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FLI KELPER SCMOS CAMERA

ASCOM DRIVERS

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Conventions

The following conventions are used in this manual:



This icon denotes a note that contains an important information.

Bold

Bold text denotes the User Interface items in the software (clickable, for example, menu items, dialog box buttons etc.).

Italic

Italic text denotes emphasis, cross-references, or an introduction to a key concept. Italic text can also denote a text that that the user must enter.

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Chapter 1 Introduction

This chapter describes the Windows environment for the ASCOM driver software.

About the FLI Kepler sCMOS ASCOM driver

The FLI ASCOM driver gives you the ability to use the FLI Kepler cameras to acquire images and preview video.



Note The cameras may operate at frame rates, depending on camera settings. Please refer to the FLI web-site for the details.

Windows Environment

This release of FLI Kepler drivers supports the following software for Windows 7 and above:

- ASCOM Platform 6.2 and above
- Microsoft .NET Framework 4 Client or .NET Framework 4 Full Installation or later
- Windows 8 and later the .NET Framework 3.5 option must be enabled in Control Panel / Programs and Features / Turn Windows Features On and Off
- Visual C++ 14.0 libraries (for FLI library)

The FLI Driver require Visual C++ 14.0 libraries. The installer will provide these if they are not already present on your PC.

Chapter 2 FLI ASCOM Driver Installation

This chapter contains the installation notes of the FLI Kepler sCMOS camera ASCOM driver.

Installation

Start **FLI-Kepler-sCMOS-Setup-v.6.exe** from Windows Explorer. The installer will perform a check for the current ASCOM platform version. On some ASCOM installations the setup may fail to determine the ASCOM Platform version showing the following dialog box (followed by other dialogs):

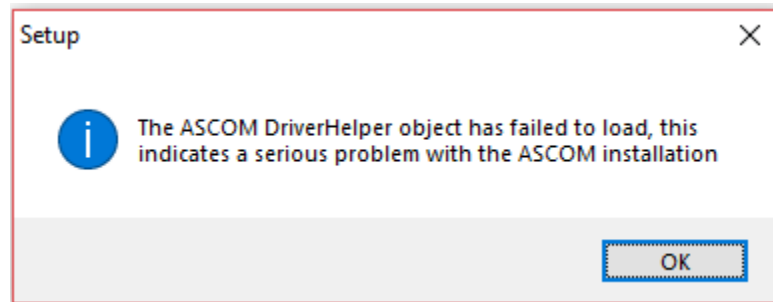


Figure 2-1. The setup fails to determine the ASCOM version.

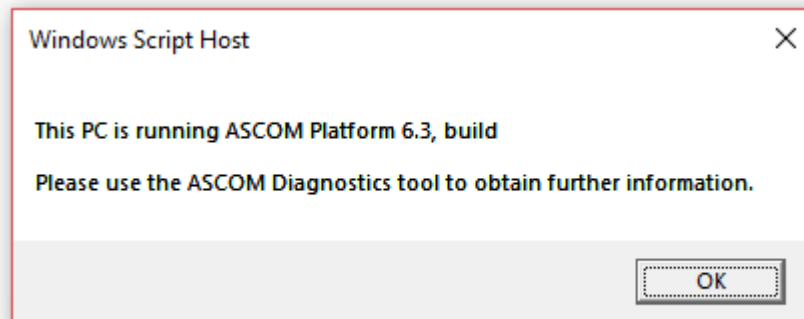
In this case start the **FLI-Kepler-sCMOS-Setup-Simple-v.6.exe** file. This setup will *not perform* any ASCOM Platform version checking prior the driver installation.



Note If using this installation please be sure that the ASCOM Platform version is 6.2 or above. To check the current ASCOM Platform version please run

```
C:\Program Files (x86)\Common Files\ASCOM>ShowPlatformVersion.vbs
```

This should give a dialog box like the following



ASCOM Drivers destination folder

All ASCOM camera drivers are installed to the following location:

C:\Program Files (x86)\Common Files\ASCOM\Camera

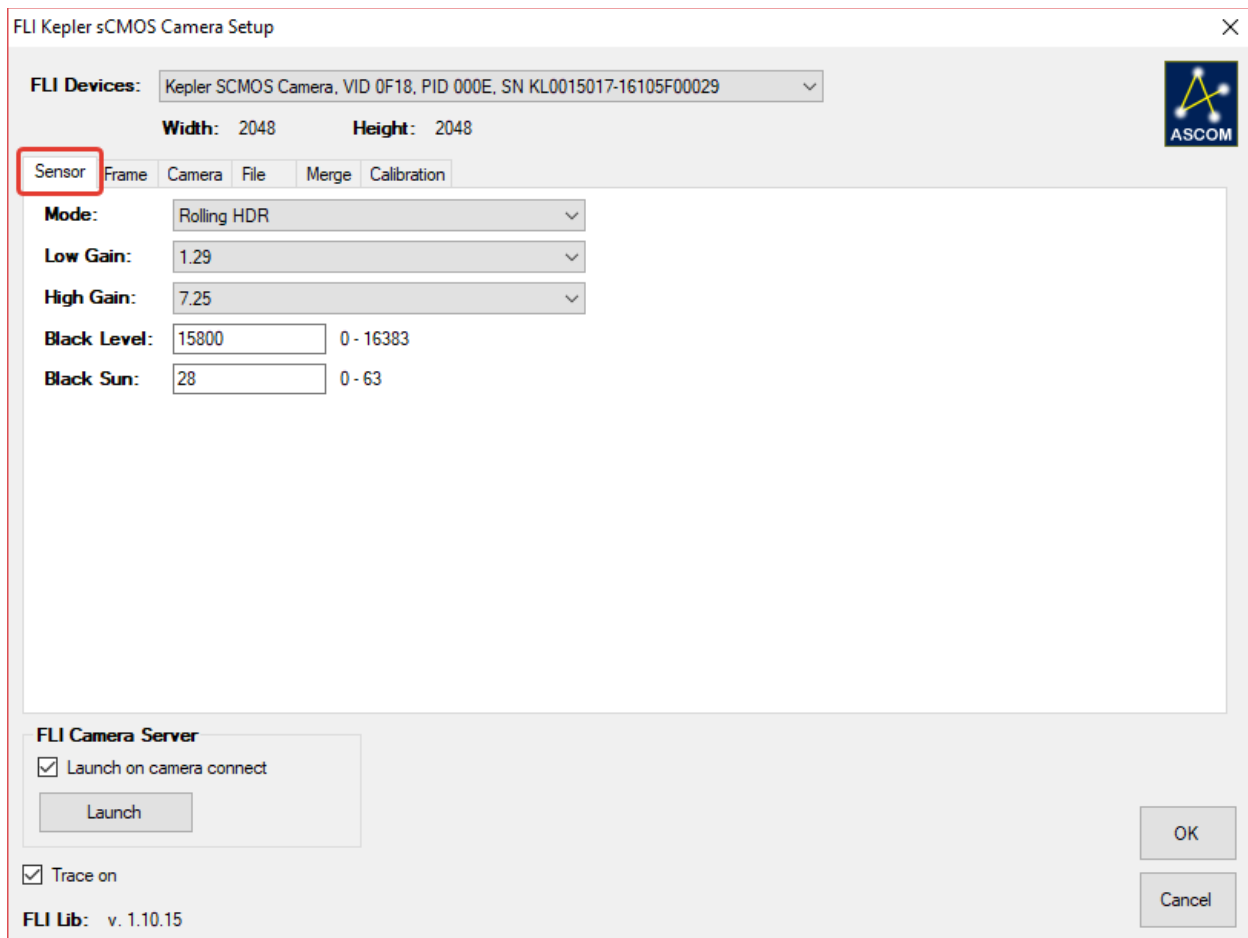
Chapter 3 FLI Camera Settings

This chapter contains the notes for the FLI Kepler sCMOS camera settings.

Sensor tab

In the **Sensor** tab the following options are available:

- Camera mode selection. Depends on the camera model. The list of available modes can include LDR (low dynamic range) and HDR (high dynamic range);
- The gain value(s) for corresponding channels. In the case when the LDR mode is selected, only the Low Gain value will be used by the ASCOM driver;
- The black level and the black sun values;



- enable/disable the Debug Trace (see below);
- enable/disable the FLI camera server external control program.

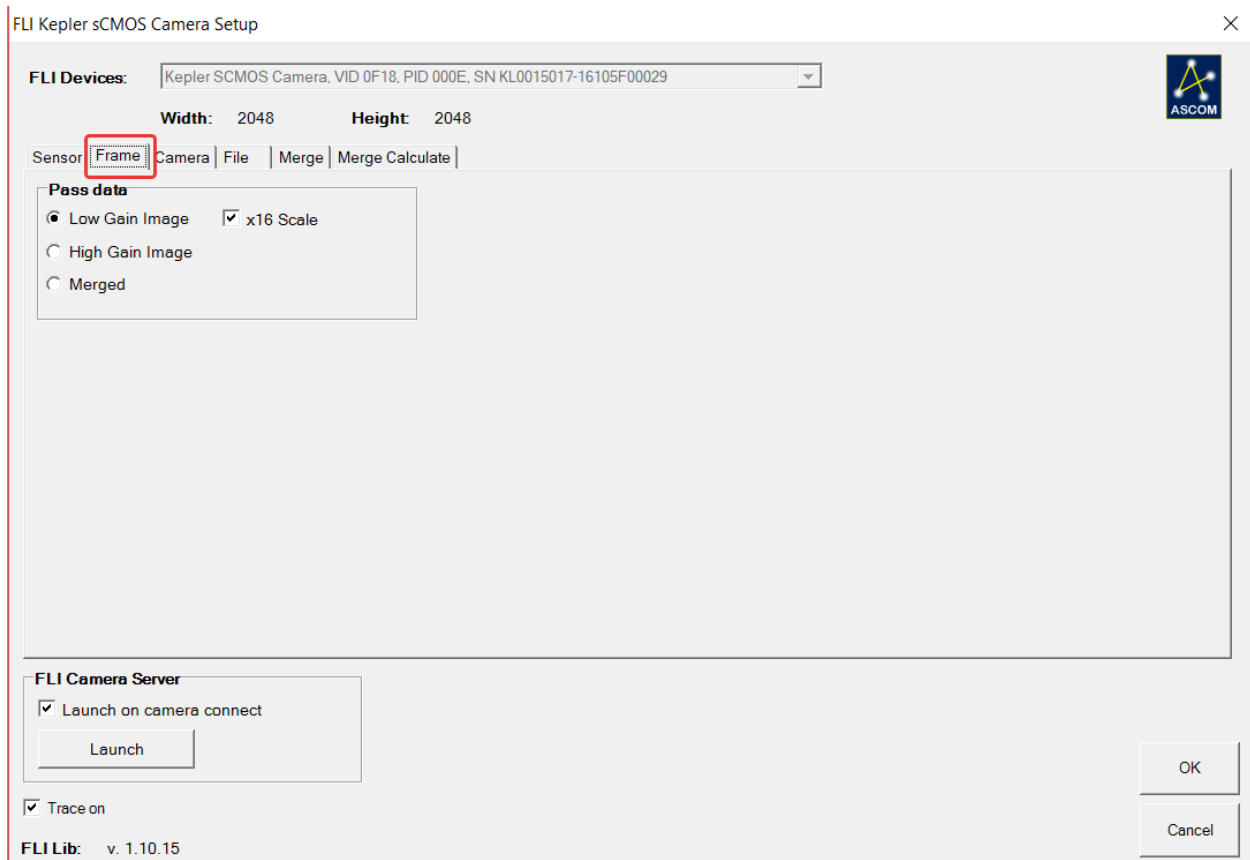
The dialog also shows (bottom line) the current version (1.10.15 on the above screenshot) of the FLI library which can be useful when communicating with the FLI support.

Simultaneously, it could be useful to set the check-box “**Trace on**” which will enable the tracing of the debug information. The log files (see Note below) can be used to communicate with the FLI support when ASCOM driver encounter problems.

Frame tab

In the **Frame** tab the user can control which channel will be used for the final frame composition:

- Low Gain Image – only the low gain channel will contribute to the final frame. If the current mode is HDR then the high gain channel data will be ignored;
- High Gain Image – only the low gain channel will contribute to the final frame. If the current mode is HDR then the low gain channel data will be ignored;
- Merged Image – both the low and the high gain channels will contribute to the final frame as a merged image;
- Scale factor of 16 can be applied for Low or High Gain channel. Each channel has 12 bits; multiplying each pixel value by 16 will map the data from [0-4095] grayscale range to [0-65520] range. Has no effect on the merged image.



NOTE: these switches are not available if the mode selected in the **Sensor** tab is not one of the HDR modes.



Note If the ASCOM log files (if Trace is enabled, see above) can be found in the following directory:

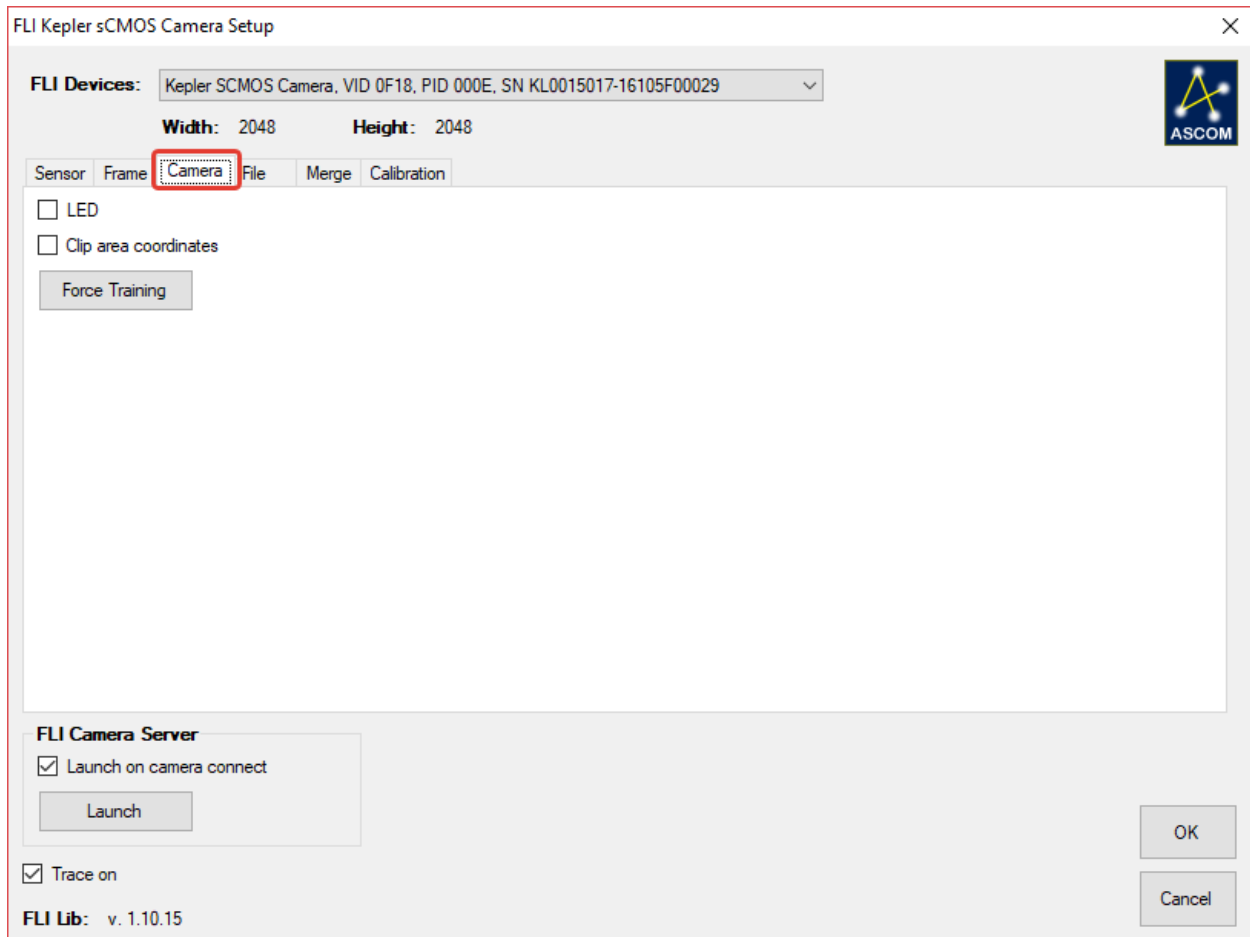
C:\Users\<USER NAME...>\Documents\ASCOM\Log_s YYYY-MM-DD

Where <USER NAME...> is the current Windows user name and the **YYYY-MM-DD** is the date when the ASCOM driver created log files.

Camera tab

In the **Camera** tab the user can control:

- The camera LED; controls the operation of the internal LED and can be enabled or disabled;
- Clip area coordinates – if set, the ASCOM driver will use the clipping of the sub-region coordinates to the closest even number;
- Force Training – the sensor training at the current temperature.

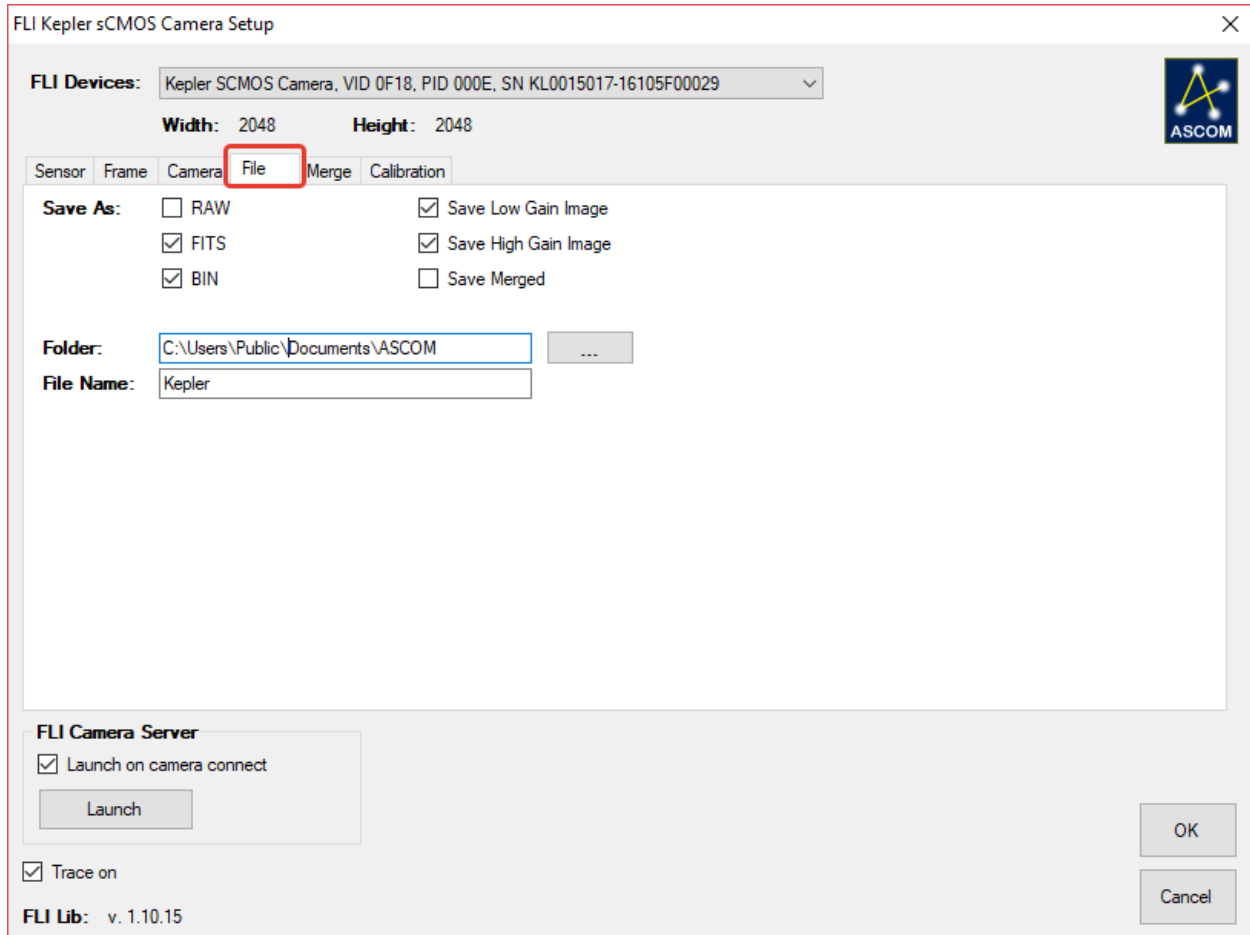


NOTE: Clip area coordinates is an experimental feature and maybe removed in the future.

File tab

In the **Files** tab the user can control the channel(s) and format(s) that should be used to store the acquired frames on the disk:

- **RAW/FITS/BIN** – the file formats that are currently available for saving by the ASCOM driver. The RAW format is the frame data as it comes from the camera (with the metadata header, packed). The BIN file format is for the binary unpacked frame data in the unsigned short (16 bit) pixel format. FITS is for the “Flexible Image Transport System”;
- **Save Low/High Gain Image/Merged** – shows which channel(s) will be stored in the selected file formats;
- **Folder** – the folder where all the files will be stored. Can be changed by pressing the “...” button;
- **File Name** – the text that will be added to each frame file name. All saved frames will start with this text.

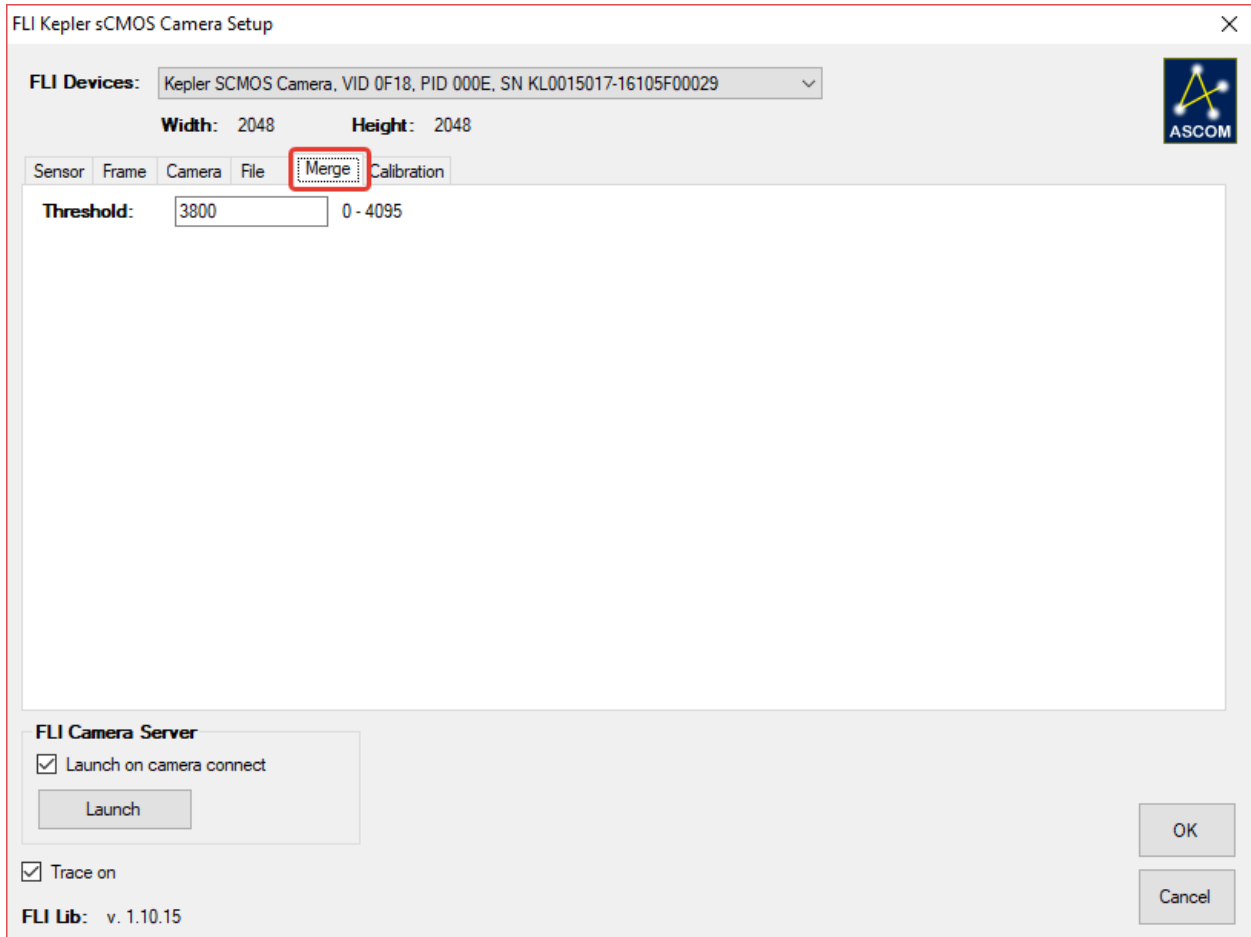


NOTE: the file format check boxes are ignored if none of the **Save ...** is selected.

Merge tab

In the **Merge** tab the user can control the threshold for the merging operation:

- **Threshold** – during merging of the low and high gain channels the threshold value will be used to check if the pixel is close to be or completely oversaturated. The default value is 3800.



Calibration tab

This tab is described in the following chapter.

Chapter 4 FLI Camera Calibration

This chapter contains the notes for the FLI Kepler sCMOS camera calibration.

Calibration tab

When the FLI Kepler sCMOS camera operates in any High Dynamic Range modes, the acquisition contains 2 channels with Low and High gain images. These channels can be merged into a single channel. In the scenario, when the High gain image is completely oversaturated (e.g. when the **Merge Threshold** value in the Merge tab is 3800, all pixels with values above 3800 will be considered as oversaturated), then there is no suitable information available in the High gain image for merging. The final frame will be composed using only the Low gain image data. However, the Low gain image should be correctly scaled. The scale factor is not known and must be calibrated by the user using the following UI of the ASCOM FLI Kepler setup dialog:

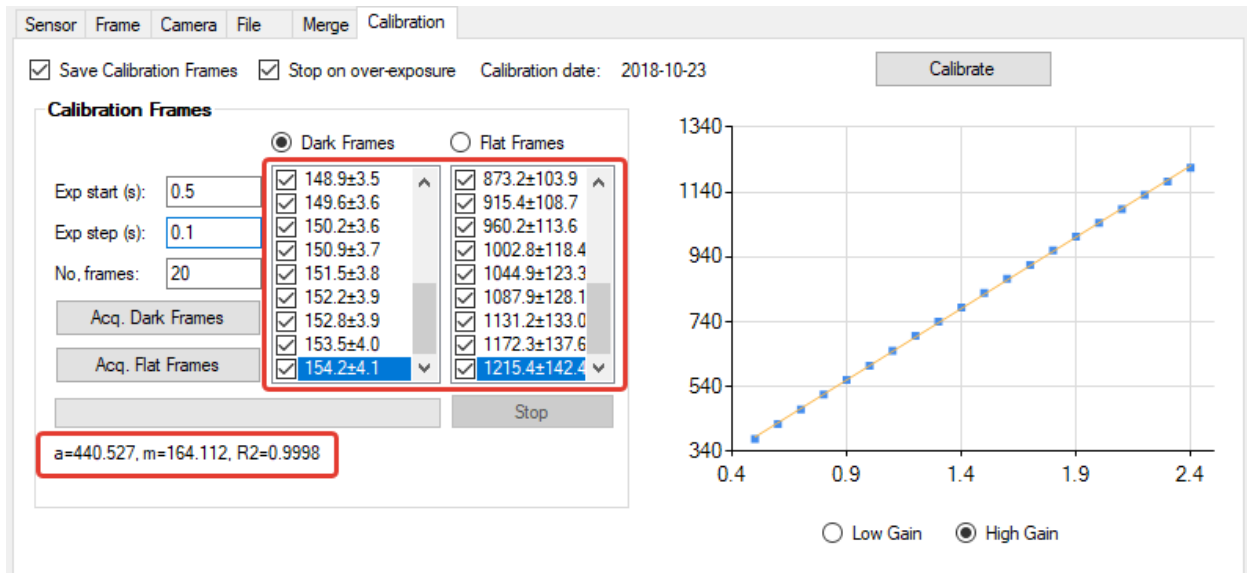
The screenshot shows the 'FLI Kepler sCMOS Camera Setup' dialog box with the 'Calibration' tab selected. The 'FLI Devices' dropdown is set to 'Kepler sCMOS Camera, VID 0F18, PID 000E, SN KL0015017-16105F00029'. The 'Width' is 2048 and 'Height' is 2048. The 'Calibration' tab is active, showing options for 'Save Calibration Frames' (checked), 'Stop on over-exposure' (checked), and a 'Calibration date' field. A 'Calibrate' button is present. Under 'Calibration Frames', 'Dark Frames' is selected. The 'Exp start (s)' is 0.5, 'Exp step (s)' is 0.1, and 'No. frames' is 20. There are buttons for 'Acq. Dark Frames', 'Acq. Flat Frames', and 'Stop'. At the bottom, 'Low Gain' and 'High Gain' radio buttons are shown, with 'High Gain' selected. The 'FLI Camera Server' section has 'Launch on camera connect' checked and a 'Launch' button. 'Trace on' is also checked. The 'FLI Lib' version is v. 1.10.15. 'OK' and 'Cancel' buttons are at the bottom right.

The idea behind the calibration is to evaluate the ratio between the intensities in the Low and High gain channels using the data from exposure series of dark and flat frames.

The procedure can be described as follows:

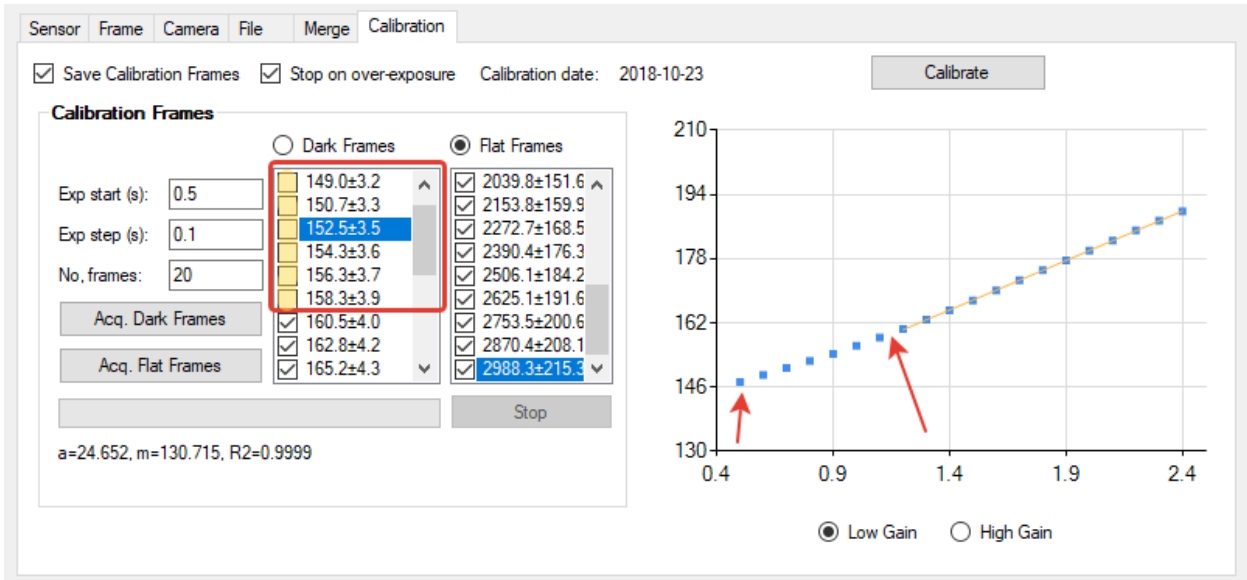
- Cover the camera objective. If the camera has a shutter it will be closed automatically;
- Set the appropriate acquisition parameters: the starting exposure (for example, 0.5 s), the exposure step (0.1 s) and the total number of dark frames to collect (for example, 20);
- Press **Acq. Dark Frames** button. Wait for completion.
- Open the camera objective and set the illumination. If the camera has a shutter it will be opened automatically;
- Set the appropriate acquisition parameters: the starting exposure (for example, 0.5 s), the exposure step (0.1 s) and the total number of flat frames to collect (for example, 20);
- Press **Acq. Flat Frames** button. Wait for completion.
- Inspect the statistics and press **Calculate** button.

The program will automatically collect the frames and output the statistics for the Low and High gain channels in the following manner:

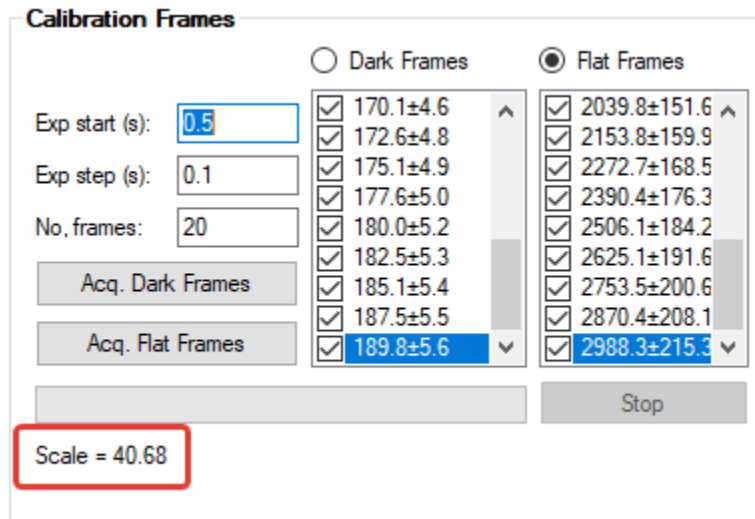


The left and right columns show the average values (\pm std. dev.) for the Low and High gain images respectively. The chart on the right shows the visual representation of the average values for the selected channel (can be changed by selecting either **Low Gain** or **High Gain** radio button under the chart). The line equation with the slope (**a**), the interception (**m**) and the **R2** is shown on the bottom left.

If some data points fall off the line, they can be unchecked (yellow marking in the left column). The unchecking will eliminate these points from the linearity test.



If the calculation of the scale factor was successful, it will be shown in the bottom left corner:



After the successful calculation of the scale factor, the calibration will be stored in the special file and will be used by the ASCOM driver during merging stage.

ASCOM Calibration destination folder

All ASCOM files will be stored (if enabled) to the following default folder (can be changed by the user):

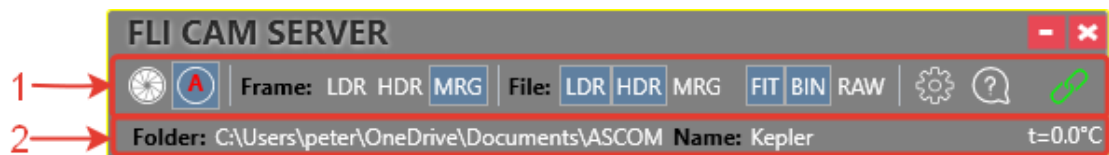
C:\Program Files (x86)\Common Files\ASCOM\Camera\Calibrate

Chapter 5 FLI Camera Server

This chapter contains the notes on the “**FLI Camera Server**” program. This software is designed to access the most frequently used settings of the ASCOM driver in real-time. The program designed in a form of a toolbar and stays on-top of all other programs.





Functionality

The basic functionality of the FLI camera can control some features of the ASCOM driver using two parts of the User Interface as it is shown on the screen shot below:



The following table gives a brief description of the “**FLI Camera Server**” main toolbar functionality:

Function	Toolbar button	Description
Shutter Open/Close		Opens or closes the camera shutter, if present. The button image reflects the status of the shutter.
ASCOM shutter control		The ASCOM driver control of the shutter: automatic (ON) or manual (OFF)
Readout channel		The channel that will be passed by ASCOM to the 3 rd party software: <ul style="list-style-type: none"> • Low gain (LDR); • High gain (HDR); • Merged image (MRG) •
Save channel		The channel that will be saved by ASCOM in the storage folder: <ul style="list-style-type: none"> • Low gain (LDR); • High gain (HDR); • Merged image (MRG) •

File save as ...		The file format(s) that will be used to save the selected channels: <ul style="list-style-type: none"> • FITS file; • BIN data; • RAW (FLI buffer)
Settings		Other ASCOM settings can be accessed
About...		About the FLI Camera Server
Camera connection		Camera is connected (green) or disconnected (red).
Storage folder	Toolbar #2	Sets the current Windows directory for the storage of the frame data.
File name for saving	Toolbar #2	Sets the base filename. See explanation in the main text.

The FLI Camera server can control

Automatic ASCOM driver shutter control follows the following rules:

- **Light frame:** the shutter opens on the frame acquisition start and closes at the acquisition end;
- **Dark frame:** the shutter closes on the frame acquisition start and is kept closed at the acquisition end.

If for some reason the default ASCOM shutter control is not enough, the “**FLI Camera Server**” program can be used to prevent the ASCOM driver automatically using the shutter (manual mode). The program communicates with the ASCOM driver and updates the camera state (**Connected** or **Disconnected**) and the status of the camera shutter (**Opened** or **Closed**). Depending on the current shutter state, the program will change the button text to **Close/Open**.

The final file name for saving will be constructed by the ASCOM driver in the following way:

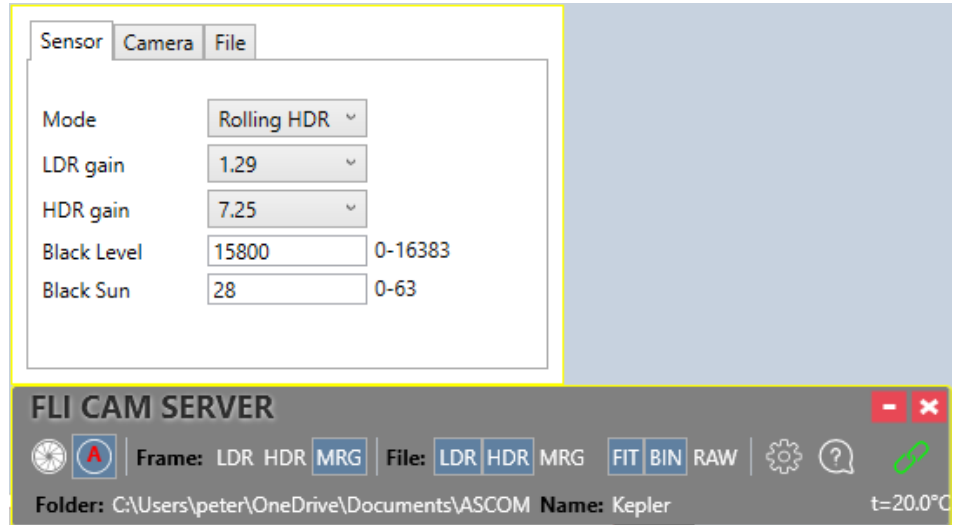
<base-file-name>_1s_1x1_t=0_231057_577-high.fits

where:

- **<base-file-name>** is specified by the user in the Toolbar #2;
- **1s** – the exposure time (here: 1 second);
- **1x1** – the frame binning (here: 1x1);

- $t=0$ – the temperature (here: 0°C);
- **231057_577** – the time stamp;
- **high** – the channel type (can be **high**, **low**, **merged**);
- **fits** – the file extension (can be **fits**, **raw** or **bin**).

The settings panel can be opened from the main toolbar by pressing the **Settings** button:



The panel provides the access to some settings of the FLI Kepler cameras that do not need to be accessed frequently.

The “**FLI Camera Server**” program can be launched from the Kepler sCMOS camera settings dialog and can be set to startup automatically when the camera is initialized.

FLI Camera Server installation folder

All ASCOM camera drivers are installed to the following location:

C:\Program Files (x86)\Common Files\ASCOM\Camera

The “**FLI Camera Server**” program will be installed into the same folder during the main FLI ASCOM driver installation.

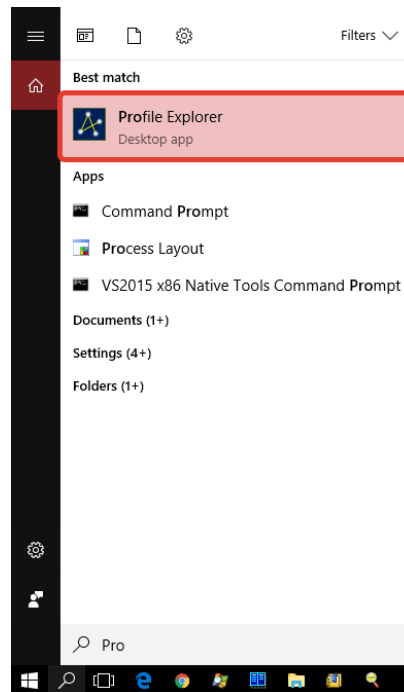
Chapter 6 Configuration profile explorer

This chapter contains the notes related to the ASCOM configuration profile explorer. It visualizes the profile store and allows editing of individual values by presenting the store as a hierarchical folder structure.

Profile Explorer

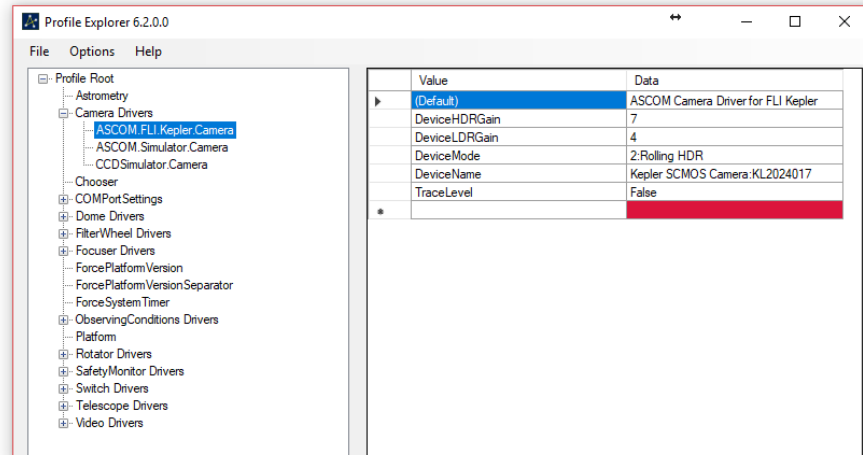
All camera settings can be viewed/modified using the ASCOM Profile Explorer. Profile Explorer is installed to the **Start Menu\ASCOM Platform\Tools** folder.

Alternatively, the user can start the “Profile Explorer” from the Windows task bar by typing “**Pro...**”:



The profile settings for the driver can be found under

Profile Root → Camera Drivers → ASCOM.FLI.Kepler.Camera:



Note If the ASCOM Profile Explorer is executed after the ASCOM FLI Driver installation but before the first run of any application that can configure the FLI Driver ASCOM, then the profile values/data will be empty.

Note Please refer to the ASCOM Platform Help on further description of the Profile Explorer.

Chapter 7 Testing the ASCOM FLI Driver installation

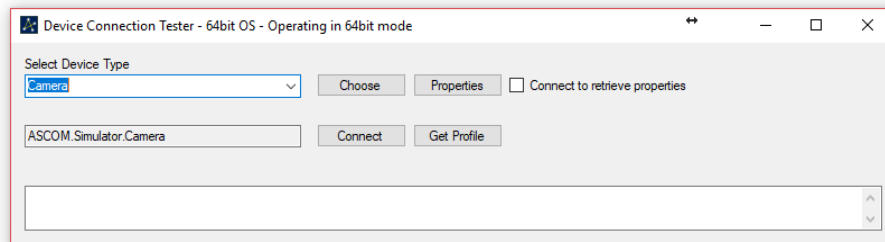
Start the **ASCOM Device Connection Tester** that is a part of the standard ASCOM Platform installation. The location of the Device tester depends on the Windows (32/64 bits) and can be either at

C:\Program Files (x86)\ASCOM\Platform 6\Tools\DriverConnect32

or at

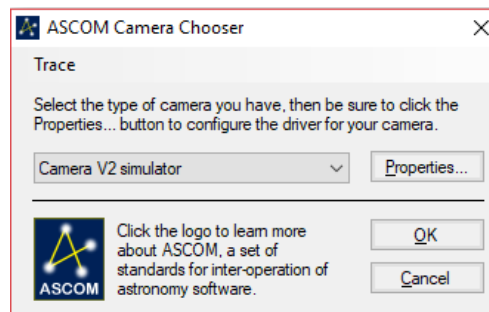
C:\Program Files (x86)\ASCOM\Platform 6\Tools\DriverConnect64

The following dialog will appear:

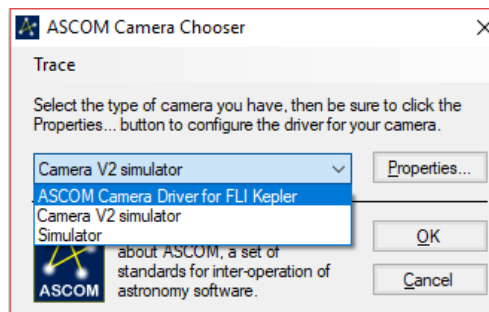


Under **Select Device Type** choose **Camera** and press **Choose** button.

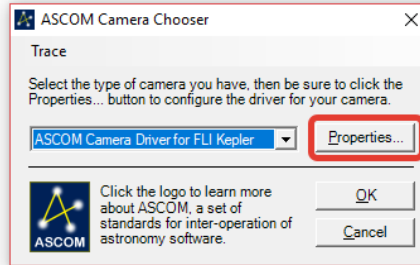
The following dialog will be shown:



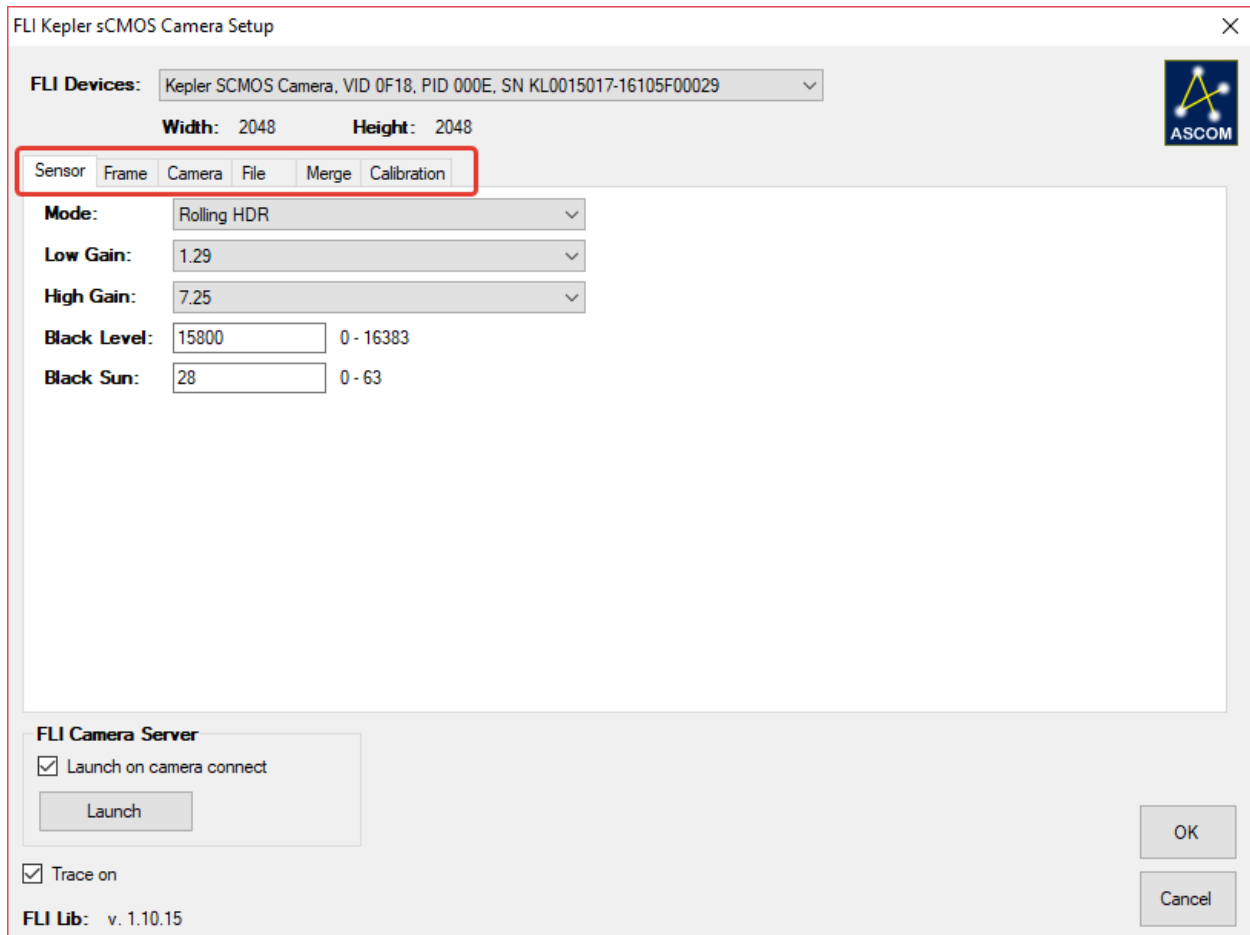
Select ASCOM Camera Driver for FLI Kepler.



Press **Properties** button.



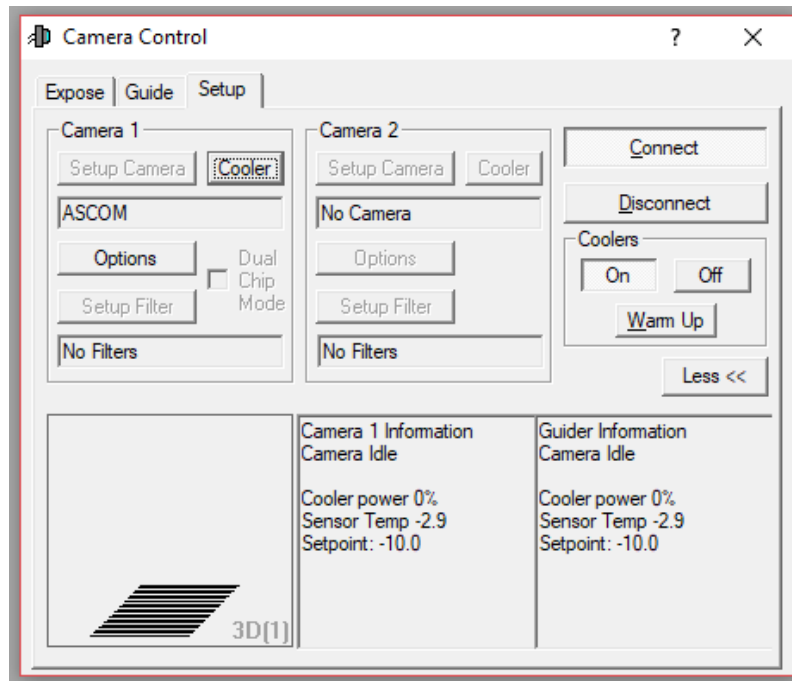
The dialog with the basic FLI Kepler sCMOS camera settings will appear:



All FLI Kepler camera main settings can be accessed through the set of tabs that are described in detail in the previous chapters.

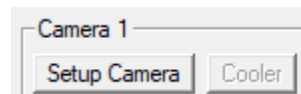
Chapter 8 Testing in Maxim DL

In Maxim DL the **Camera Control** dialog box provides the access to the ASCOM drivers:

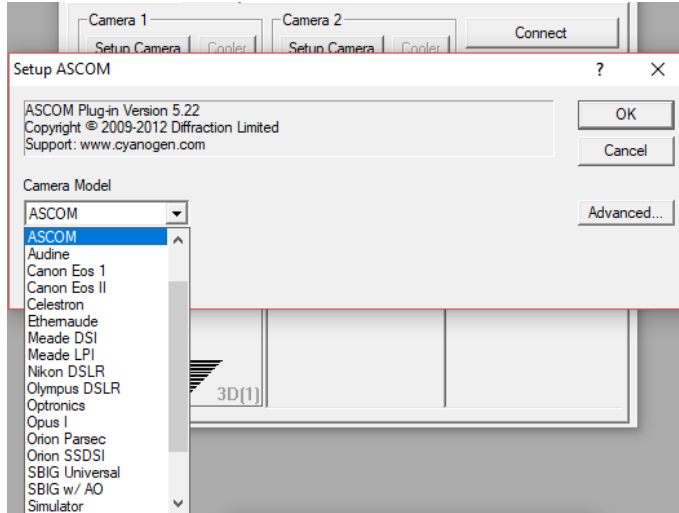


Press **Disconnect** button to close the connection to the camera.

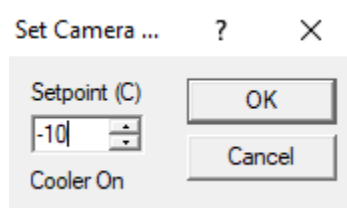
Once the current camera is disconnected the **Setup Camera** button will become available:



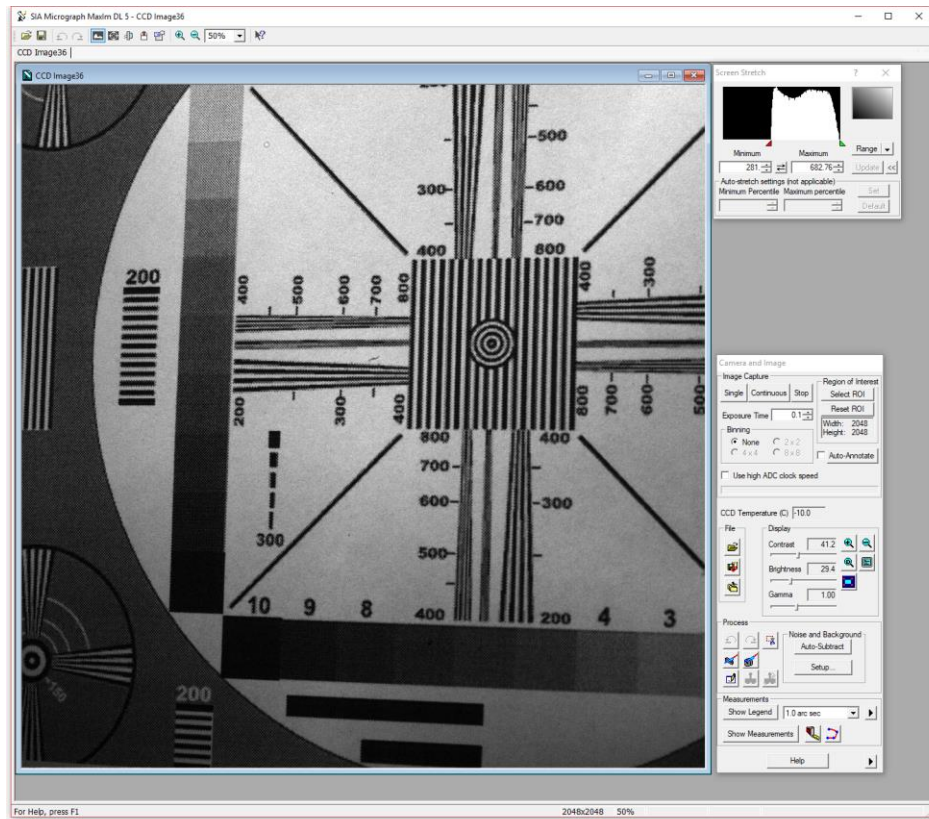
Press the **Setup Camera** button, select **ASCOM** for the **Camera Model** and setup the FLI driver as described above.



The Cooler settings can be used to set the temperature:



The LDR mode snapshot. Notice the low values of the histogram range.



The HDR merged mode snapshot. Notice the “white” values of 65535 and the histogram range:

