

FocusMax V5 Help

Table of contents

Introduction	7
What's New	8
Requirements	11
Migrating from FocusMax V4 to V5	12
Getting Started	14
Running FocusMax with Simulators	28
Focus Process	29
Support	33
Soft Buttons	34
Focus Window	35
System Window	38
Telescope Window	40
Log Window	41
Jog	43
Profile	44
Focus Plot	49
Menu Items	50
File	51
Configurations	52
System	53
Save Images	55
Import Vcurve data	56
Open	58
Mini	60
Graphs	61
Jog	63
Notes	64
Profile	65
Vcurve	66
Log	70
Temperature Log	71
Traffic Log	72
Temperature Compensation	73
Preferences	79
Setup	80
Autofocus	82
Camera	89
Filter Wheel	92
Focuser	92
Telescope	95
AcquireStar	97
Setup Tab	99
PinPoint Tab	104
Plate Solve Tab	106
Notes	108
General	111
Camera	114

Focuser	115
Telescope	116
Wizard	118
Set	119
On Top	119
Windows	120
Scripting	121
Camera	122
Properties	122
GetCameraStatus	122
Methods	122
StopGuider	122
FocusControl	123
Properties	124
AcquireStarAllowSyncEnable	124
AcquireStarAsyncStatus	124
AcquireStarCenterMethod	124
AcquireStarEnable	125
AcquireStarFinalPointingUpdate	125
AcquireStarMeridianCrossEnable	125
AcquireStarMinAltitude	126
AcquireStarMinMagTgtStar	126
AcquireStarReturnSlewError	126
AcquireStarMinSlew	127
AcquireStarBrightTgtStarMag	127
AcquireStarDimTgtStarMag	127
AcquireStarBrightCatStarMag	128
AcquireStarDimCatStarMag	128
AcquireNumberStars	128
AcquireStarReturnSlewEnable	129
AcquireStarReturnSlewEnable	129
AcquireStarSettleTime	129
AcquireStarSolveEnable	130
AcquireStarSolveExposure	130
AcquireStarSpiralSearchEnable	130
AcquireStarZenithEnable	130
AutoFocusExpMax	131
AutoFocusExpMin	131
AutoFocusFluxMax	131
AutoFocusFluxMin	132
AutoConnectTelescope	132
CCDCentralRegionEnable	132
CCDCentralRegionWidthPercent	132
DataFilePath	133
Exposure	133
FailAttempts	133
FailTimer	134
FilterNumber	134
FilterName	134
FilterNames	134

FilterWheelID	135
FilterWheelName	135
FindStarAsyncStatus	135
FocusAsyncStatus	136
FocuserBacklashDirection	136
FocuserBacklashEnabled	136
FocuserBacklashSteps	137
FocuserGuardBandSteps	137
FocuserMinTravel	137
FocuserMidTravel	138
FocuserMaxTravel	138
FocuserTempComp	138
FocusConvergenceEnable	138
FocusConvergenceSamples	139
FocusConvergenceSteps	139
FocusMaxIsLoaded	139
FocusMethod	140
FocusProcess	140
FocusRoutineFailAttempts	140
FocusRoutineFailTimer	141
FocusRoutineMaxHFD	141
FocusRoutineReturnToStartPositionEnable	141
HalfFluxDiameter	142
IsBusy	142
LastAutofocusPosition	142
LastAutofocusFilter	142
LastAutofocusTemperature	143
LastAutofocusJulianDate	143
PlateSolveMethod	143
MultiStarFocusAsyncStatus	143
PlateSolveMethodName	144
Position	144
PostCommandStatus	145
ReadFilterInfo	145
SavedImagePath	145
SavedLogPath	146
SavedScriptPath	146
SetStopButton	146
Scratch	147
ScriptToLog	147
ShowFocusHistogram	147
ShowFocusPlot	148
SingleExposeAsyncStatus	148
SingleExposeFrameWidth	149
StarXCenter	149
StarYCenter	149
SystemNumber	149
SystemFileName	150
Temperature	150
TempCompMethod	150

TotalFlux	151
Version	151
WriteFilterInfo	151
Methods	152
AcquireStarAimCamera	152
AcquireStar	152
AcquireStarAsync	153
AcquireStarPlateSolveMethod	153
AcquireStarTakeImageSolve	153
Delay	154
DeleteFilterWheelInfo	154
FindStar	155
FindStarAsync	155
Focus	156
FocusAtStarCenter	156
FocusAtStarCenterAsync	157
FocusAsync	157
GetiniValue	158
Halt	158
HardwareConnect	159
HardwareDisconnect	159
Move	159
MultiStarFocusAsync	160
PostCommand	160
RunVcurve	161
SendToLog	161
ShowLog	162
SingleExpose	162
SingleExposeAsync	163
Terminate	163
WriteFilterInfo	163
Focuser	164
Properties	165
Absolute	165
GetFocuserID	165
IsMoving	165
Link	166
MaxIncrement	166
MaxStep	166
Position	167
StepSize	167
TempComp	167
TempCompAvailable	168
Temperature	168
Methods	168
Halt	168
Move	169
SetupDialog	169
WaitForSec	170
Telescope	170

Properties	171
VerifyTracking	171
HourAngle	171
LST	171
RequiresTopoCoordinates	172
Methods	172
DegreesToDMS	172
J2000_to_Topo	172
HoursToHMS	173
Topo_to_J2000	173
Sample Scripts	173
Help	176
Undocumented Settings	177
System.ini	177
Filterwheel.cfg	179
Tips & Troubleshooting	180
Tips	181
Troubleshooting	185
Filter offsets	191
Seeing	192
Temperature Compensation	195
Version History	199

Introduction

Introduction

Focusing CCD-based telescopes is one of the drudgeries astronomers constantly face. FocusMax was designed to solve this difficult problem! With availability of motorized focusing hardware, comes an opportunity to fully automate the focusing operation. FocusMax is routinely used in unattended, all-night robotic-telescope operations such as asteroid and supernova searches, astrometry, photometry, imaging, etc. The only requirements are a CCD based telescope, a commercially available motorized-focuser and CCD camera control software.

Please visit <http://www.ccdware.com>

I hope you enjoy FocusMax!

Steve Brady

[What's New](#)

[Requirements](#)

[Migrating from FocusMax V4 to V5](#)

[Getting Started](#)

[Focus Process](#)

[Running FocusMax with Simulators](#)

[Support](#)

[Version History](#)

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What's New

What's New in FocusMax V5

FocusMax V5

FocusMax is a dynamic auto-focusing software program that enables fast and accurate telescope focusing with off-the-shelf motorized focusers. *FocusMax* is routinely used with unattended all-night robotic-telescope operations.

First offered to the astronomical community in 2001 to aid astronomers in the difficult task of focusing CCD-based telescopes. *FocusMax* has become the premier standalone auto-focusing software solution for thousands of professional and amateur astronomer's worldwide. *FocusMax* is routinely used for automated asteroid and supernova searches, minor planet astrometry, variable star photometry, deep sky imaging, and more.

The newly released *FocusMax* Version 5 includes a wide array of new features and capabilities.

What's New:

General

1. FocusMax V4 and V5 may coexist on the same pc.
2. FocusMaxV5 .ini and .cfg files **are not** backward compatible with V4 due to significant changes to user data storage and new features that have been developed.
3. Original FocusMax V4 Vcurve data files may be imported into V5. The V4 Vcurves are located in C:\Users\XXX\Documents\FocusMax V4\DataFiles and have the form Vcurve_XXX_XXX_System_1.vcl . If these files are missing, then it recommended that new Vcurves be generated to utilize the new features in FocusMax V5.
4. Filter offsets will now be applied during filter change (if desired).
5. Data is now stored in 'Configurations' subdirectory 'C:\Users\XXX\Documents\FocusMax V5\Configurations\' which organizes all user data into discrete folders for each hardware setup. Folder 'Default' and 'Simulator' are automatically generated on first startup and additional Configuration folders may be created by the user.
6. On startup, FocusMax will verify filter name and order to assure that filter order has not been changed in the filter wheel.
7. A Filter Wheel Preferences Window has been added to allow the user to manually enter Filter Offset values if known. These values will stay in effect until the Offset Filter Wizard is used to create a database or measurements for each filter.
8. Added support for PinPoint V7 and ATLAS catalog.
9. Added support for TheSkyX 64 bit and Camera add-on.

Multi-Star Focus

1. A new focus process has been developed which will utilize many stars (default 50) in the field which will allow the astronomer to focus the telescope on the current imaging field without having to slew away to center a focus star. If there are an insufficient number of stars, then AcquireStar may be enabled by the user to slew the telescope to a target field containing stars in a desired magnitude range for the selected filter.
2. Focus binning may now be specified by filter which will benefit users with narrow band filters.
3. The user has the option to define which filter is to be used for the autofocus run or to use 'Current filter' which may have been set by a host automation app.

Single-Star Focus

1. A new star detection algorithm has been developed which will identify the brightest stars (default 20)

in the field then determine the best 'single-star' candidate to be used for the autofocus run. If the brightest star is too bright, then the next brightest star in the list will be tested.

2. The focus time is approximately 30% faster than FocusMax V4.
3. Target and Focus binning may now be specified for each filter which will benefit users with narrow band filters.
4. The user now has the option to define which filter is to be used for the autofocus run or may select 'Current filter' which may have been set by a host automation app.
5. A new algorithm has been developed to identify suspect data during a focus run and automatically re-sample, statistically test and eliminate suspect data to improve focus accuracy.
6. An improved Focus Convergence algorithm has been implemented which will sample the focus star until the focus position has been determined based on current seeing conditions.
7. Added 3x3 and 4x4 focus binning which will be useful with small pixels CMOS cameras and users with narrow band filters.

Artificial Intelligence (A.I.)

1. A.I. has been implemented that when enabled, will begin to optimize various user settings based on historical data.

AcquireStar

1. The user may now specify a specific filter to be used for telescope pointing images or may select 'Current filter'. Typically, the pointing filter selected is the filter which offers the brightest image, such as Luminance.
2. AcquireStar user interface has been simplified by eliminating 'Dim star magnitude'. During the catalog search, a default value range of +1.0 mag will be used with the 'Bright' magnitude to restrict large magnitude ranges during catalog search which significantly impacts the search time.

Vcurve

1. A new algorithm has been developed that will allow the focuser to be positioned in the non-linear portion of the Vcurve during an autofocus run resulting in improved star S/N and allowing the use of dimmer stars. This will be especially useful when focusing with narrow band filters.
2. A new algorithm has been implemented to fit Vcurve data and determine to Vcurve slopes and PID.
3. A new outlier detection method has been developed to measure Vcurve fit and automatically reject suspect Vcurve data points.
4. A new method has implemented to determine if the Vcurve shape is suspect with a poorly defined 'V'.
5. An 'Optimize' button has been added in the Profile Window to identify potential suspect Vcurve slopes and PID data from Vcurve runs.
6. A Vcurve Graph may be opened to view the Vcurve data in detail with mouse-over data display.

Wizards

1. AcquireStar Wizard has been developed which will determine the optimum star magnitude to achieve the user defined target flux with a 1 sec exposure for a selected filter.
2. FilterOffset Wizard has been developed which will measure the difference in steps between a target and a reference filter. The Offset Filter Wizard system set is designed to allow the user to conveniently collect data for each filter over many runs (nights) then optimized the data to identify outliers and statistically analyze the results.

Telescope

1. A user defined max telescope altitude (tilt-up) has been added for cases where the payload may

contact mount. For example, the payload on a SCT Alt/Az mount may not be able to swing through the forks. Default = 90 degree.

What's Changed:

1. Focus calculation method (Mean / MinMax Clip) has been deprecated and replaced with a new algorithm for outlier detection.
2. Deprecated Night Vision feature
3. AcquireStar 'Spiral search ' has been deprecated. If a pointing image does not solve due to poor telescope pointing, then the user should specify PinPoint All-Sky or select TheSky Image Link and configure Image Link for All-Sky plate solving.
4. Deprecated telescope calibration and center star routine

Requirements

Requirements

Imaging software:

- TheSky Camera Add-on or CCDSoft from Software Bisque <https://www.bisque.com/sc/>
- MaxIm DL/CCD from Diffraction Limited <https://www.cyanogen.com/>
- Nebulosity 4 from <https://www.stark-labs.com/nebulosity.html>

Also requires installing the ASCOM Camera Driver <https://www.stark-labs.com/downloads.html>

ASCOM Platform V6+:

<https://ascom-standards.org/>

Drivers:

- ASCOM compliant focuser driver from focuser provider
- ASCOM compliant Telescope Drivers (required for telescope control)

Planetarium Programs (not required but desirable):

- TheSkyX or TheSky64 from Software Bisque <https://www.bisque.com/sc/>
TheSky64 ASCOM driver may be downloaded from <https://ascom-standards.org/Downloads/ScopeDrivers.htm>
- Starry Night Pro from Starry Night <https://www.starrynight.com/>
- DeepSky from DeepSky <https://www.deepsky2000.com/>
- See current listing at <https://ascom-standards.org/Community/Partners.htm>

Automation / Observatory Control Programs (not required but desirable):

- ACP / ACPS <https://www.dc3.com/>
- CCDAutoPilot <https://www.ccdware.com/products/>

Astrometric Engines:

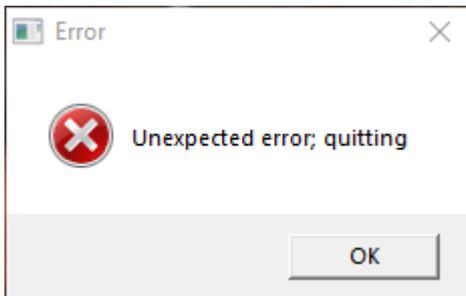
- PinPoint from DC Dreams <https://pinpoint.dc3.com/>
- TheSky Image Link (requires Camera Add-on from Software Bisque)

Migrating from FocusMax V4 to V5

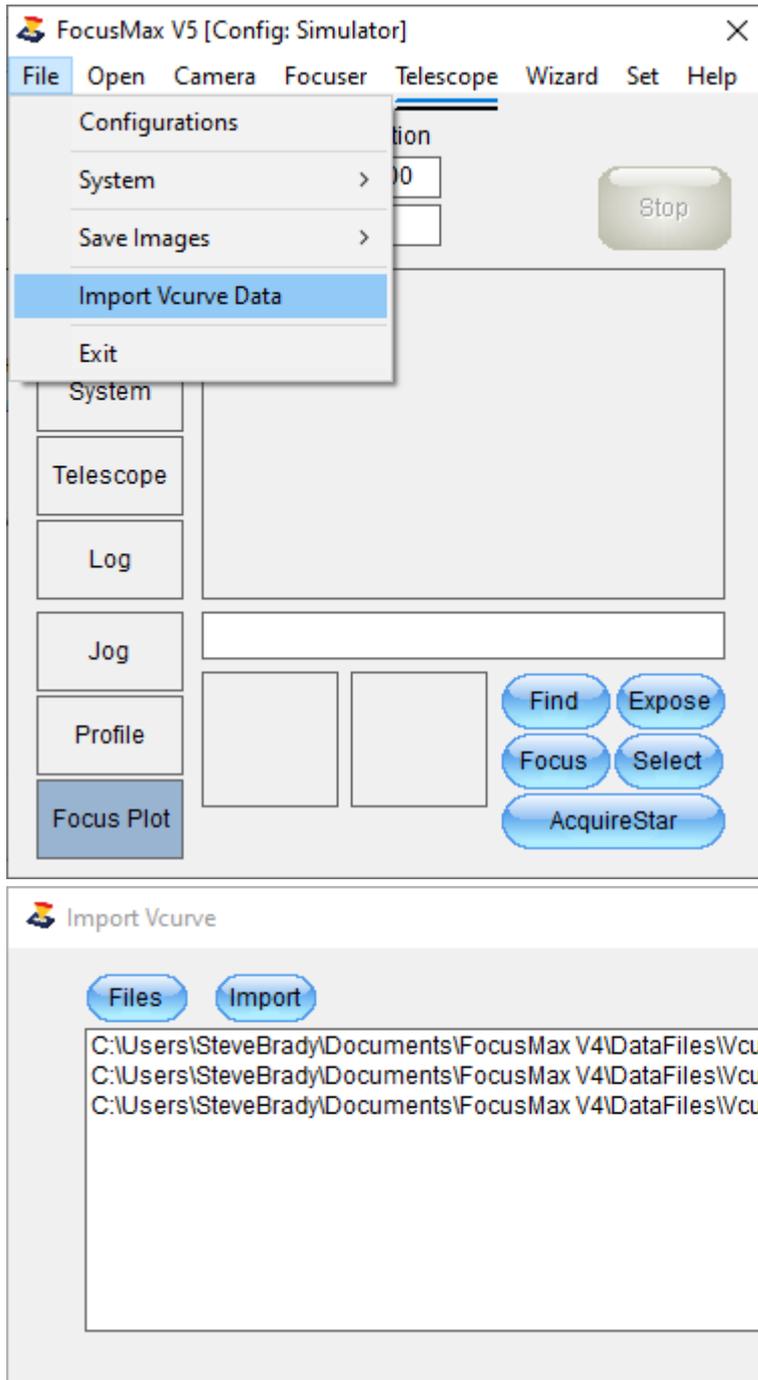
Migrating from FocusMax V4 TO V5

Follow these simple steps to migrate from FocusMax V4 to FocusMax V5

1. The V4 Vcurve data contained in *.ini and *.cfg **are not compatible** with V5 due to significant file structure changes over the last 20+ years. It is suggested that you take screen shots of the various FocusMax V4 Profile Windows, then open FocusMax V5 Preferences and apply the settings as needed. Please note that some settings have changed /deprecated in FocusMax V5.
2. Both FocusMax V4 and V5 may coexist on your PC allowing you to switch between these versions. If you switch from one version to another you must start the second version with a right click, run as administrator, close and reopen without admin rights. Failing to do this will generate a Windows error message "Unexpected error; quitting" when starting FocusMax:
 - a) Close the message
 - b) Start FocusMax with a 'right click, run as administrator'
 - c) Close FocusMax and reopen without administrative rights.



3. A new algorithm has been implemented to fit Vcurve data to determine Vcurve slope and PID. A tool has been provided that will allow you to import your original FocusMax V4 Vcurve data *.vcl files which are located in C:\Users\XXX\Documents\FocusMax V4\DataFiles.
 - To import the data select 'File/Import Vcurve data'
 - Drag and drop each file to be imported into the 'Import Vcurve' Window.
 - The data file will be read and analyzed with the Vcurve test algorithms
 - If the data is accepted you will be asked if you wish to save the data to the Profile
 - If not, then the next file in the list will be analyzed



If the Vcurve data is not available, then please plan to run new Vcurves so you benefit from the newly implemented Vcurve fitting algorithm.

If pressed for time and not able to run new Vcurves, you may temporarily use the Vcurve summary information used in V4:

- Open the V4 .ini file that you have been using (default C:\Users\XXX\Documents\FocusMax V4) and scroll down to section [System]
- Copy the slopes and PosIntercept then paste these values into the same section in your FocusMax V5 ini file.

[System]

RightSlope =0.198203

LeftSlope =-0.198065

PosIntercept =3.75

Note: The above values will be modified when a Vcurve is run using FocusMax V5 which is

HIGHLY RECOMMENDED!

Getting Started

Getting Started

Before you begin:

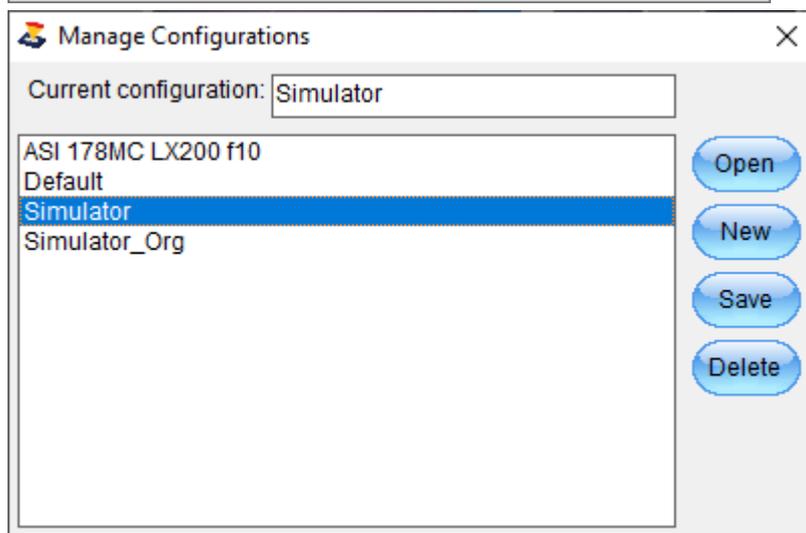
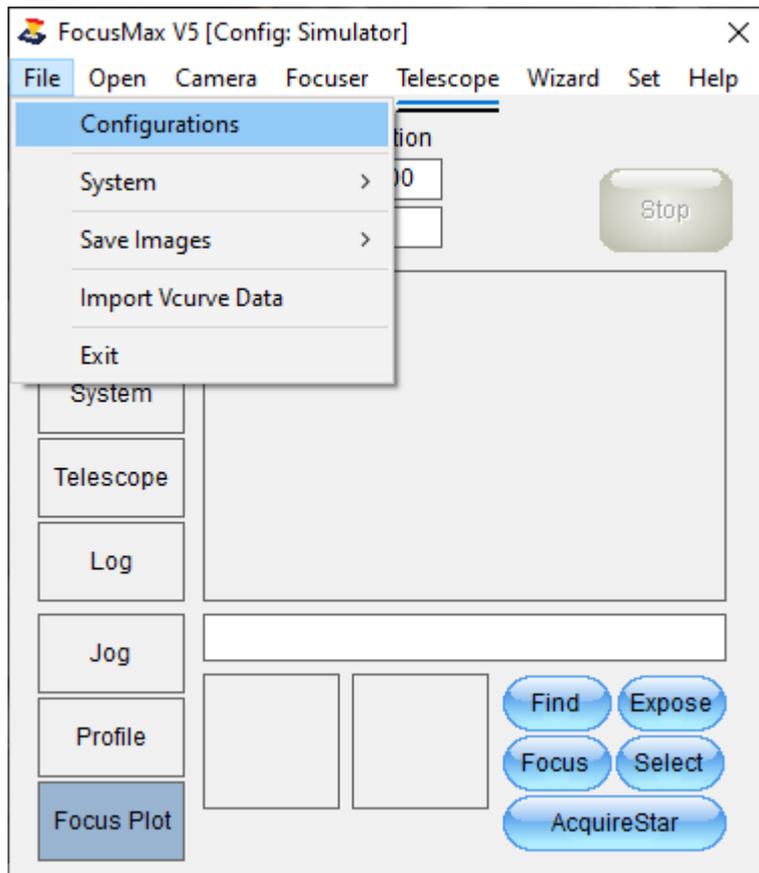
1. Install the required software as described in [Requirements](#).
2. To start FocusMax following installation, perform a right click/Run as administrator ****only once**** then close and restart FocusMax.
3. If FocusMax is opening another copy of MaxIm, Nebulosity, TheSky, etc. Review all of the installed astronomy apps administrative settings (Right click/Properties/Compatibility Tab/Settings) and verify that they are ***not*** set to Run as administrator.

Configurations:

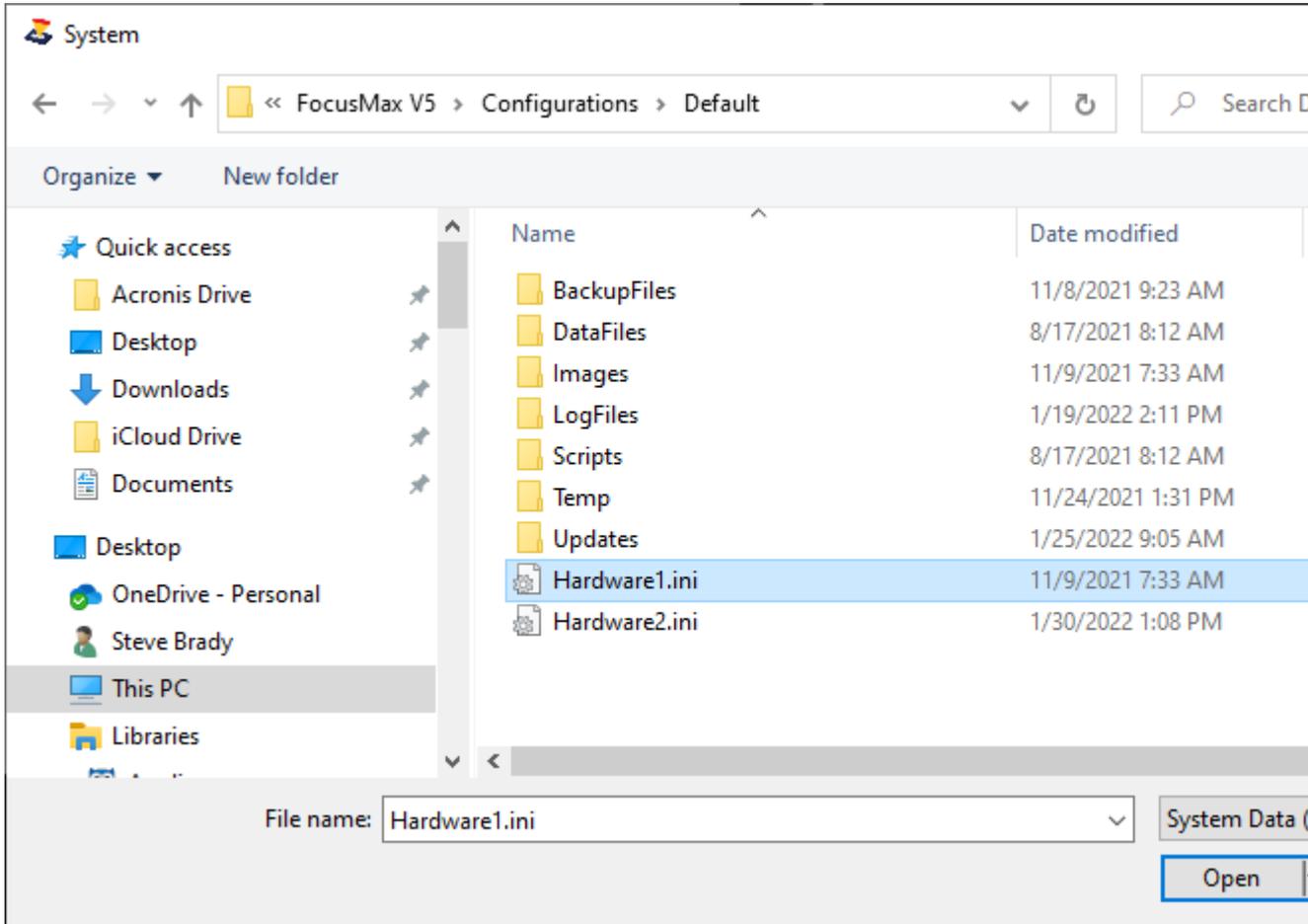
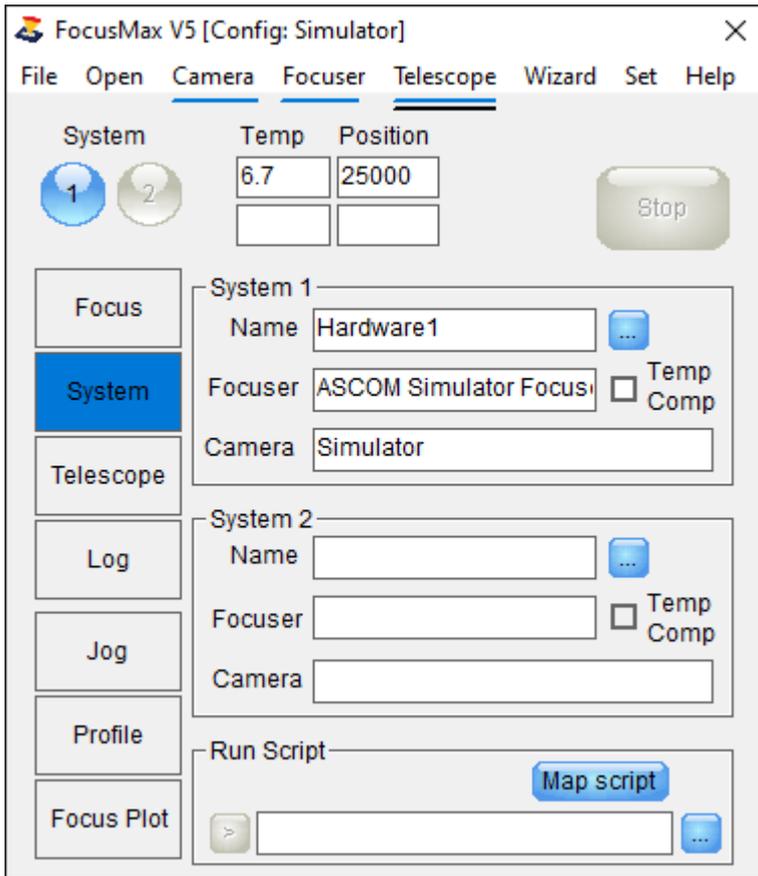
4. Data is stored in 'Configurations' subdirectory 'C:\Users\XXX\Documents\FocusMax V5\Configurations\' which organizes your user data into discrete folders for each hardware setup. Folder 'Default' and 'Simulator' are automatically generated on first startup and you may create new unique Configuration folders. To open a Configuration:
 - o Select Menu/File/Configurations
 - o Select the available Configuration and press Open

To create a new Configuration with a unique name:

- o Press New
- o Enter the new Configuration name and press enter
- o Select the newly created Configuration and press Open



- Next, open the System window and press the small button to the right of System 1 or 2.

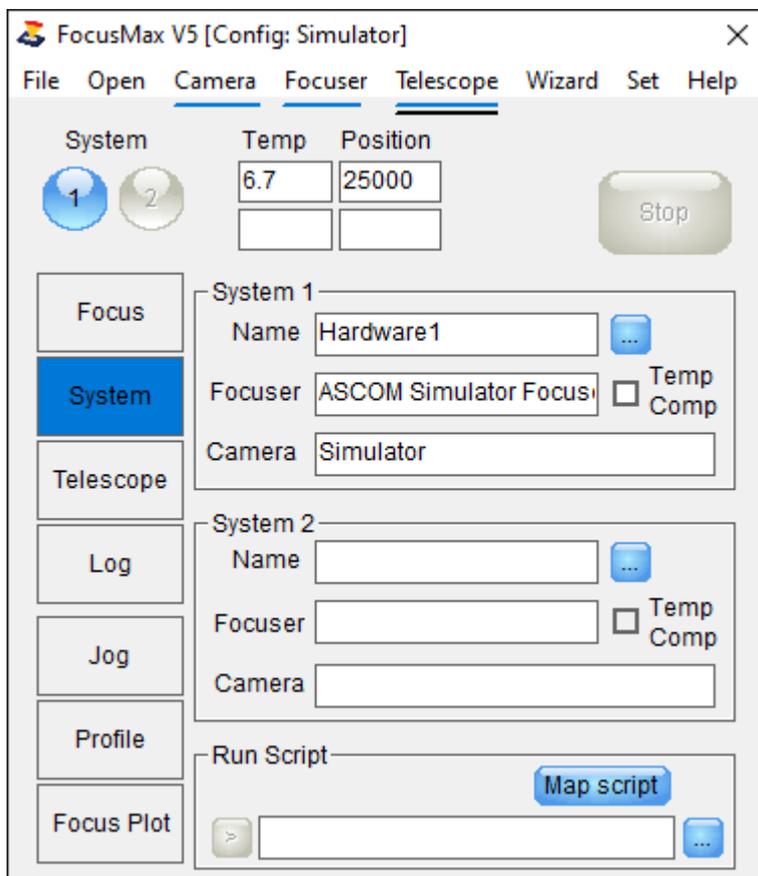


You may also open an existing 'Configuration' directory by opening the 'System' Window and navigating to the desktop directory then select the ini file which will be used to store your many of your settings.

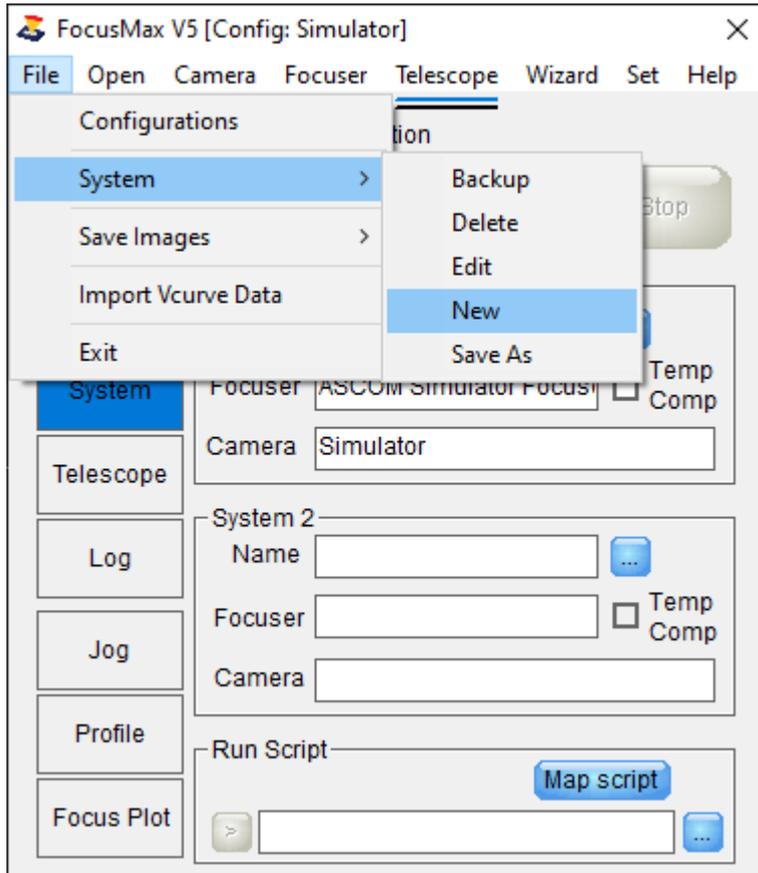
6. FocusMax will create several default directories in the Configuration directory:
- **BackupFiles** to hold changes made to your .ini files
 - **DataFiles** for Vcurve runs and Temperature Compensation runs
 - **Images**, for any images that may be saved during Vcurve measurement or autofocus runs
 - **LogFiles**, for [Log Files](#)
 - **Scripts** for custom scripts
 - **Temp** for temporary files which will be deleted on restart

System Names:

7. Default files (Hardware1.ini and Hardware2.ini) will be created in the new Configuration directory, to open and associate with a System number 1 or 2]
- press the 'System' command button on the left of the FocusMax Window
 - press the small colored button to the right of the System box
 - select the system to store your setup data



8. You may want to create a system name that is unique for your setup:
- Select Menu/File/System/New or Save As to copy which will copy current data over to the new name
 - Save the file under a unique name.

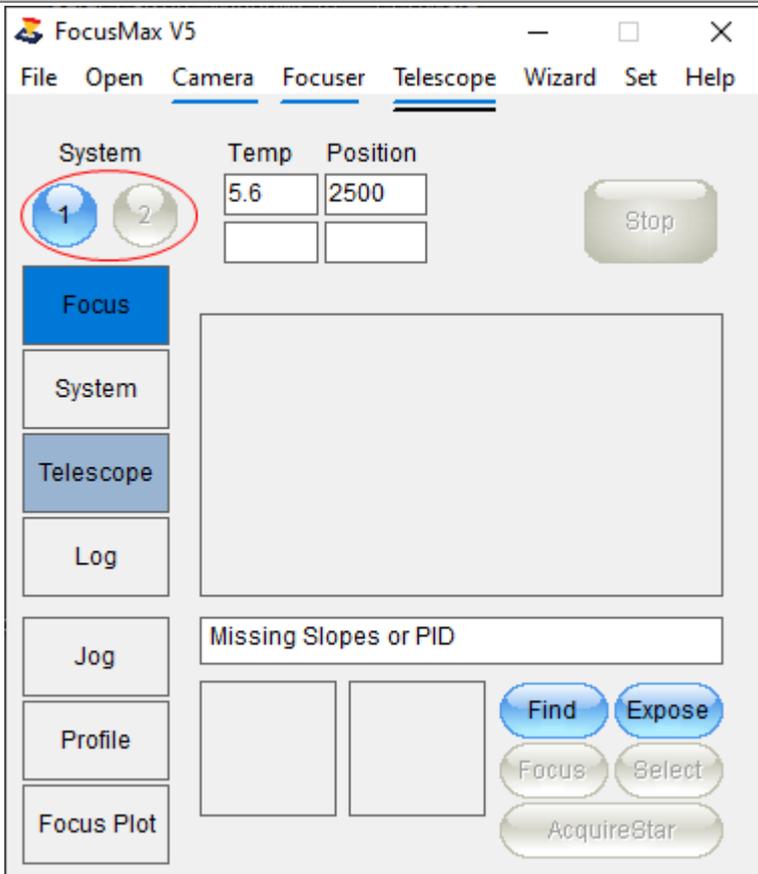
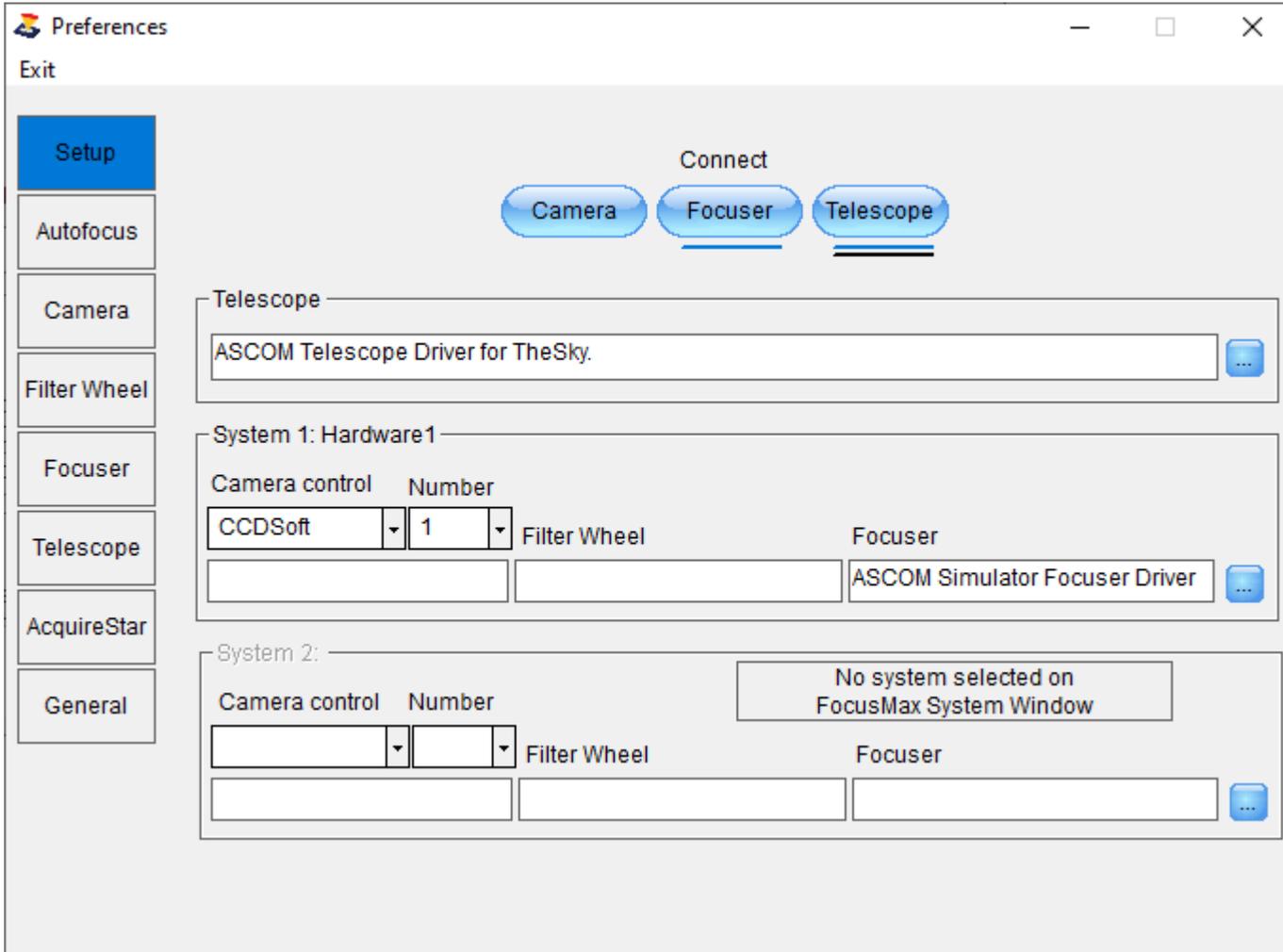


9. Setup your hardware:

Press Menu/Open/Preferences/Setup to assign your hardware to System #1 and System #2 (if you have 2 cameras and focusers). The hardware in each 'System' will be used during the autofocus run. You may quickly toggle between each 'System' by pressing the large 'System' button on the main FocusMax window.

- For each 'System' in the System boxes below, select your camera control software and set your camera assignment to 1 or 2.
- Pressing the Connect Camera button will connect to your hardware, query the imaging software and display the camera and filter wheel names.
- If the connection is successful then you will see a blue line under the Camera Connect Button.

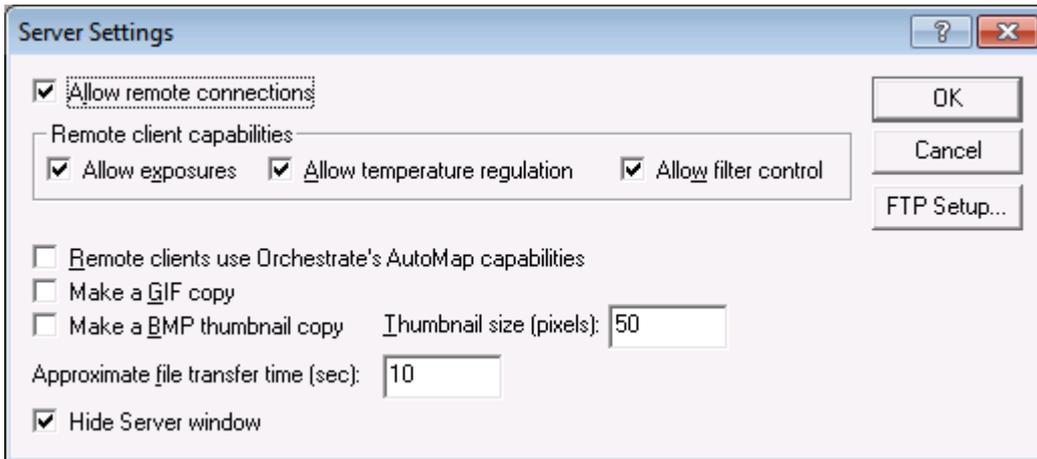
The selections made should match your actual camera configuration.



If you are using CCDSoft then the server settings must be setup.

Navigate to CCDSoft/Menu/Camera/Server Settings and enable the following:

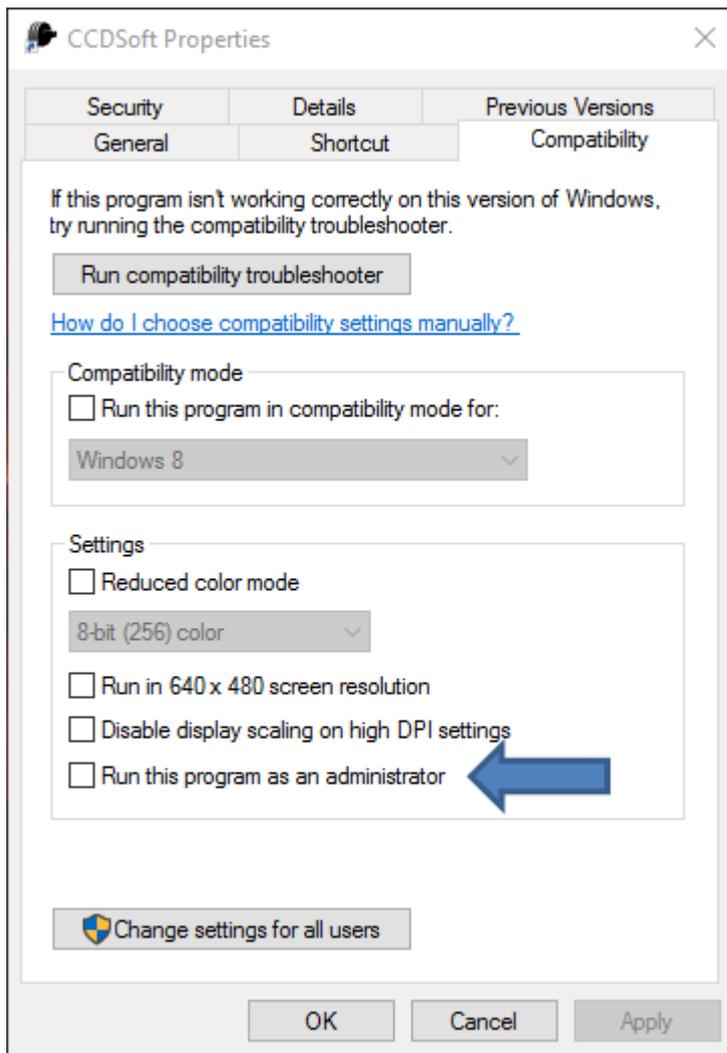
- Allow remote connections
- Allow exposures
- Allow temp regulation
- Allow filter control
- Hide server window
- Uncheck all other settings in particular make a GIF and BMP copy



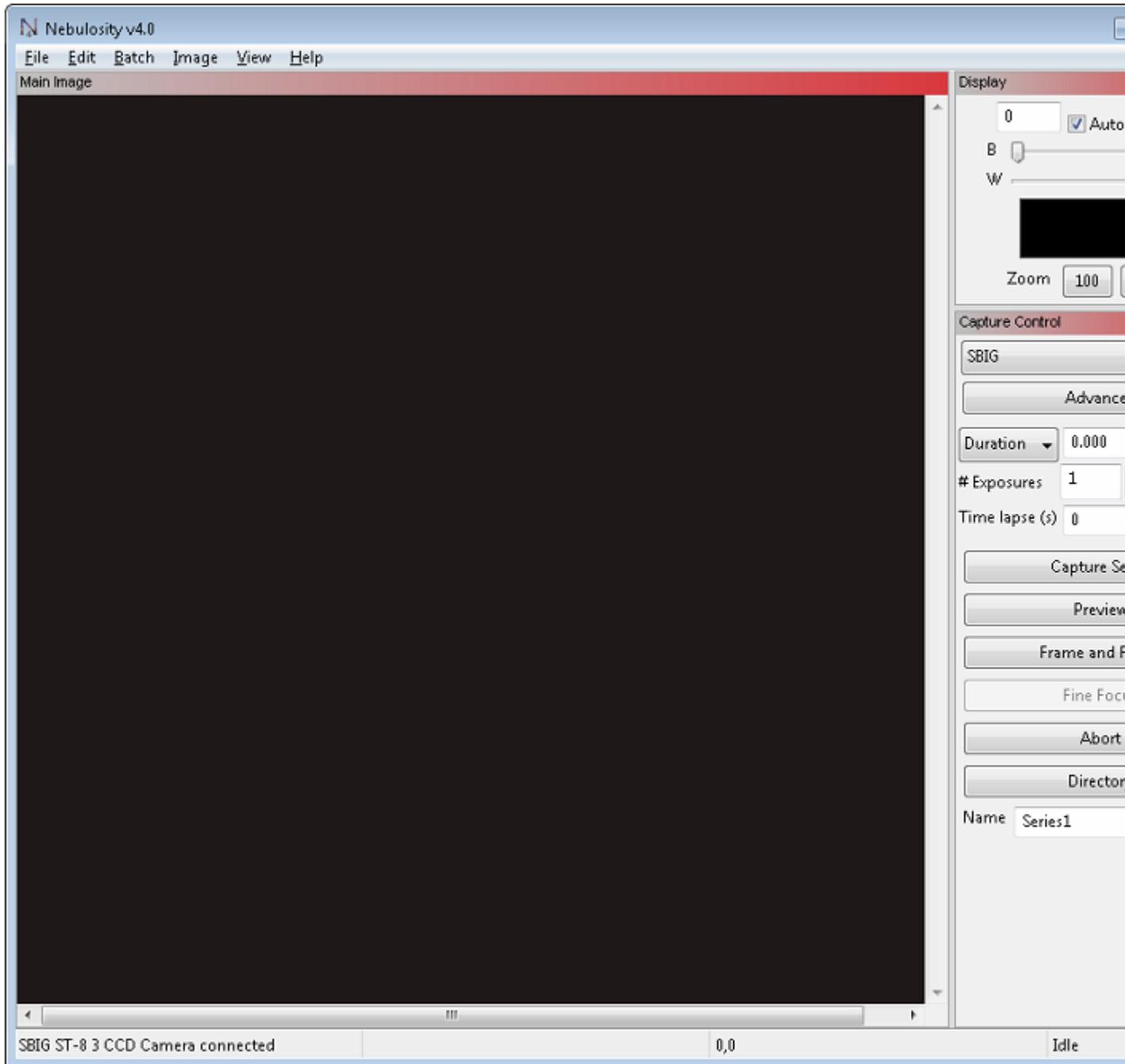
Select the Focus Tab and press the Expose button to verify that the camera will initiate an exposure – if not, then verify that your camera is connected and you have selected your camera correctly in Preferences.

Verify that CCDSoft properties *are not* set to run as Administrator:

- Right click on CCDSoft and select Properties
- Select Compatibility Tab and verify that 'Run this program as an administrator' is not select

**If you are using Nebulosity4**

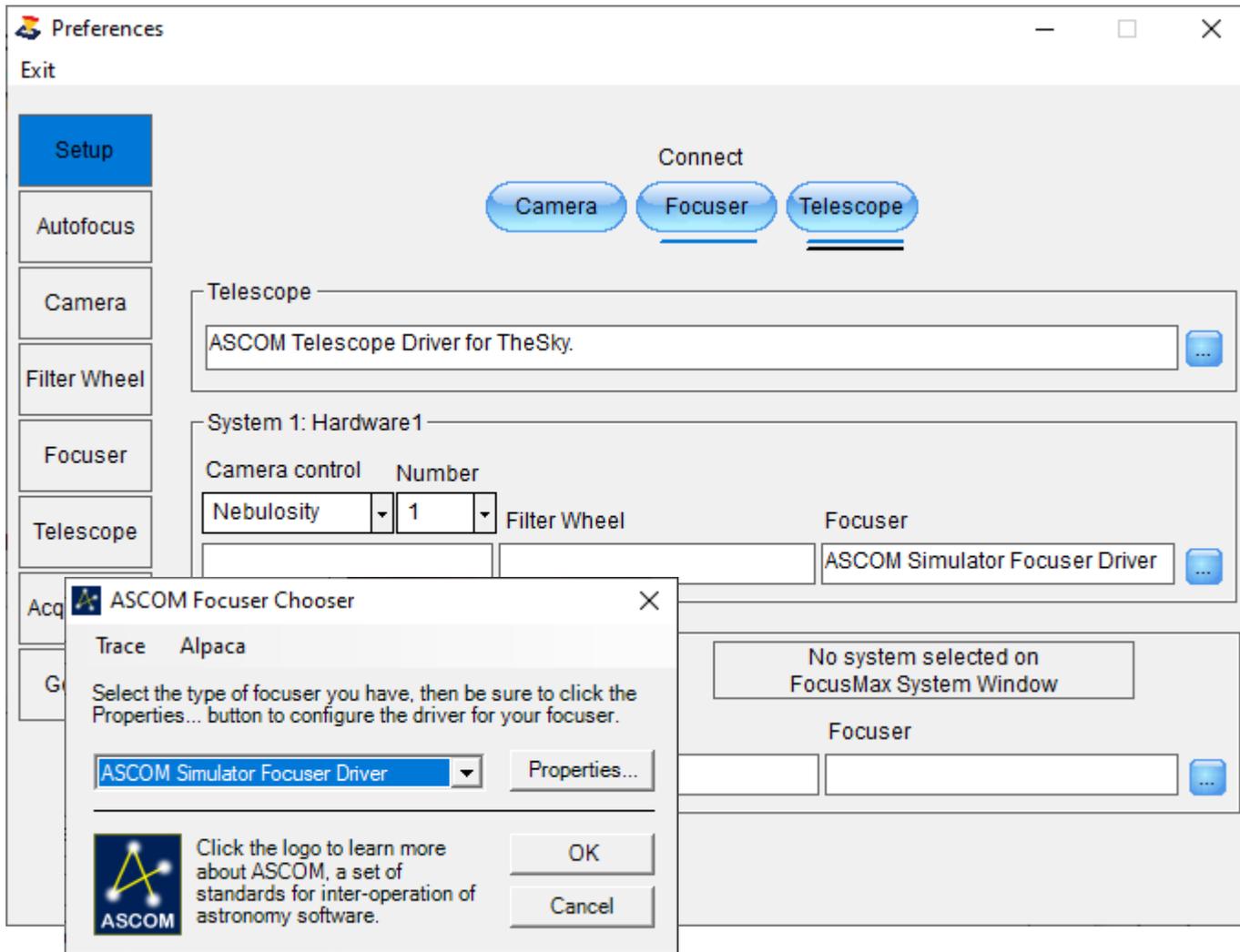
- Download and install the Nebulosity 'ASCOM Camera Driver' <http://www.stark-labs.com/downloads.html> . This will allow FocusMax to communicate with Nebulosity 4 via an ASCOM interface.
- Select your camera



10. **Select and Connect to the focuser**

Press small button to the right of the Focuser box

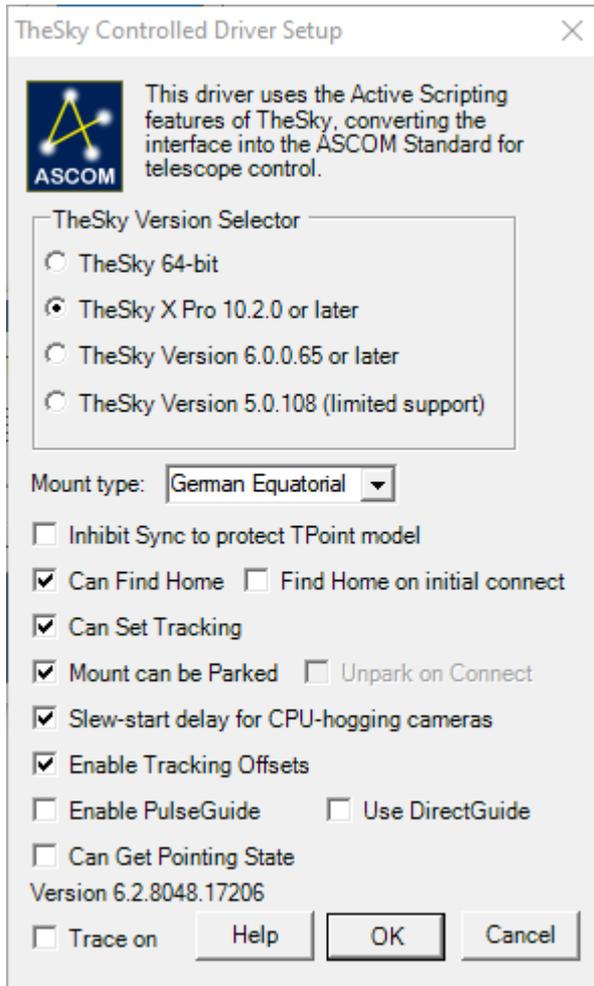
- Select your ASCOM focuser
- Press Properties to set the focuser driver com port and other driver settings
- Press Focuser Connect button to establish a connection to the focuser. If the connection is successful then you will see a blue line under the Focuser Connect Button.
-



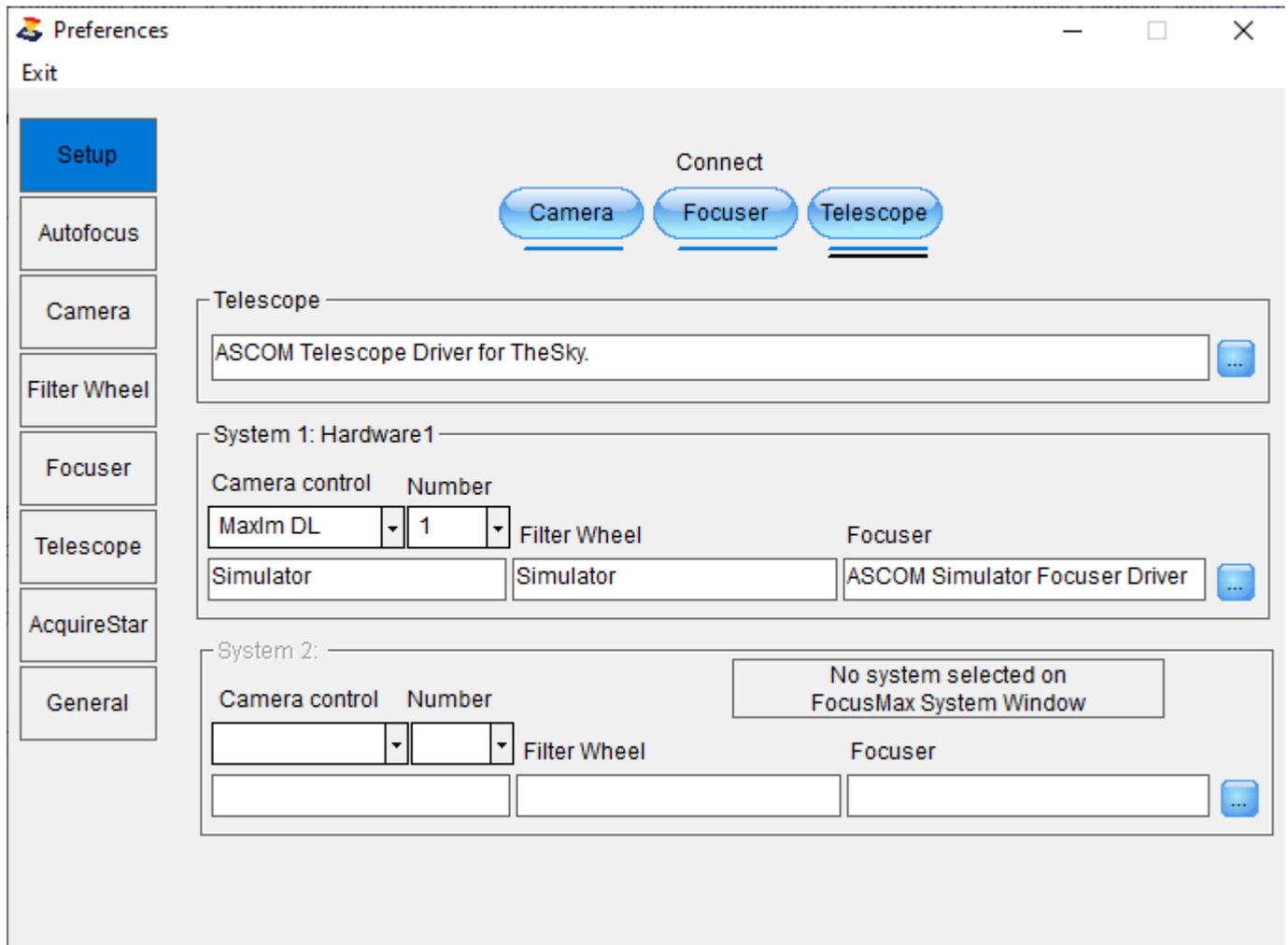
11. Select and connect to the telescope:

Press the small colored button to the right of the telescope box

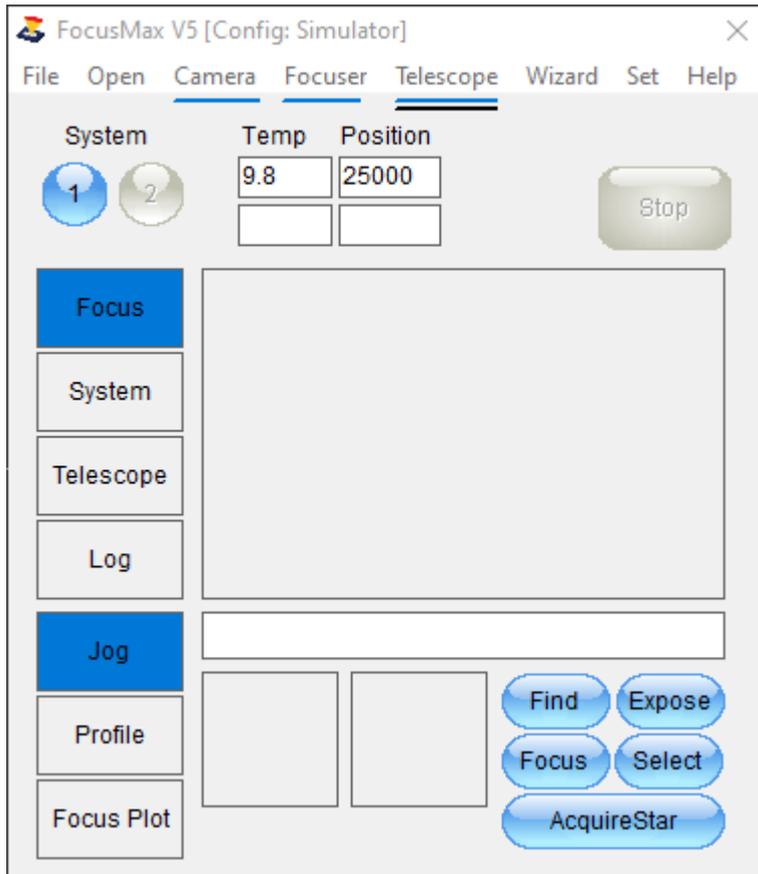
- Select your ASCOM telescope driver. If you are using TheSkyX or TheSky64 you can download the 'ASCOM 2X Mount Adapter' from [Ascom2XMount Adaptor Installer 6.2 – Software Bisque](#). This driver is supplied by Software Bisque and will translate ASCOM commands to native TheSky protocol.
- Press Properties to open the driver and select TheSky X Pro or TheSky 64 then set the telescope capabilities.



- Press Telescope Connect button - a blue line under the Telescope Connect Button that will indicate that the telescope is connected, a black line will indicate that the telescope is tracking



12. **Press the Jog button**



- Displays the focuser current position
- Allows you to move the focuser in or out X number steps
- Allows you to set a position for the focuser to move to



Verify that your focuser will move through the entire range of motion according to the focuser specifications.

- Enter 0 and press the Move To button
- Enter the Max travel position and press the Move To button
- If driver adjustments are required, press Menu / Preferences and press the small button to the right of the selected focuser to access the ASCOM focuser driver settings.

If you followed the above steps successfully you have now:

1. Selected the Default Configuration or have created a unique Configuration
2. Selected the 'System' name (System 1) or created a unique name which FocusMax will use to save your settings..
3. Specified the camera control software for each camera number and established a connection to your camera(s)
4. Selected and established a connection to your focuser(s)

5. Selected and established a connection to your telescope
6. Have learned to manually Jog your focuser

Running FocusMax with Simulators

Running FocusMax with Simulators

Please see FocusMax Tutorials for instruction on how to setup and run simulators for:

- MaxIm
- TheSkyX or TheSky64
- Nebulosity 4

Focus Process

Focus Process

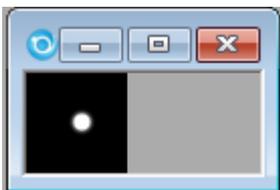
Single-Star:

The Single-Star focus process has been the standard autofocus process since FocusMax was first introduced in 2001. There have been many changes introduced in FocusMax V5 to improve the process.

1. An image is taken and the brightest stars (20 default) are identified in the image
2. The brightest star is tested to determine if the exposure may be set between the user defined Min and Max exposure limits to meet the user defined 'Target Flux' value.
 - If the star is too bright then the next brightest star in the list is tested.
 - If the brightest star is too dim then the focus process may be aborted.
3. The chosen star is subframed and the initial HFD and Flux is measured.
4. The focuser will move in or out (depending on user setting), a subframe image is taken and the star measured to determine if the focuser is on the correct side of the 'V'. If the focuser is not the correct side then a move is made to bring the focuser to the other side of the 'V'.
5. The focuser will move beyond the user defined 'Near Focus', stop then reverse move (to eliminate potential backlash) to the estimated 'Near Focus' position.
6. FocusMax will begin taking subframe images at 'Near Focus' and measuring the star. The number of images will depend on the user settings. The focuser will move to the other side of the 'V' if the 'Advanced' method is selected in Preferences.
7. The focuser is then moved to the focus position and additional subframe images taken to determine focus quality depending on the user settings.



Initial 1 sec exposure



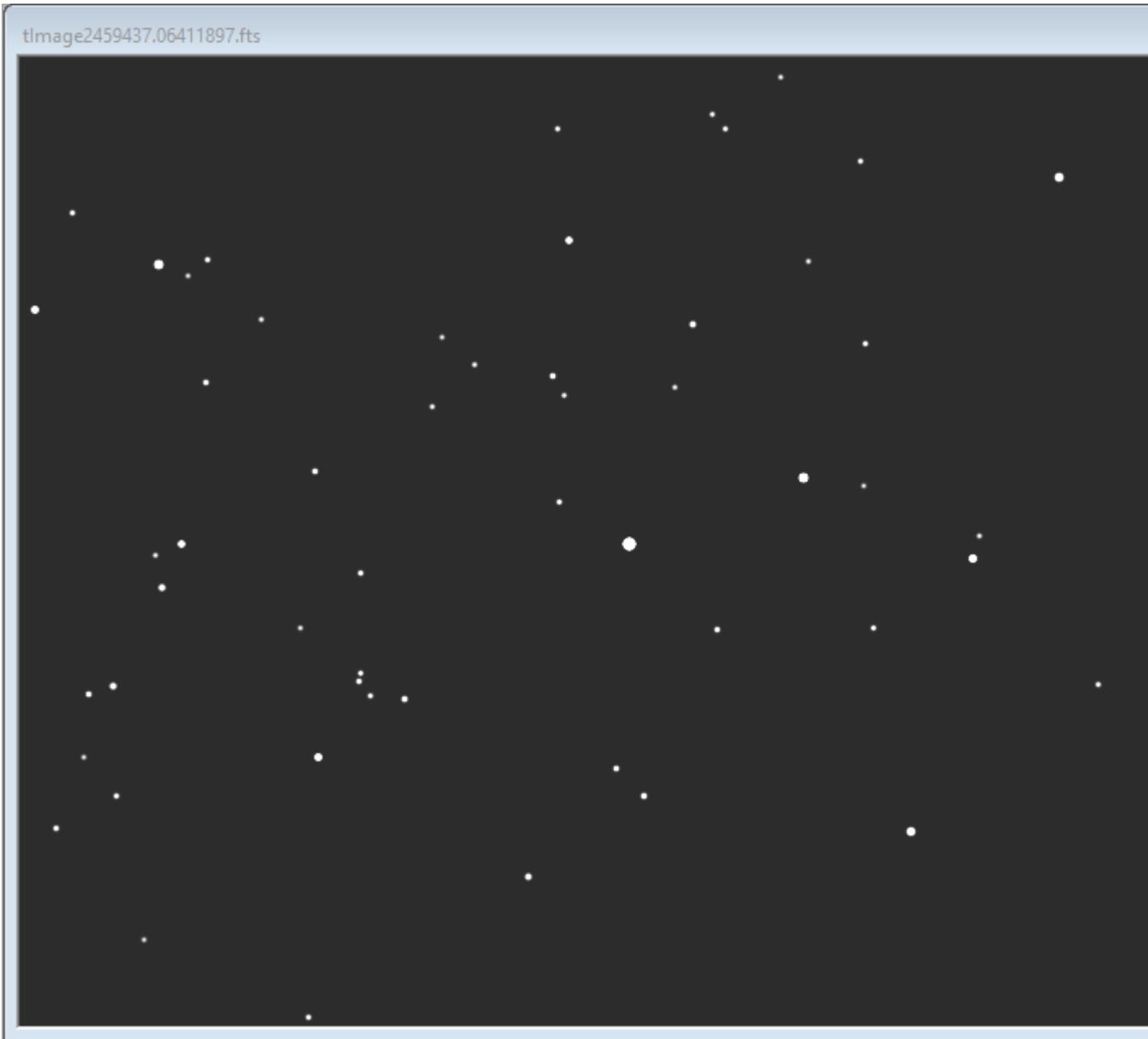
Identified single star near the center of the field will be used for Single-Star autofocus.

Multi-Star:

The Multi-Star focus process introduced in FocusMax V5 to provide additional autofocus options to the astronomer. Multi-Star is designed to allow you to autofocus the instrument

on the current imaging field so that the telescope does not require slewing away to a target star. There is an option in Preferences/Autofocus to enable AcquireStar if there are no suitable stars in the current imaging field which will enable AcquireStar to slew the telescope to a new field which contains at least one star in the user defined magnitude range for autofocus.

1. An image is taken and the brightest stars (50 default) are identified in the image
2. The exposure is set based using the star with Total Flux closest to the user defined 'Target Flux' setting. Stars that are too bright will be ignored.
3. The focuser will move in or out (depending on the user setting), an image is taken and the identified stars are measured across the field to determine if the focuser is on the correct side of the 'V'. If the focuser is not on the correct side, then a move is made to bring the focuser to the other side of the focus 'V'.
4. The focuser will move beyond the user defined 'Near Focus' position, stop then perform a reverse move (to eliminate potential backlash) to the estimated 'Near Focus' position.
5. FocusMax will begin taking images and measuring the identified stars across the field, the number of images will depend on the user settings. The focuser will move to the other side of the 'V' if the 'Advanced' method is selected in Preferences.
6. The focuser is then moved to the focus position and additional images taken to determine focus quality depending on the user settings.



Initial 5 sec exposure



Identified stars that may be used for Multi-Star autofocus.

Support

Support

There has been a significant increase in the number of focusers, cameras, telescopes and mounts, since FocusMax was first released in 2001.

It is recommended that you visit the CCDWare support forum at <https://www.ccdware.com>

Soft Buttons

Side Buttons

The rectangular 'soft' buttons on the left side of FocusMax will allow you to open the main windows in FocusMax:

[Focus](#)

[System](#)

[Telescope](#)

[Log](#)

[Jog](#)

[Profile](#)

[Focus Plot](#)

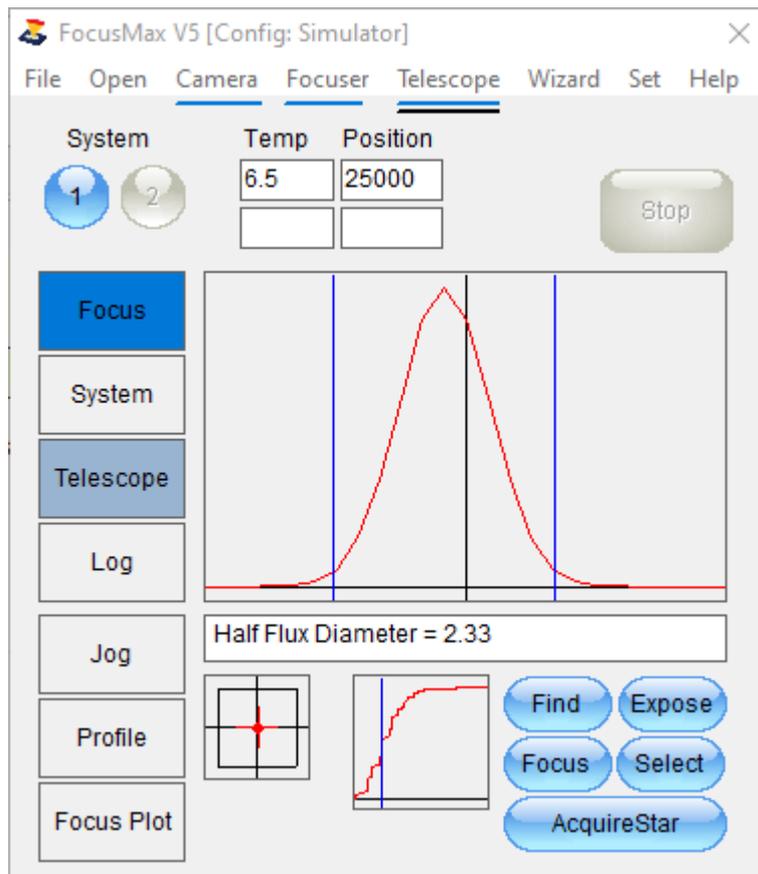
Focus Window

Focus Window

The Focus Window is the primary window that allows you to select the method for autofocus and monitor the auto focus operation with a display of the target star Half Flux Diameter (HFD).

Hardware connection status lines:

- The blue lines beneath the Camera, Focuser and Telescope indicate that the respective hardware is connected.
- The black line beneath the telescope menu indicates that the telescope is tracking



System buttons

The colored buttons in the upper left are used to manually toggle between the two configured systems. If only one system is configured, then the second system button will not be enabled. Pressing the enabled System 1 or 2 will connect all of the hardware defined in Preferences/Setup.

Find button

Pressing the 'Find' button will:

- Expose a frame
- Find the brightest star
- Subframe the star using the focus binning defined on Preferences
- Adjust the starting base exposure up or down to meet the 'Target Flux' setting in Preferences for the filter in use.

Expose button

Pressing the 'Expose' button will start single exposure subframe image using the focus binning defined in Preferences. This button is normally used following Find (star) operation.

Focus button

Single-Star Focus

Initiates the auto focus operation centered on the brightest star or selected star on the chip

- Take a binned image using settings defined in Preferences / Autofocus by filter
- Identify the brightest star
- Measure the HFD (Half Flux Diameter) and calculate total star flux
- Subframe the star using the focus binning (Preferences)
- Adjust the exposure up or down starting at the 'Base exposure' to bring the star total flux is close to the Target Flux value (Preferences)
- Make a move to verify that the focuser on the correct side of the Vcurve
- Move the focuser to the Near Focus HFD setting (Preferences)
- Take multiple images and measure the target star HFD
- Calculate the focus position
- Move the focuser to the focus position
- Take additional images to verify focus quality

Multi-Star Focus

Initiates the auto focus operation using many stars in the image which will allow you to focus on-field and does not require slewing away to center a single star.

- Take a binned image as defined in Preferences / Autofocus by filter
- Automatically find the brightest stars (default 50)
- Measure the HFD (Half Flux Diameter) and calculate total star flux for each star
- Identifies the star closest to the user defined total flux value and adjust the exposure up or down (starting at the 'Base exposure') to bring the star total flux close to the user defined 'Target Flux' value (Preferences). If none of the stars allow exposures between the min and max exposure times, then the autofocus run will fail unless 'Run AcquireStar on fail' is enabled in Preferences/Autofocus. If enabled AcquireStar will identify a suitable star field, slew the telescope, autofocus and perform a return slew (if desired).
- Make a move to verify that the focuser on the correct side of the Vcurve
- Move the focuser to the Near Focus HFD setting (Preferences)
- Take multiple images and measure the target star HFD
- Calculate the focus position
- Move the focuser to the focus position
- Take additional images to verify focus quality

Select button

Pressing Select allows the user to select a specific star in the field for auto focus (MaxIm only) which is useful in crowded star fields or if you do not want to leave the current field.

- Initiate taking a full frame image
- You to click on a target star
- FocusMax initiates the autofocus routine.

This feature is only available if the Single-Star autofocus process is selected in Preferences.

AcquireStar button

Selects a star from a star catalog, slews the telescope, performs the autofocus routine then performs a return slew. This requires TheSky Image Link with camera-add-on or the full version of PinPoint to be installed.

See [AcquireStar](#) for more.

Stop button

Can be clicked at any time during an active operation to terminate an operation.

Position & Temperature

The focuser position is displayed near the top of the Focus Tab Window along with the temperature if the focuser has temperature-sensing capability. If you are using a relative focuser then double clicking the Position window will zero the Position value.

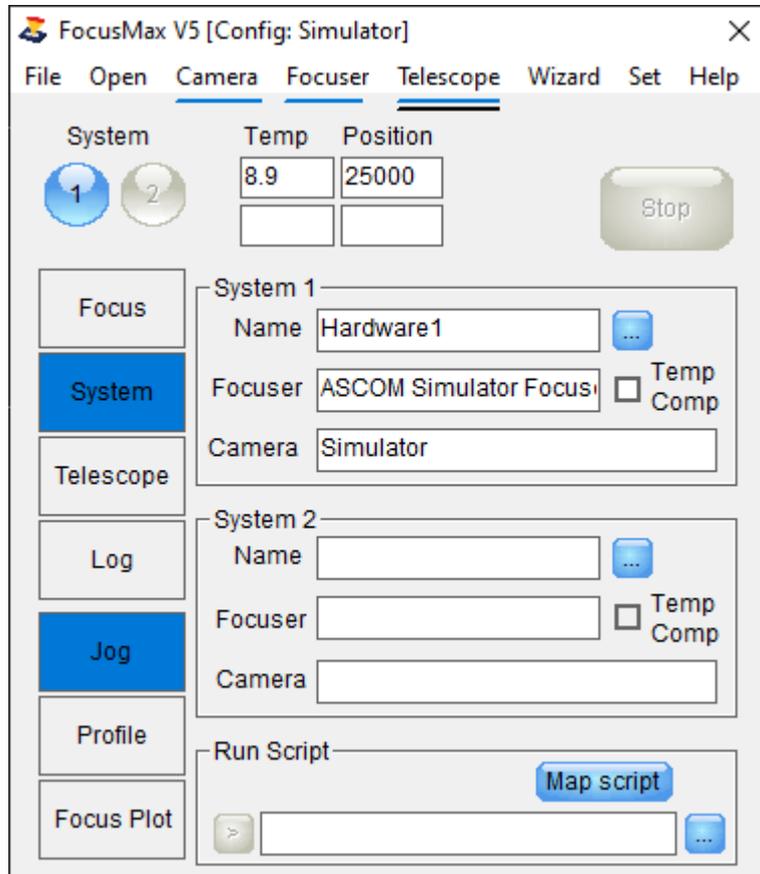
FocusMax graphical display boxes

- 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 black vertical line represents is the center of the star.
- 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.

System Window

System Window

The System window shows the camera and focuser hardware that is specified in [Preferences](#)



System 1 & System 2 boxes

FocusMax has the ability to control 2 cameras and 2 focusers.

- The information displayed in each System box shows the current assigned focuser, camera and system file for each configuration.
- Pressing the small button to the right of the System name box will allow you to select and load a new system configuration.
- Open [Preferences / Setup](#) window to assign the camera(s) and focuser(s)
- If the focuser is capable of temperature compensation then the Temp Comp check box will be enabled

See [Getting Started](#) for details on selecting and creating unique Configuration directories.

Run Script

Custom scripts may be created, loaded and run from FocusMax. Sample scripts are found in C:\Users\XXX\Documents\FocusMax V5\Scripts, you may want to copy any or all of the scripts from this directory to your working Configurations directory C:\Users\XXX\Documents\FocusMax V5\Configurations\XXXX\Scripts.

- Press the small colored button with three dots to the right of the Run Script box to open a script.

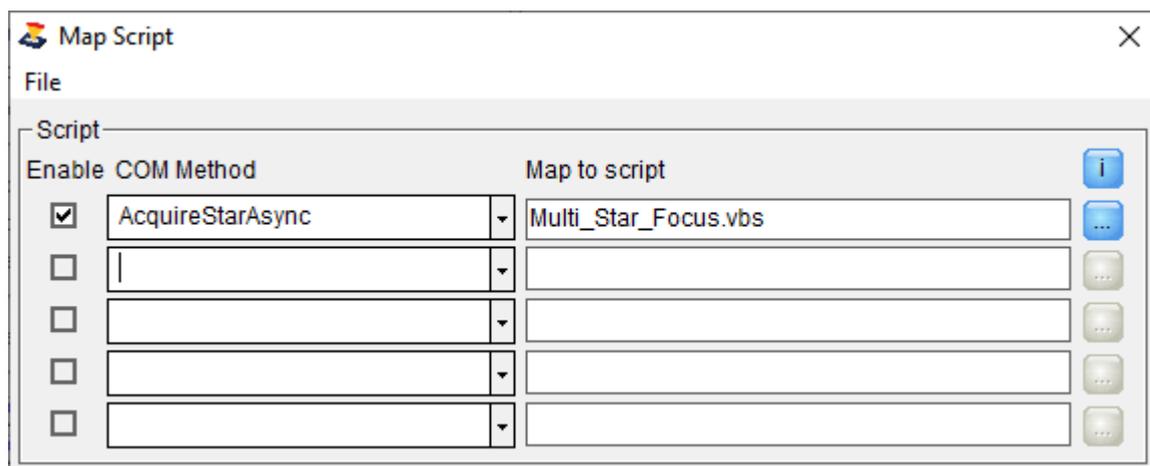
- Press the small button with '>' to run the script

Map Script

Pressing the Map script button will open a window that will allow you to 'map' a custom script to a FocusMax COM method such as:

- ExposeAsync
- FindAsync
- FocusAsync
- FocusAtStarCenterAsync
- AcquireStarAsync
- Multi-Star Focus

This will allow the user to substitute a custom script when a host application such as CCDAP, ACP, etc. calls one of the above COM methods, the custom script will be loaded and executed. Several custom scripts can be found in the script directory which may be mapped. In the example below, the script Multi_Star_Focus script is mapped to AcquireStarAsync - when AcquireStarAsync is called by the host application then Multi-Star Focus routine is initiated and the host application will wait until the operation is finished.



Example:

You have two telescopes, focusers and cameras on one mount which are setup in System #1 and #2. You would like to focus both instruments under automation via a host application. You have setup all of the parameters for each filter in AcquireStar for System #1 and #2.

Map the custom script "AcquireStar_Two_Focusers.vbs" to the AcquireStar COM method in the Map Script window. When the host application initiates AcquireStarAsync, then the custom script is loaded and proceeds to focus both instruments using the defined AcquireStar star magnitudes for the filter in use.

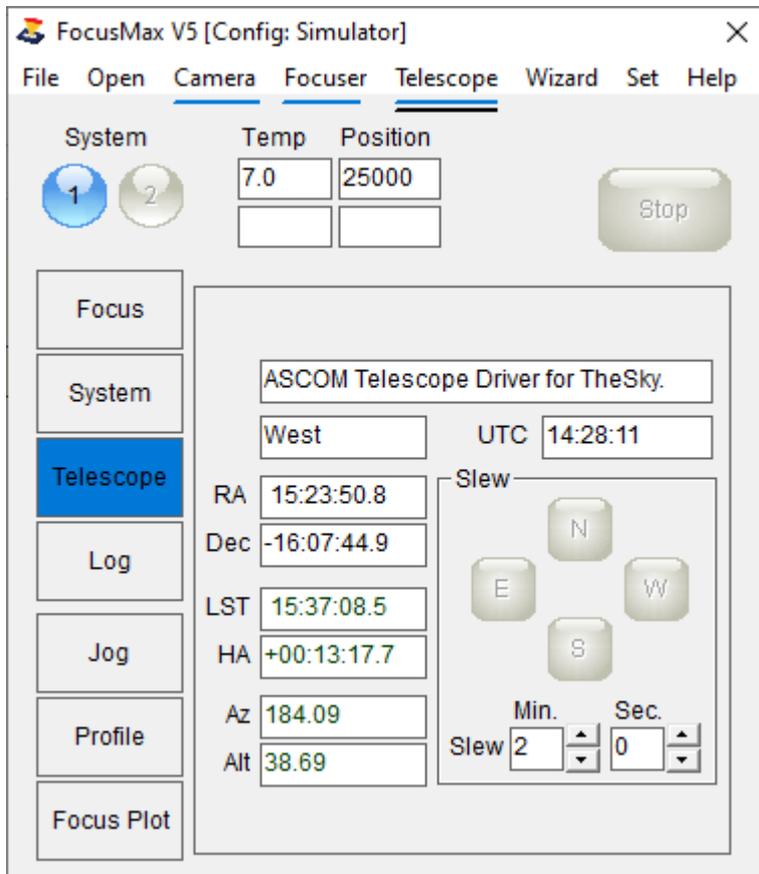
Telescope Window

Telescope Window

Telescope control is an integral part FocusMax which provides advanced capabilities such as Slewing, running AcquireStar, etc.

The Telescope window provides information on current telescope:

- Right Ascension (RA)
- Declination (Dec)
- Local Sidereal Time (LST)
- Hour Angle E (-) and W (+) of the meridian.
- Azimuth (Az)
- Altitude (Alt)



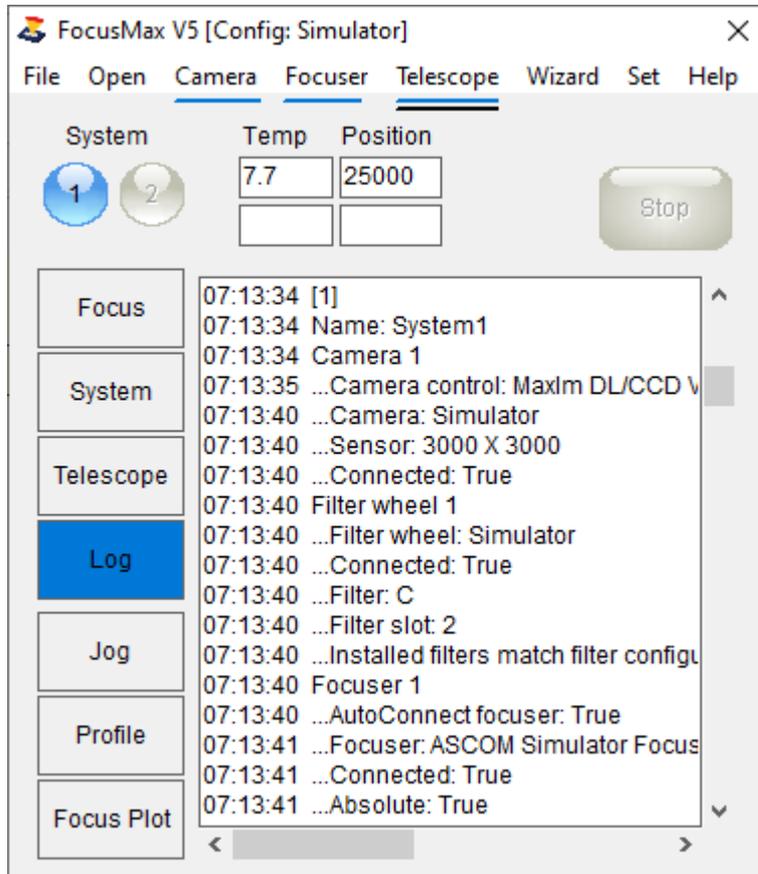
Slew buttons

N, S, E, W slew buttons will allow you to slew the telescope a specified slew distance in minutes and secs.

Log Window

Log Window

Pressing the Log command button opens the Log window which displays a record of the FocusMax activities.



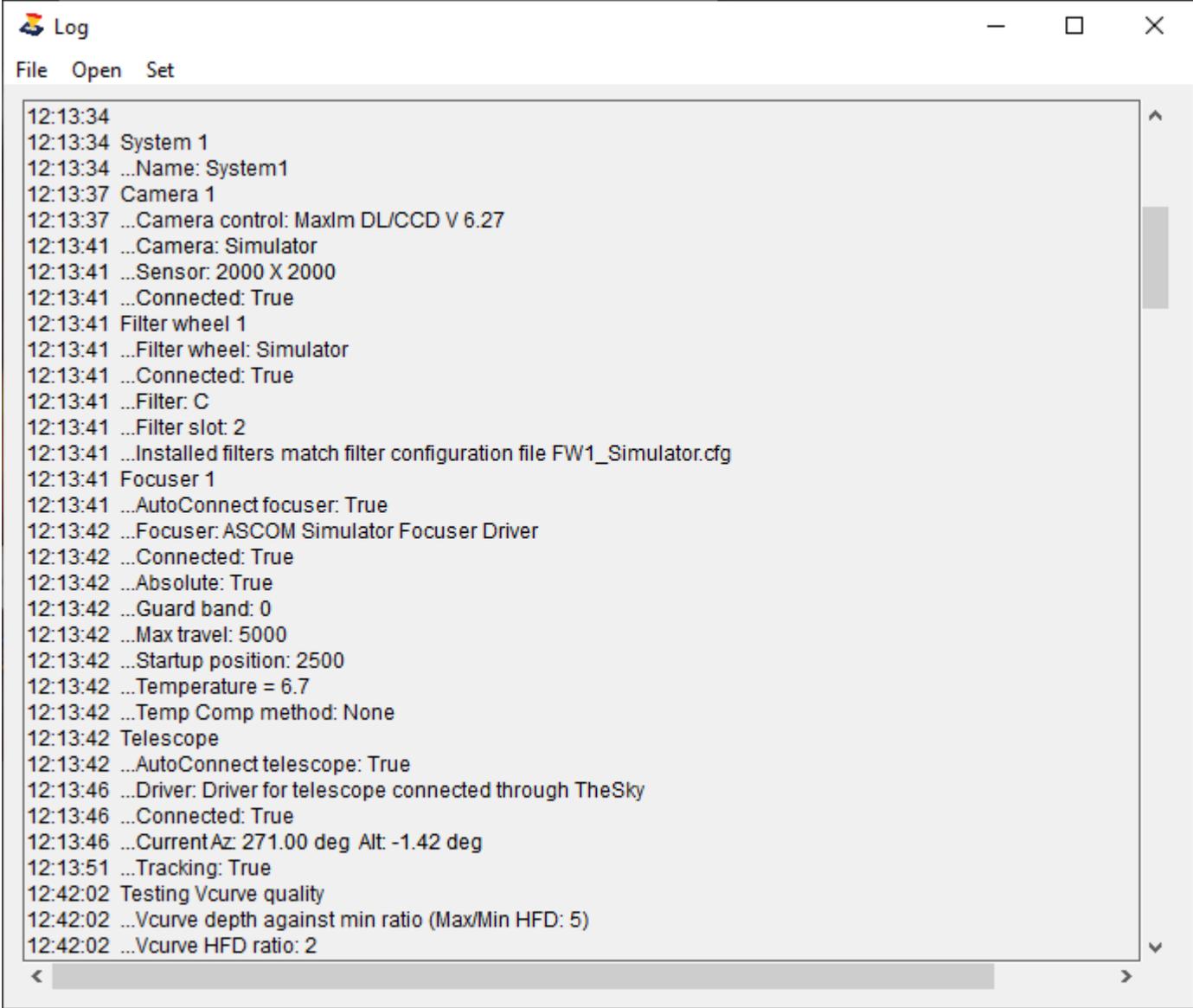
The Log is an excellent way to follow the details of the auto focus operations.

On the left of each line is a time stamp that uses the time set on your computer clock, UTC may be selected in Preferences/General.

Every time you start FocusMax, a new Log file is created in the Log directory with a unique file name. This file name has a date and time stamp that corresponds to the computer time when FocusMax was started.

The saved Log files are especially useful for tracking down focusing problems. If you request technical support, it is very helpful if you attach the Log files of the observing session where you encountered the problem.

Double clicking in the Log region will open a free standing Log which can be sized and placed on the screen by the user.



The screenshot shows a 'Log' window with a menu bar containing 'File', 'Open', and 'Set'. The log text is as follows:

```
12:13:34
12:13:34 System 1
12:13:34 ...Name: System1
12:13:37 Camera 1
12:13:37 ...Camera control: MaxIm DL/CCD V 6.27
12:13:41 ...Camera: Simulator
12:13:41 ...Sensor: 2000 X 2000
12:13:41 ...Connected: True
12:13:41 Filter wheel 1
12:13:41 ...Filter wheel: Simulator
12:13:41 ...Connected: True
12:13:41 ...Filter: C
12:13:41 ...Filter slot: 2
12:13:41 ...Installed filters match filter configuration file FW1_Simulator.cfg
12:13:41 Focuser 1
12:13:41 ...AutoConnect focuser: True
12:13:42 ...Focuser: ASCOM Simulator Focuser Driver
12:13:42 ...Connected: True
12:13:42 ...Absolute: True
12:13:42 ...Guard band: 0
12:13:42 ...Max travel: 5000
12:13:42 ...Startup position: 2500
12:13:42 ...Temperature = 6.7
12:13:42 ...Temp Comp method: None
12:13:42 Telescope
12:13:42 ...AutoConnect telescope: True
12:13:46 ...Driver: Driver for telescope connected through TheSky
12:13:46 ...Connected: True
12:13:46 ...CurrentAz: 271.00 deg Alt: -1.42 deg
12:13:51 ...Tracking: True
12:42:02 Testing Vcurve quality
12:42:02 ...Vcurve depth against min ratio (Max/Min HFD: 5)
12:42:02 ...Vcurve HFD ratio: 2
```

Jog

Jog

Press the Jog button which will open a dialog box that:

- displays the current focuser position
- allows you to move the focuser in or out X number steps
- allows you to set a position for the focuser to move to



Profile

Profile Window

The Profile Window contains the results of the Vcurve runs that characterize your system. These parameters are the heart of the FocusMax algorithm and are unique for each system configuration.

If you change a camera, focuser, add a device such as filter wheel, then a new Profile should be created with a unique name so that the system parameters may be saved and loaded when you wish to focus the telescope.

System Profile

File

System System1	Steps/HFD 5.0452	Position Intercept Difference 3.57	Total Points 8	Sigma limit 2.5
Slope 0.198276	Std Dev. 0.00383	3.29480		

Graph PID + Slope

	Use	Date	Time	PID	Slope	Steps / HFD	Fit	Commer
1	Y	2021-08-10	13:07:57	3.36	0.198411	5.0400	16.13692 3.20175 2500.03435 0.16915 0.30924	Binning=
2	Y	2021-07-30	11:48:33	1.93	0.200211	4.9947	16.93073 3.38971 2500.31028 0.05299 0.27684	Binning=
3	Y	2021-07-29	12:57:13	11.34	0.188937	5.2928	12.55093 2.37134 2499.34923 0.92203 0.26654	Binning=
4	N	2021-07-25	15:27:40	-1.41	0.202954	4.9272	19.95721 4.05039 2500.93102 -0.54357 0.85311	Binning=
5	N	2021-07-25	15:11:34	-3.08	0.210496	4.7507	20.78625 4.37543 2499.45885 -0.76313 0.87047	Binning=
6	N	2021-06-14	12:50:17	0.76	0.195443	5.1166	21.40689 4.18382 2498.60966 -0.38007 0.65188	Binning=
7	N	2021-06-14	12:42:49	16.44	0.185406	5.3936	5.13814 0.95264 2499.15425 1.49933 0.58408	Binning=
8	Y	2021-06-04	11:28:11	1.52	0.200307	4.9923	15.14862 3.03437 2500.7348 0.03612 0.85833	Binning=
9	N	2021-06-04	11:16:54	6.81	0.196887	5.0791	11.65434 2.29459 2500.46486 0.60252 0.92466	Binning=
10	N	2021-06-04	11:09:03	5.49	0.194201	5.1493	13.84228 2.68818 2500.05911 0.43877 0.75241	Binning=
11	Y	2021-06-04	10:45:03	3.42	0.199051	5.0238	13.6731 2.72165 2500.89846 0.24647 0.8486	Binning=
12	N	2021-06-04	10:38:21	5.95	0.197282	5.0689	14.16422 2.79434 2499.24258 0.48685 0.83534	Binning=
13	Y	2021-06-04	10:27:27	3.98	0.199294	5.0177	19.69805 3.92571 2499.77547 0.20219 0.79486	Binning=
14	N	2021-06-04	10:19:31	-3.06	0.204397	4.8924	23.24795 4.75182 2500.35648 -0.59058 0.90134	Binning=
15	Y	2021-03-27	12:55:51	1.47	0.2	5.0000	17.50705 3.50141 2500 0 0	Binning=
16	Y	2021-03-27	12:00:55	1.55	0.2	5.0000	17.50704 3.50141 2500 0 0	Binning=

Graph

Optimize

Delete

The header section

Shows the summary information of the detailed data saved in the bottom section.

- Number of Steps / HFD (1/slope)
- Slope defined as the slope of the best-fit line for the Vcurve
- Position Intercept Difference is defined as the number of focuser steps measured between the left and the right tangent lines where they intercept the horizontal axis (the axis where HFD = 0)
- Total Points are the number of data points used to calculate the average slope and PID

The lower grid section

- The first Column can be clicked to highlight a single row or a series of rows that may then be deleted when the Delete Records button is clicked.
- The 'Use' column can be toggled from Yes to No, or No to Yes by clicking on the cell. This will automatically include or exclude data which will update the Profile results shown in the upper part of the window.
- The 'Date' and 'Time' when the [Vcurve](#) was saved to the System Profile. The rows are sorted with more recent data toward the top.

- Position Intercept Difference defined above.
- 'Slope' of the [Vcurve](#) tangent line.
- Parameters of the Vcurve 'Fit' model
- 'Comments' contains information which is useful for identifying rows to exclude.
- 'File Name' of each Vcurve

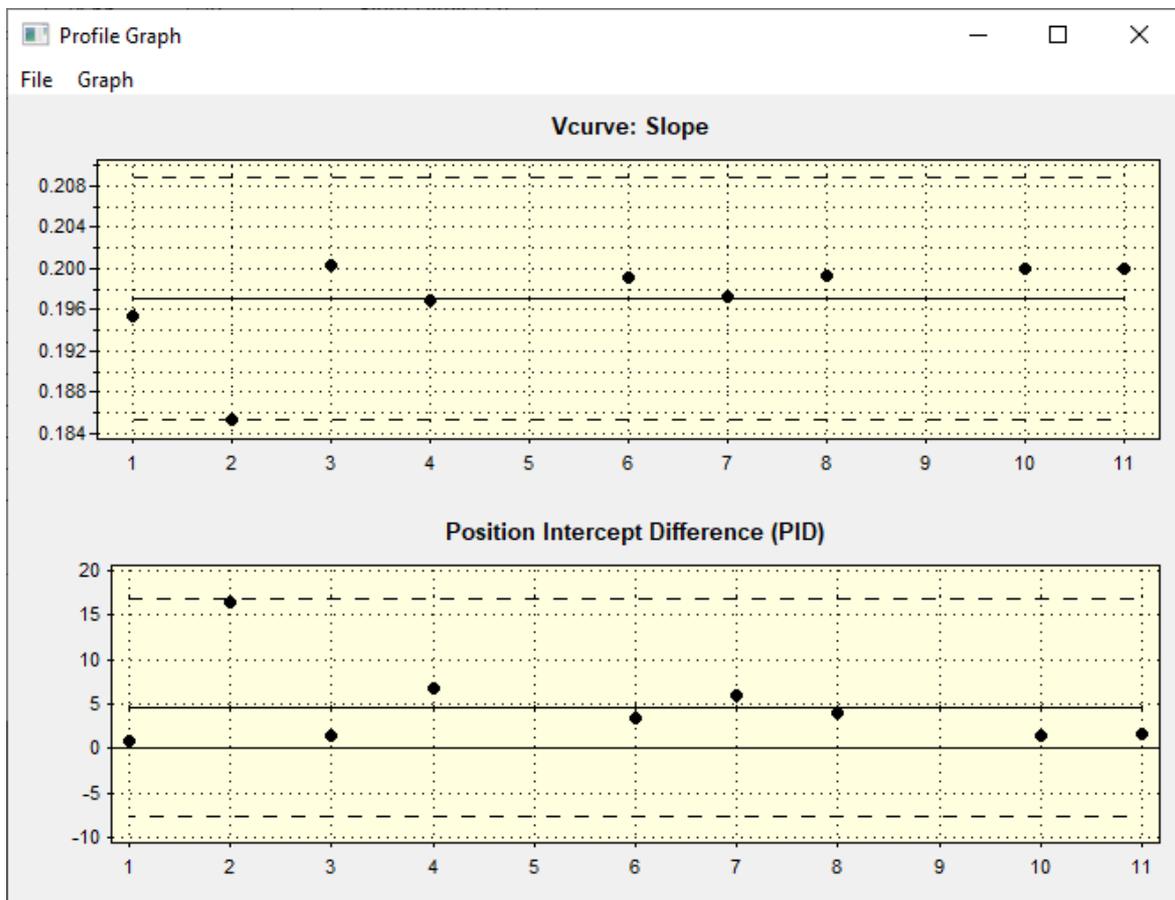
The information is easily edited by double clicking on the desired cell and entering the new information in the pop-up box. The update will be saved to the [System ini Files](#) when the System Profile window is closed. You can increase or decrease the size of the lower section by simply dragging the lower edge of the System Profile window. All changes made in the grid are immediately averaged and reflected to the upper section data.

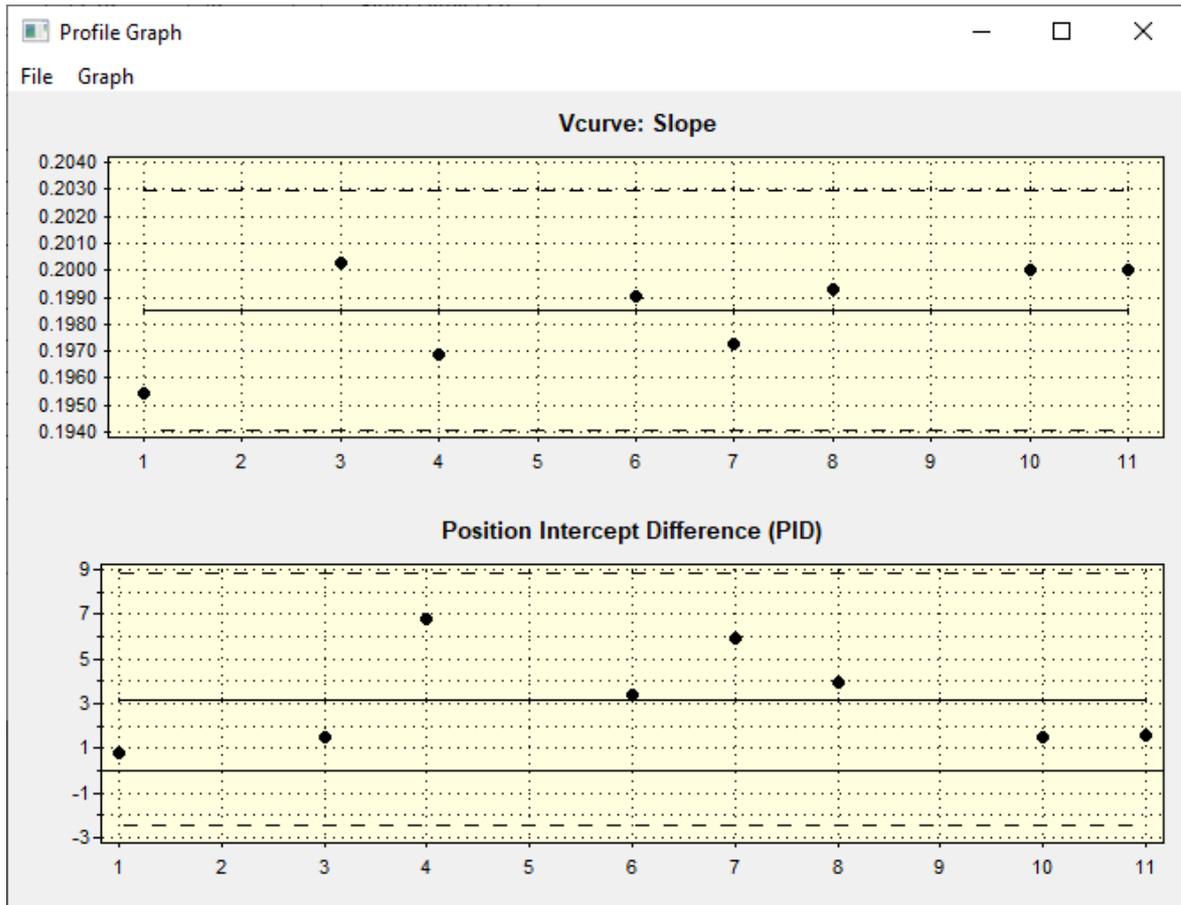
Graph

You can select and display the Vcurve data in a graph which show:

- The Sigma Limits setting in the Profile Window will allow you to identify Vcurve data that are suspect.
- Note - in the picture below that reading number 4 is at or slightly beyond the dashed Sigma Limit lines and can be considered a suspect data point. This can easily be excluded from the analysis by double clicking the 'Y' on data point #4 in the data grid which will toggle the 'Y' to 'N' and automatically update the graph.

These three characterization parameters are automatically saved to the active System and will be used by FocusMax during an autofocus run.





Optimize button:

If there are 6 or more data points in the Profile, then you may press the 'Optimize' button which will scan the Slope and PID data and identify data entries that may be suspicious which will be flagged with yellow highlight. You will note that the 'Use' column changed the 'Y' to 'N' to exclude the data row. You have the option to discard the results or save.

System Profile

File

System System1	Steps/HFD <input style="width: 80%;" type="text" value="5.0048"/>	Position Intercept Difference <input style="width: 80%;" type="text" value="2.31"/>	Total Points <input style="width: 80%;" type="text" value="6"/>	Sigma limit <input style="width: 80%;" type="text" value="2.5"/>
	Slope <input style="width: 80%;" type="text" value="0.199811"/>	1.10206		Graph <input style="width: 80%;" type="text" value="PID + Slope"/>
	Std Dev. <input style="width: 80%;" type="text" value="0.00051"/>			

	Use	Date	Time	PID	Slope	Steps /HFD	Fit	Comm
1	Y	2021-07-30	11:48:33	1.93	0.200211	4.9947	16.93073 3.38971 2500.31028 0.05299 0.27684	Binnin
2	N	2021-07-29	12:57:13	11.34	0.188937	5.2928	12.55093 2.37134 2499.34923 0.92203 0.26654	Binnin
3	N	2021-07-25	15:27:40	-1.41	0.202954	4.9272	19.95721 4.05039 2500.93102 -0.54357 0.85311	Binnin
4	N	2021-07-25	15:11:34	-3.08	0.210496	4.7507	20.78625 4.37543 2499.45885 -0.76313 0.87047	Binnin
5	N	2021-06-14	12:50:17	0.76	0.195443	5.1166	21.40689 4.18382 2498.60966 -0.38007 0.65188	Binnin
6	N	2021-06-14	12:42:49	16.44	0.185406	5.3936	5.13814 0.95264 2499.15425 1.49933 0.58408	Binnin
7	Y	2021-06-04	11:28:11	1.52	0.200307	4.9923	15.14862 3.03437 2500.7348 0.03612 0.85833	Binnin
8	N	2021-06-04	11:16:54	6.81	0.196887	5.0791	11.65434 2.29459 2500.46486 0.60252 0.92466	Binnin
9	N	2021-06-04	11:09:03	5.49	0.194201	5.1493	13.84228 2.68818 2500.05911 0.43877 0.75241	Binnin
10	Y	2021-06-04	10:45:03	3.42	0.199051	5.0238	13.6731 2.72165 2500.89846 0.24647 0.8486	Binnin
11	N	2021-06-04	10:38:21	5.95	0.197282	5.0689	14.16422 2.79434 2499.24258 0.48685 0.83534	Binnin
12	Y	2021-06-04	10:27:27	3.98	0.199294	5.0177	19.69805 3.92571 2499.77547 0.20219 0.79486	Binnin
13	N	2021-06-04	10:19:31	-3.06	0.204397	4.8924	23.24795 4.75182 2500.35648 -0.59058 0.90134	Binnin
14	Y	2021-03-27	12:55:51	1.47	0.2	5.0000	17.50705 3.50141 2500 0 0	Binnin
15	Y	2021-03-27	12:00:55	1.55	0.2	5.0000	17.50704 3.50141 2500 0 0	Binnin

Graph	
Optimize	
Delete	

Delete Button:

To delete Vcurve data, click the far left row number which will highlight the row(s) to delete then press the Delete button.

System Profile

File

System System1	Steps/HFD <input style="width: 80%;" type="text" value="5.0373"/>	Position Intercept Difference <input style="width: 80%;" type="text" value="3.18"/>	Total Points <input style="width: 80%;" type="text" value="8"/>	Sigma limit <input style="width: 80%;" type="text" value="2.5"/>
	Slope <input style="width: 80%;" type="text" value="0.198533"/>	2.25959		Graph <input style="width: 80%;" type="text" value="PID + Slope"/>
	Std Dev. <input style="width: 80%;" type="text" value="0.00178"/>			

	Use	Date	Time	PID	Slope	Steps /HFD	Fit	Comments
1	Y	2021-06-14	12:50:17	0.76	0.195443	5.1166	21.40689 4.18382 2498.60966 -0.38007 0.65188	Binning=1, Total pts
2	N	2021-06-14	12:42:49	16.44	0.185406	5.3936	5.13814 0.95264 2499.15425 1.49933 0.58408	Binning=1, Total pts
3	Y	2021-06-04	11:28:11	1.52	0.200307	4.9923	15.14862 3.03437 2500.7348 0.03612 0.85833	Binning=1, Total pts
4	Y	2021-06-04	11:16:54	6.81	0.196887	5.0791	11.65434 2.29459 2500.46486 0.60252 0.92466	Binning=1, Total pts
5	N	2021-06-04	11:09:03	5.49	0.194201	5.1493	13.84228 2.68818 2500.05911 0.43877 0.75241	Binning=1, Total pts
6	Y	2021-06-04	10:45:03	3.42	0.199051	5.0238	13.6731 2.72165 2500.89846 0.24647 0.8486	Binning=1, Total pts
7	Y	2021-06-04	10:38:21	5.95	0.197282	5.0689	14.16422 2.79434 2499.24258 0.48685 0.83534	Binning=1, Total pts
8	Y	2021-06-04	10:27:27	3.98	0.199294	5.0177	19.69805 3.92571 2499.77547 0.20219 0.79486	Binning=1, Total pts
9	N	2021-06-04	10:19:31	-3.06	0.204397	4.8924	23.24795 4.75182 2500.35648 -0.59058 0.90134	Binning=1, Total pts
10	Y	2021-03-27	12:55:51	1.47	0.2	5.0000	17.50705 3.50141 2500 0 0	Binning=1, Total pts
11	Y	2021-03-27	12:00:55	1.55	0.2	5.0000	17.50704 3.50141 2500 0 0	Binning=1, Total pts

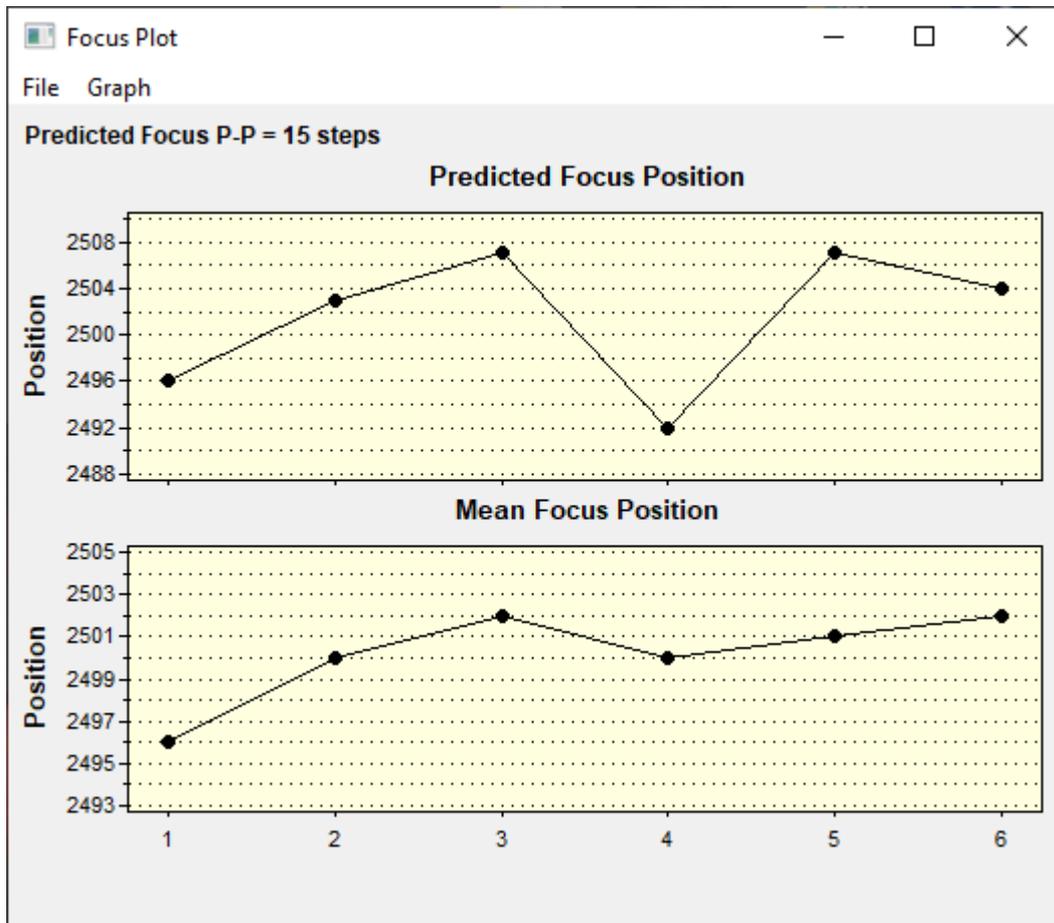
Graph
Optimize
Delete

Focus Plot

Focus Plot Window

The Focus Plot shows the focus position readings during the autofocus run.

- The top graph shows the Predicted Focus Position for each frame image taken during the autofocus run. This is a single position estimate for each subframe and is useful for displaying variation due to seeing conditions.
- Predicted Focus P-P is the peak-to-peak variation seen in the graph and is useful for displaying variation due to seeing conditions.
- The bottom graph shows the Calculated Focus Position progress. If the Focus Convergence feature is enabled in [Preferences](#), then the plot will show how the focus position is converging to meet the user defined setting.



Menu Items

Menu

The following describes each of the menu items found on the FocusMax window

[File](#)

[Open](#)

[Camera](#)

[Focuser](#)

[Telescope](#)

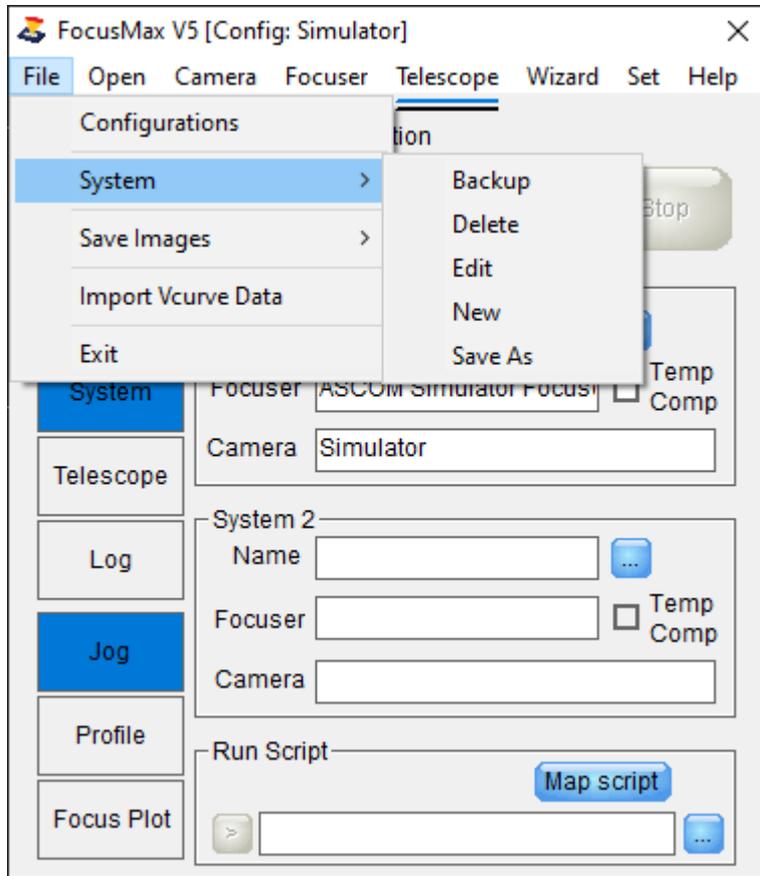
[Wizard](#)

[Set](#)

[Help](#)

File

Menu File



Configurations

Configurations

Opening the Configurations Window will allow you to :

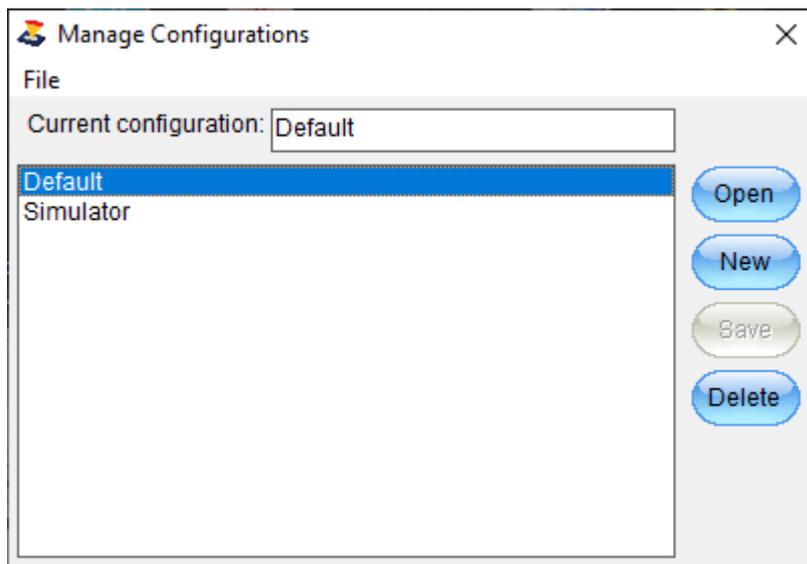
- 'Open' a predefined FocusMax Configuration
- Create a 'New' Configuration based on the current active Configuration. Enter the new name in the text box and press Save to create or press Esc key to exit. You will have the option to:
 - Copy all of the existing files of the current active Configuration to the new if the camera and optics of the new Configuration are identical
 - Create blank files which will require running new Vcurves
 - Cancel the operation
- 'Delete' the selected configuration

You may use the Configurations Window to:

- Backup your settings to a folder
- Define settings for different projects such as deep sky imaging with narrow band filters vs L, R, G, B
- Setup configurations for different users. Note there is no password required to open a configuration

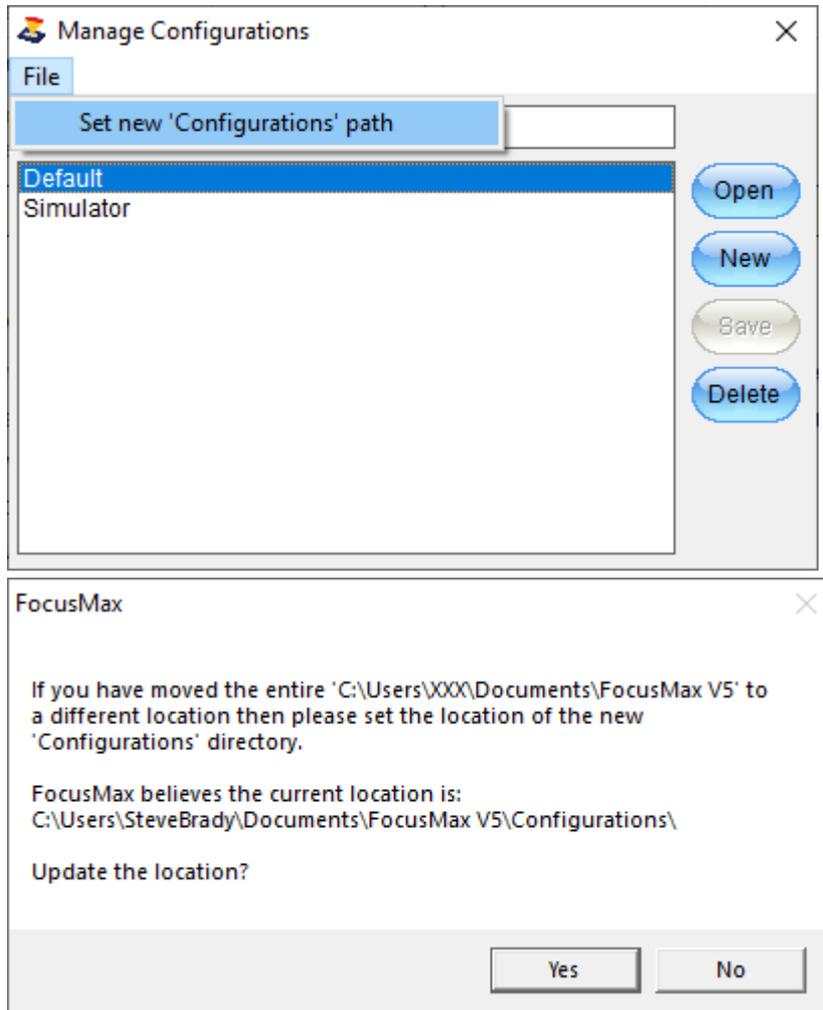
Once a Configuration is opened, any changes made to to your settings will be saved automatically and the last active configuration will be loaded automatically when FocusMax is re-opened.

- Selecting 'Default' will use the standard files located in "C:\Users\XXX\Documents\FocusMax V5\Configurations"
- New files will be written to directories 'C:\Users\XXX\Documents\FocusMax V5\Configurations\...'



If you decide to move the files from the default path 'C:\Users\XXX\Documents\FocusMax V5' to say 'D:\FocusMax V5' then you will need to set the 'Configurations' path so that FocusMax can find the data files.

Open 'Set new Configurations path' and review the message box instructions, navigate and select the 'Configurations' to reset the data files paths.

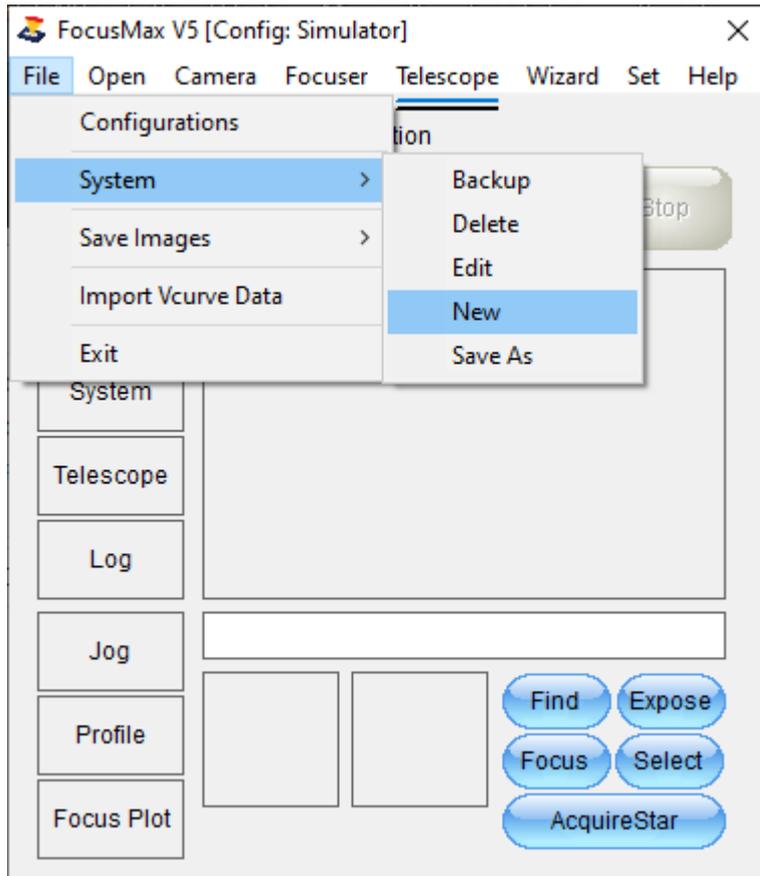


System

System

The System menu selection allows you to:

- 'Backup' - will create a backup file of the current System.ini with a .bak extension
- 'Delete' - will allow you to delete a saved System.ini file
- 'Edit' - will allow you to load a System.ini and edit the contents
- 'New' - will create a new default file with a name the you choose
- 'Save As' will save the current active System.ini to a different name

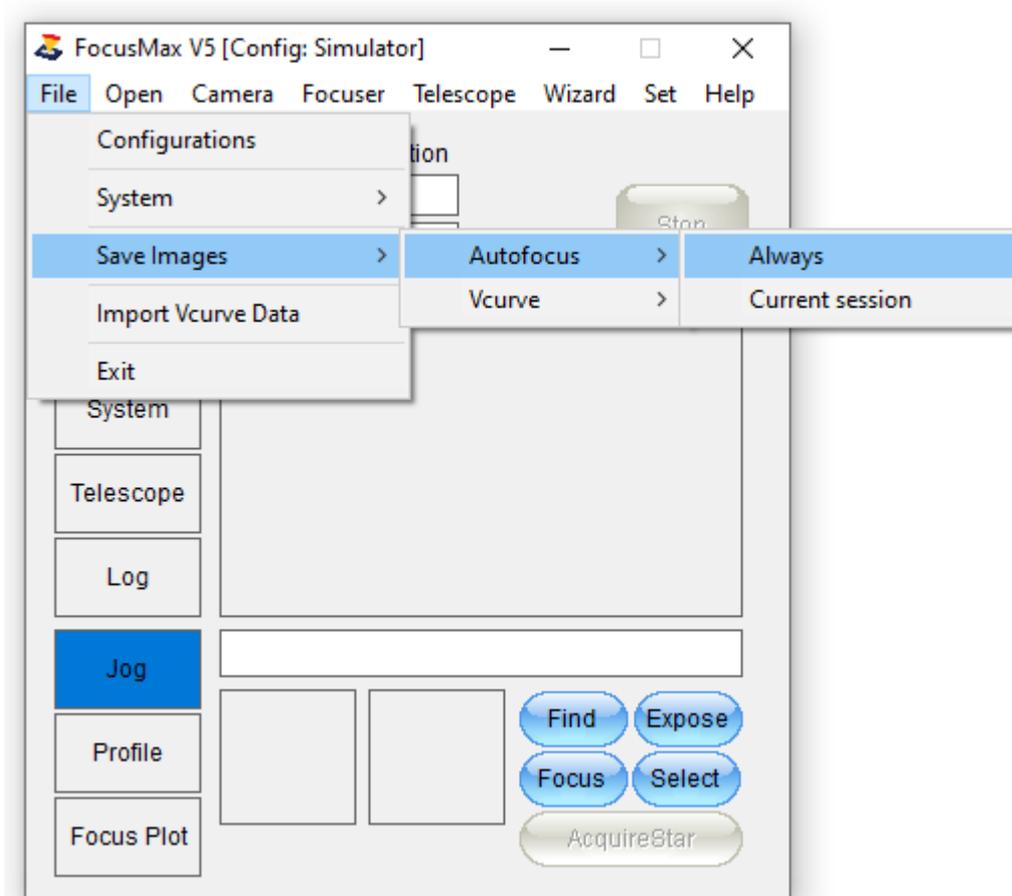


Save Images

Save Images

You may save images when the 'Focus', 'Find', 'Select' and 'AcquireStar' operations are initiated so that images will be available for off-line review and troubleshooting which is found in Menu/File/SaveImages/Autofocus. You may choose to 'Always' enable images to be saved or just the current session

The directory path that the images will be saved is defined in [Preferences / General](#)

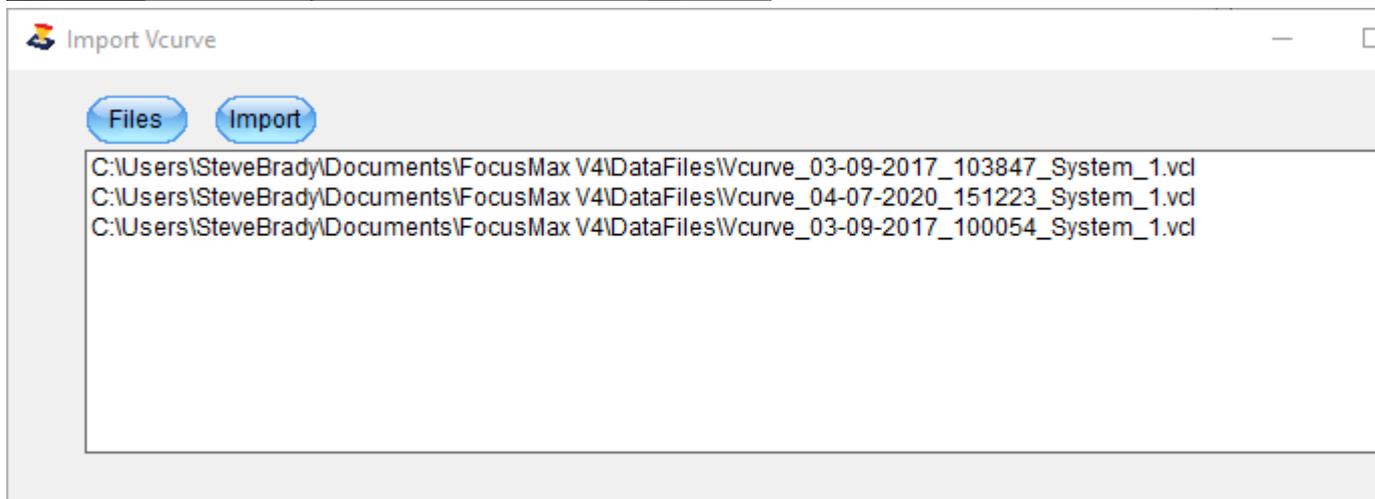
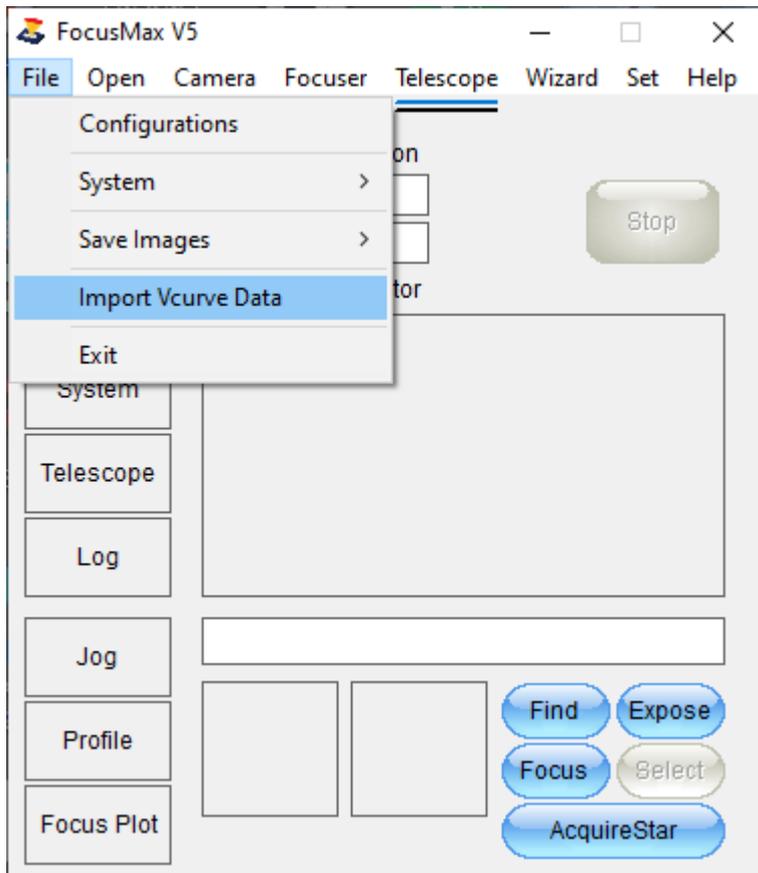


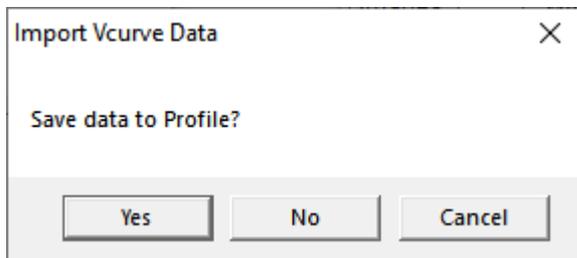
Import Vcurve data

Import Vcurve data

A new algorithm has been implemented to fit Vcurve data and determine Vcurve slope and Position Intercept. A tool has been provided that will allow you to import FocusMax V4 Vcurve data *.vcl files which are located in C:\Users\XXX\Documents\FocusMax V4\DataFiles. To import the data:

- Menu / File/Import Vcurve data
- Drag and drop each file to be imported into the 'Import Vcurve' Window.
- The data file will be read and analyzed by the Vcurve using the test algorithms when the 'Import' button is pressed:
 - If the data is accepted, you will be asked if you wish to save the data to Profile
 - If not, then the next file in the list will be analyzed





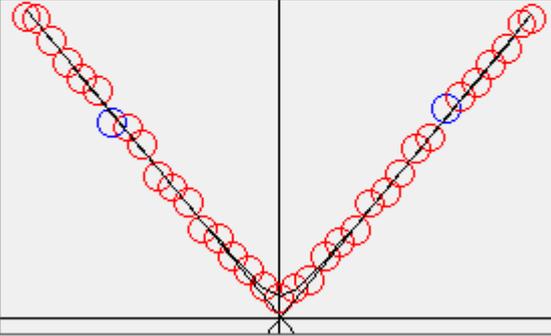
Vcurve Sequence ✕

File Open Set

Run Select

Vcurve

Est. HFD	42	
Autofocus: <input checked="" type="checkbox"/>	Initial	2310
	Center	2510
Repeat	0	
Final	2710	
Half Width	200	
Images / pos.	1	
Move Incr.	12	
Num Moves	33	

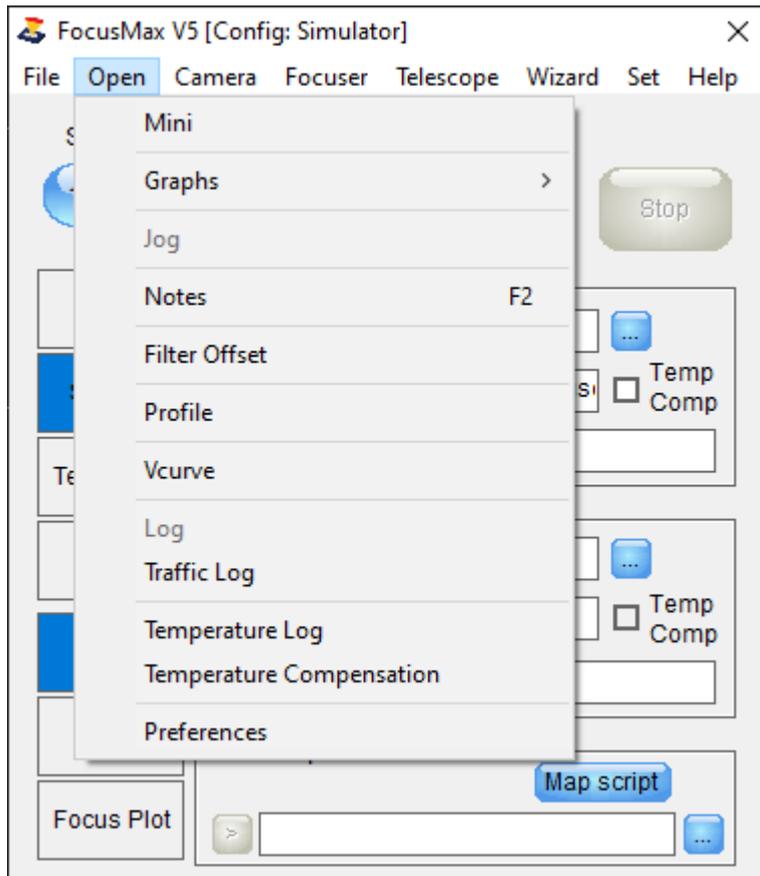


Fit

	Left	Right	
Slope	-0.198129	0.198129	Difference
Position	2503.40	2499.43	3.97

Open

Menu Open



[Mini](#)

[Graphs](#)

[Jog](#)

[Notes](#)

[Profile](#)

[Vcurve](#)

[Log](#)

[Temperature Log](#)

[Traffic Log](#)

[Temperature Compensation](#)

Mini

Mini

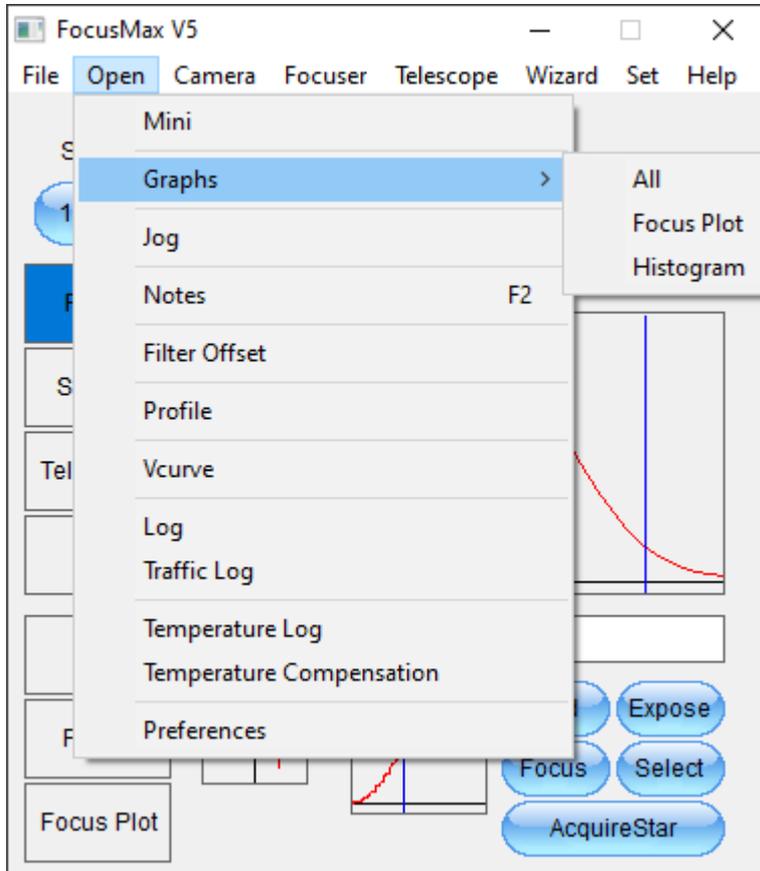
Selecting Mini Window closes the main FocusMax window and opens a window with a series of command buttons. This is useful to reduce desktop clutter.



Graphs

Graphs

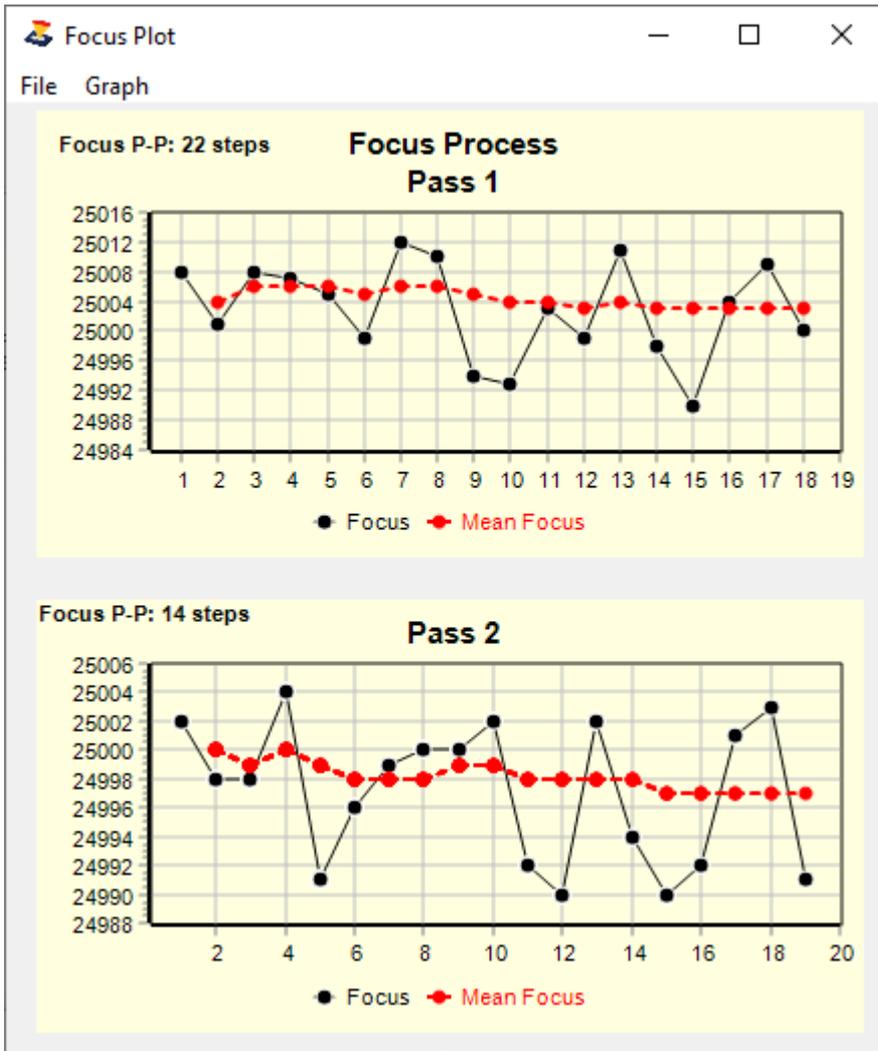
The Focus Plot shows the focus position readings during the autofocus run



Focus Plot

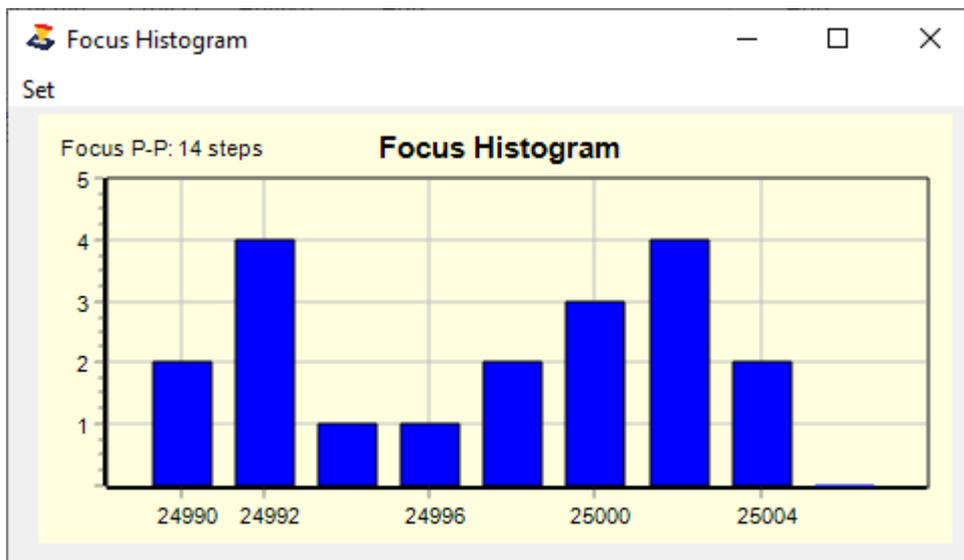
The Focus Plot shows the focus position readings during the autofocus run

- The black line in the graph shows the Predicted Focus Position for each sub-frame image taken during the autofocus run which is useful for displaying the variation due to seeing conditions. The Predicted Focus P-P is the peak-to-peak variation seen in the graph displays the variation due to seeing conditions.
- The red line in the graph shows the calculated Mean Focus Position. If the Focus Convergence feature is enabled in Preferences then the plot will show how the focus position is converging.



Histogram Plot

Shows the occurrences of number of predicted focus position and is useful as a measure of displaying seeing variation

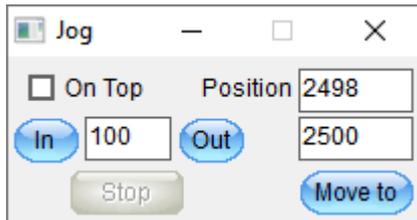


Jog

Jog

Press the Jog button which will open a dialog box that:

- displays the current focuser position
- allows you to move the focuser in or out X number steps
- allows you to set a position for the focuser to move to
- the focuser will not jog if requested to move beyond min or max focuser travel



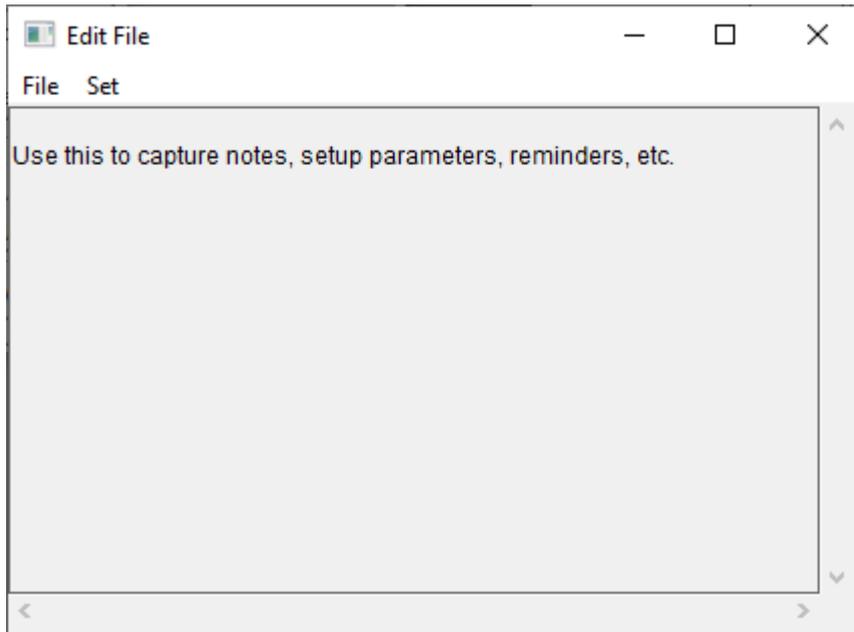
Notes

Notes

Notes window:

Allows you to enter information that will be saved in the files directory.

Examples might be setup tips, procedures, work-flow, information on various user settings, focuser driver settings, etc.



Profile

Profile

Profile Window:

Please see [Profile](#) for details.

Vcurve

Vcurve

You must characterize your system by creating Vcurves before you can perform an autofocus run with FocusMax. These parameters are unique to your system and you first need to measure them. It is HIGHLY RECOMMENDED that you run the First Light Wizard for the first Vcurve run and sets the parameters for additional runs.

Vcurve box:

1. 'Half Width'
 - 'Center' is the current focuser position
 - 'Half Width' defines the focuser move range in steps to move oneach side of center
2. 'Move Increment' is the number of focuser move steps that will be taken for each Vcurve position
3. 'Number of Moves' is the total number of moves that will be taken to generate the Vcurve
4. The 'Initial' and 'Final' focuser position is shown for reference
5. 'Images / Position' is the number of images that will be taken at each Vcurve focuser position which will be averaged. This will help smooth the Vcurve by reducing the influence of varying seeing conditions.
6. 'Autofocus' when enabled, FocusMax will perform a focus run when the Vcurve is completed

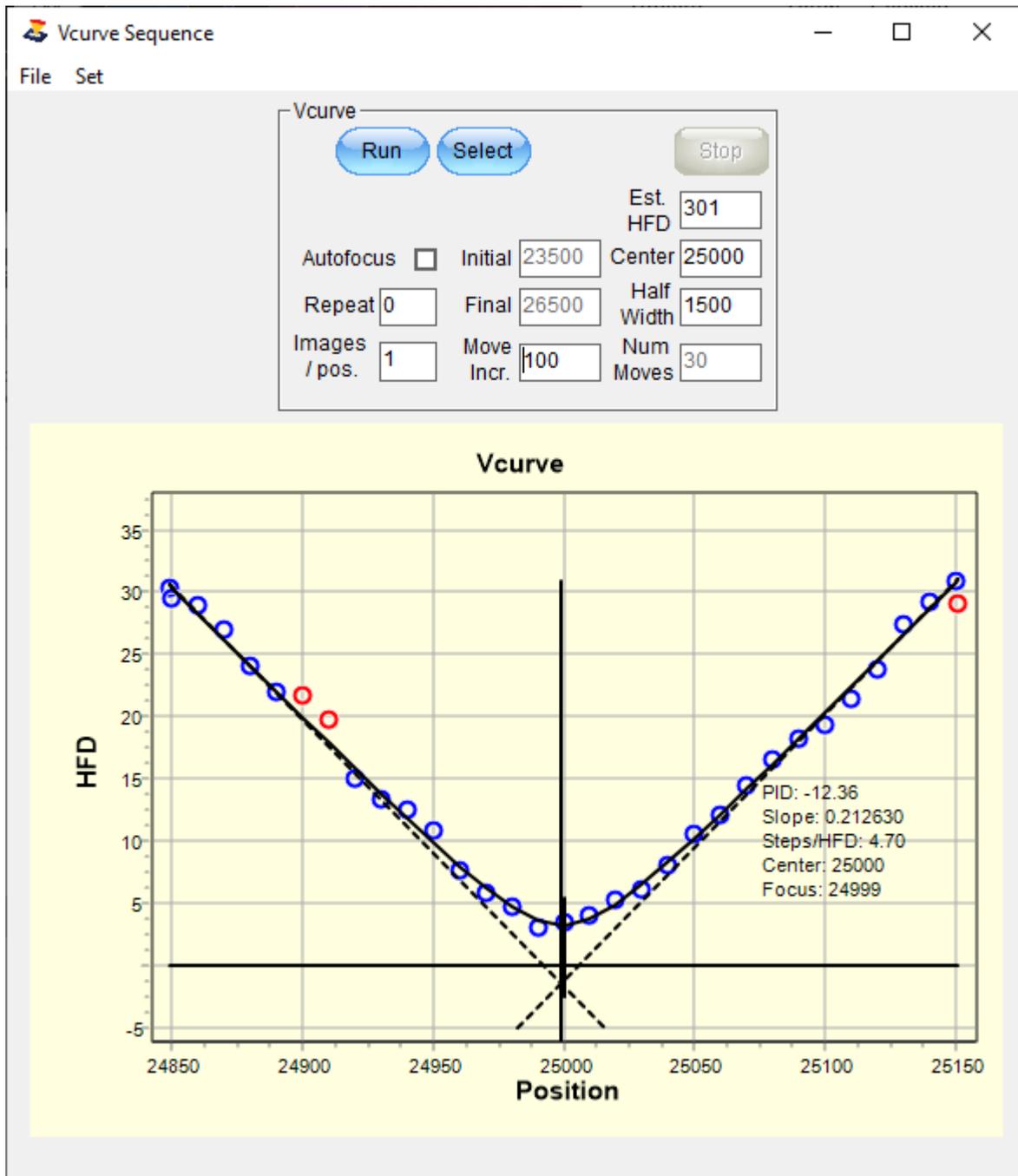
Vcurve plot:

Displays the shape of the Vcurve from the run. You should examine the plot:

- Is the minima of the 'V' positioned in the center of the plot or off to one side.
- If the minima is too far off center you will find the wings of the V have different lengths which may be problematic. Fortunately there is a statistical test that is performed at the conclusion of the run to verify that the length of the wings are reasonable.

Fit box:

1. The 'Slope' of the tangent line are shown
2. 'Position' is the focuser point in which Left & Right tangent lines cross the x-axis. Note that the minima of the Vcurve is the focus position.
3. 'Difference' is the Position Intercept Difference or PID which is the difference in position between where the Right & Left tangent lines intersect the x-axis.

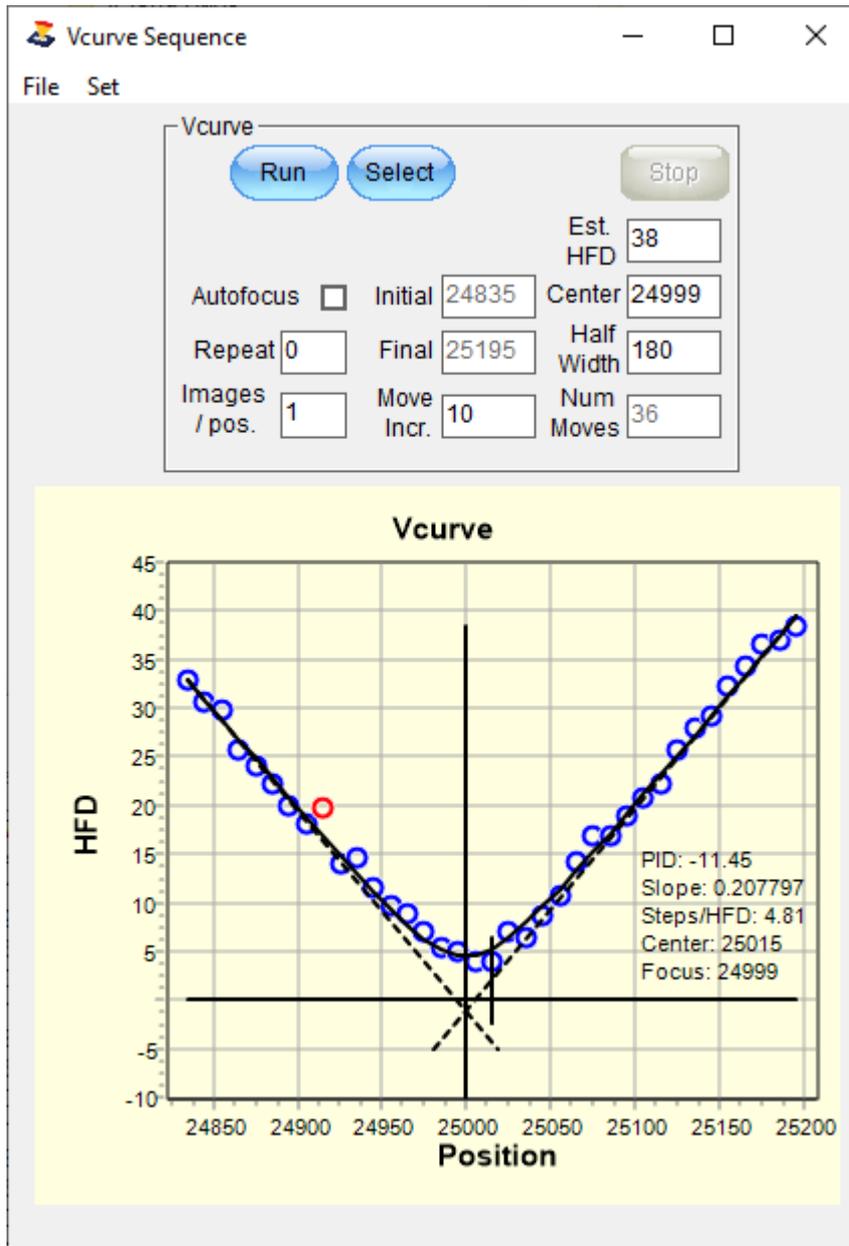


Vcurve Graph

A Vcurve data may be displayed from the Vcurve Window:

1. The graph may be resized as needed
2. Data values may be displayed when you roll the mouse over the data points
3. The best data fit to a hyperbola is shown through the points
4. The vertical line is the center line of the 'V'
5. The Left & Right tangent lines to the hyperbola are displayed
6. The Left & Right slopes and PID are shown at the bottom of the window
7. The V 'Center' and 'Focus position' are shown. Note:
 - The Focuser position (V center = 25015 is offset from the Focus position (24999) in the graph which indicates that the telescope was not in perfect focus when the Vcurve was started.

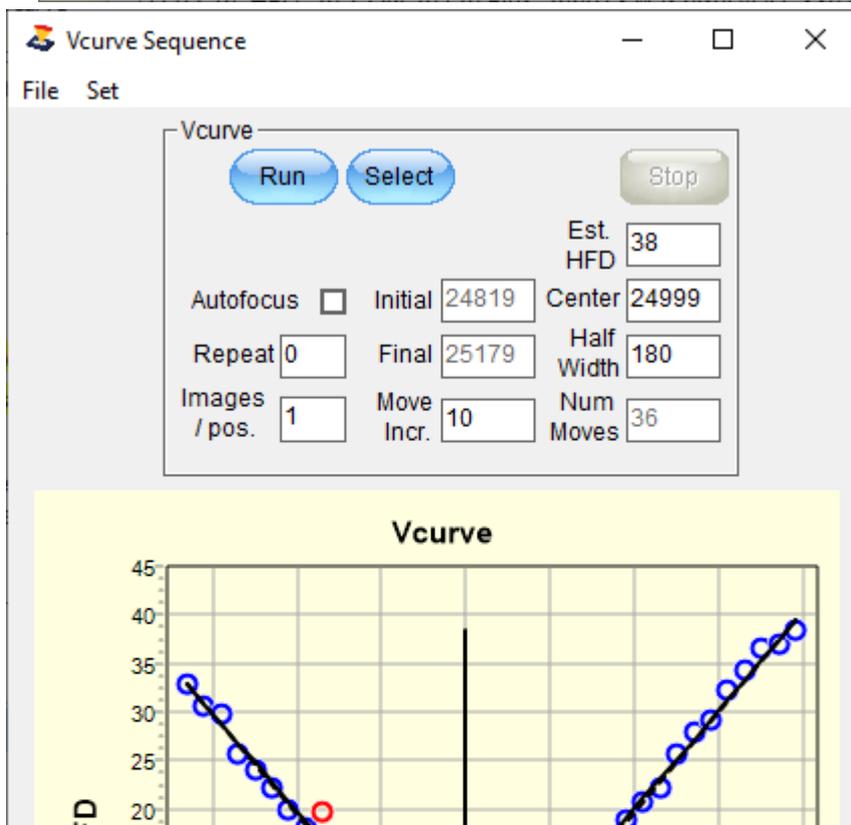
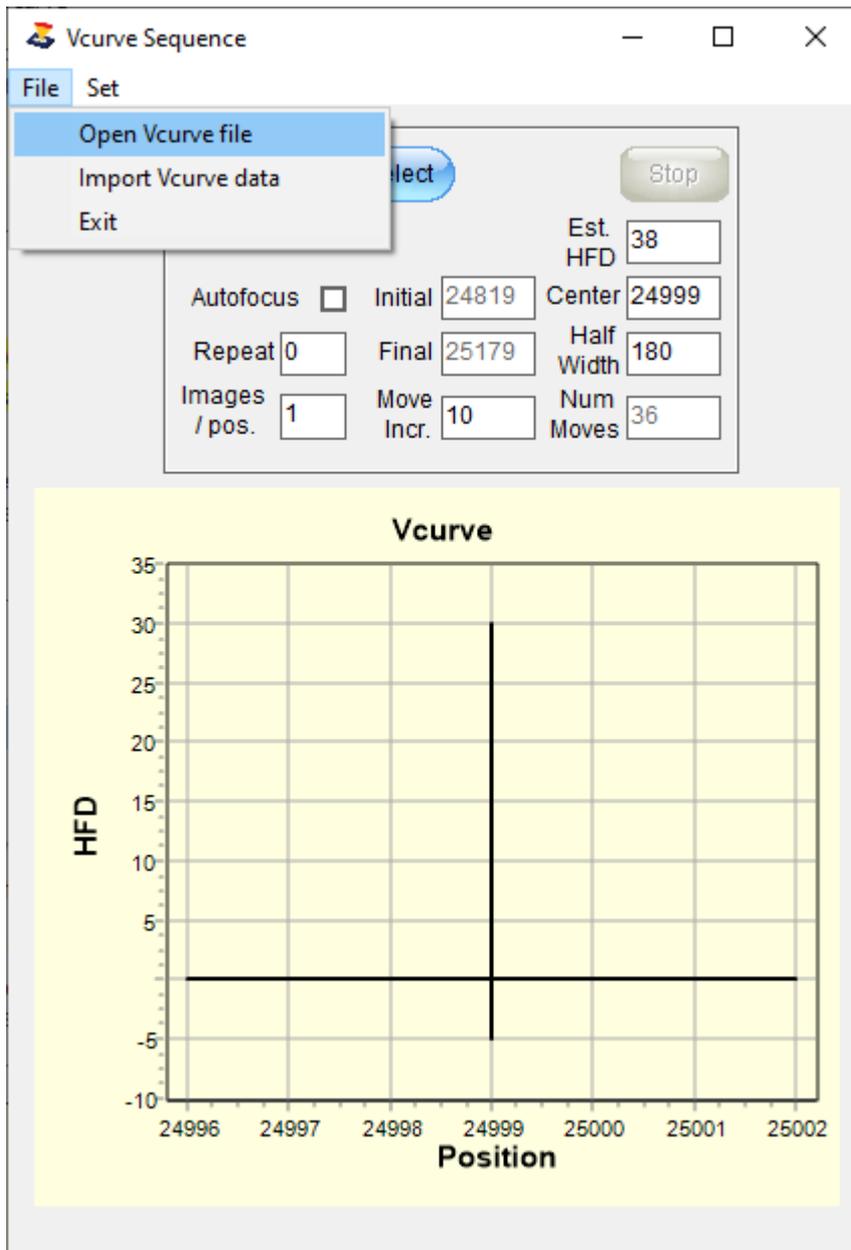
- The end points of the 'V' the same with the left tip at are not the same with the Left = 32.8 HFD and the Right = 38.4. This difference will increase the further the 'Center' is from the true focus position and the Vcurve may fail if this difference is too large. It is important that you begin the Vcurve run as close to focus as possible.



The First Light Wizard Tutorial will describe how to automate the Vcurve generation process.

Running Vcurve Tutorial will describe how to manually generate a Vcurve.

You may load a previously generated Vcurve from disk with 'Open Vcurve file' which may be inspected or shared with other users. These files can be found in C:\Users\XXX\FocusMax V5\Configurations\XXX\DataFiles.



2. See [Import Vcurve data](#)

Log

Log

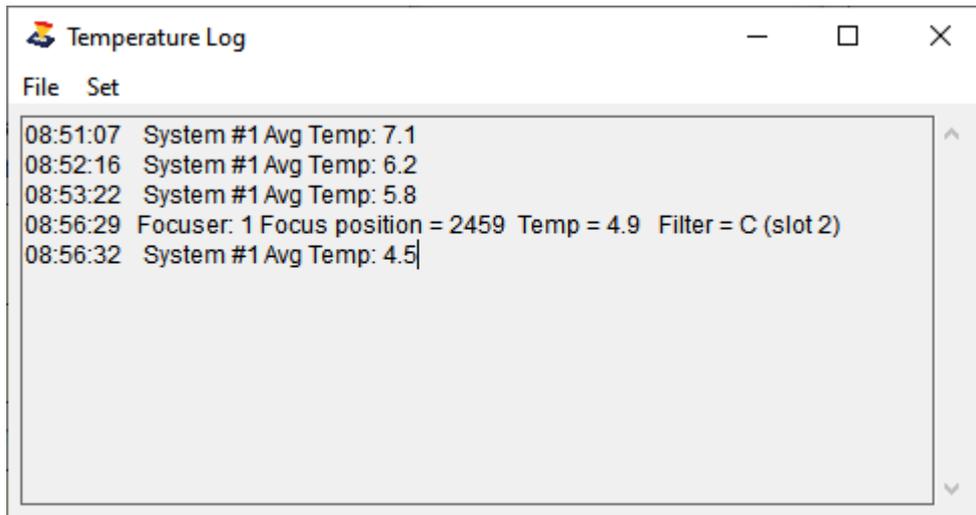
Please see [Log](#) for details

Temperature Log

Temperature Log

Temperature Log Window

The Temperature Log is useful for tracking changes in temperature and identify when an autofocus run occurred during the night

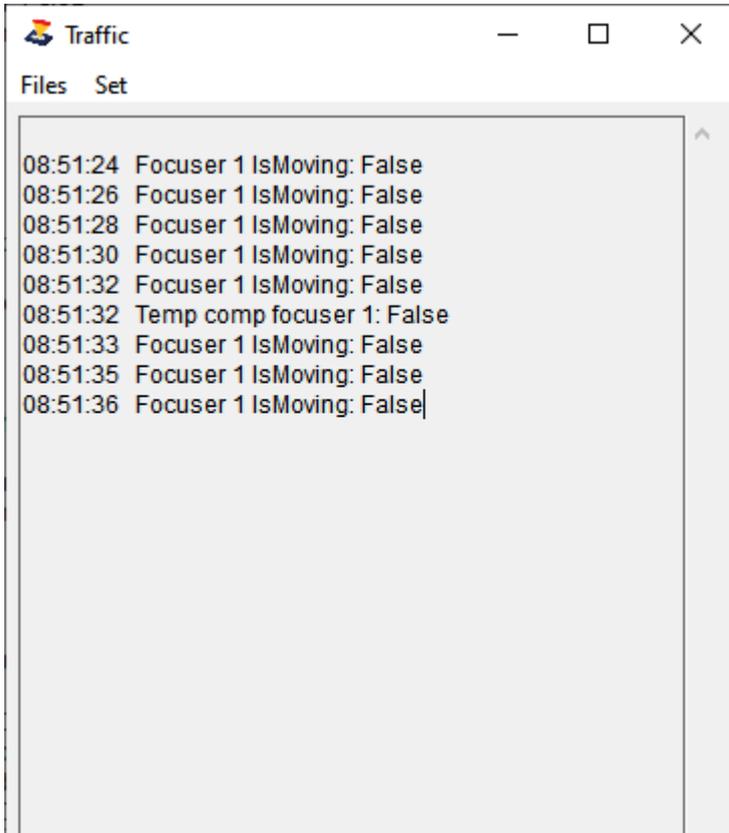


Traffic Log

Traffic Log

Traffic Log Window

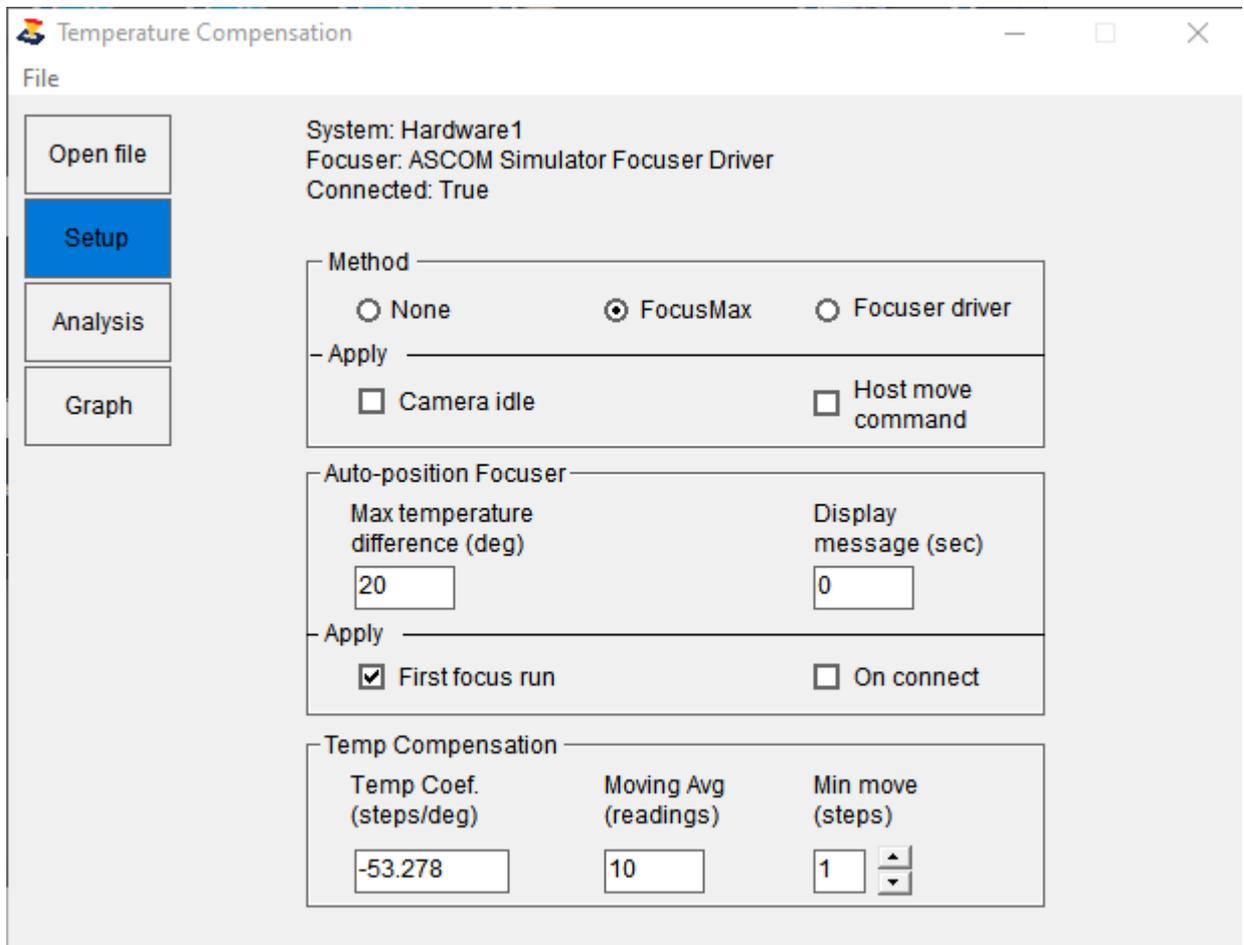
The Traffic Log will post various operations that are performed internal to FocusMax and saved as TrafficXXX.log in the 'LogFiles' directory.



Temperature Compensation

Temperature Compensation

The Temperature Compensation Window will allow you to set the temperature compensation method that will be used to apply small adjustment steps to the focuser as the temperature changes.



Method

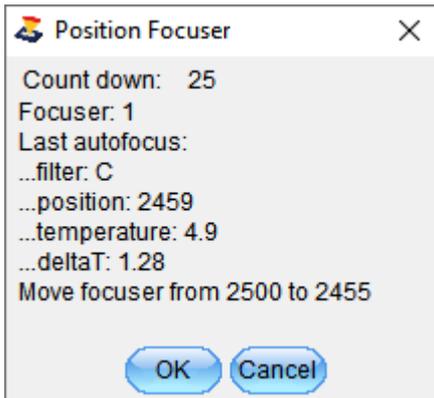
- 'None' - this option will ignore TC allowing user to turn native focuser driver TC on and run independently
- 'FocusMax' - FocusMax will track the temperature using and apply focuser steps based on the temperature coefficient setting (steps / degree)
 - The 'Moving Average' setting is used to smooth out the readings in order to reduce focuser movement from single momentary temperature readings
 - 'Min Move (steps)' is the number of steps to be made when the temperature has changed
 - Enabling 'Apply Camera Idle' will allow the focuser to move when the camera shutter is closed
 - Enabling 'Host Move Command' will initiate a focuser move when a host application (CCDAutoPilot, ACP, etc.) has instructed FocusMax to move due to filter change.
- 'Focuser driver' option will allow the temperature compensation to be performed by the focuser driver. See your focuser manual for details in setting up the driver for this feature.

Auto-position Focuser

It is common to see large out of focus donuts at the start of an observing session. Sometimes the donuts

are so large that neither PinPoint or TheSky is able to plate solve a telescope position. This option will move the focuser to an estimated position based on the last successful autofocus run and temperature and the current temperature measured by the focuser when FocusMax is opened.

- 'Max temperature' sets the max temperature difference between the temperature measured at the last successful autofocus and current temperature measured by the focuser. If the delta exceeds this setting then the focuser will abort the move.
- 'Display message (sec)' is the amount of time that a message box will be shown which will allow you to perform the move with 'OK' or abort the move with 'Cancel'. If the countdown times out, the move will be made automatically. Setting 'Display message' to 0 sec will bypass the message and the focuser will initiate the move to the predicted focus position on startup. Note the information that is displayed in the countdown message box.



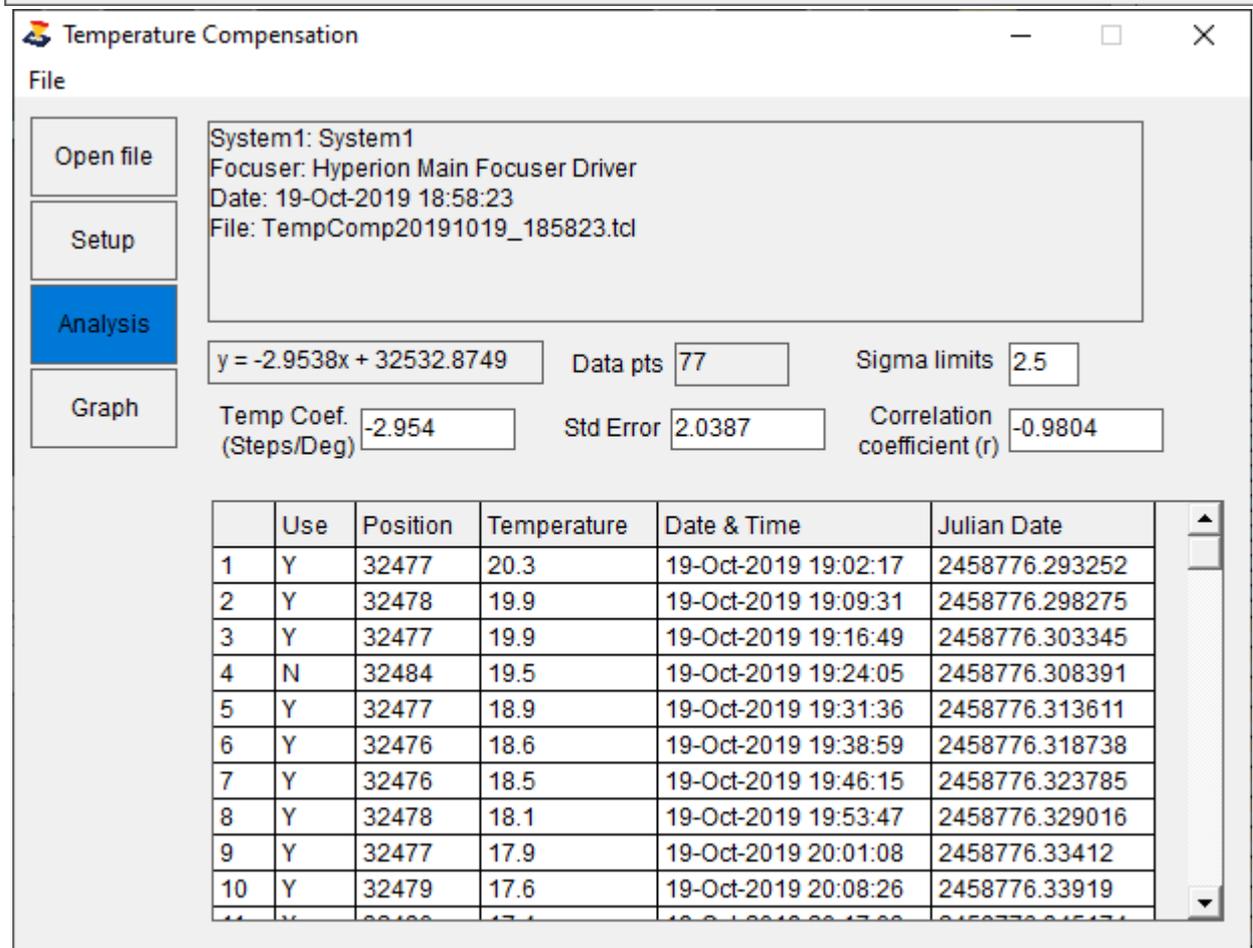
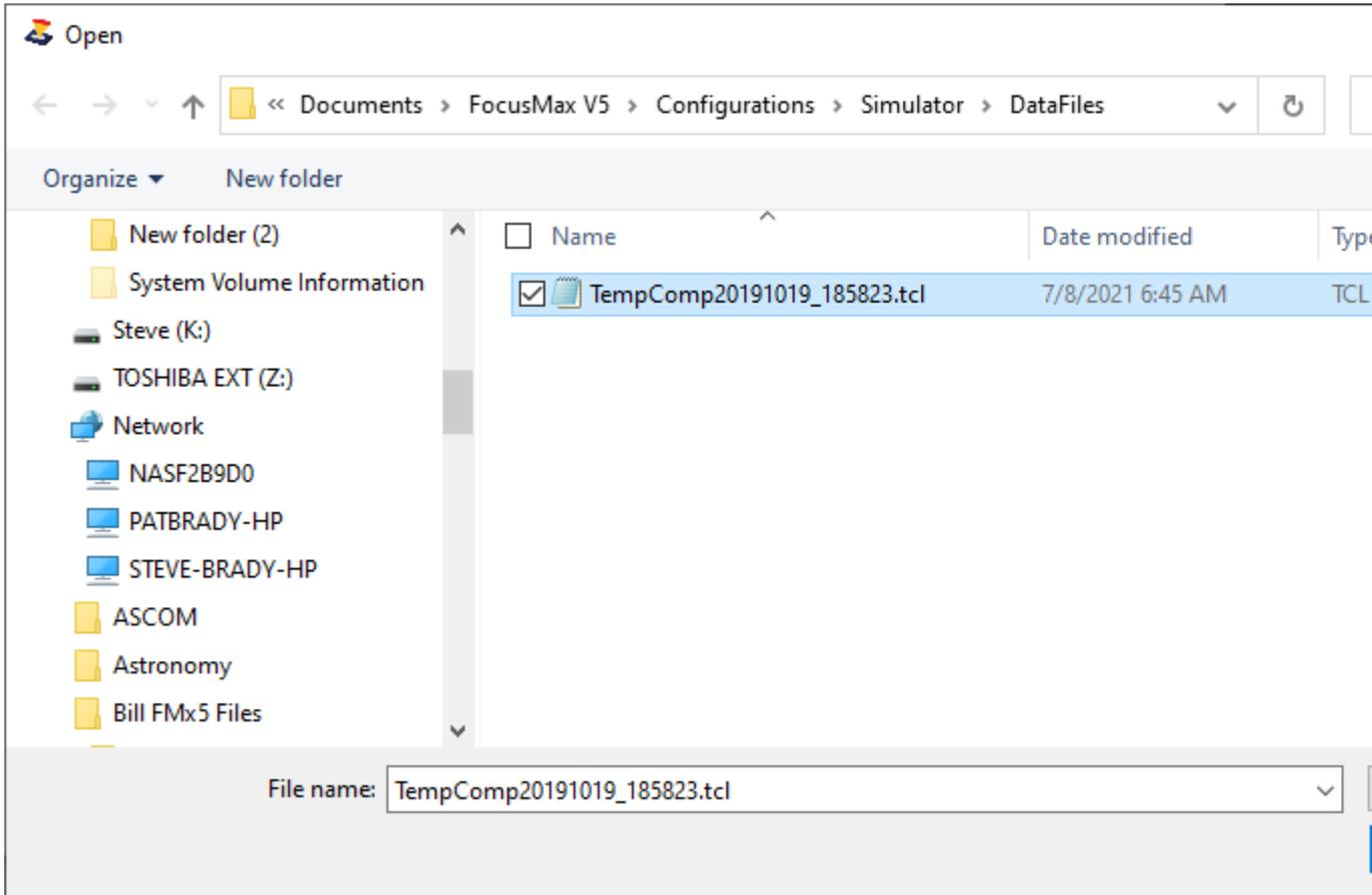
- Enabling 'First focus run' will apply the focuser offset the first time that an autofocus run is performed with no 'Display message' timer. Enabling 'On connect' will apply the focuser offset when and the focuser is set to auto-connect and FocusMax is launched.

Temperature Compensation

- 'Temperature Compensation Coefficient' - The temperature compensation coefficient has units of steps / degree. If the coefficient is known, then it may be entered here if FocusMax is performing the focuser temperature compensation or entered into the focuser driver. This box will be automatically updated if temperature compensation data is loaded into this window for analysis.
- 'Moving Average' - The moving average setting is the number of temperature points that will be collected and used to determine the average temperature. This will tend to smooth the data resulting in focuser movements when significant changes in temperature occur are found.
- 'Minimum move' - This setting will specify the number of focuser steps when a temperature compensation move is applied based on the temperature change. If you have a focuser with fine movement (such as FLI Atlas) then you may want to use a larger value

Analysis Window:

Pressing 'Open File' button will open a dialog window listing the temperature compensation files (XXX.TCL) that have been collected and saved ([Preferences / General](#)) from the Temperature Compensation Wizard. The data will be automatically loaded into the data grid.



Header

The header section displays information from the temperature compensation file:

- System Number
- System Name
- Focuser name
- Date the temperature compensation data was collected
- Temperature compensation file name

Data grid:

The data grid at the bottom of the window displays the actual data collected with the Temperature Compensation Wizard

- Data point number
- Use data point (Yes / No)
- Focuser Position
- Reported focuser Temperature
- Date & Time
- Julian Date

Analysis Window:

The analysis portion of the window displays:

- Equation of the best fit line
- Number of active data points
- Sigma limits to be used for the analysis graph
- Calculated Temperature Coefficient (slope from the best fit line)
- Stand deviation of the data around the best fit line
- Correlation coefficient (r)

Temperature Coefficient

The 'Temperature coefficient' are in units of steps/degree. If the slope is:

- + then the focuser position will decrease as the temperature drops
- - then the focuser position will increase as the temperature drops

Correlation coefficient (r)

The linear 'Correlation coefficient (r)' is a measure of the relative strength in the relationship between temperature and position in the data set.

The value of r will range between -1 and +1 ($-1 \geq r \leq +1$).

- $r = +1$ or $r = -1$ correlation is perfect between temperature and position
- $r = 0$ means there is no correlation between temperature and position
- $r > 0.8$ or $r < -0.8$ is generally considered a strong correlation
- $r = 0.5$ is no better than a guess (flip of a coin)

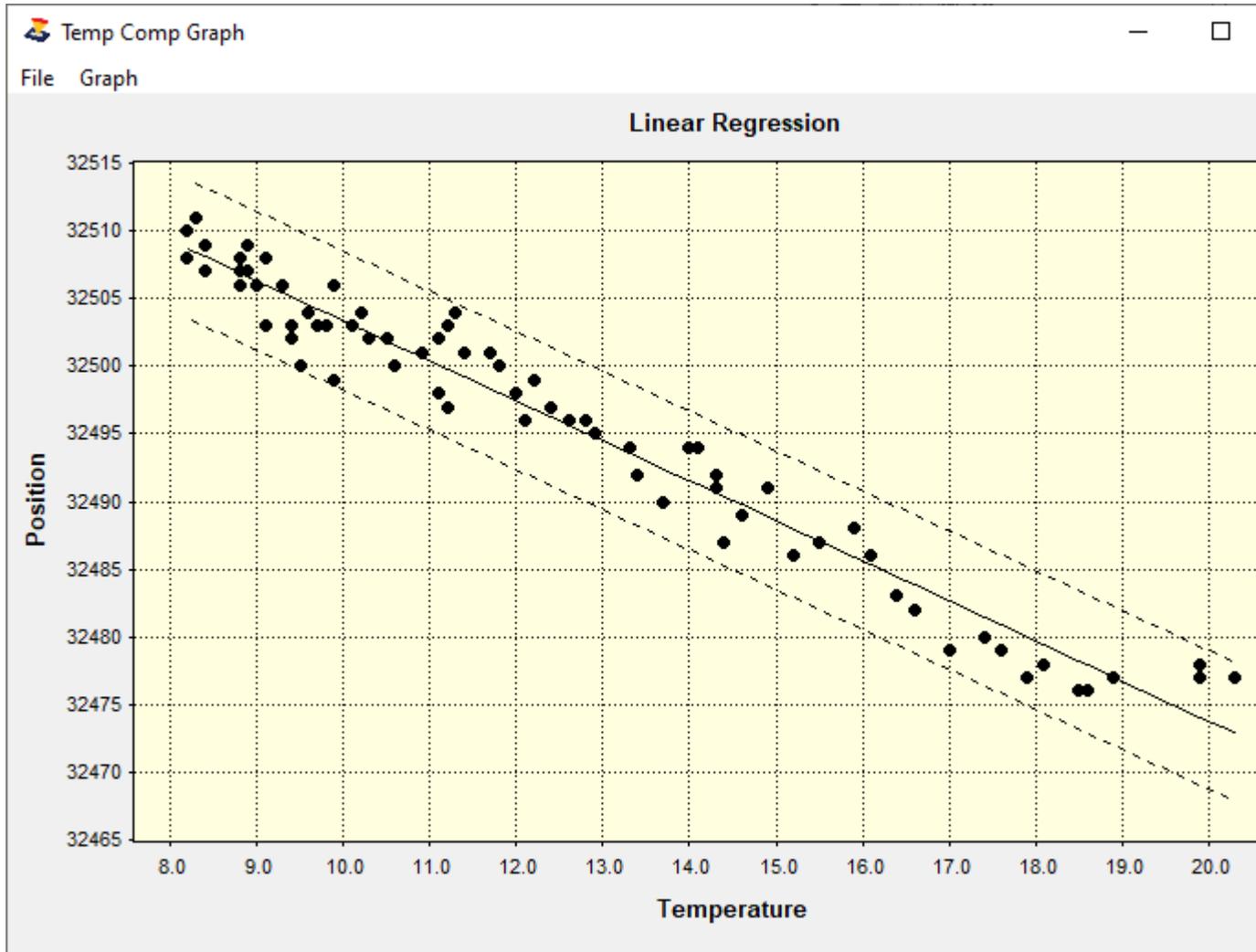
The data set shown above was shows a very strong correlation of 0.98

Graph:

Pressing the 'Graph' button will generate a plot of the temperature compensation data with:

- The best fit line through the data set
- The + / - sigma lines shown on the Temperature compensation window (default = 2.5) The

sigma lines are used to help identify data points that look suspect. If a data point is beyond or close to the sigma limits then they can be turned off in the data grid by changing the 'Y' to 'N' by double clicking the cell. This will allow you to interactively examine the data points and note the change in the Standard Error box (smaller is better) and the graph.



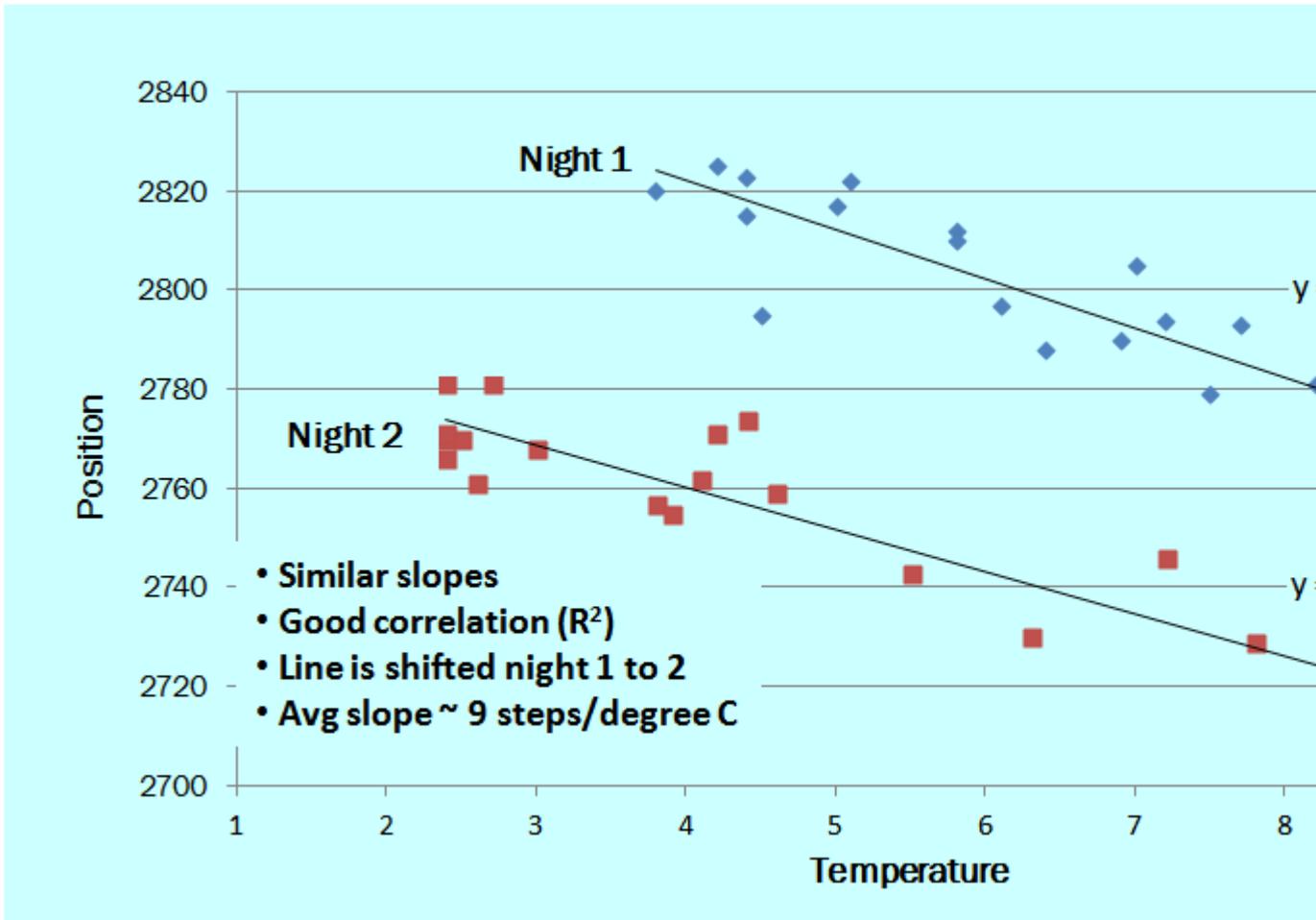
Tips:

1. Use the Temperature Compensation Wizard to collect temperature and focuser position throughout the night.
2. Plan to dedicate several full nights to data collection at a time of year that you will experience the a large temperature swing from early evening throughout the night
3. It is highly recommended that you utilize AcquireStar to find a suitable star and automatically slew and center the star. If you do not use AcquireStar then you may want to select a star near the celestial pole to maximize observing time through the night and reduce tracking errors
4. Analyze your data using statistical methods above
5. Collect temperature compensation data over several nights but DO NOT combine the data into one data-set.
 - Compare the temperature coefficients from each night - do they have similar slopes?
 - Do the regression lines overlap or cross?
 - Are the lines offset from one night to the next but have the same slopes?

6. Not all focusers are able to provide temperature readings that accurately track ambient temperature well.

The author has evaluated one focuser with the temperature probe installed in a box along with the electronics and was never able to find strong correlation between temperature and position.

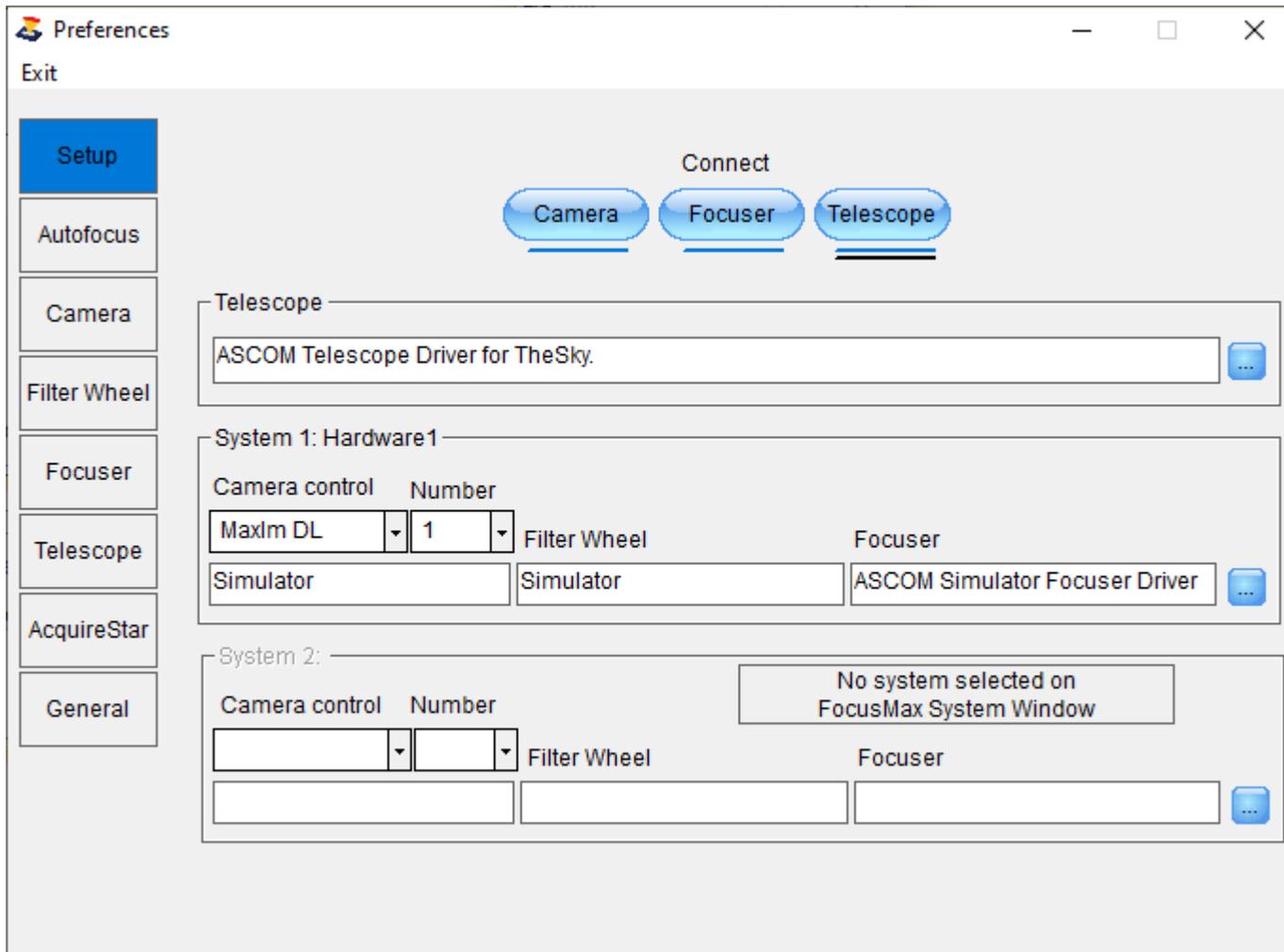
Another focuser utilizes an external sensor that is placed near the primary mirror of the 16" Newtonian reflector. This focuser tracks ambient temperature with a strong correlation between temperature and position of 89%. Temperature compensation has allowed the author to reduce the autofocus frequency from 60 to 120 minutes.



7. Some users may find that the temperature vs. position graph is not linear which may present a challenge for predicting focuser position as temperature changes.

Preferences

Preferences



[Setup](#)

[Autofocus](#)

[Camera](#)

[Focuser](#)

[Telescope](#)

[AcquireStar](#)

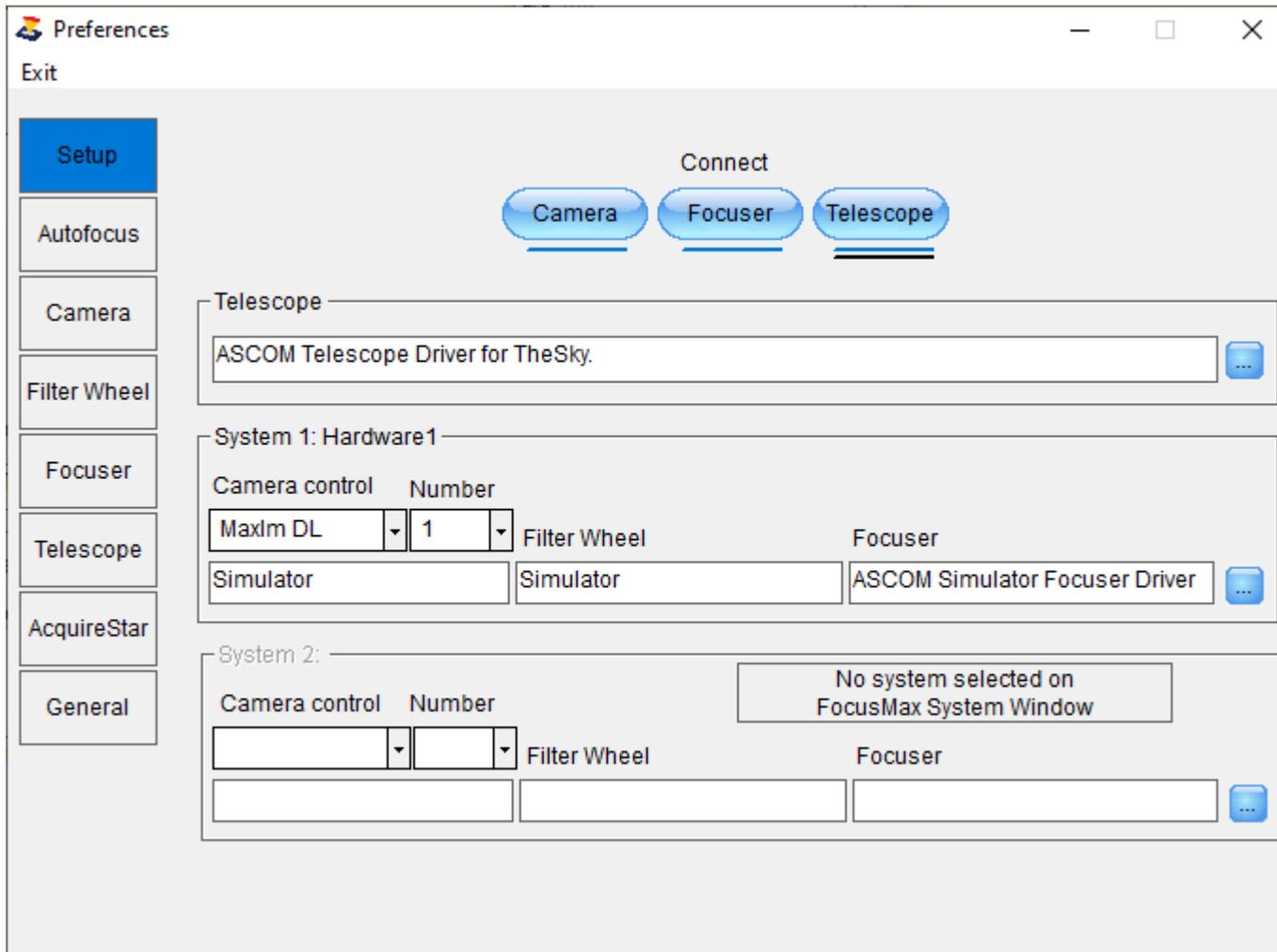
[General](#)

Setup

Setup Preferences

Currently, FocusMax supports MaxIm DL V5 and 6, TheSkyX, TheSky64 Camera Add-on, CCDSoft and Nebulosity V4 camera control.

The Setup Window is used to specify the hardware configuration and assignments.



Telescope

Pressing the small button will open the ASCOM Telescope Chooser for selecting the telescope driver and will allow you to set the driver properties.

System 1 and System 2 boxes

FocusMax V5 currently supports up to 2 cameras, 2 focusers and 2 filter wheels.

- The Camera Control combo box allows you to select the camera control software or imaging platforms
- The Number combo box is the camera number assignment in the selected imaging software. Typically camera #2 will be the autoguider camera assignment.

If you have two independent cameras, the camera control software can be configured to control different

imaging platforms. Pressing the small button will open the ASCOM Focuser Chooser to select the focuser or open the driver properties.

Connect buttons

Pressing the connect buttons will connect each hardware device.

Autofocus

Autofocus Preferences

The Setup Tab is used to specify the important parameters that will be used during the autofocus run, such as camera Base exposure, Near Focus HFD, etc.

Slot	Filter	Focus Bin	Base exp	Max exp	Tgt Flux x1000
1	E	2	10.00	30.00	100
2	C	2	2.50	30.00	800
3	U	2	5.00	30.00	100
4	B	2	5.00	30.00	100
5	V	2	5.00	30.00	100
6	R	2	5.00	30.00	100
7	I	2	5.00	30.00	100

Autofocus settings (data grid):

You may edit the autofocus setting in the data grid by first clicking on a cell then double clicking to enter a new value.

- 'Target Star Bin': The initial camera binning used to identify the target star (Single-Star focus process only).
Note: some cameras or imaging software may not support 3x3 or 4x4 binning and may generate an error message.
- 'Focus Bin': The subframe binning used during the autofocus run. If you are using a DSLR camera then it is recommended that binning be set to 2 for both Target and Focus binning.
- 'Base exp': The starting exposure that will be used after the star is identified which may increase or decrease depending on the user defined Target Flux.
- 'Max exp': The maximum exposure that will be used after subframing the target star.
Note: The Min exposure (default = 0.1 sec) is set in Preferences/Camera. FocusMax will abort an

autofocus run if the calculated exposure is less than Min Exposure or greater than Max Exposure.

5. 'Target Flux (x1000)': Flux is the total integrated light (intensity) of the star on the chip (default = 300). It is important to verify that the target flux value is not set too high which may yield saturated star on the CCD. FocusMax will attempt to adjust the exposure time to hit the desired target star flux value. If the star flux is too high, then the exposure will be adjusted down, too low the exposure will be adjusted up.
 - Single-Star focus: If the exposure falls outside to the defined Min / Max Exposure time then FocusMax will abort the autofocus run.
 - Multi-Star focus: If the exposure falls outside to the defined Min / Max Exposure time then FocusMax will abort the autofocus run unless 'Run AcquireStar on failure' is enabled then AcquireStar will be initiated to identify a target field, slew the telescope, autofocus then perform a return slew (if desired).

No filter wheel

Preferences: System #2

Exit

Setup

Autofocus

Camera

Filter Wheel

Focuser

Telescope

AcquireStar

General

Autofocus

Process: Single-Star

Method: Advanced

Filter: No filters

Near Focus

HFD	Samples
10	10

Final Focus

Images: 5

Focus offset: 0

Run AcquireStar on failure

Enable A. I.

Filter	Tgt Bin	Focus Bin	Base exp	Max exp	Tgt Flux x1000
No filter	2	1	1.00	10.00	300

Move

In

Out

Settle time: 0 sec

Convergence

Enable:

Steps	Samples
2	5

Max number exposures: 25

Return Start Position

Enable:

Max HFD: 6

Filter wheel containing multiple filters

Preferences: System #1

Exit

Setup

Autofocus

Camera

Filter Wheel

Focuser

Telescope

AcquireStar

General

Autofocus

Process: Single-Star

Method: Advanced

Filter: Current filter

Near Focus

HFD	Samples
10	10

Final Focus

Images: 5

Focus offset: 0

Slot	Filter	Tgt Bin	Focus Bin	Base exp	Max exp	Tgt Flux x1000
1	E	2	1	1.00	10.00	300
2	C	2	1	1.00	10.00	300
3	U	2	1	1.00	10.00	300
4	B	2	1	1.00	10.00	300
5	V	2	1	1.00	10.00	300
6	R	2	1	1.00	10.00	300
7	I	2	1	1.00	10.00	300

Move

In

Out

Settle time: 0 sec

Convergence

Enable:

Steps	Samples
2	5

Max number exposures: 25

Return Start Position

Enable:

Max HFD: 6

Focus Process

- '[Single-Star](#)': Single star autofocus identifies that brightest star in the field, subframes the star then begins the focus process. Single-Star autofocus has been the standard since 2001 when FocusMax was first distributed.
- '[Multi-Star](#)': FocusMax V5 introduces a new autofocus process that will identify multiple stars in the current field, determine the mean HFD across the entire field then begin the focus process. Multi-Star focus will allow the user to focus in the current field and may not require slewing the telescope to a different field to use a specific single star.

Method

Two autofocus methods are given:

- 'Standard': utilizes one side of the Vcurve to determine the focus position.
- 'Advanced': will use both sides of Vcurve to predict the focus position. This will yield the most accurate final focus position but will require additional time to complete the autofocus run.

Filter

You may choose a specific filter to be used for the focus run which is typically the filter that provides the brightest image such as Luminance. Using this feature will require 'Filter offsets' to be determined which may be easily done using the 'Filter offset Wizard'. If 'Current filter' is selected then the autofocus run will be initiated using the current filter in the filter wheel with no filter offset applied.

Near Focus HFD

- 'Near Focus HFD' (half flux diameter): This setting specifies the position (HFD) on the Vcurve where FocusMax will pause to take multiple images before moving the focus position. The HFD value is based on and reported at 1x1 camera binning. With FocusMax V5, you are not required to specify a Near Focus HFD that lies in the linear portion of the 'V'.
- 'Samples': This setting specifies the number of readings to be taken for determining the focus position. Unlike Convergence method, this is a static setting that does not adjust for variability in seeing conditions.

Final Focus

- 'Images': sets the number of images that will taken and averaged after the focuser moves to the final focus position which will give an estimate of the final focus HFD in current seeing conditions.
- 'Focus Offset': will allow the user to offset the focus position in steps in or out to defocus the image. This is useful in photometry applications where it may not be desirable to have perfectly focused stars or if the user wants to defocus the image a known amount to average the focus across the image plane.

Run AcquireStar on failure

This feature may be enabled only when Multi-Star focus is selected. Multi-Star focus is designed to operate on the target field by identifying multiple stars in the field that may be used to determine the mean HFD across the field. If the stars are too dim or the focus run fails, then AcquireStar will may be triggered to slew the telescope off-field to focus then perform a precision return slew.

Enable A. I. (artificial intelligence)

When enabled, 'A.I.' will review your autofocus history and make adjustments to various settings which will be unique to your specific optical system.

Move Direction

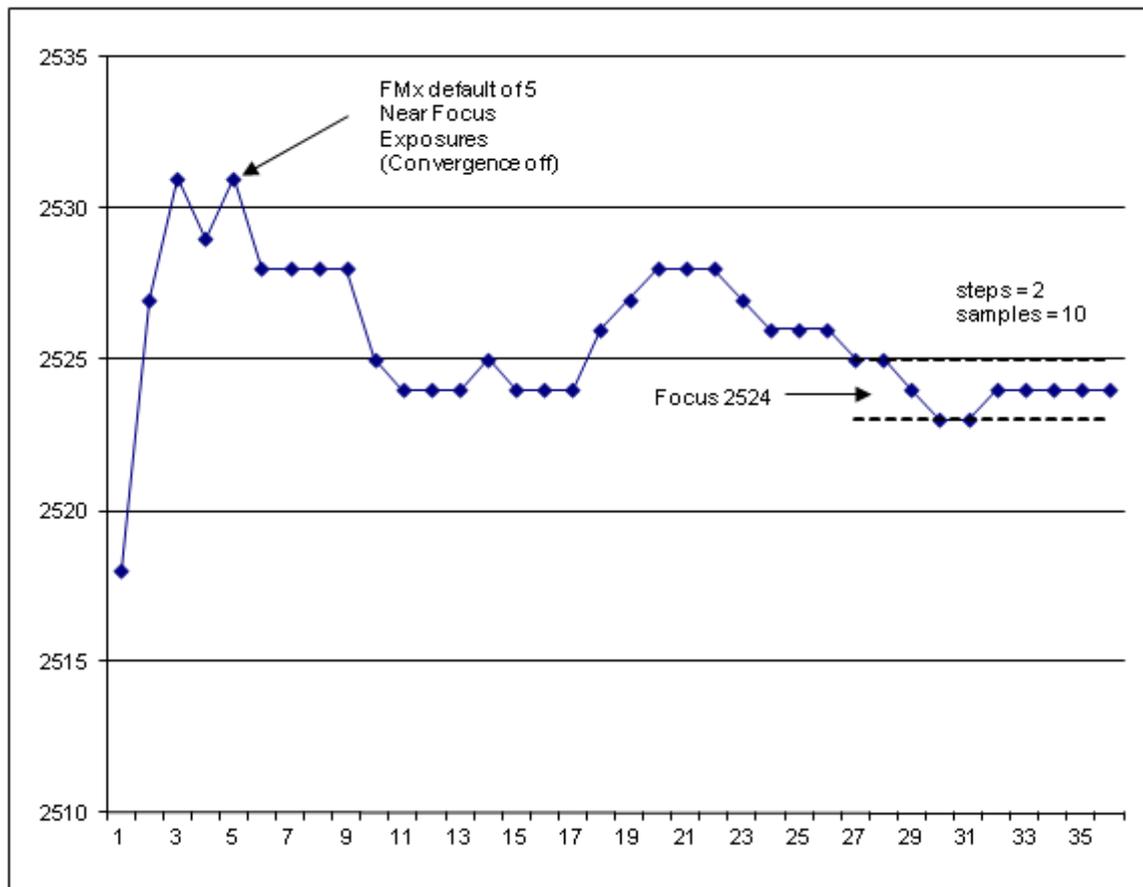
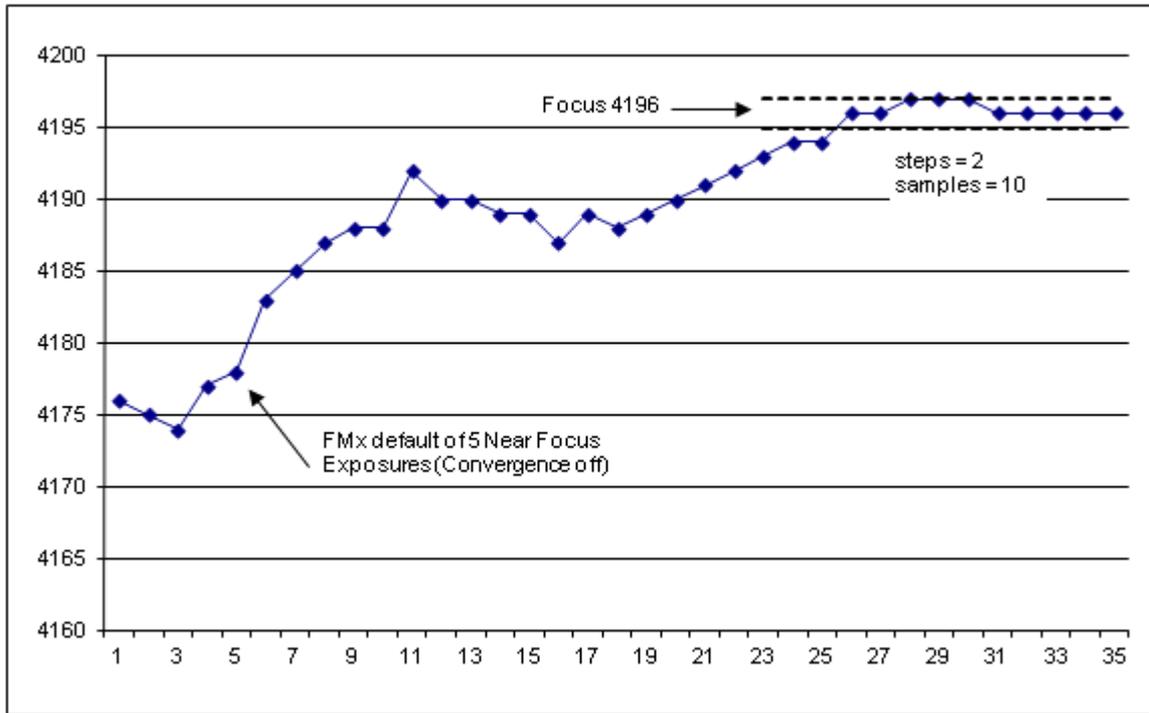
- 'Direction': Set the focuser move direction that is best for your telescope to eliminate backlash or mirror flop. For a typical SCT telescopes, the best Move Direction is In which moves the primary mirror in a direction against gravity.
- 'Settle time': Wait time following a focuser move to eliminate potential telescope shake.

Focus Convergence

Enabling this feature will find the best focus position by taking repeated images until the average HFD falls within a boundary (tolerance) that is set by the user. This feature is very useful when the seeing is poor where additional samples will be taken compared fewer samples when the seeing is steady.

- 'Steps': the number of focuser steps (units) that the average HFD must fall within. You can think of this as a tolerance.
- 'Samples': 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 during poor seeing where Focus Convergence was enabled. The default samples was 5 images 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 until the focus position 'converged'.



Return to Start Position

When enabled, the focuser will be sent back to the previous starting position before the autofocus routine was initiated if the final focus HFD exceeds the Max HFD setting. This is a useful feature for all night robotic observing sessions where thin clouds or the presence of a double star in the focus subframe may influence the autofocus routine and cause it to leave the system out of focus..

- 'Max HFD': the maximum HFD value that when exceeded, will return to the previous position. Typically, the HFD value will be larger in the early evening and improves as seeing improves - therefore the Max HFD setting should be set greater than typical early evening focus HFD results to avoid false focus run failures.

Camera

Camera Preferences

Preferences

Exit

Setup

Autofocus

Camera

Filter Wheel

Focuser

Telescope

AcquireStar

General

Properties

Sensor: CCD | Monochrome | Pixel size: X 9 Y 9 microns

Full well ADU: 65535 | Max Image ADU %: 80 | Readout mode: Normal

Min Exposure

Single-Star: 0.01 sec | Multi-Star: 1 sec

Simulator

Seeing: 3 | Guide errors: 0

Calibrate images | Enable cooler

Software bin: 0 | Flush camera: 0

CCD Central Region: 75% | Image border: 0 pixels

Pre-exp delay: 0 sec | Link delay: 0 sec

Post-exp delay: 0 sec

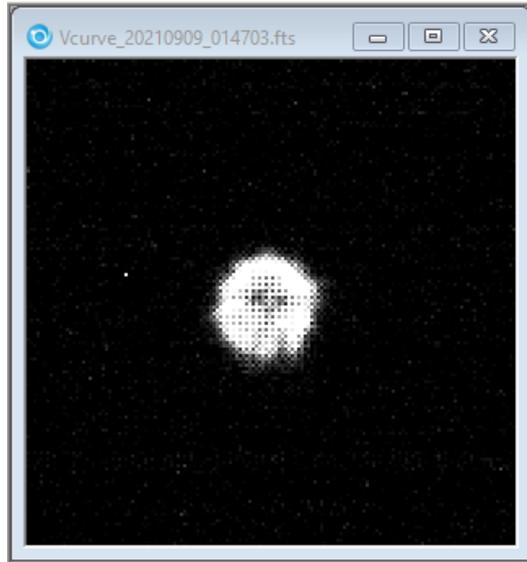
Camera Properties

FocusMax will read various camera properties from the camera/driver if connected and linked when this window is first opened.

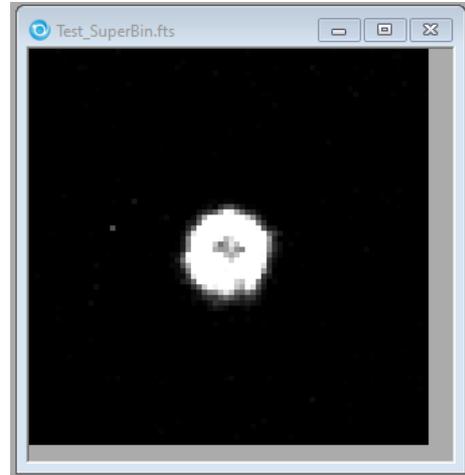
- Sensor: choices are CCD, CMOS and DSLR
- Type: Monochrome or color
- Pixel size: in microns when binned 1x1
- Full well ADU: the maximum pixel depth in ADU units that is seen for a saturated pixel. For 16 bit cameras this is typically $2^{16} - 1 = 65535$.
- Maximum ADU: (default 80%) is used to define the limit which is used to identify stars that may be too bright and may saturate the chip. The star ADU limit = (Full well ADU) x (Max image ADU %), stars that are brighter may be ignored.
- Readout mode: You may select the best readout mode if the camera / driver supports multiple readout modes.
- Software bin: additional software binning that will be applied by FocusMax on the image. This may be useful if images are significantly over-sampled and /or color CMOS camera containing a Bayer Matrix is being used. Setting ImageBin=1 (default) will not apply software binning.

Example: 12" f/10 SCT (FL = 3048 mm) with CMOS color camera containing 2.4u pixels.

Binned 4x4 yields 0.65 arc-sec/pixel
Note the Bayer pattern influence in the image
(Image magnified 400x in MaxIm)



Applying ImageBin = 2 in FocusMax
yields 8x8 binning and improves image
quality
(Image magnified 400x in MaxIm)



Calibrate images

See FocusMax Tutorials to setup image calibration

CCD Central Region

The CCD Central Region is a user defined central region on the CCD to reduce the size of the image and limit the influence of optical aberrations that may be present in the optical system. SCT and fast Newtonian users with large CCD chips may want to set this to 50% in order to minimize the influence of astigmatism, curvature of field, coma, etc. The default setting is 75%, if you have a large chip, then setting this to 50% or smaller will reduce the download time and increase the speed of the star detection routine. The CCD Central Region is drawn with a box on the CCD chip diagram found on the lower left corner of the FocusMax [Focus window](#).

Flush Camera

This setting will initiate a user defined number of exposures to flush the chip following an autofocus run to help a prevent ghost image of the target star.

Image border

Specify the number of pixels to remove around the image border (default = 3) which may help with star detection with some systems.

Link delay

This setting will initiate a delay before the camera link is performed. This is useful if camera auto-connect is enabled were the imaging software is loaded then a connection is made to the camera.

Pre-exposure delay

Specifies the number of wait seconds before an image will be taken (default = 0).

Post exposure delay

Specifies the number of wait seconds after an image is taken (default = 0).

Seeing Simulator

Specify variation that will be used on calculating the HFD when operating FocusMax in Simulator mode. A setting of 0 will introduce no seeing variation, a setting of 5 is maximum variation (default = 3).

Guide errors

Introduce guiding errors when operating FocusMax in Simulator mode. A setting of 0 will introduce no guiding error seeing variation, a setting of 5 is maximum (default = 0).

Filter Wheel

Filter wheel Preferences

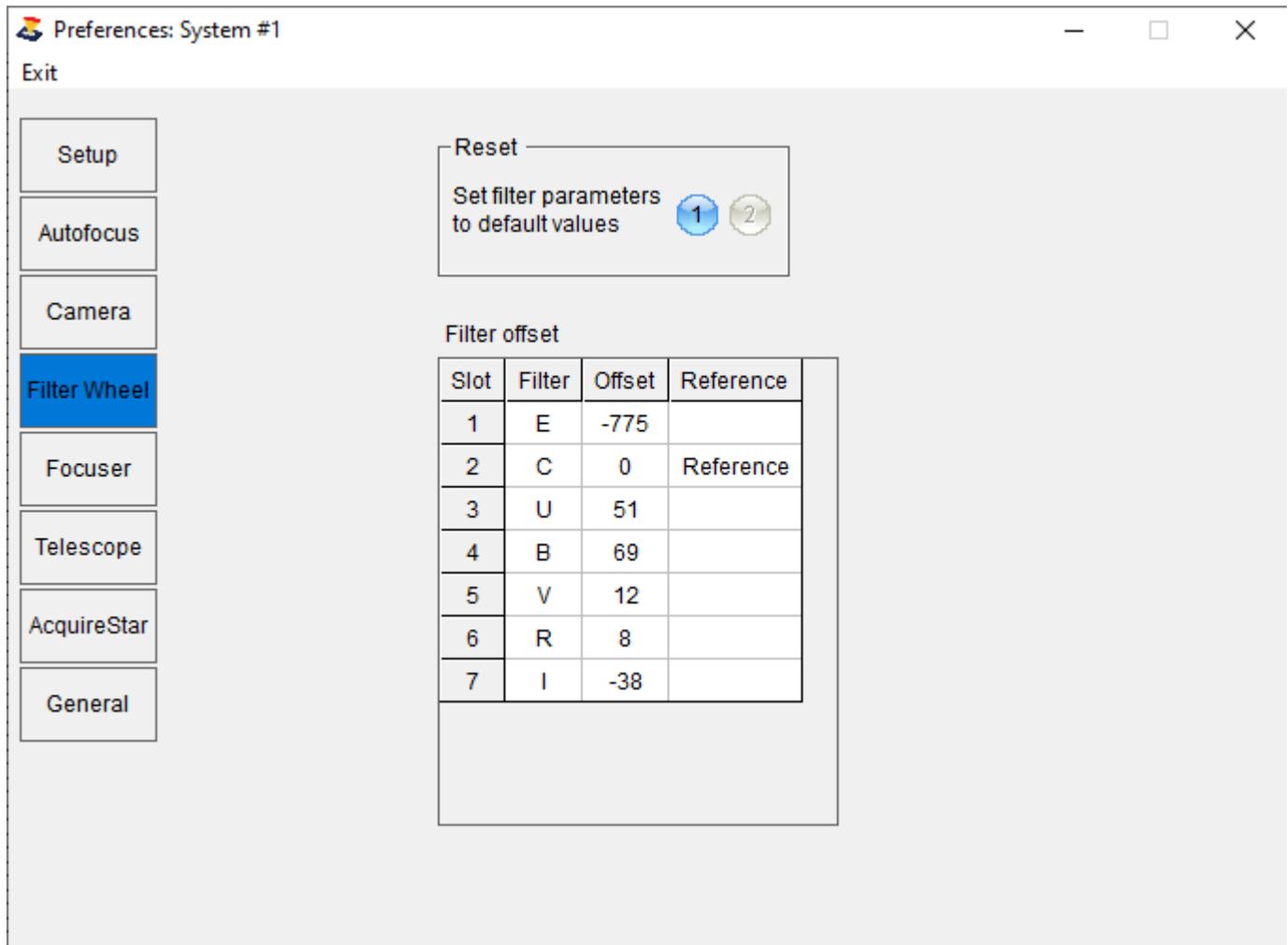
Filter wheel

The Filter offsets for each filter may be entered in the grid if known.

Reset

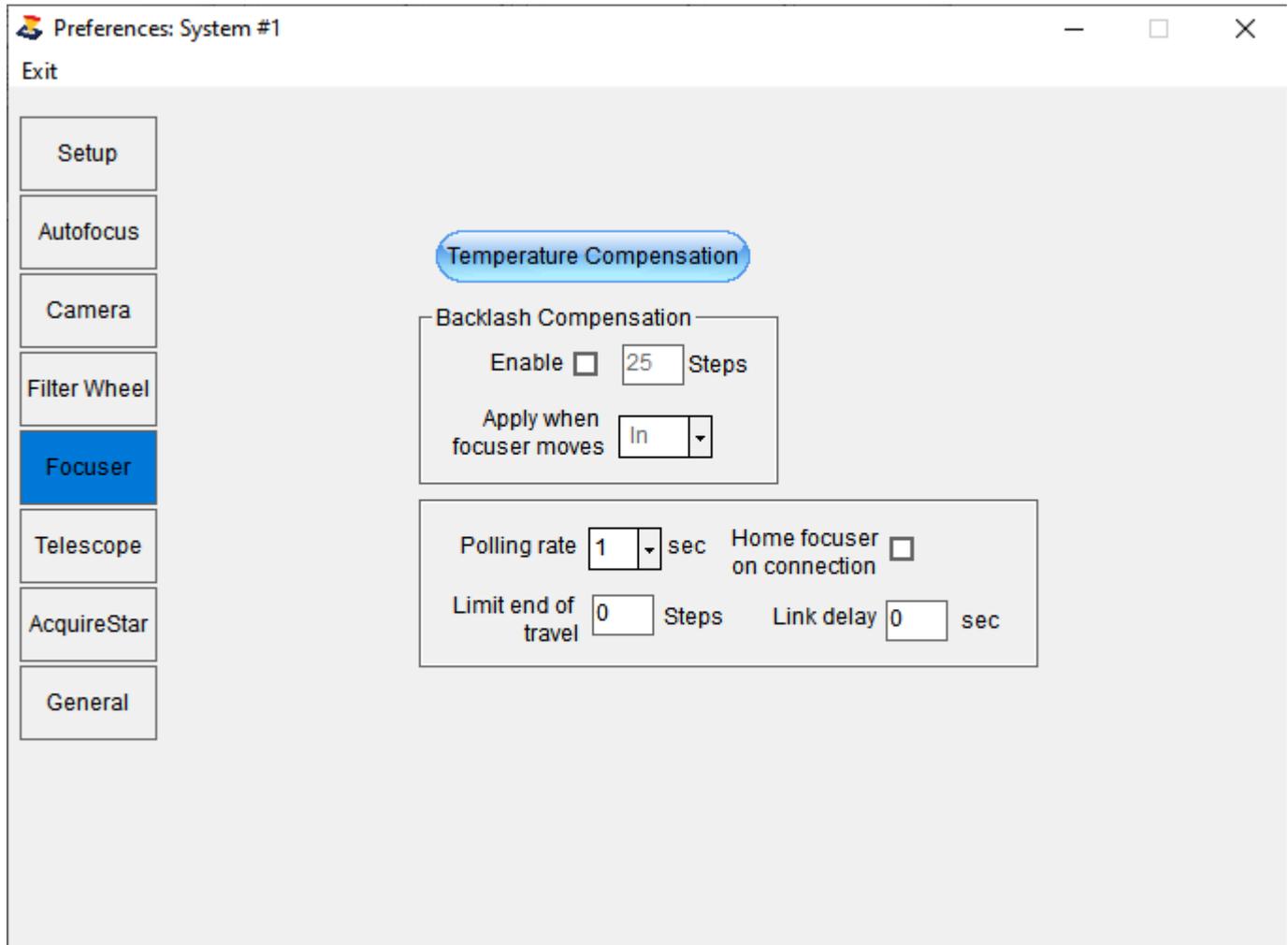
Pressing the small button associated with each 'System' will delete the current filter information used for autofocus and AcquireStar operations.

Pressing the connect camera button at the top of the window will reload the filter names for each filter wheel and apply default base exposure time, target flux, etc.



Focuser

Focuser Preferences



Polling Rate

The time in seconds in which the focuser is polled for temperature and position. Some focuser struggle with a 1 sec polling rate, setting a larger polling rate may help (default = 1 sec).

Limit End of Travel

This setting allows you to guard band or limit the full travel so as to avoid hitting a hard stop. For example, if the focuser full range is 0 to 5000; setting Limit end of travel to 10 steps; the focuser will only travel between position 10 and 4995 (default = 0).

Home focuser on connection

Enabling this feature will send the focuser home then return to the previous position. This is useful feature if your focuser is prone to slippage.

Link delay

This setting will initiate a delay before the focuser link is performed.

Backlash Compensation

This is used to set the desired backlash compensation value and direction. Use this feature if the focuser driver does not allow backlash compensation or you wish to have FocusMax make the required focuser moves. Backlash compensation is important as FocusMax is designed to drive the focuser in one direction toward the focus position thus eliminating error in the final focus position.

Do not activate backlash compensation at the same time in both FocusMax and the focuser driver.

Pressing the 'Temperature Compensation' button will display the Temperature Compensation Window.

Telescope

Telescope Preferences

Preferences

Exit

Setup

Autofocus

Camera

Filter Wheel

Focuser

Telescope

AcquireStar

General

Meridian

Flip required Flip zone 5 deg

Site

UT Offset -06:00 Mountain Standard Time

Latitude N 35 05 00.00

Longitude W 106 39 00.00

Height (m) Temp Pressure

1920.24 20 1000

Get From Telescope

Topocentric Coordinates Settle time 2 sec

Min horizon 20 deg Max slew altitude 90 deg

Polling rate 1 sec

Simulator

Simulate slew errors Slew error Min 3 Max 7 arc-min

Meridian flip

Enable this feature if the telescope performs a flip when crossing the meridian - most German Equatorial Mounts (GEM's) do. This setting is used in conjunction with AcquireStar to identify target stars near the meridian.

Flip zone

The number of degrees E / W of the meridian before the telescope will perform a flip.

Topocentric Coordinates

Telescope driver requires topocentric coordinates (JNow, Earth surface) (default is enabled).

Settle time

Time in seconds to allow the telescope to settle following a slew (default = 5 sec).

Polling rate

Time in seconds that FocusMax will use to poll and display telescope (RA, Dec, Az, Alt) information found on the Telescope Window (default = 1 sec).

Simulator

- Allow telescope slew error when operating FocusMax in Simulator mode (default = off).
- Min & Max slew error in arc-minutes may be defined when operating in simulator mode.

Min horizon

Minimum altitude in which the telescope will abort a slew if the destination coordinates are less than this min value (default = 20 degrees).

This will benefit AcquireStar users who initiate a focus run via automation from a park position which is less than the Min observatory horizon, the return slew will be aborted after the focus run.

Max slew altitude

The maximum telescope altitude (tilt-up) where the payload may contact mount. For example, the payload on a SCT Alt/Az mount may not be able to swing through the forks (default = 90 degree).

Site

The Site information is used to set the observing location, time zone, etc. Connecting to the telescope will populate these fields automatically provided the driver allows reading these settings, if not, then they must be manually entered.

The 'Get From Telescope' button will attempt to obtain the information from the Telescope driver provided the user has set the telescope driver in the Preferences/Setup Window.

Note: the information must be accurately entered if the AcquireStar feature is to be used.

AcquireStar

AcquireStar Preferences

AcquireStar

AcquireStar will identify and acquire a target star for autofocus that meets user defined requirements. This feature requires the either:

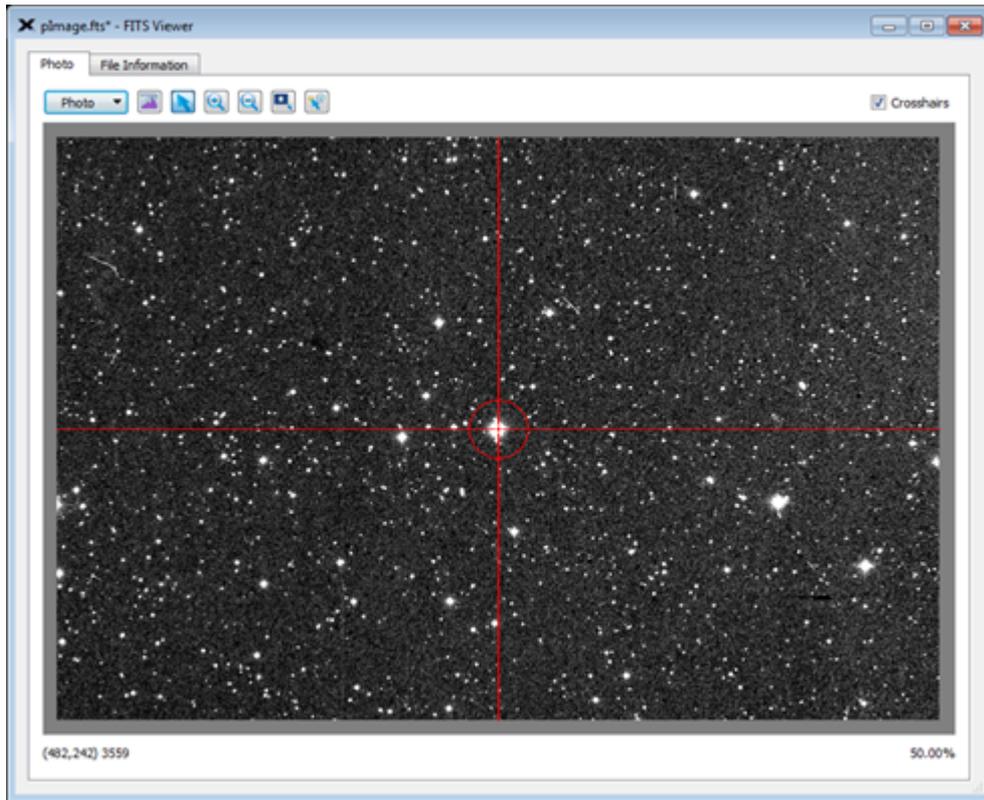
- TheSkyX or TheSky64 Image Link with the latest 'All Sky Database' installed from Software Bisque
- Full version of PinPoint - AcquireStar will not work with PinPoint LE bundled with MaxIm V4 or higher since there is no COM interface.

Astronomers are using AcquireStar with automated telescopes to perform periodic focus to assure that images are perfectly focused during the night.

AcquireStar can be operated manually by a push of a button or through automation with a script.

Acquire star can be configured to:

- take short exposure and plate solve current telescope position using PinPoint or TheSky Image Link technologies.
- initiate a star catalog search to identify stars that meet the user defined magnitude range
- identified stars will be screened for side of meridian to prevent telescope flip and min slew altitude
- slew the telescope to the first target star in the list
- take a short exposure and plate solve current telescope position
- tweak telescope pointing to center target star
- initiate autofocus routine
- perform a return slew to original position
- take a short exposure and plate solve current telescope position
- tweak telescope pointing to met user defined allowable pointing error

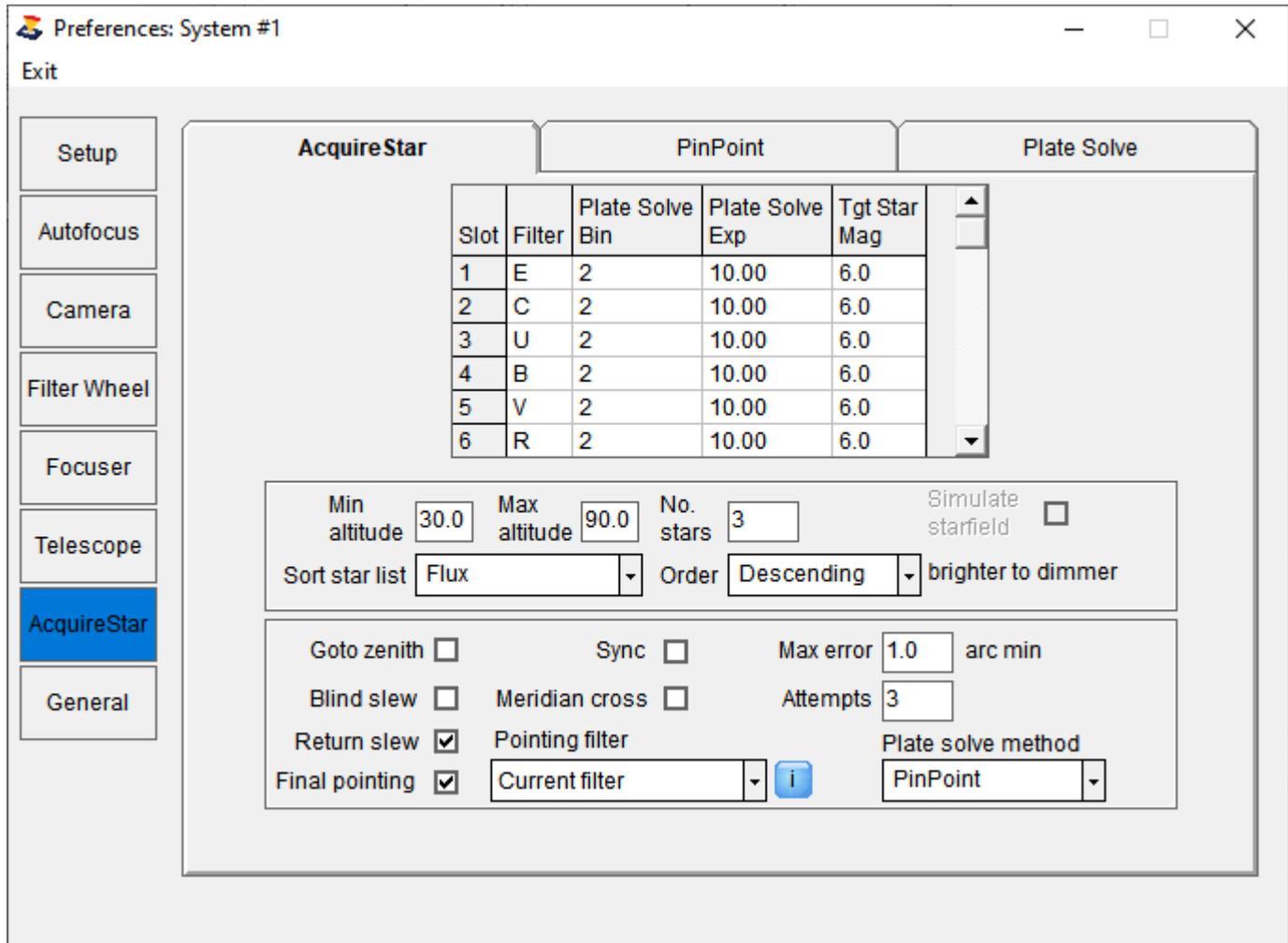


Setup Tab

Setup Tab

The Setup Tab shows the exposure and desired magnitude range that will be used for selecting a star from the stars catalog.

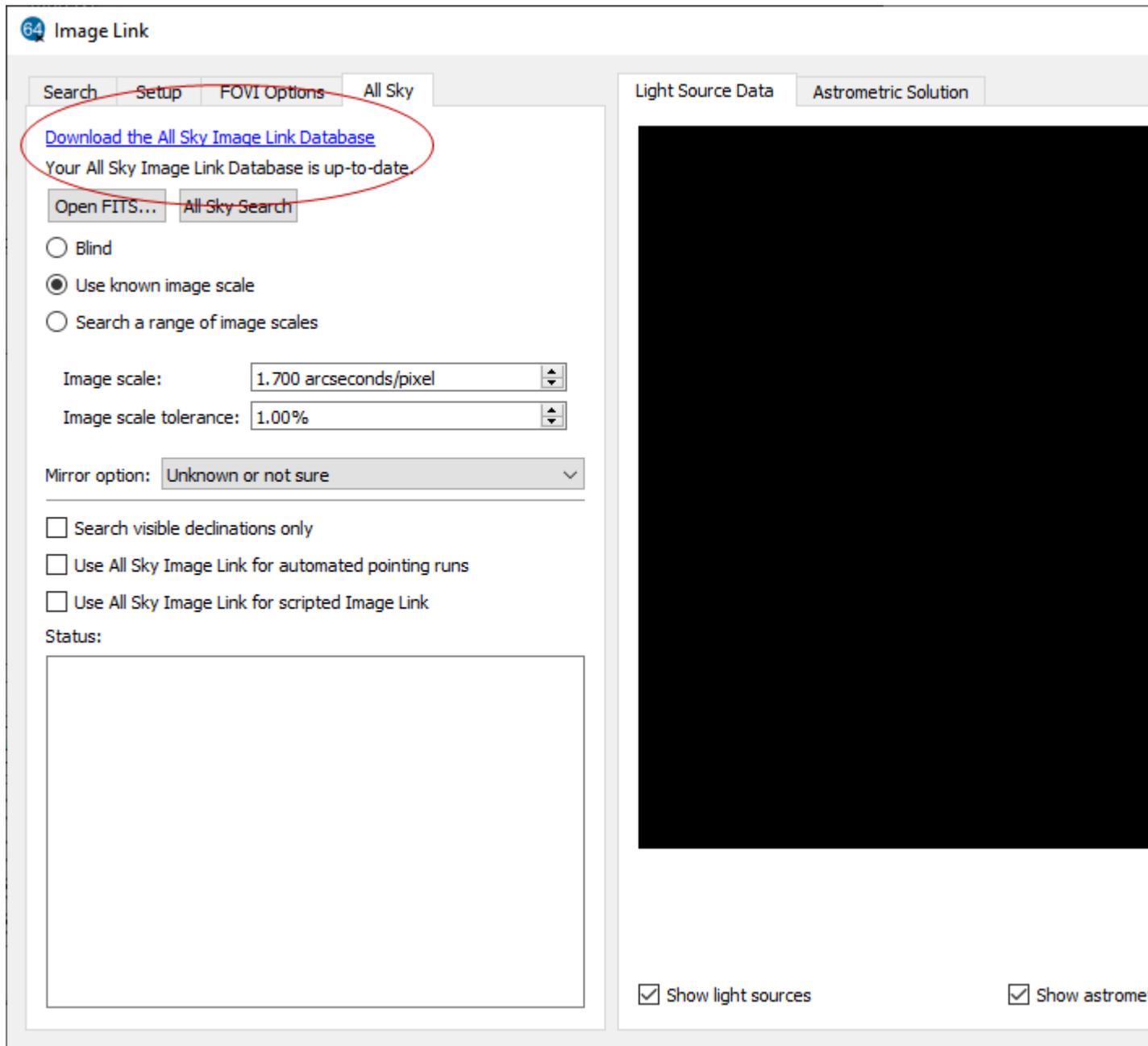
The bottom portion of the window is used up the process that AcquireStar will use in selecting and slewing the telescope to the stars found in the star catalog.



Images taken with TheSkyX, TheSky64 Camera Add-on, MaxIm, or Nebulosity 4 may be plate solved using TheSky Image Link method.

It is important to verify that you have the latest TheSky Image Link file installed on your computer.

- Open TheSky / Menu / Tools / Image Link
- Click on All Sky tab to verify that you have the latest file installed (as shown below).
- If it is not up to date, then press the link to sign in to the Software Bisque site and download 1.7 gigabyte file.



- Once installed you have the option to use 'Image Link All Sky for scripted operations Image Link' - see above screen shot
- Enable 'Use Set the Image scale for your system or enable 'Blind' or 'Search a range of image scales'

Plate Solve Bin

Set the desired camera binning that will be used plate solving the image for each filter.

Plate Solve Exp

Set the camera exposure that will be used for plate solving the image for each filter.

Note: The AcquireStar Wizard may be run to identify the optimum exposure and Target Star Mag for each filter.

Target Star Mag

Set the Target star magnitude in the data grid for each filter. By default the dim target star magnitude will be one mag fainter than the target magnitude which will reduce the number of candidate stars that will be identified in the catalog and improve the search time. If the user may change this setting:

- Open FW_XXXX.cfg in the active Configuration directory.
- Scroll down to section [Filters]
- Update the last entry in the desired filter row as shown below:
 Filter1=C|1|1|1.00|3.00|300|2|10.00|6.0|1.0
 Filter2=Blue|1|1|1.00|10.00|300|2|10.00|6.0|1.0
 Filter3=Green|2|1|1.00|10.00|300|2|10.00|6.0|1.0

Min Slew Altitude

The minimum telescope slew altitude allowed (default = 30 deg).

Number of Stars

The minimum number of stars that will be selected from the star catalog that meet the user defined parameters (default = 3).

Sort star list:

Stars found in the star catalog may be sorted by one of the following

- Declination
- Distance
- Flux - magnitude (default)

Sort Order:

The stars in the Sort star list above may be listed

- Ascending - small to large
- Descending - large to small - (Default)

For example:

To minimize slew distance select Sort star list: Distance, Order: Ascending

13:51:19.17 List sort: distance, ascending

13:51:19.18 Identified target stars:

13:51:19.22 1) GSC 3076-0221 RA: 17:06:26.5 Dec: +41:05:41.8 (Topo) Mag: 8.4 Sep: 8.03' Alt: 63.61d Az: 278.68d

13:51:19.27 2) GSC 3076-1239 RA: 17:09:40.9 Dec: +40:35:45.8 (Topo) Mag: 8.8 Sep: 39.69' Alt: 64.06d Az: 277.21d

13:51:19.31 3) GSC 3076-0009 RA: 17:03:00.6 Dec: +41:10:28.5 (Topo) Mag: 8.1 Sep: 46.79' Alt: 63.01d Az: 279.24d

13:51:19.35 4) GSC 3076-1395 RA: 17:09:18.4 Dec: +40:08:58.3 (Topo) Mag: 8.7 Sep: 59.08' Alt: 63.86d Az: 276.28d

13:51:19.39 5) GSC 3077-1156 RA: 17:12:37.1 Dec: +40:23:21.6 (Topo) Mag: 8.8 Sep: 73.99' Alt: 64.54d Az: 276.38d

13:51:19.44 6) GSC 3077-0558 RA: 17:12:16.0 Dec: +40:14:02.5 (Topo) Mag: 8.8 Sep: 76.22' Alt: 64.43d Az: 276.08d

13:51:19.49 Using 8.4 mag star at RA 17:06:26.5 Dec +41:05:41.8 (Topo) Alt: 63.61

To choose the brightest stars select Sort star list: Magnitude, Order: Descending (brightest to dimmer stars)

13:45:56.91 List sort: flux, descending (brighter to dimmer)

13:45:56.92 Identified target stars:

13:45:56.96 1) GSC 3076-0221 RA: 17:06:26.5 Dec: +41:05:41.8 (Topo) Mag: 8.4 Sep: 47.40' Alt: 64.59d Az: 278.06d

13:45:56.00 2) GSC 3077-0742 RA: 17:11:07.2 Dec: +39:39:24.2 (Topo) Mag: 8.6 Sep: 58.72' Alt: 65.03d Az: 274.22d

13:45:57.04 3) GSC 3076-1395 RA: 17:09:18.4 Dec: +40:08:58.3 (Topo) Mag: 8.7 Sep: 27.13' Alt: 64.85d Az: 275.58d

13:45:57.08 4) GSC 3076-1194 RA: 17:06:49.8 Dec: +39:54:37.5 (Topo) Mag: 8.7 Sep: 52.52' Alt: 64.32d Az: 275.38d

13:45:57.12 5) GSC 3077-1156 RA: 17:12:37.1 Dec: +40:23:21.6 (Topo) Mag: 8.8 Sep: 35.71' Alt: 65.52d Az: 275.69d

13:45:57.15 6) GSC 3077-0558 RA: 17:12:16.0 Dec: +40:14:02.5 (Topo) Mag: 8.8 Sep: 36.65' Alt: 65.41d Az: 275.38d

13:45:57.21 Using 8.4 mag star at RA 17:06:26.5 Dec +41:05:41.8 (Topo) Alt: 64.59

Goto Zenith

AcquireStar will begin the target star selection process at the zenith and expand in 2x2 degree increments until a suitable stars are found.

Blind slew

Enable to allow the telescope to perform all slews blind without using astrometric plate solving to determine precise telescope position.

Return slew

Enable to set the telescope to perform a return slew after acquiring the target star and performing the autofocus routine.

Final Pointing

Enable will allow the user to determine if the return slew following the autofocus run will be a precision slew with plate solve and final telescope pointing. This is useful if a target is centered in the field but the telescope must slew away to autofocus the telescope pointing will be fine tuned on return slew back to the target to the user defined Max error setting.

It should be noted that some observatory control apps will turn Final Pointing off before an autofocus run and will not reset the value when AcquireStar process is completed.

Meridian Cross

Enable this feature if you are using a mount that does not flip, such as an equatorial fork mount. If disabled, AcquireStar will identify target stars only on the current side of the meridian.

Sync

Allow the telescope to sync to current position following a successful astrometric plate solution of the current telescope position.

Max error

The maximum telescope position error (arc-minutes) following a telescope slew that that the user will accept before AcquireStar will attempt to fine tune the telescope position by taking another image and plate solving, (default = 1 arc-min.).

Example:

Setting Max Error = 0.0833 arc-min (5 arc-sec)

With the authors 16 f/4.5, 70" FL telescope (1.05 "/pixel), Paramount ME and a fresh TPoint model, the final return slew position is within a few arc-seconds after one pointing update.

Attempts

The number of plate solve attempts to achieve required telescope pointing, (default = 3).

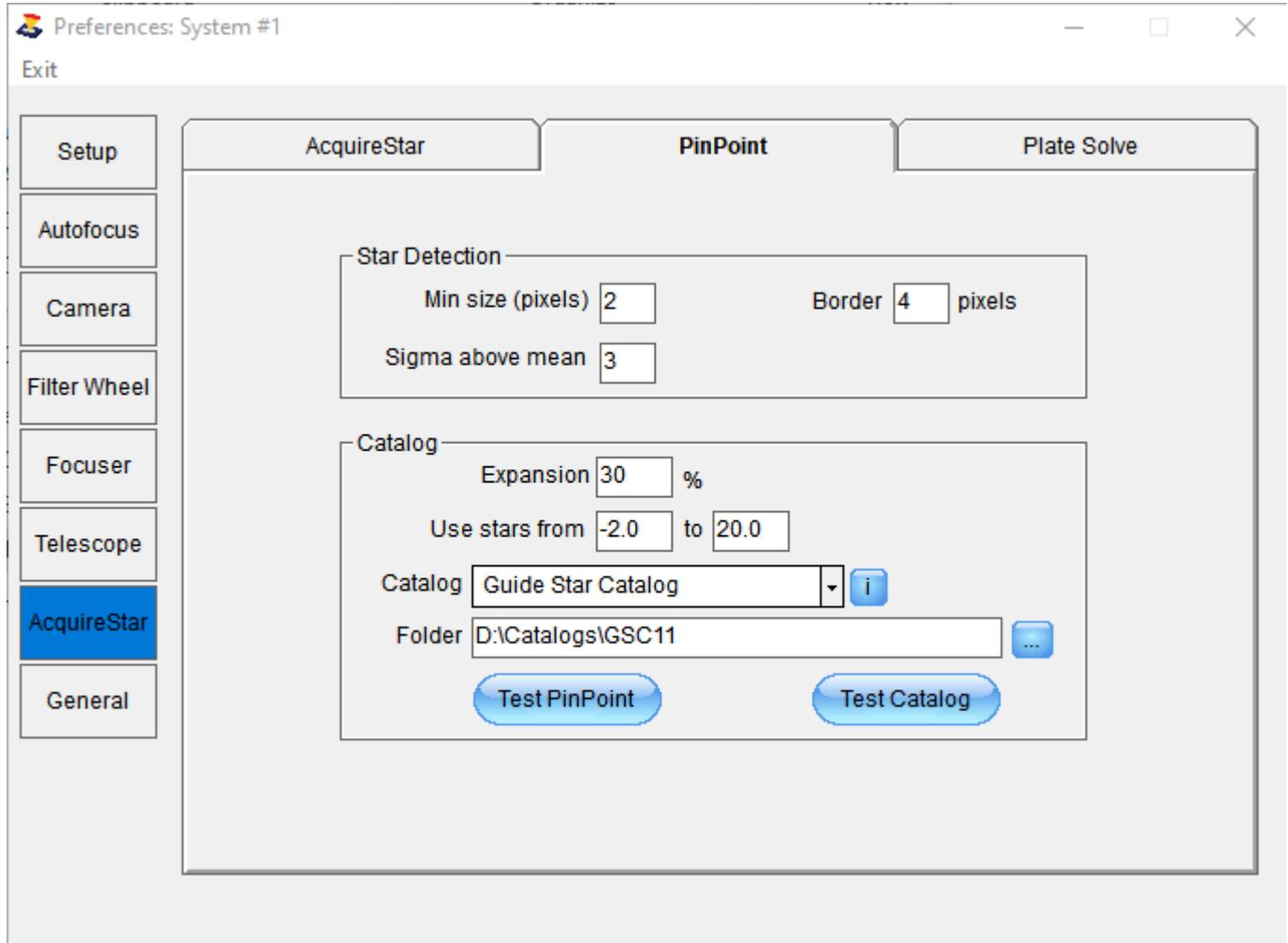
Method

- 'PinPoint' to plate solve the telescope pointing
- 'TheSky' Image Link to plate solve the telescope pointing. The user may utilize All Sky Image Link in TheSky if the appropriate catalogs have been installed

PinPoint Tab

PinPoint Tab

This tab contains information required for PinPoint settings which requires the full version not PinPoint LE.



Star Detection

- 'Min size' - minimum size in pixels for star detection (default = 2).
- 'Sigma above mean' - minimum standard deviation of the signal (star) above the background noise for star detection (default = 3).
- 'Border' - the number of pixels to ignore around the perimeter of the image when plate solving (default = 4).

Catalog

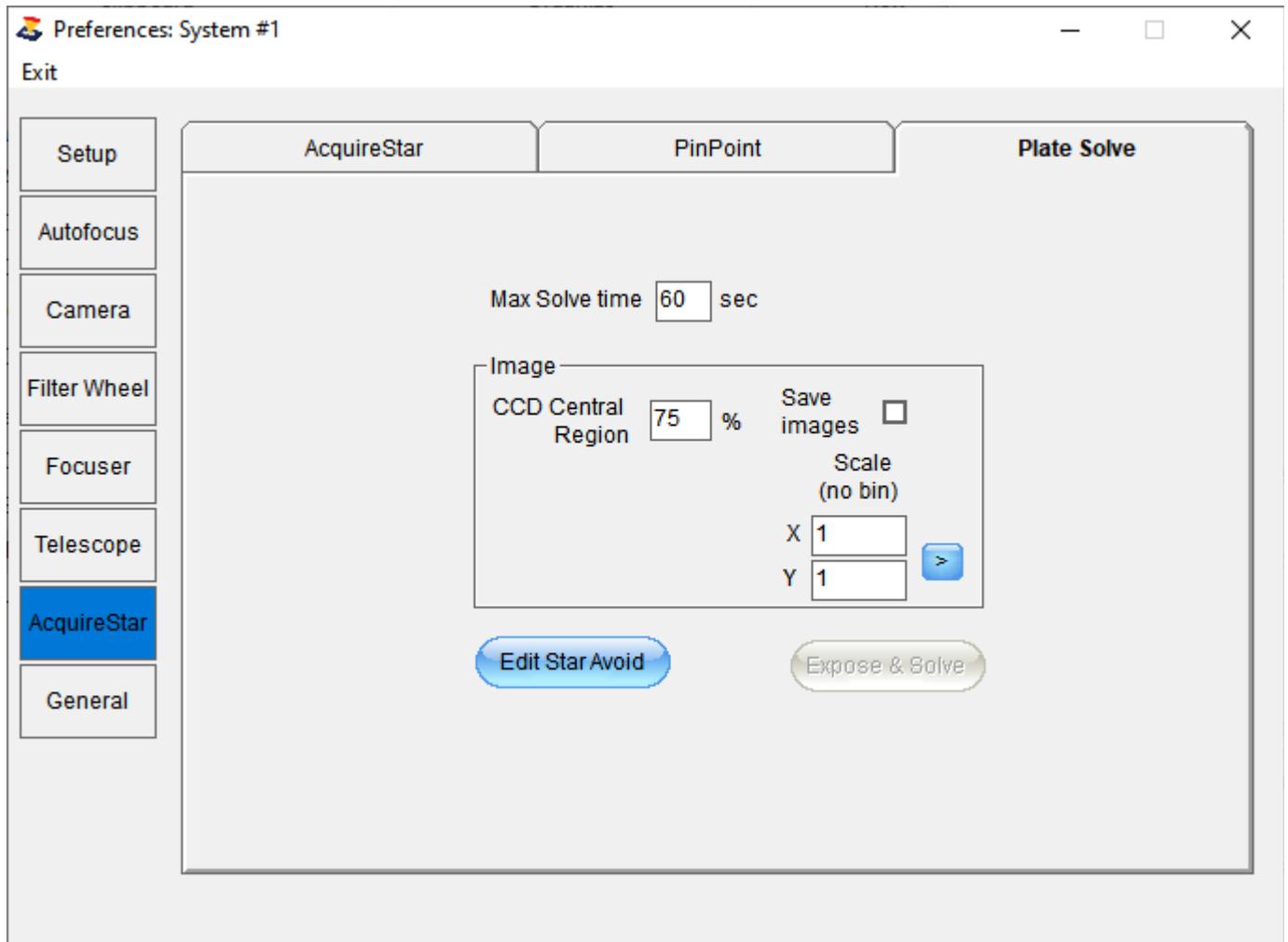
- 'Expansion' setting will read additional stars from the catalog to aid in plate solving (default = 30%)
- 'Use stars' will extract stars in the defined magnitude range from plate solving (default = -2.0 to 20.0)
- 'Catalog' lists the current catalogs that are available to be used by PinPoint. Pressing the small information button will open a text file that lists information about some of the available star catalogs. In general, the GSC is an excellent choice for most users. The ATLAS or USNO is useful if faint stars are required.
- 'Path' is the full path to the catalog chosen

Buttons

- 'Test Catalog' will verify that AcquireStar can access, 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.
- 'Test PinPoint' is used to verify that the full version of PinPoint has been installed on the PC. Unfortunately, PinPoint LE which ships with MaxIm does not provide plate solving capabilities.

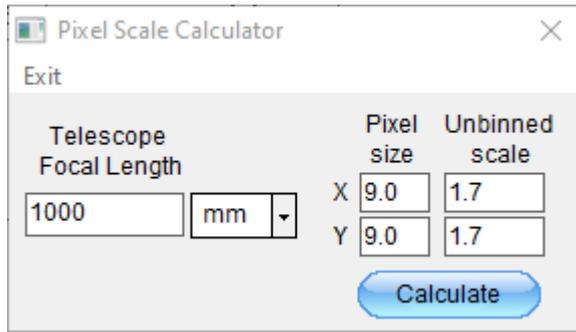
Plate Solve Tab

Plate Solve Tab



Image

- 'CCD Central Region' sets the size of the chip in percent for the image that will be used for plate solving. This should not be confused with a similar setting found on the [Preferences/Camera](#) window which defines the image size used for star detection and subframing the star during the focus run. A camera with large field of view would set the CCD Central Region to say 50% on the camera window to restrict the field for focus star detection and perhaps 75% on the Plate Solve Tab to maximize the number of stars used when an image is taken plate solving the telescope pointing.
- 'X/Y scale' is the camera unbinned scale in arc-sec / pixel.
- Press the small button to open the 'Scale calculator'



Max Solve Time

Set the maximum time in seconds to plate solve an image, (default = 60 sec).

Buttons

- 'Edit Star Avoid' - Occasionally AcquireStar may locate a star in the star catalog that appears to FocusMax as double star which will result in poor or failed autofocus run. Pressing the button will open a text file that contain a list of stars that will be ignored by AcquireStar.

'ID |RA |Dec |Mag ==> Any line starting with ' will be ignored. Do not delete this line

'GSC 3097-0115|17:52:09.2|+42:51:25.8|7.11 ==> sample - you may delete this line

SAO 49603 |20:25:26 |+42:36:18 |6.9

The file contains Star ID, Ra and Dec and magnitude delimited by '|'.

Simply add the known problem star to the list and AcquireStar will ignore it.

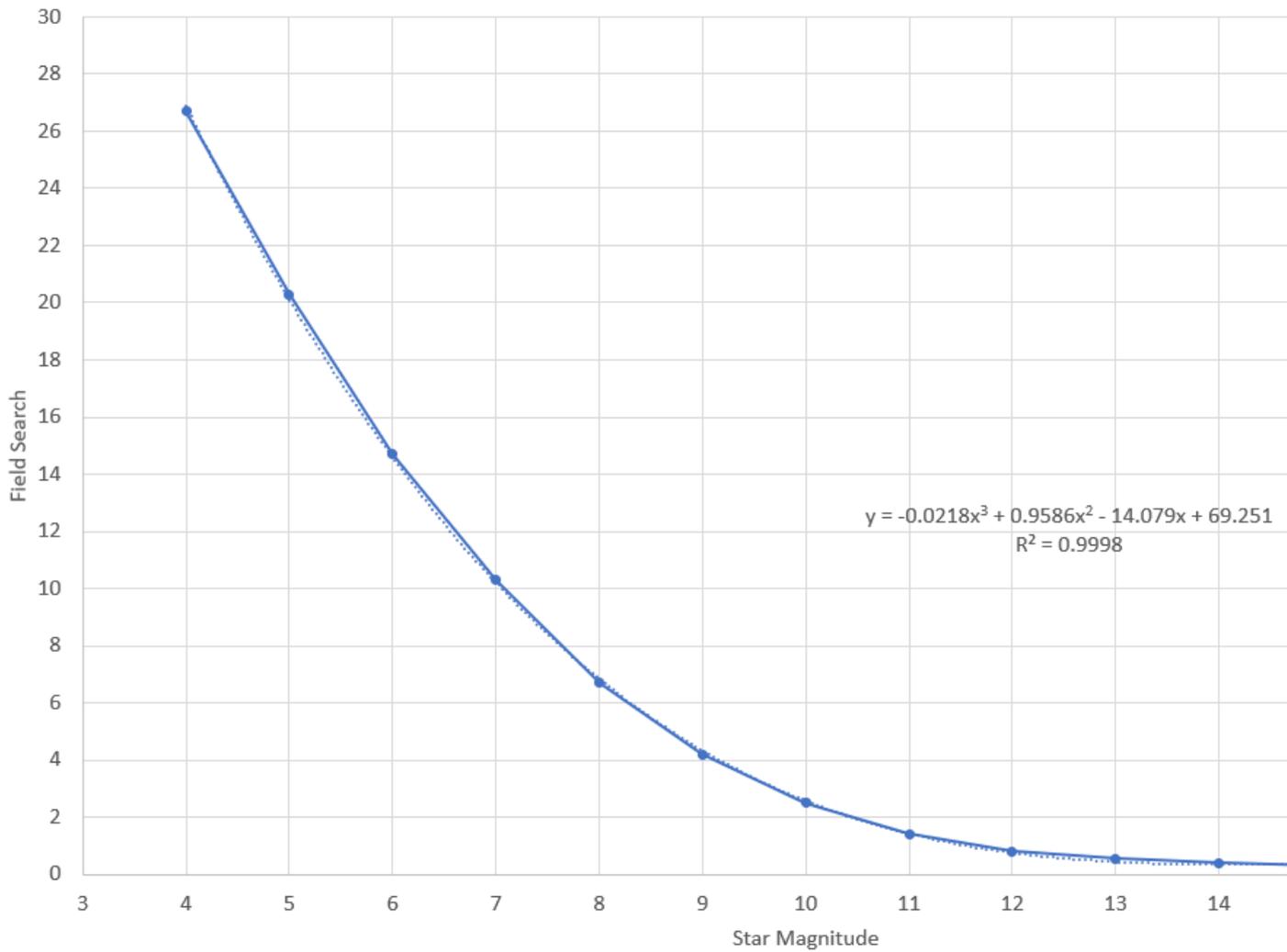
- 'Expose & Solve' will take an image and attempt to plate solve the current telescope position using the method selected on the AcquireStar Setup tab.

Notes

Notes

1. If a focus run fails when using AcquireStar, the star may potentially have been seen as a double star. When this occurs a temporary text file "AcquireStarAvoid_Temp.txt" will be created in C:\Users\XXX\Documents\FocusMax V5\Configurations\XXX which will contain the star designation, coordinates and magnitude of the failed star. This file will be read and the star(s) rejected from further AcquireStar runs for the rest of the night. The user may choose to permanently ignore these star(s) by copying and pasting the star information into the file "AcquireStarAvoid.txt" located in the same directory. The temporary file "AcquireStarAvoid_Temp.txt" will be deleted when FocusMax is restarted.
2. The field size during the star catalog search process is based on the user defined magnitude range in Preferences/AcquireStar for each filter. Since there are more fainter than brighter stars in any given field, the search field size may decrease to speed the search process. To simplify the user interface, a 3rd order polynomial was developed which is used to calculate the initial search field size (see below). This profile may be modified by user if desired. The relationship may be any order including a straight line of the type $y = mx + b$

Star Mag	Field Search
4	26.7
5	20.3
6	14.7
7	10.3
8	6.7
9	4.2
10	2.5
11	1.4
12	0.8
13	0.55
14	0.4
15	0.3
16	0.25



Work flow:

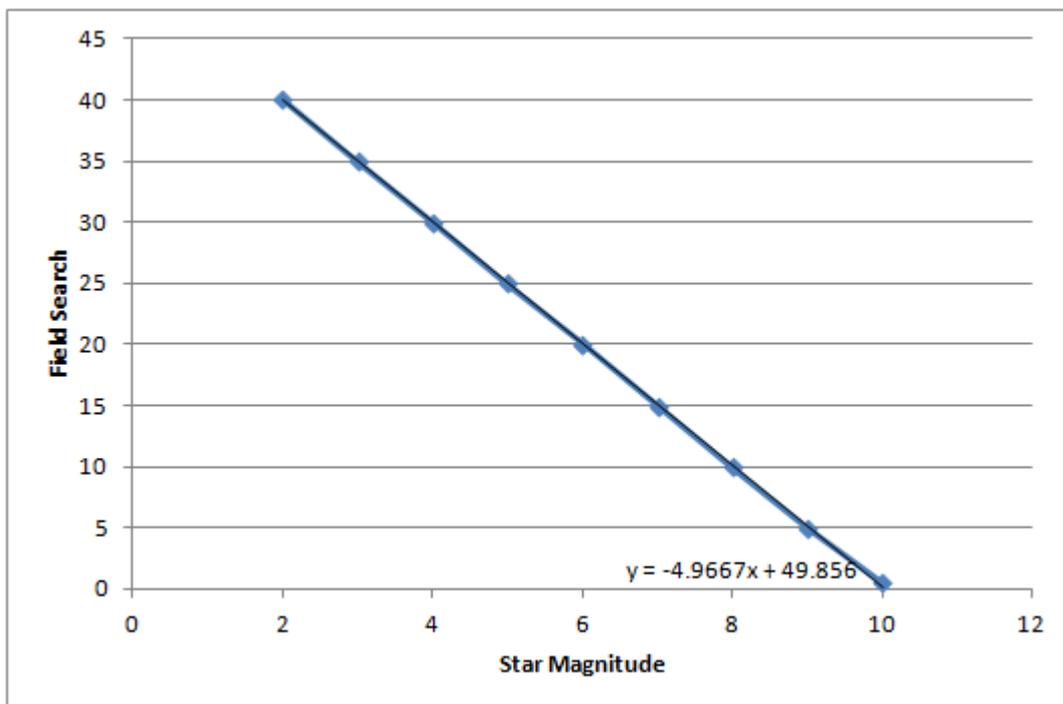
- Open Excel and generate star magnitude vs field search size (see above)

- Insert a scatter diagram onto the work page
- Insert a Trend-line onto the graph. The trend line can be based on an order X^1 to X^4 . Be sure to enable display equation for the trendline
- Find tune the data points by adjusting the field size so that the Trend-line begins to hug or transpose on to scatter diagram
- When completed, open your System.ini file and locate the following

```
[AcquireStar]
AcquireFieldSearchCoefficients = -0.0219|0.9761|- 14.395|70.378
```
- The coefficients for the relationship must start with the largest coefficient and must be delimited by '|'

As an example:

Star Mag	Field Search
2	40
3	35
4	30
5	25
6	20
7	15
8	10
9	5
10	0.5



- To implement, update the System.ini entry

```
[AcquireStar]
AcquireFieldSearchCoefficients = -4.9667|49.856
```

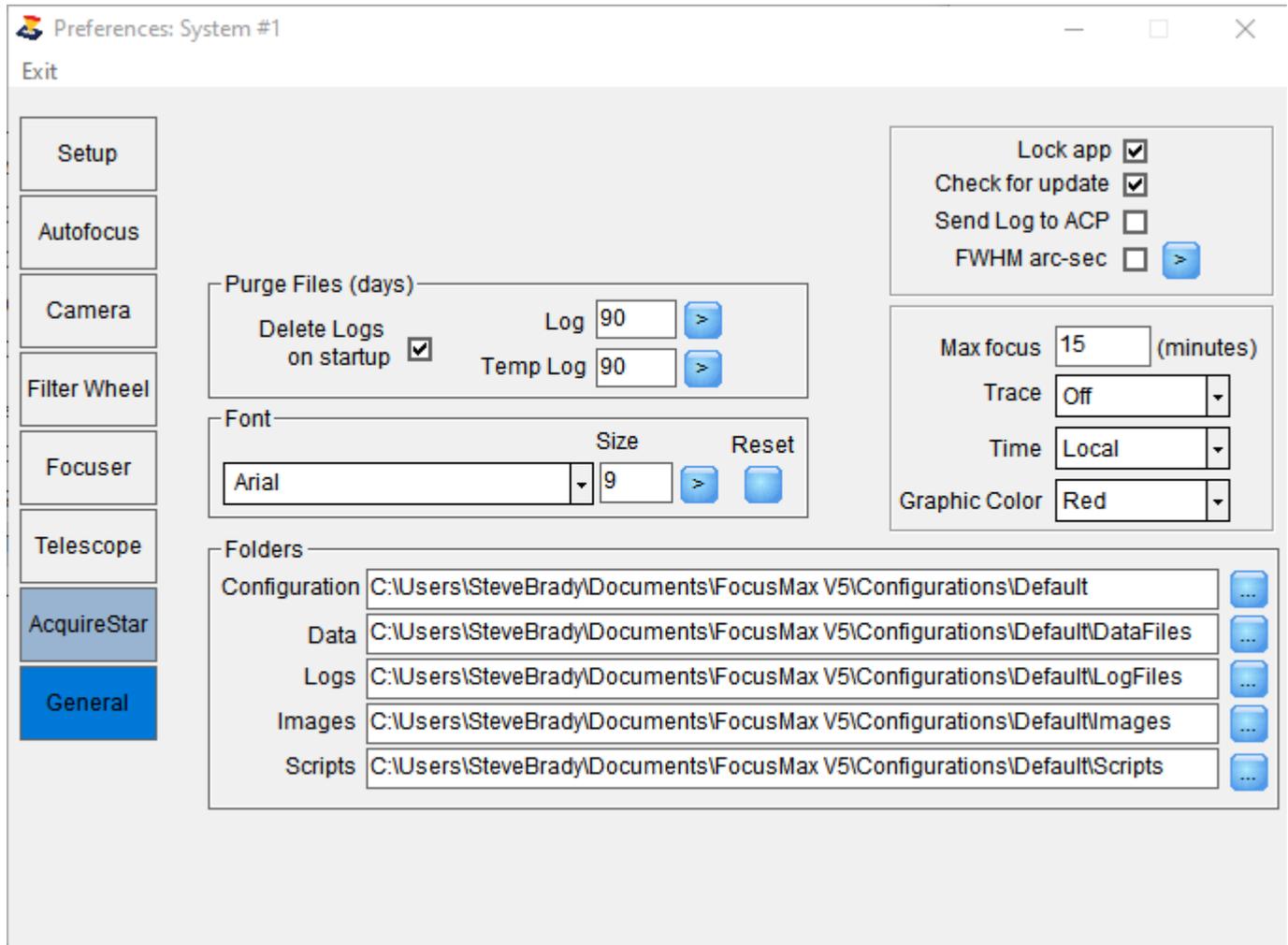
or round off as

AcquireFieldSearchCoefficients = -5|50

General

General Preferences

The Preferences window is used to set the the paths, setup purging of old files and set user font & size.



Purge Files

The Log files are created and saved with a unique file name each time FocusMax is loaded. when 'Delete Logs on startup' is enabled, FocusMax will automatically delete Log and Temperature Logs in the LogFiles directory that are older than the specified number of days. You can manually delete the files by pressing the small button containing '>' (default = 180 days).

Font

You can specify the Font type and Font Size that will used. The default is Arial, font size = 9

Folders

The Folders section allows you to set the directory path of:

- 'Configuration' - location of system.ini files which contain many of the FocusMax settings. Default C:\Users\XXX\Documents\FocusMax V5\Configurations\XXX
- 'Data' - these files are automatically saved when a Vcurve or Temperature Compensation Wizard is run:

Default C:\Users\XXX\Documents\FocusMax V5\Configurations\XXX\DataFiles

- 'Logs' - location of the Log files that are automatically generated each time FocusMax is opened.
Default C:\Users\XXX\Documents\FocusMax V5\Configurations\XXX\LogFiles
- 'Images' - you may save autofocus and Vcurve images to a directory. Default C:\Users\XXX\Documents\FocusMax V5\Configurations\XXX\Images
- 'Scripts' - location of FocusMax scripts. Default C:\Users\XXX\Documents\FocusMax V5\Configurations\XXX\Scripts

Pressing the small buttons will allow you to set a new directory path for each of the above

Send Log to ACP

FocusMax Log information will be sent to ACP is open and running. This will provide a contiguous Log of both ACP and FocusMax activities.

FWHM arc-sec

Display FWHM in arc-sec in Log instead of pixel at final focus (MaxIm only). Press the small button to open a calculator for setting arc-sec/pixels for the system.

Max focus time

Set the max time for autofocus run before giving up and stopping process (perhaps due to clouds) - default 15 minutes

Time

Log entries can be expressed in Local time or UTC

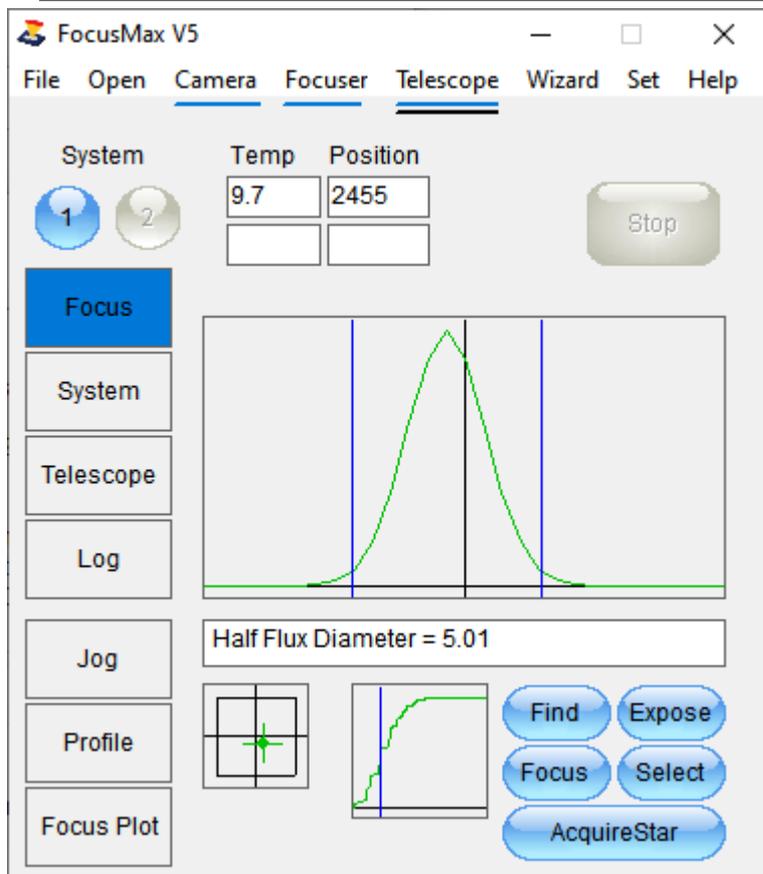
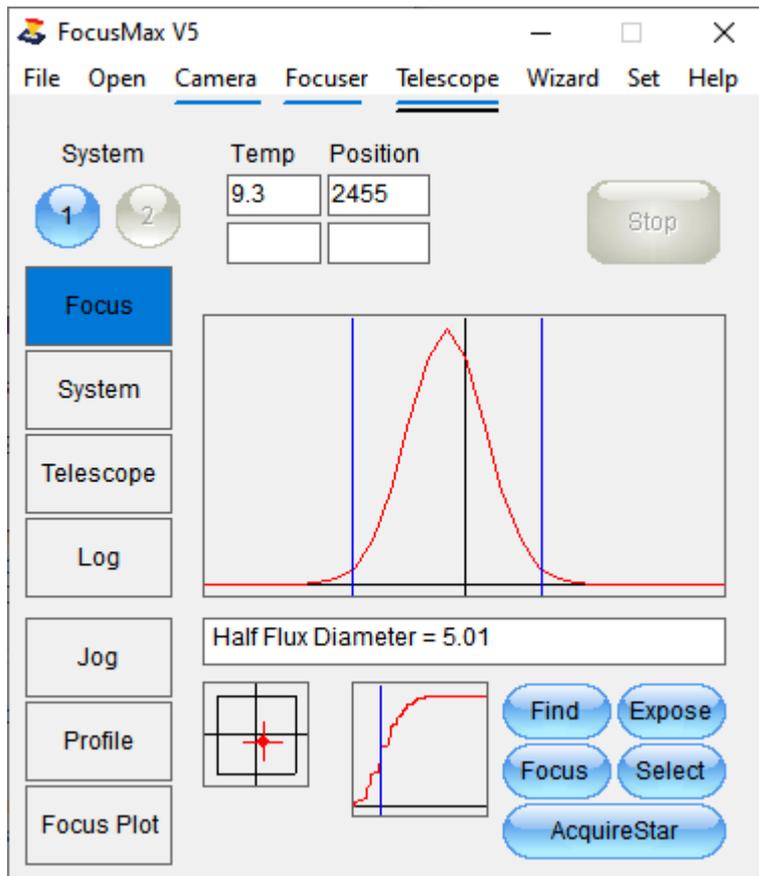
Trace

Select from the below options to enable Trace of FocusMax hardware and automation activity which is may be useful in identifying solutions to problem.

Trace files will be automatically created when FocusMax starts and will be deleted per the Purge Files setting above (default = off).

Graphic Color

The colors used for graphic display can be set for Red (default), Blue or Green colors. Users who operate a laptop with red filter may find the Blue a good choice.

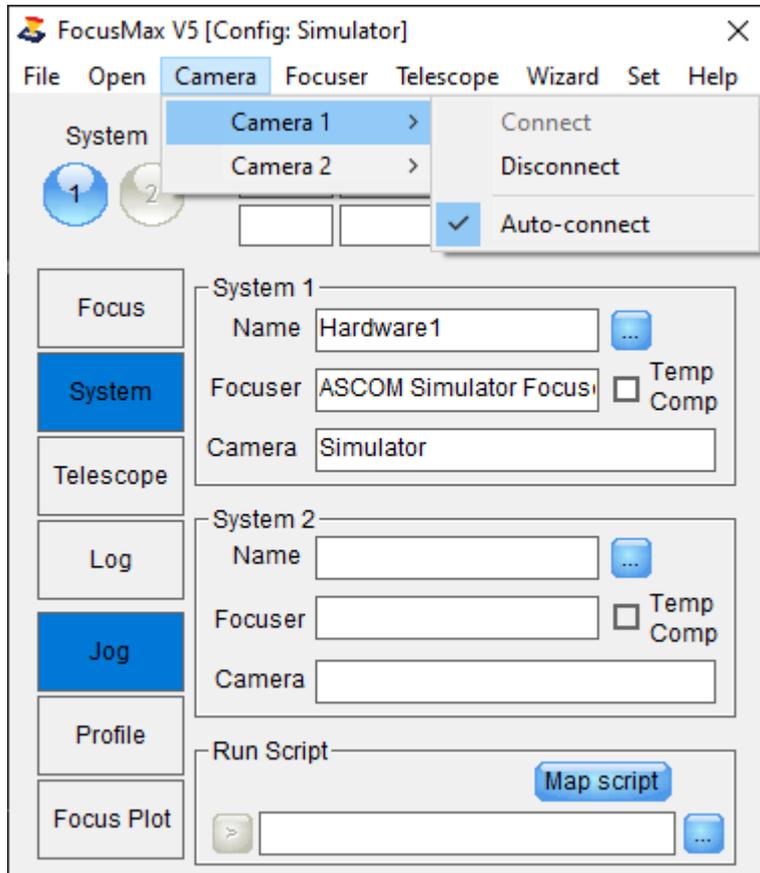


Camera

Camera

The camera can be manually connected / disconnected from the menu selection

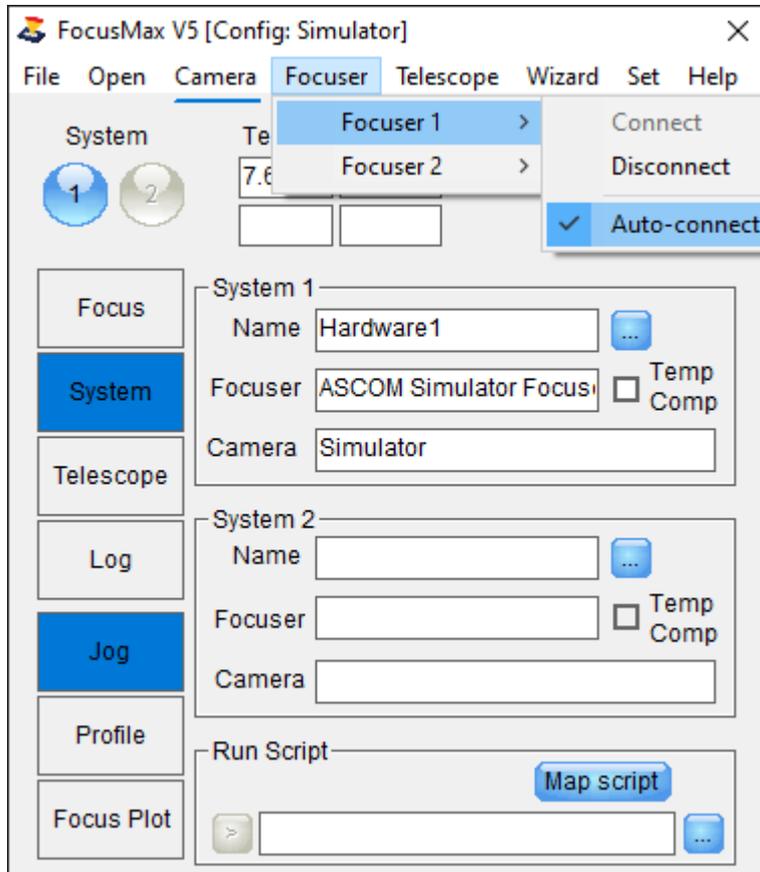
Auto-connect will load the camera control software, and connect to the camera when FocusMax is opened



Focuser

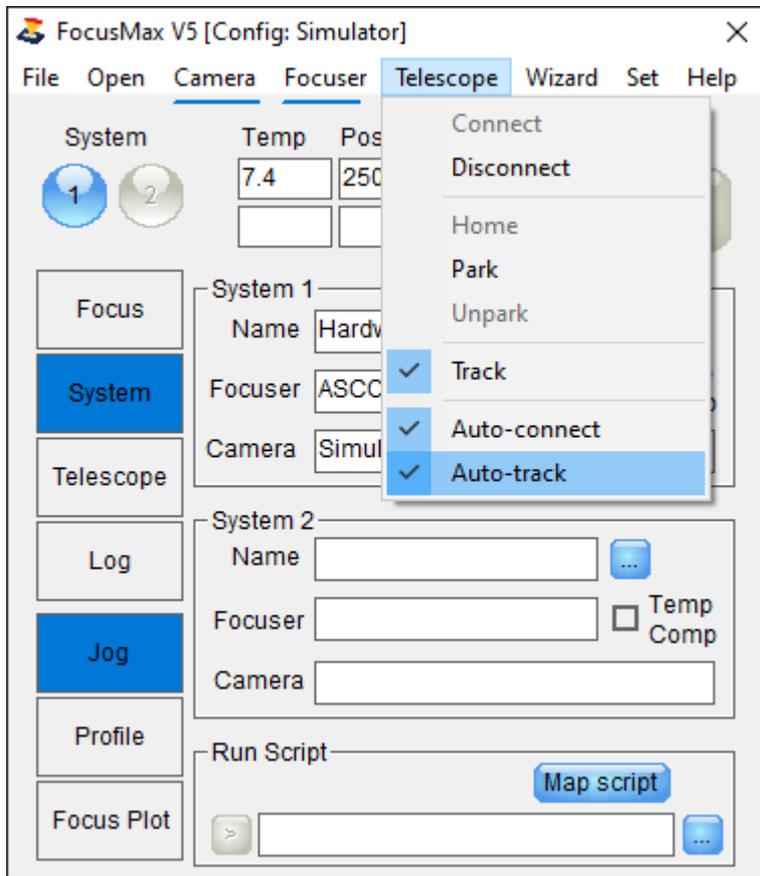
Focuser

The focuser may be manually connect or disconnect from the menu and may be set for auto-connect when FocusMax is opened.



Telescope

Telescope



Connect

Connect FocusMax to the Telescope via the telescope ASCOM interface

Disconnect

Disconnect the Telescope from FocusMax

Home

Home the telescope if this function is supported by the telescope / driver

Park

Park the telescope if it is Connected and Unparked.

Unpark

Unpark the telescope if it is connected and in the park position

Track

Will set telescope tracking on if this function is supported by the telescope / driver

Auto-connect

Will load the telescope control software and establish a connection when FocusMax is launched.

Auto-track

Will set telescope into tracking mode when telescope is connected either manually or by Auto-connect.

Wizard

Menu Wizard

Please see Tutorials for instructions:

1. AcquireStar Wizard will set the AcquireStar parameters for each filter based on a default 1 sec exposure time.
2. Filter Offset Wizard will determine the offset (in steps) between a given filter and selected reference filter.
3. FirstLight Wizard is designed to assist a new user in calibrating the system by generating a Vcurve and performing the first autofocus run
4. Focus Convergence Wizard will assist in setting the number of 'Steps' (a tolerance) when sampling at Near Focus to determine the focus position.
5. Temperature Compensation Wizard will collect temperature and position data during the night which can be used for determining the temperature coefficient that will be used by the focuser driver to move the focuser in small steps as the temperature changes throughout the night.

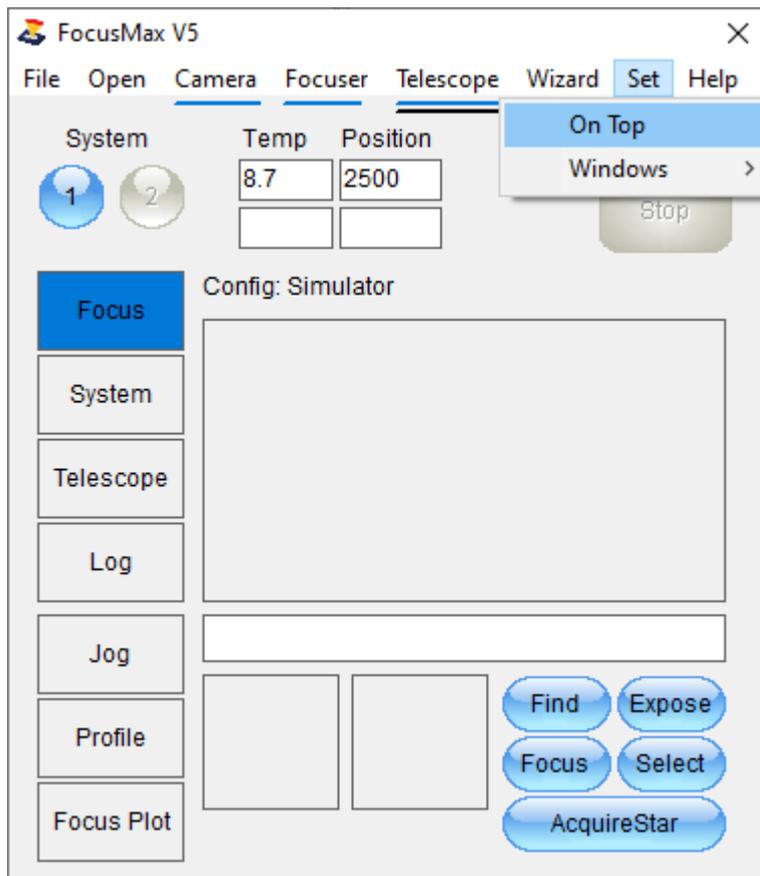
Set

Menu Set

On Top

On Top

Selecting On Top will place the window on top of all other windows.



Windows

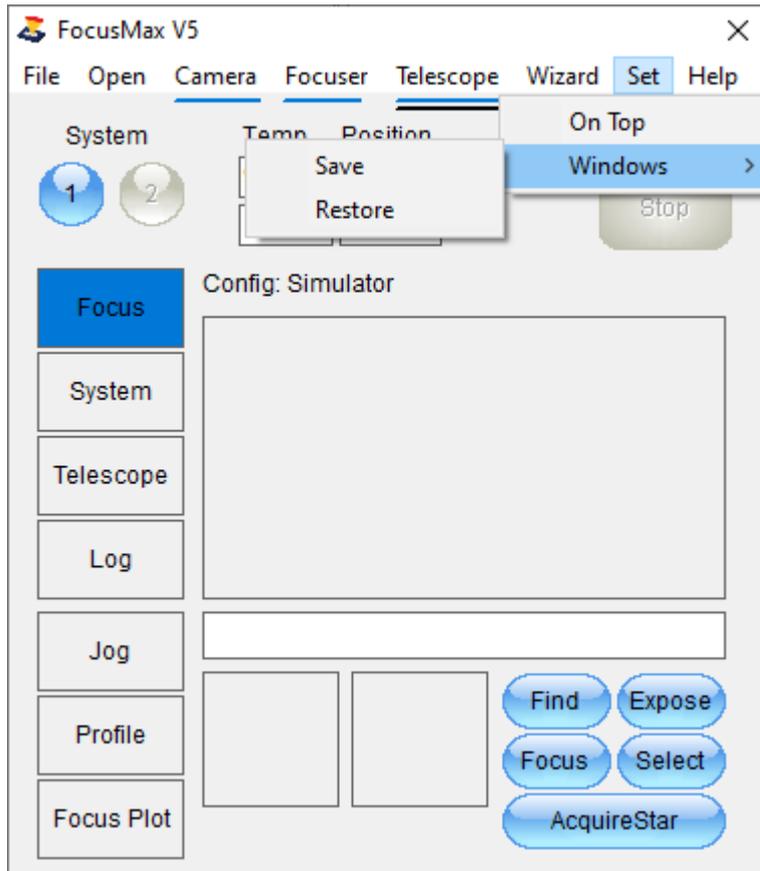
Windows

Save

Will save the current position of all open FocusMax windows which will load in the same position at startup

Restore

Will move all open windows to the saved positions (above)



Scripting

Scripting FocusMax

FocusMax exposes a rich series of methods and properties that may be scripted by the user or a host applications (ACP, CCD Autopilot, CCD Commander, etc). There are many choices as to what language to use which includes, VBScript, JScript, Perl, Python, or higher level development platforms such as MS VB6, VB.NET, etc.

FocusMax provides two primary objects:

- ▶ FocusControl: methods and properties that can be used to control FocusMax functions (see FocusControl [Properties](#) and [Methods](#)).
- ▶ Focuser: methods and properties that can be used to control focuser functions (see Focuser [Properties](#) and [Methods](#)).

To script FocusMax you must

- ▶ declare a variable
- ▶ create an instance of the FocusMax object you would like to use

Example:

```
Dim FMx
```

```
Set FMx = CreateObject("FocusMax.Focuser")
```

```
FMx.Move(1000) will move the focuser to position 1000
```

```
FMx.Position will return the current focuser position
```

[FocusControl Properties](#)

[FocusControl Methods](#)

[Focuser Properties](#)

[Focuser Methods](#)

Camera

Camera

Selected camera Methods and Properties that may be used with FocusMax scripts

Properties

Camera Properties

GetCameraStatus

GetCameraStatus

Property

GetCameraStatus (camera number) as Integer

Syntax

```
FocusMax.Camera.GetCameraStatus(camera number)
```

Parameters

Camera number = 1 or 2

Returns

Integer according to:

- 0 CameraIdle: at idle state, available to start exposure
- 1 CameraWaiting: exposure started but waiting (for shutter, trigger, filter wheel, etc.)
- 2 CameraExposing: exposure currently in progress
- 3 CameraReading: CCD array is being read out
- 4 CameraDownload: downloading data to PC
- 5 CameraError: camera error condition serious enough to prevent further operations (link fail, not linked, etc.)

Remarks

Get the current camera status per returned ASCOM values

Methods

Camera Methods

StopGuider

StopGuider

Method

StopGuider (Camera number)

Syntax

FocusMax.Camera.StopGuider

Parameters

Camera number (1 or 2)

Returns

Nothing

Remarks

FocusControl

FocusControl

The FocusControl provides a rich set of FocusMax Methods and Properties that can be utilized in a script

Properties

FocusControl Properties

AcquireStarAllowSyncEnable

AcquireStarAllowSyncEnable

Property

AcquireStarAllowSyncEnable (Boolean)

Syntax

FocusMax.FocusControl.AcquireStarAllowSyncEnable = [Boolean]

Remarks

Set or Get if the telescope will perform a sync following successful plate solve in [AcquireStar](#) / [AcquireStarAsync](#).

AcquireStarAsyncStatus

AcquireStarAsyncStatus

Property

AcquireStarAsyncStatus (Integer)

Syntax

FocusMax.FocusControlMethod.AcquireStarStatus = [Integer]

Remarks

Initiates AcquireStar method

Returns the status of the current or previous AcquireStar operation which was started using the [AcquireStarAsync](#) method.

A return value of:

0 means the operation failed

1 means the operation succeeded

-1 means the operation is in progress.

AcquireStarCenterMethod

AcquireStarCenterMethod

Property

AcquireStarCenterMethod (Integer)

Syntax

FocusMax.FocusControlMethod.AcquireStarCenterMethod = [Integer]

Remarks

Set AcquireStar centering method

0 = none

1 = auto-center

2 = plate solve

AcquireStarEnable

AcquireStarEnable

Property

AcquireStarEnable (Boolean)

Syntax

FocusMax.FocusControl.AcquireStarEnable = [Boolean]

Remarks

Set or Get the AcquireStar feature.

AcquireStarFinalPointingUpdate

AcquireStarFinalPointingUpdate

Property

AcquireStarFinalPointingUpdate (Boolean)

Syntax

FocusMax.FocusControl.AcquireStarFinalPointingUpdate = [Boolean]

Remarks

Set or Get the telescope final pointing update after autofocus

AcquireStarMeridianCrossEnable

AcquireStarMeridianCrossEnable

Property

AcquireStarMeridianCrossEnable (Boolean)

Syntax

FocusMax.FocusControl.AcquireStarMeridianCrossEnable = [Boolean]

Remarks

Set or Get if the mount will cross the meridian during target acquisition in [AcquireStar](#) / [AcquireStarAsync](#).

AcquireStarMinAltitude

AcquireStarMinAltitude

Property

AcquireStarMinAltitude (Double)

Syntax

FocusMax.FocusControl.AcquireStarMinAltitude = [Double]

Remarks

Set or Get the min altitude allowed in selecting a target star with the [AcquireStar](#) / [AcquireStarAsync](#) feature.

AcquireStarMinMagTgtStar

AcquireStarMinMagTgtStar

Property

AcquireStarMinMagTgtStar (single)

Syntax

FocusMax.FocusControl.AcquireStarMinMagTgtStar = [single]

Remarks

Sets the brightest target star to search from selected star catalog.

AcquireStarReturnSlewError

AcquireStarReturnSlewError

Property

AcquireStarReturnSlewError (Double)

Syntax

FocusMax.FocusControl.AcquireStarReturnSlewError = [Double]

Remarks

Set or Get the acceptable slew error (arc-min) in [AcquireStar](#) / [AcquireStarAsync](#).

AcquireStarMinSlew

AcquireStarMinSlew

Property

AcquireStarMinSlew (Double)

Syntax

FocusMax.FocusControl.AcquireStarMinSlew = [Double]

Remarks

Set or Get the min slew distance allowed in selecting a target star with the [AcquireStar](#) / [AcquireStarAsync](#) feature.

AcquireStarBrightTgtStarMag

AcquireStarBrightMagTgtStar

Property

AcquireStarBrightTgtStarMag (single)

Syntax

FocusMax.FocusControl.AcquireStarBrightTgtStarMag = [single]

Remarks

Sets the brightest target star to use for autofocus run.

Note:

AcquireStarMinTgtStarMag has been depreciated

AcquireStarDimTgtStarMag

AcquireStarDimMagTgtStar

Property

AcquireStarDimTgtStarMag (single)

Syntax

FocusMax.FocusControl.AcquireStarDimTgtStarMag = [single]

Remarks

Sets the dimmest target star to use for autofocus run.

Note:

AcquireStarMaxTgtStarMag has been depreciated

[AcquireStarBrightCatStarMag](#)

AcquireStarBrightCatStarMag

Property

AcquireStarBrightCatStarMag (single)

Syntax

FocusMax.FocusControl.AcquireStarBrightCatStarMag = [single]

Remarks

Sets the brightest target star in to search in the star catalog.

Note:

AcquireStarMinCatStarMag ahas been depreciated

[AcquireStarDimCatStarMag](#)

AcquireStarDimCatStarMag

Property

AcquireStarDimCatStarMag (single)

Syntax

FocusMax.FocusControl.AcquireStarDimCatStarMag = [single]

Remarks

Sets the dimmest target star in to search in the star catalog.

Note:

AcquireStarMaxCatStarMag has been depreciated

[AcquireNumberStars](#)

AcquireNumberStars

Property

AcquireNumberStars (Integer)

Syntax

FocusMax.FocusControl.AcquireNumberStars = [Integer]

Remarks

Set or Get the minimum number of stars that will be selected that based on the AcquireStar parameters that have been set [AcquireStar](#) / [AcquireStarAsync](#) (default = 3).

AcquireStarReturnSlewEnable

AcquireStarReturnSlewEnable

Property

AcquireStarReturnSlewEnable (Boolean)

Syntax

FocusMax.FocusControl.AcquireStarReturnSlewEnable = [Boolean]

Remarks

Set or Get the telescope return slew in [AcquireStar](#) / [AcquireStarAsync](#) method after completing the autofocus routine.

AcquireStarReturnSlewError

AcquireStarReturnSlewError

Property

AcquireStarReturnSlewError (Boolean)

Syntax

FocusMax.FocusControl.AcquireStarReturnSlewError = [Boolean]

Remarks

Set or Get the telescope return slew error in [AcquireStar](#) / [AcquireStarAsync](#) method.

AcquireStarSettleTime

AcquireStarSettleTime

Property

AcquireStarSettleTime (Double)

Syntax

FocusMax.FocusControl.AcquireStarSettleTime = [Double]

Remarks

Set or Get the telescope settle time (sec) following a slew in [AcquireStar](#) / [AcquireStarAsync](#).

AcquireStarSolveEnable

AcquireStarSolveEnable

Property

AcquireStarSolveEnable (Boolean)

Syntax

FocusMax.FocusControl.AcquireStarSolveEnable = [Boolean]

Remarks

Set or Get plate solve to determine current telescope pointing during pre and post slews in [AcquireStar](#) / [AcquireStarAsync](#).

AcquireStarSolveExposure

AcquireStarSolveExposure

Property

AcquireStarSolveExposure (Double)

Syntax

FocusMax.FocusControl.AcquireStarSolveExposure = [Double]

Remarks

Set or Get the plate solve exposure duration (sec) in [AcquireStar](#) / [AcquireStarAsync](#).

AcquireStarSpiralSearchEnable

AcquireStarSpiralSearchEnable

Property

AcquireStarSpiralSearchEnable (Boolean)

Syntax

FocusMax.FocusControl.AcquireStarSpiralSearchEnable = [Boolean]

Remarks

Set or Get method to perform a spiral search to determine telescope pointing if plate solve fails

AcquireStarZenithEnable

AcquireStarZenithEnable

Property

AcquireStarZenithEnable (Boolean)

Syntax

FocusMax.FocusControl.AcquireStarZenithEnable = [Boolean]

Remarks

Set or Get if the target star will be selected from a star catalog starting at the zenith in [AcquireStar](#) / [AcquireStarAsync](#).

AutoFocusExpMax

AutoFocusFluxMax

Property

AutofocusExpMax (Long)

Syntax

FocusMax.FocusControl.AutoFocusExpMax = [Long]

Remarks

Set or Get the max exposure setting used for autofocus with the [Focus](#) / [FocusAsync](#) feature.

AutoFocusExpMin

AutoFocusExpMin

Property

AutofocusExpMin (Long)

Syntax

FocusMax.FocusControl.AutoFocusExpMin = [Long]

Remarks

Set or Get the minx exposure setting used for autofocus with the [Focus](#) / [FocusAsync](#) feature.

AutoFocusFluxMax

AutoFocusFluxMax

Property

AutofocusFluxMax (Long)

Syntax

FocusMax.FocusControl.AutoFocusFluxMax = [Long]

Remarks

Set or Get the max flux setting used for autofocus with the [Focus](#) / [FocusAsync](#) feature.

AutoFocusFluxMin

AutoFocusFluxMin

Property

AutofocusFluxMin (Long)

Syntax

FocusMax.FocusControl.AutoFocusFluxMin = [Long]

Remarks

Set or Get the min flux setting used for autofocus with the [Focus](#) / [FocusAsync](#) feature.

AutoConnectTelescope

AutoConnectTelescope

Property

AutoConnectTelescope (Boolean)

Syntax

FocusMax.FocusControl. AutoConnectTelescope = [Boolean]

Remarks

Set or Get if the telescope will auto-connect when FocusMax is started. This is useful when used with [AcquireStar](#) / [AcquireStarAsync](#).

CCDCentralRegionEnable

CCDCentralRegionEnable

Property

CCDCentralRegionEnable (Boolean)

Syntax

FocusMax.FocusControl.CCDCentralRegionEnable = [Boolean]

Remarks

Enable (true) or disable (false) the CCD Central Region Width Percent for detecting a target star.

CCDCentralRegionWidthPercent

CCDCentralRegionWidthPercent

Property

CCDCentralRegionWidthPercent (Integer)

Syntax

FocusMax.FocusControl.CCDCentralWidthRegion = [Integer]

Remarks

Set or get the CCD Central Region Width Percent for detecting a target star.

DataFilePath

Exposure

Property

DataFilePath (String)

Syntax

FocusMax.FocusControl.DataFilePath = [String]

Remarks

Set or Get the Path for the Data Files (Temperature Comp and Vcuve runs). When written, this property first checks for an existing directory and if not found creates a new directory. An error is raised if the named directory does not already exist and this property is unable to create a new directory.

Exposure

Exposure

Property

Exposure (Double)

Syntax

FocusMax.FocusControl.Exposure = [Double]

Remarks

Set or Get the CCD Exposure time in seconds.

FailAttempts

FailAttempts

Property

FailAttempts (Integer)

Syntax

FocusMax.FocusControl.FailAttempts = [Integer]

Remarks

Set or get the number of attempts to obtain additional exposures after an initial failed exposure.

FailTimer

FailTimer

Property

FailTimer (Integer)

Syntax

FocusMax.FocusControl.FailTimer = [Integer]

Remarks

Get or set the wait time in seconds between attempts to recover the target star if lost. A typical setting is 5 seconds.

FilterNumber

FilterNumber

Property

FilterNumber (Integer)

Syntax

FocusMax.FocusControl.FilterNumber [= Integer]

Remarks

Set or Get the filter number in the filter wheel for current active system

FilterName

FilterName

Property

FilterName(Filter Number, read only string)

Syntax

FocusMax.FocusControl.FilterName(integer)

Remarks

Returns the name of the filter number in the current active system (1 or 2)

FilterNames

FilterNames

Property

FilterNames(read only, string)

Syntax

FocusMax.FocusControl.FilterNames

Remarks

Returns a string of all filter names delimited by '|' for the current active system (1 or 2)

FilterWheelID

FilterWheelID

Property

FilterWheelID(read only, string)

Syntax

FocusMax.FocusControl.FilterWheelID

Remarks

Returns the filter wheel ID (FWi_XXX, i = system 1 or 2) for the current active system number (1 or 2)

FilterWheelName

FilterWheelID

Property

FilterWheelName(read only, string)

Syntax

FocusMax.FocusControl.FilterWheelName(System number (Integer))

Remarks

Returns the filter wheel name for the defined System number (1 or 2)

FindStarAsyncStatus

FindStarAsyncStatus

Property

FindStarAsyncStatus (read only, Integer)

Syntax

FocusMax.FocusControl.FindStarAsyncStatus =[Integer]

Remarks

Returns the status of the current or previous find star operation started using the [FindStarAsync](#) method.

A return value of:

- 0 = operation failed
- 1 = operation succeeded
- 1 = operation is in progress

FocusAsyncStatus

FocusAsyncStatus

Property

FocusAsyncStatus (read only, Integer)

Syntax

FocusMax.FocusControl.FocusAsyncStatus = [Integer]

Remarks

Returns the status of the current or previous autofocus operation started using the [FocusAsync](#) method.

A return value of:

- 0 = operation failed
- 1 = operation succeeded
- 1 = operation is in progress.

FocuserBacklashDirection

FocuserBacklashDirection

Property

FocuserBacklashDirection (String)

Syntax

FocusMax.FocusControl.FocuserBacklashDirection = [String]

Remarks

Set or Get the focuser backlash direction:

- 0 = In
- 1 = Out

FocuserBacklashEnabled

FocuserBacklashEnabled

Property

FocuserBacklashEnabled (Boolean)

Syntax

FocusMax.FocusControl.FocuserBacklashEnabled = [Boolean]

Remarks

Set or Get the focuser backlash state.

FocuserBacklashSteps

FocuserBacklashSteps

Property

FocuserBacklashSteps (Long)

Syntax

FocusMax.FocusControl.FocuserBacklashSteps = [Long]

Remarks

Set or Get the focuser backlash setting in steps.

FocuserGuardBandSteps

FocuserGuardBandSteps

Property

FocuserGuardBandSteps (Long)

Syntax

FocusMax.FocusControl.FocuserGuardBandSteps = [Long]

Remarks

Set or Get the focuser guardband to limit travel to extreme min/max position.

FocuserMinTravel

FocuserMinTravel

Property

FocuserMinTravel (Long)

Syntax

FocusMax.FocusControl.FocuserMinTravel [Long]

Remarks

Get the focuser min travel in steps.

FocuserMidTravel

FocuserMidTravel

Property

FocuserMidTravel (Long)

Syntax

FocusMax.FocusControl.FocuserMidTravel [Long]

Remarks

Get the focuser mid travel in steps.

FocuserMaxTravel

FocuserMaxTravel

Property

FocuserMaxTravel (Long)

Syntax

FocusMax.FocusControl.FocuserMaxTravel [Long]

Remarks

Get the focuser max travel in steps.

FocuserTempComp

FocuserTempComp

Property

FocuserTempComp (Boolean)

Syntax

FocusMax.FocusControl.FocuserTempComp = [Boolean]

Remarks

Set or Get the focuser temperature compensation setting for current active system.

FocusConvergenceEnable

FocusConvergenceEnable

Property

FocusConvergenceEnable = [Boolean]

Syntax

FocusMax.FocusControl.FocusConvergence = [Boolean]

Remarks

Set or Get the FocusConvergence setting.

FocusConvergenceSamples

FocusConvergenceSamples

Property

FocusConvergenceSamples (Long)

Syntax

FocusMax.FocusControl.FocusConvergence = [Long]

Remarks

Set or Get number samples during when using autofocus convergence method

FocusConvergenceSteps

FocusConvergenceSteps

Property

FocusConvergenceSteps (Long)

Syntax

FocusMax.FocusControl.FocusConvergence = [Long]

Remarks

Set or Get the Set number of focuser steps (tolerance) when using Focus Convergence method

FocusMaxIsLoaded

FocusMaxIsLoaded

Property

FocusMaxIsLoaded (read only, Boolean)

Syntax

FocusMax.FocusControl.FocusMaxIsLoaded = [Boolean]

Remarks

Returns True or False if FocusMax has been loaded and ready.

FocusMethod

FocusMethod

Property

FocusMethod (integer)

Syntax

FocusMax.FocusControl.FocusMethod (integer)

Remarks

Set or return the focus method:

0 = Standard (one-side of Vcurve)

1 = Advanced (both sides of Vcurve)

FocusProcess

FocusProcess

Property

FocusProcess (integer)

Syntax

FocusMax.FocusControl.FocusProcess (integer)

Remarks

Set or return the focus method:

0 = Single-Star

1 = Multi-Star

FocusRoutineFailAttempts

FocusRoutineFailAttempts

Property

FocusRoutineFailAttempts (Integer)

Syntax

FocusMax.FocusControl.FailAttempts = [Integer]

Remarks

Set or Get the number of attempts to autofocus before declaring failure

FocusRoutineFailTimer

FocusRoutineFailTimer

Property

FocusRoutineFailTimer (Integer)

Syntax

FocusMax.FocusControl.FailTimer = [Integer]

Remarks

Set or get the time in seconds that the next attempted exposure will start after a failed exposure.

FocusRoutineMaxHFD

FocusRoutineMaxHFD

Property

FocusRoutineMaxHFD (Single)

Syntax

FocusMax.FocusControl.FocusRoutineMaxHFD = [Single]

Remarks

Get or set the maximum value of the Best Focus HFD value used to determine acceptability of the final focused target star following a focus run.

If the measured HFD exceeds this value, the focuser Position is returned to the start position.

Note, for this property to be active, the property [FocusRoutineReturnToStartPositionEnable](#) must be set to true.

FocusRoutineReturnToStartPositionEnable

FocusRoutineReturnToStartPositionEnable

Property

FocusRoutineReturnToStartPositionEnable (Boolean)

Syntax

FocusMax.FocusControl.FocusRoutineReturnToStartPositionEnable = [Boolean]

Remarks

Enable (true) or disable (false) the focuser return to start position if an error is encountered or Best Focus HFD is greater than the value specified by the property [FocusRoutineMaxHFD](#).

HalfFluxDiameter

HalfFluxDiameter

Property

HalfFluxDiameter (read only, Single)

Syntax

FocusMax.FocusControl.HalfFluxDiameter

Remarks

Returns the Half Flux Diameter of the brightest star measured in pixel units.

This should be preceded by some Method that measures the HFD such as [Focus](#) or a [FindStar](#) or else it will return 0.

IsBusy

IsBusy

Property

IsBusy (read only, Boolean)

Syntax

FocusMax.FocusControl.IsBusy

Remarks

Returns the status if FocusMax is busy with an operation

LastAutofocusPosition

LastAutofocusPosition

Property

LastAutofocusPosition (Long)

Syntax

FocusMax.FocusControl.LastAutofocusPosition [Long]

Remarks

Get the last autofocus position:

A returned value of -999 indicates that the data is available.

LastAutofocusFilter

LastAutofocusFilter

Property

LastAutofocusFilter (Integer)

Syntax

FocusMax.FocusControl.LastAutofocusFilter [Integer]

Remarks

Get the last autofocus filter used:

A returned value of -999 indicates that the data is available.

LastAutofocusTemperature

LastAutofocusTemperature

Property

LastAutofocusTemperature (Single)

Syntax

FocusMax.FocusControl.LastAutofocusTemperature [Single]

Remarks

Get the last autofocus temperature:

A returned value of -999 indicates that the data is not available.

LastAutofocusJulianDate

LastAutofocusJulianDate

Property

LastAutofocusJulianDate (Double)

Syntax

FocusMax.FocusControl.LastAutofocusJulianDate [Double]

Remarks

Get the last autofocus Julian Date:

A returned value of -999 indicates that the data is not available.

PlateSolveMethod

PlateSolveMethod

Property

PlateSolveMethod (Integer)

Syntax

FocusMax.FocusControl.PlateSolveMethod= [Integer]

Remarks

Set or Get the plate solve method:

0 = None

1 = PinPoint

2 = PinPoint/AllSky

3 = TSX ImageLink

MultiStarFocusAsyncStatus

MultiStarFocusAsyncStatus

Property

MultiStarFocusAsyncStatus (Integer)

Syntax

FocusMax.FocusControl.MultiStarFocusAsyncStatus = [Integer]

Syntax

None

Remarks

Initiates MultiStarFocusAsyncStatus method

Returns the status of the current or previous MultiStarFocusAsync operation which was started using the [MultiStarFocusAsync](#) method.

A return value of:

0 means the operation failed

1 means the operation succeeded

-1 means the operation is in progress.

PlateSolveMethodName

PlateSolveMethodName

Property

PlateSolveMethodName (Integer)

Syntax

FocusMax.FocusControl.PlateSolveMethod (Integer)

Remarks

Returns the plate solve method name

0 = None

1 = PinPoint

2 = PinPoint/AllSky

3 = TSX ImageLink

Position

Position

Property

Position (read only, Long)

Syntax

FocusMax.FocusControl.Position

Remarks

Returns the current focuser position, in steps. Valid only for absolute positioning focusers. An error will be

thrown for relative positioning focusers.

PostCommandStatus

PostCommandStatus

Property

PostCommandStatus (Read only Integer)

Syntax

FocusMax.FocusControl.PostCommandStatus

Initiate a sync or async command. This will be used when command function is mapped to custom script

- 1 = ExposeAsync
- 2 = FindAsync
- 3 = FocusAsync
- 4 = FocusAtStarCenterAsync
- 5 = AcquireStarAsync

Remarks

Initiates FocusMax COM method

Returns the status of the current or previous operation the method number above.

A return value of:

- 0 means the operation failed
- 1 means the operation succeeded
- 1 means the operation is in progress.

ReadFilterInfo

ReadFilterInfo

Property

ReadFilterInfo (Filter Number integer) read only string

Syntax

FocusMax.FocusControl.ReadFilterInfo(Filter Number)

Remarks

Returns the filter information string associate with the current system number (1 or 2) and filter number.

SavedImagePath

SavedImagePath

Property

SavedImagePath (String)

Syntax

FocusMax.FocusControl.SavedImagePath = [String]

Remarks

Set or get the Path for the Saved Image files. When written, this property first checks for an existing directory and if not found creates a new directory. An error is raised if the named directory does not already exist and this property is unable to create a new directory. Setting SavedImagePath has the same effect as user entered changes to 'Images' path in [Preferences/General](#).

SavedLogPath

SavedLogPath

Property

SavedLogPath (String)

Syntax

FocusMax.FocusControl.SavedLogPath = [String]

Remarks

Set or get the Path for the Saved Log files. When written, this property first checks for an existing directory and if not found creates a new directory. An error is raised if the named directory does not already exist and this property is unable to create a new directory.

SavedScriptPath

SavedScriptPath

Property

SavedScriptPath (String)

Syntax

FocusMax.FocusControl.SavedScriptPath = [String]

Remarks

Set or get the Path for the Saved Script files. When written, this property first checks for an existing directory and if not found creates a new directory. An error is raised if the named directory does not already exist and this property is unable to create a new directory.

SetStopButton

SetStopButton

Property

SetStopButton(Boolean)

Syntax

FocusMax.FocusControl.SetStopButton= [Boolean]

Remarks

Used to enable Stop buttons at beginning script operation for early operator intervention is necessary

Scratch

ScriptToLog

Property

Scratch(integer)

Syntax

FocusMax.Scratch(Int)= [Variant]

Remarks

Scratch will return values stored in temp array back to a calling application

ScriptToLog

ScriptToLog

Property

ScriptToLog(Boolean)

Syntax

FocusMax.FocusControl.ScriptToLog= [Boolean]

Remarks

Set or Get sending script information to log

ShowFocusHistogram

ShowFocusHistogram

Property

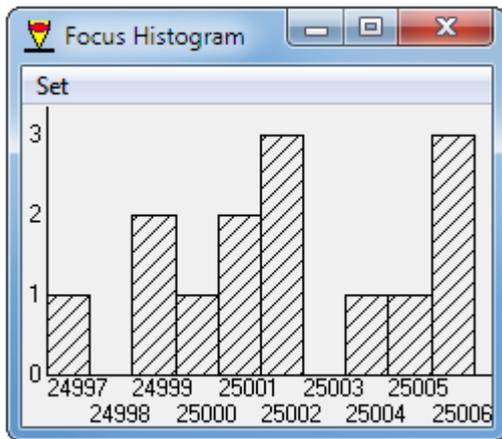
ShowFocusHistogram (Boolean)

Syntax

FocusMax.FocusControl. ShowFocusHistogram = [Boolean]

Remarks

Set or Get the focus histogram display during the autofocus routine.



ShowFocusPlot

ShowFocusPlot

Property

ShowFocusPlot (Boolean)

Syntax

FocusMax.FocusControl.ShowFocusPlot = [Boolean]

Remarks

Set or Get the [focus_plot](#) display during the autofocus routine.

SingleExposeAsyncStatus

SingleExposeAsyncStatus

Property

SingleExposeAsyncStatus (read only, Integer)

Syntax

FocusMax.FocusControl.SingleExposeAsyncStatus = [Integer]

Remarks

Returns the status of the current or previous single expose operation started using the [SingleExposeAsync](#) method.

A return value of:

0 = operation failed

1 = operation succeeded

-1 = operation is in progress

SingleExposeFrameWidth

SingleExposeFrameWidth

Property

SingleExposeFrameWidth (Integer)

Syntax

FocusMax.FocusControl.SingleExposeFrameWidth

Remarks

Returns or sets the Width in pixels of the [SingleExpose](#) Frame. The Frame is always square so that the Height equals the Width. This reads or sets the Frame Width parameter on [Preferences/Autofocus](#) window.

StarXCenter

StarXCenter

Property

StarXCenter (Single)

Syntax

FocusMax.FocusControl.StarXCenter

Remarks

Returns or sets the CCD chip X coordinate of the center of the brightest star. It will return 0 unless preceded by a [Focus](#) or a [FindStar](#) Method, or is set with the StarXCenter Property.

StarYCenter

StarYCenter

Property

StarYCenter (Single)

Syntax

FocusMax.FocusControl.StarYCenter

Remarks

Returns or sets the CCD chip Y coordinate of the center of the brightest star. It will return 0 unless preceded by a [Focus](#) or a [FindStar](#) Method, or is set with the StarYCenter Property.

SystemNumber

SytemNumber

Property

SystemNumber (Integer)

Syntax

FocusMax.FocusControl.SystemNumber

Remarks

Returns or sets the active FocusMax system number (1 or 2)

SystemFileName**SystemFileName****Property**

SystemFileName (String)

Syntax

FocusMax.FocusControl.SystemFileName

Remarks

When read: Returns the System ini File Name. When written: Selects the Named System. The Name contains the full Path, the ini File Name and the Extension. An example SystemFileName is "C:\Program Files\FocusMax\Data Files\LX 200 f 6.3.ini".

This is very useful for modifying any of the System parameters. First modify the desired parameters in a valid System ini file and then set SystemFileName equal to the System ini File Name.

Temperature**Temperature****Property**

Temperature (read only, Single)

Syntax

FocusMax.Focuser.Temperature

Remarks

Returns the current ambient temperature as measured by the focuser. Throws an error if ambient temperature is not available.

TempCompMethod**TempCompMethod****Property**

TempCompMethod(Integer)

Syntax

FocusMax.FocusControl.TempCompMethod= [Integer]

Remarks

Set or Get the temperature compensation method

0 = Native Focuser TC

1 = FocusMax TC

3 = None

TotalFlux

TotalFlux

Property

TotalFlux (read only, Single)

Syntax

FocusMax.FocusControl.TotalFlux

Remarks

Returns the Total Half Flux of the target star.

Version

Version

Property

Version (read only, String)

Syntax

FocusMax.FocusControl.Version

Remarks

Returns the current FocusMax.exe version as read by Windows.

WriteFilterInfo

WriteFilterInfo

Property

WriteFilterInfo (System number, Filter number, Filter info)

Syntax

FocusMax.FocusControl.WriteFilterInfo(System number (integer), Filter number (integer), FilterInfo (string))

Remarks

Writes the filter information string associate with a particular System number, Filter number
Use FocusMax.FocusControl.SystemNumber to get current active system number.

Methods

FocusControl Methods

AcquireStarAimCamera

AcquireStarAimCamera

Method

AcquireStarAimCamera(RA_J2K, Dec_J2K, Optional PlateX , Optional PlateY) = Boolean

Syntax

FocusMax.FocusControlMethod.AcquireStarAimCamera (RA, Dec)

Parameters

None

Returns

True if start is successful.

False if failed

Remarks

This is a synchronous operation which will take an image, plate solve current telescope pointing then fine tune telescope pointing to achieve input RA & Dec coordinates. Input Ra & Dec must in equatorial system J2000 decimal.

AcquireStar

AcquireStar

Method

AcquireStar () as Boolean

Syntax

FocusMax.FocusControlMethod.AcquireStar

Parameters

None

Returns

True if start is successful.

Remarks

Initiate AcquireStar method

AcquireStarAsync

AcquireStarAsync

Method

AcquireStarAsync () as Boolean

Syntax

FocusMax.FocusControl.AcquireStarAsync

Parameters

None

Returns

True if start is successful.

Remarks

Starts the AcquireStar autofocus operation and returns immediately. AcquireStar identifies a target star from a catalog based on user criteria, slews the telescope, acquires the star, initiates the autofocus routine and performs a return slew.

Note that AcquireStarAsync allows your script to be active during the operation, which may take many seconds. You may need to periodically check the [AcquireStarAsyncStatus](#) property to determine when the status of the operation.

AcquireStarPlateSolveMethod

AcquireStarPlateSolveMethod

Property

AcquireStarPlateSolveMethod(Integer)

Syntax

FocusMax.FocusControl.AcquireStarPlateSolveMethod= [Integer]

Remarks

Set or Get the current plate solve method

- 0 = PinPoint
- 1 = TheSky ImageLink
- 3 = Nothing

AcquireStarTakeImageSolve

AcquireStarTakeImageSolve

Method

AcquireStarTakeImageSolve(RA, Dec) as Boolean

Syntax

FocusMax.FocusControlMethod.AcquireStarTakeImageSolve(RA, Dec)

Parameters

None

Returns

True if start is successful.

False if failed

Ra & Dec is returned in Scratch (0) Scratch(1)

Remarks

This is a synchronous operation which will take an image, plate solve current telescope pointing. Input Ra & Dec must in equatorial system J2000 decimal, returned RA & Dec are catalog J2000.

Delay

Delay

Method

Delay (Double)

Syntax

FocusMax.FocusControl.Delay = [Double]

Parameters

None

Returns

Nothing

Remarks

Initiate a user defined delay which is useful to assure script operations are complete .

DeleteFilterWheelInfo

DeleteFilterWheelInfo

Method

DeleteFilterWheelInfo

Syntax

FocusMax.FocusControl.DeleteFilterWheelInfo

Remarks

Delete the filter wheel information associated with Preferences Autofocus and AcquireStar for the current active system number (1 or 2).

FindStar

FindStar

Method

FindStar () as Boolean

Syntax

FocusMax.FocusControl.FindStar

Parameters

None

Returns

True if start is successful.

Remarks

Starts the Find Star operation and returns when FindStar is complete. This looks for the brightest star on the CCD, finds its [StarXCenter](#), [StarYCenter](#), then takes a [SingleExpose](#) of [SingleExposeFrameWidth](#) at the star coordinates, and finally measures and updates the [HalfFluxDiameter](#) Property. If the star cannot be found this Method sets [HalfFluxDiameter](#) = 0. This Method has the same effect as if the user clicked the Find button on the [Focus Window](#).

Note that the FindStar may take many seconds and your script will not progress beyond FindStar method until the operation is complete. Use [FindStarAsync](#) to get immediate return to your script, which allows parallel operation with your script.

FindStarAsync

FindStarAsync

Method

FindStarAsync () as Boolean

Syntax

FocusMax.FocusControl.FindStarAsync

Parameters

None

Returns

True if start is successful.

Remarks

Starts the Find Star operation and returns immediately. This looks for the brightest star on the CCD, finds its [StarXCenter](#), [StarYCenter](#), then takes a [SingleExpose](#) of [SingleExposeFrameWidth](#) at the star coordinates, and finally measures and updates the [HalfFluxDiameter](#) Property. If the star cannot be found

this Method sets [HalfFluxDiameter](#) = 0. This Method has the same effect as if the user clicked the Find button on the [Focus Window](#).

Note that the FindStarAsync allows your script to be active during the Find Star operation, which may take many seconds. You may need to periodically check the [FindStarAsyncStatus](#) property to determine when the Find Star is complete. Use method [FindStar](#) when it is more convenient to simply stop the execution of your script until the Find Star is complete.

Focus

Focus

Method

Focus () as Boolean

Syntax

FocusMax.FocusControl.Focus

Parameters

None

Returns

True if start is successful.

Remarks

Starts the auto focus operation and returns when Focus is complete. This finds the brightest star on the CCD, and then controls the focuser Position until Best Focus is achieved. It updates the Properties [StarXCenter](#), [StarYCenter](#) and [HalfFluxDiameter](#). If the auto focus is not successful this Method sets [HalfFluxDiameter](#) = 0. This Method has the same effect as if the user clicked the Focus button on the [Focus Window](#).

Note that the Focus may take many seconds and your script will not progress beyond Focus until the operation is complete. Use [FocusAsync](#) to get immediate return to your script, which allows parallel operation with your script.

FocusAtStarCenter

FocusAtStarCenter

Method

FocusAtStarCenter() as Boolean

Syntax

FocusMax.FocusControl.FocusAtStarCenter

Parameters

None

Returns

True if start is successful.

Remarks

Perform autofocus at star defined by [StarXCenter](#) and [StarYCenter](#). This does not perform the initial full frame [Find Star](#) exposure.

FocusAtStarCenterAsync

FocusAtStarCenterAsync

Method

FocusAtStarCenterAsync() as Boolean

Syntax

FocusMax.FocusControl.FocusAtStarCenter

Parameters

None

Returns

True if start is successful.

Remarks

Perform autofocus at star defined by [StarXCenter](#) and [StarYCenter](#) as an Async function. This does not perform do the initial full frame [Find Star](#) exposure.

FocusAsync

FocusAsync

Method

FocusAsync () as Boolean

Syntax

FocusMax.FocusControl.FocusAsync

Parameters

None

Returns

True if start is successful.

Remarks

Starts the auto focus operation and returns immediately. FocusAsync finds the brightest star on the CCD, and then controls the focuser Position until Best Focus is achieved. It updates the Properties [StarXCenter](#), [StarYCenter](#) and [HalfFluxDiameter](#) . If the auto focus is not successful this Method sets [HalfFluxDiameter](#) =

0. This Method has the same effect as if the user clicked the Focus button on the [Focus Window](#).

Note that FocusAsync allows your script to be active during the Focus operation, which may take many seconds. You may need to periodically check the [FocusAsyncStatus](#) property to determine when the Focus is complete. Use method [Focus](#) when it is more convenient to simply stop the execution of your script until the Focus is complete.

GetiniValue

GetiniValue

Method

GetiniValue (sect As String, entry As String, default As String) = String

Syntax

FocusMax.FocusControl.GetiniValue (sect, entry, default)

Parameters

None

Returns

Active system ini entry

Remarks

This will return an entry in the current active Hardware ini.

Halt

Halt

Method

Halt ()

Syntax

FocusMax.FocusControl.Halt()

Parameters

None

Returns

Nothing

Remarks

Immediately stops any operation initiated by a FocusMax.FocusControl Asynchronous method.

This will terminate exposures and return the focuser back to the original position at the start of the focus run.

Some focusers such as the Optec TCF-S may not be stopped by this function.

Note that Halt is only useful for the Asynchronous methods such as [FocusAsync](#), [FindStarAsync](#) and [SingleExposeAsync](#). Halt cannot be executed during Synchronous method [Focus](#), [FlndStar](#) and [SingleExpose](#) because these methods do not return control to the script until the operation is complete.

HardwareConnect

HardwareConnect

Method

HardwareConnect(Camera (Boolean), Focuser (Boolean), Telescope (Boolean)) (String)

Syntax

FocusMax.FocusControl.HardwareConnect

Remarks

Set each piece of hardware to True to connect the device or False to ignore.

Method returns a '|' delimited string if the operation succeeded for each piece of hardware.

Example:

```
HardwareConnect (True, True, True)
```

If all devices connect, the return string will be True|True|True

HardwareDisconnect

HardwareDisconnect

Method

HardwareDisconnect(Camera (Boolean), Focuser (Boolean), Telescope (Boolean)) (String)

Syntax

FocusMax.FocusControl.HardwareDisconnect

Remarks

Set each piece of hardware to True to disconnect the device or False to ignore.

Method returns a '|' delimited string if the operation succeeded for each piece of hardware.

Example:

```
HardwareDisconnect (True, True, True)
```

If all devices disconnect, the return string will be True|True|True

Move

Move

Method

Move (Long)

Syntax

FocusMax.FocusControl.Move(Long)

Parameters

None

Returns

Nothing

Remarks

If property `Absolute` is true, then this is an absolute positioning focuser. The `Move` command tells the focuser to move to an exact step position, and `Position` is an integer between 0 and property [MaxStep](#).

If property `Absolute` is false, then this is a relative positioning focuser. The `Move` command tells the focuser to move in a relative direction, and `Position` is an integer between $-$ [MaxIncrement](#) and $+$ [MaxIncrement](#).

MultiStarFocusAsync

MultiStarFocusAsync

Method

MultiStarFocusAsync () as Boolean

Syntax

FocusMax.FocusControl.MultiStarFocusAsync

Parameters

None

Returns

True if start is successful.

Remarks

Starts the Multi-Star autofocus operation on the current field and returns immediately. You may need to periodically check the [MultiStarFocusAsyncStatus](#) property to determine when the status of the operation.

PostCommand

PostCommand

Method

PostCommand (integer)

Syntax

FocusMax.FocusControl.PostCommand

Parameters

Initiate a sync or async command. This will be used when a COM method is mapped to custom script
1 = ExposeAsync

2 = FindAsync
3 = FocusAsync
4 = FocusAtStarCenterAsync
5 = AcquireStarAsync

Returns

True if start is successful.

Remarks

Use PostCommandStatus to check status of initiated command

RunVcurve

RunVcurve

Method

RunVcurve () Boolean

Syntax

FocusMax.FocusControl.RunVcurve

Parameters

None

Returns

True if start is successful.

Remarks

Will load Vcurve window if FocusMax is not busy performing a function (autofocus, AcquireStar, ...) and initiate a synchronous Vcurve run using defined settings

SendToLog

SendToLog

Method

SendToLog ()

Syntax

FocusMax.FocusControl.SendToLog

Parameters

None

Returns

Nothing

Remarks

Sends string to the Log which is useful for documenting script steps.

[ShowLog](#)

ShowLog

Method

ShowLog ()

Syntax

FocusMax.FocusControl.ShowLog

Parameters

None

Returns

Nothing

Remarks

Opens the Log window

[SingleExpose](#)

SingleExpose

Method

SingleExpose () as Boolean

Syntax

FocusMax.FocusControl.SingleExpose

Parameters

None

Returns

True if start is successful.

Remarks

Takes a Single Exposure and returns when the exposure is complete.

The exposure is taken at the current [StarXCenter](#) and [StarYCenter](#) with [SingleExposeFrameWidth](#) and it measures a new [StarXCenter](#) ,[StarYCenter](#) and [HalfFluxDiameter](#).

If the star cannot be found this Method sets [HalfFluxDiameter](#) = 0. You can initially set the [StarXCenter](#) and [StarYCenter](#) values of the brightest star on the CCD with the [FindStar](#) or the [Focus](#) Methods.

This Method has the same effect as if the user clicked the Expose button on the [Focus Window](#).

Note that the SingleExpose may take many seconds and your script will not progress beyond SingleExpose process until the operation is complete. Use [SingleExposeAsync](#) to get immediate return to your script, which allows parallel operation with your script.

SingleExposeAsync

SingleExposeAsync

Method

SingleExposeAsync () as Boolean

Syntax

FocusMax.FocusControl.SingleExposeAsync

Parameters

None

Returns

True if start is successful

Remarks

Takes a Single Exposure and returns when the exposure is complete using SingleExposeAsyncStatus.

The exposure is centered at the current [StarXCenter](#) and [StarYCenter](#) with [SingleExposeFrameWidth](#) and it measures a new [StarXCenter](#), [StarYCenter](#) and [HalfFluxDiameter](#). If the star cannot be found this Method sets HalfFluxDiameter = 0.

You can initially set the [StarXCenter](#) and [StarYCenter](#) values of the brightest star on the CCD with the [FindStar](#) or the [Focus](#) Methods.

This Method has the same effect as if the user clicked the Expose button on the [Focus Window](#).

Terminate

Terminate

Method

Terminate()

Syntax

FocusMax.FocusControl.Terminate

Parameters

None

Returns

Nothing

Remarks

Terminate current active FocusMax instance

WriteFilterInfo

WriteFilterInfo

Method

WriteFilterInfo (integer,string)

Syntax

FocusMax.FocusControl.WriteFilterInfo (Filter Number, string)

Parameters

Filter Number (integer)

Filter info (string)

Returns

Nothing

Remarks

Write filter info to the defined filter number in the current active system number (1 or 2) of the form

Filter Name|A|B|C|D|E|F|G

A = Base exposure

B = Min exposure

C = Max exposure

D = Flux target

E = AcquireStar exposure

F = AcquireStar min star magnitude

G = AcquireStar max star magnitude

Focuser

Focuser

Standard ASCOM Focuser Methods and Properties that can be used to control focuser functions

Properties

Focuser Properties

Absolute

Absolute

Property

Absolute (read-only, Boolean)

Syntax

FocusMax.Focuser.Absolute

Remarks

Returns true if the focuser is capable of absolute position; that is, being commanded to a specific step location.

GetFocuserID

GetFocuserID

Property

GetFocuserID (read-only, String)

Syntax

FocusMax.Focuser.GetFocuserID

Remarks

Returns the focuser that is connected to FocusMax

IsMoving

IsMoving

Property

IsMoving (read-only, Boolean)

Syntax

FocusMax.Focuser.IsMoving

Remarks

Returns true if the focuser is currently moving to a new position. Returns false if the focuser is stationary

Link

Link

Property

Link (Boolean)

Syntax

FocusMax.Focuser.Link = [Boolean]

Remarks

Set true to start the link to the focuser; set false to terminate the link.

The current link status can also be read back.

An error will be raised if the link fails to change state for any reason.

MaxIncrement

MaxIncrement

Property

MaxIncrement (read only, Long)

Syntax

FocusMax.Focuser.MaxIncrement

Remarks

Returns the maximum increment size allowed by the focuser; i.e. the maximum number of steps allowed in one move operation.

For most focusers this is the same as the [MaxStep](#) property.

MaxStep

MaxStep

Property

MaxStep (read only, Long)

Syntax

FocusMax.Focuser.MaxStep

Remarks

Returns the maximum step position permitted. The focuser can step between 0 and MaxStep, if an attempt is made to move the focuser beyond these limits, it will automatically stop at the limit.

Position

Position

Property

Position (read only, Long)

Syntax

FocusMax.Focuser.Position

Remarks

Returns the current focuser position, in steps. Valid only for absolute positioning focusers.

An error will be thrown for relative positioning focusers.

StepSize

StepSize

Property

StepSize (read only, Single)

Syntax

FocusMax.Focuser.StepSize

Remarks

Returns the step size in Microns for the focuser. Throws an error if the focuser does not intrinsically know what the step size is.

TempComp

TempComp

Property

TempComp (Boolean)

Syntax

FocusMax.Focuser.TempComp = [Boolean]

Remarks

If property [TempCompAvailable](#) is true, then setting TempComp to true puts the focuser into temperature tracking mode. While in temperature tracking mode, Move commands will be rejected by the focuser. Set to false to turn off temperature tracking.

An error will be raised if [TempCompAvailable](#) is false and an attempt is made to set TempComp to true.

Setting TempComp to True will allow simultaneous temperature tracking and FocusMax autofocusing. If a

[Focus](#) or [FocusAsync](#) method is called while TempComp is True, FocusMax will temporarily turn off temperature compensation while the autofocus is active. Once the autofocus is complete, the temperature tracking will be resumed.

TempCompAvailable

TempCompAvailable

Property

TempCompAvailable (read only, Boolean)

Syntax

FocusMax.Focuser.TempCompAvailable

Remarks

Returns true if the focuser has a built-in temperature compensation mode that can be activated by property TempComp. Returns false if such a mode is not available.

Temperature

Temperature

Property

Temperature (read only, Single)

Syntax

FocusMax.Focuser.Temperature

Remarks

Returns the current ambient temperature as measured by the focuser. Throws an error if ambient temperature is not available.

Methods

Focuser Methods

Halt

Halt

Method

Halt ()

Syntax

FocusMax.Focuser.Halt

Parameters

None

Returns

Nothing

Remarks

Immediately stops any focuser motion due to a previous Move command. Some focusers may not support this function, in which case an exception will be thrown.

Move

Move

Method

Move (Long)

Syntax

FocusMax.Focuser.Move(Long)

Parameters

Long Position - Step distance or absolute position, depending on focuser.Absolute

Returns

Nothing

Remarks

If property Absolute is true, then this is an absolute positioning focuser. The Move command tells the focuser to move to an exact step position, and Position is an integer between 0 and property [MaxStep](#).

If property Absolute is false, then this is a relative positioning focuser. The Move command tells the focuser to move in a relative direction, and position is an integer between - [MaxIncrement](#) and +[MaxIncrement](#).

SetupDialog

SetupDialog

Method

SetupDialog ()

Syntax

FocusMax.Focuser.SetupDialog()

Parameters

None

Returns

Nothing

Remarks

Brings up a dialog box for the user to enter in custom setup parameters, such as a COM port selection. If no dialog is required or supported, the function returns immediately.

FocusMax does not require a setup dialog and so it returns immediately.

WaitForSec

WaitForSec

Method

WaitForSec (Double)

Syntax

FocusMax.Focus.WaitForSec(Double)

Parameters

Number of seconds

Returns

Nothing

Remarks

Delay for defined number of seconds.

Telescope

Telescope

The majority of the standard ASCOM Telescope Methods and Properties are exposed and are not published here. Instead, Methods and Properties that are unique to FocusMax are listed.

Properties

Telescope Properties

VerifyTracking

VerifyTracking

Property

VerifyTracking (Boolean)

Syntax

FocusMax.Telescope.VerifyTracking (Boolean)

Remarks

Get the telescope tracking state

HourAngle

HourAngle

Property

HourAngle (read only, String)

Syntax

FocusMax.Telescope.HourAngle (String)

Remarks

Get the telescope HourAngle

LST

LST (Local Sidereal Time)

Property

HourAngle (read only, String)

Syntax

FocusMax.Telescope.LST (String)

Remarks

Get the telescope LST

RequiresTopoCoordinates

RequiresTopoCoordinates

Property

TopoCoordinates (read only, Boolean)

Syntax

FocusMax.Telescope.RequiresTopoCoordinates (Boolean)

Remarks

Get the telescope requires topocentric coordinates

Methods

Telescope Methods

DegreesToDMS

DegreesToDMS

Property

DegreesToDMS (DD:Min:Sec, [String])

Syntax

FocusMax.Telescope.DegreesToDMS (DD:Min:Sec)

Remarks

Convert DD:Min:Sec to decimal degrees (String)

J2000_to_Topo

J2000_to_Topo

Property

J2000_to_Topo (RA_J2K, Dec_J2K, [Boolean])

Returns Boolean if successful

Syntax

FocusMax.Telescope.J2000_to_Topo (RA_J2K, Dec_J2K, [Boolean])

Remarks

Transform J2000 coordinates to topocentric coordinates.

RA & Dec Topo results are returned in
FocusMax.FocusControl.Scratch(0)
FocusMax.FocusControl.Scratch(1)

HoursToHMS

HoursToHMS

Property

HoursToHMS (RA_Hrs, [String])

Syntax

FocusMax.Telescope.HoursToHMS (Hrs:Min:Sec)

Remarks

Convert HR:Min:Sec to decimal hours (String)

Topo_to_J2000

Topo_to_J2000

Property

Topo_To_J2000 (RA_Topo, Dec_Topo, [Boolean])

Returns Boolean if successful

Syntax

FocusMax.Telescope.Topo_To_J2000 (RA_Topo, Dec_Topo, [Boolean])

Remarks

Transform Topocentric coordinates to J2000 coordinates.

RA & Dec Topo results are returned in

FocusMax.FocusControl.Scratch(0)

FocusMax.FocusControl.Scratch(1)

Sample Scripts

Sample Scripts

Copy the following to to the clipboard (Ctl-C) and paste into Notepad (Ctl-V) and save to your desktop as MyScript.VBS

Sample #1

```
Dim FMx
```

```

Dim FMxFoc
Dim Position
Dim SysName

Set FMx = CreateObject("FocusMax.FocusControl")
Set FMxFoc = CreateObject("FocusMax.Focuser")

'Get current active system name
SysName = FMx.SystemFileName
wscript.echo "System = " & SysName

'Get and store the current focuser position
Position = FMx.Position
wscript.echo "Position = " & Position

'Move focuser 100 units in minus direction from current position
FMx.Move(Position - 1000)
Do
Loop while FMxFoc.IsMoving
wscript.echo "Position = " & FMx.Position

'Return focuser to original position
FMx.Move(Position)
Do
Loop while FMxFoc.IsMoving
wscript.echo "Position = " & FMx.Position

'Load new focuser system.ini - note file name and full path is required
FMx.SystemFileName = "E:\FocusMax\Simulator.ini"
FMx.Delay (1)

'Perform autofocus async
FMx.FocusAsync
Do
Loop while FMx.FocusAsyncStatus = -1

'Load original focuser system.ini file
FMx.SystemFileName = SysName
FMx.Delay (1)
wscript.echo "System = " & SysName

wscript.echo "Press OK to exit"
=====

```

Sample #2

```
Dim FM
```

```
Dim TgtPosX, TgtPosY, TgtStarHFD
```

```
Set FM = CreateObject("FocusMax.FocusControl")
```

```
FM.ShowLog
```

```
FM.FocusAsync
```

```
Do
```

```
Loop while FM.AcquireStarAsyncStatus = -1
```

```
FM.Focus
```

```
FM.FindStar
```

```
TgtPosX = FM.StarXCenter
```

```
TgtPosY = FM.StarYCenter
```

```
TgtStarHFD=FM.HalfFluxDiameter
```

```
wscript.echo "X=" & TgtPosX & " Y=" & TgtPosY & " HFD=" & TgtStarHFD
```

```
wscript.echo "Focus position = " & FM.Position
```

```
FM.SingleExpose
```

```
FM.Move(FM.Position + 500)
```

```
wscript.echo "Position = " & FM.Position
```

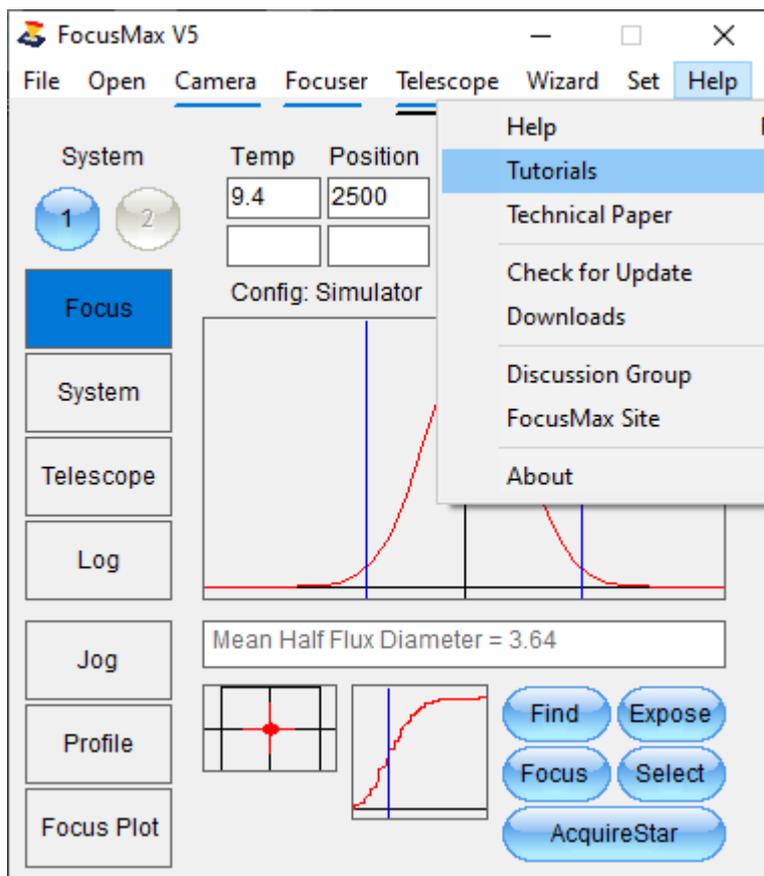
```
wscript.echo "Press OK to exit"
```

Help

Menu Help

Provides links to FocusMax:

- Help
- Tutorials
- Technical Paper which provides details on the FocusMax algorithm (first published in 2001)
- Check for Update
- Downloads
 - Help
 - Tutorials
 - Technical Paper
 - Get pdf's
- Discussion group
- FocusMax site
- About



Undocumented Settings

Undocumented Settings

This section describes settings that the user may change that do not interface with a GUI window.

System.ini

System.ini

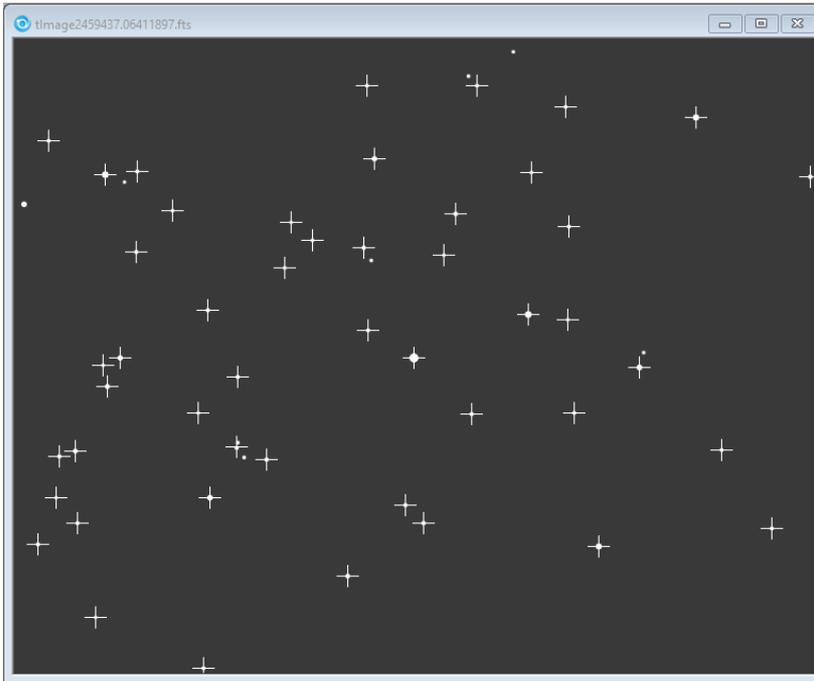
[AutoFocus_SingleStar] and [AutoFocus_MultiStar]

1. StarsLimit= (20 Single-Star, 50 Multi-Star) : Sets the number of stars that will be identified in the initial image. Note that there are more stars identified with Multi-Star focus so as to assure there is adequate star count across the field for determining the Mean Field HFD.
2. OutlierDetection=1: Set outlier detection True (1) or False (0) during an autofocus run. Enable to identify potential outliers when measuring the star(s) HFD at NearFocus or during the quality check after the focuser moves to the focus position. Outlier detection requires a minimum of 5 samples in Preferences/Autofocus.
3. MaxOutlierPass=2: The maximum number of passes that will be made on a data set to identify potential outliers. Example: If the MaxOutlierPass = 2 and 5 samples have been taken, the outlier routine will be initiated, if data is identified as suspect and eliminated then a second pass will be made after the additional samples are taken.
4. VerifySideHFD=4: The number of HFD units the focuser will move to verify that the focuser is on the correct side of focus. This value can be increased if needed for high resolution focusers.
5. LogStars=0: Send identified star information to the Log that from the 'Find' star routine - True (1) or False (0)

Example Log entry:

```
10:55:26 Star 1) HFD: 03.50 Flux: 156762 Peak ADU: 9494 Count: 1 StarX,Y: 44,408 ChipX,Y:
588,1316
10:55:26 Star 2) HFD: 03.50 Flux: 122078 Peak ADU: 7429 Count: 1 StarX,Y: 358,1238 ChipX,Y:
1216,2976
10:55:26 Star 3) HFD: 03.50 Flux: 83764 Peak ADU: 5127 Count: 1 StarX,Y: 107,61 ChipX,Y:
714,622
```

6. MarkStars=0: Identify the selected stars in the image - True (1) or False (0)



[Vcurve]

1. PerformHalfMove=0: Focuser will perform 1/2 increment move when approaching the V minima which will increase sampling and improve the data is fit to the hyperbola. This may be beneficial to users with fast optical systems. True (1) and False (0)
2. HFD_Ratio=5: A Vcurve test of the ratio of 'V' minimum HFD / 'V' maximum HFD. If the ratio is < HFD_Ratio then the Vcurve run will fail.
3. RunQuality=30: A Vcurve test to verify that the height (HFD) of the left and right Vcurve tips are within 30% of each other. Failing this criteria typically indicates that the system was not at focus when the Vcurve was run.
4. MinSubframeWidth=100: Minimum subframe size used during a Vcurve run.
5. SubframeWidthFactor=1.5: A factor applied to the first subframe width after the move to the start of the Vcurve run so that the out-of-focus star is contained within the subframe.

[ImageProcessing]

1. MirrorImage=0: Apply mirror image after the image is downloaded. May be used if camera image origin (0,0) is not standard - True (1) or False (0)
2. FlipImage=0: Flip image mirror image after the image is downloaded. May be used if camera image origin (0,0) is not standard - True (1) or False (0)

[StarDetection]

1. StarAspectLimit=1.5: An object detected in the image with an aspect ratio > 1.5 will be rejected as being non-stellar.
2. ImageBkgndStdDev=2.5: Background standard deviation factor which is used to identify pixels brighter

than the background.

3. FindStarsOutlierCutoff=2.5: 'Sigma' value used to differentiate between star image and other objects (galaxy, nebulosity, etc) in the image.
4. FullFrameSuperBin=12: Binning applied to the initial image during 'Find' star routine which is scaled for images taken at other bin values.
5. SubframeFactor=2: Factor used in setting subframe width based on the star HFD.
6. MinStarPixels=3: Minimum number of pixels to be considered a star.

[AcquireStarWizard]

1. ExpMin=1.0: Minimum exposure for determining optimum star magnitude for a given filter for AcquireStar.
2. NumberStars=3: Number of stars to be identified in the star catalog.
3. BrightMagLimit=2.0: Brightest star that may be identified in the star catalog.
4. DimMagLimit=11.0: Dimmest star that may be identified in the star catalog.
5. MagIncrement=0.5: Magnitude increment used when identifying brighter or dimmer stars from catalog. Example: if the target star magnitude is 6.0 and is found to be too bright, then the next set of stars identified in the catalog will be 6.5.

Filterwheel.cfg

FW_XXX.cfg (Filterwheel_Name.cfg)

[FilterOffset_Wizard]

1. Filters=3: The maximum number of filters that will be measured during a filter offset run. Setting this value to a larger value will allow for additional filters to be measured during the run BUT temperature influences may influence the results shifting the focus position over time. It is recommended that only a Reference and at most 2 additional filters be used during an offset run to minimize the potential temperature effects.
2. Filter matrix: This entry defines the focus parameters and AcquireStar settings for each filter. In the examples below, AF = Autofocus, AS = AcquireStar

[Filters_SingleStar]

Filter1=C|2|1|1.00|1.00|300|2|1.00|7.5|1.0

Filter2=V|2|1|1.00|3.00|300|3|5.00|5.0|1.0

...

Filter2: Filter name | AF Tgt star bin | AF Focus bin | AF Base exp | AF Max exp | AF Tgt flux | AS Bin | AS Exp | AS Tgt star mag | AS Dim star offset

[Filters_MultiStar]

Filter1=C|2|3.00|10.00|150|2|10.00|7.5|1.0

Filter2=V|3|5.00|30.00|200|2|15.00|5.0|1.0

...

Filter2: Filter name | AF Focus bin | AF Base exp | AF Max exp | AF Tgt flux | AS Bin | AS Exp | AS Tgt
Star mag | AS Dim star offset

Note:

AS Dim star mag = Tgt star mag + Dim star offset

Tips & Troubleshooting

Tips & Troubleshooting

[Tips](#)

[Troubleshooting](#)

[Filters](#)

[Temperature Compensation](#)

Tips

Tips

- Slippage can occur in a focuser which may result in the final focus position drifting when running back to back focus runs or when running consecutive Vcurves. Go through the focuser mechanism and inspect / tighten pinion gears in a rack and pinion focuser, tighten rollers that interface with the draw tube in Crayford style, etc. Here is a link to a comprehensive study performed by [Mike Dodd](#).

- Backlash:

Verify that Backlash is turned on in either FocusMax **or** the focuser driver but **not both**. The backlash setting will verify and is highly dependent on the focuser and telescope construction. For example, the traditional SCT that focuses by moving the primary mirror will require significant backlash in the winter as the mirror may experience slip-stick due to the grease applied in the ways.

Most users set the focuser backlash in the direction against gravity so as to lift the payload if appropriate for your telescope. This is difficult for a Newtonian on a German Equatorial that will experience various focuser orientation depending on where the telescope is pointed in the sky.

What backlash setting to use? This will depend on the focuser - it is best if you can measure it directly with a drop indicator or reference the manual or ask the manufacturer.

- Verify that your focuser will move through the entire range of motion from 0 to max travel and that is able to move this distance in one contiguous move. If not, then open the driver window and make adjustments. Before testing, verify that the [Limit End of Travel Position](#) setting in Menu/Open/Options is set to 0.

- You are setting up a new computer and need to transfer your system.ini files:

- Open FocusMax on the original computer
- Select the System Tab
- Press the small button to the right of the system name at the bottom of the window to identify the path where the files are stored (default C:\Users\XXX\Documents)
- Open FocusMax on the new computer and create or modify the default path
- Copy all of the .ini files to your new computer

- If the Vcurve appears flat at the bottom then increase the max HFD setting to extend the height of the Vcurve if possible.

If the Vcurve has a flat top then it may indicate that the focuser has reached end-of-travel and slippage is occurring.

- If a focus run fails and the focuser returns to the last known good focus position then check if the Return to start position is enabled. If the HFD from the focus run exceeds this setting, then FocusMax will consider the focus run a failure and return to the previously known good position. It is also a good idea to setup FocusMax to take 3 - 5 at the conclusion of the autofocus run images which will be averaged before determining if the final HFD is unreasonable - see Menu/Open/Options/Final Focus Images ([Final Focus Images](#)).

- The parameters in the Vcurve window will automatically update when the cursor leaves the text box.

To turn this feature off, open the active system.ini and find the entry: AutoUpdateVcurveParameters and set to 0 (default = 1 enabled).

8. To achieve a better Vcurve calculation set the Images/position = 2 or 3 to average momentary seeing effects.

- Next watch the FocusMax Log while running a Vcurve and note the 'lowest' HFD value recorded and its associated 'Position' value. (Some people run Vcurves to find their best focus position instead of performing a FocusMax Focus cycle. I've tried this, it does pretty good, but takes longer compared to a normal Focus run.)
- When the Vcurve cycle completes adjust your 'Center' value to the best HFD's Position from the Log and run another Vcurve, the 'V' should be centered more precisely.
- If you found each Vcurve to consistently increment, I'd look closely at your focuser.

a) First check your Backlash settings.

Backlash should 'only' be set in "one" place.

FocusMax 'or' in your focusers Driver **not** both. This tip has always been important to FocusMax.

b) Check your focuser is not slipping.

After several Focus runs or Vcurves can your focuser be commanded to return to Zero successfully?

If it returns to Zero on the counter is there any gap of the drawtube before being completely closed?

If there is a gap that could indicate slippage, where the counter is incremented but the drawtube not being moved, slippage.

c) Here's a 'poor' test for Focuser Slippage:

Change the direction the focuser movement, from In to Out or visa versa.

If there is slippage in 'both' directions then the Position increment will appear in both directions. The reason this is a poor test is it is not reliable because the weight load, camera, field corrector/reducer, filter wheel etc., being moved will react differently

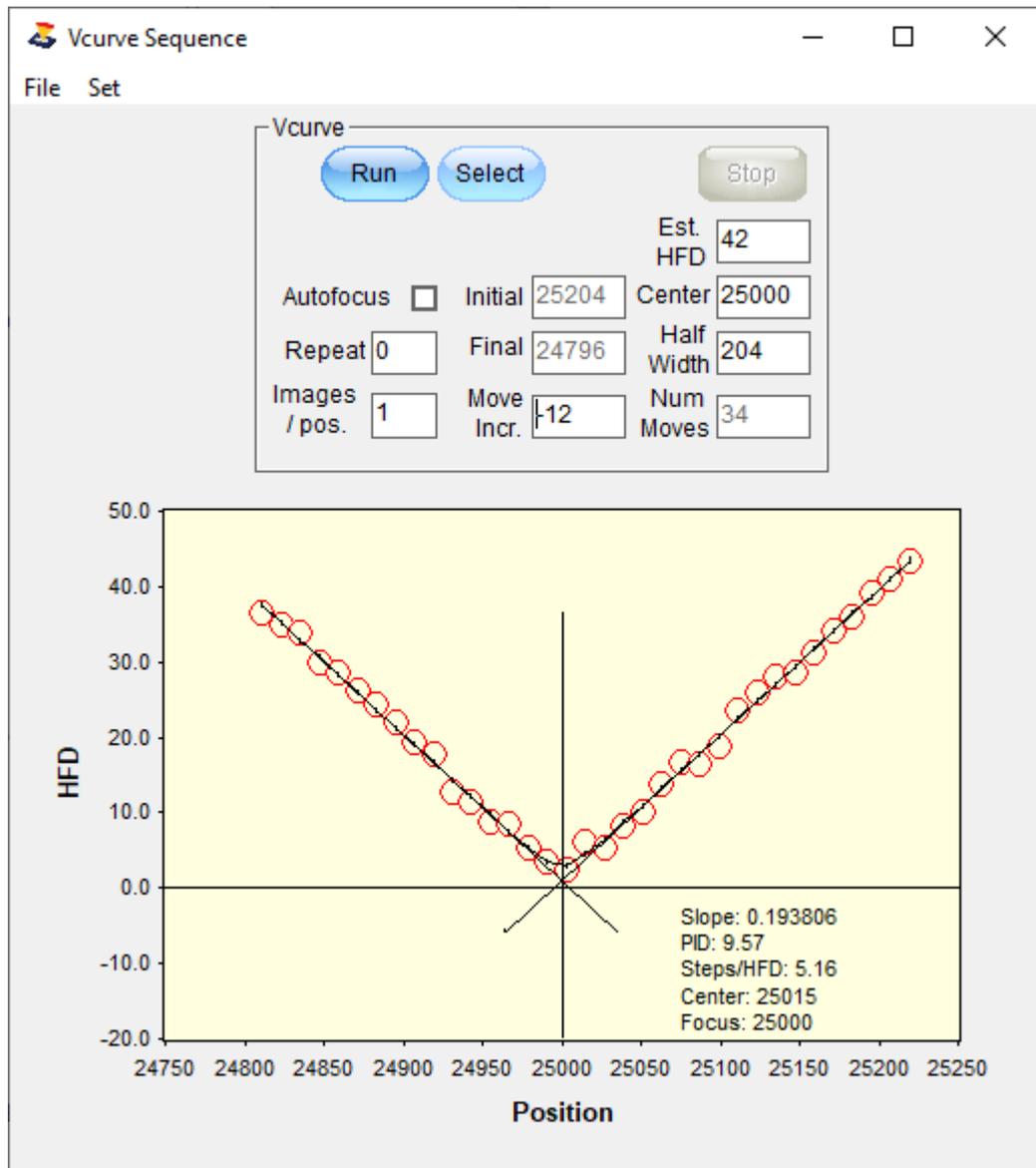
dependent upon whether the load is being 'lifted' against gravity or 'lowered' with gravity. You may find your system performs better if you 'lower' your load than the recommended lifting of the load.

"May You Go Among The Imperishable Stars"

Joe Mize www.cav-sfo.com

Chiefland Astronomy Village (CAV), Fla

StarFields Observatory, (SFO).



8. How to move a window back on to the screen when it is off the screen and not visible.
- Alt-Tab to the desired window
 - Press Alt-Space to open the Control Menu
 - Press the M key for Move
 - Press the left or right arrow key, depending on where you think the window is.

9. Using FocusMax with a Relative focuser:

FocusMax works great with Relative focusers. The only disadvantage is that the operator has to manage the position of the focuser since FocusMax can not tell when it hits the end of travel. Here is a procedure for manually taking V Curves for a Meade MicroFocuser and an LX-200 but it should also work well with your JMI and LazyFocus.

- Manually move the focuser all the way in to the stop. Then time it while it moves all the way out to the other stop. This will give you the total travel time which is about 20 seconds for my microfocuser. Take this time in seconds and multiply it by 1000. This will give you the number of counts for the full range of your focuser. For my microfocuser this is 20,000.
- Set the microfocuser to be approximately half way between the two stops. Manually focus the LX-200 using the primary mirror focuser knob. This will properly center the V Curve for your focuser range.
- Manually move the Focuser all the way IN.
- Launch FocusMax and make sure that the red number in the Position box near upper left side

- of window is "0". If it is not zero then double click on the red number and it will go to zero.
- e) Click on the Setup Tab and look in the upper right to make sure that Move Out is selected.
 - f) Click on the FocusMax V Curve button to open the Vcurve Sequence window.
 - g) Click on the End Points radio button.
 - h) Enter "0" in the Initial box.
 - i) Enter the number of counts determined in step 1 into the Final box.
 - j) Take the number of counts determined in step 1 and divide it by 30. Put this number in the Step Incr. box. For example if you have 20,000 counts in step 1 then the number for the Step Incr. box would be 666. FocusMax should automatically give you a value of 30 in the Steps box
 - k) Click the Run button and it should take the V Curve over the entire range of your focuser.
10. Some tips to get FocusMax working with my nSTEP controller from Rigel Systems:
- a) Make sure your account has ADMIN privileges.
 - b) Start your ASCOM compliant stepper controller software and check if it can run the stepper directly
 - c) Right click FocusMax shortcut and check properties/compatibility tab and and make sure the "run
 - d) in compatibility ..." and "run with admin..." check boxes are NOT checked.
 - e) Start FocusMax and pick the system tab, select your focuser application and connect.
 - f) Select the focuser tab. Correct focus position and temperature should be displayed.
 - g) Click on "jog" at the top and see if focuser moves.
11. If attempting to open MaxIm and it will not open, delete the entire MaxIm documents located in C:\Users\XXX\Documents\MaxIm DL 5

Troubleshooting

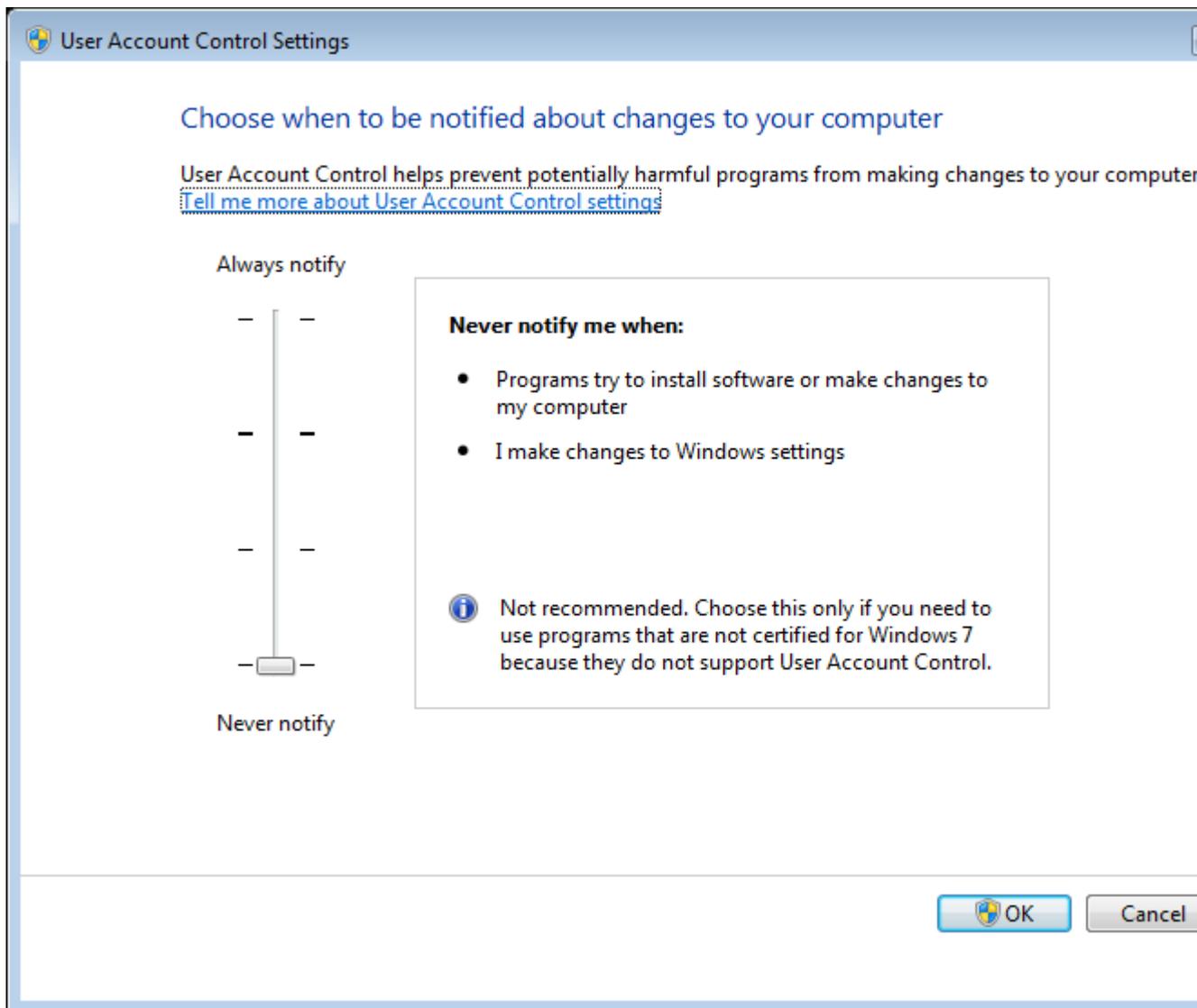
Troubleshooting

1. If FocusMax will not startup in Windows 7 / 8 / 8.1 / 10 then try running as Administrator ****only once****:

Right click FocusMax application icon
 Select Run as Administrator
 Close FocusMax and reopen without Administrative rights

If FocusMax will not run, then turn off User Access Control (UAC).
 Click on User Accounts icon in the Control Panel and select Change User Account Control Settings
 Slide the bar to the bottom to Never notify

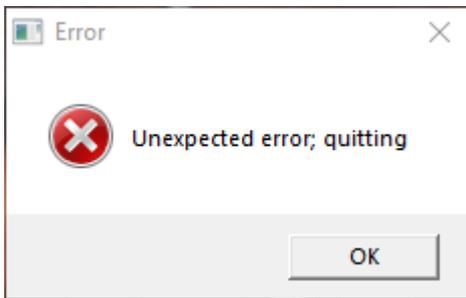
Once FocusMax is running you can try setting the bar up one or 2 notches.



2. If you see an error message "Unexpected error; quitting" when starting FocusMax:
 - a) Close the message
 - b) Start FocusMax with a 'right click, run as administrator'

- c) Close FocusMax and reopen without administrative rights.

You may find that the above process is required if you toggle between running FocusMax V4 and V5.



3. If you receive the message "TheSky was selected, but it does not appear to be installed or configured for scripting" then restart TheSkyX or TheSky 6 as administrator to allow TheSky to register the COM objects so that they may be used by other apps.
4. The error message "Timeout waiting for license info Terminating FocusMax ..." is seen and the program terminates. The FocusMax license is properly copied to "C:\Program Files (x86)\FocusMax V4". Verify that Windows user name is in English (not Japanese, Chinese, letters), if so then I have create a new Windows user named with only English letters FocusMax will start normally.
5. The dll Files are registered using regasm.exe which is distributed with NET4 Framework. XP machines may not have .NET Framework 4 since it is no longer supported by MS and can use script Buildtlb_v2.0.50727.cmd which can be found in the FocusMax install directory. When the Buildtlb.cmd script is opens and closes a command window quickly, success or error messages can be read if the ':' is deleted from script pausing the command window before closing allowing you to see status.

```

C:\Windows\system32\cmd.exe

C:\Program Files (x86)\FocusMax U4>"C:\Windows\Microsoft.NET\Framework\v4.0.30319\regasm.exe" FocusMaxSecurity.dll /tlb: FocusMaxSecurity.tlb /codebase
Microsoft .NET Framework Assembly Registration Utility version 4.0.30319.17929
for Microsoft .NET Framework version 4.0.30319.17929
Copyright (C) Microsoft Corporation. All rights reserved.

Types registered successfully
Assembly exported to 'C:\Program Files (x86)\FocusMax U4\FocusMaxSecurity.tlb',
and the type library was registered successfully

C:\Program Files (x86)\FocusMax U4>pause
Press any key to continue . . .
  
```

6. For some reason Win 10 will unregister various dll & ocx files at random (recent occurrence was

PinPoint).

As an example, to register PinPoint.dll:

64 bit:

Find C:\Windows\SysWOW64\cmd.exe

Right-click, select Run as Administrator

Type:

...> CD\

...> CD "\Program Files (x86)\Common Files\ASCOM\PinPoint" (note quotes)

...> regsvr32 PinPoint.dll

32 bit:

Find C:\Windows\System\cmd.exe

Right-click, select Run as Administrator

Type:

...> CD\

...> CD "\Program Files (x86)\Common Files\ASCOM\PinPoint" (note quotes)

...> regsvr32 PinPoint.dll

You should see a pop-up message that the file is now registered.

7. If you want to perform a complete uninstall FocusMax

- Backup your user files found in C:\Users\XXX\Documents\FocusMax V5
- Download the free program Revo Uninstaller http://www.revouninstaller.com/revo_uninstaller_free_download.html which is recommended by Microsoft tech support
- Run Revo and select FocusMax to uninstall
- Press the Uninstall menu icon then select Advanced
- After a quick scan select Yes to uninstall
- Press Next to scan for leftover files, folders, etc.
- Press Next to see results
- Press Select All Then press Delete
- Press Next to continue to folder deletion
- Reboot your PC
- Reinstall FocusMax
- Copy your license from the email received from CCDWare to your desktop then move the file to the install directory C:\Program Files (x86)\FocusMax V5

8. Error messages seen:

Error 1402. Could not open key Unknown\Components\xxxxxxx

Error 1316. A network error occurred while attempting to read from the file C:

\Windows\Installer\xxx.msi

Windows performs a reinstall of FocusMax when opened:

These error message when trying to reinstall/upgrade a software program usually means a previous installation of a software application is getting in the way of the new installation.

- a) Several users have used a free program 'Revo Uninstaller' (<http://www.revouninstaller.com>) and were able to uninstall and clean the registry of entries and keys
 - b) Reboot your PC
 - c) Reinstall FocusMax
 - d) See top of the page for notes on initial startup
9. If you use CCDSoft and receive the message Failed to start camera then the CCDSoft camera server settings need to be setup for scripting- see [Getting Started](#).
 10. If you are using a DSLR camera set the Target and Focus binning on the Setup Tab to 2x2.

11. If you see a message that the "*** Image not available (after waiting XX sec) ***" in the Log.
Open your active system.ini and increase the entry: CameraImageTimeout (new default is 30 sec)
12. FocusMax window is not visible but the icon is seen at the bottom of the page. Minimize and maximize does nothing happens. .
 - a) Right click the FocusMax icon.
 - b) Select Properties, then select "Maximized" in the "Run" pull down menu.
 - c) Open FocusMax and then close it.
 - d) Right click the FocusMax icon.
 - e) Select Properties, then select "Normal Window" in the "Run" pull down menu.
13. Problem with QHY8 camera and receive the following message "MaxIm DL error 65535: Image Not Available."
Verify that QHY8 camera does not support 3x3 - set FocusMax Binning to 2x2
14. FocusMax does not work with MaxIm LE:
MaxIm LE does not have scripting capability

16. A listing of camera error codes:

https://www.cyanogen.com/help/maximdl/Camera-Specific_Error_Codes.htm

17. FocusMax is running slow taking many minutes to complete a focus cycle.
To investigate, open Preferences/General and enable Trace which will create a second log of COM activity between FocusMax and client application.

Here is a Camera Trace Log segment:

The Log is showing it is taking 18 sec from between image start to image downloaded for a 0.5 sec exposure.

```
20:37:34.41 <Start TakeImage> ← start
20:37:34.41 ...Camera control: TheSky
20:37:34.41 ...Camera number: 1
20:37:34.41 ...Interval: 0.5
20:37:34.41 ...Camera Bin: 2
20:37:34.42 ...Camera Start X: 192 Y: 0
20:37:34.43 ...Camera Num X: 1152 Y: 1023
20:37:34.43 ...Filter slot: 0
20:37:34.43 <Start FileExists>
20:37:34.43 ...File: C:\Users\astrodoc\Documents\FocusMax V4\Images\plimage.fts
20:37:34.43 ...FileExists: True
20:37:34.43 <End FileExists>
20:37:39.75 .Start cam.TakeImage async
```

```

20:37:47.13 ...Cam.ExposureStatus: Ready
20:37:47.13 ..End cam.IsExposureComplete
20:37:47.13 .End cam.TakeImage
20:37:47.13 .Start cam.GetBisqueImage
20:37:47.13 <Start GetBisqueImage>
20:37:47.13 <...Camera number: 1
20:37:47.13 <...Method: CCDSoft2XAdaptor.ccdsoft5Image
20:37:52.39 <End GetBisqueImage>
20:37:52.39 .End cam.GetBisqueImage ← image acquired

```

Hi Steve,

I believe the problem has been resolved. I was concerned because my PC is brand new and I really didn't have much on there. Turning off Webroot AV, which I thought was the only thing running in the background, didn't do anything so I was really puzzled. I disabled open GL, updated my display drivers and also realized that the Malwarebytes program I installed that I thought was the freeware version was actually running the premium trial version which has a ton of real-time scan functions operating! Once I disabled that in addition to the other things, everything returned to normal. Focus time is now 2 minutes and I ran a full V curve in about 6 minutes! So it looks like we're good

Thanks again!

Dave

Hi Dave—

I had a similar issue with another app after installing a major update. Turns out that this app sits in the background monitoring for ransomware attempts.

Steve

18. Several users reported an issue running FocusMax after a Windows update to Version 1703 Build 15063.413 - Creator edition.

The root of the problem has nothing to do with FocusMax and is a Windows 10 issue which was solved by performing a reinstall of the OS using the MS Windows MediaCreator which will allow you to reinstall the Windows *without losing* your files and apps. Here is a link for instructions:
<http://www.intowindows.com/download-windows-10-media-creation-tool/>

=====

Another solution that was found if running MS Defender AV.

- 1) Type defender in the search box
- 2) Click on app and browser control
- 3) Turn off "Check Apps and Files"

FocusMax runs as normal, Defender will no longer check if FocusMax is legitimate in the MS App store.

19. Running Windows in Mac Parallels:

The `Document` folder maps back to `\\Mac\Volumes\Documents` but the Windows user has full read/write permissions. There is a `c:\\Users\

Solution:

I use Parallels without incident. In Parallels, go to Windows/Configure/Options, Sharing. Uncheck "Share

Mac User folders with Windows". This will keep the Documents folder in the Parallels VM.

Filter offsets

Filter Offsets

Filters used in an imaging train may not be parfocal - that is, they may not focus at the same position. If you are using narrow band filters then you will have to use bright stars with extended exposure times in order to focus.

An alternative is to measure the required filter offsets in focuser steps from a Reference filter (perhaps luminance or Clear) then apply the required offsets. This can be accomplished by running the 'Offset Focus Wizard' - see Tutorials for details. Here is my table:

[Focus Offset]

Slot=E,-775

Slot=C,0 <== base filter

Slot=U,51

Slot=B,69

Slot=V,12

Slot=R,8

Slot=I,-38

$\Delta\text{Offset} = -(\text{Current filter offset}) + (\text{New filter offset})$

If current filter is C (0) and rotate to R (+8), the focuser will require $-(+0C) + (+8R) = +8$ steps

If imaging in R (+8) and rotate to I (-38), the focuser must move $-(+8R) + (-38I) = -46$ steps total

Pick a night of good seeing in which the temperature has stabilized, you do not want to perform this procedure when there is significant temperature change occurring since the focus positions will be a moving target. Open the 'Filter Offset Wizard' and follow the instructions provided.

Papers / presentations:

[Get Focused](#) paper by Don Goldman and Barry Megdal

[New Critical Focus Zone](#) by Dr. Jeffery Winter

Seeing

Seeing

Focusing with FocusMax is fairly straight forward as it should be. However, achieving your best possible focus requires more than simply clicking and running. Other considerations should be taken into account for tweaking FocusMax parameters. Your optical system and local conditions are major items for tuning FocusMax. Study of documentation and close attention to what a focus run tells you can lead to a small parameter change which can produce surprising results. The following are some subjects which better understanding can lead to better focusing.

Focusing and CFZ, by Don Goldman:

"Get Focused article Preprint. This was submitted and published in an abbreviated format in Sky and Telescope entitled "In Perfect Focus", August 2010, page 72 (with Dr. B. Megdal). .It explains why the conventional Critical Focus Zone (CFZ) is too large to get precisely focused stars, and that a new derivation using David Suiter's book guided by data from the freeware program, Aberrator, provides more accurate, but much smaller values. For f/10/, f/7, f/5 and f/3.5 optical systems at 500 nm (green), these new CFZ values become ~ 40, 20, 10 and 5 microns in one direction, respectively. These values are incredibly small! A human hair is 50 microns thick to provide some perspective. Using a high-precision electronic focuser becomes essential for optimum focus."

PDF - [Get Focused Preprint](#)

Seeing and Air Mass:

"In astronomy, air mass (or airmass) is the optical path length through Earth's atmosphere for light from a celestial source. As it passes through the atmosphere, light is attenuated by scattering and absorption; the more atmosphere through which it passes, the greater the attenuation. Consequently, celestial bodies at the horizon appear less bright than when at the zenith. The attenuation, known as atmospheric extinction, is described quantitatively by the Beer-Lambert-Bouguer Law.

"Air mass" normally indicates relative air mass, the path length relative to that at the Zenith at Sea Level, so by definition, the sea-level air mass at the zenith is 1. Air mass increases as the angle between the source and the zenith increases, reaching a value of approximately 38 at the horizon."

[https://en.wikipedia.org/wiki/Air_mass_\(astronomy\)](https://en.wikipedia.org/wiki/Air_mass_(astronomy))

<https://spiff.rit.edu/classes/phys445/lectures/atmos/animloop.gif>

Air Mass not only provides an indication of deterioration but also to some extent atmospheric turbulence or Seeing. The more Air Mass light passes through the worse the effects.

https://spiff.rit.edu/classes/phys445/lectures/atmos/single_anim.gif

When star light encounters turbulent air cells these cells can act as lenses to distort and deflect incoming photons on very short timescales. As more and more turbulent air is encountered distortions become compounded leading to madly twinkling and highly refracted colorful stars near the horizon. When this occurs accurate focusing becomes more difficult and usually poorer. Sirius near the horizon:

<https://epod.usra.edu/a/6a0105371bb32c970b0168e5bf0ad1970c-750wi>

To minimize these effects it is advisable to focus and image within a few hours of the Zenith, both RA and DEC, where Air Mass and turbulence minimum. Imaging locations at higher elevations than Sea Level by nature reduces Air Mass some allowing greater angles from the Zenith before Air Mass and Seeing effects becomes a problem. To obtain best images, one should avoid taking exposures at an Air Mass of 1.5 or higher, (40 degrees elevation or less).

Air Mass Extinction Correction Factors

Elevation	Zenith Angle	Air Mass Extinction	Red Extinction	Green Extinction	Blue Extinction
90	00	1.000	1.000	1.000	1.000
80	10	1.015	1.001	1.002	1.003
70	20	1.064	1.005	1.010	1.014
60	30	1.155	1.013	1.025	1.035
55	35	1.221	1.018	1.036	1.050
50	40	1.305	1.025	1.050	1.070
45	45	1.414	1.034	1.068	1.097
40	50	1.555	1.046	1.092	1.132
35	55	1.743	1.063	1.125	1.180
30	60	2.000	1.085	1.172	1.249
25	65	2.365	1.118	1.242	1.356
20	70	2.923	1.170	1.356	1.535
15	75	3.862	1.263	1.574	1.892

Wm. Keck Observatory Air Mass JAVA tool shows Air Mass for objects. Enter Object, RA & DEC, press "Add/Update Object", select Air Mass or Elevation.

<https://www2.keck.hawaii.edu/software/obsplan/obsplan.php>

Seeing, Ground Layer:

Usually 0-25ft, is caused mostly by thermal radiation or vortices around or over objects .

https://www.footootjes.nl/Astrophotography_Seeing/Astrophotography_Seeing.html

Seeing, Boundary or Mixing Layer:

From the Earth's surface to ~1,000ft. Wind flow near the surface encounters obstacles reducing wind speed introducing horizontal and vertical turbulence which interacts with the atmospheric layer above. This interaction is the primary transport of smoke and dust.

https://en.wikipedia.org/wiki/Planetary_boundary_layer

NOAA's ADDS Aviation Weather Center:

This is NOAA's ADDS Aviation Weather Center site showing Flight Level Turbulence regions with 12hrs Forecast.

<https://www.aviationweather.gov/adds/turbulence/turbnav>

Seeing, High Altitude:

There are several Jet Streams flowing around the globe. They reside at a level between the Stratosphere and Troposphere, a mixing level several kilometers wide and thick, where temperatures change from rising with altitude to decreasing with altitude. Jet Streams meander, and change in altitude, split and merge, with velocities ranging from calm to 250mph.

Although high altitude wind speeds don't buffet our telescopes as low level winds they still contribute to observable Seeing because of vertical turbulence. These fast moving rivers form turbulence at boundaries of fast to slow windspeed layers. Which, just as low level convective turbulence, distorts incoming light in a similar manner.

<https://spiff.rit.edu/classes/phys445/lectures/atmos/animloop.gif>

National Jet Stream Map, updated every 12hrs:

Stream Lines

https://weather.unisys.com/upper_air/ua_cont.php?plot=str&inv=0&t=cur

300spd plots

https://weather.unisys.com/upper_air/ua_cont.php?plot=300&inv=0&t=cur

Animated 60hr 300mb Wind Speed Forecast:

https://weather.unisys.com/nam/loop/nam_300_loop.gif

"May You Go Among The Imperishable Stars"

Joe Mize www.cav-sfo.com

Chiefland Astronomy Village (CAV), Fla

StarFields Observatory, (SFO).

"New Critical Focus Zone"

Dr. Jeff Winter has proposed an alternative critical focus zone that takes into account:

- Seeing
- Telescope aperture Telescope focal ratio
- Acceptable focus tolerance

See [New Critical Focus Zone](#) for details

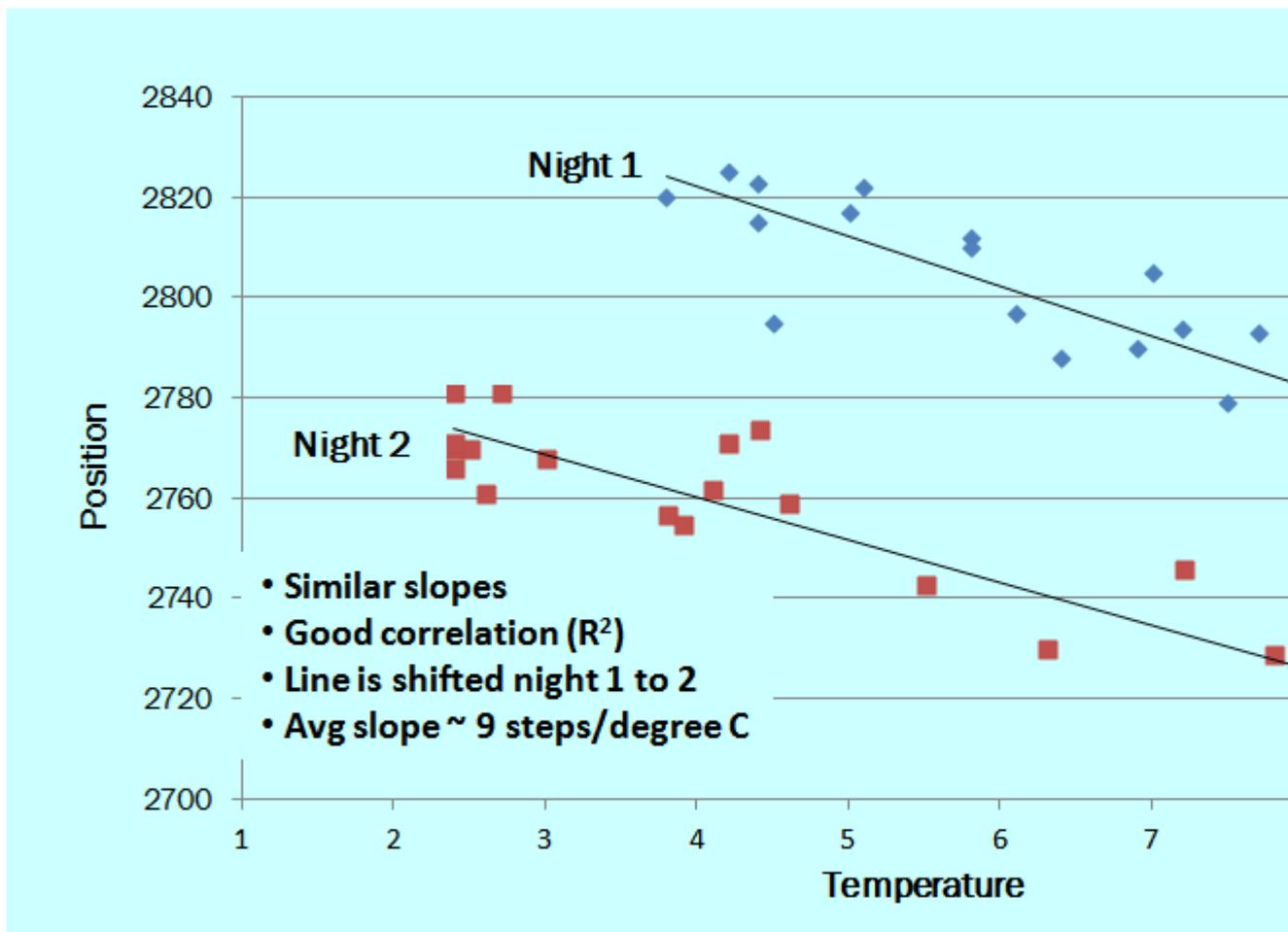
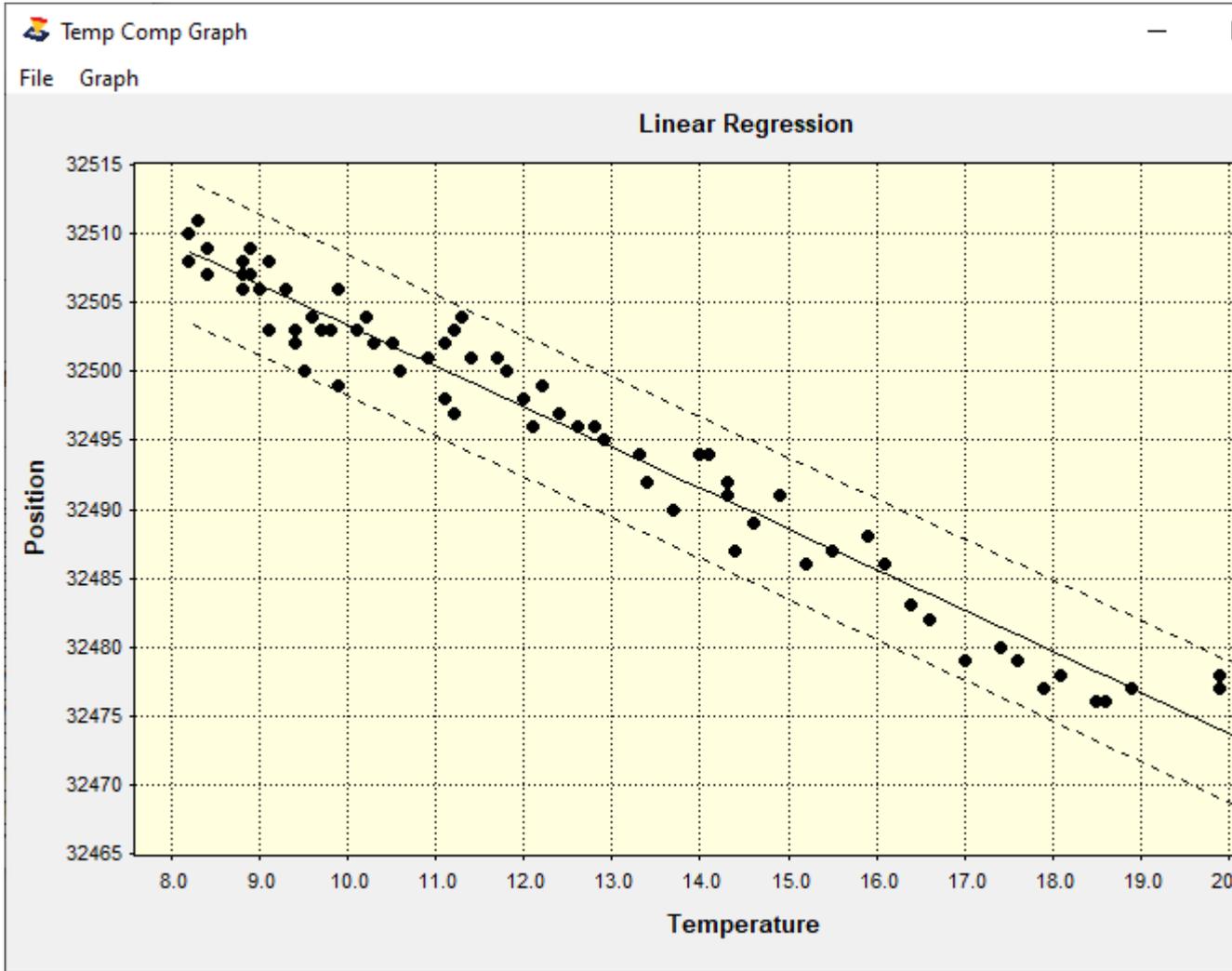
Temperature Compensation

Temperature Compensation

Notes on Temperature Compensation:

1. The [Temperature Compensation Wizard](#) is designed to collect position vs temp data during the night. Most focuser drivers allow the user to enter the slope of the best fit line for TC purposes which can be calculated using Excel.
I was never able to achieve a statistically significant correlation between temp & position with my focuser that contains the temperature sensor installed in the control box along with the electronics. I am currently using a focuser with an external temperature probe which is placed near the primary of my 16" f4.5 Newtonian. I find that within on a given night, I have good statistical correlation but poor correlation night to night with similar slopes and data spread around the regression line which is probably due to environmental differences. In other words, I **can not** use data from multiple nights to built a single TC model. The slopes are close but the line can be shifted up or down from night to night. With that, I currently focus at the start of the night, enable TC then refocus every 2 - 2.5 hours which is an improvement over every 1 hour without TC.

Steve Brady



2. In my attempts at Temperature Compensating Focusing (TCF), I have resorted to burying the Temp Probe in styrofoam (except the metal-to-metal contact against the scope near the rear doublet). This helped reduce but not eliminate the non-linearity.
3. Mini controller from Moonlite contains a temperature probe. I have been known to take the controller's plastic box apart, cut/drill holes in it to improve ventilation (faster temperature tracking that way), and then tape that controller box to the rear casting of my SCT...to track the temperature of the scope. Seems to work ok, but keep in mind that the temp. sensor is next to electronics that generate heat. After you power up the focuser the temperature readings will not stabilize until about 15 minutes have passed...and that's important if you want to do a decent job of temperature compensation.

Tom Krajci
Cloudcroft, New Mexico

4. We recently completed some work verifying how temperature compensation works with a classic C14 at our local club observatory. There is no question the relationship between temperature and focal position shift is linear.

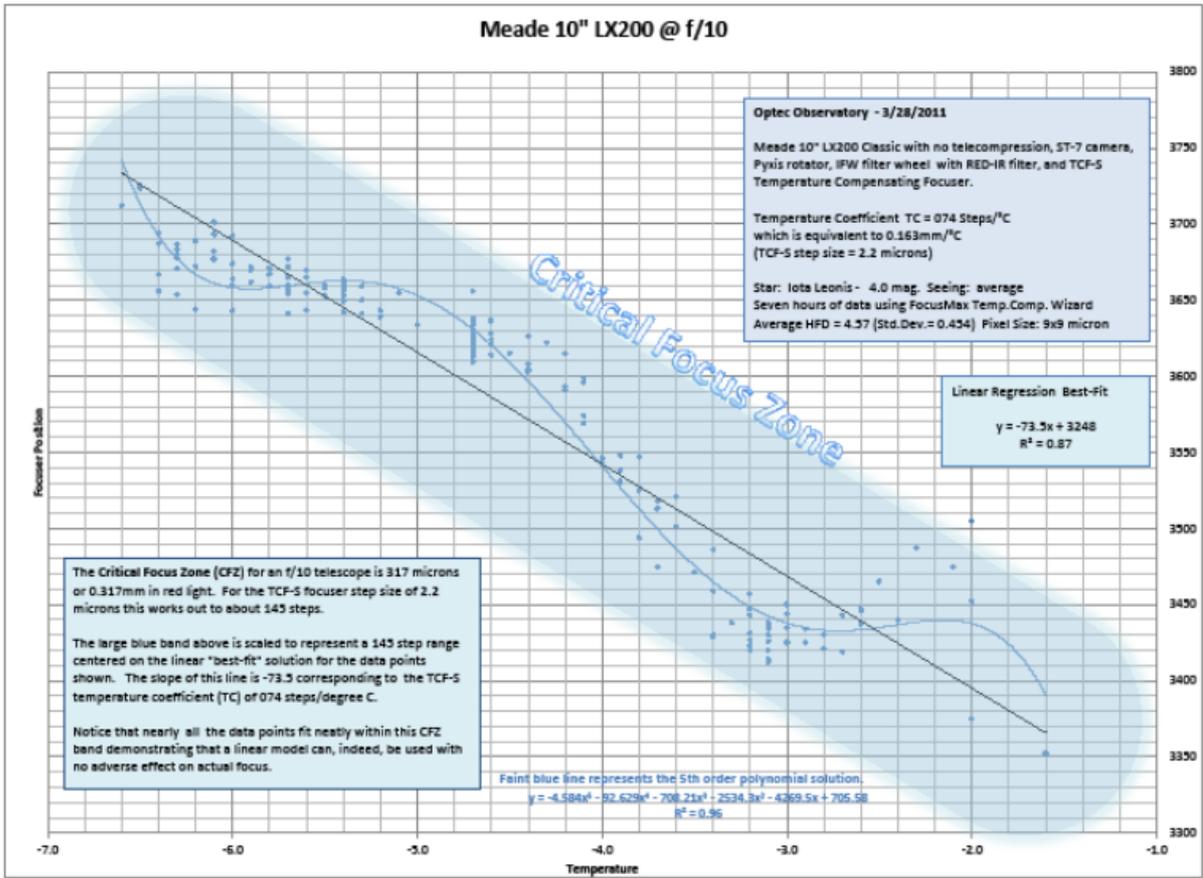
As proof, I've just uploaded plots at f/11 and f/6 taken with the C14 on a Paramount ME, Optec IFW, TCF-S focuser, Pyxis rotator and ST-9 camera. The FocusMax (v3.4.40) Temp.Comp.Data learn wizard was used to obtain all data. The two plots can be found in the files section under a new folder labeled "Temperature Compensation."

The results and corresponding Temperature Coefficient values are shown on the plots as well. These TC values relate to the 2.2 micron step size of the TCF-S focuser. In strictly linear terms we found that the C14 focus at f/11 moves nearly 0.4mm per degree C. The same scope at f/6 (using the Optec NGW 0.5X telecompressor) was only about 0.27mm per degree C.

You are most certainly correct saying that temperature compensation can and does work. We have thousands of customers using the TCF-S and temperature compensation. The key is to perform the due diligence to determine the Temperature Coefficient for your specific optical system as you have done.

Very best,
Jeff.
Jeff Dickerman
Optec, Inc.

(<http://tech.groups.yahoo.com/group/FMaxUG/message/4933>)



Version History

Version History

5.1.0.13 Feb 28, 2024

1. Fixed a bug where the scripting DisconnectHardware Method would only disconnect the active camera and focuser when two systems are defined and active
2. Fixed bug where camera settings may not be returned to pre-focus run settings when running under a given automation app.
3. Added ability to import temperature compensation data that was exported from Excel containing embedded tabs as delimiter.
4. Improvements to Vcurve import.

5.1.0.12 Apr 2, 2023

1. Fixed another user date and time regional settings bug
2. Added a new feature to AcquireStar. If the telescope pointing is above the 'Min star altitude' setting and Multi-Star focus is enable, FocusMax will attempt to focus on the current field before selecting a star field and slewing to new coordinates.

5.1.0.11 Mar 21, 2023

1. Fixed bug with user date and time regional settings

5.1.0.10 Mar 11, 2023

1. Fixed bug that may generate license has expired depending on user date regional settings
2. Several bug fixes and internal improvements for next major release of FocusMax V5.2

5.1.0.9 Oct 23, 2022

1. Added new Wizard to assist in setting 'Focus Convergence' - see Menu/Wizards/Focus Convergence Wizard.
2. Added logic to maintain constant subframe size while sampling target star at NearFocus.
3. Addressed potential error in reading filter offset if [FilterOffset] contains '|' separator but no offset data is listed.
4. Enhancements to Filter Offset Wizard.
5. AcquireStar Wizard - added code to slew telescope to the zenith for star identification. The 'Slew zenith' user setting will be reset when the wizard completes.
6. Fixed bug where 'Apply' First focus run and 'On connect' in the Temperature Compensation panel would not be enabled when FocusMax Temp Comp method was selected.
7. Added logic to trap reserved characters when creating a new Configuration directory.
8. Fixed bug in Offset Filter Wizard that may drop the active ini file if the process is stopped.
9. Added ability to enter decimal pixel size in Preferences/Camera.
10. Added the ability to set the Near Focus outlier detection limit - see [AutoFocus_SingleStar], [AutoFocus_MultiStar], OutlierCutoff = 2.5 (default)
11. Minor improvements to Vcurve quality test which is run at the conclusion of the process.
12. Improved hyperbola fit display on Vcurve graph.
13. Added new routine to create a temp file to store user defined focus parameters when Vcurve or Wizard is run. Parameters will be written back to ini files at the conclusion of the run.
14. Improved logic when setting exposure time for Single-Star and Multi-Star focus.
15. Added automatic file backup to '//Backup' when settings are changed in all Preferences windows.

5.1.0.8 July 01, 2022

1. Added the following properties to the COM interface: LastAutofocusPosition (Long), LastAutofocusFilter (Integer Base1), LastAutofocusTemperature (single), LastAutofocusJulianDate (Double). If the the data returned is -999 then the readings are missing.
2. Fixed a bug where a missing filter offset value would generate an error message.

3. Added additional startup messages to help with license debug.
4. Fixed a bug where AcquireStar may quite after first run.
5. Fixed a bug where TSX ImageLink would fail when the script 'TS_ImageLink.vbs' was run when the regional decimal separator is "," instead of "."
6. Fixed bug where an error may be generated when using MaxIm to determine FWHM in arc-sec.
7. Added a new Temperature Compensation feature to position the focuser based on the last successful focus run. Enabling 'First focus run' will apply the focuser offset the first time an autofocus run is performed - no message timer is displayed. Enabling 'On connect' will apply the focuser offset when the focuser is set to auto-connect and FocusMax is launched.

5.1.0.7 May 23, 2022

1. Added code to determine if FocusMax V5 starting up is the first time, if so, then test if the user started as Admin. If FocusMax did start as Admin then startup will continue, if not, startup will terminate with a message to restart as Admin, close and reopen without Admin tights.
2. For Windows 7 and 8 users: If a new update is posted and you click on the yellow banner, you may see a Windows message box 'You have the latest version'. Unfortunately, Microsoft did not enable TLS 1.2 with any Windows updates so it must be manually enabled- follow the instructions detailed in this link <https://hide.me/en/knowledgebase/how-to-enable-tls-1-1-tls-1-2-in-windows-7-and-8/>.
3. Added new feature to estimate and overwrite the default 'NearFocus HFD' value when the first Vcurve is run.
4. Fixed bug in Filter Offset Wizard.
5. Fixed telescope jog buttons which will now be enabled when the telescope is connected and tracking.
6. Adjusted subframe size so that the frame will not be less than specified size defined in *.ini regardless of binning used. The frame size in previous version was calculated size / bin.
7. A few tweaks to improve simulated star characteristics.

5.1.0.6 May 14, 2022

1. Fixed bug where AutoVcurve run would fail if either endpoint of the V was calculated to be outside of the focuser range of travel. Intended behavior was to have the endpoint default to appropriate focuser extreme range (0 or max travel).
2. Fixed bug where Vcurve data as not being properly imported.
3. Fixed bug where Vcurve hyperbolic fit would not properly converge if the max focuser position was > 100,000. Set default max travel to 10,000,000 to accommodate a current available focuser that supports 1,000,000 steps.
4. Fixed bug where the telescope may not disconnect when 'Disconnect' was selected from the telescope menu.
5. Added a manual ini switch to reject a host application request to update AcquireStar Bright & Dim target star magnitude. The switch may be found in the active *.ini file section [AcquireStar], DenyHostStarMag = 0 (false default), set = 1 (true) to deny host app from updating AcquireStar Bright & Dim mag settings.
6. Fixed Temp Comp bug.
7. Updated FirstLight Wizard so that it will now sample to desired max HFD when estimating the slope.
8. Added support for TheSkyX/64 Camera Add-on Readout Mode.
9. Added a new feature to allow the user to set data files location if FocusMax V5 files are moved to a different location other than the default C:\Users\XXX\Documents\FocusMax V5 - see Configurations Window which is opened Menu/Files/Set new Configurations path.
10. Added ability to 'Always' save autofocus and Vcurve images from Menu/Files/Save Images which will be saved between sessions. Selecting 'Current session' will not be sticky between observing sessions.

5.0.0.5 Apr 25, 2022

1. Improved user interface when opening Temp Comp file in TC Window.
2. Fixed a small bug where an empty TC file was saved to //LogFiles directory when running the TC Wizard
3. The Find & Expose buttons are now enabled on the main FocusMax Window when Vcurves have not been run which allow the user to find a suitable star for Vcurve run.
4. Reworked all graphics to use a new graphics engine to eliminate a potential out of memory condition when multiple graphs are displayed on the screen.
5. Fixed bug were the Nebulosity V4 ASCOM filter-wheel would not return the filter names.
6. Fixed bug where the final Mean FWHM may display in the Log as '0.00'.

7. Changed the minimum autofocus 'Tgt flux' from 100 to 25 for back illuminated CMOS camera.
8. Modified the 3rd order polynomial used to determine the field size when searching for suitable autofocus stars with AcquireStar.
9. Added new feature where user may define a region (in pixels) around the image border to avoid star detection during 'Find Star' routine. This may be set in the active system.ini file, section [StarDetection], SingleStarBorderAvoid = 25 (default) and MultiStarBorderAvoid = 10 (default). For Single-Star Focus, it will help avoid selecting a star near the extreme edge of the image resulting in a rectangular shaped subframe instead of square.
10. Added new feature to recenter focuser on predicted focus position if Vcurve run fails and data is not written to file.
11. Added new logic to speed up finding stars with TSX Query function.
12. Added new feature to allow the user to set the camera Readout Mode (MaxIm only) which will be useful for some CCD and CMOS cameras.
13. Added additional logic to AcquireStar use the target star for an autofocus run even though the star may be outside the desired slew error circle.
14. Added ability to define the Min & Max telescope slew error when running in simulator mode - see Preferences/Telescope

5.0.0.4 Mar 03, 2022

1. Fixed bug where the Mean FWHM was posted in the Log as 0.00 at the conclusion of a focus run.
2. Implemented a new Wizard to determine the temperature compensation coefficient while the observatory automation app is imaging during the night.
3. Fixed bug where an error may be thrown by the graphics engine when graphing AutoVcurve when running the First Light Wizard.
4. Added a Settings.cfg entry [Beta] SaveImages = 0 (default False) to automatically save images during beta testing.
5. Fixed bug where the menu of the main FocusMax Window would fold to the next line cutting off the lower portion of the window on a Windows 7 machine.

5.0.0.3 Feb 21, 2022

1. Fixed bug where the Vcurve graph was not updating while generating a Vcurve.
2. Added additional error codes.

5.0.0.2 Feb 18, 2022

1. Fixed bug where update message box would open even if 'Check for update' is disabled in Preferences/General.
2. Fixed bug where very old FocusMax V4 Vcurve data (*.vcl files) would not import correctly.
3. The Vcurve 'Center' will now update to the focus position following a Vcurve run if necessary.
4. Added additional logic to improve the speed of First Light Wizard AutoVcurve function which estimates the Vcurve slope.
5. Fixed bug where AcquireStar may not identify stars when scripted against TheSky.

5.0.0.1 Feb 11, 2022

1. Initial FocusMax V5 release