



# eFinder Lite

**Advanced Digital Finder**

**Aligns & Syncs the Nexus DSC**



User Manual Version 1.1

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## System Description

eFinder Lite is an add-on Digital Finder for Dobsonian or other telescopes. The eFinder Lite system comprises a single unit incorporating,

- Camera and lens
- Processor
- OLED display
- 5 way navigation switch
- Micro USB port

The eFinder Lite uses plate-solving to measure exactly where the eFinder Lite camera is looking. A semi-automatic calibration routine determines the offset between the eFinder Lite camera and the main telescope field of view, and this offset is saved and applied throughout the session. Therefore, the displayed RA & Dec solution is that of the main telescope.

The eFinder Lite is primarily designed to be used with a Nexus DSC (original or Pro), but can be used stand-alone.

The eFinder Lite communicates with the Nexus DSC exchanging data. During initial telescope 2-star alignment, and any subsequent Local Sync, the eFinder Lite sends the plate-solved solution to the Nexus DSC in place of using a catalogue object. Thus the alignment can be done on any part of the sky, not requiring an actual target object. This greatly simplifies the process and is very accurate.

The eFinder Lite includes a three line OLED text display and a 5 way navigation toggle switch. The display can show the Nexus DSC position, the solved position, a focus utility and setup parameters.

## Installing and Connecting eFinder Lite

All components should be installed where they are protected from knocks and direct rain or heavy dew. The eFinder Lite system can be configured to suit most installations, if in doubt please contact [efinder@astrokeith.com](mailto:efinder@astrokeith.com). Final system performance depends on the stability of the camera mounting and the accuracy of the mount and any drive components installed.

The eFinder Lite should be rigidly mounted to align with the main scope as far as is practicable. Care should be taken such that the field of view of the eFinder Lite is not obscured by parts of the main telescope.

Use a micro USB to USB A cable to connect the eFinder Lite to the USB socket on the Nexus DSC. The Nexus DSC firmware will need to be at least ver 1.4.14 or with a Nexus DSC Pro, ver 1.1.20. Copies of these are available from AstroDevices.com or [efinder@astrokeith.com](mailto:efinder@astrokeith.com).

The Nexus DSC must be set to '2 star align w/o alt ref' in Setup/Align.

For ServoCat systems which re using the Nexus DSC USB port, the eFinder Lite can be configured to connect to the Nexus DSC via wifi.

The eFinder Lite incorporates a tilt sensor, such that regardless of which side of a telescope it is mounted, the display and switch orientation is corrected.

## Nexus DSC settings

- Follow the Nexus DSC manual to set your encoder resolutions etc.
- In Settings/Align, set Align Method to 'Two stars w/o Alt Ref'
- In Setting/Communications/USB, set to LX200, 9600, 1, 8, None
- If using with a ScopeDog drive, in Setting/Communications/Serial, set to ScopeDog, 9600, 1, 8, None. For other drive systems refer to their instructions.
- If using Wifi to connect (ie no USB cable), set Wifi protocol to LX200, port 4060, JNow.

## eFinder Lite settings

Using the display and 5 way switch, the user can adjust:

**Camera exposure time and gain:** Typically an exposure of 0.5 to 1 sec and gain of 25 will produce reliable solves. If solves consistently fail, then try varying these a little. Use of the focus utility will help greatly. Failure to solve is more usually down to scope movement or lens out of focus.

**Enter Test Mode:** Selecting '1' sets the eFinder Lite into a mode where pre-captured images are used instead of live camera shots. This can be

useful for user familiarisation or to help resolve problems. For 'solve' and 'align' actions, an image near M14 in Ophiuchus is used. For Offset Calibration an image of the Polaris region is used.

**Adjust display brightness:** The OLED text display brightness can be adjusted (see screen Navigation Map). While adjusting the brightness changes immediately. On start up, the display starts at near full brightness. It will stay at that level until the lower status screen is accessed, whereupon it changes to the set value.

**Drive Mode:** If the Nexus DSC is connected to a drive system, then GoTo++ mode can be enabled. At the end of a normal goto, the eFinder Lite automatically images, plate-solves and local syncs the Nexus DSC, before commanding a repeat of the goto.

## Initial alignment

### Offset Calibration

Connect the eFinder Lite to the Nwxs DSC. Turn on the Nexus DSC. If the Nexus DSC has not been used for sometime, wait for it to acquire gps lock so that its date,time & location are accurate. Then power cycle the Nexus DSC.

On powering up, the eFinder Lite code starts, and looks for and connects to the camera, Nexus DSC. For about 20 seconds the eFinder Lite screen will be blank while the internal processor loads its operating system.

First task is to calibrate the offset correction between eFinder Lite and your main telescope.

Point your main scope as accurately as possible at a bright star. Polaris is best but not essential. Go to the 'OK Bright Star' screen on the handpad. Any previous measured offset will be displayed (x&y in arc minutes). Press the 'OK' button. eFinder Lite will take an image and determine the brightest star in the image. It will then display that star name, and the new offset. This offset will be saved and used until a new measurement is made.

### Telescope Initial Alignment

Scroll to the home screen showing the Nexus RA & Dec. Now point the telescope at two parts of the sky well separated in azimuth. At each point,

press the 'OK' button and wait for the Nexus DSC to beep, signifying alignment coordinates received.

Note: The top row of the Home screen displays mode or alignment status. After successful two star alignment it will change to 'Nexus Aligned'

Note: the same process is used on the eFinder Lite for both initial alignment and subsequent Local Syncs. The Nexus DSC takes the first two received as initial alignment points, and thereafter takes them to be Local Syncs (and also stores these for an MPoint analysis).

## Observing

### General use of the Handpad

The 'OK' button will start the capture and solve process from most screens. Refer to the screen menu diagram, page xx.

After a successful solve, the screen will show the solution as RA & Dec. Also the number of stars found and how long the solve took. The first solve after power up always takes longer as data is transferred from the SDcard. Solve time should then generally be less than 0.5 seconds and at least 40 stars. The focus utility can be used to adjust settings if required.

If a solve fails, usually due to the scope moving, then the screen shows the 'solution' screen, but "no solution" is displayed.

### Use of the 'Home' screen (top left box on page 10 diagram).

The Home screen shows a live relay of the Nexus DSC RA & Dec, updated every half second.

A short 'OK' press will action a Nexus DSC align/local sync, after which the displayed RA & Dec will be very accurate.

A long 'OK' press actions a repeat of the last goto, (if drive connected).

Also at top right is a 'N' for not aligned, or 'T' for aligned.

## Local Sync

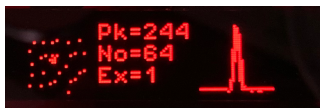
The main usefulness of the eFinder Lite is the Local Sync function. As with most encoder based systems the Nexus DSC accuracy is heavily dependent on mount build, stability and the initial alignment process. Thus the Nexus DSC includes a Local Sync function where the telescope is pointed at a nearby bright star and the Nexus DSC is sync'd to the catalogue position for that object. eFinder Lite provides a Local Sync to true sky coordinates, without having to move the telescope away from the target area.

While observing the process of finding an object would be:

1. Select catalogue object on Nexus DSC (or attached planetarium App)
2. Either, push scope to object or use Goto.
3. At this point the scope will be near to the object but typically anywhere up to 30 arc minutes away due to the contributing errors already mentioned.
4. While on the eFinder Lite home screen (top left on menu page xx), press 'OK'. The eFinder Lite will image, plate-solve and send the true sky coordinates of the telescope position to the Nexus DSC as a Local Sync.
5. The Nexus DSC (or planetarium App) display will change and now show the extra small distance the scope must be moved to reach the exact position of the object.
6. The scope can now be pushed to the object, or a Goto repeated. As the movement required is now small, the object will be centred with accuracy.
7. With compatible drives, a long 'OK' on the home screen will automatically perform steps 4,5 & 6.

## Use of the Focus Utility

Navigate to the Focus Utility screen. Press 'OK' to grab an image from the camera with the current settings. The eFinder Lite will attempt to find stars in the image. At the left of the screen is a crude image of the patch around the brightest star. In the centre is displayed, number of stars found, and the peak intensity of the brightest star (0-255). At the right of the screen a PSF (point spread function) of that star intensity is plotted.



With an exposure of between 0.5 and 1 seconds on a reasonable dark sky, a focused image should produce between 40 and 150 stars. If none or very few stars are found then

try adjusting focus. Make a small adjustment and take another measurement. Repeat as necessary until stars are resolved and brought into sharpest focus. If the focus is a long way off then this may take some time, but thereafter should not need significant change, if at all. Use the locking screw on the camera lens to fix the set focus.

After good focus has been achieved, the utility is then useful to refine exposure time. You should aim for a peak intensity no more than about 200. Stars that saturate and become extended will be ignored by the star detection process. Avoiding this is key during the Offset Calibration routine, else the bright star being used for alignment may be ignored.

### **Goto++** *\_(only available if connected to a compatible drive system)*

After a normal goto, the telescope is likely to be 10-20 arc minutes away from target. This is due primarily down to a combination of initial alignment and mount build errors.

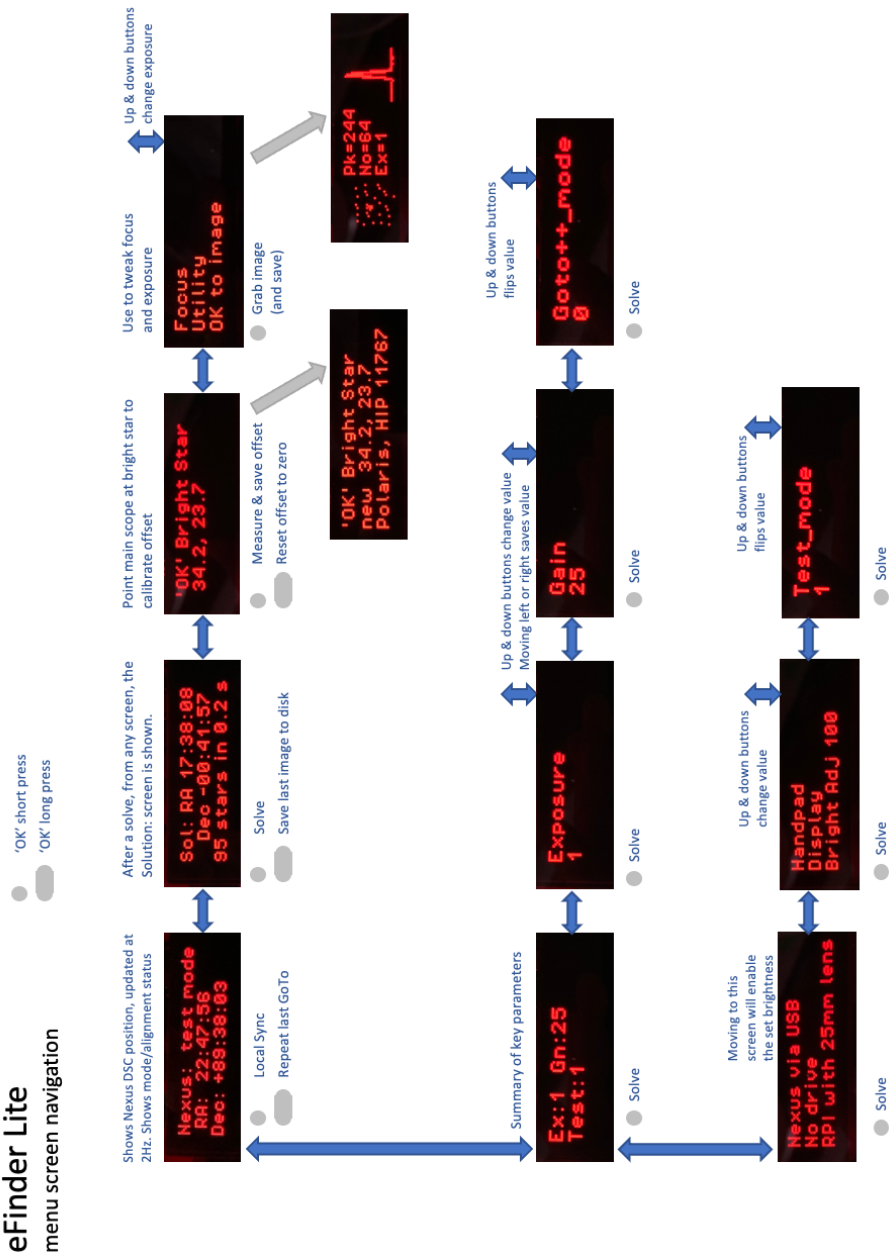
After such a normal goto, the Nexus DSC and scope drive will 'think' it is at the target though. Performing a local sync, and repeating the goto will bring the scope to the actual correct RA & Dec.

A longer press on the 'OK' button causes the eFinder Lite to read the current goto target & RA & Dec, perform a local sync, and then resend the original target back to the Nexus DSC and command a goto. Since this new goto starts with the scope near to the target and accurately aligned, the result will be very accurate. This action is called a 'GoTo++'.

Using the setup menu, this Goto++ action can be made automatic at the end of all goto's.



# eFinder Lite Handpad Menu Screen Navigation



## **eFinder Lite Accuracy**

The plate-solved solution will be accurate to about 1/2 of a camera pixel. With a 25mm lens this will be about 25 arc seconds. The displayed solution includes the offset as calibrated by the user and hence will be affected by this. Using Polaris and a short focal length reticule eyepiece, a calibration of around 30 arc seconds can be readily achieved. Thus a total or error of around an arc minute.

There is a further error that may occur due to flexure of the telescope components during the session that disturbs the alignment between the finder and main telescope. This will be unknown but can be measured and reduced by repeating the offset calibration routine during the session.

## **WiFi access to eFinder Lite**

The eFinder Lite can be configured to join a known wifi (infrastructure mode) or create its own wifi Access Point. A device on the same LAN can view and update the eFinder.config file (Appendix A) and view the latest saved image, (refer to the next section for details).

If the eFinder Lite wifi has been configured to join a Nexus DSC Pro wifi in AP mode to enable ServoCat connection, then this feature is not available.

## **Save and View camera images**

If desired the camera image can be saved and/or viewed.

After a successful capture and solve, the Sol: screen will show the result. A long press of 'OK' will save the image to the sdCard (/home/efinder/Solver/images/image.png). This is overwritten on subsequent saves. The latest image can be retrieved using Samba file sharing over LAN. It can be viewed immediately by browsing to efinder.local.

While using the Focus Utility screen, the image captured is automatically saved to /home/efinder/Solver/images/image.png and can be retrieved or viewed in the same way. This image includes an additional window showing a magnified section of the brightest star. Unlike the basic solution image, the focus image is contrast stretched to enhance the star images.

## Appendix A

### Edit eFinder Lite.config file

#### Connection method A

Using a device connected to the same LAN, enter `efinder.local` in the browser address (assuming you kept `efinder` as the `efinder` hostname during setup). You should see a web page like ...

**efinder.config file**

d_x	<input type="text" value="0.5699006144205729"/>	Finder to Main scope x offset, set automatically
d_y	<input type="text" value="0.3943661092122395"/>	Finder to Main scope y offset, set automatically
Brightness	<input type="text" value="100"/>	OLED display brightness, 1 to 255
Exposure	<input type="text" value="1"/>	Default camera exposure time
Gain	<input type="text" value="25"/>	Default camera gain
Ramdisk	<input type="text" value="True"/>	set to 'True' to use RAM for temporary image storage (recommended), else 'False'
Camera	<input type="text" value="RPI"/>	Enter 'ASI' or 'RPI' as appropriate
Drive	<input type="text" value="none"/>	Enter 'scopedog', 'servocat' or 'none'
Test_mode	<input type="text" value="1"/>	Enter '1' to cause eFinder to use test images for solving (ie not the camera), else '0'
Goto++_mode	<input type="text" value="0"/>	Enter '1' to enable automatic GoTo++ mode' else '0'
Lens_focal_length	<input type="text" value="25"/>	Enter camera lens focal length, in millimeters

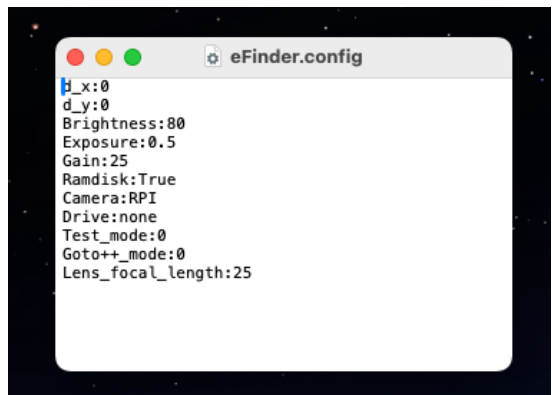
Values can be updated, and saved using the 'Save Config file' button.

#### Connection method B

Follow the instructions on page 9 of the manual to establish a remote computer connection to the eFinder Lite. Use the remote computer file manager to display the contents of the folder `/Solver`

You will find a file `eFinder.config` – right click and select text editor, which will open the file ready for editing. It should look like this image.

When editing a line, only change characters to the right of the colon and ensure no extra spaces before or after your text have been entered.



## Updating entries

The following explains the lines and valid entry options

1. d\_x & d\_y: This is the latest offset measurement in arc minutes. Should not be manually changed.
2. Brightness: OLED display brightness, 1 to 255
3. Exposure: Current camera exposure value. Set via eFinder Lite screen
4. Gain: Current camera gain. Set via eFinder Lite screen. Refer to camera specification for acceptable values
5. Ramdisk: True or False. Recommend True so that the eFinder Lite stores temporary working files in RAM rather than potentially wearing out the micro SD card.
6. Camera: The eFinder Lite should recognise most models within the specified manufacturer's range. Enter ASI or RPI.
7. Drive: Enter your scope drive type or 'none'
8. Test mode: 1 or 0. (= True or False) Set via handset
9. Goto++ mode: 1 or 0. Set via eFinder Lite screen.
10. Lens\_focal\_length: camera focal length in millimeters.

Item 1 is set by the system

Items 2,3,4,5,8 & 9 can be set via the display & navigation switch.

## Record of settings:

	Initial Value	user update
LAN hostname	efinder	
log-in username	efinder	
Initial password	efinder	
New password		
eFinder Lite firmware		
Brightness	100	
Exposure	1	
Auto Exposure	True	
Gain	25	
Ramdisk	True	
Camera	RPI	
Drive	none	
GoTo++ mode	0	
Lens focal length	25	

Note: the username 'efinder' cannot be changed.