

Telescope Mounts

by Ken Graun

Mount Basics

Understanding mounts can be just as confusing as understanding telescopes.

A good mount and tripod is essential for steady viewing of the night sky—it is a big part of “observing satisfaction.” There is nothing worse than trying to observe with a shaky mount/tripod and since we are dealing with magnifications of 50x and up, this is a very important consideration—especially with the higher magnification of 150x to 300x plus.

The mount sits on the tripod (or pedestal or stand). The mount allows movement of the telescope to point to objects in the sky. The tripod elevates the mount so the telescope is at a comfortable viewing height.

Generally, inexpensive telescopes aren't good in the mount/tripod department.

There are two basic mounts, the **Altitude-Azimuth (Alt-Az)** and **Equatorial** and are described below.

The Alt-Az mount

The altitude-azimuth (alt-az) mount is the basic up-and-down and turn-it-around mount, the same used with binoculars at tourist sites (but you don't have to insert quarters). This is usually a manual mount and is often found on small refractors and reflectors of around 6-inches or less. A motorized/computerized version is used on the SCT telescopes by Celestron and Meade.

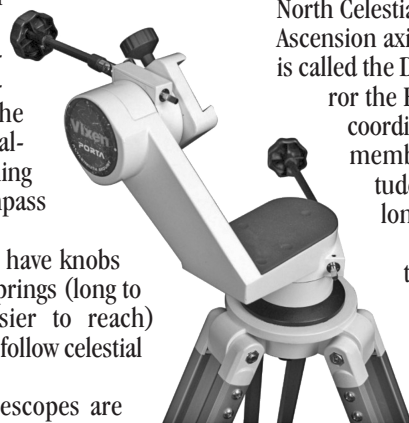
The Altitude movement is the up-and-down motion and the Azimuth movement allows horizontal or turning movement to any compass point.

Some alt-az mount have knobs on long rods or long springs (long to make the knobs easier to reach) that are turned to help follow celestial objects.

The Dobsonian telescopes are all on alt-az mounts and it is possible to motorize these mounts and/or add Digital Setting Circles.

Like anything, the quality of alt-az mounts varies, and some work horribly. Usually, the more expensive the telescope, the better quality mount you get, as well as a stable tripod.

I have a few manual alt-az mounts that I enjoy using because I can quickly and easily move the scope to objects, of course, using a reflex finder.



Alt-Az mount with knobs for slow-motion control (moves the scope slightly to keep an object in view).

The Equatorial mount / GEM

This is a more complicated mount than alt-az mounts (but easy to use) with motorized versions used/needed for amateur astrophotography. Note, there are incredibly worthless equatorial mounts on many cheaper telescopes!

This mount has different configurations but the most popular is the German Equatorial Mount (abbreviated as GEM).

All equatorial mounts have two axes, perpendicular to each other. One points to the North Celestial Pole (called the Polar or Right Ascension axis) and the other is 90° to it and is called the Declination axis. These axes mirror the Right Ascension and Declination coordinates of the Celestial sphere. Remember, Declination is akin to latitude and Right Ascension is akin to longitude.

For this mount to work properly, the Polar axis *has* to be pointed to the North Celestial Pole (very close to the star Polaris and at the same angle as your latitude). For general observing, this alignment is not critical but careful alignment is important for astrophotography. Most Equatorial

mounts have an adjustment for latitude.

One advantage of the equatorial mount is that only one axis has to turn to keep an object in view instead of two for the alt-az.

The German equatorial mount is characterized by counterweights to balance the telescope around the Polar axis, so this makes it extra heavy compared to alt-az mounts.



Tripods or Pedestal

The tripod or pedestal is the stand that the mount sits on, so three legs of some sort are usually involved which provide maximum stability with the ground.

Usually, you get a better tripod (and mount) with more expensive telescopes.

In the past, the pedestal tripod (a post with 3 legs at the bottom) was very popular but they are less common today. Most tripods today are similar to camera tripods and have three legs that are made of either aluminum or wood. Wood tripods can offer a damping quality to lessen vibration. The three legs on tripods can often be extended to bring the telescope to a comfortable viewing height.

Often, more expensive telescopes are sold without a tripod/mount—it's ala carte.

Dobsonian mounts

Remember, a Dobsonian telescope is nothing more than a Newtonian reflector on a simple alt-az mount.

Dobsonians do not have ordinary mounts/tripods—the mount is in essence the tripod—see pictures below.

For many 6, 8 and 10-inch Dobsonians, the mounts are about waist high where they pivot in altitude. Azimuth movement is very close to the ground.

On very large Dobsonians, around 15 inches in diameter or larger, the alt-az mounts are very low to the ground and are often referred to as rocker boxes.



Dob Stuff

Newtonian Reflectors

Dobs are Always on Alt-Az Mounts

Larger Newtonian on an integral mount and stand often referred to as a Rocker Box.

Manual, Motorized, Digital Setting Circles, GOTO

Mounts can be manual, motorized, have encoders or motorized/computerize for GOTO.

Manual mounts. Both alt-az and equatorial mounts can be manual—you move them totally by hand to objects and then nudge them to keep objects in view as the sky turns. Some mounts have what are called slow-motion knobs at the end of short/long rods or springs that are turned slowly to move the telescope, following objects as they move across the sky. **Digital Setting Circles** are a hand controller wired to encoders that are attached to the axes of mounts. They aid/allow finding any object in the sky. Digital Setting Circles can be used on alt-az and equatorial mounts and the mounts can be manual or motorized.

The hand controller has a very accurate built in clock that can locate any object in the sky after completion of an alignment process to two stars.

Some mounts (telescopes) come with digital setting circles and/or have encoders installed or these might be options. For example, there are digital setting circles kits that are available for Dobsonians. And, I have a motorized GEM that has built in encoders.

How do Digital Setting Circles work on an alt-az mount that does not have motors? The necessary hand controller is basically a computer with an accurate built in clock, databases of celestial objects and prompts/instructions to guide you. The encoders, attached to both axes use thousands of equally spaced marks that are counted as the axes are turned, so this keeps track of position. Initially, the telescope has to be aligned to two bright stars. Prompts from the hand controller guide you through this process. Once accomplished, the hand controller knows where everything is in the sky and its internal clock keeps pace with the stars moving across the night sky. You can then choose an object (including planets) from the hand controller's database and watch the hand controller countdown to zero as you move the telescope/mount to the object.

Motorized mounts. Both alt-az and equatorial mounts can be motorized so they automatically follow the path of celestial objects across the sky. No more nudging the scope after you find an object!

A **GOTO** (pronounced Go To) mount is a motorized/computerized mount that, once set up (aligned to two bright stars), will move to and follow any object selected from its lists of objects using a hand controller. It is available for both alt-az and equatorial mounts. A downfall of GOTO mounts is that once engaged, they cannot be moved manually without losing their alignment but very few people complain about this! Many SCTs can be purchased with alt-az GOTO mounts.

Celestial Coordinates, RA & Dec

Any place/spot on Earth can be designated with latitude and longitude coordinates. The same is true for celestial objects but the coordinates are called Right Ascension and Declination. Declination is similar to latitude. It starts at the celestial equator (a projection of the Earth's equator onto the celestial sphere), which is 0° and ends at $+90^\circ$ for the North Celestial Pole and -90° for the South Celestial Pole. Right Ascension is like longitude but it uses the 24 hours of time as its divisions. And, the 0 hour starts where the Sun is at the Vernal Equinox (beginning of Spring—Sun is in Pisces) and progresses eastward in 1 hour increments. An example of written coordinates for Sirius are Right Ascension (RA or α) 6h 45m 8s & Declination (Dec or δ) $-16^\circ 42' 58''$.



Digital Setting Circles (DSCs) is a display/input box that connects via wires to encoders attached to the telescope's two axes—either Alt-Az or Equatorial. DSCs are meant mainly for manual mounts. After aligning the scope to 2 stars, using prompts from the display, the display will guide you in pushing the scope to any selected object—planet, cluster, nebula or galaxy.



Celestron **GOTO SCT** showing the hand-controller in an arm of the Alt-Az mount. As with many GOTO mounts, the telescope has to be aligned to two bright stars using prompts from the hand controller before it can find and follow other objects.

Setting Circles

Equatorial mounts can have circular coordinate scales in the divisions of Right Ascension and Declination on their axes to help find celestial objects using their celestial coordinates. These round scales are called Setting Circles. It is not possible to have traditional RA/Dec setting circles on an alt-az mount.

Today, encoders (with an accompanying handheld display device) can be attached to the axes of alt-az and equatorial mounts to aid in finding celestial objects. These are called Digital Setting Circles.



Many equatorial mounts, including cheap ones, incorporate **Setting Circles** that are scales which could be used to find objects in the sky using the celestial coordinate system of Right Ascension and Declination.

Orientation of eyepieces with mounts

The placement of the eyepiece when pointing to objects in the sky changes depending on the object's location, the telescope and mount.

Obviously, the altitude of an object determines the angle any telescope will be pointing but the orientation of the eyepiece depends on the telescope type and mount type.

The nice thing about alt-az mounts is that the orientation of the eyepiece in any telescope does not change in relationship to this mount. The only change is that the eyepiece gets higher or lower as you "angle it" to the altitude of the object.

Now, with equatorial mounts the orientation of the eyepiece can change dramatically with a Newtonian reflector, so much so that it can make viewing in certain parts of the sky very awkward. If the telescope tube is held by rings, rotating the tube might be possible to bring the eyepiece to a more comfortable position. With refractors and SCTs, the diagonal can be rotated to place the eyepiece in a more comfortable position.

Astrophotography

Astrophotography goes way beyond this course. Many amateurs are taking photos with 3-inch refractors but you will also need a good and very steady tripod and motorize/computerized equatorial mount plus a specialized camera. To start, it will cost about \$5000 for the telescope/mount/camera and that is to just to start! And, there is a *long* learning curve to process the images. So, instead, just enjoy all the great images/photos from those really into astrophotography.