

# **ETX-Autostar Field Guide Book**

**By Ringo Li**

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## **Table of Contents**

### **The Goal: Consistency, astronomy without frustration.**

#### **What Gives You Consistency?**

- What affects the ETX-Autostar Observation System?
- How precise can the ETX-Autostar Observation System be?
- The Goal

#### **The ETX-Autostar Observation System**

- The Meade ETX-xxxEC telescope
- The Meade Autostar
- The Tripod

#### **Tools of the Trade**

- The Flash Light
- Levels

#### **Precision Time Source**

- Why is the exact time important?

#### **Setting Up the telescope**

- Viewfinder and the Telescope
- Straight-through or Right-angle Viewfinder
- Focusing the viewfinder
- The Viewfinder Mounting Problem
- The Elastic Viewfinder Alignment Tool (EVAT)
- Aligning the Viewfinder Step-by-step
- Setting up the DEC dial
- Leveling the Fork Arm in the Polar alignment position.
- The Telescope HOME positions
  - Polar Position
  - Alt/Az Position
- Setup Polar Home Position
- Setup Alt/Az Home Position

#### **The Tripod**

- A Good Tripod
- Adjustments on a #883 Tripod
- How to setup and level a Tripod
- Setting Up the Latitude of Your Location on the Tripod

#### **Gathering Information**

- Exact Location
- Getting the Precise Time
- Synchronize the Autostar Time with Precise Date/Time
- What is Your Time Zone?
- Magnetic Declination

#### **Setting Up the Autostar**

- The Autostar Keys Basics
- User-entered Information in the Autostar
- Change/Edit Site Information:
- Setting the Basic The Autostar Telescope Parameters
- Fine-tuning the Autostar
  - Motor Calibration
  - Train Drive
  - The Az/RA and Alt/DEC Percentage Settings

## **Telescope/The Autostar Mechanical Electronic Troubleshooting**

### **North**

- Where is North?
- Which North Do You Use?
- Polaris, the Pole Star, the North Star
- North Celestial Pole
- North Alignment
- Using a Compass
- Using the Compass to Find North on the Telescope.
- North Celestial Pole
- Where is North Celestial Pole?
- Where is Kochab?
- NCP Offset and Viewfinders
  - Straight Through Viewfinder (8 x 21 mm)
  - Offset with a Right-angle Viewfinder (8 x 25 mm)
  - Other Viewfinders
- Offset Polaris to North Celestial Pole
- What if I don't have a Right-angle Viewfinder?
- Tips for Eyepiece NCP Offset

### **Star Alignment**

- Why the Autostar Requires Star Alignment
- Which Star Alignment - Easy, One Star or Two Star
- Polar Alignment or Alt/Az Alignment
- Star Alignment Overview
- Rule of Thumb on the Alignment Star:
- Star Alignment Checklist
  - Telescope/Tripod/Mount Checklist
  - The Autostar Checklist
- Step-by-step Autostar Easy alignment
- Troubleshooting

### **Parking the Telescope**

### **Putting the Telescope to Sleep**

### **Star Gazing**

### **Telescope Eyepieces Magnification/Field of View Chart**

### **The ETX-Autostar PC Observation System**

### **Winstars Planetarium/Telescope Control software**

### **Connecting the Autostar to the computer**

### **Tips**

### **The ETX-Autostar PDA Observation System**

## The Meade ETX-Autostar Telescope Field Guide

### The Goal: Consistency, Astronomy without Frustration.

I bought a Celestron telescope in 1982 around the time that Comet Haley flew close enough for us to see it in the night sky. It was a telescope with a 3" refracting lens. I used it to view Comet Haley, the Moon, and even the planets Saturn and Jupiter. I became fascinated, so I bought several books on astronomy. Eventually, my interest died down for several reasons. One of which was the telescope. It was a very poorly made telescope. There was free-play everywhere and accuracy was not precise. Additionally, the telescope's instructions were badly written and unhelpful. I was lucky just to get the viewfinder aligned with the telescope. Using the telescope caused so much frustration that it was no longer worth the trouble to use. Before long, the telescope was put in the corner to collect dust.

I have always wanted an ETX-90 ever since it was released into the market. After reading about it magazines for years, the ETX-90EC came out with the Autostar. I thought, "Wow! That is NICE!" The price was a little high, so I didn't buy one right away. I waited for a few years to see if the price would drop. The price remained the same, mostly, but its quality improved. Then last year, the price finally did drop and I bought an ETX-90EC.

I bought the telescope, the tripod, hard-case and some other accessories, totaling almost a thousand dollars. I was excited. Unfortunately, much like my first telescope, the instructions included with it (and its accessories) were poor. As such, I had trouble getting it to function as advertised. To make matters worse, there was no one to ask for support. Needless to say, frustration overcame my initial excitement.

But I persisted. I had spent too much money on the equipment to simply give up. I decided to go online to search for some help. Eventually, I found just about everything that I needed. With the new information, I figured out how to make everything work and developed an entire system that is precise, consistent, and easy to use.

I have organized and compiled all of the information that I have gathered from the Internet in addition to my hard learning experience to achieve the goal: Consistent astronomy without frustration. That is what this book is all about. With this book, you'll be just a few minutes away from star glazing

This guide is not meant to replace the official Meade manuals that are originally included with the telescope, the Autostar, and tripod. As brief and unorganized as those original manuals are, they still serve as a good reference. This guide is to supplement those manuals in the areas that are only briefly mentioned or are not integrated with each other.

Even though this book was written initially for the ETX/Autostar (#497) telescopes, most of the information here applies to all Meade Autostar-controlled telescopes. For example, the precision principle applies to all telescopes, not just those made by Meade. The DS-xxxEC series of telescopes operate only in the Alt/Az mode; the Polar alignment portion will not apply, otherwise the DS-xxxEC telescope will operate precisely in all GOTO commands using my setup/alignment procedures.

### My Observation System:

Other than the ETX-90EC, I later bought a ETX-125EC and a DS-60EC. The DS-60EC was for my son. The plan was to sell the ETX-90EC after I finished with this book and keep the ETX-125EC.

DS-60EC with #494 Autostar

ETX-90EC with #497 Autostar, electric focuser

ETX-125EC with #497 Autostar, right-angle viewfinder

Eyepieces: 40 mm, 26 mm, 18 mm, 9.8 mm, 2X Barlow

### **What Gives You Consistency?**

There will be no consistency without precision steps. All of the stars are many light-years away. Therefore, a small error here, a little inaccuracy there, and things start to add up to create significant problems. If setup properly, the ETX/Autostar telescope is amazingly precise even at such a low cost.

There are no overall instructions for the beginner. There is a manual for the telescope on how to use the telescope. There is also the manual on how to setup the Autostar. There may be a manual for the tripod. These manuals are not integrated. They deal with each piece of equipment individually without any integration between them. It is important that each piece work with the other pieces.

### **What Affects the ETX-Autostar Observation System?**

The perfect result of a process is the precise completion of all of the steps that lead to the result. The more precise each step is, the more precise the end result will be. Every little error introduced at each step of the process results in larger error at the end. A precision result can only be achieved if all of the steps are completed with precision.

For example, entering the exact Altitude and Longitude of your house instead of choosing the closest city in the Autostar would introduce less error. The closest city could be many miles away. Entering the exact time read from an atomic clock instead of the time from the microwave oven would introduce less error. The time on the microwave oven might be inaccurate. A tripod that is not perfectly level would cause the Azimuth movement (horizontal turning) to not be fully horizontal. This inaccuracy could also cause the Altitude movement (vertical) to not be plumb. Your alignment therefore would not be precise. The Autostar also compensates for a degree of free-play on the motor and drive gear system. There are settings for the degree of telescope drive system free-play. These settings must be precise as well.

### **How Precise Can the ETX-Autostar Observation System Be?**

The Autostar is designed to compensate for a lot of user errors. However, your time, location, and alignment should as close to exact as possible, otherwise it may affect GOTO accuracy.. The field of view of a 26 mm eyepiece on the ETX-90 is about one degree. The straight viewfinder 8 x 21 mm has a field of view of 6.8° straight or 6.4° for the right-angle viewfinder. It is possible to have the star appear in the eyepiece 90% of time on GOTOs with a precisely completed setup. For a less precise setup, the star may not appear in the viewfinder. It might appear just outside the viewfinder's view.

### **The Goal**

My experience is that, with a proper and precise setup and alignment, you can expect better than 80% of your GOTO targets will appear (not necessarily centered) in the 26mm eyepiece of the ETX-90EC. All target stars will appear in the viewfinder. A somewhat less precision alignment, will have all the target stars appear in the viewfinder but not necessarily in the eyepiece. If you follow the instructions here, you will get good GOTO accuracy and night-after-night consistency.

The instructions here will show you the step-by-step process on how to obtain precise results. This field guide is designed to show you all of the essentials on how to use the Meade ETX/Autostar Observation System without going into a lot of boring theory. This guide is practical in that if you follow the instructions, you will get the desired results.

It is assumed that you have a Meade ETX-xxxEC series or a DS-xxxEC telescope with a #495/497 Autostar. #494 Autostars do not have numeric keys but the operation is the same as a #496/497 Autostar.

## The ETX-Autostar Observation System

The ETX-Autostar Observation System consists of the ETX telescope, the Autostar, and a tripod. The manner in which you set these three components up determines how precise and consistent your observation will be. We must look at the ETX telescope, the Autostar, and the tripod as an integrated system.

Note: ETX refers to all Meade ETX series telescopes including 60EC, 70EC, 90EC, 105EC and 125EC telescopes. The Autostar refers to Meade #497 Autostar; most of the features here also apply to the Meade #494/495 Autostars.

### The Meade ETX-xxxEC telescope

The ETX-xxxEC telescopes are compact and powerful with superb optics. On its own, it is a very high-quality telescope. The real wonder is the computer electronics and motor drive system that comes with the telescope. You can control the ETX-90EC with an external hand-held computer, the Autostar. The ETX-xxEC telescopes are amazingly accurate at an affordable price.

### The Meade Autostar

The Autostar is the brain of the computer-controlled telescope. The Autostar stores the location of stars in a database. The Autostar also stores the basic location information of your telescope. Controlling the telescope comes entirely from the Autostar. It provides many other functions and utilities to help users. The Autostar performs the two most important functions:

- 1) Find the star you want to view.
- 2) Track the star that you are viewing.

Let's take a look at the two best functions of the Autostar finding and tracking stars.

#### Finding a Star:

The Autostar stores the stars' information in a database. The Autostar queries the database for the location of the star you want, does some calculations, and then sends the appropriate commands to the telescope. The Autostar performs the calculation based on the date, time, and location of the telescope on Earth (altitude and longitude), location of the telescope in relation with the positions of KNOWN stars (star alignment)

#### Tracking a Star:

Since the Earth rotates along the North Celestial Pole (NCP), the telescope has to move in order to follow the star, otherwise the star will move out of the view in the eyepiece in a very short time. The star does not actually move, the movement is caused by the Earth's rotation. The ETX telescopes do the tracking with an internal drive motor.

There are two tracking methods:

- 1) Polar tracking
- 2) Altitude/Azimuth (Alt/Az) tracking.

Polar tracking method requires that the telescope's base be mechanically [or physically] aligned with the North Celestial Pole and uses only one drive motor (RA) to track.

The Alt/Az method requires that the telescope be in the Alt/Az position and uses both drive motors (altitude & azimuth) to track. The two methods make little difference to the everyday users if long tracking time (for activities such as astrophotography) is not required. Essentially, Polar tracking requires almost no calculation from the Autostar.

Alt/Az tracking requires constant recalculation and adjustment of BOTH drive motors to continuously track the star.

## **The Tripod**

The tripod is very important in the ETX/Autostar observation system. It must provide a level platform. It must be strong and sturdy to provide a vibration free viewing in the eyepiece. Many functions of the alignment are done on the tripod. This means that the tripod must be precisely set up. This is one component that many users neglect. Many examples here use the Meade #883 tripod, which has micro-adjustment for azimuth and Altitude.

## Tools of the Trade

These are some of the basic tools that you need to help set up the observation system efficiently:

### The Flashlight

I use a small Maglight flashlight. I actually keep mine on a necklace that I can wear around my neck. I never have to look for it when I'm in the dark. There are also some ultra-bright LED flashlights that would probably work well, too. The important thing is to have a flashlight on or near your body at all times. Some users have used a red filter on the flashlight so the irises of your eyes do not close up, maintaining maximum eye sensitivity at all times. Bright white light tends to cause you irises to close up. There is a built in flash like on the 497 Autostar which may be toggle ON and OFF with the "0" key.

### Bubble Levels

I have found that there is no single level that works for all leveling applications. The best idea is to purchase several levels, one for each leveling application.

#### The long bubble level (8")

I use the 8" bubble level to level the fork arms and the OTA on the rim. Bubble levels shorter than 8" are not long enough for this application. On the other hand, longer bubble levels are difficult to carry around and store.

#### The short bubble level (3")

I use two short bubble levels for leveling my tripod. They are placed at right angles to each other. One bubble level is for left-to-right leveling, the other bubble level is for front-to-back leveling. I have found that using two short bubble levels for this application is much easier and accurate than using a circular bubble level.

Figure 1 - Levels



Bubble levels



Dial level

### The circular bubble level

I use the circular bubble level for leveling my DS-60EC telescope tripod. This application is the only application that I use the circular bubble level for. From my experience, these bubble levels are not very accurate. However, they are the only ones appropriate for this application because there simply is not very much space for other types of bubble levels.

### The dial level

I use the dial level for rough readings of Latitude settings. These are also not very accurate, but they seem to be good enough for rough readings.

**The digital level**

Digital levels are more a convenience measure than anything else. They are no more accurate than a regular bubble level. However, many digital levels have zero alarms that beep or chime when it has reached 0°. With an audible alarm, you can use these levels for leveling applications in the dark. Digital levels also have the advantage of being able to read any angle between 0° and 90° like the latitude setting of your telescope.

## **Precision Time Source**

### **Why is the Exact Time important?**

There are 1440 (24 x 60) minutes in a day while the Earth rotates 360°. That means the Earth rotates 0.25 degree/minute. The field of view of a 26 mm eyepiece on ETX-90EC is 1.1 degrees. If the telescope is not tracking the target object, it will go out of view in 4.4 (1.1/0.25) minutes.

Every one minute of error in the Autostar's time, the target object will be off by seconds or 0.25°. If the time is off by 4 minutes, the target object will be off by 1°. Needless to say, if you do not set the Autostar's time to the exact time, the telescope will not point to the exact location of your target object either. Remember, a half of a degree off here, a quarter of a degree off there, and you will miss the target.

### **Your DC3-updated PC System Time**

If you installed DC3 as instructed in the section "Gathering Information", your PC system time should be accurate. Refer to the section "Gathering Information" for more details.

### **Radio Digital Atomic clock**

NIST (National Institute of Standards and Technology) radio station WWVB continuously broadcasts time and frequency information on its 60 kHz carrier frequency from Fort Collins, Colorado. WWVB provides coverage to the United States, Mexico, and Canada. The WWVB time code provides a convenient reference for many consumer electronic products such as desk clocks, wall clocks, and wristwatches. Other time standards are available such as short wave reception of WWV, WWVH and Canada's CHU as time standards.

Radio digital atomic clocks receive a special radio signal up to four times per day to ensure accurate time within a nanosecond. Radio digital atomic clocks are not expensive, priced at about \$40.00. Some of the radio digital atomic clocks even come with a thermometer. These atomic clocks are about the size of a pack of cigarettes.

### **Synchronizing Your Digital Watch with Computer Time**

Your computer should now be updated with DC3. You may want to synchronize your digital watch with the computer time. Since different digital watches work differently, I will just use my Casio digital watch as an example. In my case, I bring up the PC clock and set my digital watch to about 30 seconds ahead of the PC time. My watch allows me to set the seconds to "00". Let's say the PC time is 6:32:30, I would set my digital watch to 6:33:00, when PC time reaches 6:33:00, I release the button on my digital watch. My digital watch is now synchronized with the very accurate PC time. I therefore always set my watch before I start my star gazing session if I'm not using my computer.

Different digital watches work differently; please refer to your digital watch's manual.

## Setting Up the Telescope

There are two setups for the telescope: the viewfinder and the DEC dial.

### Viewfinder and the Telescope

The viewfinder has a field of view of about  $6.8^\circ$  (Meade 8 x 21 mm). The ETX-90EC with the 26 mm eyepiece has a field of view of about  $1.1^\circ$ . It is very difficult, if not impossible, to locate the target object without the viewfinder. A precisely aligned viewfinder will be very helpful in locating the target object and in star alignment.

Viewfinder of the telescope is like the riflescope of a rifle. A rifle should hit wherever you aim with the riflescope. The telescope should aim at wherever you aim the viewfinder. Therefore, it is very important to align the viewfinder precisely, especially for Polar alignment purposes. You want the alignment to be so precise that an object dead-centered in the viewfinder will also be dead-centered in the eyepiece. You should align the viewfinder with a medium-power eyepiece like a 26 mm (about  $1^\circ$  of field of view in a ETX-90).

### Straight-through or Right-angle Viewfinder

The standard straight-through viewfinder of ETX-90 is 8 x 21 mm with an erected image. The standard right-angle viewfinder for the ETX-125EC is 8 x 25 mm with an erected image but with a left-right reversed image. It is more natural to find an object using a straight-through aiming. However, the straight-through viewfinder does not work at all in the Polar home position because it is too close to the base.

A right-angle viewfinder works better because of the design of the ETX fork arm. The right-angle viewfinder also presents the image the same way the ETX does... erect, but left/right reversed. Learning to slew while at the telescope's eyepiece requires the same "reflexes" as the right-angle viewfinder. It is not natural to find an object using the right-angle viewfinder. The right-angle viewfinder works well in the Polar home position. The right-angle viewfinder is a better overall compromise. I have BOTH straight-through and right-angle viewfinder on my ETX-125EC.

## Focusing the Viewfinder

Both viewfinders of the ETX telescopes have adjustable focuses.

### Straight-through Viewfinder

The straight-through viewfinder has a locking ring to secure the adjusted focus. You must first loosen the knurled locking ring near the front before you can turn the front lens for adjusting focus. A distant target should be used for viewfinder focusing like a star. Turn the locking ring to lock the front lens ring in place. You should always adjust the focusing before installation and adjustment the viewfinder. Changing the focusing may disturb the precision viewfinder/telescope alignment for the straight-through viewfinder.

### Right-angle Viewfinder

The focusing for the Meade 8 x 25 mm viewfinder can be adjusted at any time without disturbing the viewfinder/telescope's alignment. You simply turn the rubberized ring just below the rubber eye hood.

## Setting Up the Telescope

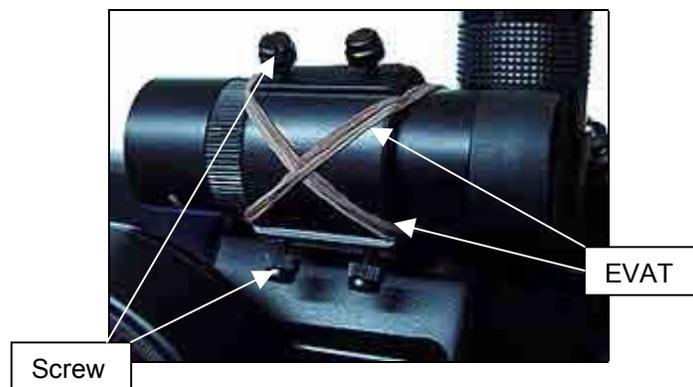
### The Viewfinder Mounting Problem

Aligning the viewfinder to the telescope is to find a distant stationary object, center this object in the telescope, and adjust the screws on the viewfinder mount to center the object in the viewfinder. The procedure itself sounds easy. But in actuality, it is not easy at all because there is no real sense of which screw to turn for which particular direction. The ETX-90/105/125EC comes with a 2-ring, 6-screw viewfinder mount that I found to be difficult to align. You must adjust two of three screws to change anything because the same screw also holds the viewfinder in place. You must loosen one screw, and then you must tighten the other two screws.

### The Elastic Viewfinder Alignment Tool (EVAT)

Aligning the viewfinder used to take a lot of time and frustration. But that is no longer the case. I found a precision alignment tool that can make the alignment much easier. It is the Elastic Viewfinder Alignment Tool (EVAT), a rubber band. With a rubber band, you only adjust two screws in the front ring and two screws in the rear ring. The rubber band holds the viewfinder to these four screws. After the viewfinder is aligned with the telescope, you can use the 2 other screws to tighten up the viewfinder and remove the EVAT. This is much easier.

Figure 2 - The EVAT installed on the viewfinder. Adjustment only requires the four pictured screws.



## Setting up the Telescope

### Aligning the Viewfinder Step-by-step

- 1) Install the EVAT (the rubber band) on the viewfinder/mount assembly. Make sure the EVAT is pushing the viewfinder to the left on the mount. Use as many rubber bands as necessary to secure it tightly.
- 2) Loosen the two inside screws (one from the front ring, one from the rear ring) on the mount. The viewfinder should now be pressed to the left and be supported by the remaining four screws.
- 3) Adjust the viewfinder so that the cross hair is straight.
- 4) Place a medium-power eyepiece (26 mm) in the telescope and make sure the eyepiece is seated properly and secured with the tightening screw.
- 5) Choose an initial target (200 yd minimum, the top of a lamp pole down the street or a lamp on top of the hill, etc.) and center the initial target in the eyepiece with the Autostar keypad.
- 6) Adjust the four screws until the target object is centered. Check repeatedly that the target object remains centered in the eyepiece. Use the arrow keys to re-center the target object if necessary.
- 7) Now choose the final target. You should be able to use the viewfinder to help you. Center the final target object in the eyepiece, and then center the object in the viewfinder. Polaris would be the perfect final target object. Polaris should be covered right at the center of the cross hair so that you can barely see any starlight.
- 8) Turn the two inside screws slowly back in as the same time until the viewfinder is equally tightened. Be careful not to disturb the settings.
- 9) Make any minor adjustments as needed.
- 10) Remove the EVAT if you wish. I usually leave the EVAT on the viewfinder.

Viewfinder alignment should be checked periodically. Perfect viewfinder alignment is critical for Polar alignment.

## Setting up the Telescope

### Setting Up the DEC dial

When the telescope Optical Tube Assembly (OTA) is horizontal, the DEC dial must read 0. It should read 90 when the OTA is pointing straight up. This is important for star alignment or if you want to be non-GOTO and find the star with RA and DEC reading.

#### Step-by-step Procedure:

- 1) Put the telescope on a leveled tripod or on a leveled surface. The surface must be leveled left to right and leveled front to back. You may use a bubble level to verify the leveling of the surface.
- 2) Loosen the DEC dial lock knob so that you can turn the dial.
- 3) Point the OTA straight up with the lens.
- 4) Place a long bubble level on top of the edge of the lens. Do not put the bubble level on the lens cap. I have both an ETX-90EC and an ETX125EC telescope. The lens cap of both ETX90-EC and ETX-125EC are raised in the center. The cap is NOT flat!

Figure 3 – Setting up the DEC dial



Long bubble level resting on top of the lens.



The dial reading 90.

- 5) Adjust the OTA back and forth until the bubble level is centered.
- 6) Turn the dial so that it reads 90 without disturbing the position of the OTA.
- 7) Hold down the DEC dial and tighten the DEC dial lock knob.
- 8) Verify the bubble level is still centered. If not, repeat the process.

A properly calibrated DEC dial is critical for precise star alignment.

## Setting Up the Telescope

### Leveling the Fork Arm in the Polar Alignment Position

Leveling the fork arm should be done every time prior to performing a Polar star alignment. If the fork arm is not leveled, the vertical movement of the telescope will be tilted to one side.

The flat part of the fork arms is a good location for placing the bubble level. After the telescope is placed in the Polar position, with the telescope pointing at Polaris, leveling the fork arms becomes difficult. We want left-to-right (East-West) leveling of the fork arms but there is no obvious "stopper" where you can place the bubble level squarely on the fork arm so the level is not affected by the front-to-back leveling. We need a square stopper on the fork arm so the leveling is not affected by the front-to-back leveling.

Fortunately, there is a square stopper. The attachment pad at the bottom of the telescope is for attaching the telescope to a photo tripod. The attachment pad makes a good square stopper for leveling the fork arms. Refer to Figure 4.

Figure 4 – Leveling the Fork arms



Press the bubble level against the attachment pad to eliminate the front and back effect.

You could also press the bubble level against the telescope base on the ETX-125EC, however the attachment pad is a more universal solution. The telescope base on the ETX-90 is not suitable for this purpose.

### Leveling the Fork Arms

- 1) Loosen the RA lock lever.
- 2) Point the telescope down until the attachment pad is square with the fork arm.
- 3) You can now push the bubble level against the attachment pad and eliminate the front-to-back leveling effect.
- 4) Turn the telescope until the fork arm is leveled.
- 5) Tighten the RA lock lever.
- 6) Check the level again to make sure the fork arms remain level.
- 7) Point the telescope back to 90° on the DEC dial.

The fork arms are now leveled.

Note: Check the rubber cushion on the attachment pad and make sure it is not peeling off. This could cause the attachment pad surface to become un-level.

## Setting Up the Telescope

### The Telescope HOME Positions

There is an option in the Autostar that sets the Mount for ETX telescopes. You can choose to put the telescope in the Polar or Alt/Az position. This refers to the HOME position of the telescope. This is the initial position that you must place the telescope in when you start the alignment procedure. You must place the telescope in the same position that you chose in the Autostar. DS series telescopes cannot operate in Polar position.

Let's take a look at the characteristics of these two positions:

#### Polar Position

The official Meade manual for the ETX-90EC/125EC does not include good instructions on how to place the telescope in the Polar mount position. To make matters worse, the picture provided in the manual of the Polar position is incorrect. This, in itself, can cause confusion. Refer to Figure 5.

Figure 5 – Photo of Polar position (incorrect)



The characteristics of Polar home position are:

- 1) The telescope should be pointed to the general direction of North.
- 2) If you are facing north, the computer control panel should be on the left (west) side.
- 3) The telescope should be turned counter clockwise until it reaches a hard stop and reversed back so that the DEC dial is above the computer panel.
- 4) The fork arm should be leveled.
- 5) The DEC dial should point to 90° on the DEC dial.
- 6) The latitude adjustment on the tripod should be set to the latitude of your location.
- 7) OTA should point at NCP.

**Alt/Az Position:**

The characteristics for the ETX telescope Alt/Az position are:

- 1) Tripod/telescope base should level.
- 2) If you are facing north, the computer control panel should be on the west side.
- 3) The telescope should be turned counter-clockwise until it reaches a hard stop and reversed back so the DEC dial is above the computer panel.
- 4) The OTA should be level.
- 5) The DEC dial should be at 0°.
- 6) The OTA should point to North. Refer to Figure 6.

Figure 6 – OTA leveled and DEC dial at 0°



## Setting Up the Telescope

### Polar Home Position:

#### Step-by-step Setup

- 1) Set up the latitude of your location on the tripod setup and level the tripod.
- 2) With the telescope in the upright position, loosen the RA lock level.
- 3) Turn the base table of the telescope counter-clockwise until it reaches a hard stop.
- 4) Turn the base table of the telescope clockwise until the DEC dial side of the fork arm is just above the computer panel.
- 5) The telescope should now also point to the general direction of North.
- 6) If you can see Polaris, point the telescope towards Polaris by tilting the OTA upwards.
- 7) Find and center Polaris in your viewfinder, center the east-to-west direction with the keypad.
- 8) Place the telescope in the Polar position.
- 9) Level the fork arms (see "Leveling the Fork Arm in the Polar alignment position").
- 10) Put the telescope back to the upright position.
- 11) Aim the telescope towards Polaris.
- 12) Find and center Polaris in your viewfinder, center the east-to-west direction using ONLY the azimuth adjustment on the tripod. Do not use the Autostar keypad.  
Note: This process (step 3 to 7) aligns the vertical movement of the polar mount with the vertical movement of the fork arm. This process makes sure that Polaris remains in the vertical line when the telescope is placed in the Polar position and when the telescope is moved up and down in the fork arms.
- 13) Point the telescope straight up with the DEC dial at 90° (easier) or level the rim of the (preferred) telescope with a level the same way as you would you calibrating the DEC dial.
- 14) Place the telescope down to the Polar position.

Figure 7 – Polar Position



If the latitude is set correctly on the tripod, you should see Polaris in the eyepiece. If you have a dial protractor or digital protractor, it should read your latitude on the OTA as in Figure 8.

Figure 8 – OTA with digital protractor displaying latitude.



## Setting Up the telescope

### Alt/Az Home Position

Step-by-step:

- 1) Aim the northern leg of the tripod to the general direction of North.
- 2) Attach the telescope to the tripod.
- 3) Level the Tripod with the telescope attached. Refer to the page on leveling the tripod, if necessary. This is very important. If the tripod is not level, horizontal movement will be inclined and vertical movement will be tilted.
- 4) Loosen the RA lock level.
- 5) Turn the base table of the telescope counter-clockwise until it reaches a hard stop.
- 6) Turn the base table of the telescope clockwise until the DEC dial side of the fork arm is just above the computer panel.
- 7) The telescope should now point to the general direction of North.
- 8) If you can see Polaris, center Polaris in your viewfinder. You may use the Autostar keypad to do this.
- 9) Tighten the RA lock lever.
- 10) Push the OTA down to a near level position.
- 11) Place a bubble level on top of the OTA and use the Autostar keypad at a low speed to level the OTA.

Your telescope is now in the Alt/Az home position.

Figure 9 - OTA leveled and pointing North



## The Tripod

The tripod is a very important component of your observation system. The following is my description of a good tripod.

- 1) Strong and sturdy legs to support the telescope. No part of the tripod should flex or give when a telescope is attached on it. It should settle from any vibration quickly. When you are looking into the eyepiece and focusing the telescope, it should maintain the image without vibration. It should take less than 2 seconds for any vibration to settle. The tripod should also match the weight of the telescope.
- 2) The tripod should have micro-adjustment controls for latitude and azimuth. You should be able to fine-tune the latitude and azimuth adjustment. Most tripods have micro-adjustment for latitude. You also need a fine azimuth adjustment on the tripod for precision alignment. You should be able to turn the telescope without moving the entire tripod. You do not want to level the tripod and then have to turn the entire tripod for star alignment.
- 3) The tripod should have adjustable leg lengths. It is difficult to level the tripod if the leg length is not adjustable. You would have to use a wedge block to raise the tripod legs to level it, which can introduce more difficulty.
- 4) The tripod should have some kind of vibration dampening. Some tripods have rubber feet to dampen vibrations, but they may be too long and flex too much to be useful. There are vibration-dampening pads available for tripods for this purpose.
- 5) All controls on the telescope should be simple and usable and without needing extra tools. The controls should be simple enough to use so that you can complete all adjustments in the dark.
- 6) Portability of the tripod really depends on how small a telescope your tripod can use and still meet the other requirements. ETX-90 is 9 lbs. while the ETX-125 is 18 lbs.

## Adjustments on a #883 tripod

Figure 10 – Tripod with adjustment knobs.



Left knob: Latitude adjustment  
Center knob: Latitude lock  
Right knob: Azimuth adjustment

## How to Set Up and Level a Tripod

Some tripods have a leg marked “North”. Point this leg to the general direction of north. This is also the side the telescope tilts if it is used in the Polar position. This leg supports and maintains the center of gravity of the telescope and tripod assembly.

### You only need to adjust two legs to level a tripod

You only need to adjust 2 legs to level the tripod. When all three legs are adjusted, you are raising or lowering the tripod but not leveling the tripod. It would be easier if you think of leveling the tripod in terms of front-to-back and left-to-right. If you stand facing north between the east-to-west legs, the north leg adjusts the front-to-back leveling, the east OR west leg adjusts the left-to-right leveling. I usually only adjust the north and east legs. The west leg only sets the proper height and is not used for level adjustment.

### Meade 883 deluxe field tripod



### Meade 884 deluxe field tripod



Note: The side where the bubble stays is the side that should be lowered.

### Set up the Latitude of your location on the tripod

Depending on the model of tripod you have, the latitude adjustment on the tripod may be different. A precision adjustment for latitude is not important. You only need to be somewhat close. An exact setting of latitude will be done with Polaris and the NCP offset. You will read details for that later. The latitude scale on the tripod probably does not allow any kind of precision setting anyway. It will be fine tuned with the telescope attached when you perform the star alignment. You can just set it to the nearest value of your location. For example, if your latitude is  $36^{\circ} 16'$ , you could just set it to a little over  $34^{\circ}$ .

## **Gathering Information**

Before we start setting up the Autostar, we must gather the needed precision information. Much of the information you will enter into the Autostar will affect the accuracy of the GOTO. Therefore, we want to enter the most precise information possible. The Internet is very helpful for gathering this information.

Here are the values that we need:

1. Latitude
2. Longitude
3. Time zone
4. Time
5. Magnetic declination

Note: Magnetic declination is not needed in the setting up of the Autostar, but will be needed later.

## Gathering Information

### Exact Location

If you live in one of the major cities listed in the Autostar, it's location might be precise enough. However, if you do not feel it is precise enough or if where your location is not listed, you may want to find the exact latitude and longitude coordinates of your observing location.

To get the exact coordinates, visit the following URL: <http://www.geocode.com/eagle.html-ssi>

When you reach the web page, enter your address information as shown in Figure 11.

Figure 11 – Entering information into the latitude/longitude look-up web site

Street Address:  
720 S. Michigan Ave  
City:  
Chicago  
State:  
IL  
Zip:  
60605  
Address Info  
Address & Map request

Click on the “request” button, and you will get a detailed location report as shown in Figure 12.

Figure 12 – Location report

Original Address	Standard Address	Matched Address
720 S. Michigan Ave Chicago, IL 60605	720 S MICHIGAN AVE CHICAGO, IL 60605-2116	720 S MICHIGAN AVE CHICAGO, IL 60605

EZLocate returned a Block Face Match from the Tele Atlas map database.

Location (NAD-27)		Postal	2000 Census
<u>Decimal Degrees</u>	<u>Deg:Min:Sec</u>		
Lat: 41.872833	41:52:22.199N	Carrier: C017	FIPS County.: IL031
Lon: -087.624357	87:37:27.685W	DPBC.: 99	UAC.: 1601
			Pop. Density.: U
			HCD.: IL031030
			Place.: IL1051
			Tract.: IL031320600
			BlockGroup.: IL0313206002

Dec:Min:Sec

You will want the information in Deg:Min:Sec format. You should write this information down for later use.

## Gathering Information

### Get the Precise Time

It is possible to set up the time in the Autostar so that it is within one second of an atomic clock. There is a free program called Dimension 4, which you can install on your computer. Dimension 4 can update the computer clock automatically at regular intervals. Dimension 4 is an SNTP (Simple Network Time Protocol) client that resides in the Windows system tray and adjusts your computer's clock to one of several time-servers on the Internet.

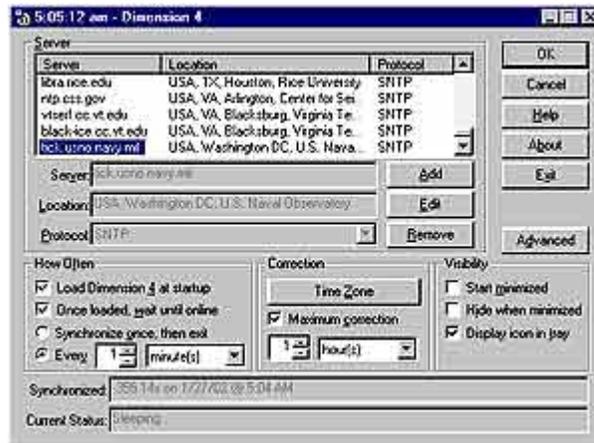
Dimension 4 is available for download at the following URL:

<http://www.thinkman.com/dimension4/index.html>

Once you download Dimension 4, you can install it on the computer you wish to use to control the telescope. There are options in Dimension 4 that you can set to update your computer whenever you are connected to the Internet.

Figure 13 shows an example of what the Dimension 4 screen looks like when activated.

Figure 13 – Sample of Dimension 4 running



You can manually update the PC clock by clicking on the OK button and the program will update your PC clock with a time clock server, as seen in Figure 14. In this particular example, the PC clock is update by  $-0.17$  seconds.

Figure 14 – Updating the PC clock



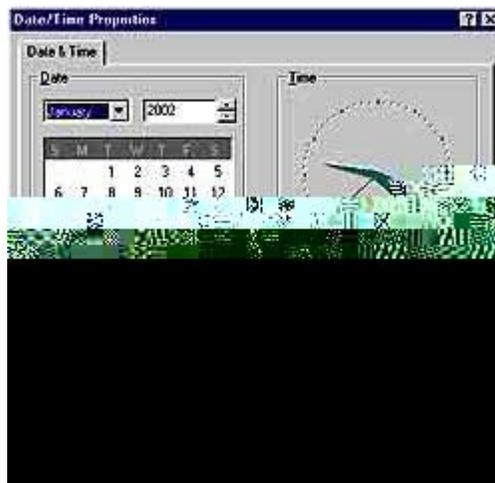
### Synchronize the Autostar Time with Precise Date/Time

Once Dimension 4 is installed on your computer, your computer time should now be very precise. Whichever precision time source you have, whether it is a radio-controlled atomic clock or digital watch, you should have it next to your telescope so that you can set the time on the Autostar.

- 1) If you are not using your PC with Dimension 4 updated system time as your precision time source, skip to step 3.
- 2) Double-click on PC clock so it will display on the screen (refer to Figure 15). The clock is usually located in the bottom right of the screen, within the Windows system tray on the taskbar.
- 3) Press the MODE key on the Autostar until you reach the setup and then press the ENTER key. You are now in the setup mode.
- 4) Press the SCROLL down key until you reach the date setting and then press the ENTER key.
- 5) Set the date on the Autostar.
- 6) Press the MODE key on the Autostar.
- 7) Press the SCROLL down key to get to the time option.
- 8) Check your precision time source (computer time clock, atomic clock, or digital watch) to see the current time.
- 9) Enter the time about 30 seconds ahead of the current time without pressing the ENTER key on the Autostar. For example, if the computer time is 08:15:30 PM, you should enter 08:16:00 PM. This should give you enough time to enter the time and be ready to synchronize with the computer time or digital watch time.
- 10) Press the ENTER key on the Autostar when the time source is at the exact time as the time you have set on the Autostar.

The Autostar should now be set up within one second of the time on your precise time source.

Figure 15 – PC clock

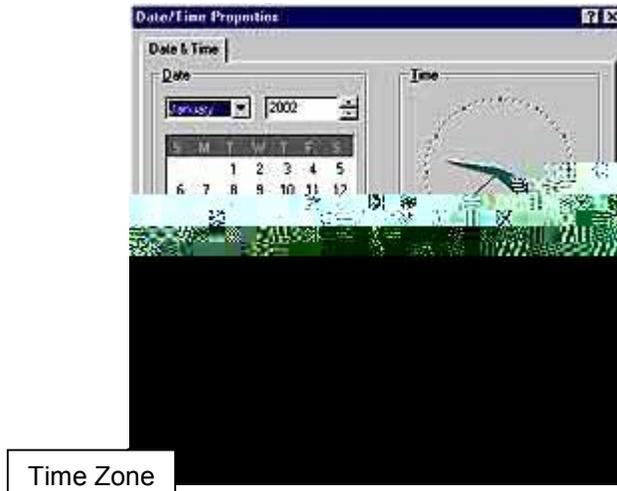


## Gathering Information

### What is Your Time Zone?

If you do not know your time zone, you can check your computer's clock. Double-click on the clock (in the bottom right of your screen in the Windows system tray) so it will display on the screen (refer to Figure 16). You should see a Time Zone drop down menu near the bottom. It should display something like "(GMT -8:00)". This is your time zone.

Figure 16 – PC clock



You will need to enter the correct time zone into the Autostar.

## Gathering Information

### Magnetic Declination

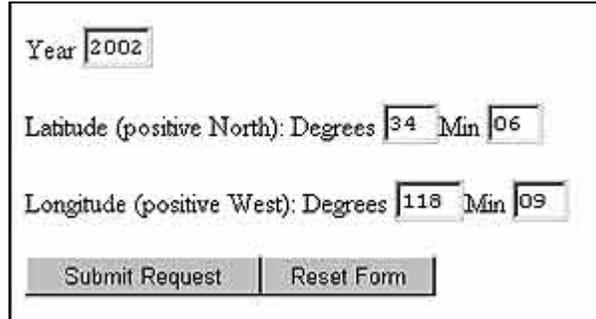
#### Magnetic Declination

Magnetic Declination is the difference or offset between the magnetic north and Geographic North Pole (GNP). For example, Los Angeles, California is 13° 34' East of GNP. Therefore, if you use a compass to point to North without knowing the magnetic declination offset, will not be pointing to North at all. If you use a compass to find North, you must know the Magnetic Declination of the location where you are using the compass.

There is a web site that can produce the Magnetic Declination of any location. The URL for this web site is as follows: [http://www.geolab.nrcan.gc.ca/geomag/e\\_cgfr.html](http://www.geolab.nrcan.gc.ca/geomag/e_cgfr.html)

When you reach the web site, enter the location information into the form. Note that you also need to enter the correct year.

Figure 17 – Location form



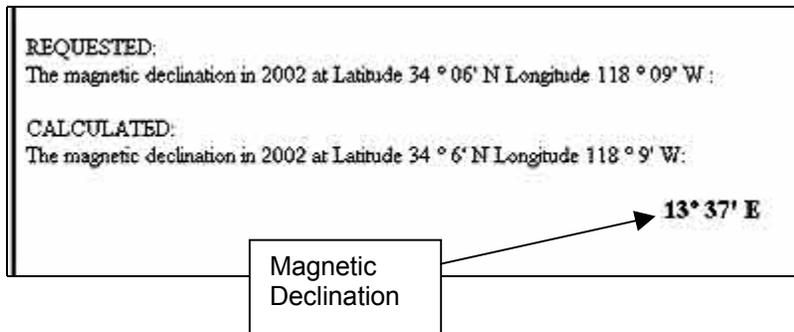
Year

Latitude (positive North): Degrees  Min

Longitude (positive West): Degrees  Min

Click on the Submit Request button. It should produce a report similar to the one in Figure 18.

Figure 18 – Location report



REQUESTED:  
The magnetic declination in 2002 at Latitude 34 ° 06' N Longitude 118 ° 09' W :

CALCULATED:  
The magnetic declination in 2002 at Latitude 34 ° 6' N Longitude 118 ° 9' W:

**13° 37' E**

Magnetic Declination

In this case, the magnetic declination is 13° 37' East.

This means that geological North is 13° 37' East of what the compass indicates is North.

This is how much your compass should be offset. A difference of this magnitude will make the Autostar point your telescope to the incorrect direction.

## Setting up the Autostar

### The Autostar Keys Basics:

#### ENTER:

The ENTER key has two functions - Confirm selection and Sync at current position.

##### **Confirm Selection**

Pressing the ENTER key selects whatever option is displayed on the LCD screen. This also returns you to the previous level in the menu selection.

##### **Sync**

By pressing the ENTER key, holding it in for two seconds, and releasing, the telescope will start to synchronize the current position. Synchronize is synonymous to tracking. The telescope will start tracking the target object by pressing the ENTER key again. If your telescope was not aligned correctly, the synchronize function can correct bad alignment in many cases.

#### SCROLL up/down:

These keys change the option in the menu up or down. You can use the SCROLL up/down keys to change the speed of the scrolling text in the display.

#### MODE:

The MODE key has two functions:

##### **Change menu level** (back one level)

Each time you press the MODE key you will be returned one level back on the menu selection. If you continue to push the MODE key, you will eventually reach the main level ("Objects").

##### **Telescope Status**

Pressing the MODE key, holding it in two seconds, and releasing displays the telescope status. Use the SCROLL up/down keys to change display.

##### **RA-Dec**

RA in HH:MM:SS and Dec in degrees and minutes.

##### **Alt/Az**

Altitude and Azimuth in degrees, minutes, and seconds

Note: You may use the ARROW keys to change direction and see how the value changes in the RA/Dec and Alt/Az. You may change motor speed with numeric keys. If you press the GOTO key, you may enter the RA and Dec value, press Enter and point the telescope to the location you entered.

##### **Site Name/Date**

The current site name and current date.

##### **Latitude**

The latitude of the current site.

##### **Longitude**

The longitude of the current site.

##### **Time/LST**

The current time and LST.

##### **Timer/Alarm**

The timer and alarm setting.

##### **Battery Level**

The battery power level in percentage of specification.

##### **Focus Control**

If you have installed the Meade Electric Focuser, and if the focuser is plugged into one of the auxiliary ports, you can control the focuser on the Autostar. You activate the focusing function by pressing the MODE key, holding for two seconds, and releasing. You may then use the ARROW keys to control the electric focus motor.

#### GOTO:

The telescope goes to the object or position specified on the LCD display. If you press the GOTO key, you may enter the RA and Dec value, press Enter and point the telescope to the location you entered. You can do the same thing with the Alt/Az display

#### Number Keys:

Press the number keys to enter a numeric value or change the motor speed - 1 through 9. The 0 key toggles the LED red flashlight on or off. Tapping the zero key is a direct way to reach the focus dialog, too. This avoids [mode] effects upon Tours, etc.

? See help information for the selected option, if available,

## **The Autostar Setup**

### **User-entered Information in the Autostar**

The Autostar must be set up correctly so it can control the telescope precisely. Therefore, the information you entered directly affects the pointing (GOTO) of the telescope. In order for the Autostar and ETX telescope to find and track the stars for you, you must enter some essential information into the Autostar as precisely as possible.

## **Setting Up the Autostar**

### **Setting Up a Custom Site for Your Exact Location in the Autostar**

This is the first reference point for the Autostar, the location of the telescope. If you live in a major city, your location will probably be in the Autostar database. However, the major city could be many miles away. You want to be as precise as possible. These are instructions on how to create a custom site in the Autostar.

### **Determining your Exact Location**

If you have a GPS unit, you can use that to obtain information about your exact location. You can also find the exact latitude and longitude coordinates of your street address from a web site. The URL for this web site is as follows:

<http://www.geocode.com/eagle.html-ssi>

When you reach the web site, fill in the street address, city, state, zip code. Then click on the Request button. The latitude and longitude coordinates should be displayed in both decimal and deg:min:sec formats. Write down the latitude and longitude of your address somewhere for future reference. You may disregard the “seconds” value, because the Autostar does not allow for entering a value for the seconds. Please note that a 3 arc minute error is almost invisible in an EtX90EC. Therefore you do not need to be obsessive with too much accuracy. You should truncate the second and set to the nearest minute for the Autostar.

### **Setting Up the Custom Site for Your Address**

1. Press the MODE key on the Autostar until “Select Item: Object” is displayed.
2. Press the SCROLL keys until “Select Item: Setup” is displayed.
3. Press the ENTER key.
4. Press the SCROLL keys until “Setup: Site” is displayed.
5. Press the ENTER key.
6. Press the SCROLL keys until “Site: Select” is displayed.
7. Press the ENTER key.
8. Press the SCROLL keys until “Country/State: Custom” is displayed.
9. Press the ENTER key.

### **Setting the Site Name**

The site name should be displayed. Use the SCROLL up/down keys to change the letters and use the left/right arrow key to move to the next/previous space and enter the name of your custom site. It should be something that is easy to remember like “HOME” or “South Pasadena”. Press the ENTER key when you are finished.

### **Setting the Latitude**

Use the number keys to enter the latitude coordinates (generated by the above web site). Press the ENTER key when you are finished.

**Setting the Longitude**

Use the number keys to enter the longitude coordinates (generated by the above web site). Press the ENTER key when you are finished.

**Setting the Time Zone**

Use the number keys to enter the time zone that you are in. This is the offset from Greenwich Mean Time (GMT). Use the number key to enter numbers and use the SCROLL up/down keys to change the + and – signs. Use the left/right arrow keys to change position. See Time Zone.

## The Autostar Setup

### Setting Up the Autostar

#### Change/Edit Site Information:

1. Press the MODE key until "Select Item: Object" is displayed.
2. Press the SCROLL UP keys until "Select Item: Setup" is displayed.
3. Press the ENTER key.
4. Press the SCROLL keys until "Setup: Site" is displayed.
5. Press the ENTER key.
6. Press the SCROLL keys until "Site: Select" is displayed.
7. Press the ENTER key.
8. Press the SCROLL keys until "Select: Your Site" is displayed.
9. Press the ENTER key. (Your site is the name of your location)
10. This selects the site you want to edit. You must select the site before you can edit it. Otherwise you will edit the site that was previously selected.
11. Press the SCROLL keys until "Select: Edit" is displayed.
12. Press the ENTER key.
13. You may now edit the site name, latitude, longitude, and time zone values.
14. Use the number keys to enter the value. Press the ENTER key when you are finished. Press the MODE key to go back to the previous selection step.

## The Autostar Setup

### Setting the Basic Autostar Telescope Parameters

The Autostar is designed for many types of telescopes. Each telescope has its own specific options to be set. They must be set correctly for the Autostar to work correctly.

Note: A ">" mark appears on all user-selected options. The previously set option always appears first with the ">" in the latest version of the Autostar.

- 1) Press the MODE key until "Select: Object" is displayed.
- 2) Press the SCROLL keys until "Select: Setup" is displayed.
- 3) Press the ENTER key.
- 4) Press the SCROLL keys until "Setup: Telescope" is displayed.
- 5) Press the ENTER key.
- 6) Telescope Model display.
- 7) Press the ENTER key.
- 8) Press the SCROLL keys until your telescope model is displayed.
- 9) Press the ENTER key. A ">" mark is now on the left of the model you selected.
- 10) Press the SCROLL keys to access the telescope focal length. The Autostar defaults to the correct focal length. No change is necessary.
- 11) Press the SCROLL keys until "Az/RA ratio" is displayed. The Autostar defaults to the correct value. No change is necessary.
- 12) Press the SCROLL keys until "Alt/DEC ratio" is displayed. The Autostar defaults to the correct value. No change is necessary.
- 13) Press the SCROLL keys until "Telescope: Mount" is displayed.
- 14) Press the ENTER key. This selects which telescope position you will be using - Alt/Az or Polar. Use the up/down SCROLL keys to select. Please note that you must use the telescope in the selected position or you will not have a successful alignment.
- 15) Press the MODE key until you are back to "Object" to exit.

For additional help, see the detailed procedures for:

- Motor Calibration
- Motor Drive Training
- Gear Percent for Az/RA and Alt/Dec

Other settings should be left unchanged except if you want to reverse the up/down and left/right alignment of the Autostar.

## The Autostar Setup

### Fine-tuning the Autostar

#### Fine-tuning the Autostar for Your Telescope

Each telescope has its own mechanical characteristics. This is because of the motor drive systems (motors, gear system, worm drives) in each telescope has small differences in free-play (clearance between gears) and inertia. The Autostar must be set to compensate for the differences between each individual motor drive system. For example, the number of turns that the motor has to rotate before the telescope actually starts moving is different from telescope to telescope. The Autostar must be set up for these specific values. The three major ones are:

- 1) Motor Calibration
- 2) Motor Drive Training
- 3) Percentage for Az/RA and Alt/Dec

It is very important these three parameters are set correctly in the above listed order because it will affect the accuracy of the GOTO.

#### Motor Calibration

This is basically the Autostar's need for matching the power level source (battery/AC adaptor) to the motor and the brightness of the encoding LED sensor. This is the setting that tells the Autostar at this particular level of power, a particular LED light level should be used. Motor Calibration causes the drive motor to turn for a short time and stops.

A "Drive Motor unit Failure" message means that there is a change in the motor calibration value caused by a change in power source level. As your battery runs down you will get a "Drive motor Failure". The Autostar will perform a motor calibration itself and reboot (restart). If your battery power is too low, the motor calibration may fail entirely. If you change the power source from battery to an external AC/DC adaptor, you should do a motor calibration or you will also get a "Drive Motor Failure". This is because the power level changed and the motors need to be re-calibrated.

Therefore, whenever you change the power source you should do a motor calibration before you start the star alignment procedure. This is because after you entered all of the alignment data as date, time, and set the telescope to the precise position and ready to align you telescope, the telescope starts to go to the first star and you may get a "Drive Motor Failure". The Autostar then immediately performs a motor calibration on itself and restarts itself. Your precision positions of the telescope will be lost and you will have to restart the entire alignment process.

To complete a motor calibration, follow these steps:

- 1) Press the MODE key until "Select: Object" is displayed.
- 2) Press the SCROLL keys until "Select: Setup" is displayed.
- 3) Press the ENTER key.
- 4) Press the SCROLL keys until "Setup: Telescope" is displayed.
- 5) Press the ENTER key.
- 6) Press the SCROLL keys until "Telescope: Calibrate motor" is displayed.
- 7) Press the ENTER key.

Each motor should run for about a second and stop. This will not cause the Autostar to restart. If you were aligned before performing a Calibration, the operation destroyed that. You must realign after Calibrating.

## The Autostar Setup

### Fine-tuning the Autostar

#### Train Drive

Train Drive is probably the most important telescope-specific setting on the Autostar. This setting tells the Autostar how many times the motor has to turn before the telescope actually moves. If you do not have this parameter set properly, you are not likely to have precise GOTO or successful alignment.

This process requires you to center a distant target object in the eyepiece. The Autostar will then command the telescope to move a small distance. You then use one of the Arrow key to re-center this target object. This process must be performed on both drive motors.

This process must be set up before, you can actually start it:

- 1) Level the tripod as best as you can. This process requires the telescope to move horizontally and vertically. Therefore if the tripod is not leveled, the horizontal movement will be inclined and the vertical movement will be tilted. If you noticed during the Train Drive process, if your target object goes away off-centered or comes back off-centered, your tripod is not leveled. This is more obvious with higher power eyepieces and could affect the accuracy.
- 2) Choose a very distant stationary object. The Polaris is an ideal target since it hardly ever moves and is many light-years away. Polaris also has the advantage of being neither in the horizontal position or vertical position. It allows the telescope to be "loaded" vertically. Polaris also has the advantage of being a small bright dot which makes it easy to center. If this must be done during the day, you should choose an object located high above the ground and miles away.
- 3) Use the highest power eyepiece you have so you can detect centering more accurately.
- 4) Use the slowest practical motor speed since you cannot "backup" at all. Once the target passes the center, you cannot go backwards. You must start over. Do not use the keypad to back up and re-center
- 5) Use an AC power adaptor or fresh battery.
- 6) Calibrate the motors.
- 7) Set the RA and DEC percentages to 0.
- 8) Some of the steps are meant to take up the slack from one direction so the Autostar does not have to deal with slack from both directions.

Some experienced users recommend that the Train Drive process be performed while in the same Mount position that the telescope is in when you are using it - that is if you use the telescope in the Polar position, you should train the drive in the Polar position; if you use the telescope in the Alt/Az position, you should train the drive in the Alt/Az position.

## The Autostar Setup

### Fine-tune the Autostar

#### Train Drive Step-by-step:

- 1) Level the tripod.
- 2) Use the arrow keys to center the distant target object.
- 3) Install a high power eyepiece, for example, a 9.8 mm eyepiece.
- 4) Focus the distant target object.
- 5) Use the left/right arrow keys to center the target object.
- 6) Use the → key to move the target off center.
- 7) Set the motor speed to 3 or lower.
- 8) Use the ← key to center the target object again  
Note: These steps are to make sure you only have gear slack once, in one direction. Do not use the other arrow key to reverse the direction; otherwise you will pick up the slack again.
- 9) Press the MODE key until "Select: Object" is displayed.
- 10) Press the SCROLL keys until "Select: Setup" is displayed.
- 11) Press the ENTER key.
- 12) Press the SCROLL keys until "Setup: Telescope" is displayed.
- 13) Press the ENTER key.
- 14) Press the SCROLL keys until "Telescope: Train Drive" is displayed.
- 15) Press the ENTER key.
- 16) "Train Drive: Az/RA" should now be displayed.
- 17) Press the ENTER key.
- 18) The Autostar will ask you to center a distant object, which you already did. Press the ENTER key.
- 19) The telescope will move a small distance. Follow the instructions on the Autostar to center the distant target object with the left key and repeat with the right key.
- 20) Press the MODE key to return to "Train Drive: Az/RA".
- 21) Center the target object with the arrow keys.
- 22) Use the down arrow key to move the target object off center.
- 23) Use the Up arrow key to move the target object back to center  
Note: These steps are to make sure you only have gear slack once, in one direction. Do not use the arrow keys to reverse the direction, otherwise you will pick up the slack again.
- 24) Press the SCROLL keys until "Train Drive Alt/DEC" is displayed.
- 25) Press the ENTER key.
- 26) The telescope will move a small distance. Follow the instructions on the Autostar to center the distant target object with the up arrow key and repeat with the down arrow key.
- 27) Press the MODE key to exit Train Drive.
- 28) Re-enter your RA and DEC percentage values.

The Train Drive procedure should be done periodically. The better you train the drive, the more accurate your GOTO will be.

## The Autostar Setup

### Fine-tuning the Autostar

#### The Az/RA and Alt/DEC Percentage Setting

This percentage setting compensates for the slack of the drive motor gear system. When the motor comes up to speed, all of the drive gears become disoriented and the telescope starts moving. This is especially apparent when you reverse the direction. If you try to go one way and then try to reverse the direction, you will get a long delay. This setting gives the drive system a little kick-start to shorten the slack time.

#### Do I Need to Change this Setting?

There is a small test that you can go through to see if you need to change this setting. Set the slew rate to "3" by pressing the 3 key on the Autostar. Press any directional key. If you can detect any actual motion within 3 seconds, there is no need to make a change. Since each axis has its own drive motor gear system you will need to try this test on each drive motor gear system.

#### Step-by-step

It is recommended that these two settings be set at 15 for Az/RA 1 for Alt/DEC initially.

To set the Az/RA and Alt/DEC percentages, follow these steps:

- 1) Press the MODE key until "Select: Object" is displayed.
- 2) Press the SCROLL keys until "Select: Setup" is displayed.
- 3) Press the ENTER key.
- 4) Press the SCROLL keys until "Setup: Telescope" is displayed.
- 5) Press the ENTER key.
- 6) Press the SCROLL keys until "Telescope: Az/RA Percent" is displayed.
- 7) Press ENTER.
- 8) Enter 15 and press the ENTER key.
- 9) Press the SCROLL keys until "Telescope: Alt/DEC Percent" is displayed.
- 10) Press ENTER.
- 11) Enter 1 and press the ENTER key.

This setting is helpful on a low speed slew of the telescope. Instead of an unresponsive low speed movement with a long slack time, now the Autostar gives the motor a little kick-start and you have faster response. Please note you may need to experiment for the best setting for your telescope.

A delayed response on arrow key commands indicates that the percentage is set too low. A jumpy, jerky motion is a good indication that the percentage of the drive is set too high.

## Telescope/The Autostar Mechanical/Electronic Troubleshooting

Here are some of the most common mechanical problems that users encounter:

- 1) **I am getting “Motor Failed” Messages**  
Make sure you have a fresh battery. A set of old batteries can cause a lot of problems including motor failure, inaccurate GOTOs, and total failure. Pressing the MODE key, holding it in for 2 seconds, and releasing will display the Telescope status. Scroll to battery and check the battery level. A sealed battery pack or AC/DC adaptor is preferred because they are more stable and steadier power sources than the AA batteries.
- 2) **My telescope is getting “Motor Failed” Messages whenever it is very cold**  
Low temperature can cause the batteries to lose power. Check the battery power and replace if necessary.
- 3) **The display on the Autostar goes dark whenever it is very cold**  
Low temperatures will cause the Autostar to go dark. The Autostar LCD screen will not display at low temperatures even though it is still functioning.
- 4) **The target object drifts slowly out of my field of view in the eyepiece**  
Make sure you train your drive correctly, accurately, and periodically. Training the drive is the easiest tune up for the telescope. Retraining the drive motors properly will eliminate most GOTO and tracking problems
- 5) **I am not getting consistent GOTOs, I have done everything correctly**  
Make sure everything everywhere is tight. Free-play anywhere should be eliminated if possible, tripod, mount, and motor drive systems. Free-play anywhere can cause inconsistent GOTOs.
- 6) **The telescope movement is jerky**  
The Alt/Az or Dec/RA percentages are set incorrectly, most likely too high.
- 7) **The telescope response very slowly at speed lower than 3**  
The Alt/Az or Dec/RA percentages are set incorrectly, most likely too low.

## North

There are three Norths: Geological North, Magnetic North, and Celestial North

**Geological North:** The physical North of the axis along which the Earth rotates.

**Magnetic North:** This is the North that a magnetic compass points to.

**Celestial North:** A point in the sky which the Earth's "axis of rotation" or POLE extends towards.

The Geological North Pole (GNP) and the Magnetic North Pole are NOT the same and Celestial North is somewhere in the sky.

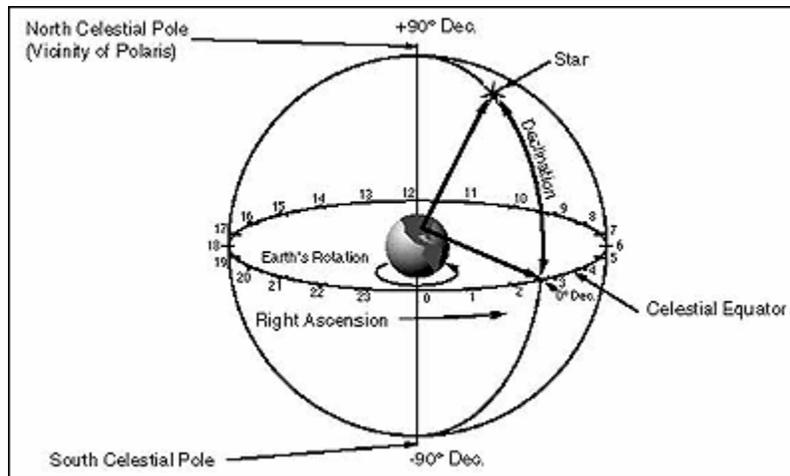
### Which North should you use?

You should use the Geological North if you use your telescope in the Alt/Az position.

You should use the Celestial North if you use your telescope in the Polar position.

The Magnetic North should only be used to help you to find Geological North with the correct magnetic declination correction. Magnetic North should only be used with proper magnetic declination correction. Using the Magnetic North without proper magnetic declination correction will give you a totally wrong directions and total alignment failure.

Figure 19 – North Celestial Pole and magnetic declination



### Polaris, the Pole Star, the North Star

What about Polaris, the Pole Star, is that North? Isn't that the Celestial North? The Polaris is very close to the Celestial North. The Pole star is within one degree of North Celestial Pole (NCP) which is good enough for most Polar alignment purposes.

### North Celestial Pole

NCP is where the optimum North you should be using for star alignment. There will be detailed instructions on how to locate NCP.

## North

### North alignment

#### How which North you choose affects GOTO?

You have a choice of how precise you want your alignment to be. Assuming you have a leveled tripod and correctly set telescope, you can expect the following results:

Telescope in Alt/Az position

- 1) Magnetic North with no magnetic declination correction (unacceptable)
- 2) Magnetic North with magnetic declination correction (acceptable)
- 3) Pole Star (good)

Telescope in Polar position

- 1) Magnetic North with no magnetic declination correction (unacceptable)
- 2) Magnetic North with magnetic declination correction (acceptable)
- 3) Pole Star (good)
- 4) Celestial North (excellent)

Where:

**Unacceptable:** None of the alignment stars are close. Everything will be off. There will be too much error to compensate. The Autostar alignment will end in failure.

**Acceptable:** Alignment stars appear somewhere in the viewfinder or just outside the viewfinder. You have successful Autostar alignment.

**Good:** Alignment stars all appear in viewfinder. You have successful Autostar alignment.

**Excellent** Alignment stars all appear in view finder, maybe even close to the center. You have successful Autostar alignment. Everything must be perfect in order to reach these results.

The magnetic compass will be helpful to find the general north even if not used for alignment. If you don't know how to find Polaris, a compass will at least indicate which direction to look. You will have to use the magnetic compass if hills, buildings, or trees obscure Polaris. The magnetic compass must have a declination correction dial.

## North

### Using a Compass

The Geological North Pole is not the same as Magnetic North. In fact, the North indicated on a magnetic compass could be off by as much as 25°, depending on where you are in the United States. That is obviously unacceptable. You must offset the Magnetic North with the correct magnetic declination. The compass must have a magnetic declination dial for this purpose.

### Magnetic Declination

Magnetic declination is the difference or offset between the MNP and GNP. For example, Los Angeles, California is 13° 34' East of GNP. Therefore, if you use the compass to point to North without knowing the magnetic declination offset, it will not be pointing to the correct direction. If you want to use a compass to find North, you must know the magnetic declination of your location and correct for it on your compass.

### Finding the Exact Magnetic Declination of Your Address

There is a web site that can provide you with the exact magnetic declination of your location. The web site is located at the following URL:

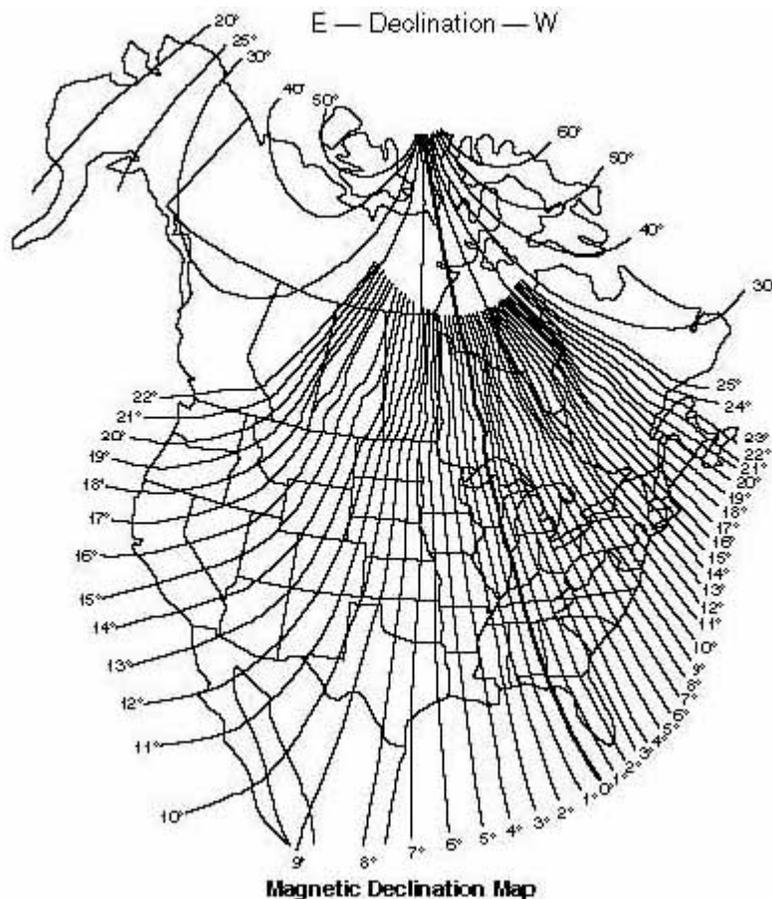
[http://www.geolab.nrcan.gc.ca/geomag/e\\_cgrf.html](http://www.geolab.nrcan.gc.ca/geomag/e_cgrf.html)

You can simply enter the latitude and longitude coordinates of your location and it will provide you with the exact magnetic declination for it.

### Magnetic Declination of North America

As you can see in Figure 20, the offset could produce an inaccuracy as large as 20°.

Figure 20 – Magnetic declination map



## North Using a Compass

### Setting Magnetic Declination

In order to obtain an accurate reading from the compass, first, you must determine the Magnetic Declination in your area using the Isogonic Chart (or from the web site mentioned previously: [http://www.geolab.nrcan.gc.ca/geomag/e\\_cgrf.html](http://www.geolab.nrcan.gc.ca/geomag/e_cgrf.html)).

Figure 21 – Compass with declination scale



The compass must have a “declination scale” which you can adjust. A high degree of accuracy is not expected from using a magnetic compass for alignment. This is to be used only when Polaris is not visible.

Figure 22 – Setting for 16° West declination



Note: Eastern magnetic declination is to the right of the "North" position and western magnetic declination is left of the "North" position. As an example, Figure 22 shows the correct setting for 16° West declination, which covers Providence, Rhode Island.

## North Using a Compass

### Using the Compass to Find North on the Telescope

- 1) Place the telescope in the Alt/Az home position.
- 2) Place the compass on top of the OTA, with the base line (N-S) aligned with the centerline of the OTA. Two rubber bands are used to hold the compass to the OTA securely. A small white card (an upside-down business card) is placed under the compass to aid with reading the scales. Refer to Figure 23.
- 3) Turn the telescope with the azimuth adjustment until the magnetic needle is aligned with North.

Figure 23 – OTA with compass



- 4) Turn the telescope with the azimuth adjustment until the compass needle points to the specific value on the correct side (east or west) of the declination scale. In this case, about 13° East in Los Angeles, California. Refer to Figure 24.

Figure 24 – Compass at 13° East



Note: You can turn the declination dial at the correct declination value to align it with the centerline of the compass base and turn the telescope until the needle point to the N mark on the compass.

As you can see Figure 24, the declination scale is small and can be difficult to set accurately. It would not be efficient to use a magnetic compass for alignment in the Polar position.

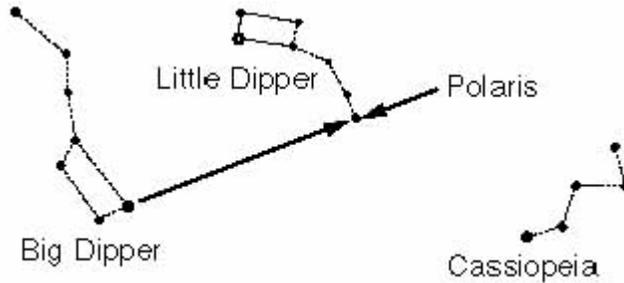
## North Celestial Pole

Note: if you are using your telescope in the Alt/Az position, you will not need to find NCP or do a NCP offset. All you will need to do is put the telescope in the correct Alt/Az home position.

### The North Star, Polaris

The center of a rotating circle does not seem to move. Polaris is very close to being exactly North of the Earth's axis of rotation. Polaris is so far away that it does not seem to move. This makes it a good reference point.

Figure 25 – Polaris in relation to the Little Dipper and Big Dipper constellations



Polaris is the last star on the handle of the Little Dipper. If we joined the two stars at the tip of the bowl of the Big Dipper with a line, the line would point directly to Polaris (refer to Figure 25). Polaris is at a  $89.2^\circ$  declination. This means that Polaris is  $0.8$  degrees away from the NCP. That is almost a full degree off of the NCP. For comparison purposes, the diameter of a full Moon measures about half of a degree. This means that the NCP is almost twice the diameter of the Moon away from Polaris. Even so, using Polaris as the North is good enough for most observations. But for those who want absolute perfection, the true NCP must be used for alignment.

### Where is North Celestial Pole?

The North Celestial Pole is the imaginary point in the sky that is the extension of the Earth's axis of rotation.

True Celestial North is found by drawing an imaginary line from Polaris to the second-brightest star in Ursa Minor, Kochab. The NCP is located  $55'$  arc from Polaris to Kochab along that line.

We can find Kochab, but doesn't Kochab rotate around Polaris too? Polaris and Kochab rotate around the NCP on the opposite side of NCP. Kochab just seems to be rotating around Polaris. That is why we need to use Polaris and Kochab to find the NCP. We can find NCP using the position of Kochab in relation to Polaris.

How do we know how far a  $55'$  arc from Polaris is? The diameter of one full Moon is about half of a degree. Therefore NCP is about twice the diameter of a full Moon away. Unfortunately, we cannot easily use the diameter of a full Moon for measurement. But we do have a tool for this. We know that the standard  $8 \times 21$  mm viewfinder has a field of view of  $6.8^\circ$ . From the center to the edge of the viewfinder would be  $3.4^\circ$ . Divide that by 4 ( $1/4$ ), and you will get  $0.85^\circ$  or  $51'$ .

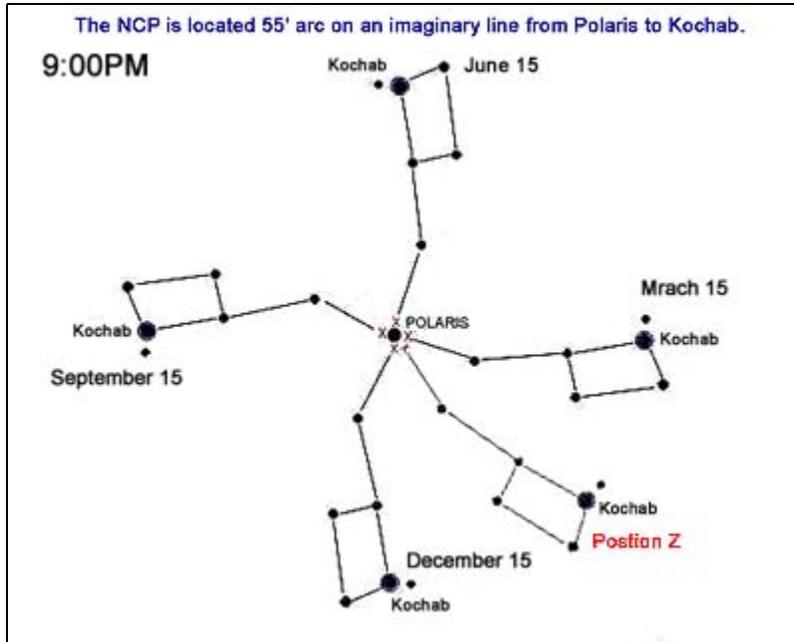
Now that we know that the telescope should be aligned with NCP and have the tool to locate NCP, how do we do a precision alignment? Dr. P. Clay Sherrod of the Arkansas Sky Observatory in Arkansas has developed the "Clay's Kochab Clock" method: Precise Portable Polar Alignment that will help to perform precision polar alignment. For details, see "Telescope Star Alignment" section.

## North Celestial Pole

### Where is Kochab?

Kochab rotates around the NCP on the opposite side of Polaris. Just like a clock, Kochab rotates to different positions at different times (refer to Figure 26). You should offset Polaris opposite to whatever position Kochab happens to be located. Remember the CNP is between Polaris and Kochab.

Figure 26 - The Kochab Clock



Note: The Xs near Polaris in the above picture represent where the NCP is located.

### The Cardinal Points

The cardinal points of Kochab occur on March 15th, June 15th, September 15th and December 15th. Kochab can be found at the 3 o'clock, 12 o'clock, 9 o'clock and 6 o'clock positions at 9:00 PM on those dates.

Date	Time	Position
March 15	9:00 PM	3 o'clock
June 15	9:00 PM	12 o'clock
September 15	9:00 PM	9 o'clock
December 15	9:00 PM	6 o'clock

When Kochab appears on the cardinal point, you only need to offset in one direction, either up, down, left, or right by a 55' arc after centering Polaris. This is the easiest and most accurate point to use. These dates would be the best times to align your permanent telescope pier or stand.

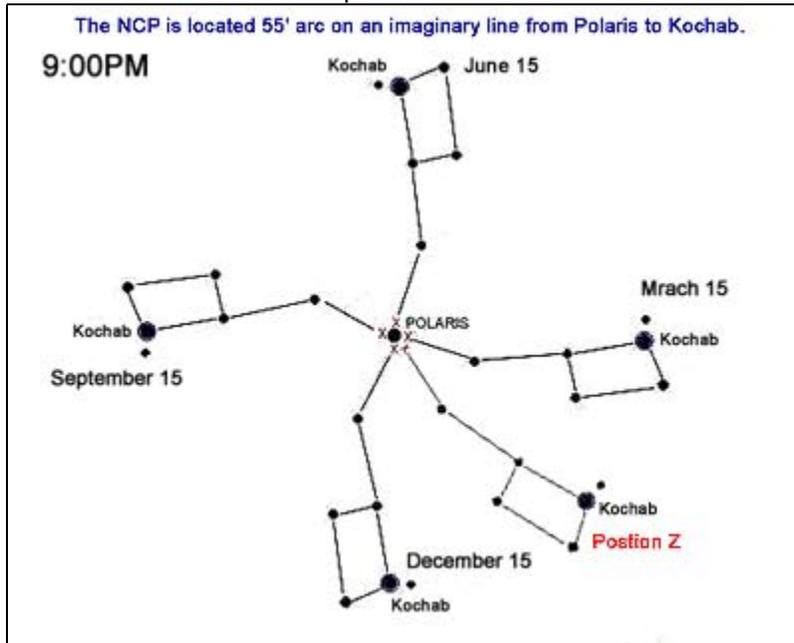
Kochab also appears on other cardinal points during the day. However, you cannot see Kochab or Polaris during other times of the day.

**What if Kochab is in between the cardinal points?**

If Kochab is in between the cardinal points, you can complete the same procedure - put Polaris in the center and offset it to the opposite direction of Kochab. Take a look at Kochab at Position Z. For example, Kochab is at the 4 o'clock position. It does not look it is exactly at 4 o'clock in the picture, but we just assume that it is at the 4 o'clock position. Therefore, Polaris should be at the 10 o'clock position with NCP as the center.

**NCP Offset and Viewfinders**  
**Straight-through Viewfinder (8 x 21 mm)**

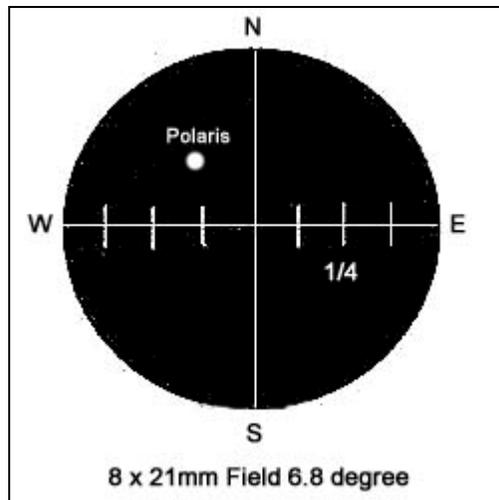
Figure 27 - Kochab at the 4 o'clock position



Note: The Xs near Polaris in the above picture are where CNP is located.

The standard straight-through 8 x 21 mm viewfinder for the ETX-90EC has a normal (up-right and left-right normal) image (refer to Figure 28). It has a 6.8° field of view. From the center to the edge is 3.4°. 1/4 of the distance from center to edge is 3.4°/4 or 0.85° or 51' arc. At Position Z, Kochab is at the 4 o'clock position (refer to Figure 27). You can simply put Polaris in the 10 o'clock position, 55' from center or a little over 1/4 of the distance from the center to the edge.

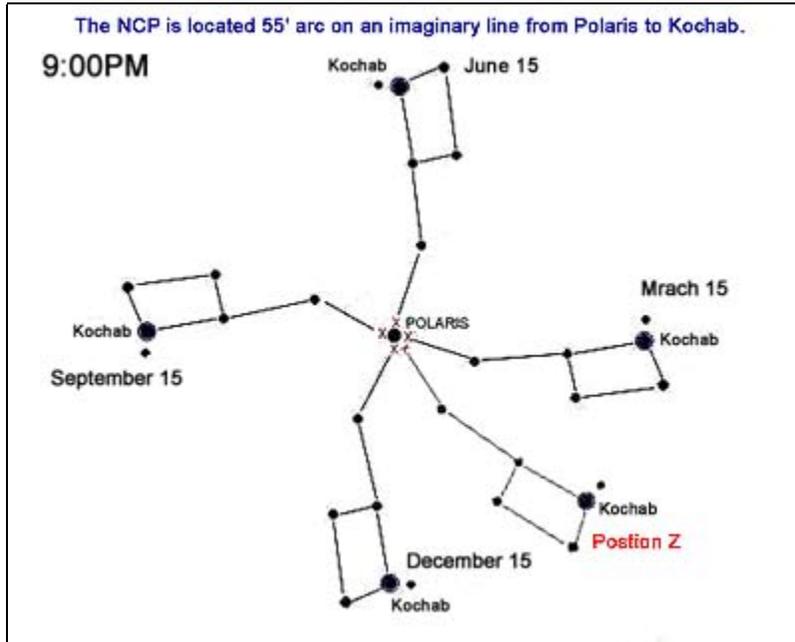
Figure 28 – 8 x 21 mm field of view



In the straight-through viewfinder, Kochab is at the South-East direction of the 4 o'clock position. We can offset Polaris to the N-W at the 10 o'clock position. That is slightly more than 1/4 of the distance from center to edge at the 10 o'clock position. Be aware of the actual direction position (South East) of Kochab. We offset to the North-West direction.

**Offset with a Right-angle Viewfinder (8 x 25mm)**

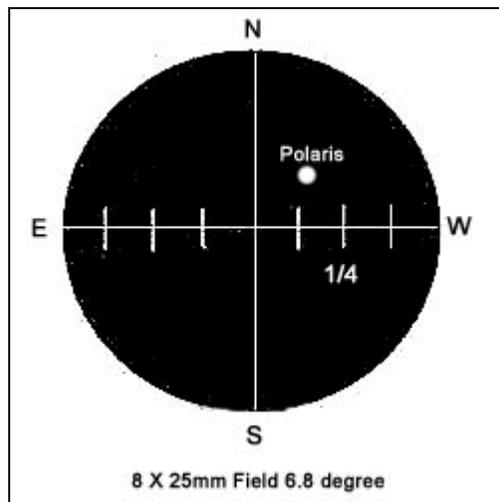
Figure 29 - Kochab at the 4 o'clock position



Note: The Xs near Polaris in the above picture are where CNP is located.

The right-angle 8 x 25 mm viewfinder has a up-right and left-right reversed image. It has a field of view of  $6.4^\circ$ . From center to the edge is  $3.2^\circ$ .  $\frac{1}{4}$  of the distance from center to edge is  $48'$  arc. We need  $55'$  arc. Note the directions in the right-angle viewfinder, North-South normal, East-West reversed (refer to Figure 30).

Figure 30 – 8 x 25 field of view



In the straight-through viewfinder, Kochab is at the South-East direction of the 8 o'clock position. We can offset Polaris to the North-West at the 2 o'clock position. That is slightly more than  $\frac{1}{4}$  of the distance from center to edge at the 2 o'clock position. Be aware of the actual direction position (South-East) of Kochab. We offset to North-West direction. This may seem confusing in the right-angle viewfinder.

### **Other Viewfinders**

For other viewfinders you must first find the field of view from the manufacturer, sub-divide the field of view and offset accordingly.

### **What do I do if I cannot see Kochab?**

It is not very important that you actually see Kochab, as long as you know what is the correct clock position (direction) of Kochab. Since most users' do not be only observing on the Cardinal Point dates, you need to know where is Kochab whenever you need to do an NCP offset. You can find the position of Kochab from software of sky map very easily.

### **Use Planetarium Software to Find Kochab**

There is a hill behind my backyard. I can see Polaris all of the time. However, I cannot see Kochab whenever it is south of Polaris (in the winter and spring). Kochab is behind the hill during those times of the year. I use planetarium software to help me. With the correct date and time, I can look up the clock position of Kochab in the planetarium software. I can then use the information to perform the Kochab clock NCP offset.

### **Use a Dial Type of Sky Map**

Any inexpensive sky map should be able to help you to find the Kochab for NCP offset. You should be able to determine the position of Kochab by turning the dial of the sky map to the correct date and time.

### **Short summary:**

#### **Celestial North Pole**

True Celestial North is found by drawing an imaginary line from POLARIS to the second-brightest star in Ursa Minor, which is Kochab. The NCP is located 55' arc from Polaris to Kochab along that line.

#### **The Kochab Clock**

Kochab rotates around the NCP like a clock on the opposite side of Polaris. You should offset the Polaris 55' arc from center of the viewfinder on the opposite side of wherever Kochab is located

#### **Offset in the Viewfinder (8 x 21 mm)**

You should offset the Polaris a little more than  $\frac{1}{4}$  the distance from the center to the edge of the viewfinder on the opposite side of wherever Kochab is located in the 8 x 21 mm or 8 x 25 mm viewfinder.

## Offset Polaris to North Celestial Pole

You must have azimuth (horizontal turn) micro-adjustment on your tripod for this procedure to work. The azimuth adjustment allows the telescope to turn horizontally without turning the tripod legs. It would be difficult if not impossible to turn your entire telescope a few degrees accurately. You will use the azimuth micro-adjustment to center and offset Polaris in the East-West direction. You will use the latitude adjustment to center and offset Polaris in the North-South direction. A right-angle viewfinder is preferred. You will need an 8" bubble level to level the fork arm of the telescope. Please understand that the NCP alignment is really a tripod-mount alignment. You use the telescope to aim. You will make all adjustments on the tripod mount only.

NOTE: Make sure the viewfinder is precisely aligned with your telescope. An object dead-centered in the viewfinder must be dead-centered in the eyepiece.

The step-by-step procedure to offset to NCP with Polaris:

- 1) Orient the north leg of the tripod to North.
- 2) Attach the telescope to the tripod.
- 3) Level the tripod. This is very important if you do not have a right-angle viewfinder.
- 4) Loosen the RA lock lever.
- 5) Turn the telescope counter-clockwise until you reach a hard stop.
- 6) Turn the telescope clockwise until the DEC dial is directly above the computer panel.
- 7) Set the telescope in the Polar position.
- 8) Push the OTA so that it is pointing down.
- 9) Level the fork arm (for details, see "Level the Fork Arms" section). The OTA is now leveled in East-West directions.
- 10) Tighten the RA lock. The fork arm is now leveled. Recheck the fork arm level after you tighten the RA lock. This assures when the telescope is set to the Polar position or when the telescope swings up and down, it stays in the same vertical line. This is very important. If Polaris is aligned in this straight line, you should be able to find it with only vertical movement of the telescope or the latitude adjustment of the mount.
- 11) Take the telescope back to the Alt/Az position.
- 12) Find Polaris with the viewfinder with only the azimuth adjustment aiming at North. Manually move the OTA up and down to your latitude on the DEC dial. You only need to center Polaris in the East-West direction (vertical cross-hair). It is not necessary to center Polaris in the North-South direction at this point. This aligns the telescope with Polaris when it is pushed back down to the Polar position.
- 13) Point the OTA straight up and at 90° on the DEC dial (for details, see "Set the Dec Dial" section). You can get a little more precise if you level the rim of the OTA, with the OTA pointing straight up, and using a bubble level instead of just reading the DEC dial.
- 14) Push the telescope back to the Polar position. Since we leveled the fork arm, Polaris should be very close along the centerline on the viewfinder.
- 15) Center Polaris in the viewfinder, using **only** the azimuth and latitude adjustment.
- 16) Check the position of Kochab in the sky or check with a sky map software where Kochab determines the direction of offset.
- 17) Offset the Polaris a little more than  $\frac{1}{4}$  of the distance from the center to the edge of the viewfinder on the opposite side of wherever Kochab is located with the 8 x 21 mm or 8 x 25 mm right-angle viewfinder using **only** the azimuth and latitude adjustment.  
If Kochab is at the 3 o'clock position, offset Polaris 55' arc at 9 o'clock position.  
If Kochab is at the 5 o'clock position, offset Polaris 55' arc at 11 o'clock position.

You are now aligned with the NCP. You may proceed to perform the Autostar's star alignment. Note: The first 15 steps are actually putting your telescope in the precise Polar home position.

## Offset Polaris to North Celestial Pole

### What if I Do Not Have a Right-angle Viewfinder?

You must use the eyepiece to offset Polaris to NCP if you don't have a right-angle viewfinder. If your telescope is set up correctly through instruction steps 8 through 18, Polaris should now be in the eyepiece in the Polar position. You should be able to find Polar by adjusting only the latitude adjustment. This is the method I always use with my ETX-90EC until I got a right angle viewfinder after I bought the ETX-125EC.

The 26 mm eye has a field of view of 1.1° on an ETX-90EC. You should put Polaris on one edge and offset it almost to the opposite side of the field of view. For details, see the Telescope Eyepieces Magnification/Field of View chart.

Telescope	Eyepiece	Field of View	Offset
ETX-60/70	26mm	3.9° (234' arc)	¼ distance from center to edge (234/4 or 58.5')
ETX-90	26mm	1.1° ( 66' arc)	Almost edge to edge.(55')
ETX-125	40mm	55' arc	Edge to edge

If you cannot find Polaris with just the vertical movement of the OTA using the latitude control, you must go through and make sure you completed steps 3 through 18 correctly. Most likely, your tripod is not level or the fork arm is not level. There is only one up and down movement for the OTA, and Polaris must be in that straight line. If Polaris is not in that straight line, you may have too much free-play somewhere in the tripod or fork arms or the RA base.

An eyepiece of longer focal length will give you a wider field of view. You will find Polaris easier with a wider field of view.

### Which is Better, Offsetting with the Viewfinder or Eyepiece?

If you have an eyepiece with a wide enough field of view, it is more accurate to offset with the eyepiece. This is simply because you are using a much smaller field of view. It is easier and more accurate to sub-divide ( $\frac{1}{2}$ ,  $\frac{1}{4}$ ,  $\frac{1}{3}$ ...etc) a smaller area than a bigger area.

### Tips for Eyepiece NCP Offset

Since the offset must be done with the latitude and the azimuth adjustment on the tripod, I have found it helpful to know the actual number of turns of these adjustments to cause the target object to go from one edge to the other edge in the eyepiece. The field of view of a 26 mm eyepiece is 1.1° on my ETX-90EC. This means if I place an object at one edge and turn one of the adjustment knobs to move the telescope so the object is now at the opposite edge, I have moved 1.1°. I would put a piece of masking tape on the adjustment knob to see how many turns it takes to move this 1.1°. I have found that I need to turn the adjustment knob almost one full turn to move this 1.1° on my tripod.

So here is the calculation:

$$1.1^\circ = 66 \text{ arc seconds}$$

If I center Polaris from the center to the edge, it is 33 arc seconds.

I need to offset 55 seconds.

I can:

- 1) Place Polaris at one edge and offset almost to the other edge
- 2) Place Polaris at the center and offset it out of view with a little more than  $\frac{3}{4}$  turn of the adjustment knob.

Either way I should be off very little. The ideal situation would be the ETX-60/70 with the 26 mm eyepiece, which has a field of view of 3.9° which is just  $\frac{1}{2}$  the distance from the center to the edge in the eyepiece.

## Star Alignment

### Why the Autostar Requires Star Alignment

The Autostar stores the coordinates of the stars in its database. It then calculates the relative location of the stars based on the time, date, latitude, longitude, and relative positions of known stars. The star alignment provides the Autostar with the position of the star to known positions: Polaris and position of your telescope on earth.

Position of the telescope on Earth is the latitude and longitude coordinates that you (the user) entered into the Autostar site information. Since the Earth rotates, it is important that the time position of the telescope is entered each time you turn on the Autostar. Position of the telescope in relation to known position of stars is provided to the Autostar by star alignment.

The star alignment is basically a triangulation with known positions of stars. If the observing angles of two stars are measured and the angle to NCP is known, the Autostar can calculate what the observing angle should be for the other stars. The Autostar then commands the telescope to turn to the calculated position of the requested GOTO stars.

The Autostar provides two alignment positions (Polar and Alt/Az), each with three alignment methods (Easy, One Star, and Two Stars). The Easy and Two Stars methods both use one known position (NCP) and two known stars. The Autostar chooses the best two alignment stars for you in the Easy alignment while you choose the two alignment stars yourself in the Two Stars alignment.

### Which Star alignment, Easy, One Star or Two Star

Star alignments using two stars are more accurate than One Star alignments. Consider that in geometry, you need two points to define a line, 3 points to define a plane, and 4 points to define a 3-dimensional object. The position of the NCP, the position of the telescope on Earth, and two stars makes 4 points that define a 3-dimensional object. One-star alignment has only three points - position of the NCP, the position of the telescope on Earth, and one star. Those are enough points to only define a plane.

### The Important Reference Points:

The resulting Autostar GOTO accuracy depends on how precise you set the various reference points. Star alignment depends on the following references:

- 1) Date and time
- 2) Location of the telescope (latitude, longitude, time zone)
- 3) Location of North (North, Polaris, Celestial North Pole)
- 4) First alignment star
- 5) Second alignment star

### Polar Alignment or Alt/Az Alignment

Alt/Az alignment is easier to perform. It is not as accurate because you start out with the Optical Tube Assemble (OTA) in the horizontal position. As a result, you cannot point the telescope at the NCP. The best you can do is point the telescope at the NCP first and then swing the OTA back down to level. The Autostar calculates and uses both drive motors for tracking continuously. It has to constantly activate the RA and DEC motor to track the star. A perfectly leveled tripod is required.

Polar Alignment takes slightly more steps to perform. It can be very accurate. Polar alignment is a must for astrophotography.

## Star Alignment

### Star Alignment

Here is a brief description of the Autostar alignment process:

The Autostar has two alignment positions (also known as mounts) for ETX telescopes: Polar and Alt/Az

The Autostar has three alignment methods: Easy, One Star, and Two Stars.

Easy:	The Autostar provides you with the best stars based on the date, time, and location.
One Star:	The Autostar points to Polaris plus one other star.
Two Stars:	Same as the Easy method, but you choose the two stars used for alignment.

You can see that whichever alignment you choose, it uses at least three points of reference.

One Star alignment is not recommended for precise GOTOs.

The Autostar's selected alignment stars are at least 90° apart in the sky and are the brightest stars in the direction at that time and date. Therefore, unless you are very familiar with the stars, it is better to let the Autostar select the alignment stars for you with the Easy alignment method.

Whatever mount position you choose and whichever alignment method you select this is the general process:

- 1) The Autostar confirms that your telescope is in the proper mount position.
- 2) You or the Autostar chooses the first star and points the telescope to it.
- 3) You center the first star with the keypad and press Enter to confirm.
- 4) You or the Autostar chooses the second star and points the telescope to it.
- 5) You center the second star with the keypad and press Enter to confirm.
- 6) The Autostar gives either a successful or failed alignment message.

If everything is set up according to the instructions, the alignment stars should always appear in the viewfinder (or just outside the field of view of the viewfinder). You should not have to scan the sky to find the alignment star. How accurate the alignment star appears initially in the center of your viewfinder is a good indication of how accurate your initial set up is.

It has been my experience that whenever something went wrong in a star alignment, I would go back and recheck all of the settings in the Autostar (time zone, mount type, date, time) and also recheck the telescope tripod leveling, OTA, or Fork arm leveling. I would usually find one or more of those items not set correctly.

Rule of thumb on the alignment star:

- 1) If there is only one star, this is the right star.
- 2) If there are several stars in the general direction of the alignment star, it is usually the brightest one in the group. The Autostar always chooses the brightest star in the group for alignment.
- 3) If you cannot decide on a star, you can press the SCROLL down key for the next star.

## Star Alignment

### Star Alignment Checklist

This is the checklist you should go through before you start the star alignment. You do not want to redo the setup and offset again because after the Autostar moves your telescope, you will have to level the fork arm or the OTA and point to north again. This is similar to the pre-flight checklist for the pilot.

Please remember, performing the entire pre-alignment checklist and alignment procedure may seem like a lot of work, but in reality, it should not take more than 3 minutes to complete. Spending those 3 minutes to make sure everything is correctly set up can pay off with an entire night of accurate GOTOs.

Note: It is possible to check some of the information by pressing the MODE key for two seconds, holding it in, and releasing (for details, see the “Autostar Key Basics” section), but it will not provide you with telescope model, mount, daylight saving, or time zone information.

Checking these settings is especially important if you use your computer to control the ETX-Autostar. Some software might change the settings in your Autostar during its operation. These changes made by the PC software may cause total star alignment failure or incorrect GOTOs if not corrected.

### Telescope/Tripod/Mount Checklist:

#### Polar Position

- Tripod level (See “Leveling Tripod”)
- Fork arm level (See “Leveling Fork Arms”)
- Telescope points to 90° on DEC dial (See “DEC Dial”)
- Telescope in Polar home position
- Polar offset performed (See “Polaris Offset”)

#### Alt/Az Position

- Tripod level (See “Leveling Tripod”)
- OTA points to North and is level (See “Alt/Az Home Position”)

### The Autostar Checklist:

#### Telescope

- Model
- Mount (Polar or Alt/Az)

#### Site

- Latitude
- Longitude
- Time Zone

#### Date

- Time** Synchronize with a precision time source

#### Daylight Savings

### **The Autostar Pre-alignment Check Step-by-Step:**

- 1) Press the MODE key until "Object" is displayed.
- 2) Press the SCROLL down key until "Setup" is displayed.
- 3) Press the SCROLL down key until "Telescope" is displayed.
- 4) Press the ENTER key.
- 5) Press the SCROLL down key until "MODEL" is displayed.
- 6) Press the ENTER key.
- 7) Check if your telescope model is selected indicated by the "<" mark. If not, press SCROLL down key until your model telescope is displayed, and press the ENTER key.
- 8) Press the MODE key.
- 9) Press the SCROLL down key until "Mount" is displayed.
- 10) Press the ENTER key.
- 11) Check if the mount position is correct indicated by the "<" mark. If not, press the SCROLL down key until you see the position desire, and press the ENTER key.
- 12) Press the MODE key.
- 13) Press the SCROLL down key until "Site" is displayed.
- 14) Press the ENTER key.
- 15) Press the SCROLL down key until "Select" is displayed.
- 16) Press the ENTER key.
- 17) Check the name of your site. If it is not correct, press the SCROLL down key until your site name appears, and press the ENTER key.
- 18) Press the MODE key.
- 19) Press the SCROLL down key until "Edit" is displayed.
- 20) Press the ENTER key on latitude, check, or enter value.
- 21) Press the MODE key.
- 22) Press the ENTER key on longitude, check, or enter value.
- 23) Press the MODE key.
- 24) Press the ENTER key on time zone, check, or enter value.
- 25) Press the MODE key.
- 26) Scroll down until "Date" is displayed, press the ENTER key, and enter the correct date.
- 27) Press the MODE key.
- 28) Scroll down until "Time" is displayed, press the ENTER, and enter the correct tTime (see "Precision Time").
- 29) Press the MODE key.
- 30) Scroll down until "Align " is displayed.

You are now ready for alignment.

## Star Alignment

### Star Alignment Step-by-step

Assuming the tripod and telescope are already set up for alignment for the desired telescope mount position, you have gone through the entire pre-alignment checklist, and you are ready for alignment.

Note: Center the alignment star with a one-direction, stop-and-go movement. You should avoid centering the target star with any movement that involves changing direction. For example if you are adjusting by moving to the left, try not to make adjustments that involve moving to the right.

#### Step-by-step Autostar Easy Alignment:

- 1) Press the MODE key until "Object" is displayed
- 2) Press the SCROLL down key until "Setup" is displayed and press the ENTER key.
- 3) Press the SCROLL down key until "Alignment" is displayed and press the ENTER key.
- 4) Press the SCROLL down key until "EASY" is displayed and press the ENTER key.
- 5) The Autostar will start to search. It will eventually find the first alignment star and point the telescope in that direction. The telescope will come to a complete stop and the Autostar will display the instructions on how to center the first alignment star.
- 6) Assuming the first alignment star is in or just outside the field of view of the viewfinder, look into the viewfinder to center the alignment star in the viewfinder using the Autostar's directional keys at a slow speed. If you know enough about your viewfinder and eyepiece, adjust so that the alignment star appears at the edge of the field of view.
- 7) Make adjustments at a reasonably slow speed. Remember the drive gear slack. Look into the eyepiece and center the first alignment star in the eyepiece (using a one-direction, stop-and-go movement for adjustment). Press the ENTER key when the target is centered.
- 8) The Autostar will start to search. It will eventually find the second alignment star and point the telescope in that direction. The telescope will come to a complete stop and the Autostar will display the instructions on how to center the second alignment star.
- 9) Assuming the second alignment star is in or just outside the field of view of the viewfinder, look into the viewfinder center the alignment star in the viewfinder using the Autostar's directional keys at a slow speed. If you know enough about your viewfinder and eyepiece, adjust so that the alignment star appears at the edge of the field of view.
- 10) Make adjustments at a reasonably slow speed. Remember the drive gear slack. Look into the eyepiece and center the second alignment star in the eyepiece (using a one-direction, stop-and-go movement for adjustment). Press the ENTER key when the target is centered.
- 11) The Autostar will calculate and display a message that your alignment was successful or a failure.

For two star alignment, you would use the SCROLL up/down keys to select the alignment star in steps 5 and 9. All other steps are the same. This is not recommended unless you are very familiar with the stars and the sky.

My experience with star alignment has shown that while you can tell how good your GOTOs will be based on how close your alignment stars appear in the viewfinder, the more precise I perform the leveling of the tripod, fork arms, and setting the DEC at 90 degree and Polaris NCP offset, the closer the alignment stars will appear in the viewfinder.

## Star Alignment

### Troubleshooting

***If anything goes wrong, always check the basic setup and information.***

If your observation system is setup correctly before alignment, the alignment stars should always appear in the viewfinder or just outside the view of the viewfinder. You should never have to scan the sky to find the alignment star.

***What if I cannot see the star that the Autostar selected anywhere?***

Assume that it is a cloud or atmospheric condition or the star is obscured. You can just skip to the next star. Press the SCROLL down key for the next star. If your view is not obscured and you cannot see the alignment star, check your settings.

***What if there is more than one star in the general direction and they look to be about equal brightness?***

You could consult your star chart, but it is just as easy to press the SCROLL down key to skip to the next one. Do not confirm, unless you are sure about the correct star. Otherwise, the Autostar will “compensate” to figure out a compromise result based on the wrong star you confirmed. The GOTO will not be accurate. If you are unsure, do not confirm.

***What if the first star is way off?***

You might as well start over. Assuming your tripod is level and you pointed the telescope to North correctly, check ALL of the settings in the Autostar.

***What if the alignment failed?***

Check all the settings and start over.

***How do I get out of the alignment process?***

That depends on how far you are into the process. You can try pressing the MODE key. If that does not work, you will have to complete the process or turn off the telescope. Turning off the telescope would wipe out the data and time information.

***Can I run out of alignment stars?***

Yes, there are a limited number of alignment stars in the Autostar for any given date, time, and location. If you keep skipping through the Autostar’s selected stars, you will eventually return to the first star. This is also a good indication that something in your setup is wrong.

***Why is my GOTO not accurate?***

If the GOTO is not accurate, some steps in your setup may not have been completed accurately, such as time, leveling of the tripod, leveling of the fork arms, the pointing to North or NCP, or the training drive is not accurate.

***Why are the Easy alignment stars different from the night before?***

The selection of Easy alignment star will change from time to time. After a while, you will notice that the Autostar uses the same pair of stars night after night until one day the Autostar decides that it needs to change to a different star or a different pair entirely.

***Why does the target object drift slowly out of my field of view in the eyepiece?***

- 1) The drive motor is not trained properly. Retraining the drive motors properly will eliminate most GOTO and tracking problems.
- 2) The North alignment or star alignment was not completed precisely.

## **Permanent Telescope Stands or Piers**

You might be asking, “Do I have to go through all these steps to level, offset, and align everything time I take out my telescope?” It depends. You do if your telescope is mobile; you don’t if your telescope is stationary.

If you have a permanent type of telescope stand or telescope pier, you only have to perform the NCP offset once. Remember that the NCP offset aligns the tripod/mount. If you did not change any of the settings on the tripod/mount, you do not have to do the NCP offset every time.

## **Park the Telescope**

If the telescope is not moved between observation sessions, you do not have to perform star alignment. There is a feature in the Autostar called the “Park Scope” in the Utility menu. After you finish an observation session, just park the scope. The Autostar will turn the telescope to the park position and instruct you to turn off the power. The “Park” position is actually the home position. The next time you turn the telescope back on, you only need to enter the date, time, and daylight savings information into the Autostar.

I often align the telescope in the early evening, stargaze until I am tired, then park the telescope and go to bed. Then I get up in the early morning and stargaze again. All I have to do is to turn the telescope on again, enter the date, time and daylight savings information. The Autostar then recalculates everything else and I am ready to GOTO again with star alignment. I could leave the telescope on but parking the scope saves power. It is important that you have the date and time entered as precisely as possible because the Autostar GOTO computations are based on the correct date and time.

### **Park Scope**

- 1) Press the MODE key until “Object” is displayed.
- 2) Press the SCROLL down key until “Utility” is displayed, press the ENTER key.
- 3) Press the SCROLL down key until “Park Scope” is displayed, press the ENTER key.
- 4) Wait for the telescope to go into the park position.
- 5) Turn off telescope power when the Autostar instructs you to do so.

There have been reports from other users that they could remove the telescope from the tripod, pier, or stand that remained unmoved after each session without doing a star alignment for the next session simply by using the Park Scope feature. However, your telescope and tripod must be in top mechanical condition for you to do so. Top mechanical condition means your telescope should have very little free-play in DEC and RA drive system. Your tripod/mount must also be tight. Excessive free-play in the motor drive system could render any previous alignment unusable.

## **Put the telescope to Sleep**

The Utility/Sleep feature turns off both the Autostar display and the tracking motors. If you press any of the keys, the telescope resumes all functions. The power is not turned off and the Autostar and the telescope retain their existing states. This is a power saving feature for your battery.

### **Sleep Scope**

- 1) Press the MODE key until “Object” is displayed.
- 2) Press the SCROLL down key until “Utility” is displayed. Press the ENTER key.
- 3) Press the SCROLL down key until “Sleep Scope” is displayed. Press the ENTER key.
- 4) The Autostar display will disappear. Telescope should now be asleep.
- 5) Press any key to resume all functions.

## **Star Gazing**

### **Autostar-Guided Star Gazing**

Once you have successfully completed all of the setup and alignment procedures, the Autostar and telescope will work exactly as advertised - you select a target object on the Autostar, press GOTO, and the telescope will point precisely to the target.

The 497 Autostar has a database of 3000 celestial objects. These are the objects that the user can select and command the telescope to GOTO. The celestial objects are grouped in the following categories:

- Solar Systems
- Constellations
- Deep Sky
- Stars
- Satellites

Each category then has its own set of sub-groups which is more specific categories. Please refer to the original manual for details on sub-groups.

Basically, you select the category by pressing the ENTER key, scrolling up or down the available option until you find the target object, then pressing the ENTER key again and finally pressing GOTO. The telescope will then go to the star you have selected.

## **Name that Star**

### **Identify A Star**

The "Identify" function under the "Object" menu will attempt to identify the object at the current telescope pointing position. It is possible to point the telescope in any direction and ask the Autostar to identify the target object. You simply center the target object and press the ENTER key. The Autostar will then search its database and give you the name of the closest object in the database that matches the telescope's current pointing position. This is the feature that answers the question: What is the name of that star?

## Telescope Eyepieces Magnification/Field of View Chart

<b>ETX-60/70</b>		
<b>Focal Length</b>	<b>Magnification</b>	<b>Field of View</b>
26 mm	13.5X	3.9°
20 mm	17.5X	3.0°
15 mm	23.4X	2.3°
12.4 mm	28.3X	1.9°
9.7 mm	36.1X	1.5°
<b>ETX-90</b>		
<b>Focal Length</b>	<b>Magnification</b>	<b>Field of View</b>
40 mm	31X	1.5°
26 mm	48X	1.1°
20 mm	63X	49'
15 mm	83X	37'
12.4 mm	101X	30'
9.7 mm	129X	24'
6.4 mm	195X	15'
<b>ETX-125</b>		
<b>Focal Length</b>	<b>Magnification</b>	<b>Field of View</b>
40 mm	48X	55'
32 mm	59X	52'
26 mm	73X	42'
20 mm	95X	32'
15 mm	127X	24'
12.4 mm	153X	30'
9.7 mm	196X	15'
6.4 mm	297X	10'

## The ETX-The Autostar PC Observation System

If you like the GOTO ability of the ETX-Autostar Observation System, you will be interested in the ETX-Autostar PC Observation System. Instead of using keys on the Autostar to point the telescope, you can use the PC's mouse. From behind a computer screen, preferably a laptop computer, you can point the cursor to a star, click the mouse, and the telescope will point to the target star. It is very convenient.

This system can also find constellations easily. Just look at the computer screen and compare it to the sky. Click on each star of the constellation, and point the telescope to the stars in the constellation one by one. Learning astronomy becomes much easier. You can actually see what Orion looks like now with the help of the computer screen and the names of all of the stars that make up that constellation.

The system can also find Kochab for NCP alignment. In my case, I cannot see Kochab for at least 4-5 months out of the year due to the hill behind my backyard. I use the feature on the computer planetarium program to determine the clock position of Kochab. This is very helpful with my NCP alignment.

You will need a computer (preferably a laptop computer), a Meade #505 or 506 cable, and planetarium software that has telescope control functions. Connect the computer to the Autostar, start the planetarium software, and you now have an ETX-Autostar PC Observation system. If you want to add more convenience, add an Internet connection to the PC. The computer should be reasonably close to the telescope so that you do not have to walk far from the telescope. If you want to add more convenience, put a CCD eyepiece on the telescope with the appropriate cable. You now have a remote-controlled telescope system. You do not even have to go outside.

### How to connect the computer to the ETX-Autostar Observation System:

#### Cables and The Autostars

The #506 cable has an electronic "black box" within the cable. You use this cable with #494 Autostars.

The #505 cable has no electronic "black box". You use this cable with #495 or #497 Autostars.

The #494 Autostar has no number keys.

The #497 Autostar has number keys.

#### Connecting Cables

Meade recommends that both the telescope and computer should be turned off before making connections with the #505 cable.

#505 cable (use with the #495/497 Autostars)

You connect the DB-9 end to the serial port of your computer and the RJ-22 end to the Autostar. The #505 must **NEVER** be connected to the telescope itself.

#506 cable (use with the #494 Autostar)

You connect the DB-9 end to the serial port of your computer and the RJ-22 end to the auxiliary port on your telescope.

## WinStars Telescope Control Software

### Controlling your Meade ETX 90/105/125 EC telescope from your computer

#### I. Downloading and Installing Winstars

You will need WinZip to unzip the WinStars file before you can install WinStars. If you do not have WinZip install on your computer, visit the following URL to download and install WinZip.

WinZip: <http://download.cnet.com/downloads/0-10097-100-1757502.html?tag=st.dl.10001-103-1.lst-7-1.1757502>

Once you have WinZip (or if you already have it), visit the following URL to download and install the WinStars Planetarium software:

WinStars: <http://winstars.free.fr/english/index.html>

When the download dialog box appears, you will have the choice of saving the file to disk or to open the file. If you decide to save the file to your hard disk be sure to remember the directory for future reference.

WinZip will unzip and install WinStars after the download has completed. WinStars will be installed in a directory named "WinStars" on your local C: drive.

WinStars does not create a program group or shortcut automatically. If you would like to create a desktop shortcut, follow this procedure:

- 1) Double-click on My Computer.
- 2) Double-click on C: drive.
- 3) Go into the WinStars directory.
- 4) Right-click on the WinStars icon.
- 5) Select "Create Shortcut" from the menu. A new Winstars shortcut will be created.
- 6) Drag the WinStars shortcut icon to your desktop.

You can now execute the Winstars program from your desktop by double-clicking the shortcut.

#### II. Connecting the Autostar to the computer

Connect the cable to the Autostar ONLY. Do not connect the cable to the telescope.

Check that both the computer and your ETX telescope are OFF, and follow this procedure:

- 1) Connect the large end of the cable to the serial adapter.
- 2) Connect the small end of the cable to the small socket in the Autostar hand box.
- 3) Connect the serial adapter to the serial port of you computer.

You may now turn on the computer and your telescope.

### III. Initializing the Autostar

Press the appropriate key sequence to get out of the Warning Message, the Getting Start message, Date, Time, Align screens until you see Object display on the Autostar hand box. Press the Arrow key to make sure the telescope can be controlled from Autostar properly.

### IV. Testing the connection between the Autostar and your computer

Double-click on the WinStars shortcut to start the program. By default, WinStars has COM1 selected as your serial port. If your serial port is located on another COM port, you will have to change the setting manually. To change the setting manually, follow this procedure:

- 1) From the Menu bar, click on Telescope.
- 2) Select Config RS232.
- 3) Select the correct COM port for your serial port.
- 4) Click Apply.

You must now open the connection from the computer to the telescope. To open the connection, follow this procedure:

- 1) From the Menu bar, click on Telescope.
- 2) Select Open LX200.

Autostar uses a subset of the telescope commands as the Meade LX200. LX200 is the big brother telescope. You will not find any ETX telescope setting anywhere in the software. If the Autostar and telescope are correctly connected, the LX200 module dialog will appear. Using your mouse, you can click on the direction button in the LX200 dialog box to aim the telescope. If an "Error, impossible to communicate with the serial port!" message appears, check your connections, check your power supply, and check your serial port settings.

### V. Setting Up Your Location

To set up your location, follow this procedure:

- 1) From the Menu bar, click on Observation.
- 2) Select Time and Location.
- 3) Enter the SAME time zone that you entered in your Autostar.

You will have to adjust for daylight savings time in Winstars. For daylight savings time, add one hour to the time zone. For example, if you are in the Pacific Time Zone, you are in -8 hour. Add one hour for daylight savings time:

$$-8 + 1 = -7 \text{ hours}$$

You can select your location from the Town drop-down menu, or you can enter the geographic coordinates manually. For exact coordinates, visit Tele Atlas at <http://geocode.com/eagle.html> to find the exact the coordinates of any address in the U.S. Enter these coordinates into your Autostar and WinStars. Accurate Latitude and Longitude coordinates are very important for precise alignment of the telescope. Refer to your Autostar manual on how to create a custom site in Autostar with the exact Latitude and Longitude coordinates.

Check that your computer is displaying the correct time. The time on the Autostar should be the same as the time on your computer. This will keep the two synchronized with each other.

## VI. Aligning Your Telescope

Check all of your basic settings before alignment!

If your alignment procedure is NOT precise, it will affect the precision of your telescope readings. If you check the Autostar again, you will usually find that one or more of the settings has been changed, the time is not correct, the time zone is not correct, the mounting (polar/AltAz) and site location (longitude, latitude, time zone). Make sure the base of the telescope is on a level surface. If the base is not on a level surface, the horizontal movement may be inclined, and the vertical movement will not be plumbed.

You may now begin the telescope alignment procedure using any one of the Autostar alignment (Easy, One star and Two star) methods. Polar Easy or two stars alignment is more precise than the other alignment methods. Please note that the more precise your alignment of the telescope is, the more precise the telescope will point with Autostar and WinStars. The Autostar should remain connected to the computer. However, please minimize the WinStars window before you start the alignment procedure.

The accuracy of the telescope depends on your alignment procedure and telescope set-up. The WinStars program does not affect the accuracy. After you have properly aligned your telescope, you can now start the WinStars planetarium software. Check that the WinStars location and time settings (click Observation on the menu bar, click Time and Location) are correct. Open the Connection to control the telescope: click Telescope on the menu bar. Click Open Connection LX200. You are now ready to control the telescope from your computer.

Please refer to the online help (Click on the “?” on the Menu bar) for detailed information on operation and customization of WinStars.

Important: An operation must be allowed to complete on one device before another operation is allowed to start on another device. You can do a GOTO with the Autostar OR WinStars. However, never start one operation on the Autostar and another operation on the WinStars or vice versa. Doing so may confuse the telescope, cause the telescope to lose its alignment, or even cause the telescope's motor to fail.

## IV. Tips

- 1) You can hide the LX200 module dialog box so it does not obstruct the WinStars screen. From the menu bar, click Telescope, and select Hide LX200 module. You will not need the LX200 module dialog box for normal operation.
- 2) Click on the Zoom buttons (magnifier buttons) to change the size of the sky view. If you have a mouse with a wheel, you can adjust the sky size with the wheel.
- 3) Click on the Sky View Direction Buttons (the pointing triangle buttons) to move the direction of the sky view.
- 4) Click and hold down the left button of your mouse and drag to move the entire sky.
- 5) Click on the N, E, S, W, and Z to send the sky view directly to the North, East, South, West and Zenith direction.

- 6) Double-right click (not double-left click) on the star on the screen to select the star. Selecting the star put the star in the center of the screen with a red cross. The About Object dialog box also appears with the star information. **Click the Follow button and the telescope will point to the star and stops.**

**Note:** WinStars depends on the accuracy of your alignment. WinStars functions exactly as the GOTO functions in your Autostar except that you are doing the GOTO from the computer screen, which is much easier. If your GOTO value with the Autostar is off, the Follow of WinStars will be off by the same amount.

- 7) Double left-click centers the selected and center object on the screen only without the About Object dialog box.

Customize your WinStars with Options on the Menu Bar.

## The ETX/Autostar PDA observation system:

The Autostar does not have a graphic interface. PC or PDA have a graphic interface to do point and click. If I don't feel like to take the 6 lb notebook computer with me, I would just use the 6oz Palm OS PDA. Even though the PDA screen is considerably smaller than the PC screen, it is still a very nice interface to work with. I use the stylus to do the point and click and the telescope points to the target object.

The ETX/Autostar must be aligned properly prior to use with the PDA for it to work properly.

If you like the GOTO ability of the ETX-Autostar Observation System, you will love the ETX-Autostar PDA Observation System. Instead of using keys on the Autostar to point the telescope, you can use the stylus of your PDA. From a graphic screen of PDA you can point the cursor to a star, the stylus, and the telescope will point to the target star. It is very convenient.

This system can also find constellations easily. Just look at the screen and compare it to the sky. Point with your stylus on each star of the constellation, and point the telescope to the stars in the constellation one by one. Learning astronomy becomes much easier. You can actually see what Orion looks like now with the help of the graphic screen and the names of all of the stars that makes up that constellation.

You will need a Palm/Autostar cable adaptor. Either case you need planetarium software that has telescope control functions. You can find this Palm/Autostar cable adaptor at:

[http://www.atozastro.com/products/palm\\_cable.asp](http://www.atozastro.com/products/palm_cable.asp)

*You must still use the Meade #497 Autostar to connect to the telescope. The PC or PDA is connected to the Autostar and NEVER to the telescope directly. It is still the Autostar that control the telescope movement. The PC or PDA just tell the Autostar where to point. Whatever software on your PC or PDA cannot control the telescope directly. .*

Note: The 505 cable adaptor has a female DB-9 connector. The Palm/Autostar has a male DB-9 connector. The DB-9 may is NOT interchangeable even with a gender changer.

## **The Planetarium for Palm OS PDA**

Yes, point your stylus on the Palm organizer screen and control the telescope. Point to a Planet, a star, a galaxy... on your Palm hand held screen and command the telescope to point to wherever you have selected. This is a cable set and software combo that allows you to control your Meade telescope with Meade 497 Autostar from your Palm organizer. The software sends commands to the Meade #495 or #497 Autostar to control the telescope.

### **Compatibility**

- Runs on PalmOS 2.0 or higher.
- Uses gray shades on PalmOS 3.0 or higher.
- Uses colors on color devices.

You need a serial hot sync cable for your Palm PDA. Different Palm PDA model may need a different serial hot sync cable. This cable is available on ebay for about \$10-\$15.00 depending on model. This Palm/Autostar cable & adapter set connects the Autostar to the Palm device in the cradle OR with a Palm serial hot sync cable.

The Planetarium software is a shareware and is fully functional. If you install it on your Palm it will run as demo version and will give you plenty of time to try it out and check if you like it. After a while it will begin to show a remainder screen at program start to convince you either to register it or to remove it again from the Palm. If you decide to register, you will receive a registration code, which you enter into the program. This will convert the program into the registered version and disable all remainder screens. When you register you will get a registration code you can enter into Planetarium that disables the reminder screens, so you can fully enjoy the program. The shareware fee is not very high compared to the amount of functionality you get. This allows the author to give you the software for a very competitive price (\$24). However, The author needs some revenue to be able to continue developing software and supporting our users.

### **Installation**

You install Planetarium into you Palm PDA the same way you install other software. The software is in the Planetarium folder. The detail manual is in the Manual folder in the Planetarium folder when you download the software.

You must install the LX200 telescope driver to use Planetarium with you ETX/Autostar observation system. Autostar uses many of the command of the LX200 telescope.

For latest update and other Planetarium related info go to <http://www.aho.ch/pilotplanets/>