Holder rod — north reference for Polar Mount Align

For the free app Polar Mount Align, on Android and iPhone · Google Play: https://play.google.com/store/apps/details?id=app.polarmountalign · App Store: https://apps.apple.com/app/id6818107225

What it does

The holder rod provides an optical daytime true-north reference for telescope mounts running the Polar Mount Align app.

While the phone rests in its cradle attached to the equatorial mount saddle, the rod projects a sharp shadow onto the smartphone screen. The app calculates the exact local solar ephemeris and renders parallel target lines across the display indicating where the shadow falls when the mount points north. When the mount is rotated in azimuth until the shadow is parallel to the lines, the app registers and holds true north for the alignment.

Once confirmed by tapping "The shadow is on the lines", the phone's internal gyroscope maintains the true-north heading without moving any hardware. Selecting "Save the compass correction for this mount" saves the correction for this mount, so later sessions can rely on the compass alone.

What you need

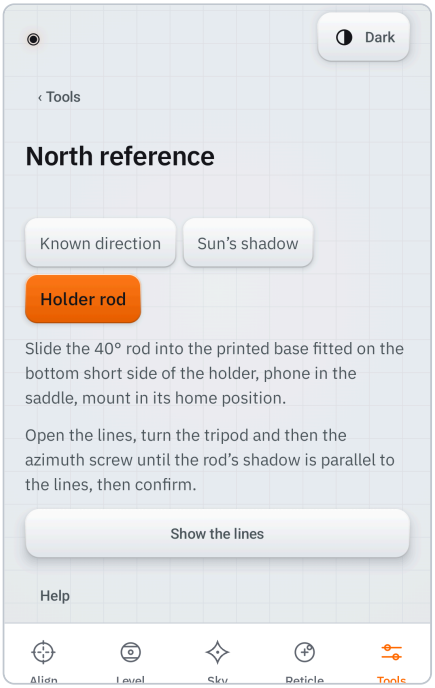
- An Android phone or an iPhone with the free Polar Mount Align app installed (Google Play, App Store).
- An equatorial mount equipped with a Vixen saddle and a phone cradle.
- The two 3D printed parts (`04_Holder_Rod_Base.stl` and `05_Holder_Rod.stl`) sized for the Pixel 7a cradle, or an equivalent custom rod built to the specifications detailed below.

Fitting the base and the rod

1. Place the phone securely into the cradle.
2. Take the base (`04_Holder_Rod_Base.stl`) and slide it onto the bottom short end of the cradle from the rear. An integrated indexing key slides into the USB opening of the cradle, locking it on centre. The base mounts purely to the exterior shell of the cradle and does not contact the glass screen. No screws or clamps are required.
3. Slide the foot of the rod (`05_Holder_Rod.stl`) into the inclined front slot of the base along the two guide channels until fully seated.
4. When seated, the 3 × 3 mm rod leans forward at 40° relative to the perpendicular of the screen, angled towards the top edge of the phone, projecting 190 mm outward from the base. (An earlier 80 mm prototype was found insufficient in testing, as the shadow fell short of the active display area with the phone level around 2:00 PM; 190 mm keeps the shadow on the screen in more Sun positions).

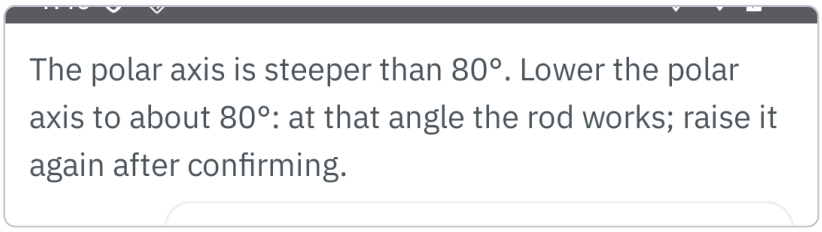
Step-by-step alignment in the app

1. Set the equatorial mount in its home position (saddle parallel to the polar axis), with the top edge of the phone pointing towards the celestial pole.
2. Launch Polar Mount Align and navigate to: Tools › North reference › Holder rod.



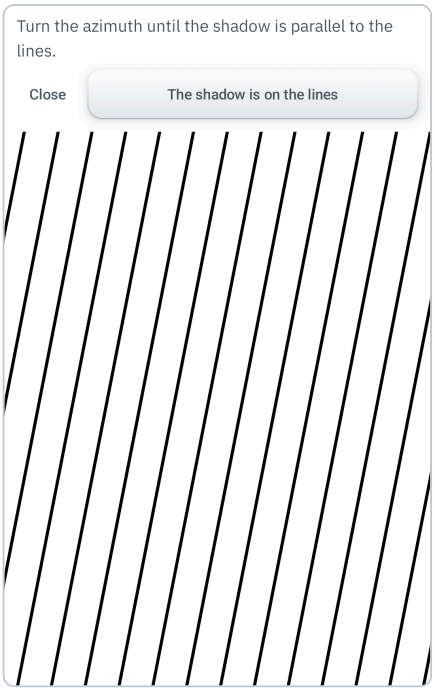
The North reference page with "Holder rod" selected.

3. Tap "Show the lines". If the Sun is positioned towards the pole, the app detects that the shadow cannot fall across the screen in the standard position. It displays a screen requesting to lower the polar axis to a specific target angle.



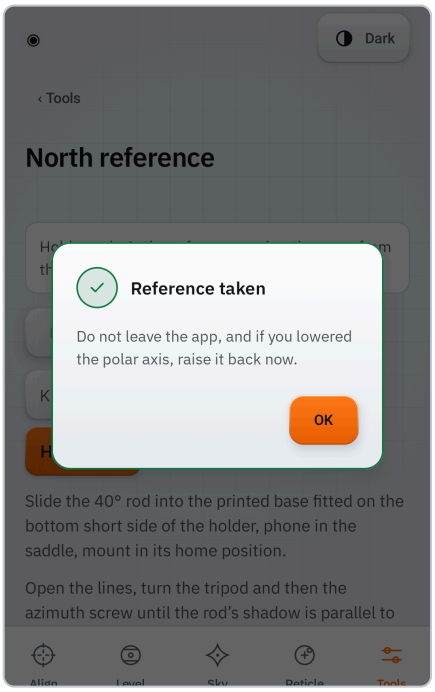
The message asking to lower the polar axis to a stated angle.

4. If prompted to lower the polar axis, adjust the altitude screw of your mount until the displayed angle is reached.
5. Observe the shadow cast by the rod across the screen lines. Coarsely rotate the tripod base, then use the azimuth adjustment knobs on the mount until the rod's shadow is parallel to the target lines on the screen.



The target lines on screen with the "The shadow is on the lines" confirmation button.

6. Tap "The shadow is on the lines". The app registers and holds the true north reference via the gyroscope.



The "Reference taken" confirmation message.

7. If you lowered the polar axis in step 4, the app now prompts you to raise the polar axis back up to your station's latitude.
8. Tap "Save the compass correction for this mount" to save the correction for this mount, so later sessions can rely on the compass alone.

When the holder rod cannot be used

The holder rod method requires direct sunlight. The app refuses only when:

- the Sun is below 10°
- the Sun is behind the screen
- the polar axis is steeper than 80°
- the shadow would be too short or off the screen
- the shadow turns too little
- two directions would give the same shadow

In each case, the app explains why and points to the "Sun's shadow" method (a separate method where the phone is laid flat out of the holder with an upright object such as a rod or a tripod leg).

Making your own rod

If you use a phone cradle other than the Pixel 7a design, you can fabricate a compatible rod assembly:

- **Geometry**: A straight, rigid rod approximately 3 mm thick, projecting 190 mm from its mounting point.
- **Placement**: Mounted rigidly to the phone cradle—never attached directly to the phone body or screen glass—at the midpoint of the bottom short edge just clear of the screen area.
- **Orientation**: The rod must tilt 40° from the perpendicular to the screen towards the top edge of the phone, with 0.0° of lateral (sideways) lean.
- **Invariance**: The physical attachment height and exact translation along the edge do not alter the calculation; only the pointing vector (direction) of the rod matters.
- **Tolerances**:
  - *Lateral lean (critical)*: Sideways tilt is the primary source of azimuth error. A lateral deviation of just 1.0° generates approximately 0.6° to 1.1° of azimuth error (calculated at 52° N in late October). Lateral alignment should be held within 0.1°.
  - *Elevation angle (40° tilt)*: Longitudinal angle errors cancel out when the Sun is due south (local solar noon). Pitch errors increase away from noon, producing roughly 0.5° to 0.75° of azimuth error per degree of pitch error 2 to 3 hours before or after solar noon.

Refer to the dimensioned drawing on the following page for the rod geometry.

Accuracy tips

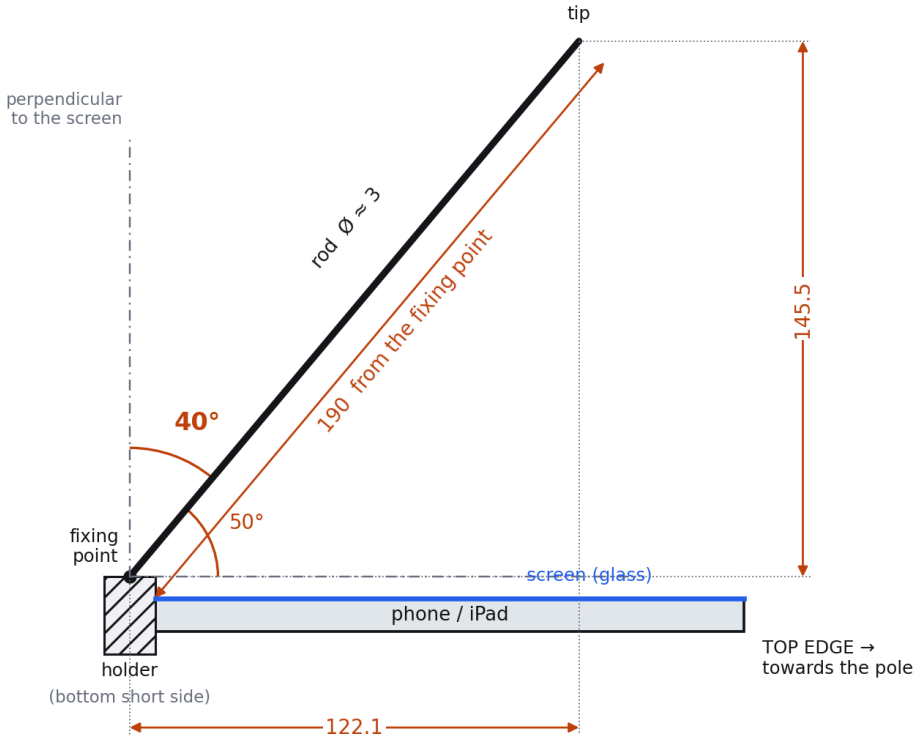
- **Perform alignment near solar noon**: Running the alignment within an hour of local solar noon minimizes sensitivity to rod pitch angle errors.
- **Verify rod straightness**: Check 3D printed or fabricated rods periodically against a flat edge to ensure they have not warped under heat or stress.
- **Hands off during confirmation**: Do not touch the mount or phone when tapping "The shadow is on the lines" to prevent sensor disturbance while the gyroscope acquires the heading.

Polar Mount Align on Google Play: https://play.google.com/store/apps/details?id=app.polarmountalign · on the App Store: https://apps.apple.com/app/id6818107225

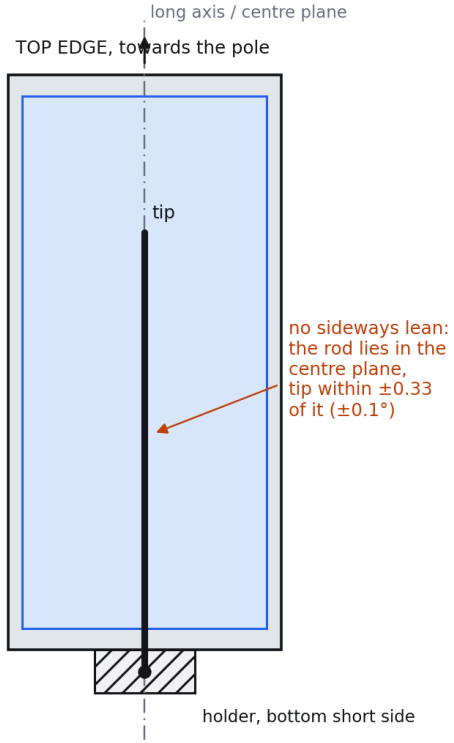
Polar Mount Align · Holder rod, make your own

Dimensions in mm, angles in degrees. Not to scale. Only the rod's direction is used by the app.

SIDE VIEW (section through the long axis)



SEEN FROM ABOVE THE SCREEN



WHAT MATTERS

1. Straight, stiff rod, about 3 mm in diameter, sticking out 190 from the fixing point. Length is not critical: a longer rod keeps the shadow on the screen in more Sun positions.
2. Fixed to the holder, never to the phone or iPad, clear of the glass, at the middle of the bottom short side (the end away from the pole), just beyond the screen.
3. Only the direction counts: where the fixing point sits along the edge and how high it is make no difference.
4. Sideways lean is the critical error: 1° gives 0.6 to 1.1° of azimuth error (52° N, late October Sun). Keep it within 0.1°. A bend in the rod counts as lean.
5. The 40°: 1° of error gives nothing with the Sun due south and 0.5 to 0.75° of azimuth 2–3 hours from local noon. Keep it within 0.2° (check dimensions ±0.6), or take the reference near local noon.
6. Check dimensions, from the fixing point to the tip: 145.5 perpendicular to the screen and 122.1 parallel to it towards the top edge, both in the centre plane.

In the app: Tools › North reference › Holder rod. Mount in its home position, top edge towards the pole, Sun above 10° and on the screen side.