

# EquinoX

## Operation Manual



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# Copyright

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Equinox requires a G3, G4 or G5 Apple Macintosh computer with 50 Meg free RAM and OS 10.2 or later. QuickTime 6.2+ is also recommended.

The Equinox webcam window requires version 1.1+ of the IOxperts FireWire driver or the built-in Apple FireWire driver for OS X.

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## Contacting Microprojects

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# Introduction

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Whether you are just starting to learn about astronomy or are an advanced amateur, I hope you will find Equinox both useful and intuitive. There is nothing quite like being out in a field, under a dark summer sky, looking through a telescope and letting your imagination transport you millions of kilometers away. I hope that Equinox can, in some small way, help you in that journey.

And please, support Mac shareware. *This is not a free program.* If you use Equinox please register.

## This Manual

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This manual does not document the obvious, but many features in Equinox do need some explanation. It is designed so that you can look up just the information you are looking for - you do not have to read the entire manual (unless you want to). Any feature that requires registration to be active is clearly marked.

## Initial Setup

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When Equinox launches for the first time it builds the database and sets up the Home location according to the Mac location information. *With some versions of OS X this information may not be correct. See the Setup Dialog, Location tab section of this manual to set up your Home location.*

You can adjust the startup time in the Setup Dialog, Date/Time tab. Equinox always starts up at the current date, startup time and Home location. You might also want to investigate the other tabs in the Setup Dialog. Most of the entries should be obvious, but more detailed information is available under different headings in this manual.

Once you save any setup changes the next step is to design the sky display the way you like. For example, you probably will want to identify constellations and display planet names. You do this from the Identify menu, or you can open the Identify window (under the Windows menu) and use the buttons. Equinox can remember these selections when you Quit, so the next time you start up the sky display will appear the way you left it.

If you have a telescope you can enter your telescope and eyepiece information. A sample telescope has been configured for you. Go to the Telescope Dialog section of this manual for help in setting up your telescope information.

You now have a basic setup, so go investigate and have fun.

# Dialog Save All, Apply All Buttons

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All dialogs have Cancel, Save All and Apply All buttons. The Cancel button leaves the dialog with no changes. The Apply All button will activate any changes you make under any tab for this session, *but the changes will not be active the next time you start up*. The Save All button will make the changes active and save them so that they will be active the next time you start up.

## Setup Dialog

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### Date/Time Tab

This dialog allows you to manually enter the date and time, establish the startup time, elect to start up at the Mac clock time and select daylight savings. The Julian Day entry allows you to set the date and time by a julian day number. After you enter the julian day select the “Process JD” button to calculate the date and time.

### Location Tab

This dialog allows you to manually enter different locations, select cities from two lists (double click on a city), save your Home and four other locations. The cities lists and location save panels are displayed by clicking on the disclosure triangles. To save a location, set up the latitude, longitude and time zone. Select Save As and check a location (set up Home first). Save your changes with the Save All button.

Registration: you can modify the US and world cities lists yourself. See the Build Database section of this manual.

### Options Tab

**Astronomical Twilight:** use astronomical twilight definition vs. civil definition. Astronomical twilight is much darker (to be considered still in twilight) and lasts longer.

**Limit Photo Window Size:** this will limit photographs shown in the sky display to a maximum of 300 pixels. If this option is not checked any photo will be displayed at its original size or what fits in the sky display.

**Remember Window Positions:** start up Equinox with the same windows displayed, in the same position and the same size as they were when you last Quit.

**Remember Identify List:** start up Equinox with the same list of Identify menu items selected as were selected when you last Quit. If you want Equinox to always start up with the same selections, set up the sky display the way you want, Quit, start up again and uncheck this option.

**Talk to AstroPlanner:** Equinox and Paul Rodman's AstroPlanner application can talk to each other. You can add Equinox objects to AstroPlanner's plan by using the caps lock key and then clicking on objects in the sky display. If you command+click on an object, and AstroPlanner is connected to a telescope, AstroPlanner will slew to that object. AstroPlanner can also send objects to Equinox to view and control. This gives both applications access to each other's database and telescope control capabilities. For more information on AstroPlanner go to:

<http://www.ilangainc.com/astroplanner/>

**Show Horizion Mist:** the usual low limit for observing is 15° above the horizon so this mist effect helps identify that limit, as well as adding realism to the display.

**Use Custom Colors:** the items listed on the right side of this dialog can have their colors set by you. The default colors of Equinox are never lost, but check this option and your custom colors will be used.

**Use Custom Constellations:** you can build your own constellations if you have registered. This option switches between the standard constellations and your custom ones. You must have this option checked in order to build custom constellations.

## Info Panel Tab

The Info Panel appears at the bottom of the sky display. You can select what information you wish to appear, in what order, by dragging and dropping the available information to the panel display in the dialog. To remove an item, click the item in the dialog panel. NOTE: not all of your selections may appear in the sky display panel depending on your monitor size. If there is not enough room, items on the right side of the panel are dropped.

## Arrow Keys Tab

The keyboard arrow keys are a convenient way to move around the sky, zoom in and out and change the time. You can establish how much of a change each key press produces by making your selections here. The Var (Variable) entry may be the best choice for display changes. This selection will automatically alter the amount of change caused by each key press based on the current view angle. This has the effect of moving the sky an equal amount visually no matter what the view angle.

# Filter Dialog

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## Stars Tab

The magnitude sliders allows you to adjust how many stars appear in the sky display and the Telescope View window. The sky display never shows stars past 6th magnitude (the naked eye limit). If you are observing under light polluted skies, you can adjust this setting to more accurately display what you can actually see. The Telescope View window can display stars to 12th magnitude (requires registration).

The **brightness** and **contrast** sliders allow you to adjust the visual appearance of the sky display. These controls can accommodate differences in monitors and personal preference. Play around with these sliders to produce the effect that you like.

The **Double** and **Variable** check boxes allow you to display double stars (best and advanced) and variable stars with special symbols. These stars are always visible (if within magnitude limits) but these choices allow you to find them easily.

The **Stars with Planets** checkbox identifies those stars that are known to have planets. As this list is rapidly changing you can update the list by modifying the star database.

## Deep Sky Tab

The slider controls the magnitude limit for all deep sky objects. The check list allows you to further refine what deep sky objects are displayed. The “Best” selection is a list of the best deep sky objects observable with amateur telescopes. The “Advanced” selection adds more challenging objects. The Caldwell, Herschell (400 and II) and Arp catalogs are often used in club observing sessions.

Registration: You can modify the deep sky database yourself, including what objects appear in the Best and Advanced lists. See the Build Database section of this manual.

## Planets Tab

This dialog controls which planets are displayed by magnitude limit and checkbox. A planet must be checked and within the magnitude limit to be displayed.

The **Planet3X** checkbox will display the planets at three times their actual size in the Scope View window. Through a telescope planets often appear larger in the field than they really are. However, this setting should never be used if you are observing occultations, eclipses or any event where the actual size is required. The **Sun/Moon 3X** checkbox does the same for the sun and moon in the main sky display.

**High Precision Calculations** should be checked unless you have a very slow Mac. This option must be checked to see Saturn’s satellites and have the most accurate calculations of Jupiter’s satellite events.

The **Planet/Comet Path** entries define how the planet, comet and minor planet path is plotted. The Number of Days defines how many days of the object's total orbit is calculated and the Future setting determines how much of that path is plotted into the future from the current object's position. Note: to display the path, choose the Planet/Comet Path item in the Identify menu first and then click on a planet, comet or minor planet in the sky display.

## **Comets Tab**

This dialog adjusts the magnitude limits for comets and minor planets. The check boxes must be checked to display these objects.

Registration: The comet and minor planet databases can be updated with the Update Comet/MP Database menu items under the Equinox menu.

## **Telescope Dialog**

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### **Telescope Tab**

You can define up to three telescopes. This dialog can be used to "try out" different size telescopes and to allow more detailed views in the Telescope View window. Limit your telescope IDs to eight characters - that is all that can be displayed in the Telescope View window. Be sure to select the correct telescope type (NexStar, ETX/LX200 or LX200 GPS). Although this selection is not used for the telescope connection, it is used to enable/disable some specialized controls.

A typical 8" telescope has been entered for you as an example.

### **Eyepieces Tab**

You can enter up to ten eyepieces. You can "try out" different eyepieces to see what effect they will have with your telescope. If your eyepieces do not list their field of view, most good eyepieces are around 50 degrees.

Four eyepieces have been entered for you as an example: 40mm, 20mm, 10mm, 5mm all with a field of view of 50 degrees.

### **SBIG Tab**

If you have a Santa Barbara Instrument Group (SBIG) CCD camera, you can configure the Telescope View window's SBIG graphic from this tab. You must be registered for the SBIG version of Equinox to enable this tab. See the Equinox SBIG Manual for details.

## Find Dialog

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The Find Dialog (requires registration) allows you to search for some object in the database. You can enter a star's name, Bayer/Flamsteed designation or SAO number, a constellation name, planet name, deep sky object name, Messier number or NGC number, Caldwell or Arp number, comet name or id or a minor planet name or RA and DEC coordinates. The syntax for the name entries are described when the Instructions disclosure triangle is selected.

The Find button will either not find the object (could be filtered out - see the Edit/Select All menu item), find the object but state that it is below the current horizon, or center the object in the sky display if it is found. The Track button will center the object in the Telescope View window and begin tracking the object. The Cancel button (or escape key) will leave the dialog.

## Menus

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Hopefully most of the menus and menu items are obvious, but here are a few descriptions about items that are a bit tricky.

### EquinoX

The Sky Clock menu item allows you to add the Sky Clock graphic to the top right corner of the main sky display. You can display either the Sky Clock thumbnail graphic or the complete graphic you see in the Sky Clock web page (which is quite large). The graphic will appear in the top right corner of the Equinox main sky display. You must enter the URL for one of the graphics in the MPjNotes/MPjURL file. The two different URL's are given on your Sky Clock web page and look like either "http://cleardarksky.com/csk/getcsk.php?id=Halifax" for the complete graphic or "http://cleardarksky.com//c/Halifaxcs0.gif?1" for the thumbnail. Of course your Sky Clock URL's won't say Halifax.

### File

**Print:** the Print command (requires registration) prints a copy of the current sky display with a white background and non-antialiased stars. Whatever selections you have in the Identify menu will appear in the printout. The printout will also include the current location, date and time, a symbols list and other information. Landscape printouts will produce a larger star chart. If the Telescope View window is open you can also print that display.

**Print Visible Objects:** the Print Visible Objects command (requires registration) prints a list of all the objects currently visible. This command observes all filters, so the list can be organized by identified objects and filter settings.

**Open OrbiTrack:** the OrbiTrack application plots satellite positions from AMSAT data files. Select the "Voyager" format for the OrbiTrack output files. Once produced, the Open OrbiTrack menu item can read these files and plot the

satellite path in the sky display. Download links for the OrbiTrack application and AMSAT data files can be found on the Microprojects web site / site map.

**Open Tour:** this command opens the selected tour file and sets up the tour window. Tour files are built by clicking on objects in the sky display, but this build function is not available until Equinox is registered.

## Edit

**Copy:** the copy command will put a PICT image of the entire sky display onto the clipboard. If you wish to copy only a section of the sky display, first Control + Drag a copy marquee over the area of the display you want to copy, then use the copy command. You can also copy the Telescope View, Solar System and Earth windows.

**Show All:** this command disconnects all the filters used to organize the sky display. Everything in the database is displayed. The only use for this command is for the Find Dialog, which observes all filters. With this command you can search the entire database for an object, even if it is normally not visible because of some filter limit.

## Setup

**Startup D/T:** this command sets the time to the startup time and turns off any run time settings. Use this to reset Equinox to the date and time used at launch.

**Mac D/T:** use this command to set the time to the current Mac clock time while leaving any run time settings active.

**Run Real Time:** this locks the time to the Mac clock time and updates once per second. Normal time controls are disconnected. Run Real Time is automatically selected whenever you are connected to a telescope.

**Run 1 Sec/Sec:** use this setting if you want to run in real time but also be able to use the normal time change controls. The update rate is once per second.

**Run 1 Sidereal Day/Sec:** The stars move by sidereal time, so this setting keeps the stars stationary while the motion of planets and comets can be observed. You can also change the time by one sidereal day by holding down the option key and using the Day little arrows in the contols window.

## View

**Pin Selected Object:** an object can be “pinned” to its current display location with this command *when you change the time*. This allows you to monitor sky changes near an object or a section of the sky as the time is changed.

**Center Selected Object:** this command will move any selected object to the center of the sky display. This makes zooming in on an object much easier. You can also shift+click on any object to center it.

**Night Vision:** Night Vision mode draws all displays in red. If you go to another application while Equinox is running in this mode the main screen will remain red. It is suggested that you turn off Night Vision mode or quit before going to another application. Although unlikely, if your screen gets “stuck” in red go to the display preferences and re-select your normal color profile.

**No Twilight:** If you want to clearly view objects in the sky display during twilight or daylight, you can turn off the twilight display entirely with this command. This gives you a black sky during daylight hours.

**Help Tags:** Most controls have an associated short and long (command key) help tag. These tags are useful while you are learning about the features in Equinox, but can get in the way when you don’t want them. This menu item toggles the help tags on and off.

## Windows

**Earth:** This window displays the earth with day and night shown. It can be animated at various rates and the earth can be rotated. This window requires QuickTime 5.0.2+ to work.

**Shortcuts:** This window lists the various keypress combinations that are available. Most are straight forward but a few may need a bit of explanation.

**Control+Drag:** forms a rectangular copy marquee in the sky display, Telescope View window or Solar System window to form the region of the display that the copy command (command+C) will put onto the clipboard.

**Option+Drag:** draws a line between the starting cursor position and the current cursor position and displays the angular separation between those two points. This is used primarily to calculate how close two objects are during conjunctions.

**Shift+Drag:** a hand cursor appears and you can drag the sky display around - sort of. This works better away from zenith. To center an object shift + click on the object.

**Control+Arrow Keys:** this combination will alter the site latitude and longitude. This can be used to find the location of a star grazing event or solar eclipse totality. Control+Option+Arrow keys give you a finer adjustment.

**Option+L key:** this key combination toggles the constellation names on and off. It is useful if you want to learn the constellations with the connecting lines visible but not the names.

## Connect

Registration: This menu is enabled only when Equinox has been registered. It allows you to connect to a telescope or GPS.

**Telescope:** if a telescope is found, and its type can be determined, the connection is made. Equinox then switches to the current Mac time and the Telescope View window is displayed at the current telescope position. Telescope connection can also be made by voice command - see the voice command section of this manual for more information.

**GPS:** if a GPS unit is found, Equinox will adjust to the transmitted location and the Mac clock will be set. The GPS unit is then automatically disconnected.

**Scope Poll Rate:** this command adjusts how often your telescope is polled for a position update. The default rate is once every five seconds, but this can be adjusted or polling can even be turned off. Polling can interfere other things you may be doing with your telescope, like using the webcam interface, because the serial connection is slow. Choosing a slower poll rate can minimize this effect.

**Scope Scan:** if you slew to an object and it is not in the field of view, this window can help find it. Scope Scan moves the telescope position to overlapping fields, initially based on the current telescope and eyepiece selection in the Scope View window (so have these correct). However, you can set the amount of overlap, rate and field of view manually. Once you see the object through the telescope stop the scan or Equinox will move the telescope to the next field.

**LX200 Control:** this window gives you access to slew and focus controls and a few other settings for LX200 telescopes. Some of these commands also work with Meade ETX Autostar scopes.

You can jog a focus or slew control with an option+click (1/10 sec) or shift+click (1/2 sec) on the command buttons. The slider controls set the slew or focus speeds. The ETX does not have slew speeds above a setting of 4.

Setup: The Sync button tells the LX200 to sync to the current Equinox tracking position. This is a very useful command as it assures very accurate slewing to new objects. Use this command every time you have moved to a different part of the sky and centered a new object.

The 1, 2 and Switch buttons allow you to record two different locations and then switch back and forth between them. This is used to switch between the object of interest and a focus star, for example. Center the object, hit the 1 button, move to a bright star, center and hit the 2 button. You can now accurately slew back and forth between them with the Switch button.

Newer LX200 scopes allow different baud rates to be used for serial communication. The scope always starts up at 9600 baud, and so does Equinox.

Once connected you can use the baud rate button to change the rate. A higher rate means that scope communication can happen faster with less interruption of other Equinox functions. A slower rate allows for longer cable lengths and more reliable communications.

**Site:** The D/T button will send the Mac date and time to the scope. The Location will adjust the scope's site information. If you have a GPS scope, the GPS command will tell the scope to re-initialize to new GPS information and the Off button will turn off the scope's GPS connection.

**Park:** The Store button will slew the scope to the prime meridian and 90° Dec. This will align the scope tube to the fork arms for equatorial mounts and is the usual "put away" position. The Park button works for ETX scopes, but does weird things for a LX200 (at least it does on mine). The Sleep and Wake buttons are useful if you are running on batteries and want to "power down" the scope for a period of time without losing the setup information.

**Temperature:** some LX200 scopes have an internal temperature sensor. When you disclose the temperature graph it will plot the scope's temperature for about an hour. This is useful if you need to wait for the scope to reach a steady ambient temperature for CCD imaging. No temperature readings are taken when the graph is hidden.

**Webcam:** inexpensive webcams can be used for astro-imaging. This window gives you a live zoomable preview of the webcam image, a focusing aid, a movie frame setting and even a dark frame blocker for "modified" webcams.

The default window size was made small so that it would not crowd out other controls and windows that you may have showing. However, if you want to see the video preview at the full size of the webcam, click in the zoom box (the green LED in the title bar). This action will toggle between the default size and a full resolution preview.

The slider control to the right of the preview area allows you to zoom in on a section of the video image. You can click in the preview area to center that part of the image. Zooming in on the image can be helpful when you are trying to focus the webcam.

The Focus check box enables a focusing algorithm. Check the box and a bar graph will appear at the bottom of the preview area. As you focus your webcam try to get the bar as long as possible. The focus algorithm was designed to work on a bright star or planet in a black background. It will not work on a large object like the moon. This focus algorithm may or may not help you focus.

The Center checkbox places a red grid on top of the video preview and identifies the frame center. This can be used to help center an object in the webcam field and it also has some use if you are visually guiding the scope during the movie recording. The Guide checkbox places a cross-hatch grid on top of the video

preview. If you are guiding your scope during the movie recording this grid should help.

The Settings button takes you to the Video Settings dialog. This dialog is defined by the webcam drivers you have installed. These settings usually override anything you may try to do with other controls in the webcam window. And just because there is some value or setting in the dialog, that does not mean that it will work. It is all up to the driver. The webcam window does save your settings so you do not have to reenter everything each time you start up Equinox

The Record button has several functions. Primarily it allows you to start and stop recording a movie. If the button says "Movie File" that means that you have not entered a name for the movie. Hit the button and a dialog will appear that allows you to enter a movie name and location. The default name is the name of the object you are currently tracking (if any) and then the date and time with a "mov" extension. Once you enter a name that name will be used for each successive movie with a "-" and an incrementing number appended to the name. If you wish to use a different name, hold down the option key and hit the button. Rather than recording the next movie the name dialog will appear. Once you are recording a movie this button allows you to stop the recording. However, if you have selected a maximum frame amount the movie will automatically stop after that many frames have been recorded.

Max Frame: the Run setting will record a movie until you stop it manually. All the other settings are how many frames you want in the movie. Once the movie has accumulated the selected number of frames the movie recording will stop automatically.

Preview: there are several choices for preview image processing. B&W drops the color information while Red, Green and Blue show only those color channels. The Reverse mode will show grey scale objects on a white background. Stack will sum the average of each successive frame. However, because there is no alignment the image can quickly turn to mush unless your scope tracks very precisely. Sum will add each successive frame to the total. An attempt is made to keep the background black, but objects can go pure white very fast. This mode can show objects that might not otherwise be visible. The Mod mode is discussed in detail below.

Resolution: this allows you to record a movie at less than full resolution. I have no idea why someone would want to do this for astro-imaging, but the control is there if you want to use it.

Mod Mode: the Mod preview setting is for modified webcams. The problem with previewing the video image from a modified webcam is that you get a stream of dark frames, then the one long exposure frame, then more dark frames until you initiate another long exposure. Even during the long exposure the webcam sends a stream of "false" frames. What the Mod setting does is block the dark frames in the preview window. You start off with the webcam previewing at 1/30 second or

whatever. As soon as a long exposure frame comes along, the preview window will lock onto that image and not display any more dark frames. When another long exposure frame comes along, that will be displayed and then the dark frames will be blocked again. This function uses the frame brightness to know what is a long exposure and what is a dark frame, but every webcam, exposure length and video setting will produce a different "dark level". The slider control is used to adjust how the bright frame detection is calculated. Take several long exposures while adjusting the slider. Try for a setting that catches every long exposure but does not show any dark frames.

The Mod mode will also capture those long exposure frames as individual TIFF files. These files have no compression to guarantee that all the detail is preserved - so it makes sense not to use a codec in the video settings dialog that heavily compresses the image. These TIFF files use the same naming convention as the movie files, and can be used together with Keith's Image Stacker and other programs for processing. The Max Frames setting can be used to limit the number of frames captured - only the long exposure frames are counted in Mod mode.

**Webcam Exposure:** The Webcam Exposure window can be used with the Webcam window or on its own for use with another video capture program. This window controls the exposure time for modified webcams that are designed so that the long exposure signal can be controlled by a serial port. You first select the serial port that is connected to your webcam exposure control line. This can be the same port that you use to connect to your telescope. For RS-232 ports, like the Keyspan high speed adaptor, the RTS line is controlled. For Mac RS-422 mini-din ports, like the Keyspan dual adaptor, the HSKo line is used. The "M" checkbox controls whether the signal goes space to mark (signal dropped) or mark to space (signal raised) during the long exposure. The "R" checkbox sets the exposure into a repeat mode where exposures are repeated after a 1/2 second delay. Exposure times can be set up to 99 minutes in 1/10 second increments. If the Webcam window is being used to capture the long exposure images, the MaxFrames setting will turn off the repeat exposure setting when that many images have been captured.

## Database

**Registration:** This menu is enabled only when Equinox has been registered. The menu items allow you to build a new database from text files contained in the MPjBuild folder. Note: before modifying any database, make a copy of the database text file and modify only the copy. That way, if you really screw it up, you can always get back to the original database. The files use a tab separated value (tsv) format, so they can be imported and exported from spreadsheets.

**Build Star:** you can modify the star database, but be careful here. *Do not delete any stars in the list.* If you want to add stars add them at the end of the list. However, you can modify data for the existing stars. Fields that have no data, like a name or id, should not be left empty - use a space character instead ( 'tab-tab' may crash where 'tab-space-tab' will work). Also, the first field of this file is the

number of records it contains. If you add stars you must correct this number. To update the “stars with planets” list, set the D/V code to 4 for stars that have planets. To add double stars to the “Best” list, set the D/V code to 5.

*Do not modify the GSC catalog stars or folders in any way.*

**Build Deep Sky:** the header identifies the fields, but note the following. The first number is the number of objects (records) in the file. This must be corrected if you add or delete objects. The Size field is the angular size of the object in minutes of arc. The Best field is set to 1 if you want to include it in the Best filter option, 2 for the Advanced filter option. For a step by step tutorial on modifying the deep sky database go to:

<http://www.microprojects.ca/BuildDS.html>

**Build Cities List:** the first number in the header is the number of cities listed - it must be correct. The names should include the state or country. Just follow the examples given and you should be able to modify these lists easily. Any text edit program is enough. This menu item builds both US and world lists at the same time.

**Build Constellations:** custom constellations are not built with a text file (you can thank me later). Turn this menu item on and the sky display goes into a custom constellation build mode. Note: this item is not enabled until you check the custom constellations option in the Setup Dialog, Options tab. Custom constellations are built with individual line segments, not continuous lines. Click on the first star, then click on the second star to form a line. If the line is to continue on, click on the second star again and then on the third star to form the second line. Option click on two stars to delete a line segment between them. With a little practice you can build up constellations very quickly. When you are done unselect the menu item and your new lines will be saved. You do not have to build everything at one time. Do a few constellations, save them and do some more next time. The custom constellations database begins as a duplicate of the standard constellations.

**Build Constellation Names:** you can rename the custom constellations with this file. This might be desirable if you are changing the language, designing a different set of constellations altogether or changing from the astronomical names to popular names (like Big Dipper or Teapot). Again, get the number of records right in the first field if you change the total number of constellations. The RA and Dec values list where you would like the name to appear in the sky (hopefully somewhere within the constellation!). You can not change the default constellation names.

**Build Comets:** do not modify the Soft00Cmt.txt file. Download a more recent one from the Minor Planet Center. The link can be found at the site map page of the Microprojects web site. Save the file as a text file with your web browser, then put the file into the MPjBuild folder and rebuild the comet database.

The “Update Comet Database” item under the Equinox menu will do all this for you automatically. Just make sure you are connected to the internet before selecting this menu item.

**Build Minor Planets:** do not modify the Soft00Bright.txt file. Download a more recent one from the Minor Planet Center. The link can be found at the site map page of the Microprojects web site. Save the file as a text file with your web browser, then put the file into the MPjBuild folder and rebuild the minor planet database.

The “Update MP Database” item under the Equinox menu will do all this for you automatically. Just make sure you are connected to the internet before selecting this menu item.

**Build Tour:** this menu item puts the sky display into a tour building mode. The idea is that you can build up a list of objects that you would like to see in an evening’s observation. Then, once outside and connected to your telescope, you can easily go from one object to the next by saying “Go to next” or clicking the space bar. To build the list, just select this menu item, click on the objects you would like to be in the tour, in the order that you would like to observe them, and then unselect the menu item when you are done. When you unselect the menu item a dialog appears that allows you to save the file under whatever name you like. You can build as many tour files as needed.

**Build Custom Horizon:** the supplied text file gives examples of how to create a horizon that matches your observing site. It even defines a house outline. If you are connected to a telescope, you can use your scope to define your horizon. A dialog will appear with instructions on how to mark points along your horizon. You can build a custom horizon for each site location that you have defined.

**Do NOT modify the BuildConstNames, BuildConstBoundary or BuildRegion files in the MPjBuild folder.**

## Telescope View Window

---

From this window you can view the sky as it would appear through a telescope - well, sort of. You can select which telescope and eyepiece to use. The telescope and eyepiece choices come from the definitions built in the Telescope Dialog. The default setting is a 8 degree binocular view. The power slider control allows you to adjust the power from about 6 to over 2000 power, bypassing the telescope settings. The bottom panel displays the power and field of view for the current telescope/eyepiece combination and the right ascension and declination. The arrow buttons allow you to shift the display up, down, left or right. To center an object in the telescope view, command + click on that object in the sky display, find the object in the Find Dialog and select Track or use voice commands.

Registration: This window uses a simplified version of the Hubble Guide Star Catalog (GSC-ACT) to display stars to 12th magnitude. The Stars tab in the Filter dialog has a magnitude slider control that can limit the magnitude of the displayed stars from 6th to 12th magnitude.

When you select the “Pwr” eyepiece the power slide control is activated and telescopes are disabled. The display is not inverted - there is no E/W or N/S conversion. To go back to a telescope view select a different eyepiece.

When the field of view is above 2 degrees a RA and DEC grid is drawn. You can toggle this grid on and off by an option+click anywhere in the Telescope View window.

When you track an object, if that object has a photograph in the MPjPhoto folder and Deep Sky Photos is selected in the Identify menu, the photo will be displayed in the Telescope View window. The size of the photo will be adjusted to match the size of the object and the current field of view of the telescope/eyepiece combination. If a deep sky object has no size definition in the database, no photo will be displayed even if it exists in the MPjPhoto folder. See the section on photographs in this manual for more information.

Registration: If you are connected to a telescope, the LED turns from red to green. The green LED blinks every time a new position is read from the telescope. The LED turns yellow if the telescope is slewing. When you track a new object (command + click, Find Dialog, Tour or voice command), the telescope will automatically slew to the new object. Note: if the object is not centered in the telescope, adjust the telescope position to center the object, then click on the Sync button in the Telescope View window. The correction will be calculated and then applied to the tracking command the next time you slew to a new object. This does help to center objects with your telescope, especially if the objects are reasonably close together, but don't expect miracles. To remove this correction click on the Clear button.

If you are connected to a telescope you may not want the Telescope View window displayed. If you click in the close box the window will close but the telescope connection will remain. The window will remain closed even when you command+click on another object. If you want to display the window again, select it from the Windows menu or option+command+click on another object.

The DSS (Digitized Sky Survey) button (requires registration) will download the current sky image from the STScI web site, reverse the image N/S, E/W according to the current telescope settings and display that image in the window. This allows you to view any area of the sky with a photo image. If you hold down the option key and then hit the DSS button, a popup menu will appear that allows you to select any DSS server. Hit the DSS button again and that server will be used to retrieve the image.

The DSS popup menu also allows you to turn on image caching. When caching is on any downloaded image will be saved in the MPjCCD folder. A saved image will always be used for display if one is available, but the images match the Scope View FOV and position exactly. You can fill up a hard disk very quickly if you cache lots of images.

You can use the Telescope View window to view events like Jupiter's satellite eclipses and transits, Saturn's satellites, conjunctions, eclipses, etc. Use the power slider control for the maximum object size. Be sure High Precision Calculations is checked in the Filter dialog, Planets tab.

## Information Window

---

Whenever you click on an object in the main sky display an information window will be displayed. This window identifies the object, lists the RA and Dec, magnitude, rise/set/transit times and other information.

If the object is the moon the rise/set times can be in error by 15 minutes or more. Over the years I have tried every different equation I could find and none of them were 100% reliable. If you want exact rise/set times for the moon you can use the US Naval Observatory calculations. The USNO ([http://aa.usno.navy.mil/data/docs/RS\\_OneYear.html](http://aa.usno.navy.mil/data/docs/RS_OneYear.html)) can create a table of moon rise/set times for a year. Go get that table, save it from your browser as "Moon Rise-Set.html" and put the file into the MPjNotes folder. Equinox will use the moon rise/set times from that table. If you are on daylight savings time generate the table with an altered time zone (eg. EDT should use a timezone of 4 hours West rather than 5 hours West). You will only have to generate the file once or twice a year and Equinox will be as accurate as the USNO!

## Solar System Window

---

The Solar System window displays the planets and their orbits in three dimensions. Each dimension has a scroll bar that can be adjusted. The time buttons in the sky display control window modify the solar system time when the Solar System window is displayed, but the time values for each button are changed. If you are displaying comets and minor planets, click on the object and its orbit will be displayed as well. Option + click in the window to remove the star background.

This takes a little practice to visualizing the orbits in 3D. As you move the scroll bar controls around you can get a sense of the orbits in 3D. The line in the top left graphic indicates the position of the vernal equinox.

## Photographs

---

Photographs are linked to Equinox by their file name, and should be placed in the MPjPhoto folder. The photo's name must match an equivalent name in the Equinox database. For example, if you have a photo of the Orion Nebula, the photo's file name must be 'Orion Nebula', 'M42' or 'NGC 1976'. File extensions JPEG, PICT, TIFF and GIF can be used.

If you double click on an object in the sky display, the MPjPhoto folder is searched for a matching file. If you have the Setup Dialog, Options, Limit Photo Size option checked, the photograph will be drawn in a window with it's largest dimension at 300 pixels. If this option is not checked, the photograph will be drawn in a window the size of the photograph or the size of the sky display, whichever is smaller.

The Telescope View window and the sky display (if the "Deep Sky Photos" menu item is selected) also search for photographs of any deep sky objects. If one is found, the photograph will be drawn rather than the object's size circle. The size of the drawn image will be based on the object's size and the current telescope and eyepiece combination. If an object does not have a size entry in the database, no photo will be drawn even if it exists in the MPjPhoto folder.

In order to have deep sky objects appear close to how they actually look in your telescope, images that you use should be modified (if you have software to do it). First, crop the photo to enclose just the object. Photos do not have to be square. Make sure the edges of the photo are completely black. And you should probably darken the image down a bit. I doubt that your little 3" scope is going to show you the object like a two hour exposure from the Hubble telescope. You might also desaturate the image some as your night vision can not see a nebula in brilliant colour. For a step by step tutorial on adding photographs to Equinox go to:

<http://www.microprojects.ca/AddPhoto.html>

Most of the deep sky photographs provided in the MPjPhoto folder are from the National Optical Astronomy Observatory (NOAO). If you want additional photos or to use higher resolution images this is a great source for astronomical photographs ([www.noao.edu/image\\_gallery](http://www.noao.edu/image_gallery)).

## Telescope Connection

---

Registration: You can not connect Equinox to a telescope until you have registered.

Equinox can connect to Celestron NexStar (both GPS and non-GPS models), Meade ETX Autostar and LX200 telescopes and most other scopes that can emulate LX200 commands. Equinox will automatically detect what telescope model you are connect to.

If you have the PC cable supplied by the telescope manufacturer, you can use the Keyspan High Speed USB Serial Adaptor that has a DB9 connector. The Keyspan USB Twin Serial Adaptor requires a Mac modem DIN8M to DB9M cable. Other USB/Serial adaptors can be used. If you do not have the telescopes PC cable you can home-brew your own. Consult the telescope's manual for wiring information.

I suggest you try out your telescope connection inside first so you can see what you are doing. First, plug in the cable that connects your telescope and your USB/Serial adaptor. Then turn on your telescope and Mac.

Align your telescope as you normally do. One note, if you tell your telescope it is 10:00 PM, make sure you set the Mac's clock to 10:00 PM as well (Equinox will lock onto the Mac clock as soon as the connection is made) but the times do not have to match exactly. Start up Equinox, go to the Connect menu and select the telescope menu item. If a successful connection is made, the Telescope View window will appear showing you where the telescope is pointing. The green LED will blink every time it reads a good position from the telescope, about once every five seconds (it is normal for Equinox to miss a read every so often). If the connection times out for some reason (LED turns red), just connect again from the Connect menu.

Command+click on some object in the sky display and the telescope should automatically slew to that object in the sky. The LED will turn yellow during the slew. To truly amaze your family and friends, read the Voice Commands section of this manual and get your telescope to move by voice alone. I have had people literally laugh to the point of tears the first time they saw this happen.

## GPS Connection

---

Registration: You can not connect Equinox to a GPS until you have registered.

To connect a GPS unit to Equinox you need the GPS manufacturer's cable and a USB to serial adaptor. The connection protocol is fixed at 4800 8N1, so you may have to adjust your GPS settings.

The Connect menu has a GPS menu item as well as the Telescope item and you can connect with a voice command as well. Equinox will scan the NMEA data stream coming from the GPS looking for a "GLL" message. If it finds the message the Equinox latitude and longitude will be automatically set. The Mac clock will also be updated so that when you connect to your telescope and Equinox starts updating in real time, the clock time will be accurate. If the Mac clock can not be set a dialog will tell you how much time to set the clock ahead or back yourself.

After the location and time have been read the GPS is automatically disconnected. You should unplug the GPS before connecting to a telescope.

## Voice Commands

---

Equinox uses your Mac's Speakable Items to respond to your voice commands. It is the AppleScript that actually tells Equinox what to do.

I will leave setting up Speakable Items to you. It takes a bit of fiddling and practice to get Speakable Items to consistently understand you, but it can be done. The real work on your part is writing the AppleScripts. Even if you have never written one before, it is easy and I have given you lots of scripts ready to use and samples of how to write your own.

Remember that Speakable Items looks for an AppleScript file name. If you don't like my commands, like 'Track Jupiter', you do not have to modify the script to use a different command phrase. Just rename the file (for example: "Go find me Jupiter, eh"), and you now have a new voice command to track Jupiter.

Each script file can do one thing and only one thing. You can not have one script that will search for any and all objects. That is why you may end up wanting to write lots of scripts - one for each object that you want to find under voice control. I have supplied several scripts that you can open with the Script Editor and modify yourself. Simply change the object in quotes to the object you want and Save As to a new file name that will be the command to use (save as a Compiled Script). Not hard, just don't change anything in the script other than the object name. Here is an example:

```
tell application "Equinox"
  try
    activate
    Track Object "Jupiter"
  on error
    say "Track command failed."
  end try
end tell
```

Just change the Track Object "Jupiter" to Track Object "NGC 1976" and save the file name to "Track Orion Nebula" or whatever command you like.

There is a way to avoid having to write any scripts at all, and yet be able to have Equinox track anything you want by voice command. You set up a Tour file - see that section in this manual - and then you can move through the list by simply saying 'Go to next' or 'Go to previous'. The idea is that you can create a tour file before an evening's viewing, and then once outside and set up all you have to do is move through the tour to see everything in your list.

Look around the supplied scripts and you can see that you can also change the sky display by voice commands as well as track things. I thought this might be useful if you are in total darkness and do not want to fumble with a keyboard and mouse to change the sky display. Note: you can automatically connect and disconnect your telescope or GPS by voice command.

**IMPORTANT:**

Before any of this works you need to tell Speakable Items about Equinox. You do this by turning on Speakable Items and then starting up Equinox. Speakable Items then creates a folder called Equinox and you put all the AppleScripts into that folder. OS X creates it at Home/Library/Speech/Speakable items/Application Speakable Items.

# Photograph Copyrights

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M5, M55, M92: Hillary Mathis, REU Program/NOAO/AURA/NSF  
M8, M22, M52, M106, NGC 2237, NGC 6027: N.A.Sharp, REU program/NOAO/AURA/NSF  
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NGC 6822: Local Group Galaxies Survey Team/NOAO/AURA/NSF  
NGC 7331: Davis Scharff/Adam Block/NOAO/AURA/NSF  
NGC 7635: Doug Williams NOAO/AURA/NSF

# Credits

---

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Milton has lead me through the Sequence Grabber wilderness. Without his sustained help, explanations and sample code the webcam window would not exist. With his kind permission I have used his routines for writing FITS files and 48 bit color TIFF files.

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AO-7 control was particularly tricky and Stéphane ran tests, produced debug logs and helped me solve the many problems encountered along the way. He continued his support with color camera testing and offered many helpful suggestions.

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The SBIG contgrol functions in version 5.0 required many on-scope tests. Developed during the winter, I had few chances to do the testing myself. Mel ran my tests, reported every problem and made many helpful suggestions. When I started working on AO-7 control, Mel continued to run tests, produced debug logs and never gave up helping me when beta version after beta version kept failing.

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Equinox 5.1 has an updated list of stars with planets (extrasolar planets). Ryc updated the star database (not easy to do!) and kindly allowed me to use his updated database.

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