Supplementary Instruction Manual for SXP and SXD2 Equatorial Mounts on the use of the Polar Alignment Scope PF-L
This instruction manual describes on the build-in polar alignment scope PF-L for the SXP Mount-PFL and SXD2 Mount-PFL. The usage of the polar alignment scope PF-L with an SXD2 mount is explained mostly by way of example.

Table of Contents

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is a Polar Alignment Scope?</td>
<td>3</td>
</tr>
<tr>
<td>Basic Operation</td>
<td>5</td>
</tr>
<tr>
<td>Replacing the Battery</td>
<td>6</td>
</tr>
<tr>
<td>Polar Alignment</td>
<td>6</td>
</tr>
<tr>
<td>in the Northern Hemisphere</td>
<td>7</td>
</tr>
<tr>
<td>in the Southern Hemisphere</td>
<td>17</td>
</tr>
<tr>
<td>About PF-L Assist App</td>
<td>30</td>
</tr>
</tbody>
</table>
BEFORE USE

What is a Polar Alignment Scope?

The polar alignment scope is a small telescope that is installed parallel to the R.A. axis of an equatorial mount that enables you to point precisely to the north (or south) celestial pole.

Accurate polar alignment is essential for successful long exposure astrophotography of deep sky objects with the equatorial mount. The polar alignment scope can align the polar axis of the mount as accurately as 3 arc minutes or less.

Check longitude and latitude of your observing site with a GPS system or a map before the polar alignment.

The SX series of equatorial mounts (SX2, SXD2 and SXP) are set for use in the middle latitude zone (35 degrees plus or minus 15 degrees in latitude) at Vixen’s factory. If your observing site is lower or higher than the range of the middle latitude zone, you need to change the current altitude setting to match the latitude of your observing site. For details, refer to “Change the Altitude Setting” in the instruction manuals of your SX mount.

Caution

- Inaccurate polar alignment could result in trailed stars and field rotation in your imaging device.
- It is not possible to use the SX mount in the north latitude over 70 degrees and in the south latitude over 70 degrees.

Name of Each Part
### BEFORE USE

#### Reticle of the Polar Alignment Scope PF-L

<table>
<thead>
<tr>
<th>Names</th>
<th>Constellations</th>
</tr>
</thead>
<tbody>
<tr>
<td>POLARIS</td>
<td>Little Bear</td>
</tr>
<tr>
<td>δUMi</td>
<td>Delta UMi Little Bear</td>
</tr>
<tr>
<td>51Cep</td>
<td>Cepheus</td>
</tr>
<tr>
<td>“W” shape</td>
<td>Cassiopeia</td>
</tr>
<tr>
<td>Big Dipper</td>
<td>Big Bear</td>
</tr>
</tbody>
</table>

**In the Northern Hemisphere**

<table>
<thead>
<tr>
<th>Names</th>
<th>Constellations</th>
</tr>
</thead>
<tbody>
<tr>
<td>σOct</td>
<td>Octans</td>
</tr>
<tr>
<td>τOct</td>
<td>Octans</td>
</tr>
<tr>
<td>χOct</td>
<td>Octans</td>
</tr>
<tr>
<td>Southern Cross</td>
<td>Crux</td>
</tr>
<tr>
<td>αEri</td>
<td>Eridanus</td>
</tr>
</tbody>
</table>

**In the Southern Hemisphere**

**Meaning of numbers**

15 – the year 2015

40 – the year 2040

The position scales on the reticle are 5-year increments.
Basic Operation

ON/OFF the Dark Field Illuminator

There is a push switch on the top of the brightness adjusting dial of the polar alignment scope. Pushing the switch will illuminate the polar alignment reticle in red light. The red light becomes dimmer gradually after a certain interval of illumination (about one or two minutes) and turns off automatically.

Focusing on the Polar Alignment Reticle

You can focus on the polar alignment reticle by turning the eyepiece of the polar alignment scope. While holding the body of the polar alignment scope on one hand, turn the eyepiece part with the other hand.

Adjusting the Brightness of the Dark Field Illuminator

The brightness of the red light for the polar alignment reticle can be varied in 8 steps by turning the brightness adjusting dial of the polar alignment scope.
Replacing the Battery

1. While holding the brightness adjusting dial by hand, remove the battery cover (the switch for illuminator) on the top of the brightness adjusting dial by turning it counterclockwise.

2. Turn the battery compartment on the polar alignment scope downward as shown in the figure so that the old battery can fall out from the battery compartment.

3. Turn the battery compartment upward and insert a fresh battery in the battery compartment. The bottom of the battery compartment is the plus side.

4. Replace the battery cover in place. Be sure to check if the dark field illuminate is lit by turning on the switch.
The polar axis of the equatorial mounts is aligned to the North Celestial Pole in the northern hemisphere. The polar alignment scope utilizes 3 stars of Polaris, Delta UMi and 51 Cep near the North Pole. Positions of the above stars are plotted on the reticle of the polar alignment scope. To locate the N.C.P, you simply match the scale position on the reticle with the designated 3 stars seen in the polar alignment scope. Also, the patterns of the Big Dipper and Cassiopeia are engraved on the reticle for use as a guidepost for the North Pole.
USING THE POLAR ALIGNMENT SCOPE PF-L

1 Check your observing site with a compass, a GPS system or a map in advance to confirm that Polaris, Big Dipper and Cassiopeia can be seen from your observing location on the date of observation.

2 Set up the mount on flat and hard ground where you can see Polaris in the sky. Point the polar axis of the mount in the direction of north as shown in the figure. Adjust the tripod legs so that the tripod is as level as possible.

3 Take off the polar axis front cap on the declination body by turning it counterclockwise to remove.

Note: Be sure to extend the counterweight bar fully for polar alignment. Otherwise, the sight of the polar alignment scope will be obstructed.

While looking into the polar alignment scope, turn the polar alignment scope body so that the engraved Big Dipper (or Cassiopeia) on the reticle matches the Big Dipper (or Cassiopeia) in the real sky.
4 Turn ON the power of the mount and advance the setting to the home position with the STAR BOOK TEN so that the telescope's optical tube points toward the west and is level.

5 While looking into the opening of the polar alignment scope on the declination body, turn the declination body with the ▲ or ▼ direction key so that the objective lens of the polar alignment scope can be seen in the opening.

Note:
The declination axis can not be turned manually without the STAR BOOK TEN controller.
Loosen the altitude clamp lever. Turn the altitude adjustment knob so that the indication of the altitude scale fits the latitude of your observing site.

Note:
The declination axis can not be turned manually without the STAR BOOK TEN.

While looking into the eyepiece of the polar alignment scope, turn the polar alignment scope’s body so that the engraved Big Dipper (or Cassiopeia) on the reticle matches Big Dipper (or Cassiopeia) in the real sky.
The patterns of the Big Dipper and Cassiopeia on the reticle are positioned to correspond to the real sky. They are used as a guidepost to know the turning direction of the polar alignment scope's reticle. The locations of the Big Dipper and Cassiopeia on the reticle have no relation to the location of Polaris, Delta UMi and 51 Cep on the reticle.

Note: The real stars of Big Dipper (or Cassiopeia) are not visible in the field of view of the polar alignment scope.
While looking into the eyepiece of the polar alignment scope, adjust the direction of the mount by turning the altitude adjustment knob and azimuth adjustment knobs so that Polaris comes as close as possible to the designated position on the reticle.

Set Polaris to the gap between the two segments of the lines marked 2014 and 2040 adjacent to a mark “POLARIS” as shown in the figure.

Set Polaris to an approximate position that is corresponding to the year of your observation.
Unfastening one side of the azimuth adjustment knobs will allow fastening the knob on the other side.

Turn the altitude adjustment knob.
As Polaris shifts to the designated position on the reticle, both Delta UMi and 51 Cep come close to their own designated position scales respectively. While looking into the eyepiece of the polar alignment scope, turn the polar alignment scope body so that each of the position scale for Delta UMi and 51 Cep come to the closest to actual Delta UMi and 51 Cep respectively.

The numbers 15 and 40 on the position scales for Delta UMi and 51 Cep show the years 2014 and 2040 respectively.

Adjust the red light illumination to be dimmer if the reticle is too bright to see the stars.
Polaris is out of place from the designated position. This is part of the process.

Since there is no mark that points at the North Celestial Pole, you need to match the polar axis of your mount with the N.C.P using the conspicuous polar star and two stars in the same area of the sky.

As an illustration here, Polaris is set to the edge of the line on the side of 2014, and both Delta UMi and 51 Cep are to set to the middle of the curved lines of the position scale at the protruded edge on the side of 15 respectively. (In case of the year 2014)

Turn the polar alignment scope body so that Delta UMi comes near to the location of the year 2014 on the scale. And then, Polaris will get out of position from the gap between the lines.
The movement of Polaris from 2014 to 2040 by precession

The movement of Delta UMi from 2014 to 2040 by precession

The movement of 51 Cep from 2014 to 2040 by precession

The locations of Polaris, Delta UMi and 51 Cep on the position scales change year by year due to precession of the Earth. You need to compensate the locations of the 3 stars on the position scales yearly.

If the 5th magnitude 51 Cep is hard to see in the polar alignment scope's field of view, at least be sure to set Delta UMI to the position scale on the reticle.
While looking into the eyepiece of the polar alignment scope, turn the altitude adjustment knob and azimuth adjustment knobs so that Polaris comes to the gap between the two segments of the lines marked 2014 and 2040.

Correcting the position of Polaris with the altitude adjustment knob and azimuth adjustment knobs
Correcting the position of Delta UMi and 51 Cep with a rotation of the polar alignment scope
Repeat the procedures 11 and 12 until Polaris, Delta UMi and 51 Cep come to the proper locations on the designated position scales respectively. Tighten the azimuth adjustment knobs at both sides to finish the polar alignment.

As an illustration here, Polaris is set to the edge of the line on the side of 2014, and both Delta UMi and 51 Cep are set to the middle of the curved lines of the position scale at the protruded edge on the side of 15 respectively.
(In case of the year 2014)
USING THE POLAR ALIGNMENT SCOPE PF-L

Polar Alignment in the Southern Hemisphere

The polar axis of the equatorial mounts is aligned to the South Celestial Pole in the southern hemisphere. The polar alignment scope utilizes 3 stars of Sigma Octantis, Tau Octantis and Chi Octantis near the South Pole. Positions of these stars are plotted on the reticle of the polar alignment scope. To locate the S.C.P, you simply match each of the position scale on the reticle with the designated 3 stars caught by the polar alignment scope. Also, the pattern of the Southern Cross and Alpha Eridani are engraved on the reticle for use as a guidepost for the South Pole.
USING THE POLAR ALIGNMENT SCOPE PF-L

1. Check your observing site with a compass, a GPS system or a map in advance to confirm that Octans, the Southern Cross and Alpha Erinadi can be seen from your observing location on the date of observation.

2. Set up the mount on flat and hard ground where you can see Octans in the sky. Point the polar axis of the mount in the direction of south as shown in the figure. Adjust the tripod legs so that the tripod is as level as possible. Take off the polar axis front cap on the declination body by turning it counterclockwise to remove.

3. Turn ON the power of the mount and advance the setting to the home position with the STAR BOOK TEN so that the telescope’s optical tube points toward the east and is level.

Make sure to align the mount to the south celestial pole as accurate as possible. There is no conspicuous bright star around the S.C.P unlike Polaris in the N.C.P and it makes the polar alignment more difficult. When a magnetic compass is used for finding a direction, be sure to take account of the influence of magnetic declination.
While looking into the polar alignment scope, turn the polar alignment scope body so that the engraved Southern Cross (or Alpha Eridani) on the reticle directs the Southern Cross (or Alpha Eridani) in the real sky.
Both the Southern Cross and Alpha Eridani on the reticle are positioned to correspond to the real sky. They are used as a guidepost to know the turning direction of the polar alignment scope's reticle. The locations of the Southern Cross and Alpha Eridani on the reticle have no relation to the locations of the Octantis stars on the reticle.

Note: The real stars of the Southern Cross (or Alpha Eridani) are not visible in the field of view of the polar alignment scope.
While looking into the eyepiece of the polar alignment scope, adjust the direction of the mount by turning the altitude adjustment knob and azimuth adjustment knobs so that Sigma Octantis comes as close as possible to the designated position on the reticle.

Set Sigma Octanits to the gap between the two segments of the lines marked 2014 and 2040 adjacent to a mark “σ Oct” as shown in the figure.
As Sigma Octantis shifts to the designated position on the reticle, both Tau Octantis and Chi Octantis come close to their own designated position scales respectively. While looking into the eyepiece of the polar alignment scope, turn the polar alignment scope body so that each of the position scale for Tau Octantis and Chi Octantis come to the closest to actual Tau Octantis and Chi Octantis respectively.

The numbers 15 and 40 on the position scales for Tau Octantis and Chi Octantis show the years 2014 and 2040 respectively.
Now, Sigma Octantis gets out of place from the designated position but it is not necessary to correct for it at this stage.

Since there is no mark that points at the South Celestial Pole, you need to match the polar axis of your AP equatorial mount with the S.C.P using the relatively dim Octantis stars in the neighborhood.

As an illustration here, Sigma Octantis is set to the edge of the line on the side of 2014, and both Tau Octantis and Chi Octantis are to set to the middle of the curved lines of the position scale at the protruded edge on the side of 15 respectively. (In case of the year 2014)

Turn the polar alignment scope body so that Tau Octantis comes near to the location of the year 2014 on the scale. And then, Sigma Octantis will get out of position from the gap between the lines.

Adjust the red light illumination to be dimmer if the reticle is too bright to see the 5th magnitude Tau Octantis.
The movement of Sigma Octantis from 2014 to 2040 by precession

The movement of Tau Octantis from 2014 to 2040 by precession

The movement of Chi Octantis from 2014 to 2040 by precession

The locations of Sigma, Tau and Chi Octantis on the position scales change year by year due to precession of the Earth. You need to compensate the locations of the 3 stars on the position scales yearly.
While looking into the eyepiece of the polar alignment scope, turn the altitude adjustment knob and azimuth adjustment knobs so that Sigma Octantis comes to the gap between the two segments of the lines marked 2014 and 2040.

Correcting the position of Sigma Octantis with the altitude adjustment bolt and azimuth adjustment knobs

Correcting the position of Tau and Chi Octantis with a rotation of the polar alignment scope

Set Sigma Octantis to an approximate position t that is corresponding to the year of your observation.
Repeat the procedures 6 and 7 until Sigma, Tau and Chi Octantis come to the proper locations on the designated position scales respectively. Tighten the azimuth adjustment knobs at both sides to finish the polar alignment.

As an illustration here, Sigma Octantis is set to the edge of the line on the side of 2014, and both Tau and Chi Octantis are set to the middle of the curved lines of the position scale at the protruded edge on the side of 15 respectively. (In case of the year 2014)
The constellation Octans is made up of dark stars about 5th magnitude on average. The nearest star to the south celestial pole is Sigma Octantis, which is one of four stars forming a trapezoid in Octans, visible at 5.5th magnitude. There are a few methods to locate inconspicuous Octans using the surrounding stars.

Note: The orientation of Octans changes depending on the season of year.
1. Directing to Octans using Small Magellanic Cloud and the Southern Cross (Crux) as pointers

Draw an imaginary line between the center of Small Magellanic Cloud and Beta Crux, and divide it at a ratio of one to two. You will find the four stars of Octans at the divide.

2. Directing to Octans using the arrangement of stars in the Southern Cross (Crux) as pointers

Draw an imaginary line straight through the two stars (Alpha and Beta Crux) of the Southern Cross making the vertical line of the cross toward Small Magellanic Cloud. You will find the four stars of Octans at a place about 4.5 times extended from the span of the two stars.

3. Directing to Octans using Small Magellanic Cloud, Beta Hydrus and Gamma Octantis as pointers

If you cast your eyes toward Crux from Small Magellanic Cloud, you will see Beta Hydrus. Going southward from Beta Hydrus will find you Gamma Octans which consists of a row of three stars. Continue on your eyes by the same distance toward the Southern Cross and you will find the four stars of Octans.
The free download PF-L Assist app is available for iPhone, Android and Kindle fire.

For details of the app, visit our web site at: http://www.vixen.co.jp.

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### Specifications

<table>
<thead>
<tr>
<th>Name</th>
<th>Polar Alignment Scope PF-L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polar Alignment Scope</td>
<td>6X20mm (8 degrees actual field of view)</td>
</tr>
<tr>
<td>Polar Alignment reticle</td>
<td>Reticle with scales for pointing 3 stars</td>
</tr>
<tr>
<td></td>
<td>N. Hemisphere: Polaris, Delta UMi and 51 Cep</td>
</tr>
<tr>
<td></td>
<td>S. Hemisphere: Sigma Oct, Chi Oct and Tau Oct</td>
</tr>
<tr>
<td>Illumination</td>
<td>Self-light-off dark field illuminator, brightness adjustable by 8 steps</td>
</tr>
<tr>
<td>Battery</td>
<td>CR2032 battery (Checking purpose only)</td>
</tr>
<tr>
<td>Setting Accuracy</td>
<td>3 arc minutes or less</td>
</tr>
<tr>
<td>Dimensions</td>
<td>47 x 55 x 142mm</td>
</tr>
<tr>
<td>Weight</td>
<td>155g (w/o battery)</td>
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<tr>
<td>Applicable to</td>
<td>SX2, SXD2 and SXP</td>
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