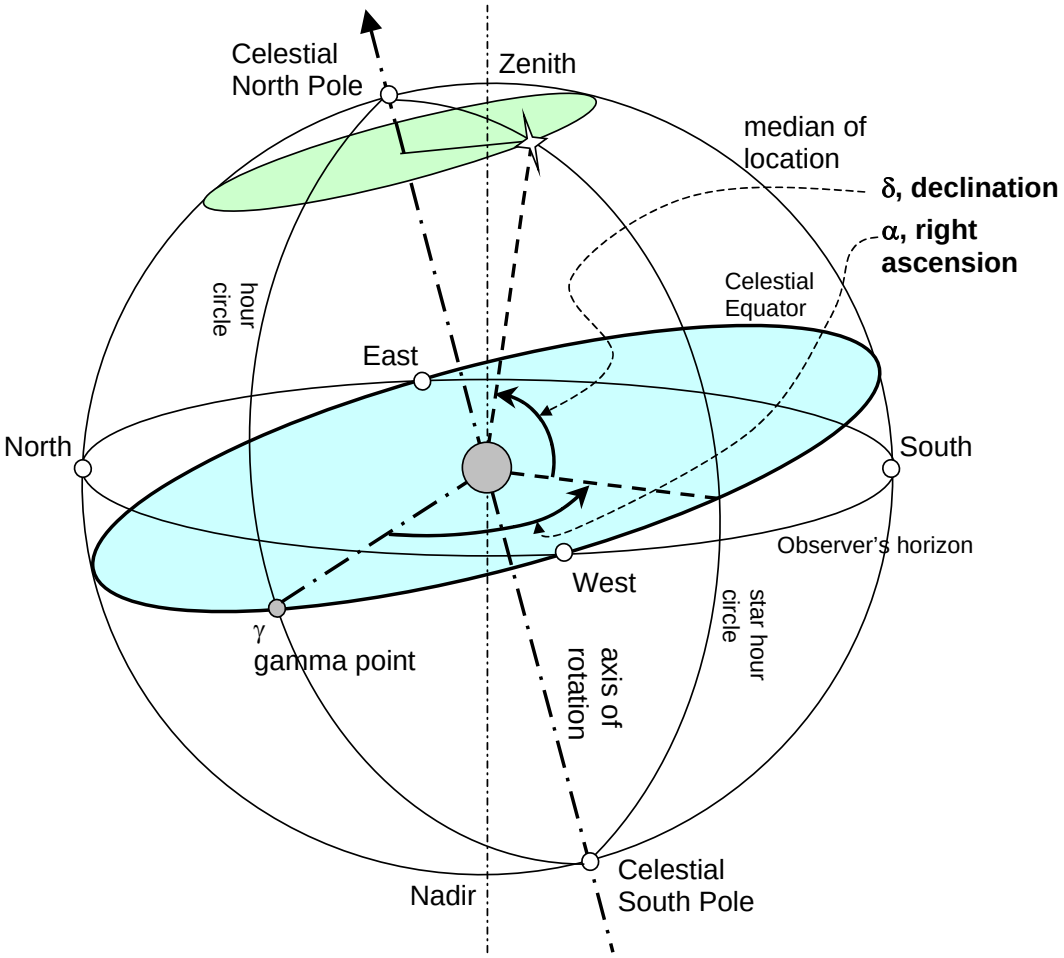



FIG. D3

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.

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

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.

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°).

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

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

**A-Series Specifications**

LCD Display……8-line
Mount……The Cube
Alignment……Altazimuth/Equatorial
GPS……32-channel GPS included
CPU……32 bit
USB Port……Yes
RS232 Port……Yes
Slewing Speeds……9-Speed (1x, 2x, 8x, 16x, 64x, 128x, 256x, 512x, MAX)
Tripod……Stainless Steel(6.0 lbs)
Batteries(User-Supplied)……8 x AA
GoToNova™ Version……8402
Objects in database……50000+
Weight……4.0lbs

**A-R80**

Optical Design……Refractor
Clear Aperture……80mm
Focal Length……400mm
Focal Ratio……f/5
Resolving Power……1.4 arc secs
Finder……5x24
Weight……2.2lbs

**A-N114**

Optical Design……Reflector
Clear Aperture……114mm
Focal Length……1000mm
Focal Ratio……f/8.8
Resolving Power……1 arc secs
Finder……Red dot
Weight……6lbs

**A-MC90**

Optical Design……Maksutov-Cassegrain
Clear Aperture……90mm
Focal Length……1200mm
Focal Ratio……f/13.3
Resolving Power……1.3 arc secs
Finder……red dot
Weight……4.4lbs

**A-MC100**

Optical Design……Maksutov-Cassegrain
Clear Aperture……109mm
Focal Length……1400mm
Focal Ratio……f/14
Resolving Power……1.2 arc secs
Finder……red dot
Weight……4.5lbs

# 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 | | |

## Appendix G
## Alignment Stars

# Stars for Alignment (iOptron SmartStar, GoToNova)

www.iOptron.com

| StarName | Constellation | RA | DEC | Additional Information |
|---|---|---|---|---|
| Achernar | Eri | 1.6285685 | -57.2367575 | TYC 8478-1395-1 PPM 331199 SAO 232481 HD 10144 CPD -57 00334 |
| Acrux | Cru | 12.443056 | -63.098611 | TYC 8979-3464-1 PPM 359410 SAO 251904 HD 108248 CPD -62 02745 |
| Al Na'ir | Gru | 22.136944 | -46.960833 | TYC 8438-1959-1 PPM 327928 SAO 230992 HD 209952 CPD -47 09830 |
| Albireo | Cyg | 19.511944 | 27.959167 | TYC 2133-2964-1 PPM 109139 SAO 87301 HD 183912 BD +27 3410 |
| Aldebaran | Tau | 4.598611 | 16.508889 | TYC 1266-1416-1 PPM 120061 SAO 94027 HD 29139 BD +16 0629 |
| Alphard | Hya | 9.459790 | -8.658602 | TYC 5460-1592-1 PPM 192393 SAO 136871 HD 81797 BD -8 2680 |
| Alphecca | CoB | 15.578056 | 26.714444 | TYC 2029-1690-1 PPM 104146 SAO 83893 HD 139006 BD +27 2512 |
| Alpheratz | And | 0.139444 | 29.090278 | TYC 1735-3180-1 PPM 89441 SAO 73765 HD 358 BD +28 0004 |
| Altair | Aql | 19.846111 | 8.868333 | TYC 1058-3399-1 PPM 168779 SAO 125122 HD 187642 BD +8 4236 |
| Antares | Sco | 16.489722 | -26.431667 | TYC 6803-2158-1 PPM 265579 SAO 184415 HD 148478 CD -26 11359 CPD -26 05648 |
| Arcturus | Boo | 14.260833 | 19.182222 | TYC 1472-1436-1 PPM 130442 SAO 100944 HD 124897 BD +19 2777 |
| Betelgeuse | Ori | 5.919519 | 7.406944 | TYC 129-1873-1 PPM 149643 SAO 113271 HD 39801 BD +7 1055 |
| Canopus | Car | 6.399167 | -52.695556 | TYC 8534-2277-1 PPM 335149 SAO 234480 HD 45348 CPD -52 00914 |
| Capella | Aur | 5.277778 | 45.997500 | TYC 3358-3141-1 SAO 40186 HD 34029 BD +45 1077 |
| Deneb | Cyg | 20.690000 | 45.280000 | TYC 3574-3347-1 PPM 60323 SAO 49941 HD 197345 BD +44 3541 |
| Denebola | Leo | 11.817500 | 14.571667 | TYC 870-988-1 PPM 128576 SAO 99809 HD 102647 BD +15 2383 |
| Deneb Kaitos | Cet | 0.726111 | -17.986389 | TYC 5847-2333-1 PPM 209214 SAO 147420 HD 4128 BD -18 0115 |
| Dubhe | UMa | 11.061667 | 61.750556 | TYC 4146-1274-1 PPM 17705 SAO 15384 HD 95689 BD +62 1161 |
| Fomalhaut | PsA | 22.960833 | -29.622222 | TYC 6977-1267-1 PPM 274426 SAO 191524 HD 216956 CD -30 19370 CPD -30 06685 |
| Hamal | Ari | 2.119444 | 23.462222 | TYC 1758-2416-1 PPM 91373 SAO 75151 HD 12929 BD +22 0306 |
| Markab | Peg | 23.078889 | 15.205000 | TYC 1711-2475-1 PPM 142158 SAO 108378 HD 218045 BD +14 4926 |
| Mirfak | Per | 3.405000 | 49.861111 | TYC 3320-2808-1 PPM 46127 SAO 38787 HD 20902 BD +49 0917 |
| Mizar | UMa | 13.398333 | 54.925278 | TYC 3850-1385-1 PPM 34007 SAO 28737 HD 116656 BD +55 1598 |
| Nunki | Sgr | 18.920833 | -26.296667 | TYC 6868-1829-1 PPM 269078 SAO 187448 HD 175191 CD -26 13595 CPD -26 06590 |
| Pollux | Gem | 7.754722 | 28.025833 | TYC 1920-2194-1 PPM 97924 SAO 79666 HD 62509 BD +28 1463 |
| Procyon | CMa | 7.655000 | 5.224444 | TYC 187-2184-1 SAO 115756 HD 61421 BD +5 1739 |
| Rasalhague | Oph | 17.581944 | 12.560000 | TYC 1000-2508-1 PPM 133563 SAO 102932 HD 159561 BD +12 3252 |
| Regulus | Leo | 10.139444 | 11.967222 | TYC 833-1381-1 PPM 127140 SAO 98967 HD 87901 BD +12 2149 |
| Rigel | Ori | 5.241944 | -8.201389 | TYC 5331-1752-1 PPM 187839 SAO 131907 HD 34085 BD -8 1063 |
| Rigel Kentaurus | Cen | 14.660138 | -60.833958 | TYC 9007-5849-1 SAO 252838 HD 128620 CPD -60 05483 |
| Schedar | Cas | 0.675000 | 56.536944 | TYC 3663-2668-1 PPM 25578 SAO 21609 HD 3712 BD +55 0139 |
| Sirius | CMa | 6.752222 | -16.716111 | YC 5949-2777-1 SAO 151881 HD 48915 BD -16 1591 |
| Spica | Vir | 13.419722 | -11.161111 | TYC 5547-1518-1 PPM 227262 SAO 157923 HD 116658 BD -10 3672 |
| Suhail | Vel | 9.133056 | -43.432222 | TYC 7689-2617-1 PPM 313999 SAO 220878 HD 78647 CD -42 04990 CPD -42 03366 |
| Vega | Lyr | 18.615556 | 38.783611 | YC 3105-2070-1 SAO 67174 HD 172167 BD +38 3238 |

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

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

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

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Customer Service Department
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Woburn, MA 01801
www.ioptron.com
Tel. (866)399-4597
Fax. (781)935-2860
Monday-Friday 9AM-5PM EST

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