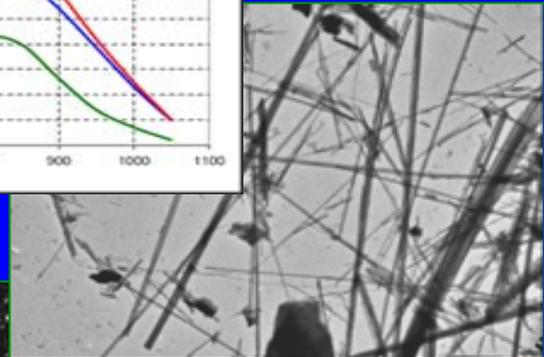
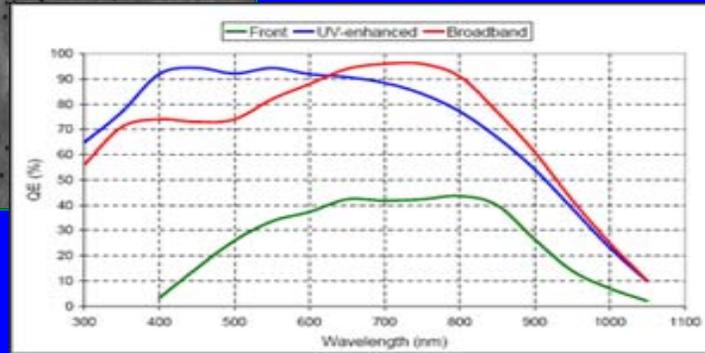
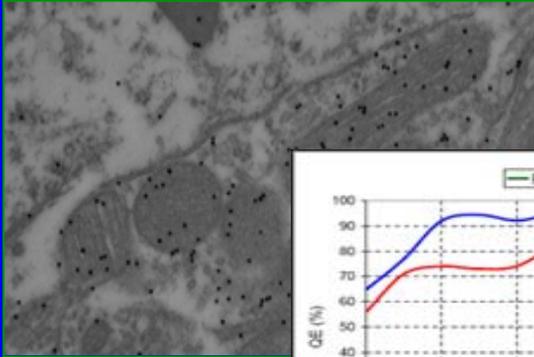


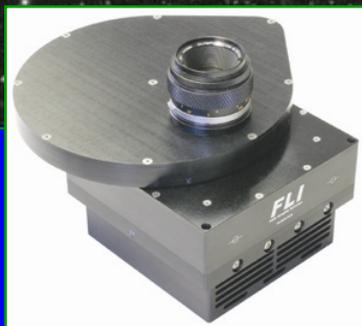
FLI

Finger Lakes Instrumentation

ProLine
MicroLine



Camera Installation Guide



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Finger Lakes Instrumentation, LLC
7298 West Main Street
Lima, New York 14485

Welcome

Thank you for purchasing an FLI camera. We know that your new camera will bring you years of enjoyment and excellent imaging results.

Please read the following instructions carefully and follow them closely to ensure trouble-free installation of your hardware and software.

A short tutorial is included that will allow you to take your first image and get acquainted with the basic operation of your new camera. Should you have any questions about your purchase, please contact us.

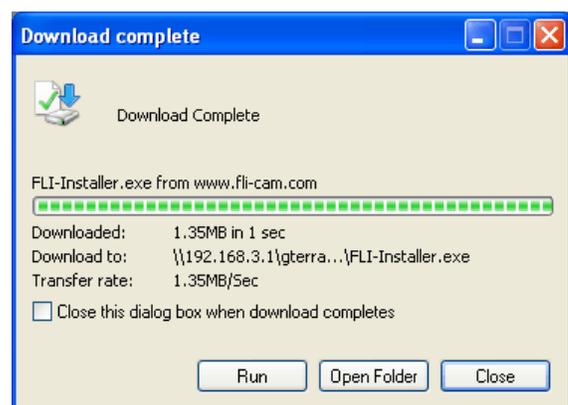
Check your Shipment

Please ensure that everything has arrived safely and verify that everything you ordered was properly shipped to you. Immediately notify your FLI dealer or FLI in the unlikely event of a missing or damaged component. Your order should include the following items:

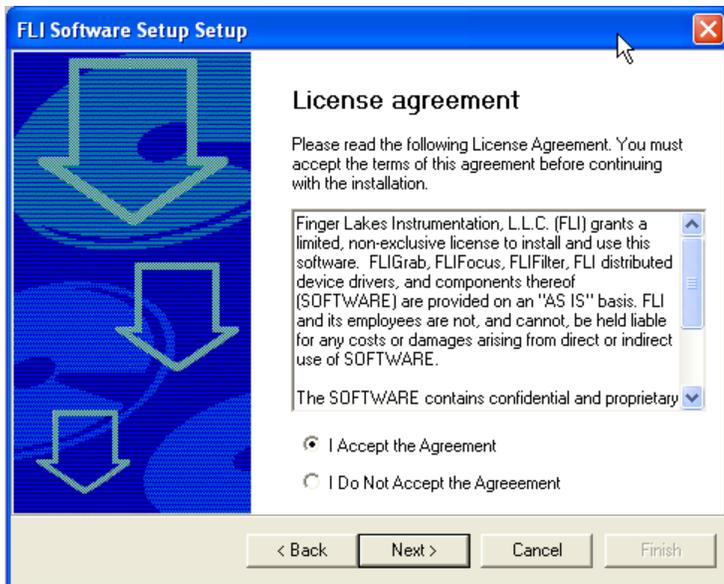
1. Camera with shutter cover
2. Camera Test Sheet
3. USB cable
4. 12 volt power supply
5. Power supply line cord
6. FLI installation information
7. Packing list

Installing the FLIGrab Camera Control Software

- ✓ Use the following link to download and install the FLI Install Kit
HTTP://WWW.FLI-CAM.COM/SOFTWARE
- ✓ A security warning similar to the one below will appear - Please select 'Save' to save the file to a location of your choosing.
- ✓ Once the download is complete, select 'Run'.

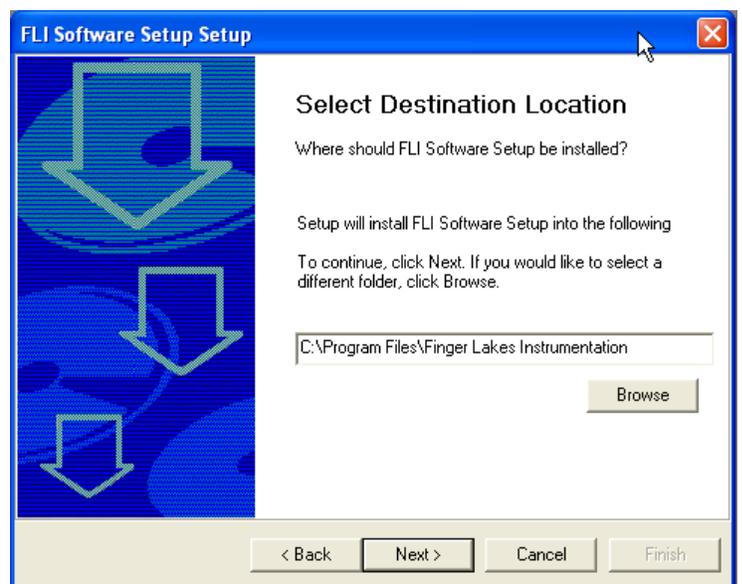


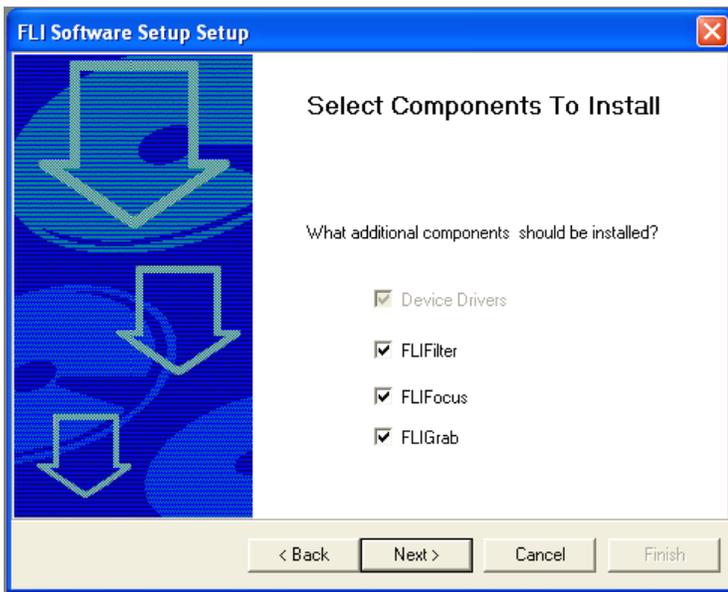
- ✓ A second security warning may appear at this time. (Please select 'Run' again.)
- ✓ The software setup wizard will appear, selecting 'Next' will begin the software setup process.



- ✓ Agreeing to the License Agreement will take you to the next step. Click on Next to proceed.

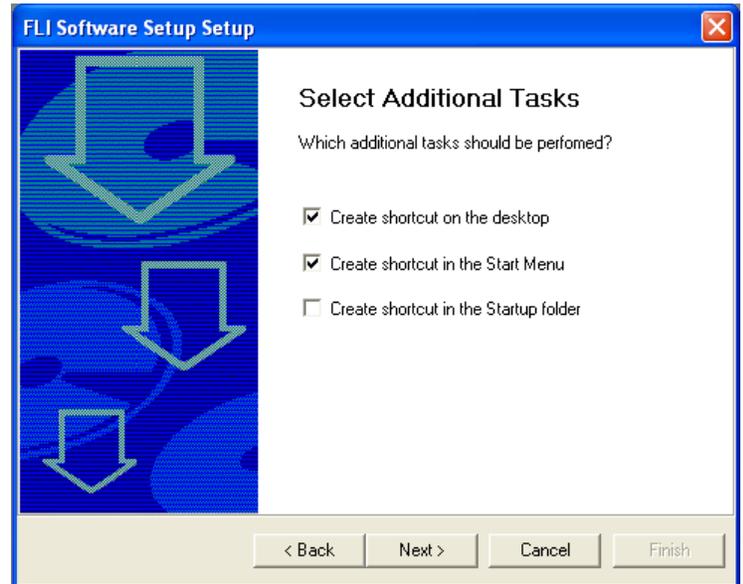
- ✓ Select where you would like the FLI software to be installed on your PC. Hit 'Next' once you have either browsed to the location or if you accept the location chosen by the FLI Install Kit. The installation program installs the camera drivers and software itself and further Windows intervention is not required.



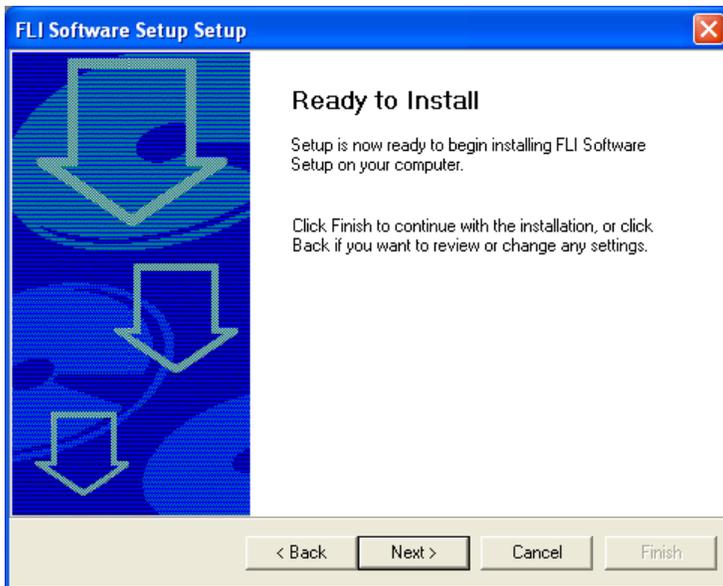


- ✓ Select the FLI software components that you wish to install. The default is for all software components to be installed. Deselect the item(s) that are not to be installed. Hit 'Next' once you are ready.

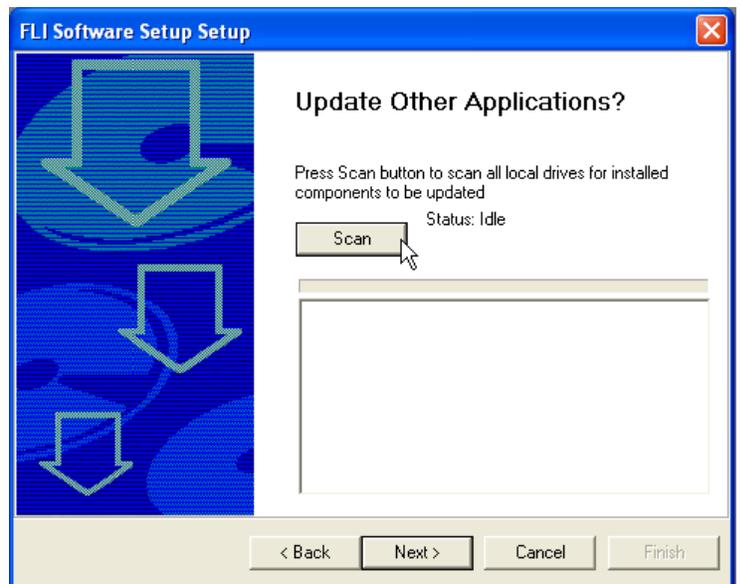
- ✓ You will be given a chance to select where Window's shortcuts are created. Select 'Next' to go to the next screen.

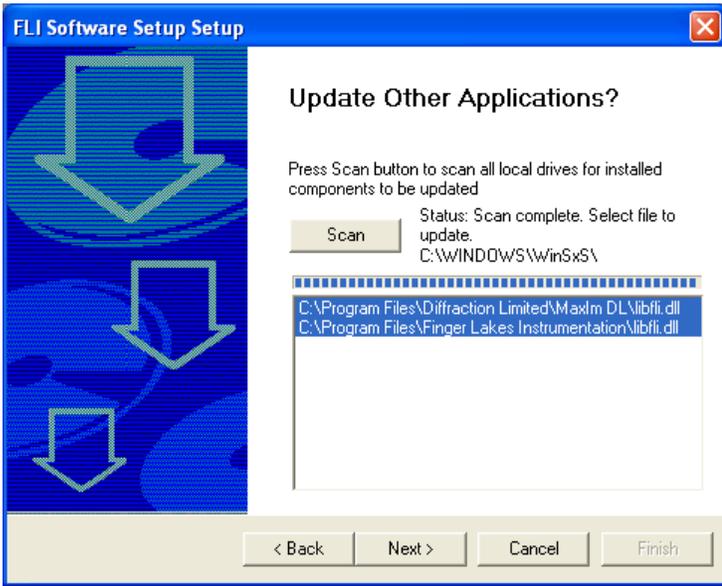


- ✓ FLI Software is ready to install. Click 'Next' to begin the software installation.



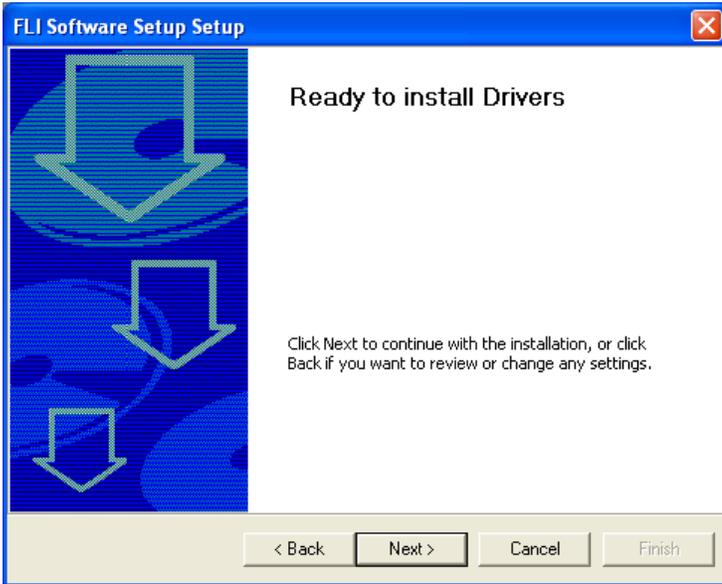
- ✓ If you use 3rd party software programs such as MaxIm DL, AstroArt or CCDSoft, you will want to select the 'Scan' button. Doing so will allow the install program to search your hard drive for FLI drivers.





- ✓ Once the file locations are found by the install kit **select the files that you wish to update using your mouse (left clicking each location).**

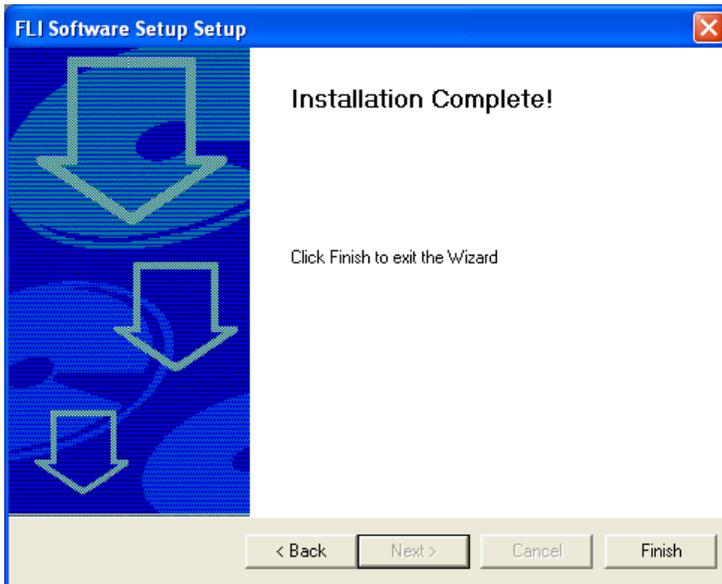
- ✓ The files will be updated.



- ✓ The FLI drivers are ready to install. Should you have any changes that need to be made, simply hit the 'Back' key.

- ✓ A Window's warning may appear at this time. Select 'Continue Anyway' if you wish to continue the FLI installation process.





- ✓ Success! The installation process is complete.
- ✓ Select 'Finish' to close the final installation window.

Third Party Software

A number of third party software is available that allows you to control the functions of your camera as well as process images captured with your FLI camera.

Such software include Astroart from MSB software that has a multi-lingual interface, MaximDL from Diffraction Ltd and CCDSoft from Software Bisque.

Before acquiring one of these or any other software to control your camera you are strongly advised to check with the software vendor that your camera is supported. New cameras and versions of the software are always been released and may differ in functionality than previous versions of the same software.

You can obtain information on these software by visiting the following websites.

MSB Software: www.msb-astroart.com

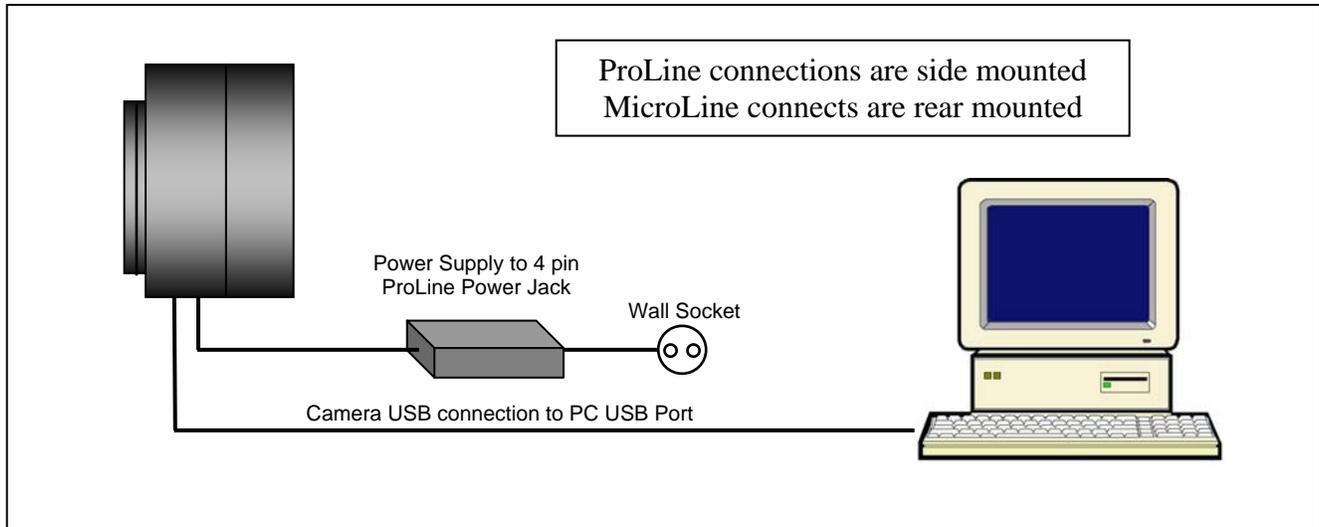
Diffraction Ltd: www.cyanogen.com

Software Bisque: www.bisque.com

Assembling and Powering-up your Camera System

Please bring together all parts. Make certain that during assembly the camera shutter cover stays in place to avoid damage to the metal iris. Only remove the cover when you are ready to connect the camera to your telescope. Please connect the various system components as follows:

CAUTION: Always plug your camera power cord into the camera “DC Power Jack” first, before applying AC power to the power supply. “Hot Plugging” the camera may result in a blown power supply fuse.



1. Attach the USB cable to your ProLine or MicroLine camera.
2. Attach the USB cable to your PC.
3. Plug in the 12 volt power supply 4-pin “DC Power Jack” connector into your camera.
4. Plug in the ProLine or MicroLine power supply unit into a wall socket or switched AC power strip.
5. Ensure that the camera’s fans are running.

Confirming Driver Installation

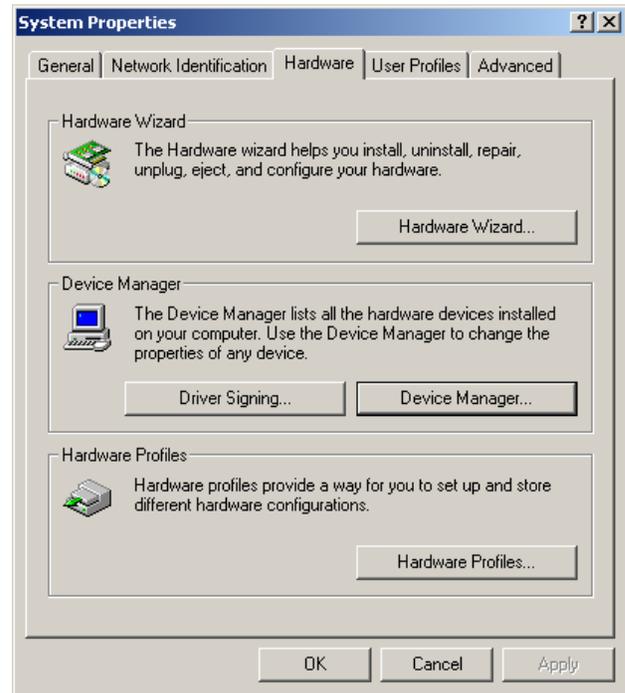
To ascertain that the camera drivers have been installed properly you can do so at any time if required.



At the Windows Desktop right-click on the **My Computer** icon

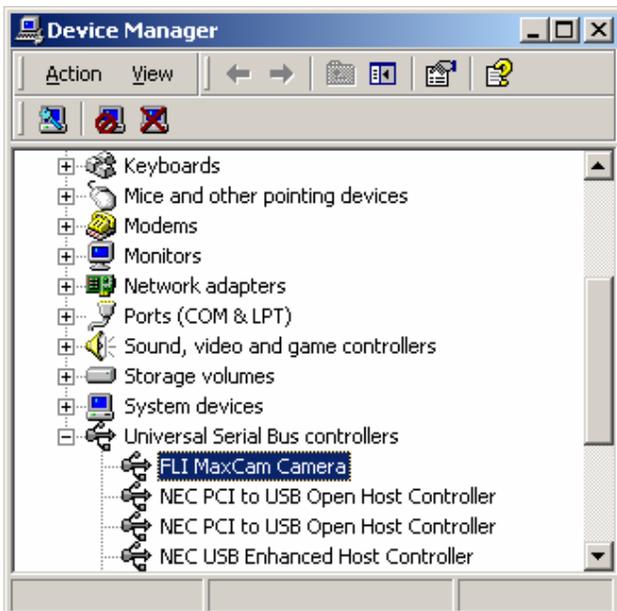


Click on **Properties**.



Click on the **Hardware** tab.

Click on the **Device Manager** button.



Click on **Universal Serial Bus Controllers**. The **FLI [type] Camera** entry should be present in the list.

If the **FLI [type] Camera** does not appear in the list you will need to re-install FLIGrab.

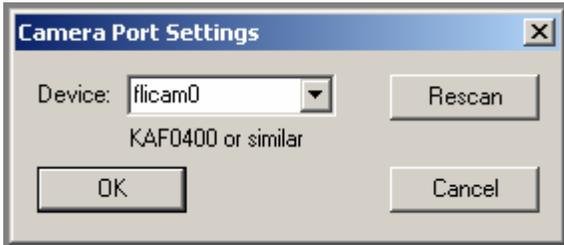
Please follow the installation instructions very

A Short Tutorial

FLIGrab is a Windows based program and allows you to fully control your camera. The following two sections will show you how to capture your first image as well as how to focus your camera.

Capturing your First Image

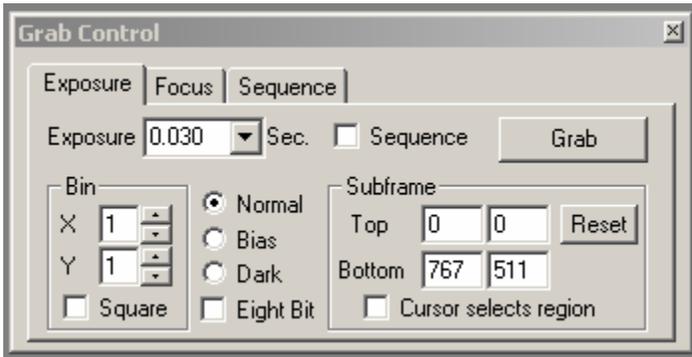
Ensure that your FLI camera is connected to your computer and that power is switched on. The fan on your camera should now be turning. Double click on the FLIGrab icon to open the application.



FLIGrab will automatically identify your camera. Click on OK to proceed.

If FLIGrab fails to find your camera, check all connections. Stretched cables can cause connectivity problems and/or system instability.

Click on File, and then click on Camera Control (Ctrl+W). Click on the Exposure tab to select it.



Set the fields as in the example on the left. If you are imaging during daytime set Exposure to 0.03 seconds. If you are testing your camera at night time a minimum 0.3 seconds exposure is recommended.

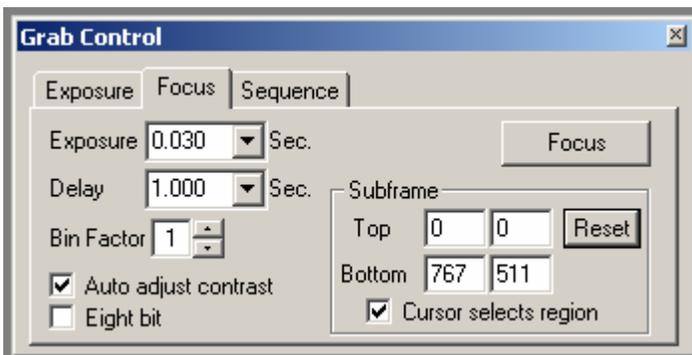
Note that overexposing can produce a black flat frame and not a bright frame.

Ideally, you would use the Grab command after the camera system is set up and focused. Click on Grab. You should be able to hear the shutter opening and closing while capturing the image.

It will take a few seconds for the image to appear on the computer screen. The image on your computer screen is likely to be out of focus.

Focusing your Camera

Click on File, and then click on Camera Control (Ctrl+W). Click on the Focus tab to select it.



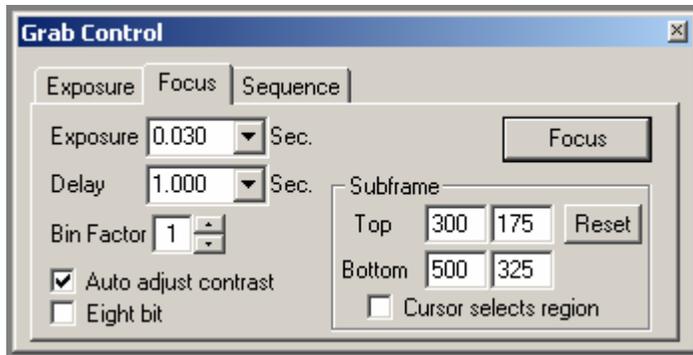
Set the fields as in the example on the left. If you are imaging during daytime set Exposure to 0.03 seconds. If you are testing your camera at night time a minimum 0.3 seconds exposure is recommended.

Note that overexposing can produce a black flat frame and not a bright frame.

Click on the Focus button. You will notice that the camera will start taking images at a slow rate and transferring them to the screen. Click on the Abort button to abort.

Wait for the camera to finish transferring the last frame to the computer screen. The slow frame rate makes focusing difficult.

To increase the frame rate you will need to set the camera so that it will only transfer a part of the whole image captured during the focusing process, i.e. the centre area. This makes focusing more intuitive and easier to achieve.



Set the fields as in the example on the left. If you are imaging during daytime set Exposure to 0.03 seconds. If you are testing your camera at night time a minimum 0.3 seconds exposure is recommended

Note that overexposing can produce a black flat frame and not a bright frame.

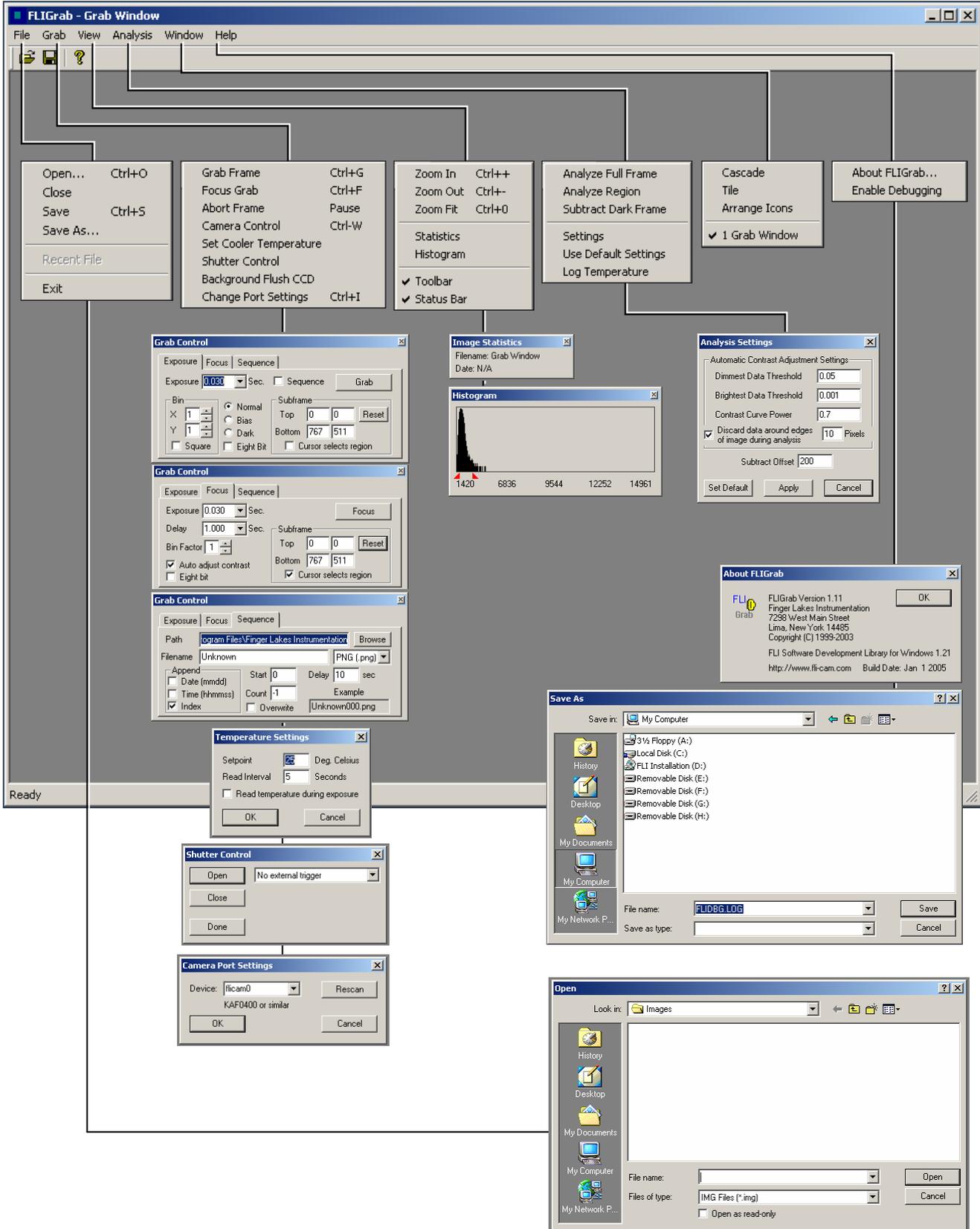
Checking the Eight bit box will increase frame rates further but the quality of the image will be affected as only 256 graduations will be used for rendering the image. It is still adequate for the purpose of focusing the camera in this example.

Once you have focused your camera you will be able to capture your first focused image.

Please refer to **Capturing your First Image** above.

FLIGrab Camera Control Software

FLIGrab is a Windows based program. The menu structure of FLIGrab will change depending upon circumstances and in this case, whether or not a file is opened, a MICROLINE or PROLINE CCD camera is present, etc.



Status Bar

The Status Bar is located on the lowest-most portion of FLIGrab. It provides information about FLIGrab activities and is continuously updated. When a ProLine or MicroLine camera is connected and initialized, the Status Bar will display the camera temperature, connection status, and exposure status.

When an image is open, the image size, view zoom ratio, pixel value and location will be indicated on the Status Bar.

Shortcut Keys

Frequently employed menu choices can also be reached by using shortcut keys. Each shortcut key can be found to the right of each command as seen in the menu. Additionally, a list of shortcut keys can be found by selecting the Help menu. For example, holding down the "Ctrl" key and then hitting the "G" will open the Grab Window. You may find that once learned, these shortcuts increase productivity and speed of operation on the most frequently performed functions.

Menu Bar

The upper most portion of the screen contains the pull-down menus, which include File, Grab, View, Analyze, Window and Help. Each menu item selection further comprises functions that are similar in nature to one another.

File

Open: This command loads an IMG, PNG or FITS* file format from disk into memory where it can be displayed or processed. When the Open window is displayed, you will be able to select files by moving through the directory structure. The shortcut key is Ctrl + O.

Close: Closes the currently opened image window by removing it from memory. If the image has changed, you will be prompted to save your changes before the window closes. The shortcut key is Ctrl + F4.

Save: Saves the currently opened image to disk. The same file name that was used to open the file will be used with the Save command. The shortcut key is Ctrl + S.

Save As: Allows you to save the currently opened image in a different file format or with a different name.

Recent File: The most recently opened files are displayed, allowing you to preview and select files that have been recently accessed.

Exit: Exits FLIGrab. The shortcut key is Alt + F4.

* Many professional astronomical image-processing programs support the FITS format (Flexible Image Transport System). The format is described in "Implementation of the Flexible Image Transport System (FITS)" published by NOST, NASA/OSSA Office of Standards and Technology, NASA Goddard Space Flight Center, Greenbelt, MD.

Grab

Grab Frame: The Grab command is used to take a single exposure or begin a sequence of exposures using the Save Filename Format String command. Ideally, you would use the Grab command after the camera system is set up and focused. There are several options associated with the Grab command that expand its usage. You can choose to take a Normal, Bias or Dark Frame exposure. For exposure longer than a minute, you may wish to take matching (duration and temperature settings) Dark Frames and store them on disk for later manual subtraction from Light frames.

Another feature of the Grab command is that you don't always have to take full frame images. You can choose to take sub-frames, which can be selected with your mouse cursor or by simply typing in the coordinates. A sub-frame has the benefit of reducing the image file size and associated storage requirements; it is most useful for small objects such as Planets and small galaxies that do not require the full field of view that a full-frame provides.

You can also Grab Control menu to reduce the camera's resolution by binning or by reducing to 8-bit format. This lower resolution maintains the field of view but reduces the download times; a useful feature when centering objects.

There are several other exposure options that are available under the “Advanced Grab Settings” command. These options will allow for automated grabs, predetermined file name suffixes and more. The shortcut key is Ctrl + G.

Grab Settings

Focus Delay: The delay in seconds between each focus integration. The delay is useful when you're focusing the system; allowing you time to make a change and let the optical system settle before another exposure is begun.

Frame Delay: The delay in seconds between each exposure. This feature is useful if you are using a robotic mount and require time in-between exposures, to center a new object.

Flushes Between Grabs: The number of flushes between each exposure.

Flush BIN factor: Set this to match the exposure bin factor

BIN factor is square: For example 1x1, 2x2, ... , 16x16.

Adjust contrast during focus: FLIGrab will automatically adjust the image contrast for each focus display.

Shutter opens with external trigger: Refer to External Triggering on Page 18.

Set Cooler Temperature: This selection sets the operating temperature for the Thermal Electric cooling device. (The TEC cooler is used to cool your camera which in turn reduces the rate of dark current build-up during an exposure). **See Page 14 program details.**

Re-Initialize Camera: Send the initialization command to the camera should you loose power or camera connection.

Troubleshooting

Issue	Remedy
I have checked my packing list and items are missing.	In the unlikely event please contact your FLI dealer immediately.
The fan on the camera does not turn.	Check that the camera is plugged to a suitable power supply and that there is power available.
The fan turns but when I use FLIGrab the camera does not work or works erratically.	Make certain that all cables are well seated and are not stretched.
FliGrab runs, the camera fan turns but FLIGrab cannot locate the camera. Sometimes I get a Windows "Communication" error.	Please turn off your computer and camera and leave them switched off for 2-3 minutes. This will flash the USB chips. Try again.
Everything is connected and FLIGrab has been installed but the software cannot locate the camera.	Please make certain that you have installed the software and drivers as per the instructions in this manual. Letting Windows to locate the camera during installation is likely to create problems. Uninstall FLIGrab and install again as per the instructions provided in this manual.
FLIGrab runs and has identified my camera. I have Grabbed an image but the image appears as a flat black frame.	You are over exposing or under exposing. Please read the Capturing your First Image section in this manual.
My images are out of focus. I have problems focusing my camera.	Read the section Focusing your Camera in this manual.

Contact Details

US Mail:

Finger Lakes Instrumentation, LLC
 PO Box 19A
 7298 West Main Street
 Lima, New York 14485

WWW

Web: www.fli-cam.com
 Email: support@fli-cam.com
 Fax: 585-624-9879
 Phone: 585-624-3760

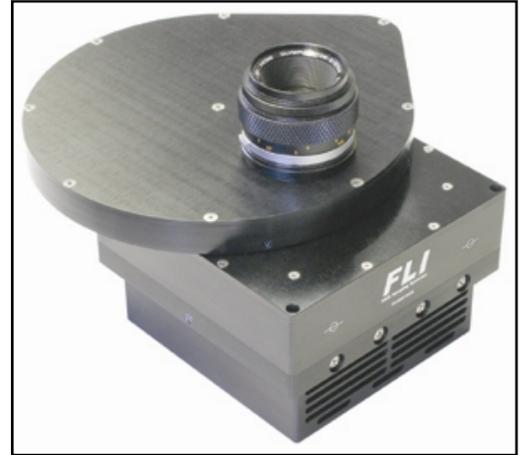
Appendix

Camera Options

ProLine and MicroLine cameras allow the selection of several types of CCDs that include full frame *front-illuminated*, full frame *back-illuminated*, and *interline* sensors from Kodak, Fairchild Imaging and E2V Technologies.

Sensors Coatings

Several CCD manufacturers have special coatings available to optimize the sensor's sensitivity for certain wavelengths. ProLine and MicroLine fully support the use of these sensors. Options include UVAR, mid-band and broadband coatings. Contact FLI for details.



Cooling

All FLI cameras incorporate fan-assisted triple stage TEC cooling that reduces the temperature of the sensor up to 55°C below ambient for MicroLine and 65°C below ambient for ProLine. An LC (liquid cooled) option is available on all cameras that typically improve cooling by another 10 deg.

Celsius. Regardless which camera cooling system is employed, FLI guarantees that our camera systems will operate without encountering 'thermal runaway', requiring special cooling techniques or complex precautionary measures.

Custom Cameras

ProLine and MicroLine imaging systems cameras are designed to accommodate customization. Past applications have included high altitude imaging, x-ray applications, mine searches, ultra cold weather installations, and internal lens mounting within 0.006" of the sensor surface. Please contact FLI for quotes.

FLI Accessories

FLI provides a wide range of high quality accessories including the renowned FLI Digital Focusers and Filter Wheels. The finest obtainable research grade UBVRI, LRGB, OIII, Ha and SII filters are available. We also have a large number of adaptors that support our products for many optical applications. Please contact us for more information or visit our website at www.fli-cam.com.



PDF: State-of-the-art digital focuser with temperature compensated focusing (88mm aperture, 7000 steps, 0.35" travel)



DF-2: high quality digital focuser (50mm aperture, 2000 steps, 0.20" travel)



CFW-1-5: Five 50mm filter positions.



The CFW-6-6: six filter positions (up to 7mm thick, 79.5mm diameter) Internal wheels are custom made to your specifications.



CFW-2-7: Seven 50mm diameter filter positions



CFW-4-5: Five 50mm square filters

CFW-5-7: Seven 50mm square filters



FLI research grade filters are available in 28mm, 50mm round and 50mm square sizes. (LRGB, UBVRI, OIII, SII and Ha)



FLI manufactures and provides an extensive range of high quality adaptors and accessories.

Please visit the Finger lakes Instrumentaion website for more information on these and other products.
www.fli-cam.com

External Triggering

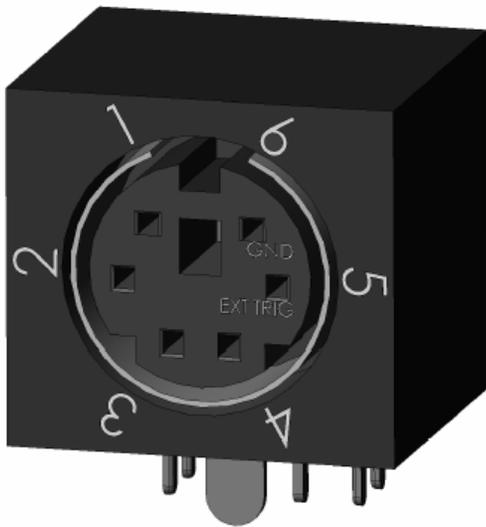
The ProLine and MicroLine imaging systems use 6 pin connectors that are labeled “AUX I/O”. The camera shutter can be triggered by shorting pin 5 to pin 6.

In FLIGrab:

- Run FLIGrab
- Select the Shutter Control
- Select the desired triggering on the pull down menu:
 - Select 'External trigger on LOW' for low edge triggering
 - Select 'External trigger on HIGH' for high edge triggering
- Select 'Done'
- Open the Grab Menu
- Select desired frame and exposure settings
- Click the Grab button
- Short pin 3 to pin 2
- The shutter will trigger

Notes:

- Pin 1 – Pin 6 are labeled below.
- Pin 6 is the electrical ground. Pin 5 is the logic input. (This input has a 22.1K pullup resistor to +3.3V).
- Trigger can be set to either rising edge or falling edge. To select the desired edge:
 - Select 'External trigger on HIGH' in the shutter control menu and apply a 0 to +3.3V signal to pin 5.
 - Select 'External trigger on LOW' in the shutter control menu and apply a +3.3V to 0V signal to pin 5.



External Trigger for pre-wired systems

1. The Black wire is ground and the yellow wire is the external trigger signal.
2. The external trigger signal (yellow wire) is rated for 0 to 3.3V and it is LVTTL compatible. The edge can be selected in software.
3. The external trigger signal (yellow wire) has a 22.1K pull-up resistor to 3.3V in the camera. This allows the user to simply connect the collector (drain) of a transistor to the yellow wire and the emitter (source) to the black wire if desired. A relay across the two wires will also work.

Shutter Open Indicator

Pin 1 on the AUX I/O connector provides a LVTTL compatible signal for shutter open indication. When the shutter is opened, pin 1 is pulled to +3.3V through an internal 22.1Kohm resistor. When the shutter is closed, pin

1 is pulled down to ground through a 332-ohm resistor within the camera. Pin 6 is the ground reference for this signal.

Camera Specifications — PL09000 and PL16803

ProLine PL09000 / MicroLine ML09000

Camera System Performance	
PC Interface	USB 2.0
Maximum cable length	5 meters between hubs; 5 hubs maximum
Digital resolution	16 bits at all speeds
Read Noise	8 – 9 electrons RMS typical
Cooling ProLine	Thermoelectric cooler with forced air: 55-60° C below ambient temperature Optional LC cooling: 63-68° C below ambient temperature
Cooling MicroLine	Thermoelectric cooler with forced air: 40-45° C below ambient temperature Optional LC cooling: 50-55° C below ambient temperature
Dark Current (nom.)	1 e-/pixel/sec (-30° C)
ProLine Camera Head	6.2" width x 6.2" depth x 4.2" height
MicroLine Camera Head	5.25" diameter head x 3.75" square body x 4.75 height
Mounting	One ½-20, Two M5, Nose piece v-groove. Optional Nikon Mount
Back focal distance	Standard: 1.19" (may be adjusted to suit customers requirements)
Operating Environment	Temperature: -25° to 35°C. Relative humidity 10 to 90% noncondensing
Shutter	65mm Uniblitz shutter / MTBF = 1 million cycles
Remote Triggering	Standard via AUX connection
CCD Specifications	
CCD	KAF-09000
Array Size	3056 x 3056
Pixel size	12 micron
Linear Full Well	110,000 e-
Dynamic Range	84 dB

ProLine PL16803 / MicroLine ML16803

Camera System Performance	
PC Interface	USB 2.0
Maximum cable length	5 meters between hubs; 5 hubs maximum
Digital resolution	16 bits at all speeds
Read Noise	9-11 electrons RMS typical
Cooling ProLine	Thermoelectric cooler with forced air: 55-60° C below ambient temperature Optional LC cooling: 63-68° C below ambient temperature
Cooling MicroLine	Thermoelectric cooler with forced air: 40-45° C below ambient temperature Optional LC cooling: 48-53° C below ambient temperature
Dark Current (nom.)	1 e-/pixel/sec (-30° C)
ProLine Camera Head	6.2" width x 6.2" depth x 4.2" height
MicroLine Camera Head	5.25" diameter head x 3.75" square body x 4.75 height
Mounting	One ½-20, Two M5, Nose piece v-groove. Optional Nikon Mount
Back focal distance	Standard: 1.19" (may be adjusted to suit customers requirements)
Operating Environment	Temperature: -25° to 35°C. Relative humidity 10 to 90% noncondensing
Shutter	65mm Uniblitz shutter / MTBF = 1 million cycles
Remote Triggering	Standard via AUX connection
CCD Specifications	
CCD	KAF-16803
Array Size	4096 x 4096
Pixel size	9 micron
Linear Full Well	100K electrons
Dynamic Range	76 dB

Camera Specifications — PL4240 and PL3041 (Broad band or UV)

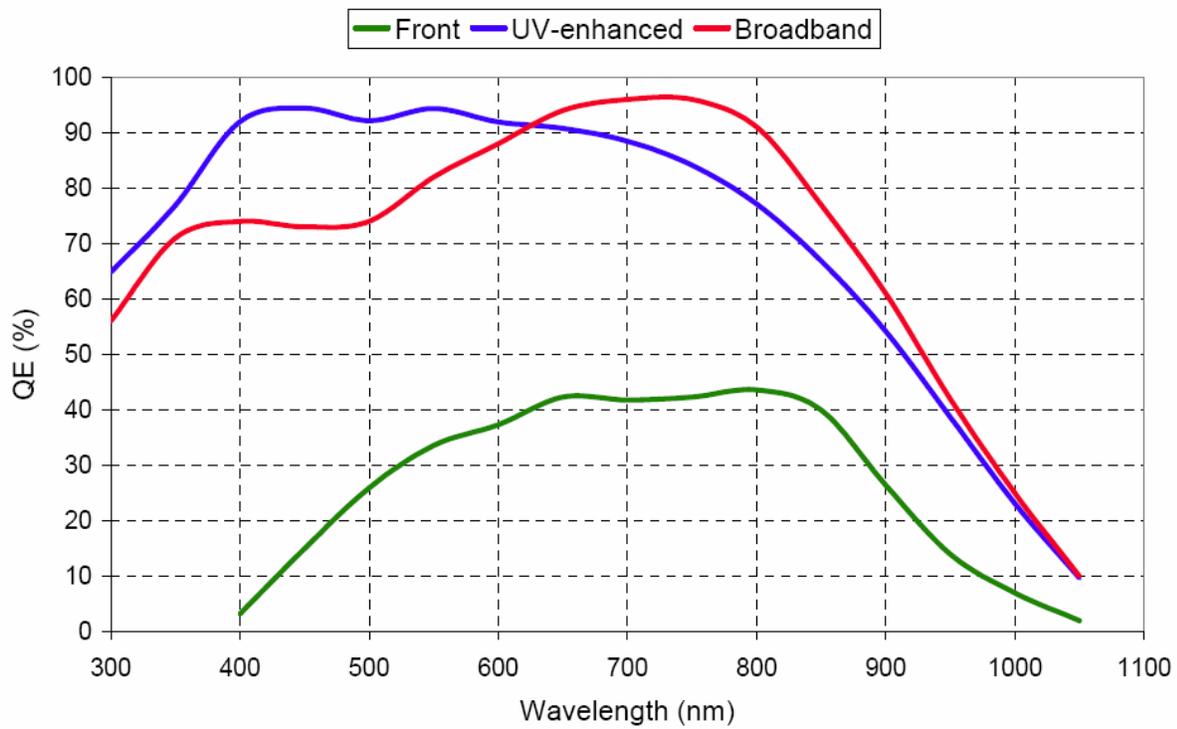
ProLine PL4240

Camera System Performance	
PC Interface	USB 2.0
Maximum cable length	5 meters between hubs; 5 hubs maximum
Digital resolution	16 bits at all speeds
Read Noise	8 – 11 electrons RMS typical (low download speed)
Cooling ProLine	Thermoelectric cooler with forced air: 55-60° C below ambient temperature Optional LC cooling: 63-68° C below ambient temperature
Cooling MicroLine	Thermoelectric cooler with forced air: 40-45° C below ambient temperature Optional LC cooling: 50-55° C below ambient temperature
Dark Current (nom.)	<1 e-/pixel/sec (-30° C)
ProLine Camera Head	6.2" width x 6.2" depth x 4.2" height
MicroLine Camera Head	5.25" diameter head x 3.75" square body x 4.75 height
Mounting	One ½-20, Two M5, Nose piece v-groove. Optional Nikon Mount
Back focal distance	Standard: 1.19" (may be adjusted to suit customers requirements)
Operating Environment	Temperature: -25° to 35°C. Relative humidity 10 to 90% noncondensing
Shutter	65mm Uniblitz shutter / MTBF = 1 million cycles
Remote Triggering	Standard via AUX connection
CCD Specifications	
CCD	E2V CCD42-40-0-368 back illuminated
Array Size	2048 x 2048
Pixel size	13.5 micron
Linear Full Well	100,000 e-
Dynamic Range	82 dB

ProLine PL3041

Camera System Performance	
PC Interface	USB 2.0
Maximum cable length	5 meters between hubs; 5 hubs maximum
Digital resolution	16 bits at all speeds
Read Noise	12-14 electrons RMS typical @ 1 MHz
Cooling ProLine	Thermoelectric cooler with forced air: 55-60° C below ambient temperature Optional LC cooling: 63-68° C below ambient temperature
Cooling MicroLine	Thermoelectric cooler with forced air: 40-45° C below ambient temperature Optional LC cooling: 50-55° C below ambient temperature
Dark Current (nom.)	1 e-/pixel/sec (-30° C)
ProLine Camera Head	6.2" width x 6.2" depth x 4.2" height
MicroLine Camera Head	5.25" diameter head x 3.75" square body x 4.75 height
Mounting	One ½-20, Two M5, Nose piece v-groove. Optional Nikon Mount
Back focal distance	Standard: 1.19" (may be adjusted to suit customers requirements)
Operating Environment	Temperature: -25° to 35°C. Relative humidity 10 to 90% noncondensing
Shutter	65mm Uniblitz shutter / MTBF = 1 million cycles
Remote Triggering	Standard via AUX connection
CCD Specifications	
CCD	Fairchild Imaging CCD3041B1
Sensor Coatings	Broad Band and UV Enhanced Available
Array Size	2048 x 2048
Pixel size	15 micron
Linear Full Well	100,000 e-
Dynamic Range	82 dB

Camera Specifications — PL3041 QE and Readout Noise



CCD3041 Typical Readout Noise

