



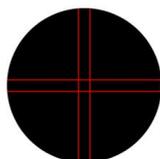
Skywatcher handset polar alignment routine [v1]

James Dawson, [Nottingham Astronomical Society](http://www.nottinghamastronomicalsociety.org)

1. Make sure the firmware in the handset is the latest; currently v3.37.
2. Roughly polar align the mount.
 - a. At this stage I do a polar scope polar alignment, but this isn't necessary, it just means I can do the rest of the process more quickly. You could just point the RA axis at Polaris or at magnetic north if you have a compass.
 - b. If you can't see Polaris: move the mount and get it roughly level in a location where you can see Polaris, and alter the altitude adjustment so that Polaris is visible in the polar scope, then move the mount to where you want to set up, and using a compass point the RA axis to the north, and leave the altitude adjustment alone for now.
3. Put the scope in the home position.
 - Weights down
 - Scope pointing at Polaris



4. I use an AZEQ6 so at this point I reboot the mount else the encoders cause problems further down the line. If your mount has no encoders, there is no need to reboot.
5. Ideally use a reticle (or reticule) eye piece for the rest of the process. The cheaper ones usually have a focal length of about 12mm.



These can be obtained for £20-30



- a. The reticle eye piece can be used in combination with a Barlow lens or a Powermate or equivalent to shorten the focal length and give more magnification and therefore greater precision. I use my 12mm reticle eye piece with a 2x Barlow so it effectively becomes a 6mm eye piece.
6. Undertake a two star alignment using the handset. **Pick two stars which are the same side of the meridian**, so either two stars that are in the eastern half of the sky, or two stars that are in the western half of the sky. Do not use one star in the east and one star in the west.
 7. When the scope slews to the first star, you may need to just use the reticle eyepiece on its own to centre the star, then swap it out and replace with the reticle and Barlow if you are

doing that, and centre again. Always end the movement of centring with the same two direction keys, I use the up and right keys, but you could use the down and left keys, just always use the same pair. Get the first star bang in the middle of the cross hairs of the reticle eyepiece. Press enter.

8. Select your second star and repeat step 7 for the second star.
9. The handset will hopefully then say "alignment successful".
10. The handset will also give you a screen showing the Mel and Maz errors:
 - a. Mel is the error in elevation. If your mount was perfectly polar aligned, this error would be zero. If you had started this whole process after polar aligning with the polar scope, I'd expect this error to be in the order of half a degree or so at present.
 - b. Maz is the error in azimuth. If your mount was perfectly polar aligned, this error would be zero. If you had started this whole process after polar aligning with the polar scope, I'd expect this error to be in the order of half a degree or so at present.
 - c. The goal of the next few steps is to make adjustments in the elevation and azimuth of your mount to reduce these errors to nearer zero, and in doing so get your mount much better polar aligned.
 - d. The errors in the image below are: Mel -1 degree, 44 arcminutes, 22 arcseconds; Maz +7 degrees, 15 arcminutes, 38 arcseconds. This is a big error and this mount is very poorly polar aligned. The positive and negative values are essentially unimportant.



11. Now select "Polar alignment" from the alignment menu.
12. The handset will ask you to pick a star. Pick one of the two stars you did you two star alignment on.
13. The mount will slew to that star and the handset will ask you to centre the star using the arrow buttons.
14. Centre the star using the arrow button. Remember to end the move using the same two arrow buttons as before (step 7); I use up and right. I also drop the slew speed right down to about speed 2 and really slowly slew the star into position in the cross hairs. Once centred, press enter.
15. The mount will then slew the scope away from that star and ask you to re-centre the star using only the elevation knob. If you initial polar alignment in step 2 was poor, the star could be a long way out of the field of view, so you may have to use the finder scope to locate it, or gently remove the Barlow if you are using one and just use the reticle eye piece alone. **Do not use the arrow keys at this stage.**

16. **Only use the elevation knob** to get the star as close to the centre of the FoV as possible. Quite often the star will not go into dead centre, but get it as near as possible.
17. This is an awkward bit. Remember where the star is in the Fov. It is unlikely to be dead centre, but if it is half way between the centre and the top of the FoV (as in the image below), remember where it is, that is needed for the next step.



18. Press enter to accept you have centred the star with the elevation knob.
19. The mount will then slew away from the star again.
20. Now it will ask you to centre the star only using the azimuth knobs. If you initial polar alignment in step two was poor, the star could be a long way out of the field of view, so you may have to use the finder scope to locate it, or gently remove the Barlow if you are using one. Do use the arrow keys at this stage.
21. **Only use the azimuth knobs** to get the star as close as possible to its earlier position (position of the star at the end of step 17).
22. Press enter to accept.
23. The handset will now give you Mel and Maz errors and these are likely to be very close to zero, but don't get too excited as these don't mean anything!
24. Now you need to do a new two star alignment. Pick the same two stars. Repeat steps 7 and 8.
25. Again the handset will say the alignment is successful.
26. The handset will give you new and revised Mel and Maz errors. Hopefully these errors are much smaller than the initial errors. I often take a photo of the various error screens on my phone to remind me of the values.
27. Now repeat steps 11 to 25, as this will be the second time you'll run through the polar alignment routine.
28. The handset will give you new and revised Mel and Maz errors. Hopefully these errors are smaller than the errors given in step 26.
29. Repeat steps 11 to 25 as many times as you like; each time you are likely to be getting the Mel and Maz errors smaller, and the mount better polar aligned.
30. At some point you'll encounter the law of diminishing returns, and the errors won't get any better or may even get worse. It is quite easy (with my set up at least) to get the errors under 5 arcminutes each within three cycles of the routine.
31. Once you are happy with your Mel and Maz errors, undertake a three star alignment as this will give you the best possible GOTO, but be warned the Mel and Maz after a three star alignment are going to be shocking again. But don't worry, your polar alignment will still be as good as it was when the Mel and Maz were small numbers, it is just that your three star alignment will be picking stars from either side of the meridian, and you'll be introducing other errors into the system which will make the handset think the polar alignment is bad again.
32. This may sound complicated, but once you have the hang of it, three cycles can be undertaken in under 5 minutes.
33. I think that is all, but do submit comments and I can always make revision to this.