M-uno

SINGLE ARM EQUATORIAL MOUNT
(Made in Italy)

USER MANUAL

Version 2.0.1 July 2020

SAFETY RECOMMENDATIONS AND WARNINGS

- **Read carefully the manual before installing and using the mount.**
- **Use the power cable supplied with the mount or a 12V- 3A stabilized power supply as suggested in the manual.**
- **Connect the power cable correctly and securely to the power socket.**
- **Do not bend, pull or press the cable as this may damage it.**
- **For any assistance or repair, please contact only the manufacturer.**
- **Be sure to remove the power supply at the end of its use or before any cleaning or maintenance.**
- **This mount must be used exclusively by adults, do not allow use to children or to people with reduced mental capacity.**
- **Avoid to operate the mount except as strictly indicated in the manual.**
- **Modifying or altering in any way the characteristics of the mount will void the manufacturer's limited warranty.**
- **Never modify the tension of the belts (by dedicated screw), these is set in the factory and any unauthorized change will void the manufacturer's limited warranty .**
- **After using it, avoid to store the mount 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.

Table of Contents

Technical Specifications

Type of mount	Single Arm Equatorial Fast-Reverse
Head weight	14,9 kg (32.8 lb)
Maximum load	20 kg (44 lb) for photographic use, 25 kg for visual.
Motion System	Four-step reducer via pulley toothed-belt system on ball bearings, with zero play on both axis. (Belt Drive System)
Construction Materials	Machined from solid blocks of anodized aluminum with high precision CNC machines
Transmission System	Pulleys made with special polymer + fiber glass and high quality toothed belts
RA Axis	Heavy duty steel, diam. 35mm; all roller bearing axis movement
DEC Axis	Heavy duty steel, diam. 35mm; all roller bearing axis movement
Polar Scope	Skywatcher (Losmandy optional)
Control System	Avalon StarGO GoTo control system
Dovetail Plate	Losmandy, 3" (75mm) dovetail, single knob with 2 tightening points
Warranty	2 years from the purchase date, 5 years for the transmission system (Belt Drive System)

Forewords

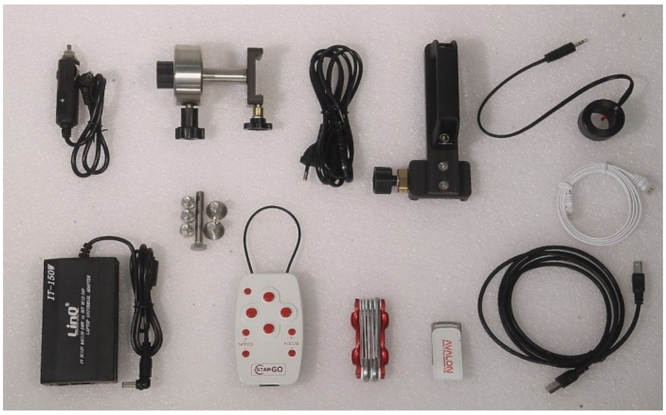
This manual describes the Avalon M-Uno mount, the procedures for its mounting and tuning on the tripod and for the installation of a telescope. Additional Information on the M-Uno mount and on the StarGO control system, containing also the procedures for the use with third-party software and in particular with the ASCOM driver, are reported in the StarGO manual which is part of the mount supply.

A careful reading of this manual will enable the use of your mount safely and with the maximum satisfaction.

The mount design and its configuration could be subject to modifications, without prior notification, based upon designer's improvements and the requests, if applicable, by the mount users.

1. Packing Content

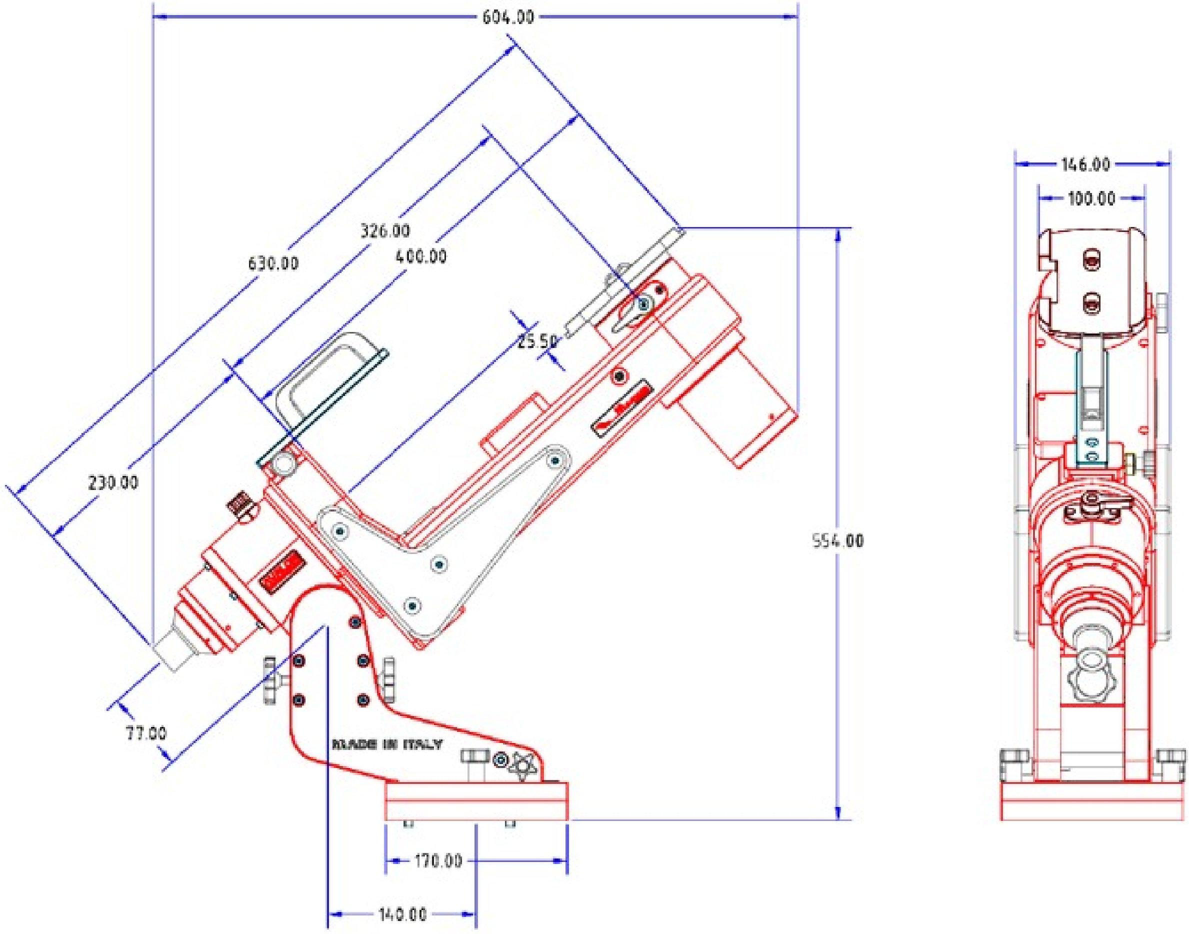
Open the box to take all the content out. Extract all the components from the small cardboard box and from the mount bag side pocket putting them on a clean, flat surface.

Component List	
Car lighter power cable Counterweight with support shaft 125/240 VAC / 12 VDC power supply with related cable StarGO control Keypad. Keypad connection cable Metric Hexagonal key set Mount Transport Handle	Mount head with tripod plate and dovetail platform, including the StarGO control system USB pen drive containing all needed software and manuals Polar finder and LED illuminator kit Mount Transport case Attachment screws Documentation, warranty certificate
	
Contents of the upper part of the box	Contents of the bottom part of the box

2 Mount Description

The M-uno Fast Reverse mount is a portable single arm fork mount devoted to deep-sky imaging in the capacity range up to 20 kg (44 lb).

The following drawing show the M-Uno mount dimensional characteristics. Dimensions are in mm.



The M-uno design was developed on the basis of the linear fast reverse, making use of the same technical concepts:

- Fast Reverse technology
- 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 M-Uno motion transmission technology is based on pulley-tooth belt without play, while its peculiar geometry makes easy the imaging at the meridian crossing regardless the typical problem affecting the classic German Equatorial Mounts, for both the risk of touching the tripod and the need of waiting for the object cross the meridian.

Moreover, considering that at the meridian the sky is less subject to light pollution and to atmospheric turbulence, the M-uno is the ideal tool to shoot deepsky objects in their best conditions, close to the meridian, especially when the time is short and the sky is not so dark and clear.

The M-uno is mainly designed for astroimaging with high focal length catadioptric tubes (such as SC-Maksutov, RC, SC cameras, Cassegrain, DK, etc) up to 10″ aperture and 20 kg (44 lb) weight, according to the tube length. It is possible to use the M-uno with Newton optics (for example 8" f4) and even with short refractors (400-500 mm), with a piggyback or parallel guidescope.

To allow the use of refractors with length exceeding approximately 500 mm, an optional accessory has been realized allowing to distance the telescope from the mounting flange in order to allow the passage over the RA axis. It is also available a special kit that, in addition to distance the telescope from the mount, allows the housing of a small guide-scope obtaining also a better telescope balancing. With this configuration it could be necessary to perform the telescope inversion at the meridian passage in the case of the telescope striking the tripod.

However the larger overhang of the single arm system will allow a greater pointing angle compared to the classic German Equatorial Mounts.

Another M-uno basic advantage is that it doesn't need neither counterweights, nor the bar. Its declination axis can be quickly balanced like in an equatorial mount, while, for the RA axis, it is possible to fix the arm on three possible positions and to make the fine balance using a very small counterweight. The M-uno mount, as well as the LINEAR, is equipped with the super tested, simple to use and inexpensive Synscan control system. The M-uno total weight is only 14.9 kg (11 lb) and it is provided of a confortable handle for easy transportation. With these features, in terms of lightness and transportability, the M-uno ranks at the top of the mounts with capacity up to 20 kg (44 lb).

The use of pulleys and toothed 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: from here the mount name FAST REVERSE. The toothed belts used in the M-uno have the structure made of special material with steel strands to avoid any deformation, elongation and stress, much better than those used in the automotive engine distribution system (which are generally made of rubber with nylon strands). Considering that the service time for the automotive toothed belts is around 100.000 km (60.000 miles), assuming a medium regime of 2.000 rpm and thermal stress from 0 to 90°C (30 to 195 F) in a few minutes, we can think that the life cycle of the M-uno toothed belts will be extremely long ! 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-toothed 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, 13 for the RA axis and 13 for the DEC axis 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 M-uno 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.

3. M-Uno Initial Setup

The M.Uno can work at latitudes range from about 15° to about 70°. For compactness purposes, the supplied is mount preset at about 40° and therefore the first operation to perform is the regulation of the latitude to the value related to the site in which the mount will be used. The same operations will be carried out in the case the mount is transferred in a site with a different value of latitude. This operation will be described in the section 3.1 below.

It is strongly recommended that the M-uno mount is used with the Avalon Instruments T-pod tripod which has been designed to guarantee maximum performance. If a different kind of tripod is used, it must have dimensions and characteristics compatible with the mount weight and with the astronomical load to be installed. Section 3.2 describes the mount installation on T-Pod tripod.

The installation of suitable optical tube will be described in section 3.3.

3.1 Latitude Range Setting

This section describes in detail the procedures to set the correct range of latitudes of the site where the mount will be used. The latitude range setting must be performed before installing the mount on the tripod.

As said, the M-uno can be used in a wide range of latitudes from about 15° to 70°. This range is divided into three different ranges of latitude.

- Position 1 between 15° and 40°,
- Position 2 between 32° and 55°
- Position 3 between 45° and 70°.

These values correspond to the three latitude setting holes on the underside of the mount.

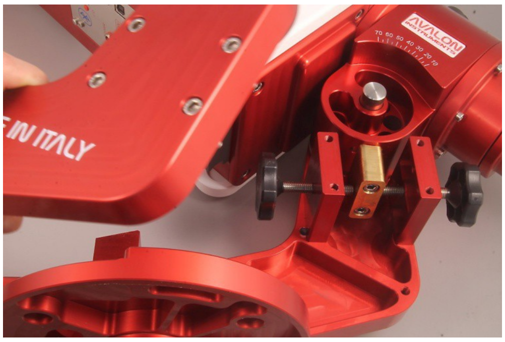
Observe that the values of the three latitude ranges partially overlap. The choice of latitude setting should be made considering the greatest numerical distance between the latitude of the observation site and the closest range choice. For example, if the site latitude is 53°, it would be best to choose the third range. This is because there is an angular distance of 8° between latitude 53 and the third range value of 45°. Using second range setting would be less desirable because there are only 2° between the site latitude of 53° and the largest value of the second range of 55°.

The steps needed for establishing the correct latitude operating range are as follows:

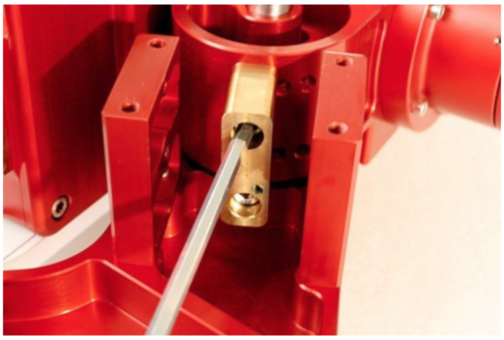
Remove the screws (1) and (2) under the base

Remove the screws numbered 1, 2, 3 and 4 from the side plate.

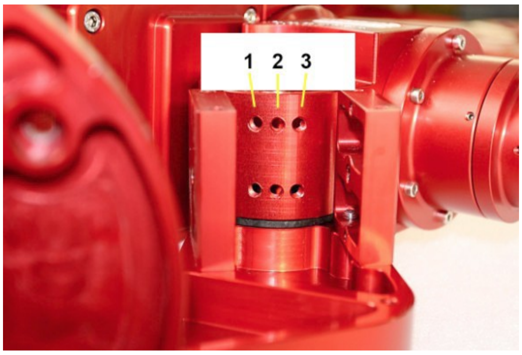
Remove the plate to expose the brass plug.



Remove the two screws from the brass latitude adjustment plug.



Place the brass latitude adjustment plug over the set of holes (1, 2 or 3) corresponding to the needed latitude range as described on the previous page. Re-attach the brass plug in the preferred latitude range position using the screws removed earlier. The mount is shipped from the factory with the brass post in position 2.



Re-attach the side plate using the four screws 1, 2, 3 and 4, previously removed.

Next, replace the two screws previously removed from under the mount

3.2 Installing the M-Uno on the Tripod

Whatever type of tripod is used it must be mounted with the right orientation. This need that the brass contrast block which is installed over the tripod mounting plate, is oriented to the North with sufficient approximation. A mechanical or digital compass can be used to perform this task.

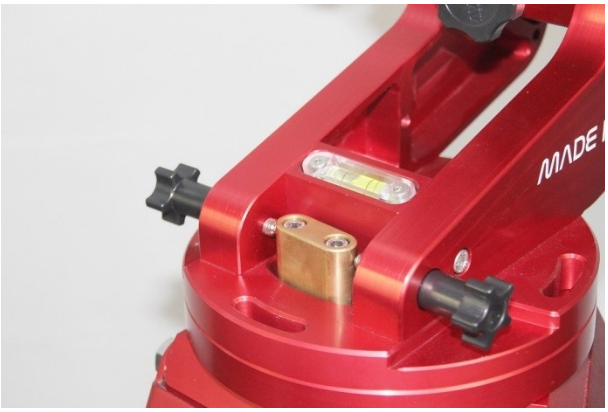
The M-Uno comes with a plate for attaching the mount on the tripod. It is shipped with the correct holes for most of the tripods available on the market. The following figure shows how to mount it on a T-Pod:

Place the plate on the top of the tripod and rotate it until the brass is aligned with one of the legs, chosen arbitrarily. This leg will be designated the “North Leg” because it must be pointed to the North to achieve a polar alignment. Attach the plate with the 3 screws provided for that purpose.

The following are the steps necessary to install the M-Uno mount on a T-Pod tripod:

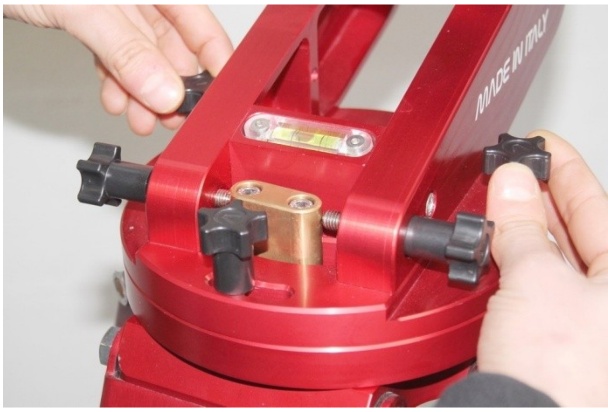
Unscrew the azimuth adjustment knobs a few turns by rotating the azimuth adjustment knobs in opposite directions.

Put the mount on the base plate so that the brass adjustment plug projecting up from the plate will fit in the proper space between the two azimuth adjustment screws.



Turn the azimuth regulation knobs until the screws touch the brass contrast plug

Tighten the three fixing screws equipped with plastic knobs in the three elongated lateral holes to keep the mount firmly in position.



Note: *During the azimuth regulation for polar alignment, these three screws must be slightly loosened just enough to allow the mount to rotate on the base.*

When alignment is achieved, tighten the screws again.

3.3 Telescope installation

After securely attaching the mount to the tripod, the next step is to install the telescope. However, due the M-uno's unique architecture, it is possible that the polar alignment scope could be obstructed by the optical tube. Some telescopes, such as long refractors, may require the use of the optional extension cylinder which could also block the polar alignment scope. An easy solution to this problem is achieved with an optional accessory to enable mounting the polar scope on the side of the mount, thus allowing the polar alignment scope to be free and unobstructed. This solution also allows the use of the hole for passing through electrical and control cables, such as those used in astrophotography.

The next step in using a telescope on the mount is accurate polar alignment, which is covered in greater detail in a later section of this manual. This section is focused solely on telescope installation.

The M-uno comes equipped with a Losmandy type 75 mm female dovetail saddle which is used to attach the optical tube assembly on the mount.

Remove the mount transport handle (if installed) and place the mount arm in the position shown on the left picture, unlock the declination knob and rotate the axis until the female dovetail saddle is horizontal. Firmly lock both the axis knobs. Firmly keep the OTA and insert its male dovetail plate into the female saddle, making sure that the side closer to the ground goes in first, as shown in the picture.

While holding the telescope with one hand, use your other hand to rotate the knob on the dovetail saddle clamp, as shown in the right picture, until it is firmly locked.

Before leaving the telescope, be sure it has been securely attached by making certain that the male dovetail bar is in close contact with the female saddle and there is no space between them.

Test the saddle's locking knobs as well as the RA and DEC clutch levers to make sure they are tight

4. Telescope Balancing

To guarantee a precise mount tracking it is necessary to correctly balance the telescope in both the rotation axes. To perform this operation is needed to move manually and freely the telescope in RA and DEC. As anticipated, the LineAR is provided of latches in both axes. To freely move the telescope, the latches need to be released by rotating the related levers in the counter clockwise direction.

Note: Before performing the balancing of the telescope be sure to have the full control of it before releasing the latches. An over unbalanced mount can move very quickly causing damages to the optical tube or to the mount itself.

4.1 Dec Balancing

To obtain the best tracking performance from the mount, the telescope must be balanced in both axes. Even if the telescope does not track in Declination, it must be balanced on this axis to avoid sudden movements when the declination knob is unlocked. Good balance also helps to prevent vibrations and overly-quick responses while guiding and reduces strain on the motors. With the M-uno mount it is better to start balancing the DEC axis rather than the RA axis. The M-uno is unique in that it allows the RA axis to be almost automatically balanced with any telescope.

Before beginning the balancing operation, it is worthwhile to test the saddle locking knobs to make sure they are tight. Telescopes do not like to being dropped!

Perform the following operations:

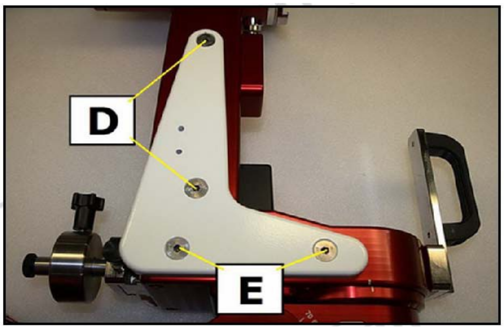
- Unlock the RA axis knob and move the arm of the mount to an equilibrium position, as seen in the image, and re-tighten the RA axis knob.
- Loosen the DEC knob and move the telescope parallel to the ground as seen in left picture, but do not let go of the telescope.
- Move the tube SLOWLY and CAREFULLY – to see in which direction, if any, it rotates around the DEC axis. If the front end moves down, the telescope must be moved backwards in the mount. If the front end moves up, the telescope must be moved forwards. To do either of these, maintain a good grasp of the OTA and slowly loosen the dovetail knob on the mounting saddle.
- Move the tube back or forth in the saddle, depending on whether it moved up or down, until it stays in a horizontal position by itself when you remove your hand.

Note: Always lock the clamp before checking the balance with the new tube position! If the tube remains stable in a horizontal position when the DEC knob unlocked, the DEC axis will be balanced. Tighten the dovetail clamp to firmly lock the telescope tube in its new position. Do NOT leave the telescope while the dovetail clamp is loose. In the unlikely event that your telescope should fall off the mount onto the ground, it could ruin your entire day.

4.2 RA Balancing

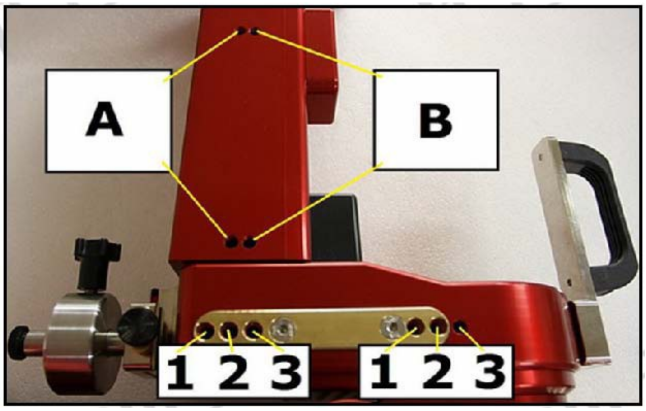
Balancing the M-uno mount in the Right **Ascension** axis is different from the other German Equatorial Mounts, but it is quite easy to do. The balance is performed in two phases, one raw and the other more precise.

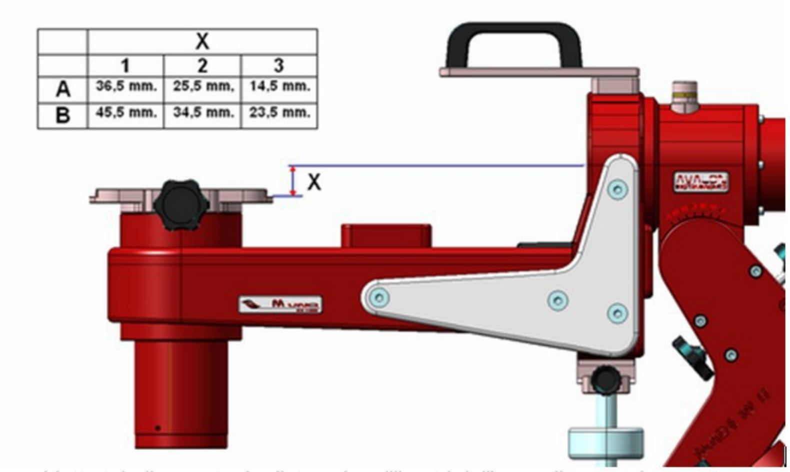
Raw Balancing



The initial raw balancing must be performed without the telescope on the mount.
Put the arm of the mount parallel to the ground as seen on the left picture. Unscrew and set aside the "E" screws holding the lateral flanges on both sides of the mount. Loosen but do not remove the D screws on the upper side just enough to allow the arm to move freely.

The picture on the right reveals the brass fitting and the holes that allow the position of the arm to be changed, which then changes the RA balance of the system. In this picture, the lateral flange is removed for clarity, but it is not necessary to remove the flange in order to achieve the balancing. The numbers in this illustration indicate where the lateral arm screws are to be inserted to achieve the approximate balance of the system. Position 1 identifies the greatest extent of the axis and it is used for larger diameter, heavier optics, while position 3 is suitable for smaller and lighter) OTAs. Position B allows the distance to be increased even further, but this is advisable only for large diameter OTAs such as use of the: Celestron C11, in which case it is necessary to completely remove the lateral shafts





	X		
	1	2	3
A	36,5 mm.	25,5 mm.	14,5 mm.
B	45,5 mm.	34,5 mm.	23,5 mm.

The table on the left shows the change in vertical distance in millimeters between the dovetail and the polar axis as a function of the positional holes chosen. Position A2 = 25.5 mm is set by default at the factory, and is suitable for many catadioptric OTAs.

Warning: do not use different screws other than those supplied or serious damage to the gear system may occur!!

Precise balancing

Once the mount arm has been set in the correct position for approximate balancing, tighten all screws and, if necessary, perform the fine balancing. This is performed by mounting the small counterweight, its shaft and the female dovetail as shown in the previous picture above. Insert the counterweight in the shaft and slide it in the equilibrium position. When that is accomplished, firmly tighten the counterweight locking knob and the shaft end knob. Of course all the precise balancing operations should be performed with the telescope installed.

NOTE: Most German Equatorial mounts are based on worm gear technology. They need to be slightly unbalanced in the easterly direction to avoid any unwanted pendulum-like behavior when crossing the meridian. The M-uno's toothed-belt transmission technology eliminates the need for this small amount of east-bias unbalance. This is a major improvement because once the M-uno is balanced, the counterweights do not need to be moved at all. The design provides a level of stability that is most appreciated during long

exposures and remote observing sessions.

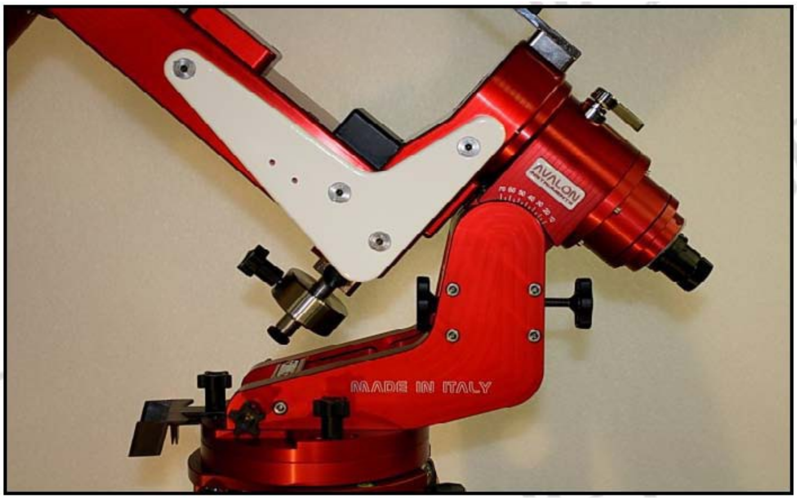
5. M-uno mount stationing

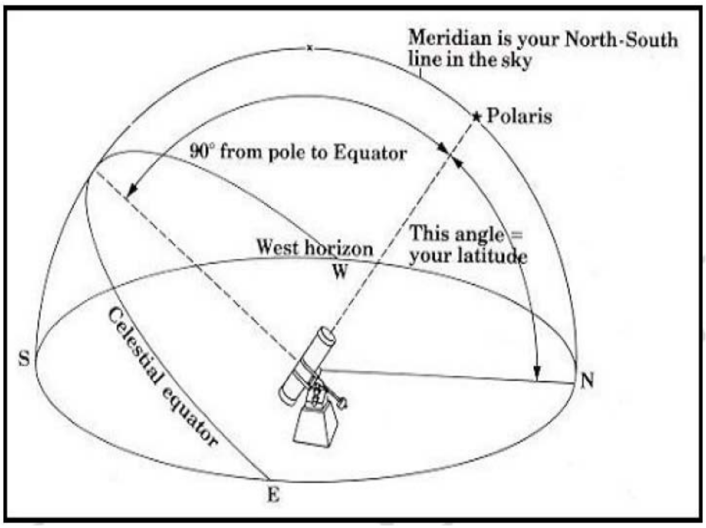
Before using the M-uno mount it is necessary to position its polar axis parallel to the earth's axis of rotation.

In this chapter the operations to trim the latitude and the azimuth and to perform the mount alignment to the celestial pole using the standard polar scope (or the optional alternative) will be described.

5.1 Latitude Fine Adjustment

During this operation the mount arm must be kept in its equilibrium position with the counterweight down as shown on the right. After leveling the mount base using built-in the bubble level, the next step in this process consists of approximately setting the polar axis at an angle equivalent to the latitude of the observation site. For example Rome is about 42° North, Milan and Venice 45° North and Palermo 38° North. Refer to the latitude scale on the side of the mount.





The latitude adjustment must be performed using both hands to turn the two latitude adjustment knobs in conjunction with each other. While one hand is tightening the front knob, the other hand should be loosening the rear knob and vice-versa. To increase the latitude (i.e. raise the polar axis), the rear knob must be turned in the clockwise direction while the front one is turned in the counterclockwise Direction. To lower the axis, the opposite actions are performed.

NOTE: It is generally better to perform the fine latitude operations against the force of gravity, that is, by raising the mount.

5.2 Azimuth Regulation

The azimuth regulation is performed in a similar manner, using both hands to turn the other two adjustment knobs in opposite directions simultaneously. When a knob is rotated in one direction the other is rotated in the opposite direction. Turn them so that the screws attached to the knobs press against the brass adjustment post and move the mount to the right or left by a small amount. The azimuth adjustment knobs are those positioned on both sides of the mount as seen in the picture on the right.

Remember that setting up the mount in both Latitude and Azimuth should be performed only during the important phase of precise polar alignment, before starting an observation or photographic session. Once the polar alignment has been reached, THE MOUNT SHOULD NOT BE MOVED FOR ANY REASON USING ALTITUDE OR AZIMUTH KNOBS OR THE ALIGNMENT WILL BE LOST. After the alignment has been established, moving the mount in Right Ascension and Declination and pointing the telescope to celestial objects should be performed only by using the keypad or the software commands.

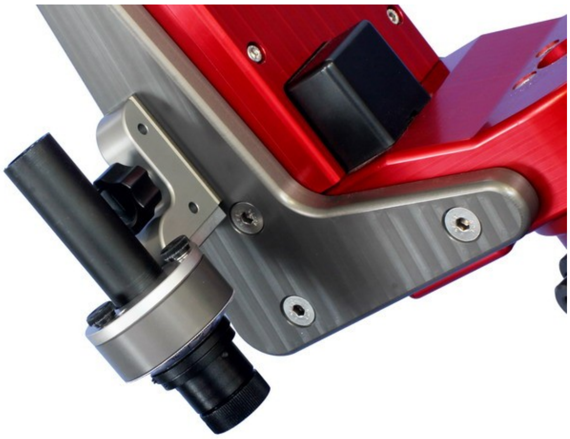
Alt-Az Polar Alignment

The following table shows the knobs rotation arc-minutes amount for a fine Polar Alignment adjustment with one full knob turn.

MOUNT	LINEAR		M-UNO		M-ZERO	
MOUNT AXIS	ALT	AZ	ALT	AZ	ALT	AZ
ARC MINUTES PER KNOB TURN	91,2	79,2	78,74	79,2	61,8	110,4

5.3 M-Uno Polar Alignment

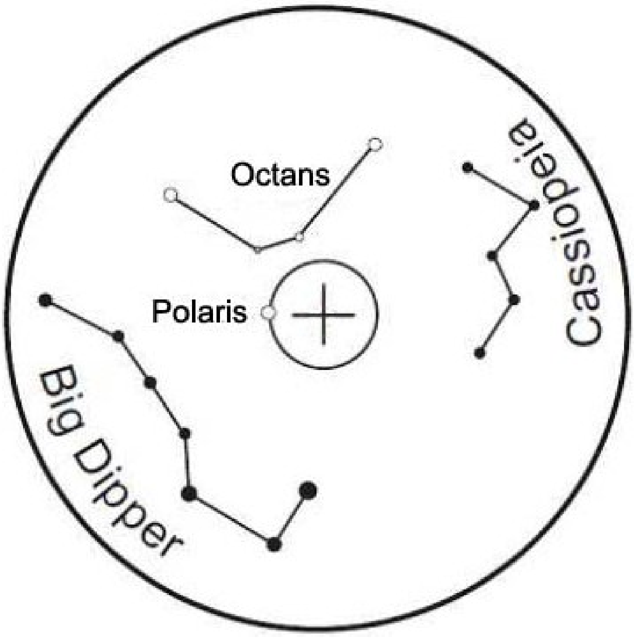
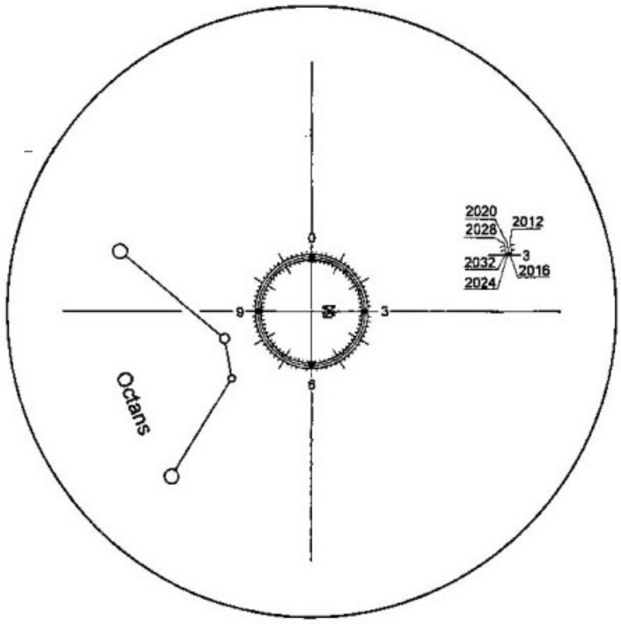
The procedure for Polar Alignment with the M-Uno mount depends on the Polar-scope model. The M-uno mount comes with the Skywatcher Polar-scope inserted on the RA axis. The optional Polar-scope external mounting kit is also available the for using an alternate Polar Alignment procedure and/or polar scope use. Furthermore a Losmandy polar-scope is also available as an option.

	
Default Polar-scope shipped with the M-Uno	Polar-scope with the optional external mounting kit

Beginning in 2016, the Skywatcher polar-scope included with the mounts have a different reticle view than earlier models. However the Polar Alignemnt procedure with the M-Uno mount remains the same and is explained in the following paragraphs.

5.3.1 Polar Alignment with a Skywatcher polar-scope

The Skywatcher type of polar scope is normally included with the Avalon Instruments mounts. The first series of Avalon Instruments mounts was provided with a classical reticle having the engraving reported as shown below. Mounts produced later are instead provided with a newer type of reticle with a different engraving. The two pictures below show two kind of skywatcher polarscope model: the classical reticle (with Octans, Big Dipper and Cassiopeia) and the new one (with the only Octans constellation). 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.

	
Skywatcher polarscope view with classical reticle	Skywatcher polarscope view with new reticle

As it is known the Polaris is several tens of seconds from the Celestial Pole and therefore it appears to orbit around the pole at a given distance, making a full orbit, every 24 hours. The circle in the reticle centre represents the Polaris orbit. On the left, the small one, with the name of the star, represents the position of the Polaris. The problem here is to turn the reticle around the small cross in the centre, to put the small circle in the position where the Polaris is seen from a given observation site, at a specified date and time. In the past this position was obtained using several types of graduated circular scales. The Avalon mounts are not provided of these scales.

Presently the most suitable method to get the exact Polaris position is the use of one of the several computer programs or mobile devices applications, both for Apple iOS or Android as, for example, "Scope Help" for iOS or "Polar Finder" for Android. These programs, that provide the Polaris position both visually and in the hour form, are briefly described in section 4.3.2.

NOTE: Once the Polaris position has been determined and the telescope has been mounted with the contrast blocks oriented to the North the following operation are needed, if using the left polar-scope:

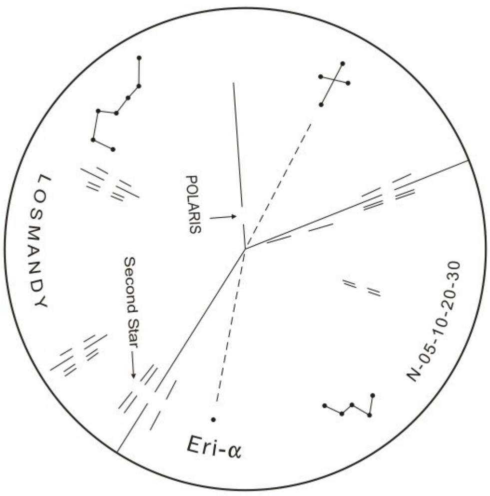
In case of use of the default reticle (that of the left) the operations to be performed are the following:

1. Loosen the DEC latch and rotate the axis until the hole in the axis is in the front of the polar scope, allowing it to see the sky and the Polaris in the field of view. Tight the DEC latch in this position.
2. Loosen the RA latch and rotate the axis until the small circle in the reticle is in the position indicated by the used application. Tight the RA latch in this position. It is possible to have a small help verifying that the position of the figures of the Big Dipper and Cassiopeia roughly correspond to the real position in the sky.
3. Loosen slightly the two screws that fix the mount to the tripod to allow the mount base to rotate respect to the tripod mounting plate.
4. Acting on the two azimuth regulation knobs bring the Polaris under or over the small circle. Acting on the two altitude regulation knobs bring the Polaris inside the small circle.
5. Repeat this operation until the Polaris is centered in the circle.
6. Tight the Azimuth and Altitude knobs against the contrast blocks.
7. Firmly tight the screw that lock the mount movement respect to the tripod.

In case of use of the new reticle (on the right figure) the only difference is that the operation number 2 is not more necessary. The position of the Polaris on the circle can be defined with the help of the circle gradations and therefore is not more necessary to move the RA axis.

5.3.2 Polar Alignment with a Losmandy polar scope

The Losmandy polar scope allows an more precise alignment because it is based upon the coincidence of three star (Polaris, δUMi e OV Cep) position with the correspondent locations in the scope reticle which has the following aspect:



The dotted axes shall be neglected because they belong to the Southern Hemisphere.

The alignment operations with this kind of polar scope are the following:

1. Untight the DEC latch and rotate the axis until the hole in the axis is in the front of the polar scope, allowing it to see the sky. Tight the DEC latch in this position.
2. Untight the RA latch and consequently the polar scope until the axis in the reticle with the slot for the Polaris (well indicated in the reticle) is roughly oriented in the position indicated by the used application.
3. Act alternatively on the Azimuth and Altitude regulation knobs and on the reticle rotation until the three stars are exactly located in the respective slots. In the three axes. Take into

consideration that the position in the slots varies depending on the year. The four slots for two of the axes are related to the observation years reported in the border of the reticle.

4. When the three star are correctly positioned in the slots tight the Altitude and Azimuth knobs against the respective contrast blocks and,
5. At the end, firmly tight the screw that lock the mount movement respect to the tripod.

Note: In case of difficulty to correctly orientate the constellation in the right position it is possible to get the help of a PC, smartphone or tablet applications to perform the initial orientation of the Polaris axis, as explained below.

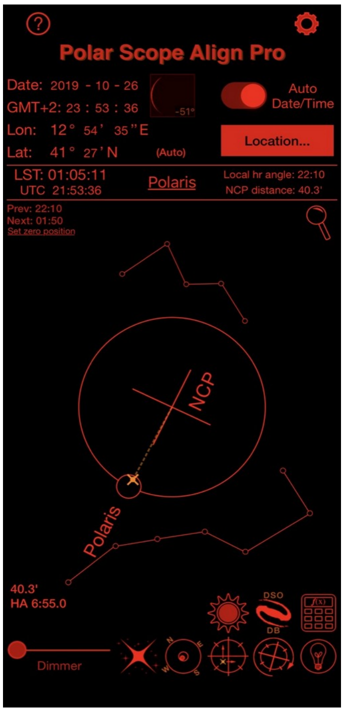
5.3.3 External programs for Polaris Finding

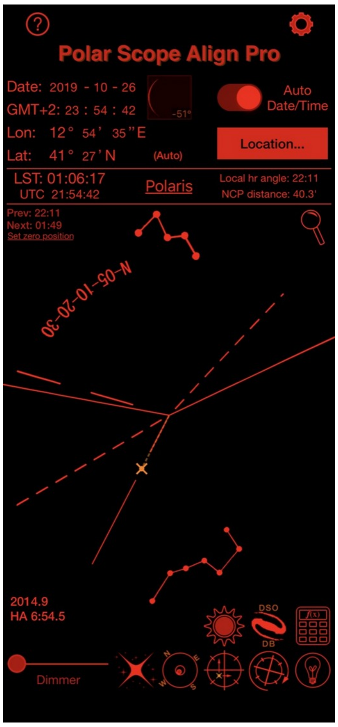
Several applications exist to help executing a good Polar Alignment using PC (Windows and Mac) and mobile devices (iOS and Android). All of them are based on a similar concept: A virtual reticule, often representing the real reticule present in the Polarscopes, with the position of the Polaris in function of the observation site coordinates, the local date and time.

In this section we present an application available for iOS but with very common feature that are easily applicable to all other applications with the same purpose.

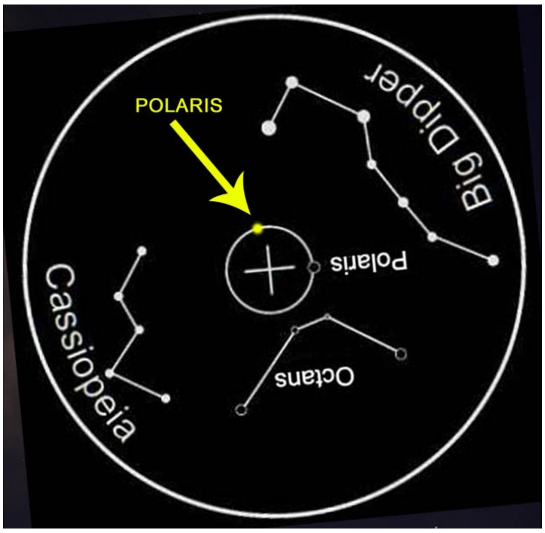
Polar Scope Align Pro allows the choice of a large number of reticules, used by almost all commercial mounts developed in the last ten years. The three reticules presented here represent those discussed in the previous sections (old Skywatcher, new Skywatcher and Losmandy).

The first is the very simple Skywatcher reticule described in section 4.3.1 representing the approximate position of the Big Dipper and Cassiopeia asterisms



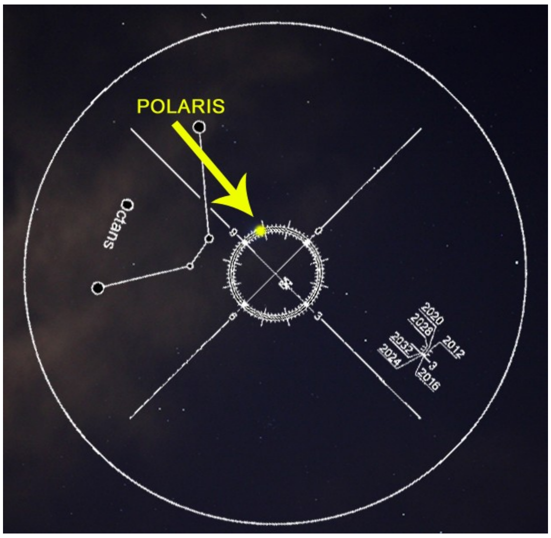


Using it is very simple, rotate the RA axis until the polar-scope reticule is oriented as the virtual one and operate on the Alt and Az Knobs to bring the Polaris inside the small circle located on the star route around the North Pole. A simpler alternative is not to rotate the axis and put the Polaris in the same position it appears in the application screen. This is done with much more precision with the new type of reticle. Below is reported one example where the Polaris is located at about hour 11:15.



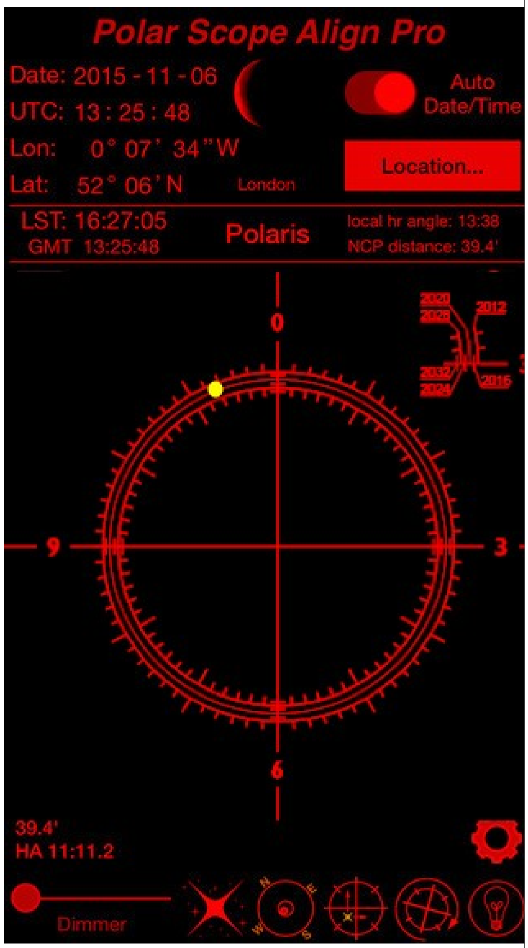
Example with old Skywatcher reticle.

As previously said it doesn't matter how the reticle is rotated. If Polaris is in the same position on the orbit indicated by the chosen Polar Finder app, an accurate Polar Alignment has been accomplished



Example with new Skywatcher reticle

It is the same as described above. As long as the position of the star Polaris in the polar-scope reticle is in the same position indicated by the smartphone or PC app a good

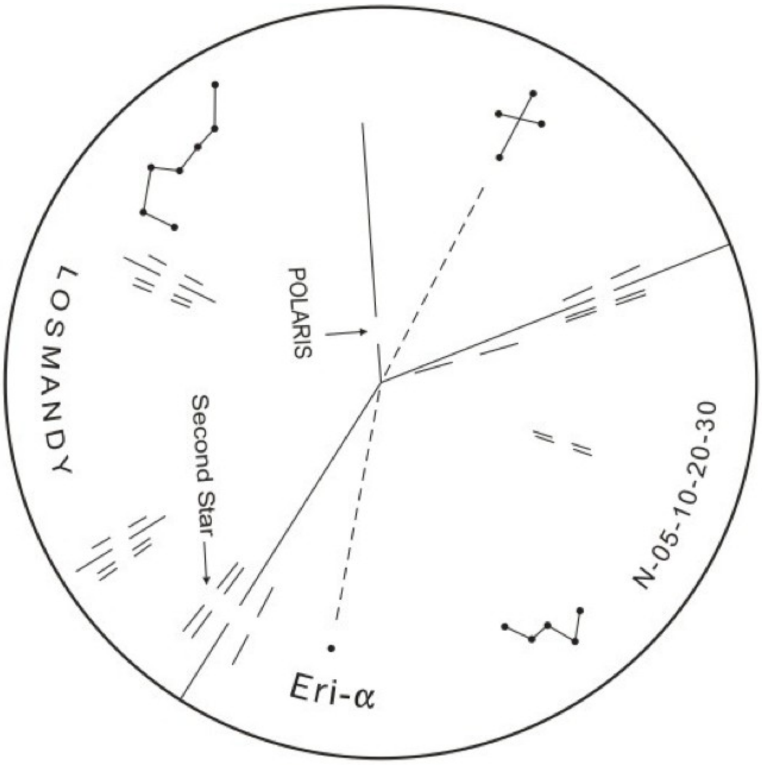


As it appears in the application

The graduated circle represen the Polaris orbit in 24 hours. The yellow dot represents the polaris position at the observation time.

polar alignment will be achieved.	In this example the polaris is located at 11:15 position considering a 12 hours watch dial.

The Losmandy polar scope allows a more precise alignment because it is based upon the positions of three stars (Polaris, δ UMi e OV Cep) and their correspondent locations in the scope reticle as seen in this illustration.



The alignment procedure with this kind of polar scope wil be as follows:

1. Loosen the RA clutch and rotate the main telescope around the RA axis very slowly until the line in the reticle with the slot for the Polaris (indicated in the reticle) is oriented at the same angle by the chosen smartphone or tablet application.

2. Make very small movements of the azimuth and altitude adjustment knobs, then rotate the polarscope until Polaris and the other stars are exactly located in their respective slots in the three axes. When the three stars are correctly positioned in their slots, tighten the Altitude and Azimuth knobs against the respective stops. It should be noted that the positions of the slots vary depending on the year. The four slots for the two stars other than Polaris are related to the observation years shown in the border of the reticle.

3. **Firmly tighten the screws that lock the mount movement with respect to the tripod**
4. The line drawings of Ursa Major and Cassiopeia should appear in the reticle in approximately the same orientation as those constellations appear in the sky.
5. The dotted lines pertain only to the Southern Hemisphere and are not important unless the observation site is in that hemisphere.

5.3.4 More modern and precise approaches to Polar Alignment

In the last years a special CCD camera has been commercialised, called Polemaster, 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).

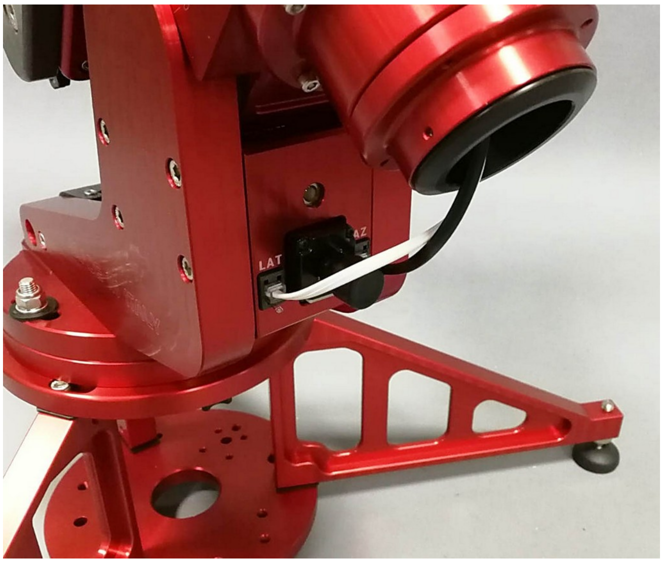
That CCD must be firmly installed on the mount keeping a good parallelism with the polar axis of the mount itself. Avalon Instrument has developed an adapter for fixing the CCD to the LineAR body. This adapter is provided as an optional one among the several accessories for the mount.

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.

APPENDIX A

MOTORIZED POLAR ALIGNMENT KIT

With the M-uno it is possible to assemble the optional Motorized Polar Alignment Kit. The kit is composed by two motors: the Altitude motor and the Azimuth motor, they are controlled by the AUX1 and AUX2 port of the StarGo. In order to manage them, they should be connected with the two provided RJ11 cables as shown in the picture below.

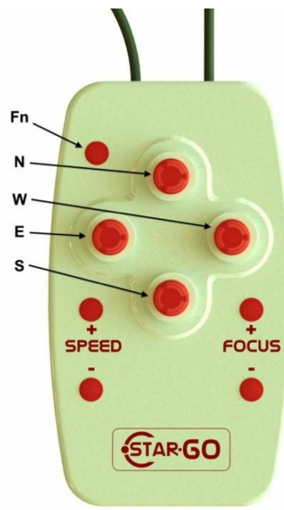


NOTE for the M-uno with the Optional Motorized Polar Alignment kit: In order to allow the mount free rotation on the Azimuth, being at the same time firmly assembled on the base flange, the three bolts must be tightened with the correct pressure. This adjustment it is performed from the factory. So in case the mount will be disassembled from its base, it must be reassembled taking care to adjust the three knobs with the same pressure. To check that the system is fine adjusted, it is just necessary to try to move the mount on the azimuth with the keypad and verified that a smooth rotation is achieved without play.

The Alt/Az motors can be controlled in two way, with the StarGo Keypad and via StarGo.exe GUI.

Alt/Az motors control with the StarGo Keypad:

With the StarGo Keypad it is possible to move the motors one by one. Before to start moving one of them, it must be chosen the AUX port to use first. Normally the first enabled is the AUX1, so by pressing FOCUS +/- the motor connected with the AUX1 will move on



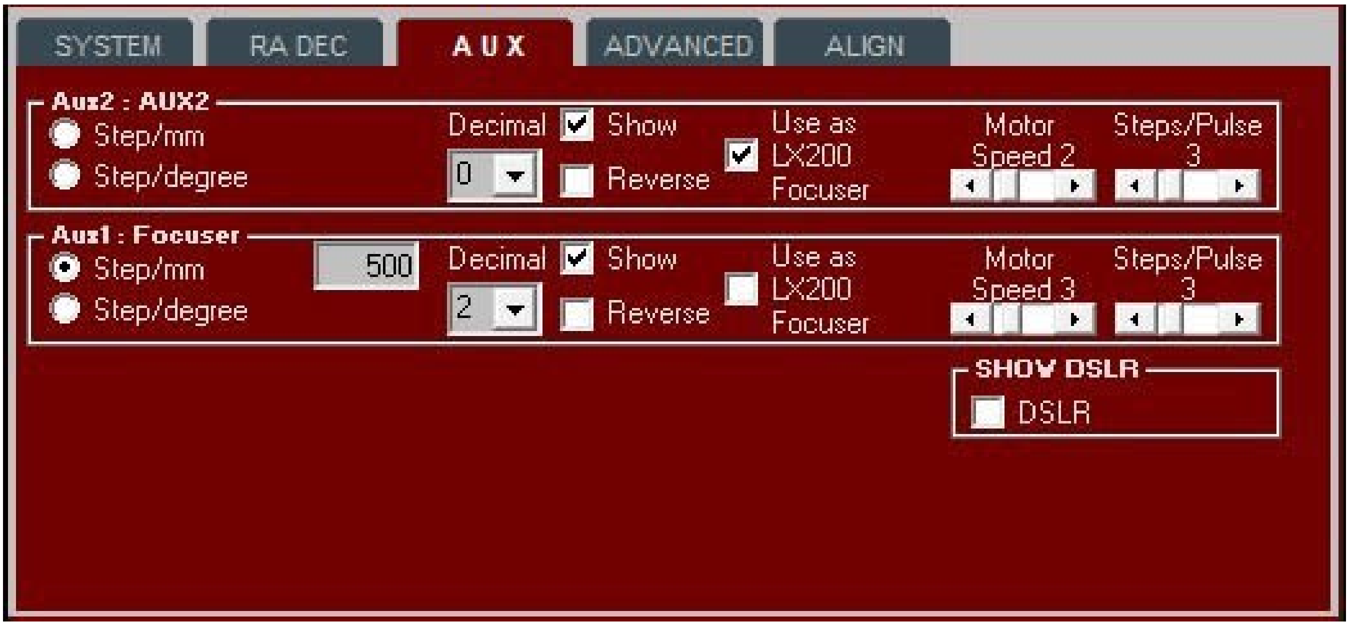
depending on the button pressed up or down in case of Latitude motor or left/right in case of Azimuth motor.

By holding pressure on the Fn key and then pressing the FOCUS+ key, it is possible to switch the control from the AUX1 to AUX2.

Alt/Az motors control with the StarGo GUI

With the StarGo.exe Software via StarGo GUI, it is possible to manage the Alt/Az motors connected via AUX1 and AUX2 port.

The AUX1 and AUX2 port control on the StarGo GUI can be found on the AUX panel as described at page 30 of the StarGo User Manual.



By clicking on this tab the ports settings will show up, then by enabling the “Show” checkbox in each of the two AUX port settings panel, the corresponding + and – button will show up in the upper side of the StarGo GUI. By by pressing on the + or – button the motor connected with the AUX1 will move on depending on the button pressed up or down in case of Latitude motor or left/right in case of Azimuth motor.

Starting from the StarGo_620_SP4 software version, it is also available an intuitive tool that allow more controls on the Alt/Az motors.

To enable this software version it must be checked the AUX as Motorized Polar Alignment option in the AUX tab, as shown in the picture below.

This tool allow to move the selected motor with the ArcMin unit, allowing also to perform GoTo by simply typing the choosen value in ArcMin and pressing on the GOTO button.