# Accurate Polar Alignment



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## Table of Contents

# 1 Introduction

I have found that aligning a scope to obtain *acceptable accuracy* in its GoTo operations is actually a multi-faceted process that needs some care. This document explains the procedure I always use after having tried various methods.

My metric of an *acceptable accuracy* is that a GoTo to any object should result in it being placed in an approximately ½ degree field of view. This is of course massively dependant upon the quality of your mount, but I'm really taking about what you should be able to expect of a £1000 class mount for example. In my case this is my Sky-Watcher EQ6 Pro mount.

Just about every GoTo capable mount either has a polar align scope built in (or has an after sales add on option) or has a controller than includes polar alignment routines. There is also a plethora of software applications that are dedicated to, or contain tools for, polar aligning your scope.

My experience is that all the software/firmware packages (and I write this as having spent 30 years designing and implementing software systems) tend to give different results – no doubt partially due to the type of the alignment algorithm implemented and the quality of the software design, writing and testing.

Irrespective of what initial technique you use for polar alignment (I use the polar align routines n PHD2) there is one technique that will always give you the definitive result of how accurate your alignment is; namely using your eyeball (either via an eyepiece or CCD image capture software) and using the **drift** method to check your alignment. Your eyeball won't lie, but software may!

In the section below I therefore describe the drift method that I use to make a definitive check and adjustment to achieve accurate polar alignment once I have achieved alignment using any of the mount controller or software-based approaches.

Accurate polar alignment such as this is only really needed is you are intending to take long exposure deep sky images.

## 1.1 Orientation

So which way is NESW when viewed through your eyepiece / CCD / Webcam?

If you are unsure which direction the star moves for North/South and East/West through your eyepiece, CCD or Webcam view then observe a star and use the handset's (or software such as EQMOD etc) slew controls to determine the direction; for example to check which way in the eyepiece/display is **North**, use the **South** control to slew the scope South and the direction that the star appears to move is **North**, slew the scope West and the direction that the star appears to move is East.

## 2 Polar alignment using the drift method

1. Find a star near the meridian (within ½ hour RA of the meridian) and about 0 degrees declination (within +/-20 degrees will do) and orientate a reticule in your guiding eyepiece or CCD software so that it is aligned with the north-south motion of the telescope when using the North/South slew controls. Now centre the star on the cross hairs.

   Let you mount track at **sidereal rate** and watch for North/South (i.e. up/down) drift only; you may guide in RA only if you want to

   - If the star drifts **North** in the cross hairs, the azimuth alignment is West of North and hence use the mounts **azimuth** knob to move the mount to the **East**.

   - If the star drifts **South** in the cross hairs, the azimuth alignment is East of North and hence use the mounts **azimuth** knob to move the mount to the **West**.

   - For good alignment repeat until you have no drift for 5 minutes.

2. Find a star within 20 degrees above eastern horizon and about 0 degrees (within +/-20 degrees) declination.

   - If the star drifts **North** in the cross hairs, the altitude alignment is too high and hence use the mounts **altitude** knob to **lower** the alignment (i.e. reduce the altitude reading on the mounts altitude scale).

   - If the star drifts **South** in the cross hairs, the altitude alignment is too low and hence use the mounts **altitude** knob to **raise** the alignment (i.e. increase the altitude reading on the mounts altitude scale).

   - For good alignment repeat until you have no drift for 5 minutes.

**Summary**

| Star near Meridian | Star near Eastern Horizon |
|---|---|
| If star drifts **North**, move azimuth **East** | If star drifts **North**, move altitude **Lower** |
| If star drifts **South**, move azimuth **West** | If star drifts **South**, move altitude **Higher** |

## 3 Notes

You may use a star in the west, but adjustments must then be reversed as follows:

If star drifts **North**, move altitude **Higher**

If star drifts **South**, move altitude **Lower**

Drift in less than 5 seconds at 200X means alignment is probably 10 or more eyepiece fields off on azimuth; give the knob a good crank! If no drift in 30 seconds or so then alignment may only be 1 or 2 eyepiece fields off.

Remember: for good polar alignment you must have no drift for 5 minutes.

# 4 Further Information

Please visit my website www.astroworkbench.co.uk for further documents and articles.

Thanks.

Keith.