# EVO-zero

*Belt Drive System*

## Compact Equatorial Mount


# INSTRUCTION MANUAL

*Version 1.0.2 May 2022*

# SAFETY STANDARDS AND WARNINGS

- **Read the manual carefully before installing and using the mount.**
- **To make the document easier to read in the field, we recommend that you to copy all documentation files from the supplied USB flash drive to a smartphone or, even better, to a computer or tablet.**
- **Use the power cable supplied with the mount or else a 12V- 3A stabilized power supply as suggested in the manual.**
- **Make sure that the power cable is connected correctly and securely to the power socket.**
- **Do not bend, pull or press the cable as this may damage it.**
- **For any assistance or repairs, please contact only the manufacturer.**
- **Be sure to remove the power supply at the end of an observing or imaging_session or before performing cleaning or maintenance. When removing from a power outlet, pull on the plug, not the cable.**
- **This mount is intended for use exclusively by adults. Do not allow it to be used by children under 12 or by people with impaired mental faculties.**
- **Operate the mount only as indicated in the manual.**
- **Modifying or altering the characteristics of the mount in any way will void the manufacturer's limited warranty.**
- **Never modify the tension of the belts (governed by a dedicated screw). These are set in the factory and any unauthorized change will void the manufacturer's limited warranty .**
- **After using the mount, avoid storing it in areas exposed to sunlight or in wet places.**

**IMPORTANT NOTE: DO NOT USE ANY KIND OF LUBRICANT, SPRY, LIQUID OR OIL ON THE BELT DRIVE SYSTEM !!!**
**Any use of lubricants will void the manufacturer's limited warranty.**

**IMPORTANT NOTE: THE EVO-ZERO IS A CLUTCHLESS MOUNT WITH A SAFETY BRAKE SYSTEM THAT MUST BE DISABLED IN ORDER TO ALLOW THE MOUNT START WORKING.**

# Summary

# Technical Specifications

| | |
|---|---|
| Type | Equatorial/Alt Az mount |
| Weight | 4,6 Kg |
| Load Capacity | Also without counterweights or with a small counterweight on depending on the setup specs |
| Transmission | Belt Drive System composed by four stage reducer with pulleys and timing belts. |
| Construction material | Anodized aluminum, machined from single blocks with high precision CNC machines |
| Goto system | Avalon StarGO GOTO System - Wi-Fi |
| Counterweight bar | W = 16 mm / L = 235 mm |
| Counterweight | 3 kg |
| Mounting Saddle | Vixen style |
| Warranty | 2 years from the purchase date, extended to 5 years for the transmission system |

## Foreword

This manual describes the mounting, operation and correct setup of the EVO-zero single arm mount, including the proper installation of a suitable optical tube.

Please read this manual carefully to guarantee that you can use the EVO-zero mount in complete safety and with the maximum satisfaction.

The instructions related to the StarGO control system and related software are described in separate Instruction Manuals:

***Avalon Instruments - StarGO Control System***

Both the above manuals are included in **the flash drive supplied with the mount**.

The design and the configuration of the mount can be subject to modifications without prior notice, based on design decisions leading to continuous improvements and on the suggestions of mount owners.

# 1. Packing Content

Open the box and take out all the contents. Remove all the components from the small cardboard box and from the mount bag side pocket, and place them on a clean, flat surface.

**Component List**

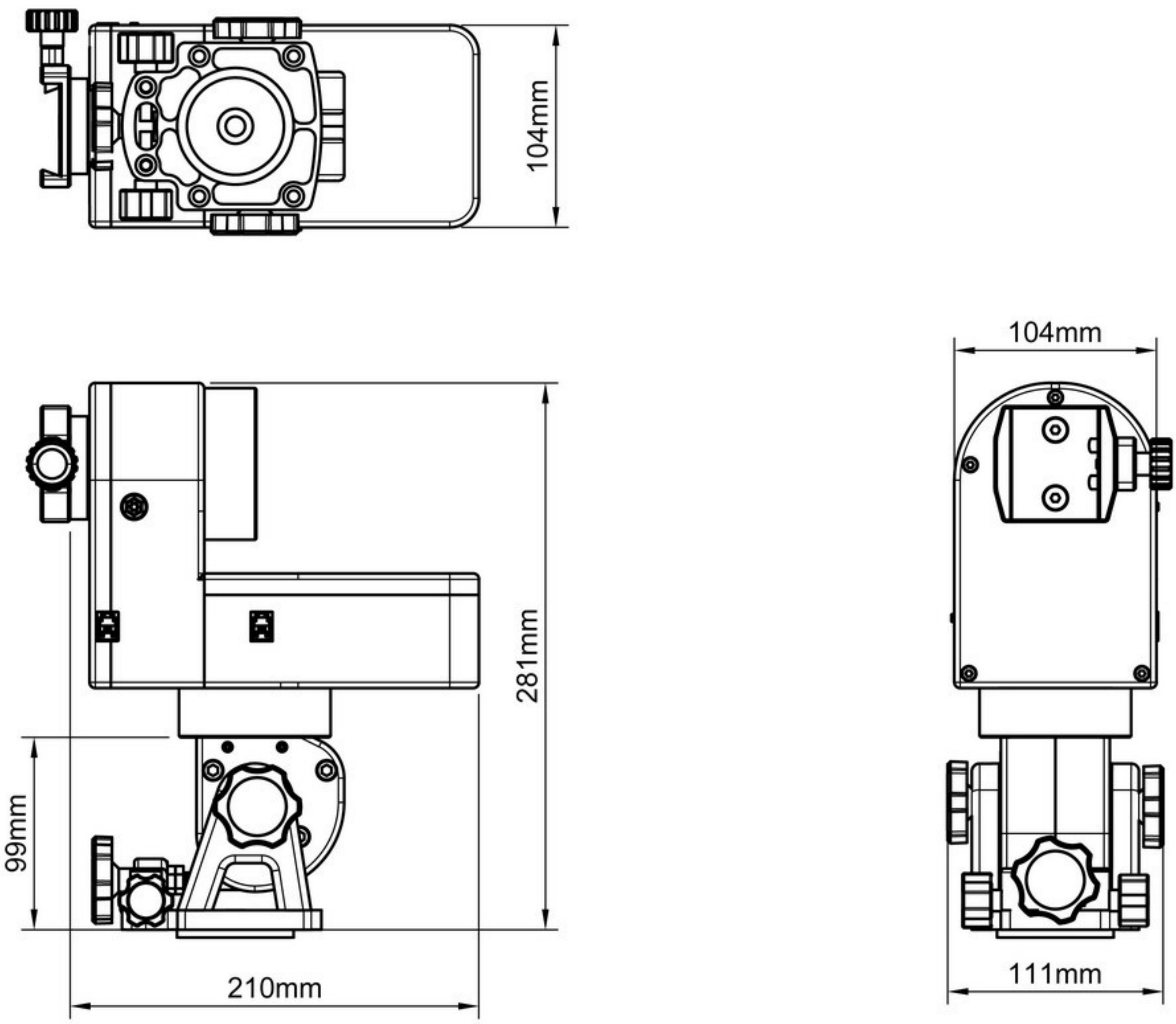
- Mount Head
- StarGo Controller
- StarGO Keypad
- 3 kg Counterweight
- Counterweight rod
- Mount transport bag
- RA/DEC Motor's connecting cable
- Brake Safety System connecting cable
- Power supply
- Safety Brake System dedicated Power Supply
- Allen wrench
- USB cable
- Azimuth adjustment pin
- 3/8" Mount fixing knob
- USB flash drive with manuals and software


**Package picture**

## 2 Mount Description

The EVO-zero is a compact mount for travelling astronomy and light setup with a payload up to 13 kg, also without counterweights or with a small counterweight on depending on the setup specs

The following drawing show the EVO-zero mount dimensional characteristics.



The EVO-zero was developed on the basis of:

- Belt Drive System improved (more rigidity)
- Computer aided design (CAD)
- High quality manufacturing with digital control 5 axes CNC machines (CNC + CAM)
- Absolute quality materials: Anodized aluminium from milled mono-bloc, stainless steel components and screws, brass components, techno-polymers

The EVO-zero is mainly designed for astro-imaging with medium-short length tubes (such as SC-Maksutov, RC up to 6-8″ aperture and 13 kg weight, according to the tube length).

It is possible to use the EVO-zero even with refractors (400-500 mm), with a piggyback.

Thanks to the Belt Drive System improved with more rigidity and double belt tensioner per axis, with telescopes within the mount payload capability, it is only required to fix the telescope on the top vixen clamp without perform a fine balancing adjustment.

The use of pulleys and timing belts has allowed to obtain several advantages: a really steady motion without play (no backlash) and sudden peaks, factors of paramount relevance for long guided exposures and during high magnification visual observations. These features are of particular relevance especially for the declination axis motor that can now quickly reverse the motion without breaks to recover the plays. The timing belts used in the EVO-zero have the structure made of special material with steel strands to avoid any deformation.

It is important to underline that in the gear-worm systems the motion transmission has only one tangent point of contact, any errors on each of the two components will, sooner or later, result into a tracking errors. On the contrary, in the pulley-timing belt system, no direct contact occurs between the pulley and the motion is transmitted by the belt engaging from 50% to 90% of the girth surface. Consequently any error, eventually present, is averaged among the cogs, moreover soft, greatly reducing the tracking error.

No wearing effects since no relevant frictions occur. In fact, all the pulleys and the axes rotate on roller bearings that allow to reduce the total friction almost to zero.

Another significant advantage of very low frictions is that the risks of motor slipping during GOTO operation is virtually null. On the contrary, it is well known the difficulty to regulate the coupling between gear and worm in the conventional mounts. If the coupling is tight the motors can stuck with consequent loss of the position, if the coupling is too loose the plays increase. On the other hands, the absence of significant play in the EVO-zero makes the initial calibration of guiding CCD quick and easy.

Since there are no gears, there is no need of periodical lubrication of the internal components and therefore the maintenance is extremely reduced and limited to the external cleaning.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INSTRUMENTS

# 3. Initial EVO-zero Setting

The EVO-zero has been designed for the T-pod 70 and in the next paragraphs will be described the operations required to fix this tripod.

The operations described here require the EVO-zero to be firmly set on the T-Pod 70. Therefore the first portion of this chapter will describe the operation needed to set up the tripod and install the mount on it.

To put the EVO-zero on the T-pod 90 is required the EVO-ZERO TPOD 90 ADAPTER PRODUCT CODE: AV-9ATM014.

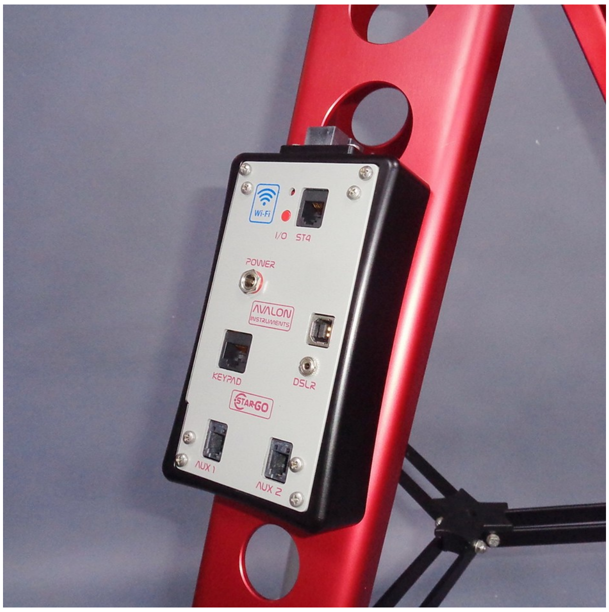
The EVO-zero is also compatible with photographic tripods that allow the use of 3/8” fixing knob.

## 1.1 T-pod Mounting

The T-pod 70 setup is very simple. The operations to perform are the following:

- Place the T-Pod tripod head up with the legs on the ground. After loosening the knobs on the legs, adjust their length to the desired height.
- Pull the legs outward by extending the three tie-rods until they click in fully opened position.
- By using the EVO-zero with a T-pod 90 or a T-pod 70, it will be possible to assemble the StarGo controller on one of the tripod legs thanks to the matching holespacing as described on the sequenced pictures below.

We suggest to perform this operation before to put the mount on the tripod, in order to operate in a more safe and secure situation.




- Adjustment of the tripod height will depend on the type of telescope to be used with the mount. A Newtonian optical tube will require a minimum height because its eyepiece is placed at the distal end of the tube, close to eye height for a person of average stature. If the telescope is a refractor or a Schmidt-Cassegrain, the eyepiece is on the proximal end of the OTA and viewing will be more comfortable if the tripod is at its full height. Use the bubble level to adjust the length of each leg to put tripod head in an approximate horizontal position.

- Firmly tighten the knobs on each leg to set the leg lengths and the height of the tripod head.
- Install the Azimuth adjustment pin as seen in the illustration.


## 3.2 Installing the Mount on the Tripod

The EVO-zero can be operated within a latitude range from about 0° to about 90° in both Equatorial and Alt/Az configurations. To facilitate packing it is shipped with a latitude setting of 0°. Therefore the first operation to be performed is to set the latitude range and scale for the location where the mount will be used. The same operations must be performed when the mount is moved to a site with latitude outside the range originally set.

## 3.4 Latitude range settings

The EVO-zero latitude range are subdivided into 5 sub-intervals as follows to be adjusted before to use the mount.

| | |
|---|---|
| First interval | 0° --- 6° |
| Second interval | 5° --- 27° |
| Third interval | 26° --- 48° |
| Fourth interval | 47° --- 69° |
| Fifth interval | 68° --- 90° |

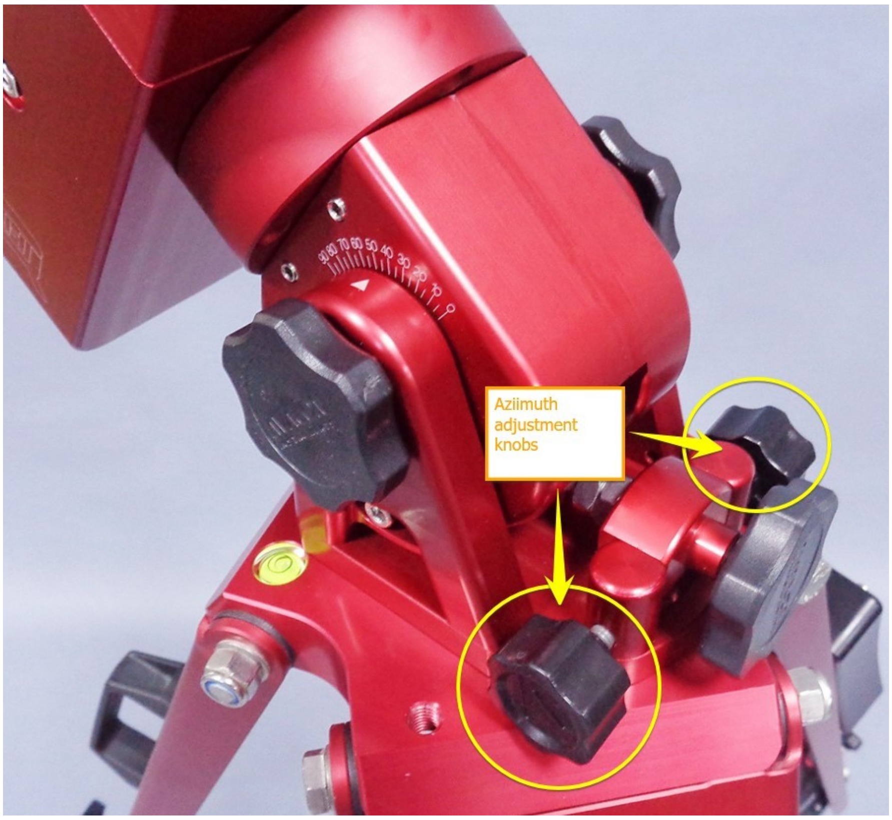
The illustrations below shows how to perform the raw and fine latitude adjustment.

| | |
|---|---|
| | Remove the latitude range blocking screw |
|  |  |
| Loose both the latitude blocking knobs placed on the left and right base mount sides. | |
|  |  |
| Move the mount base as long as the raw latitude as achieved, matching the latitude arrow indicator with the corresponding user observatory location latitude degree. | Put back the latitude blocking screw without firmly tightening. |

| | |
|---|---|
|  |  |
| Now is possible to perform a fine latitude adjustment by using the latitude settings knob on the mount rear side. | When a fine latitude adjustment has been set, it is possible to firmly tight the latitude blocking screw. |
|  |  |

| | |
|---|---|
| When this operation has been completed, by using the mount fixing knob from the T-pod bottom head side, it is possible to fix the mount on the tripod. |  |

The Azimuth adjustment is performed with the two Azimuth adjustment knobs circled in yellow in the image below. The fine adjustment procedure is explained in the 5.2 section.



## 3.3 StarGo and EVO-zero cabling connections

**The EVO-zero is a clutchless mount that comes with an improved Belt Drive System. This features allow, on depending on the setup specs, to work even without counterweights or with the counterweight included.**

**Even if, according to the basic astrophotography rules, the best performances come with a fine balanced setup, the EVO-zero has been designed to work with a certain amount of unbalancement.**

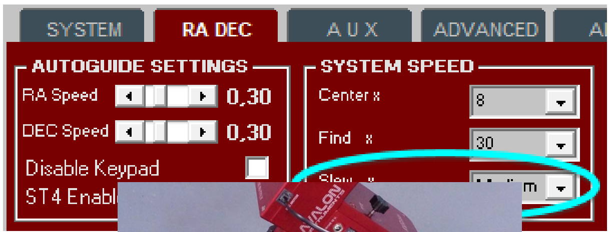
**In order to have a safe mount usage the user should follow the precautional steps listed below:**

- With setup up to 6 kg, no counterweights are required.

- With setup in the range of 6 to 9 kg is suggested the use of the 3 Kg counterweight included in the mount package.

- With setup heavier than 9 kg is suggested the use of 2 x 3 Kg counterweights.

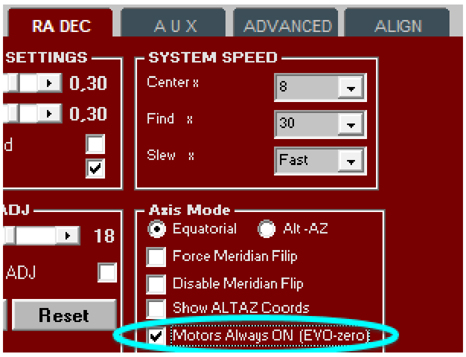
**- The higher the unbalancement amount, the lower should be the Slew speed selected as shown in the table below.**

| Setup weight | Slew X | StarGo.exe Slew Speed setting panel |
|---|---|---|
| Less than 3 Kg | Ultra/Fast |  |
| Up to 6 Kg | Medium | |
| More than 6 Kg | Low | |



**With the RA-DEC motor cables plugged in, power on the StarGo.**

**Check that the "Motors Always ON (EVO-zero)" option is correctly enabled in the StarGo Software "RA DEC" panel, as shown in the screenshot on the right. This option allow to immediately provide tensions to the motors as soon as the StarGo and the mount are powered.**




- Plug the Brake Safety System dedicated Power Supply **from the same StarGo Power Source and connect it to the corresponding connector on the mount.**

In order to safely assemble the telescope on the mount, is suggested to put the tube pointing to east with approximative DEC 0°.

**NOTE: do not manually unlock the "Brake Safety System"** when the mount is unpowered **with an unbalanced telescope assembled on.**

| Operating mode | Telescope type | Picture | Note |
|---|---|---|---|
| | Optical tubes up to 8” RCs and SCs and Newtonians up to 6” . | <br> | Also with 8” telescopes 6,7 kg weight, as seen in the illustration, nocounterweight are required. |
| Alt-azimuth | Any type of optical tube | In the Alt-azimuth operational mode, the telescope setups do not change from the previous configurations as seen in the above figures | The telescope in installed on the mount externally as explained in the previous paragraph 1.5. |

# 4. Telescope Balancing Operations

**The EVO-zero is a clutchless mount that comes with an improved Belt Drive System. This features allow, on depending on the setup specs, to work even without counterweights or with the counterweight included.**

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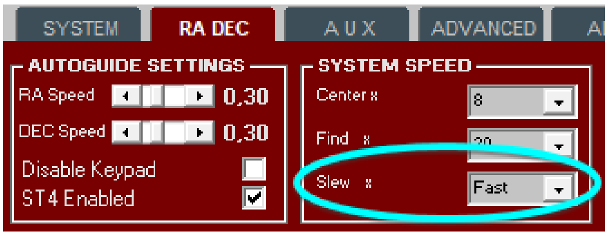
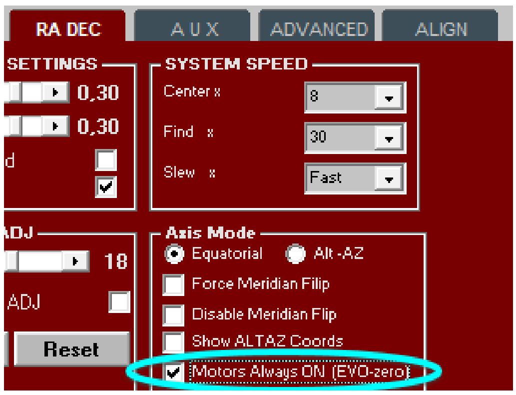
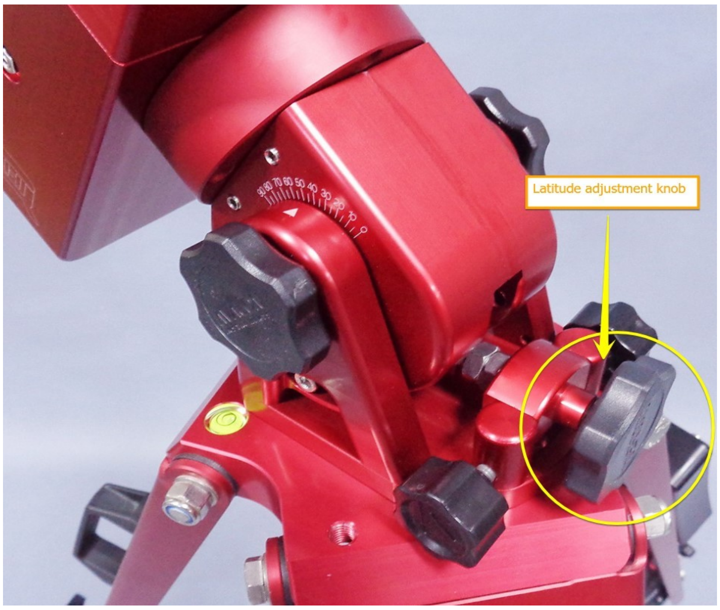
<table>
<tr><th>Setup weight</th><th>Slew X</th><th>StarGo.exe Slew Speed setting panel</th></tr>
<tr><td>Less than 3 Kg</td><td>Ultra/Fast</td><td rowspan="3">
</td></tr>
<tr><td>Up to 6 Kg</td><td>Medium</td></tr>
<tr><td>More than 8 Kg</td><td>Low</td></tr>
<tr><td colspan="2">Before to power on the system, check that the “Motors Always ON (EVO-zero)” option is correctly enabled in the StarGo Software “RA DEC” panel, as shown in the screenshot on the right. This option allow to immediately provide tensions to the motors as soon as the StarGo and the mount are powered.</td><td>
</td></tr>
</table>

# 5. EVO-zero Alignment in Equatorial Mode.

The mount alignment in equatorial mode consists of adjusting the mount's altitude and latitude such that its declination axis points exactly to the celestial North Pole.

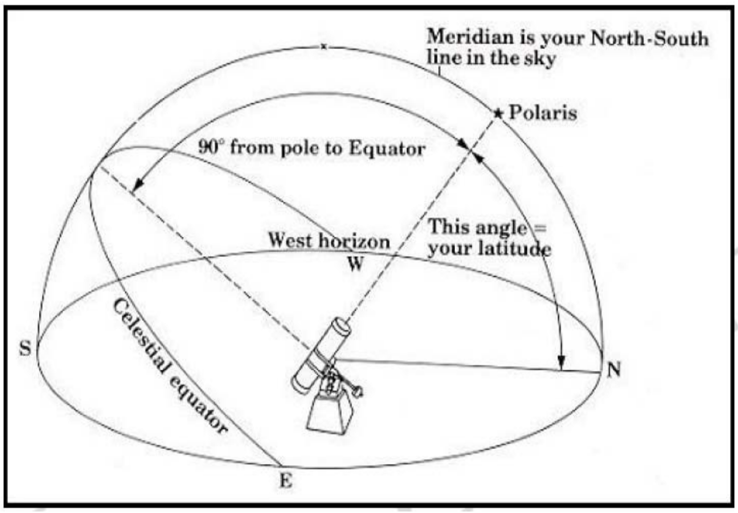
To perform such an adjustment, the actions necessary to set the altitude and the latitude of the mount to those of the observation site are described here. For more precise alignment, the polar-scope provided with the mount (or a different type of optional polar-scope) is used.

## 5.1 Precise Latitude Adjustment




To correctly use the mount it is necessary to make the mount's DEC axis parallel to the Earth's axis of rotation. The process of approximate latitude adjustment was described earlier. In this section it is assumed that the mount has been previously adjusted roughly to the latitude of the observation site.

Next, the mount's polar axis must be adjusted to an angle equal to the latitude of the observation site. For example the latitude of Paris is about 49°, London about 51.5°, San Francisco about 38° and Tokyo about 35°. The toothed adjustment wheel (1) controls the angle and the latitude scale (2) on the mount side indicates the mount's latitudinal angle.

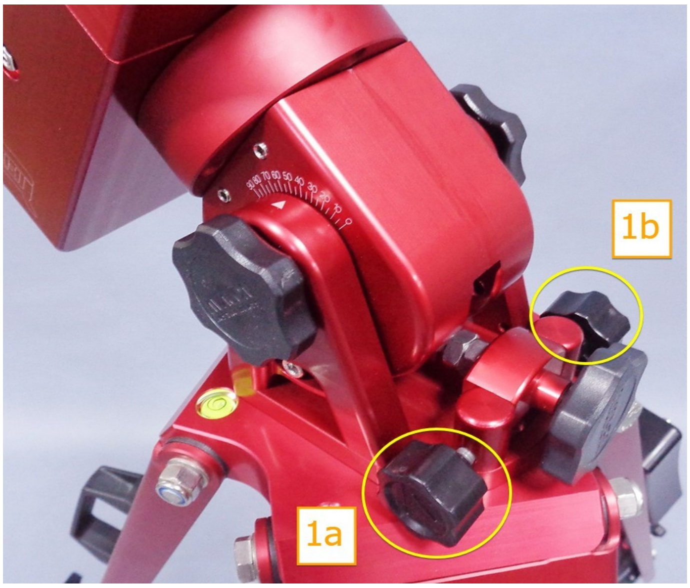



To increase the latitude (raising) of the mount's polar axis, the knurled wheel (1) must be turned clockwise. To decrease the latitude, the wheel must be rotated counter-clockwise.

The latitude adjustment range is between 0° and 90°.

NOTE: *In general it is preferable to perform the precise latitude adjustments by moving the mount opposite to the force of gravity, i.e. raising the mount polar axis.*

## 5.2 Azimuth adjustment




To adjust the mount in azimuth the two knobs (1a) and (1b) are turned to exert pressure against the pin. The adjustment is performed using both hands: When one of the knobs is rotated in one direction it is necessary to rotate the other knob in the opposite direction at the same time and in the same number (or fraction) of turns. This moves the mount very slightly in one direction or in the other. The two knobs must be rotated oppositely and simultaneously either forward or backward.

This operation must be performed only during the polar alignment procedure. Once the desired alignment has been achieved, **DO NOT MOVE THE MOUNT ANY MORE**, as per the instruction in this chapter. After unlocking the clutches on both axes, all subsequent movements in RA and DEC shall be performed using the keypad and/or the StarGO software commands.

## 5.3 EVO-zero Polar Alignment

Currently are available several methods, easy and accurate, that can be performed via software and without any accessory thanks to the Plate Solve function.
This feature is really helpful and can works even in case the Polaris is not visible.

In case the user wish to adopt the method that require the Polar Scope can follow the instructions described below.

In this case is required to separately purchase the optional Polar Scope Kit.

### 5.3.1 Polar Kit (optional) Installation

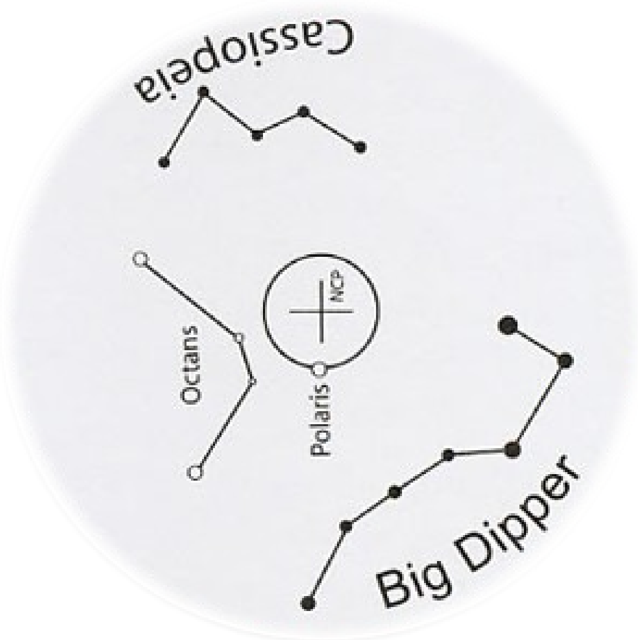
The precise polar alignment of the EVO-zero mount is performed with the polar scope installed externally on the mount.

The kit for the polar alignment consists in an adapter that allow to attach the Polarscope externally on the mount right side.

A standard Celestron or Skywatcher Polarscope can be simply installed by screwing insider the aluminium threated ring. as shown in the picture below.

### 5.3.2. Polar alignment with a Polarscope

The picture below shows the Skywatcher polarscope reticle. For an accurate polar alignment with Avalon Instruments mounts it doesn't matter for the constellation position. The reference point it will be the small circle that represent the Polaris position or a defined degree in the graduated circle.




*Celestron polarscope reticle*

It is well known that the Polaris is at about 40 arcmin distance from the Celestial Pole and therefore it orbits around the pole at that distance every about 24 hours. The cross in the reticle center indicates the position of the Pole. The circle around it represents the orbit of Polaris. The small circle on the orbit represents the variable Polaris position. The problem here is to position the smaller circle at the correct Polaris angle as it is seen from the observation site at the observation date and time. Years ago this position was obtained using several types of circular dials and performing few calculations.

Currently the most common method to get the exact position of Polaris is using one of several available computer programs or, better, mobile device applications. These programs provide the position of Polaris both visually and in the hourly format as described in section 5.3.3. Once the Polaris position has been determined in terms of hour angle, the polar scope should be rotated to bring the small circle in that position. With this type of reticle this operation is approximate, but is accurate enough and is satisfactory for most applications.

The small circle representing Polaris must be put in the annulus corresponding with that hour, starting with the 0 of the annulus in the upper position.

Once the correct position of the small Polaris circle has been established, the following operations should be performed:

Once the correct position of the small Polaris circle has been established, the following operations should be performed:

1. Slightly loosen the black knurled side knobs to allow the Latitude (altitude) movement.
2. Put the polar scope's star diagonal in a comfortable position and tighten all knobs in this position.
3. Once you are confident that the polar scope is correctly oriented, use small movements of the Azimuth and Altitude adjustment knobs to place Polaris exactly in the center of the classical reticle's corresponding small circle in or in the defined hour position for the newer type reticle.
4. When finished, firmly re-tighten the Altitude and Azimuth knobs as well as those fixing the mount to the tripod. The mount is now aligned to the celestial North Pole.

In case of use of the new reticle (on the right figure) the only difference is that, being missing the small circle correspondent to the Polaris, the star must be brought to the position in the graduated circle defined by the specific application.

### 5.3.4 External Programs for Finding Polar Position

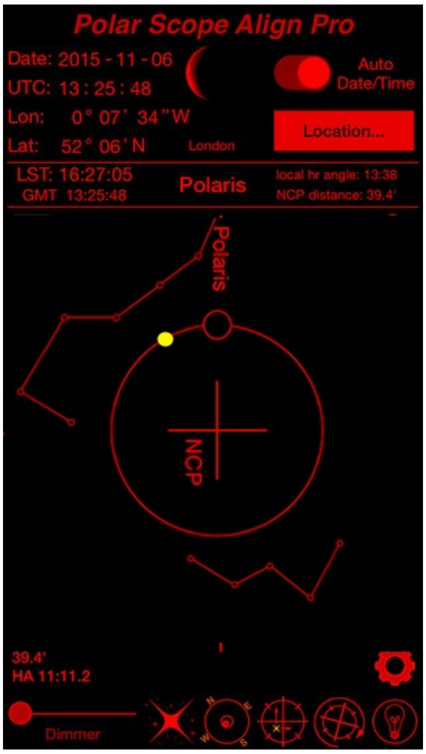
Many apps exist to determine the position of Polaris compared to the exact position of the celestial North Pole. Only two of these apps are discussed in this section. However the same concepts described here are applicable to all other existing apps.

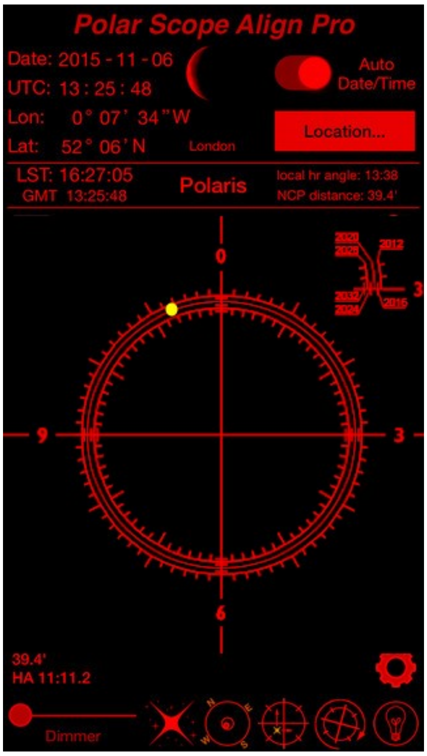
“Polar Scope Align” is an app which runs on iOS smart devices. This program uses the device’s internal GPS to evaluate the geographical coordinates of the observation site to calculate the exact position of Polaris around the North Celestial Pole. It also provides some additional information that can be useful for correct setup of the telescope.

With his application it is possible to interchange the kinds of reticles to be used for the polar alignment, including the Skywatcher classic reticle, as well as the newer version and the Losmandy type.

The position of Polaris is represented by a small yellow circle on a larger circular reticulum. To effectively use this app with the older Skywatcher reticle or with the newer type, it is necessary to take note of the hour angle where Polaris is located and rotate the Polarscope reticle to the same angle, bringing the Polaris circle around to the correct position. You will observe that the reticle reproduces exactly the same optical inversion caused by the Polar-scope optics.

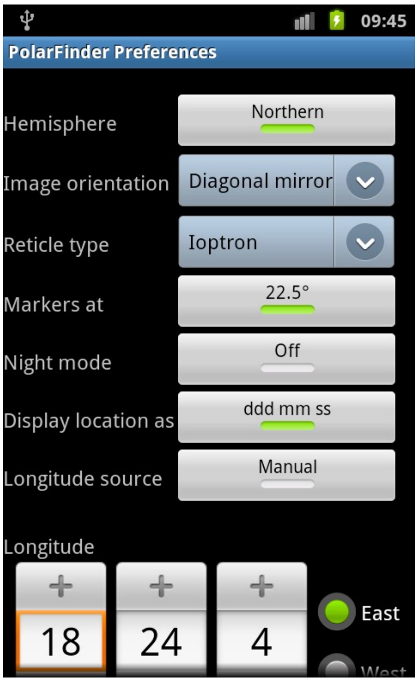
The following figures illustrate the screenshot of the Polar Scope Align app with the classic and new polar-scope reticles.

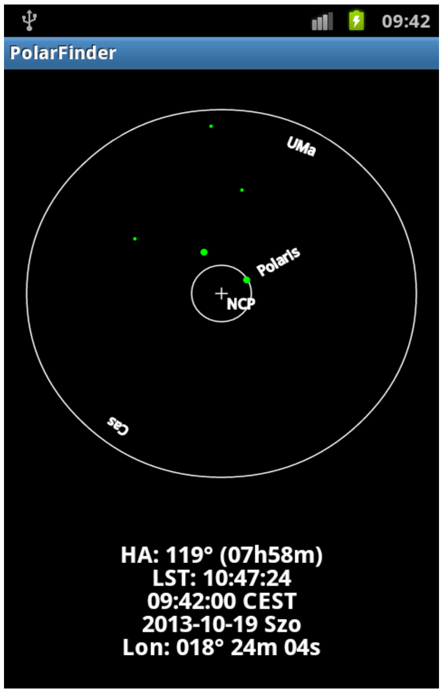


The “Polar Finder” is a similar application available for Android smartphones and tablets of different brands. The “Polar Finder” app is flexible and able to replicate a variety of the more common reticles suitable for use in the Northern or Southern Hemisphere.

The following figures illustrate the Android “Polar Finder” app.




Polar Finder Preferences

Classical Reticle Layout

The “Polar Finder” app also takes the observation site’s geographical coordinates from the Android device’s internal GPS if available. If the device has no internal GPS the geographical coordinates of the site must be manually entered.

### 5.3.4 More modern and precise approaches to Polar Alignment

In the last years a special CCD camera has been commercialised as, for example Polemaster and iPolr, to perform a very precise polar alignment using an expressly developed software (requiring therefore a Windows or Mac PC that, however should be available for the successive astrophotography session).
That CCD must be firmly installed on the mount keeping a good parallelism with the polar axis of the mount itself. Avalon Instrument has developed adapters for fixing the CCDs to the EVO-zero body. This adapter is provided as an optional one among the several accessories for the mount.
**The Avalon Instruments has also developed a special software that, among several others functions, has a tool to perform a precise polar alignment using the “plate solving” algorithm which is shipped together with all other software for the StarGO included in**

**the supplied USB pendrive. Detaile description of this tool in done in the StarGO User Guide.**