FocusMax Tutorials

Table of contents

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Contents

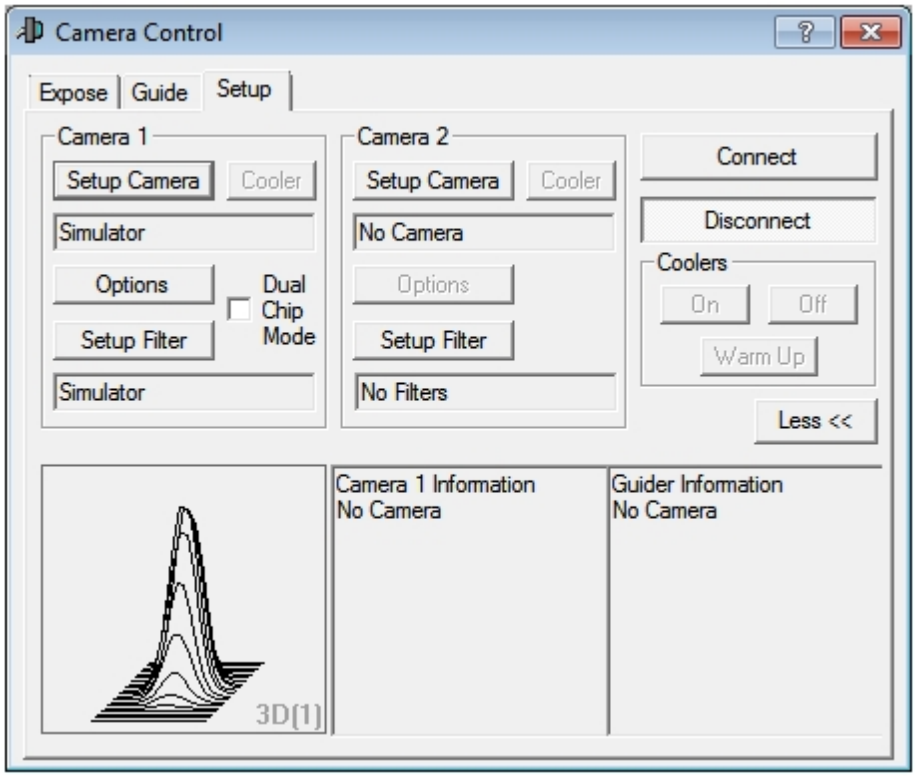
Simulator

Running FocusMax in Simulator Mode

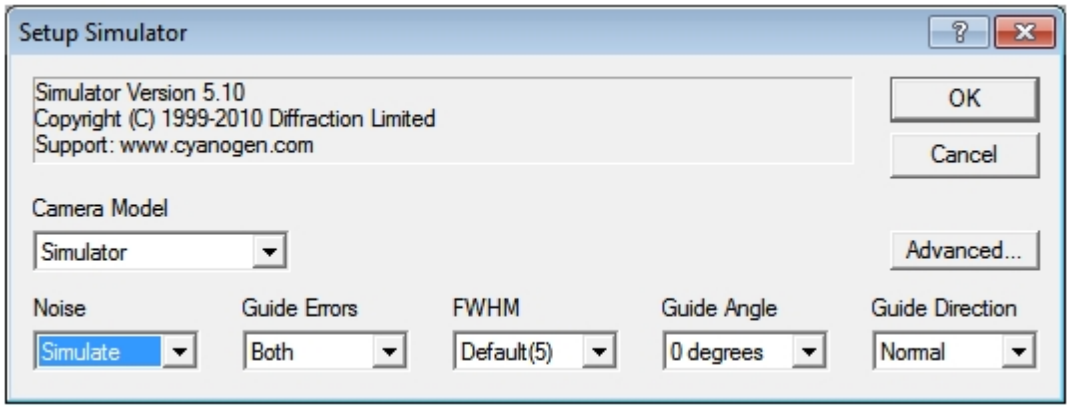
Running FocusMax in Simulator Mode

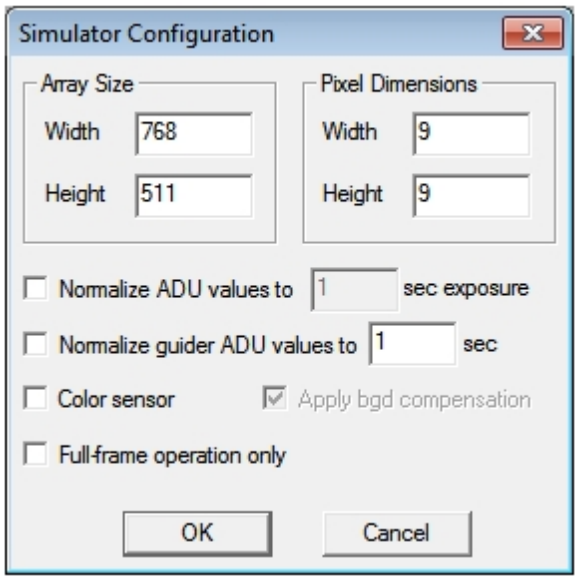
FocusMax can setup to run in simulator mode which will give you an opportunity to learn the many features available which unfortunately this only works with MaxIm. MaxIm will generate 5 artificial stars when the Simulator camera is loaded and an image is taken.

1. Open MaxIm
2. Press Setup Camera

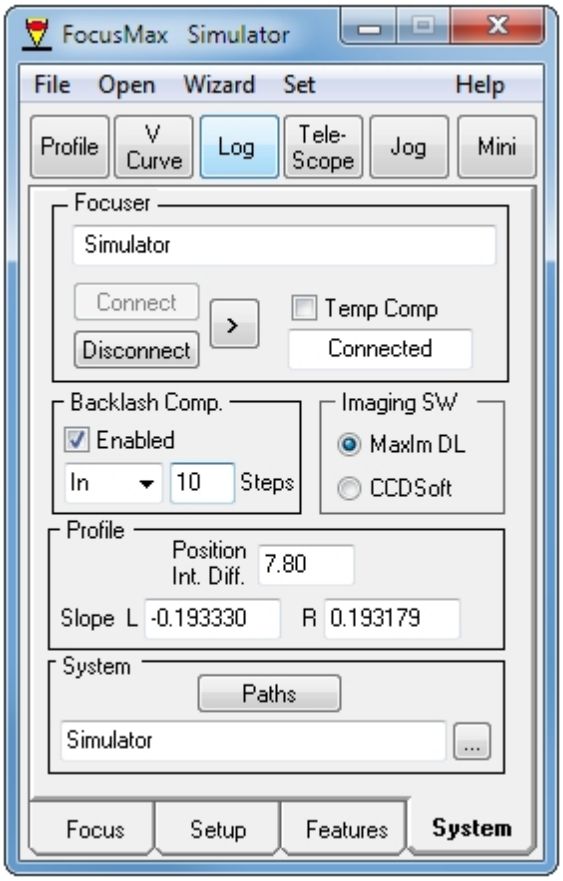


3. Press Advanced and set camera chip size to 768 x 511 with 9u pixels.





4. Click on the FocusMax System Tab and select System Simulator by pressing the small button to the right of the system text box



5. In the Focuser frame, press the > button and Choose "Simulator" focuser and connect to the focuser
6. Verify that MaxIm is selected as the Imaging Software on the Setup Tab
7. Generate a Vcurve using the FirstLight Wizard or the Vcurve Window
8. Press the Focus Button and watch FocusMax perform an autofocus run
9. Press the Find Button and watch FocusMax take an image and identify the brightest star in the field
10. Press the Expose button and watch FocuMax take a subframe image of the star found in the step above
11. Press the Profile button to review the Vcurve data
12. If you have the full version of PinPoint installed then you setup and run AcquireStar to select a suitable star from a star catalog, slew, center the star, perform an autofocus run and return slew.

Notes:
If FocusMax cannot detect a star when the Find or Focus button is pressed:

a) Examine the Log - the Flux of the brightest artificial star found in the lower right corner is approximately ~57,000 (57K)
b) Review the MinFlux setting in FocusMax (default is 100K) and adjust to 40K which should find the lower right star

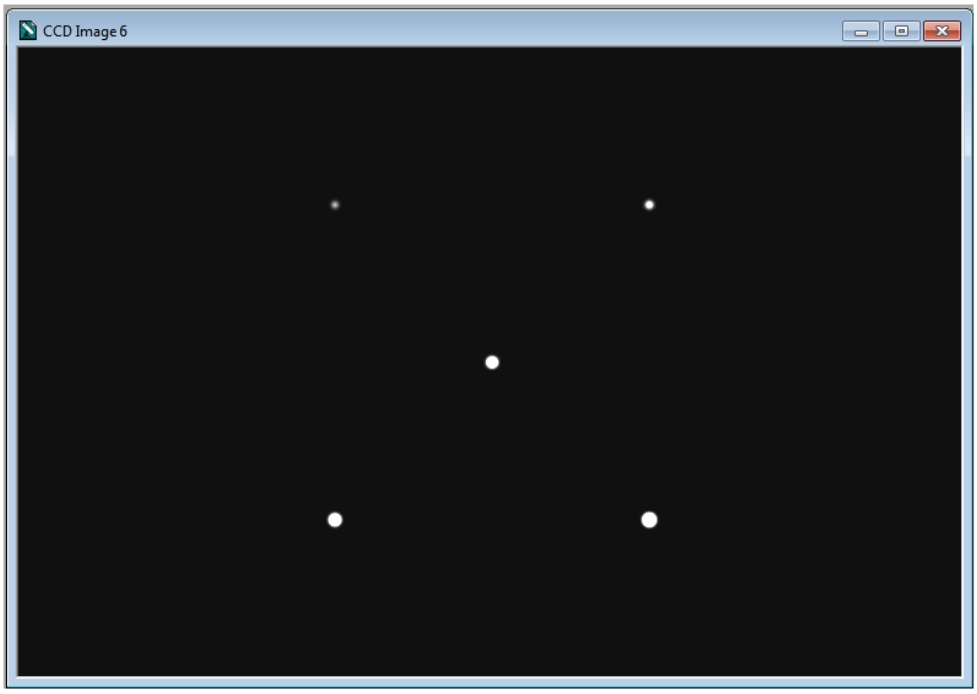


Image of artificial stars from MaxIm

Getting Acquainted with FocusMax Functions and Settings

This tutorial will describe the major FocusMax functions and settings:

Select a moderately bright star near the zenith
Manually focus by jogging the focuser in/out until you have achieved a reasonably focused star – it does not have to be perfect, just close

Press the Find button and FocusMax will take an image and proceed to:

- find the brightest star in the field
- automatically adjust the exposure time to achieve a total flux between 50,000 and 500,000 (as defined in the Setup tab)
- subframe the star

Log

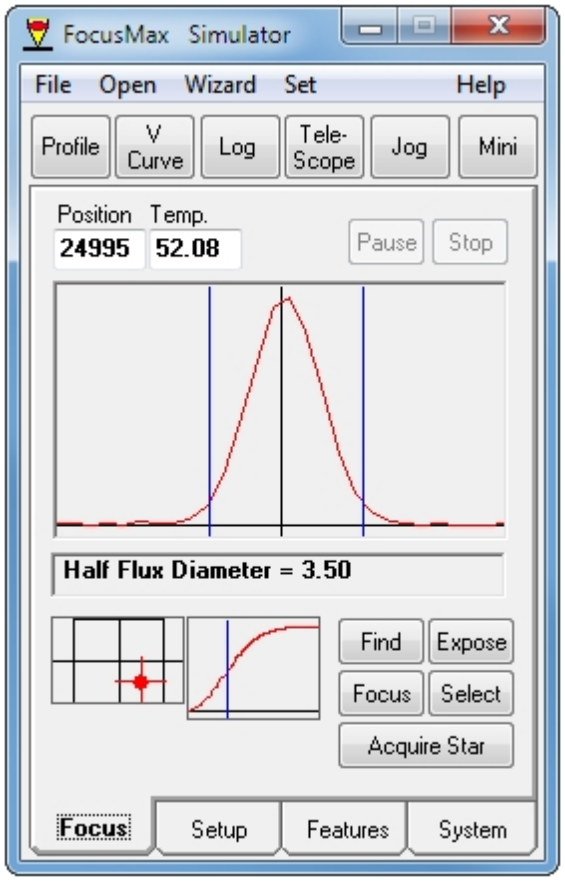
Press the Log button if the Log is not open on the desktop. The Log is an important window which documents basic FocusMax settings and activities.

Here is a sample log using the 'simulator' camera and 'simulator' focuser after pressing the Find button:

14.07.34 FocusMax Version 3.7.0.0
14.07.34 ASCOM Platform = 6.0
14.07.34 ** Camera is not connected **
14.07.34 PinPoint is connected
14.07.34 System is MySystem
14.07.34 Focuser driver = Simulator
14.07.34 ** Focuser is not connected **
14.07.34 Temp. compensation available = False
14.07.34 ** Telescope is not connected **
14.07.34 NOVAS-COM Vector Astrometry Engine is connected
14.07.34 Regional setting: United States (decimal = '.')
14.07.54 Simulator is connected
14.07.54 Simulator is an Absolute Focuser
14.07.54 Temp. compensation available = True
14.07.54 Focuser temp. compensation is off
14.07.56 MaxIm DL/CCD V 5.12 is the Imaging Software
14.07.56 Camera is Simulator
14.07.56 Camera number is 1
14.07.59 * Start Find Star *
14.07.59 Min/Max flux setting = 50/500K
14.07.59 Exposure = 0.11 sec
14.07.59 Initial camera binning 2 x 2
14.08.01 Target star found HFD = 4.79 X: 511 Y: 383 Flux: 57972
14.08.01 Binning = 1x1
14.08.02 Decreasing subframe width to 37
14.08.03 Total Flux = 57548
14.08.03 Target star found HFD = 5.01 X: 511 Y: 383 Flux: 57548
14.08.03 Exposure = 0.11 sec

Focus Tab

Current focuser position and temperature are displayed at the top of the window.



FocusMax graphical display boxes

- The large graphical box is a vertical bin of the framed region centered on the star. The vertical lines to the left and right of the curve is the boundaries of the star. The regions outside of the boundaries are used to determine the background level of the image, which is subtracted from the image before the vertical bin curve is plotted.
- The left small box near the bottom shows the position of the selected star on the camera chip. The smaller box inside shows the Central Region defined by the Features Tab, "CCD Central Region" when enabled and Percent of the chip specified to look for the star to be used.
- The right small box shows a plot of the star diameter along the x-axis and integrated flux along the y-axis. The integrated flux is zero at the edge of the star and increases to the full star flux at the star diameter. The Half Diameter (HFD) is the point marked on the flux integral plot with a vertical line.

Buttons

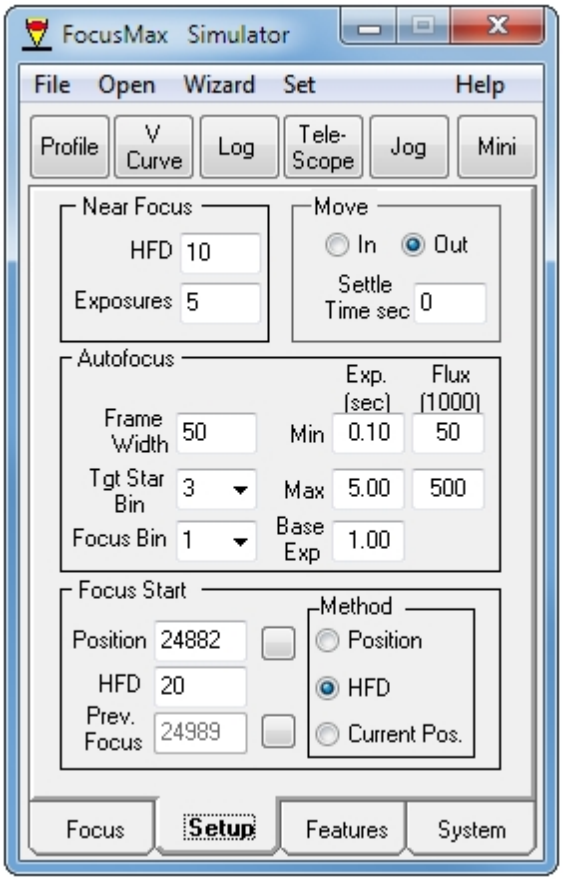
- Find will find the brightest star in the field and subframe the star
- Expose will take a single subframe image of the identified target star
- Select will allow the user to click on a star for autofocusing (MaxIm only)
- Focus will identify the brightest star, subframe the star and begin the autofocus process
- AcquireStar will use PinPoint to find a star in the magnitude range specified by the use, slew the

telescope, center the star autofocus and perform a return slew - see AcquireStar for more details

See Focus Tab in Help for additional details

Setup Tab

The Setup tab is used to set autofocus binning, exposures and method that FocusMax will use to begin the autofocus run. FocusMax is designed to move the focuser toward the focus position which eliminates backlash which can be significant on some telescopes such as SCT that focuses by moving the primary mirror.



Near Focus:

- Near Focus HFD is the value that the focuser will find and then begin to sample the target star to determine the best focus position.
- Exposures is the number of images that will taken and averaged at the Near Focus HFD position. This value will be ignored if Focus Convergence is enabled.

Move:

- Move In/Out is the desired focuser move direction during the autofocus run which is designed to eliminate backlash from the system.
- Settle time is the momentary pause after a focus move to eliminate potential vibration of the subsequent images taken.

Autofocus:

- Frame Width is the initial frame size that will be used when FocusMax finds the brightest star in the field. The frame may be adjusted to larger or smaller to optimize star detection which is based on the measured star HFD. Default is 100.

- Target Star Bin is the initial camera binning used to detect the brightest star in the field. Setting the bin size to 1 will produce a full frame image which may be a time consuming depending on the camera in use. If the cameras is a DSLR then bin =2 should be used. Default is bin = 2
- Focus Bin will be the camera binning used during the autofocus run which is typically set to 1 unless the cameras is a DSLR in which case it should be set to 2.
- Min/Max Flux is the desired flux range for the target star. If the flux is too low or too high, the exposure will be adjusted down too low and the exposure will be adjusted up. Flux is the total integrated light (intensity) of the star on the chip.
- Min/Max Exp. setting allows the user to set the min and max exposure that FocusMax will use to bring the target star into the flux min/max setting.
- Base Exp is the starting exposure that will be used to bring the target star flux into the min/max flux setting.

Focus Start:

Focus Start is the position or HFD measurement in which the autofocus must achieve in order to begin the autofocus run. Three methods are available:

- Position will move the focuser to a given position to begin the autofocus run. Only use this method if you know that the position is valid.
- HFD will move the focuser until it finds the user defined HFD value . This is the most often used selection.
- Current Position will begin the autofocus run at the current focuser position.

The boxes to the left are the settings that will be used for the above selection position.

See Setup Tab in Help for more details

Features Tab

The Features Tab contains user settings that allow the user to optimize FocusMax for their particular observing program.

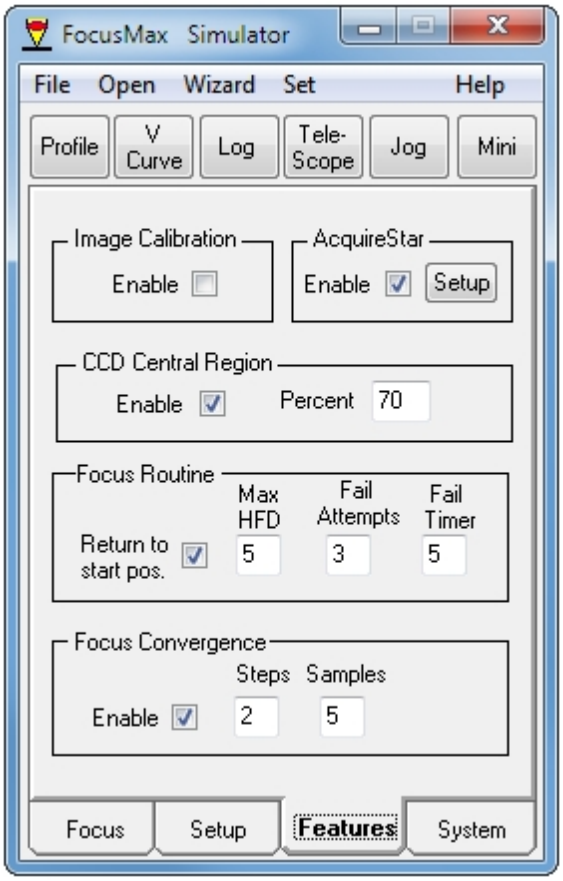


Image Calibration

Requested by users that have CCD defects such as hot pixels which FocusMax may attempt to use utilize for focusing. Enable image calibration which is found on the Features tab and follow this procedure:

AcquireStar

will identify and acquire a target star for autofocus that falls within a user defined requirements and requires the full version of PinPoint - see AcquireStar for more details

CCD Central Region

Is used to limit the automated target star detection to a user defined central region on the CCD. This reduces the influence of optical aberrations that may be present in the optical system.

- Percent setting sets the central region limit - typical is 70%

Focus Routine

Enabling this feature will send the focuser to the previous starting position before the autofocus routine was initiated if the final HFD exceeds the Max HFD setting (typically the Best Focus Position of the last successful autofocus run).

- Max HFD is the maximum HFD value that is considered a reasonable If the value is exceeded, then an error message is posted to the Log and the focuser will return to the previous position.

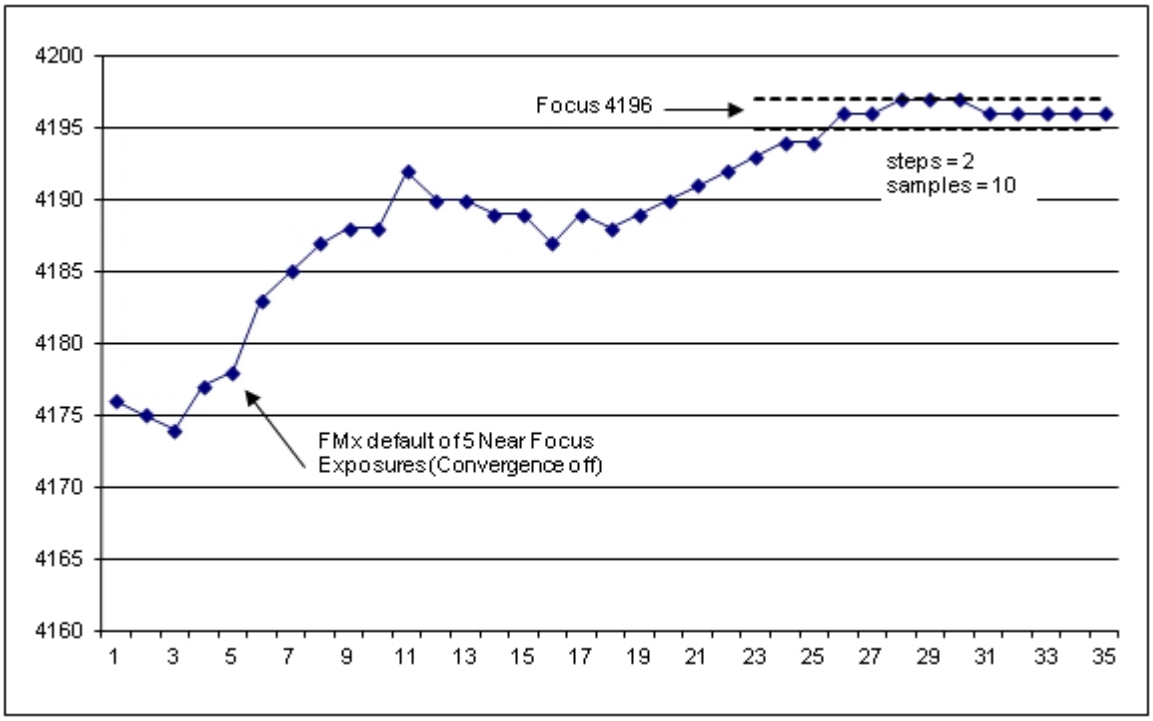
- Fail Attempts is the number of iterations that FocusMax will attempt repeated exposures if the target star is lost. A typical setting is 5. This is useful when encountering scattered clouds.
- Fail Timer is the wait time in seconds between attempts to recover the target star if lost (perhaps due to a passing cloud). A typical setting is 5 seconds.

Focus Convergence

Enabling this feature will find the best focus position by taking repeated sub-frame images and measuring until the average HFD falls within a boundary (or tolerance) that is set by the user. This feature is very useful when the seeing is poor.

- Steps are the number of focuser steps (units) that consecutive average HFD must fall within.
- Samples is the number of consecutive measurements that must fall within the above 'Step' setting before FocusMax determines that sufficient sampling has occurred and considers the predicted position as the position for the final focuser move.

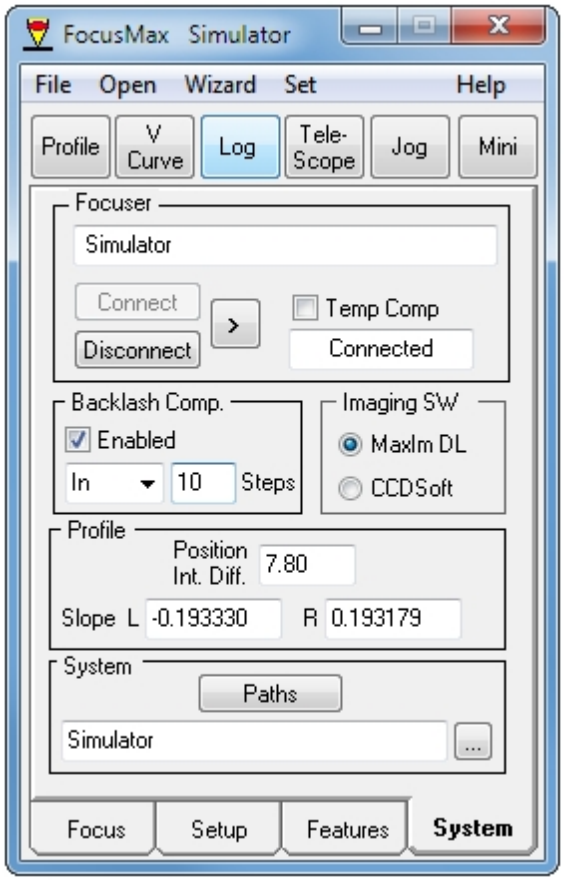
Below is an example of an autofocus run in which Focus Convergence was enabled. The default sampling rate is 5 samples which would have yielded a final focus position of 4178. Note that the average position continued to trend upward and did not begin to converge until sample measurement 27 resulting in a final focus position of 4196 which is difference of 18 steps. Note that FocusMax would have stopped at the default of 5 exposures but continued



See Features Tab in Help for details

System Tab

The System Tab allows selection of the focuser and the System information. It also displays the three parameters used during the auto focus routine that characterize the selected System.



Focuser

- The focuser can be selected or changed by clicking the > button and select the ASCOM Focuser Chooser
- Setup will allow you to customize the settings for the selected ASCOM focuser.
- Connect button on the System Tab Focuser frame to load the selected focuser.
- Disconnect button will terminate communication with the focuser

Backlash Compensation

- Direction of move In/Out when backlash will be applied
- Steps to be applied with the move

Note:
Do not activate FocusMax and Focuser Driver backlash compensation at the same time.

Imaging Software

Currently, FocusMax supports MaxIm DL and CCDSoft for camera control. When a selection is made, the application will be automatically loaded (provided it is installed and fully functional).
If you like to use both MaxIm DL and CCDSoft, you can quickly switch between the two with these radio

buttons. This will automatically disconnect your camera from one imaging software and reconnect it to the other.

Profile

These parameters are the heart of the FocusMax algorithm and are unique for each system configuration. After System characterization, the text boxes will display:

- Left & Right Slopes
- Position Intercept Difference (PID).

These Profile parameters are calculated and automatically entered from the System Profile window.

System

System contains the information and file location for FocusMax for a particular configuration.

- Clicking the small button to the right of the system name will open the System selection window.
- To create a new System name, type in a unique new name in the File name box. When you click Open, a new system will be created with default parameters.

Paths button

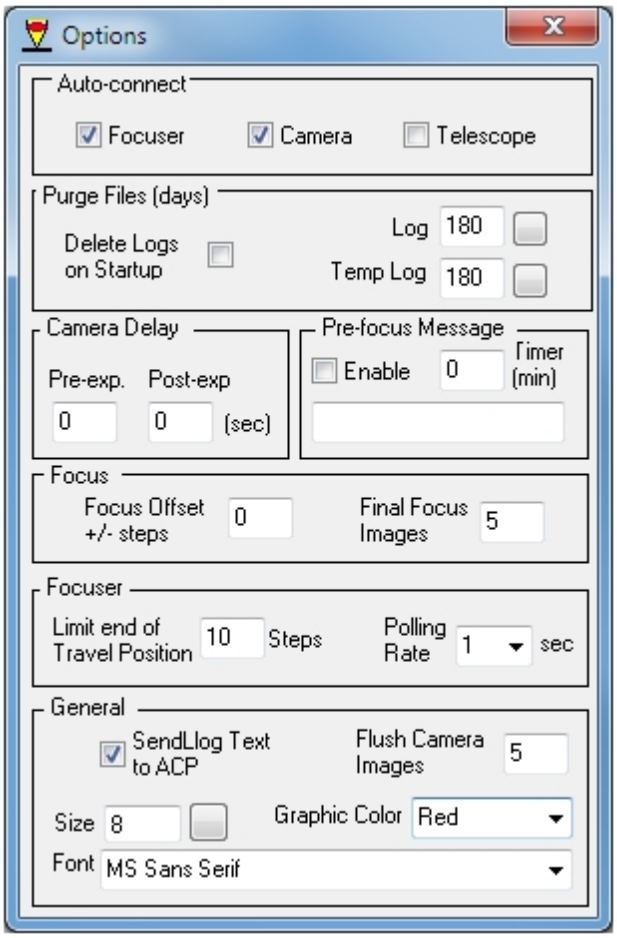
Used to set the path for your Log Files and Image Files.

- The Log Files stores a running log of actions, measurements and errors that may be encountered while operating FocusMax.
- The images from an autofocus run or Vcurve Sequence can be saved in the Image files directory for review at a later time.
  You turn on the Save Images feature from the top menu with File>>Save Images.

See System Tab in Help for details

Setting up User Options:

FocusMax menu > Open > Options



Auto-connect

- Some users do not want FocusMax to auto-connect to the focuser, camera, focuser and telescope.
- You can select which function you would like enabled at start up.

Purge Files

- Allows you to set a time frame in which to save you Log files in days
- Pressing the buttons to the far right will allow you to purge the files immediately

Camera Delay

Pre and Post exposure delay will allow the user to insert a pause before the shutter is opened and after the shutter is closed.

Pre-focus Message:

WIll allow you to create a message and set the time for the message to be posted to the screen before the auto-focus routine is initiated. This can be used a a reminder to do perform an activity. Default is 0

Focus

- Focus Offset (for photometry) Some users purposely defocus a star when acquiring images for photometry. In the Focus box you can set how many steps to offset the focuser either + or – following the autofocus run. Leave at 0 if you do not want to use this function.
- Final Focus Images defines how many images are to be taken and averaged after the best focus has been determined. This is an important feature as it yields an improved estimate of the HFD of the star at focus. Default is 3

Focuser

- Limit End of Travel Position setting will guard-band (restricts) the focuser at the extremes of the focuser travel to eliminate the worry of hitting a focuser hard-stop. Default is 5 steps
- Polling rate is the interval in which FocusMax will poll the focuser for position, temperature, etc. Some focuser require a longer polling rate to avoid communication problems. Default is 1 sec.

General

- Graphic Color allows you to select the color that will be used for graphical display which is often set to Green for users that use red filters on computer display screens. Default is red
- Flush camera images setting will initiate user defined number of exposure to flush the chip to help prevent ghost image of the target star after the autofocus run. This is useful for users who are performing photometry.

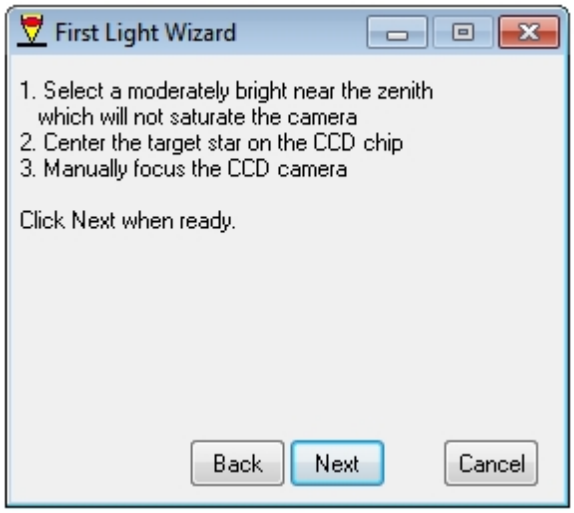
See Options in Help for more details

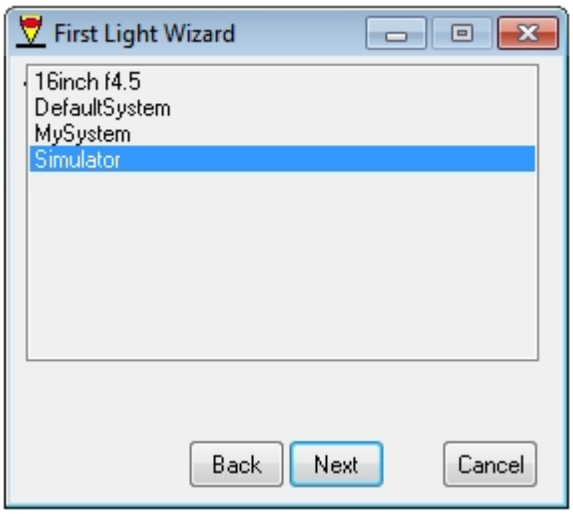
FirstLight Wizard

The First Light Wizard is designed to assist the new user in setting up the parameters for running a Vcurve for the first time.

Running the First Light Wizard:

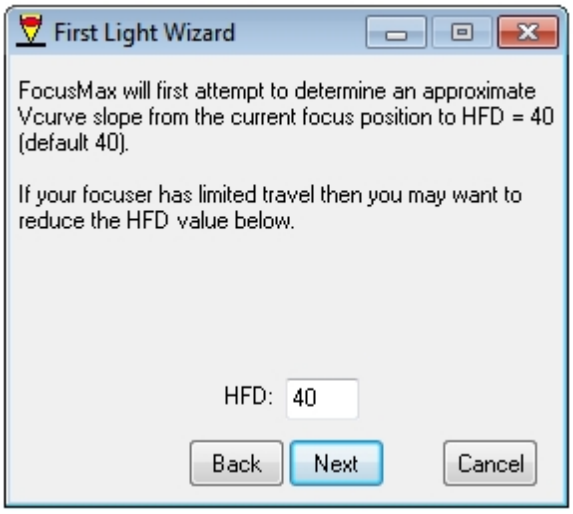
1. Manually focus the telescope – the focus does not have to be exact, just close.
2. It is best if you can adjust the draw tube or move the primary mirror (SCT) so that the focus position is mid-way in the in and out travel of the focuser. This is important as FocusMax will require sufficient travel range inside and outside of focus in order to develop the full Vcurve.
3. Select a star near the zenith, press the Find button and verify in the Log that the resulting min/max flux falls within the boundary on the Setup tab and verify that the star is not saturated.
4. Select the First Light Wizard from the Wizard menu.
5. The wizard will prompt you at each step of the process.

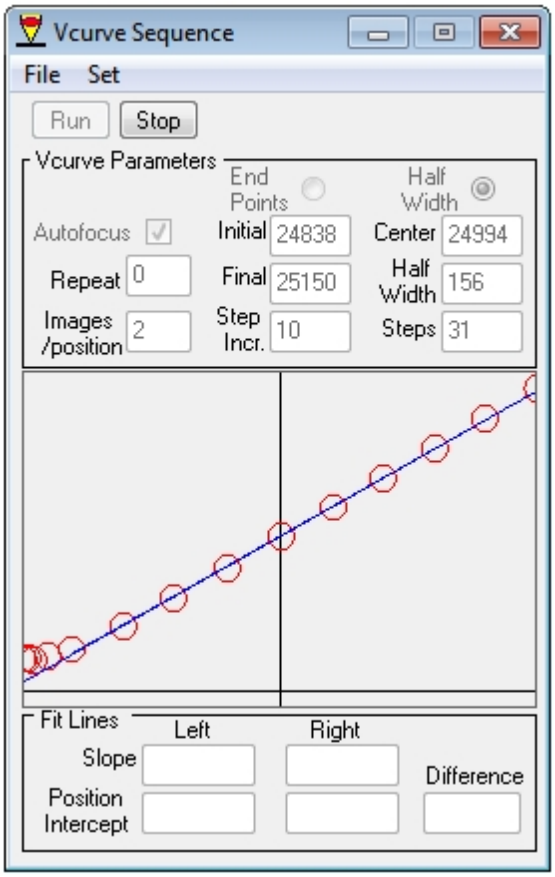




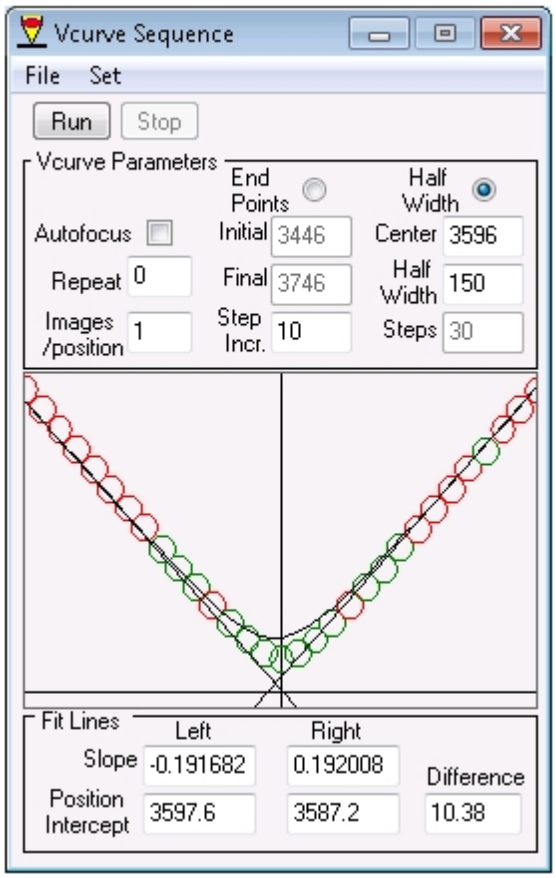
6. The First Light Wizard will start by moving the focuser in small then larger increments away from the focus point as it attempts to estimate the slope of one side f the 'Vcurve'. The wizard will continue to move the focuser until it achieves the HFD setting (default = 40). If your focuser can not achieve this

setting then re-run the First Light Wizard and reduce the HFD value when prompted. This is not uncommon if the focuser is not centered in the travel range of the focuser (as per step 2 above) or the focuser has limited travel.





7. Now that the First Light Wizard has estimated the Vcurve slope, it will proceed to take a series of subframe images from outside of focus, through focus to the other side of focus.



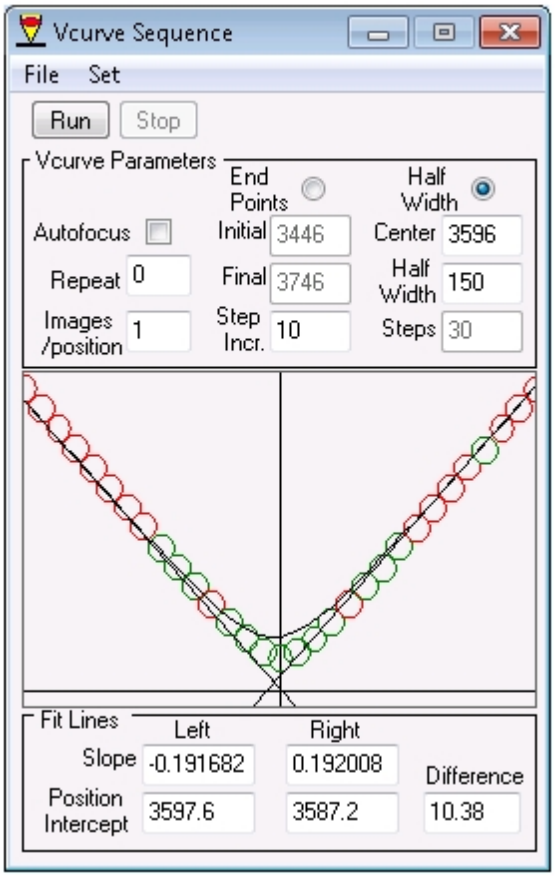
8. Open the Log if closed and watch the HFD change as the focuser is moved, an image taken and measured by FocusMax.
9. The slope of the lines for both left and right Vcurve lines and the Position Intercept Difference (PID) will be calculated and saved in your system profile that is active.
10. FocusMax will then use the result to perform an autofocus run
11. You have the option to rerun the Vcurve or exit. It is suggested that you collect multiple Vcurves
12. Pressing the Focus button on the Focus Tab which should result in a perfectly focused star

Notes:

- Set the Target Star and Focus binning to 2 if you camera is a DSLR
- Verify that the focus position is approximately centered in the focuser travel range (step 2). This is particularly important if the focuser has limited travel and may not be able to move the focuser to achieve the max HFD value.
- If the FistLight Wizard fails because it cannot achieve the max HFD setting (40 HFD in step 6), then reduce the max HFD value to the largest found in the Log. For example: If the default HFD setting =40 BUT the largest HFD found in Step 6 is 35 then adjust then set HFD = 35 in the text box.

See Profile Window to review Vcurve data.

Running Vcurves



Some users find that the First Light Wizard is not able to characterize there system.

1. Focus the telescope

2. Adjust the focuser so that the focus position is approximately mid-way in the full range of travel on your focuser.
   Example - an Optec TCF-S focuser has a total range of 7,000 steps so the focus position should be adjusted to roughly correspond at 3,500 steps by adjusting the draw tube, primary mirror (SCT), etc.

3. Refocus the telescope and verify that the focus position is ~ 3,500
   - Select a 4th-5th-6th mag star (fainter for larger apertures) near the zenith and center on CCD
   - Using your imaging program, set the exposure time to the 'recommended' value of 0.5 sec with your imaging software, take an image and measure the star intensity. Adjust the exposure or use a brighter/fainter star until the target star intensity is mid-way in the camera's ADU range.
4. Open the Vcurve window, the current focuser position will be entered in the ‘Center' box.

5. Vcurve Parameter Settings:
   - Half Width is the movement in steps away from the Center in both directions
   - End Points are the Initial and Final focuser positions.
   - Step Increment sets the number of steps the focuser will move at one time

- Steps is the resulting number of moves that will be made when generating the Vcurve. Note that as you make adjustments in the boxes that the parameters will change once you leave the entry box or press Enter.
- Enable Autofocus If you want to perform an autofocus run after the Vcurve is completed.
- Repeat setting will rerun the Vcurve using the same settings above
- Images/position setting will take multiple images and average the HFD measurements at each focuser position. This feature is useful for reducing noise and will yield a more consistent Vcurve. Downside is it takes more time and if the temperature is dripping rapidly then it may negatively impact the overall accuracy of the Vcurve. A setting of 3 under stable conditions is recommended for many users.

6. Method #1 - Determining Half Width
   - Press the Jog button and move the focuser In or Out 100 units then press the Find button
   - Continue to move the focuser until you achieve an HFD of 20+ (30 - 40 is better)
   - Note the focuser position
   - Bring the focuser back to the focus position and press the Half Width button on the Vcurve window
   - Enter the difference between the focus position and the position achieved when you manually jogged the focuser

     Example:
     - Focuser position is 3,500 and 4,000 was the position to achieve 30 HFD.
     - Enter the difference of 500 into the Half Width box
     - Adjust the Step Increment value until you see 30 - 40 Steps displayed
     - Adjust the Step Increment until the Steps has an 'odd' number which helps sharpen the 'V' because each side of the 'V' Plot will have an even number of points.

7. Method #2 - Determining End Points
   - Press the End Points button on the Vcurve window
   - Press the Jog button and move the focuser 100 units 'Out' then press the Find button
   - Continue to move the focuser until you achieve an HFD of 20+ (30 - 40 is better)
   - Enter the focuser position in the Initial position
   - Move the focuser In 200 units 'In' then press the Find button
   - Continue to move the focuser until you find the position approximately equal to the HFD value above
   - Enter the focuser position in the Final position
   - Bring the focuser back to the focus position

     Example:
     - Focus position is 3,500
     - 'Out' position = 4,000 to achieve 30 HFD
     - 'In' position = 3,000 to achieve 30 HFD
     - Adjust the Step Increment value until you see 30 - 40 'Steps' displayed

8. Press the Run button and 'enjoy the show' as FocusMax characterizes your system by creating a Vcurve

9. While running a V-Curve cycle watch the 'V' plot. As the points on the 'V' near the bottom watch the FMx Log's HFD value for each point on the 'V'. When the HFD reaches its lowest value and starts increasing note the lowest HFD's focuser Position. That position will be the (approximate) point of best focus.

10. Upon completion of the V-Curve cycle change the "Center" field before running another V-Curve cycle. {the 'Initial' and 'Final' fields should automatically adjust} This also helps center the apex of the 'V' on the center line of the V-Curve plot.

11. If the lowest HFD in the Log continually changes or the apex of the 'V' in the V-Curve plot drifts this can indicate:

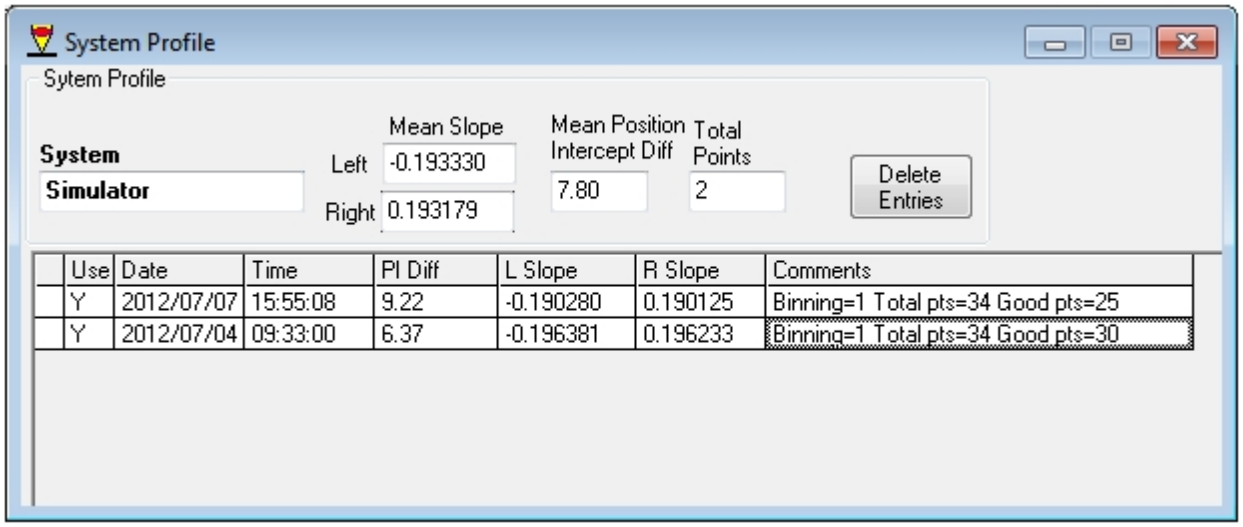
- The telescope has not reached thermal equilibrium with ambient temperature - wait until the telescope cools closer to air temperature.
- Temperature changed causing the focus point to drift - wait until temperature and telescope stabilize.
- Continual drift of lowest HFD in the V-Curve Log, or centering of the 'V' on the V-Curve plot can also indicate the focuser might be slipping - investigate and resolve.

Notes:
The extremes of the Vcurve should be on the order of 30 - 40 HFD. The primary reason for the large HFD values is to improve the ability for FocusMax to determine the slope of the line. The larger transition from max to min (focus position) the better. This may be a challenge for some telescopes with short range of travel and/or telescopes with low focal rations which yield a shallow Vcurve.

See Profile Window

Profile Window

Profile window



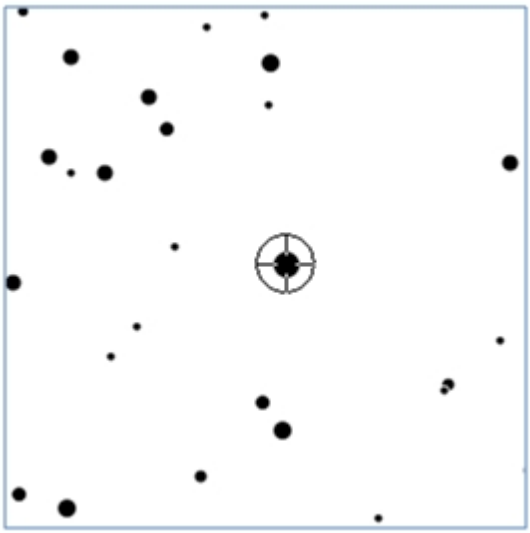
1. Vcurve data is stored in the system ini file and can be viewed by opening the Profile window.

2. The system name, average slopes and Position Intercept Difference along with the total number of points used to calculate the mean values.

3. The data grid:
   - Use column is used to select or deselect the data to be averaged
   - Date and time
   - Position Intercept (PI) Difference
   - Left and Right Slopes
   - Comments with lists the camera binning, Total points used to generate the Vcurve and the number of points used to estimate the slope of the line
4. Review the data and look for any significant difference in the R and L Slopes, PI Difference.
   - Entries that looks suspect can be excluded by clicking the 'Y' in the Use column.
   - If the Comments column that many points were excluded then you may want to consider removing the row
   - You can permanently delete entries by clicking in the small box to the left of the Use column which will turn red then press the Delete Entries button.

AcquireStar

Setting up AcquireStar



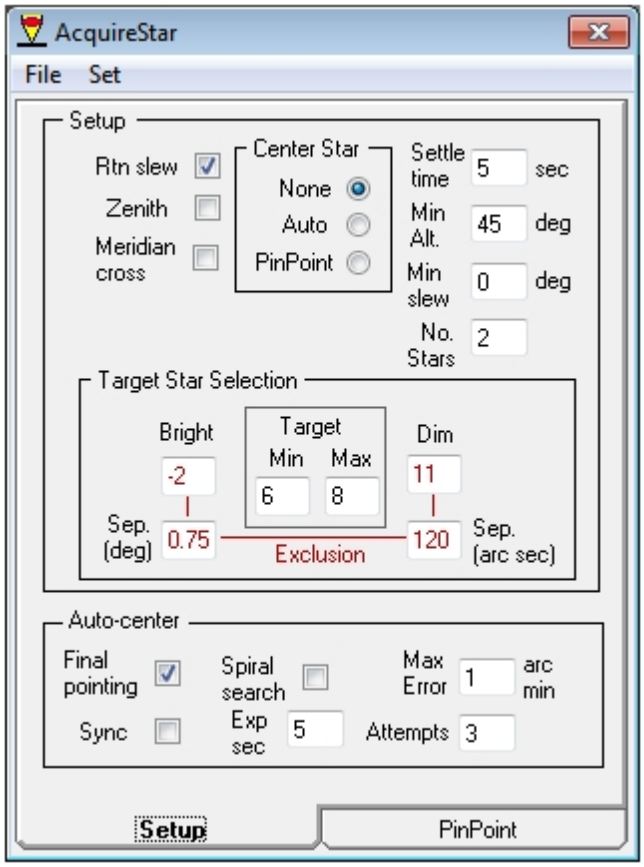
AcquireStar will identify and acquire a target star for autofocus that falls within the user defined requirements. This feature requires the full version of PinPoint and will not work with the current version of PinPoint LE bundled with MaxIm V3 or higher.

At the push of a button or from a script, AcquireStar will (depending on user settings):

- Take an image and plate solve the current telescope position
- Open a star catalog of choice and identify three stars that match the user set up requirements
- Slew the telescope to the first star
- Center the star
- Initiate the Auto-focus routine
- Re-slew the telescope to the starting position
- Take an image, plate solve the current telescope pointing position and fine adjust the telescope pointing

Astronomers are using AcquireStar with automated telescopes to perform a periodic focus update to assure that images acquired during the night are perfectly focused. AcquireStar can be operated manually by a push of a button or through automation within a script.

Setup Tab



Setup

- Return Slew will determine if the telescope will perform a return slew after acquiring the target star and performing the autofocus routine.
- Zenith will start the target star selection at the zenith and expand in 2x2 degree increments until a suitable star is found.
- Meridian Cross when checked will permit a target star from being selected on the other side of the meridian. Enable this feature if you are using a mount the does not flip, such as a fork equatorial mount.
- Settle Time the number of seconds the telescope will pause following a telescope slew
- Min Alt the minimum altitude that the user wants to use for target star identification.
- Min Slew the minimum distance that the telescope must slew away from the current position. This might be handy for deep-sky imager's who must leave the current field that has nebulosity so that FocusMax will not be confused during the autofocus routine.
- Number of Stars allows you to select the minimum number of stars that meet the above input parameters before the telescope slews to acquire the star (default = 3).

Center Star

- None to turn off star centering - can be used if telescope pointing always places the star near the center of the field
- Auto to use the Telescope Center Star feature to center the brightest star in the filed before beginning the autofocus routine. The Auto option does require that the telescope move directions must be calibrated (see Telescope Setup in Help).
- PinPoint to plate solve the telescope pointing

Target Star Selection

- Target Min / Max settings are used to specify the desired target star magnitude range that will be selected from a star catalog.
- Bright is the brighter magnitude range that is undesirable for a target star
- Dim is the dimmest star that will be rejected which will range from the Max magnitude to Dim setting. Thus we should avoid any dimmer stars that may fall in the FOV of the CCD and appear as a possible

double star.

- Separation Exclusion (Bright) is the minimum separation in degrees that AcquireStar will accept for a bright star to reduce the chance that a bright star may be in the FOV of the CCD.
- Separation Exclusion (Dim) is the minimum separation in arc-seconds that AcquireStar will accept for a dim star to reduce the chance that the selected target star will appear as a double star when FocusMax performs the sub-frame images during autofocus.

Auto-Center

- Final Pointing will allow PinPoint to plate solve telescope pointing for the current position and the return slew (if desired)
- Sync will perform a telescope sync following a successful plate solve.
- Spiral Search will be initiated if selected. PinPoint performs a plate solve by overlaying the image over adjacent catalog positions looking for a plate solution.
- Exposure setting (seconds) that will be used for the PinPoint plat solve routine.
- Max Error is the maximum error that the user will accept before AcquireStar will attempt to fine tune the telescope position and then perform another plate solve attempt.
- Attempts is used to set the number of plate solve attempts for telescope pointing.

Notes

- Do not select a target star magnitude range that will saturate the camera sensor.
- Three stars will be identified from the catalog before the telescope slew is initiated. If the autofocus run fails on the first star due to clouds, or final HFD fails, then the second star in the list is used.

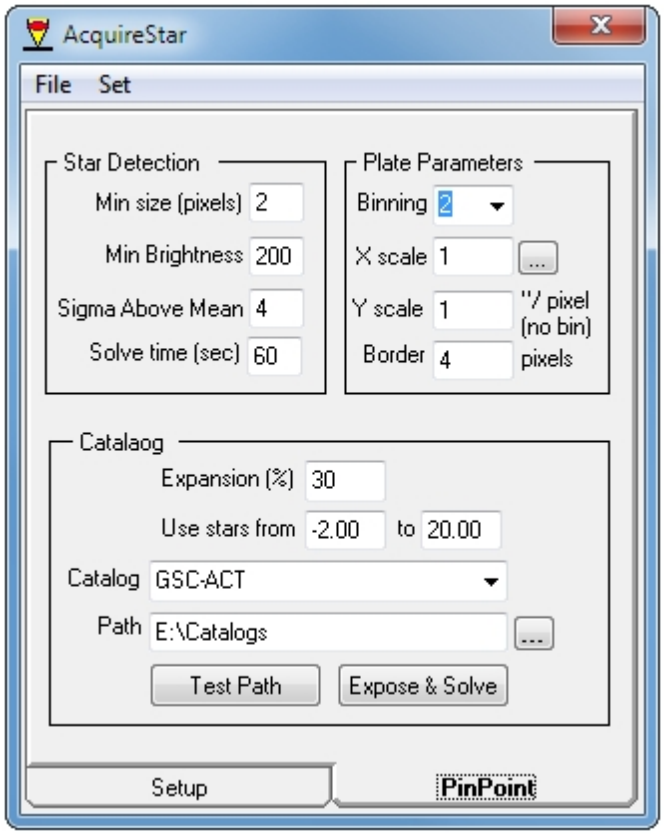
The tables below describe different combinations that can be selected with Center Star, Return Slew and Final Pointing Update and a description of the operational process.

Method	Center Star	Return Slew	Final Pointing Update
1	PinPoint	√	√
2	PinPoint	√	X
3	PinPoint	X	X
4	Auto	√	√
5	Auto	√	X
6	Auto	X	X
7	None	√	√
8	None	√	X
9	None	X	X

Method	Process Description
1	PinPoint plate solve current position → find target stars from star catalog → slew telescope to target star → PinPoint plate solve → refine telescope position to user defined Max Error → autofocus → return slew → PinPoint plate solve → refine telescope position to user defined Max Error → AcquireStar completed
2	Use current telescope RA & Dec → find target stars from star catalog → slew telescope to target star → PinPoint plate solve → refine telescope position to user defined Max Error → autofocus → blind return slew (no PinPoint plate solve) → AcquireStar completed
3	Use current telescope RA & Dec → find target stars from star catalog → slew telescope to target star → PinPoint plate solve → refine telescope position to user defined Max Error → autofocus →

	AcquireStar completed (no return slew)
4	PinPoint plate solve current position → find target stars from star catalog → slew telescope to target star → auto-center star → autofocus → PinPoint plate solve → refine telescope position to user defined Max Error → AcquireStar completed
5	Use current telescope RA & Dec → find target stars from star catalog → blind slew telescope to target star → auto-center star → autofocus → blind return slew (no PinPoint plate solve) → AcquireStar completed
6	Use current telescope RA & Dec → find target stars from star catalog → blind slew telescope to target star → autofocus → AcquireStar completed (no return slew)
7	PinPoint plate solve current position → find target stars from star catalog → slew telescope to target star → autofocus brightest star → PinPoint plate solve → refine telescope position to user defined Max Error → AcquireStar completed
8	Use current telescope RA & Dec → find target stars from star catalog → blind slew telescope to target star → autofocus brightest star → blind return slew (no PinPoint plate solve) → AcquireStar completed
9	Use current telescope RA & Dec → find target stars from star catalog → blind slew telescope to target star → autofocus brightest star → AcquireStar completed (no return slew)

PinPoint Tab



Star Detection:

The settings above are typical PinPoint settings except for entries listed in the Plate Parameters frame which are unique to your system and the catalog used.

Plate Parameters:

- Binning defines the camera binning that will be used for determining telescope pointing. It is recommended that you use 2+ to improve S/N and reduce image download time
- X/Y Scale are to be entered for you camera unbinned. A calculator is provided by pressing the small button.
- Border is the number of pixels to ignore around the perimeter of the image when plate solving

Catalog:

- Expansion setting will read additional stars from the catalog to aid in plate solving
- Use Stars from will extract stars in this range form plate solving
- Catalog combo lists the current catalogs that are available to be used by PinPoint.
- Path is the full path to the catalog chosen

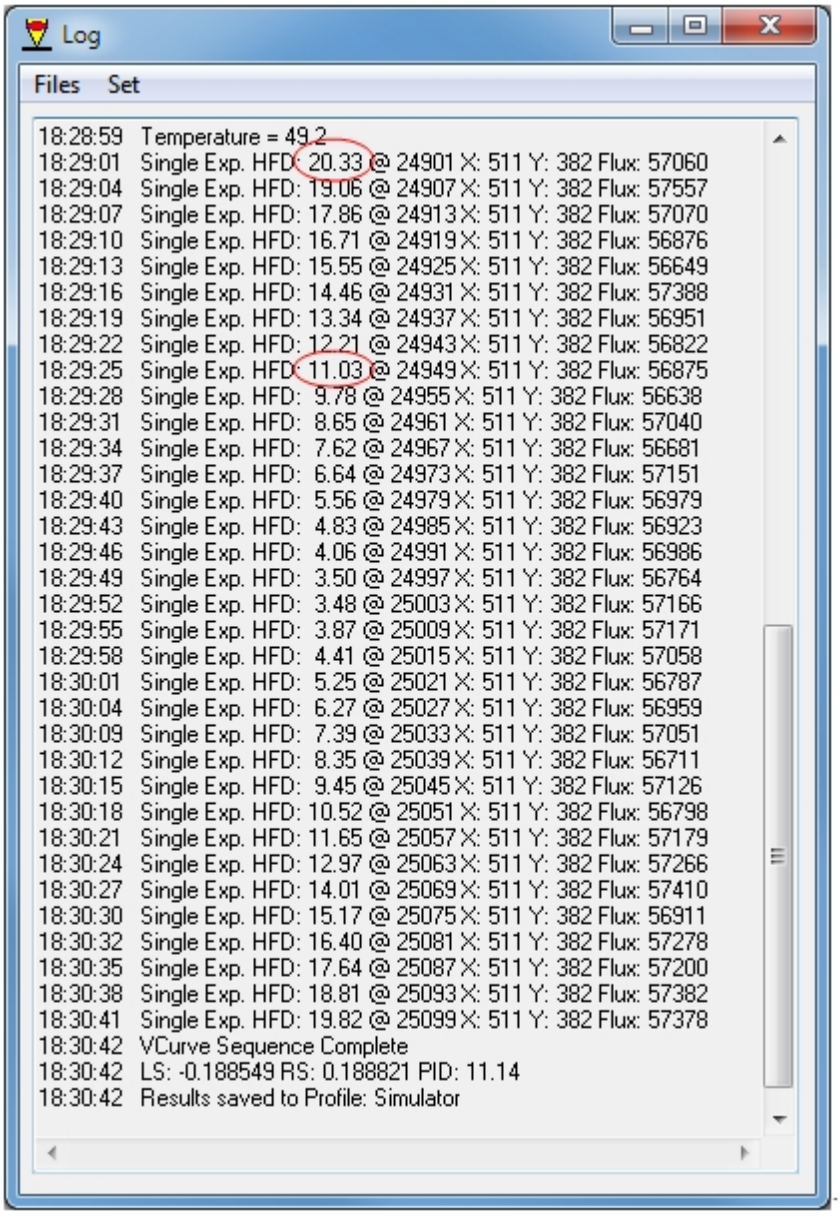
Notes:

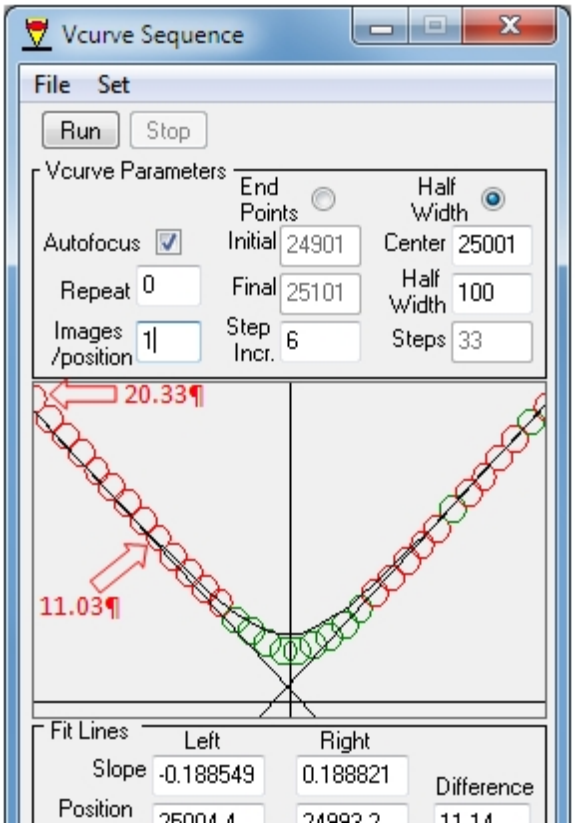
- Press the Test Path button to verify that AcquireStar can access and read and count the number of stars in a 1.0x1.0 degree field centered on RA 00:00:00, Dec 0:00:00 from the chosen star catalog.
- Under stars, press the Expose and Solve button and verify that AcquireStar can successfully plate solve your telescope
- If the above is successful, goto the FocusMax Focus Tab and press the AquireStar button.

Focus Start and Near Focus HFD Settings

The Focus Start is the Position or HFD value that the focuser will achieve at the start of the autofocus run. All moves from the Focus Start to the Near Focus HFD position will be in one direction to eliminate focuser backlash. To determine the best setting for Focus Start HFD and Near Focus HFD (see Setup Tab)

a) Generate a Vcurve
b) From the Log identify the right or left most extreme HFD value (20.33 in the example below).
c) Examine the Vcurve graph and identify the circle which begins to deviate from a straight line.
d) Determine the circle position in the Log by counting down the number of circles (step 2).
e) Round up the HFD value in the Log and add 1 or 2 HFD units to assure that the Near Focus Position is on the linear portion of the 'V'. Enter the value in the **Near Focus HFD** box would be 12 in the example below.
f) Enter the **Focus Start HFD** some 5 units higher than the Near Focus HFD which would be 17 in the example below.


Log
Files Set
18:28:59 Temperature = 49.2
18:29:01 Single Exp. HFD: 20.33 @ 24901 X: 511 Y: 382 Flux: 57060
18:29:04 Single Exp. HFD: 19.06 @ 24907 X: 511 Y: 382 Flux: 57557
18:29:07 Single Exp. HFD: 17.86 @ 24913 X: 511 Y: 382 Flux: 57070
18:29:10 Single Exp. HFD: 16.71 @ 24919 X: 511 Y: 382 Flux: 56876
18:29:13 Single Exp. HFD: 15.55 @ 24925 X: 511 Y: 382 Flux: 56649
18:29:16 Single Exp. HFD: 14.46 @ 24931 X: 511 Y: 382 Flux: 57388
18:29:19 Single Exp. HFD: 13.34 @ 24937 X: 511 Y: 382 Flux: 56951
18:29:22 Single Exp. HFD: 12.21 @ 24943 X: 511 Y: 382 Flux: 56822
18:29:25 Single Exp. HFD: 11.03 @ 24949 X: 511 Y: 382 Flux: 56875
18:29:28 Single Exp. HFD: 9.78 @ 24955 X: 511 Y: 382 Flux: 56638
18:29:31 Single Exp. HFD: 8.65 @ 24961 X: 511 Y: 382 Flux: 57040
18:29:34 Single Exp. HFD: 7.62 @ 24967 X: 511 Y: 382 Flux: 56681
18:29:37 Single Exp. HFD: 6.64 @ 24973 X: 511 Y: 382 Flux: 57151
18:29:40 Single Exp. HFD: 5.56 @ 24979 X: 511 Y: 382 Flux: 56979
18:29:43 Single Exp. HFD: 4.83 @ 24985 X: 511 Y: 382 Flux: 56923
18:29:46 Single Exp. HFD: 4.06 @ 24991 X: 511 Y: 382 Flux: 56986
18:29:49 Single Exp. HFD: 3.50 @ 24997 X: 511 Y: 382 Flux: 56764
18:29:52 Single Exp. HFD: 3.48 @ 25003 X: 511 Y: 382 Flux: 57166
18:29:55 Single Exp. HFD: 3.87 @ 25009 X: 511 Y: 382 Flux: 57171
18:29:58 Single Exp. HFD: 4.41 @ 25015 X: 511 Y: 382 Flux: 57058
18:30:01 Single Exp. HFD: 5.25 @ 25021 X: 511 Y: 382 Flux: 56787
18:30:04 Single Exp. HFD: 6.27 @ 25027 X: 511 Y: 382 Flux: 56959
18:30:09 Single Exp. HFD: 7.39 @ 25033 X: 511 Y: 382 Flux: 57051
18:30:12 Single Exp. HFD: 8.35 @ 25039 X: 511 Y: 382 Flux: 56711
18:30:15 Single Exp. HFD: 9.45 @ 25045 X: 511 Y: 382 Flux: 57126
18:30:18 Single Exp. HFD: 10.52 @ 25051 X: 511 Y: 382 Flux: 56798
18:30:21 Single Exp. HFD: 11.65 @ 25057 X: 511 Y: 382 Flux: 57179
18:30:24 Single Exp. HFD: 12.97 @ 25063 X: 511 Y: 382 Flux: 57266
18:30:27 Single Exp. HFD: 14.01 @ 25069 X: 511 Y: 382 Flux: 57410
18:30:30 Single Exp. HFD: 15.17 @ 25075 X: 511 Y: 382 Flux: 56911
18:30:32 Single Exp. HFD: 16.40 @ 25081 X: 511 Y: 382 Flux: 57278
18:30:35 Single Exp. HFD: 17.64 @ 25087 X: 511 Y: 382 Flux: 57200
18:30:38 Single Exp. HFD: 18.81 @ 25093 X: 511 Y: 382 Flux: 57382
18:30:41 Single Exp. HFD: 19.82 @ 25099 X: 511 Y: 382 Flux: 57378
18:30:42 VCurve Sequence Complete
18:30:42 LS: -0.188549 RS: 0.188821 PID: 11.14
18:30:42 Results saved to Profile: Simulator


Vcurve Sequence
File Set
Run
Stop
Vcurve Parameters
End Points
Half Width
Autofocus
Initial 24901
Center 25001
Repeat 0
Final 25101
Half Width 100
Images /position 1
Step Incr. 6
Steps 33
20.33¶
11.03¶
Fit Lines
Left
Right
Slope -0.188549 0.188821
Difference
Position 25004.4 24993.2 11.14

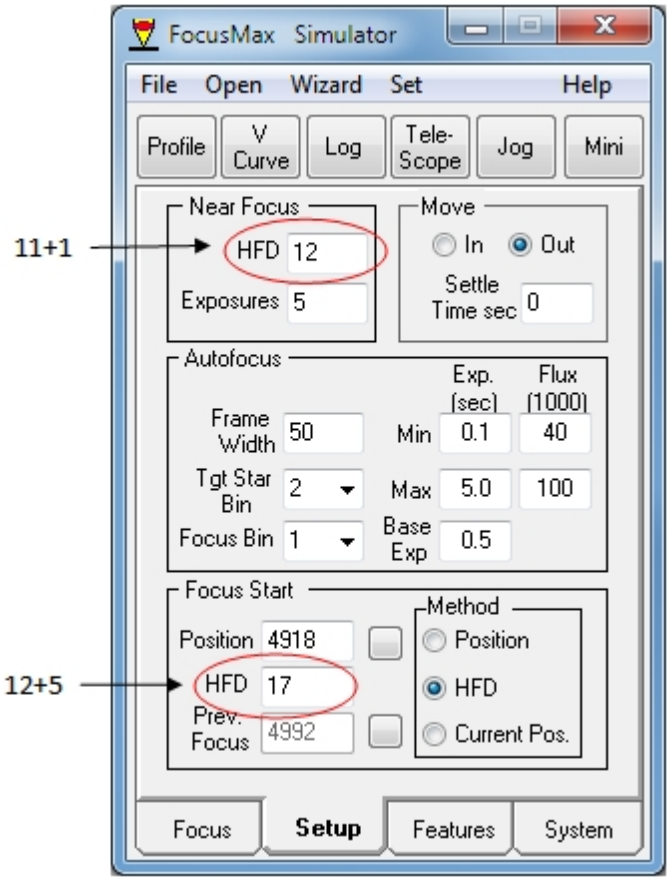


Image Calibration

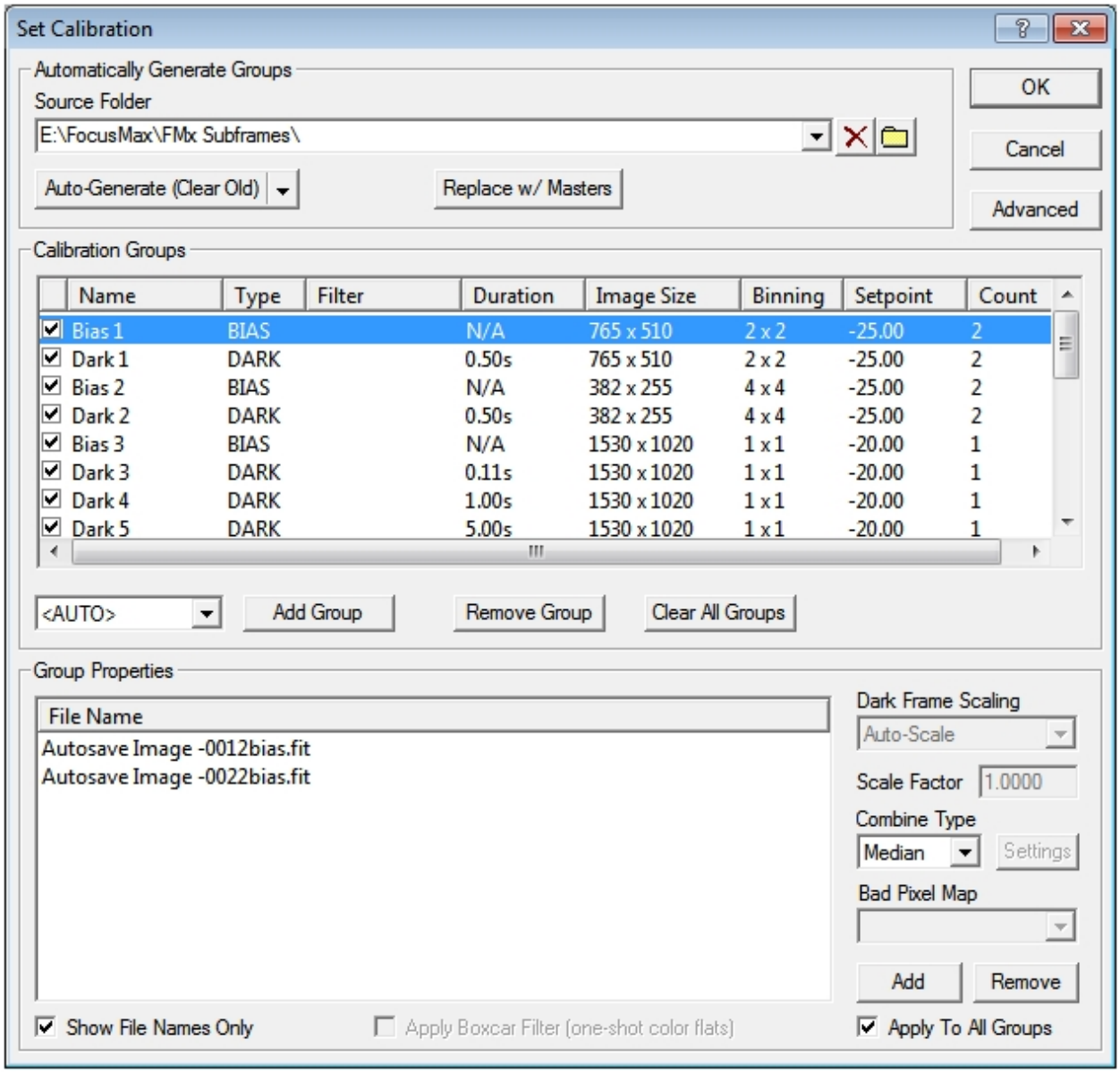
Image Calibration

This feature is requested by users that may have CCD defects such as hot pixels which FocusMax may attempt to use utilize for focusing. Enable image calibration which is found on the Features tab and follow this procedure:

MaxIm image calibration

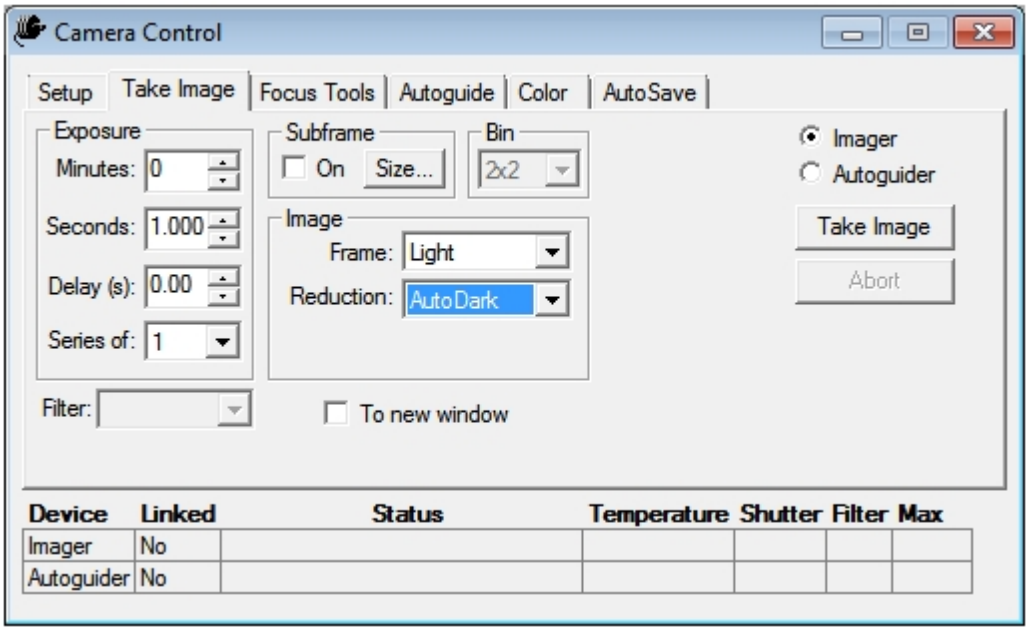
1. Create a set of dark & bias frames at the binning used for the initial image and autofocus sub-frame images (see Target Star Bin and Focus Bin on Setup Tab for settings).Dark frame exposures should span the range which FocusMax may use (0.1, 1, 5, 10 sec…). You may want to create a set of calibration frames from 1x1 through 4x4 just in case you decide to change bin size.
2. Save the calibration frames to a directory
3. Load the saved images into MaxIm using menu/Process/Set Calibration

MaxIm will extract the appropriate image and position in the calibration image to calibrate the FocusMax frames for the initial target star section and autofocus sub-frame images.



CCDSoft image calibration

CCDSoft will utilize the Image Reduction: AutoDark with each frame for image calibration.


Camera Control
Setup
Take Image
Focus Tools
Autoguide
Color
AutoSave
Exposure
Minutes: 0
Seconds: 1.000
Delay (s): 0.00
Series of: 1
Filter:
Subframe
On
Size...
Bin
2x2
Image
Frame: Light
Reduction: AutoDark
To new window
Imager
Autoguider
Take Image
Abort
Device Linked Status Temperature Shutter Filter Max
Imager No
Autoguider No