



# **KODO Controller**

# **DSLR Imaging Control & Autoguider Manual**

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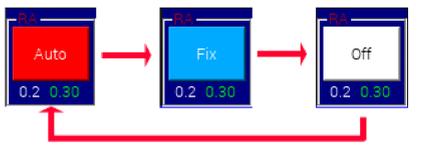
<https://hutech.com>

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## Introduction

Control of DSLR cameras and an autoguider are via the [Auto Guider] button on the Kodo main menu. This opens the menu screen shown below.



<p>Status Indicator (upper left)</p>	<p>This shows the DSLR settings in white characters. From left, the number of frames, exposure time (mm:ss), and frame delay (seconds). For example, 12 00:10 03 shows that the DSLR is set for 12 frames, exposure time of 10 seconds, with a 3 second delay between frames. If autoguider binning has been enabled, "Binning" will be displayed in red characters next to the DSLR settings.</p>
<p>Directional indicator</p>	<p>Indicates the autoguider direction calibration. Prior to calibration, "E" or "-" will be displayed.</p>
<p>Mount axis settings (Lower right)</p> 	<p>The RA and Dec fields at lower right show the autoguider settings for each axis. The digits in white show the [Threshold] settings, which is the tolerable guide error in pixels. No guide correction is attempted below this value.</p> <p>The value in green indicates correction aggressiveness which shows how large a guide correction is applied when required. A large value means faster corrections, but may result in overcorrection or jerky guiding.</p>  <p>[Auto] indicates Aggressiveness is automatically set. Alternate settings are [Fix] (manually selected value only) and [Off] (no guiding)</p>
	<p>These values can be manually set in the Parameter [Param] menu.</p>

At the bottom of the autoguider menu, the following functions are available.

[Calibration]	Starts calibration. This is required before autoguiding each time the Kodo is restarted as the calibration data is not saved.
[Guide]	Starts autoguiding
[Shutter]	Starts the DSLR imaging. Yellow indicates shutter closed (waiting between frames) while red indicates that the shutter is open.
[Parameter]	Sets guide parameters manually.
[Timer]	Sets various DSLR imaging parameters such as interval time and dithering.
[Quit]	Stop autoguiding and return to the main Kodo menu.

## Setting Guide Parameters [Parameter]

The parameter setup screen is shown below.

Exposure/Gain	Brightness/Contrast	Star bright level
Motor Test	Guide Port Select	Enable Binning
Guide Parameters	Close	

## Guide Camera Parameters

### [Exposure/Gain]

Press [Exposure/Gain] to pop up a dialog window for adjusting guide camera sensitivity settings. Note that autoguider camera must be plugged in to adjust these settings.



Gain	Set the guide camera gain value [1 to 25]. Adjust the value by clicking on the [Up] or [Down] button below the setting.
Exposure	Set the exposure time [1/64" to 2"]. Adjust the value by clicking on the [Up] or [Down] button below the setting.
Gamma	Set the gamma value [0 to 10]. Adjust the value by clicking on the [Up] or [Down] button below the setting.
StarGain	Adjust the guider camera image contrast. A higher value increases contrast between the stars and background, but increases the noise in the image.

The following guide parameter values are initially recommended.

	No binning	Binning
Gain	25	25
Exposure	1/2"	1/4"
Gamma	5	1
StarGain	2	2

When you have finished editing the camera parameters, press [Close] to return to the main parameter menu.

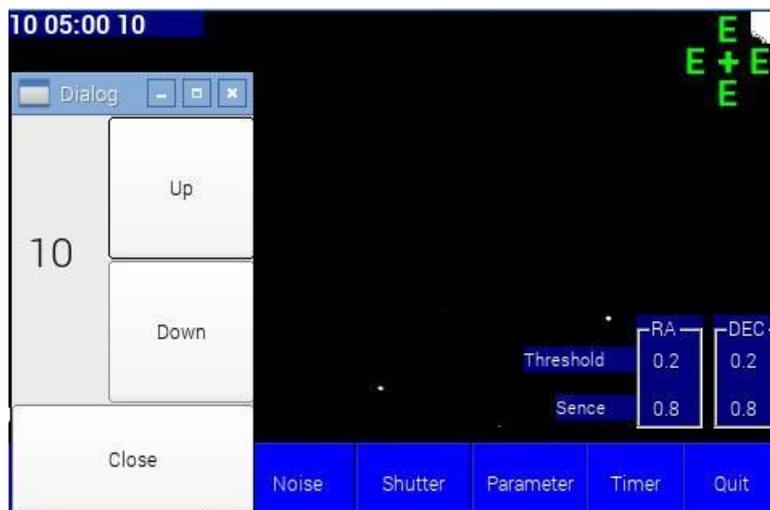
## [Brightness & Contrast]

Press [Brightness/Contrast] to adjust the autoguider camera view. Default values are Brightness=5, and Contrast=3. Use the [Up] and [Down] buttons to adjust the settings. Press [Close] to exit the adjustment dialog.



## [Star Brightness]

Press [Star bright level] to adjust the brightness threshold for star detection.

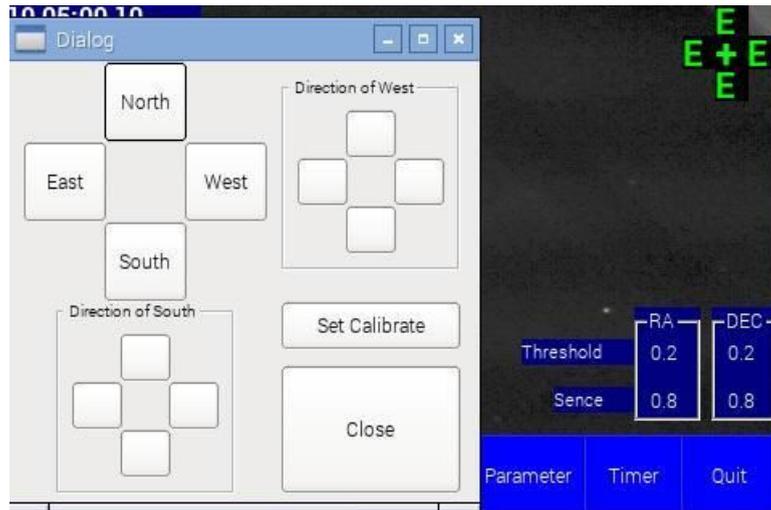


Increasing the value (default is 0), increases contrast between the stars and background. The star sizes become smaller, but fainter stars will disappear. Adjust this value upwards until the background noise disappears.

[Close] exits to the main autoguider menu.

## [Motor Test]

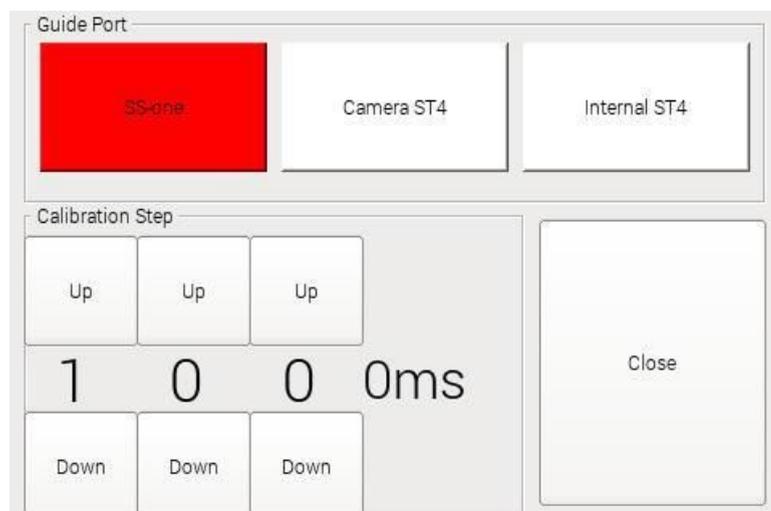
This function allows checking and setup of the guider movement manually in case automatic calibration fails.



Verify that motor for each axis works in both directions by pressing button marked [North] [West] [South] [East]. Use the section labeled “Direction of West” to indicate the proper motor movement for moving towards the West. Use the section labeled “Direction of South” to indicate the motor movement for moving towards the south, then press [Set Calibrate] and [Close] to complete the procedure.

## [Guide Port Select]

Use this control to specify the destination for guiding corrections and the duration of movement during calibration.



## Guide Port Section

This section allows for selection of the guiding correction destination.

SS-one	Kodo directly controls mount motors (e.g. SS-one mount)
Camera ST4	Camera ST-4 interface used for mounts with motors not controlled by Kodo
Internal ST4	(Not in used)

## Calibration Step Section

This sets the movement duration for calibration of the mount response and guider optical system. A long calibration time is recommended for short focal length guider optics or slow mount guide speed. If a long focal length is used for the guider or the mount moves quickly in response to guide corrections, use a smaller value.

Initial recommended values are:

- 3000ms : 100mm focal length or shorter.
- 1000ms - 3000ms : longer than 100mm focal length.

## [Disable Binning] / [Enable Binning]

This control toggles 2x2 binning mode. Binning increases the sensitivity of the camera by a factor of 4 at the expense of resolution. You may need to decrease the camera's gamma value for less noise.

Initially recommended values

	No binning	Binning
Gain	25	25
Exposure	1/2"	1/4"
Gamma	5	1
StarGain	2	2

## [Guide Parameters]

This function allows you to control the autoguider algorithm parameters.

Threshold		aggressiveness	
RA	DEC	RA	DEC
Up	Up	Up	Up
0.2	0.2	0.10	0.10
Down	Down	Down	Down
Moving Average N		Close	
Count	Ratio	Up	Down
3	0.5		

### Threshold

This is the threshold (in pixels) for applying a mount correction (each axis is separate). No guide correction is applied as long as the guide star deviates less than the pixel value selected. A threshold value of 0.2 is recommended initially. Set the threshold to 0.1 or 0.0 for more precise guiding.

### Aggressiveness

This sets the “aggressiveness” of corrections applied. The parameter value is the fraction [0 to 1.0] of the error which is attempted with a mount movement. A low value means that the mount correction is applied gradually. A high value means the mount correction is applied quickly. Too high a value could cause the correction to overshoot the desired position.

If the Auto/Fix/Off setting for an axis is set to [Auto], this parameter is ignored. This parameter is only needed for the manual [Fix] setting. First, start with a value of 0.4 and adjust it based on the resulting quality of the guiding. This may vary with mount loading, seeing conditions, or other mechanical factors.

If the guiding is not stable (e.g. overshooting corrections), decrease the value. If guide corrections do not keep up with the guide star’s drift, the correction value could be too small. Increase the value and/or check the mount’s polar alignment. For RA-only guiding, set the DEC value to 0.0.

## Moving Average N

Count is the number of samples used (1-30) over which the running average error value is calculated. Setting the averaging count to a larger value may be useful under the following conditions:

- The guide star is not stable because of poor seeing.
- Low image contrast due to camera noise, sky brightness, and poor sky transparency.

A large averaging count value tends to improve guiding stability. However, a large averaging count value also causes correction responses to be slower. The autoguider corrections may not keep up with guiding error in following situations.

- Poor polar alignment
- Large periodic error or sudden changes due to worm gear rough spots
- Excessively large backlash in the mount's gears
- Differential flexure (i.e. flexure between guide scope and imaging scope)

The Ratio parameter is the weighting of the averaged error [0.0 to 1.0] applied to the final mount correction. This allows you to apply more or less emphasis to the average versus the current error. The maximum value of 1.0 means corrections are based entirely on the calculated average. 0.0 means that average value is not used at all and the mount correction will be based only on the most recent error position.

Recommendation: Initially try an averaging Count of 3 and Weighting of 0.5 and adjust values while watching guiding performance. Generally recommended values are 1 to 5 for the Count and 0.5 to 1 for the Averaging Weighting. Setting Count=1 disables averaging.

## [Center Mark]

This button allows activation of a central crosshair on the autoguider view window. The crosshair can be fixed in place in the center of the screen or be moveable.

## [Close]

Use this button to return to the Kodo autoguider menu.

## [Calibration]

Press [Calibration] to calibrate the guiding movement. Calibration is required before starting autoguiding. This step is necessary to allow the autoguider program to find out how far the mount will move in each axis in response to a move command from the autoguider.



In the upper right quadrant of the display, red boxes indicate potential guide stars. The green box is the best star selected by the controller. Press [OK] to immediately proceed with calibration or just wait for 3 seconds, after which the calibration automatically starts.

To manually select a guide star, press the [Next] or [Prev] to select another guide star. Once you are satisfied with the selection, press the [OK] button to start. A good selection of a guide star should have a clean star edge and not be so bright as to cause a large star image.

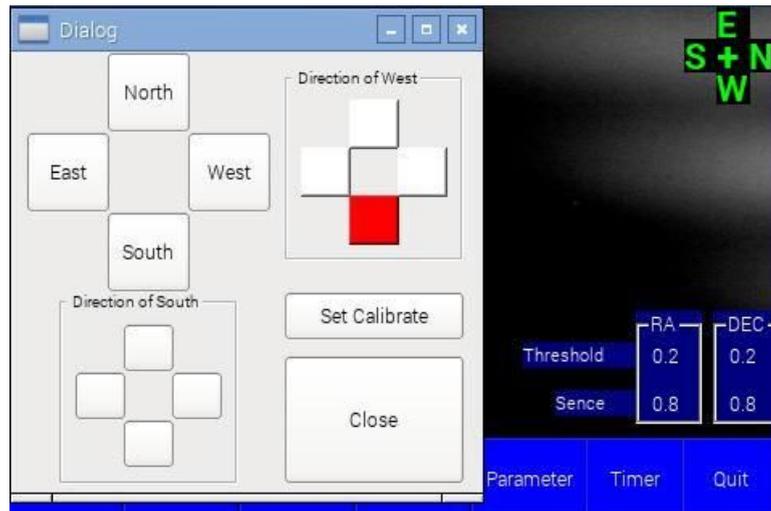
Once the calibration is successfully completed, E/W/N/S marks show up at upper right corner of the the screen and guiding starts automatically.

If the star image moves too much or too little during the calibration, adjust the Calibration Step parameter in the Mount setup menu.

After doing a mount meridian flip, recalibrate or select [E/W Reverse] in the setup menu.

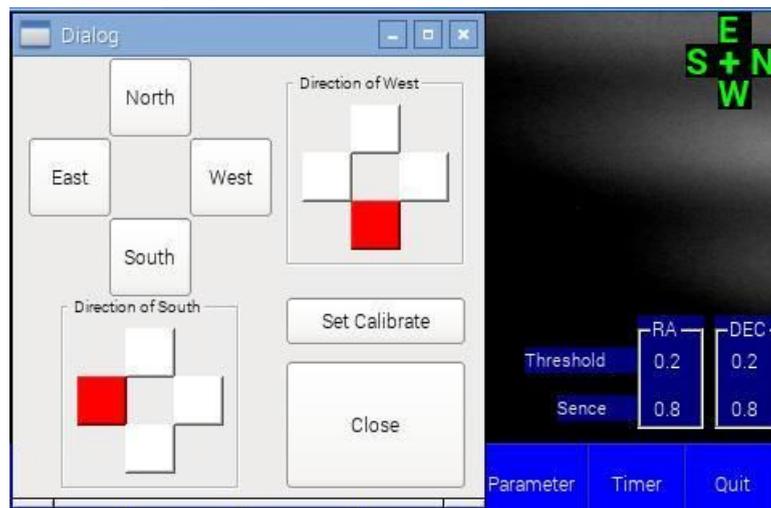
## Manual Calibration

If the calibration fails for some reason, you may calibrate manually by selecting [Motor Test/Calibration].



Press [West] and watch which way the star moves on the screen. Within the “Direction of West” section, press the button which matches the movement of the star. The selected direction will change to a red color to indicate your selection as shown in the example above.

Next press [South], watch the movement of the star. Within the “Direction of South”, press the button corresponding to the movement of the star so that the selected button turns red as shown in the example below.



Press [Set Calibrate] to complete the manual calibration.

## Start Autoguiding

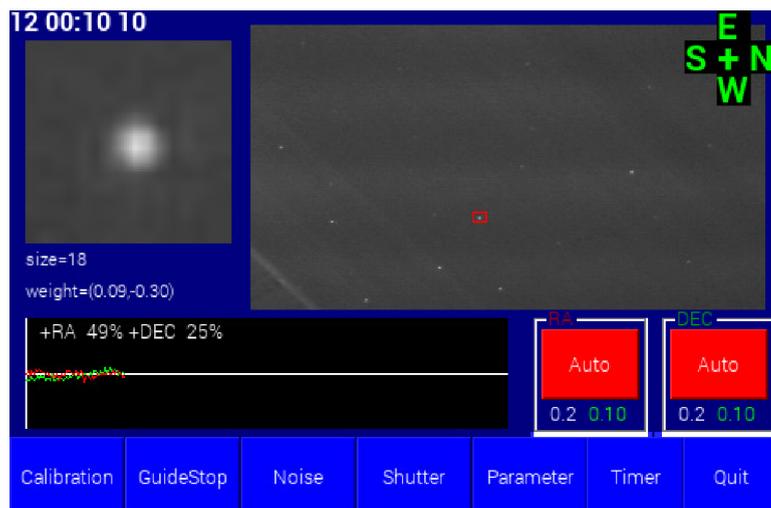
Press [Guide] to begin autoguiding. Potential guide stars within the guide camera's field of view are indicated as shown below.



Red boxes indicate potential guide stars. Automatic selection of the best star is highlighted in a green box. Press [OK] to start guiding or just wait for 3 seconds, after which the guiding automatically starts.

To manually select a guide star, press the [Next] or [Prev] button within 3 seconds to jump to the next potential guide star. Once selected, press the [OK] button to start guiding. A good guide star should have a clean edge and not be so bright that the star image is saturated and appears bloated.

Once the guiding starts, the selected guide star is highlighted in a red box. The guiding status may be monitored in a plot of guiding errors in the lower part of the screen. The red trace is the RA axis, and the green trace is the Dec axis. Each vertical screen pixel represents 4 camera pixels of error.



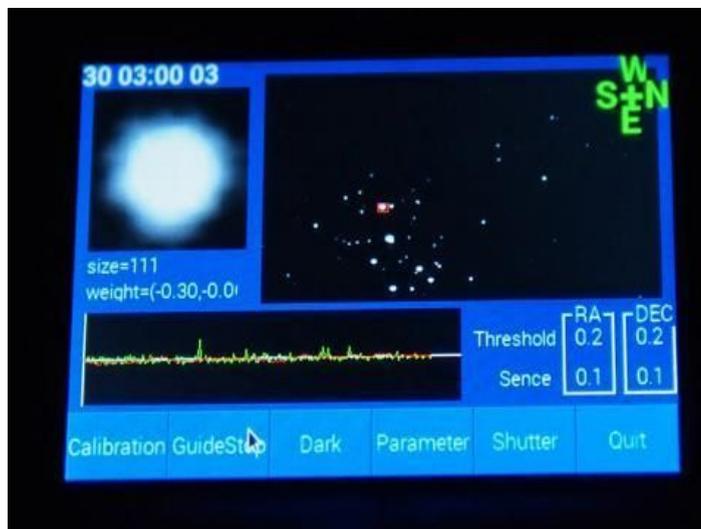
## Adjusting Guide Parameters

If guiding in [Auto] mode does not seem satisfactory, change to [Fix] (manual) mode to adjust parameters manually.

- Decrease [Aggressiveness] if the guiding is not stable because of poor seeing.
- Increase [Aggressiveness] if the correction steps are too small and the guide plot is indicating a drift in one direction (i.e. not a flat correction plot).

Press [Parameter] - [Guide Parameter] to manually adjust guide settings.

If the guiding seems unstable (see below), the guide star's centroid calculation may need adjustment.



Unstable tracking may be due to one of the following:

- Excessively bright star has been selected as a guide star.
- The background is too bright because of sky glow or moonlight.

Possible solutions are:

- Increase the value of the star brightness threshold [Star bright level].
- Increase the averaging window size [Move Average N].

## “No Star” Error Message

This warning message will be displayed if there is no suitable guide star within the field of view.



In this case, try increasing the exposure time using [Exposure/Gain] or decrease the star brightness threshold with [Star bright level].

Under some conditions, a false target such as a hot pixel may have been selected as a guide star. In this case, try increasing the star brightness threshold with [Star bright level] or decreasing the value of exposure or gain at [Exposure/Gain].

## Stopping Autoguiding

Press the [Stop] button to stop guiding.

## Autoguiding in RA Only (Single-axis trackers)

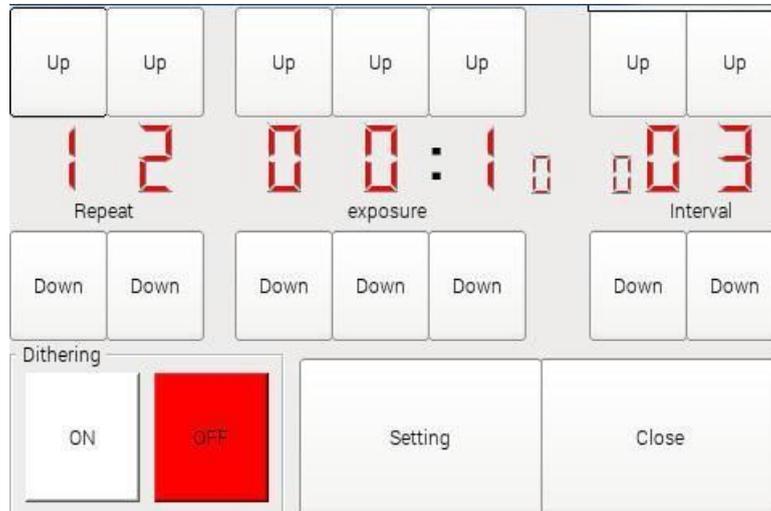
Change the guide mode to [Off] by pressing DEC box at the lower corner of the screen. This changes the guide mode to RA guiding only with the following effects:

- Only RA corrections are issued to the mount.
- Calibration is performed only in RA.
- Dithered guiding adjustment is only in the RA direction. This moves westward at the selected rate.
- Automatically refreshes the guide point if DEC drift causes the guide star to move more than 2 pixels.

## Intervalometer Control Function for DSLR Cameras

### Setting Intervalometer Parameters

Press [Timer] to open the intervalometer setup screen:



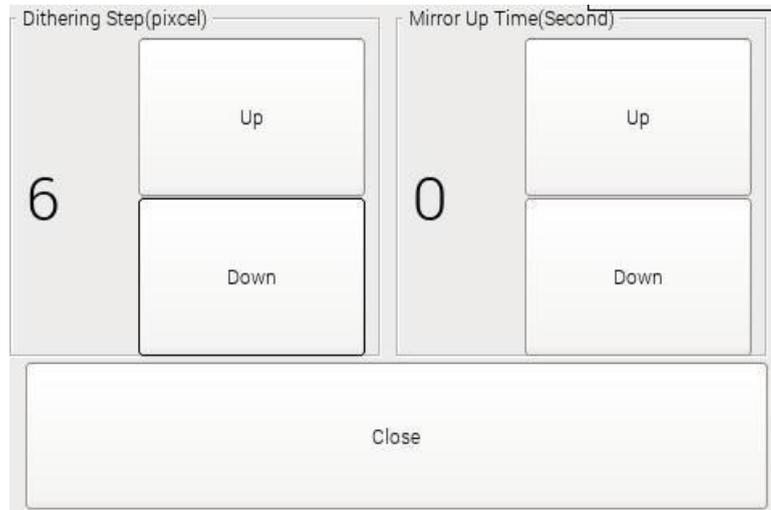
Repeat	Number of frames
Exposure	Exposure time in minutes and seconds (MM:SS)
Interval	Inter-frame delay time in seconds (must be long enough for camera write to memory card and dithering step time)

### Mirror-up Delay

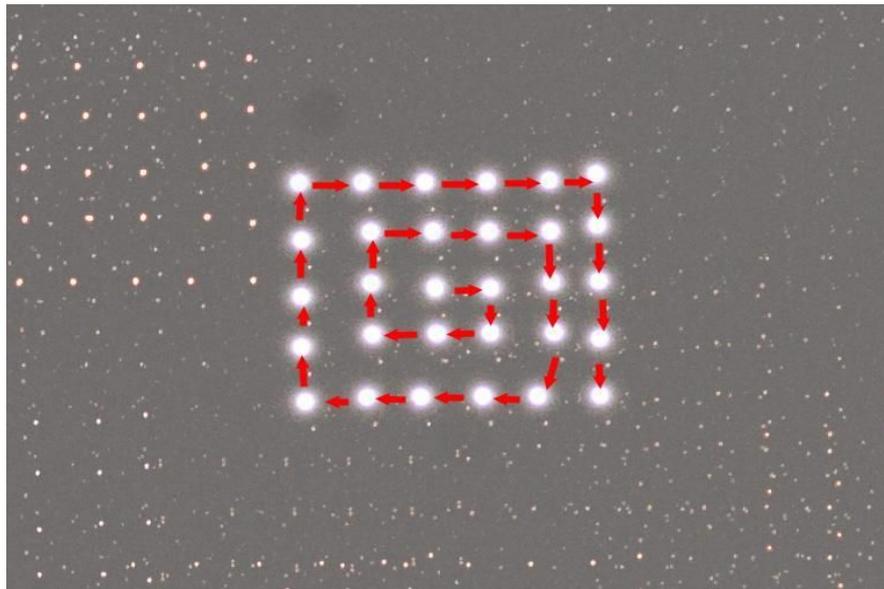
Set the DSLR mirror-up delay to allow camera movement to damp out before starting the exposure. For mirrorless type cameras, set the delay to zero.

- Also enable the mirror-up selection at camera menu.
- Cameras which have been tested are Canon and Nikon brands only.

For dithered imaging, turn [Dithering] [ON] and press [Setting] to set the number of pixels to step between frames.



An exposure start delay may also be set from this screen as described below. This delay allows camera vibrations to damp out before opening the shutter.



When dithering is enabled, the movement pattern is as shown above. Between exposures, the guide point is adjusted and guiding is resumed. Once 3 consecutive guider image samples indicate stable guiding has resumed, the next exposure is started. However, guiding stability could be affected by an individual mount's condition (gear condition, loading, etc.) a conservative interval between exposures is recommended. Try 30 to 60 seconds delay as a starting point.

## Begin Interval Shooting

Press [Shutter] to begin imaging:



During exposures, [Shutter] alternates between red (shutter open) and yellow (inter-frame delay). Press [Shutter] again to stop imaging.