FLI
Finger Lakes Instrumentation

Engineering Excellence

Because Your Image Depends On It

ProLine LDR Radiography Imaging Systems

Welcome

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

This User Guide is intended as a reference tool for you to use with the ProLine LDR Imaging System. Please read it and follow the procedures to ensure trouble-free installation of your hardware and software.

If you have any questions about your purchase, please contact us.

Contact Information

Finger Lakes Instrumentation LLC
200 Tech Park Drive
Rochester NY 14623 USA
Tel USA 585-624-3760
https://www.flicamera.com

Table of Contents

ProLine LDR Radiography Imaging Systems 1

Welcome 2

Contact Information 2

Check your Shipment 4

Product Safety 4

System Accessories 5

Liquid Cooling Information 5

ProLine LDR Imaging System Connections 6

Setting-up and Powering Your System 7

Camera, Spacer, Lens Configuration 8

Appendix A - External Triggering 9

- Exposure Active Indicator—9
- Shutter Open Indicator—10

Appendix B – Troubleshooting 11

Appendix C - Camera Specifications 12

- ProLine PL09000LDR LINOS System—12
- ProLine PL16803LDR-LINOS System—13

Appendix D - Quantum Efficiency Curves & Drawing 14

- Kodak KAF-09000—14
- Kodak KAF-16803—14
- ProLine LDR Drawing—15

Appendix E - Warranty for FLI Products 16

Appendix F - FLI Return Procedure 17

Return Addresses by Carrier 18

- UPS and Fed Ex Returns—18
- USPS Returns—18

Appendix G - Liquid Cooling Options 19

- The following connection fittings are currently available: —19

Check your Shipment

Please ensure that all the components have arrived safely and verify that all the items you ordered were properly delivered to you. In the unlikely event of a missing or damaged component, immediately notify your FLI dealer or FLI.

A camera order should include the following items:

- Camera with shutter cover installed (save this cover)
- Camera Test Report
- USB cable
- 12 volt power supply
- Power supply line cord
- Packing list

If you ordered accessories or options, these items should be included. Please check that your order is complete.

Product Safety

The ProLine LDR Imaging System is shipped with a 12-volt power supply. Do not use any other power supply with this System or use the power supply in a way other than described in this Guide as it may cause damage to the Camera that will not be covered under the warranty.

If you are concerned about lightning strikes in the area in which you use your Camera, you may want to take safety precautions as electrical surges can damage electrical equipment. We recommend that when your Camera is not in use that you unplug the Camera from power and unplug the USB cable from the Camera.

System Accessories

A variety of accessories that are available for your ProLine System are described below.

- Our Color Filter Wheel's robust mechanical design provides the basis for uncompromised images. Each FLI color filter wheel is precision engineered with a highly accurate, no-slip drive chain driven and stepper motor. The large diameter pivot pin and bushing are precision ground and matched for smooth, quiet no-fuss operation night after night. FLI color filter wheels use no internal lights for homing to protect your images from stray light interference.
- High Speed Filter Wheels use high-performance servo motors featuring rare earth magnets coupled with backlash-free power transfer to provide ultimate torque which translates to ultimate speed. Filter exchange rates under 30 milliseconds are possible.
- Digital focusers are designed for CCD astronomy where the digital imaging system is mounted very close to correct focus. The thin designs allow focusing with short-travel optical designs. All of our focusers are ASCOM compliant. Additional information about the Focuser is available in a separate document, "Focuser User's Guide" that is supplied with this product.
- FLI stocks a large variety of adapters for the most popular telescopes. We will design custom adapters to meet your imaging needs free of charge when ordering an imaging system.
- FLI Research Grade filters are high transmission filters manufactured in the United States with the highest quality fabrication techniques available. FLI offers a full line of filter types and sizes. Choose from LRGB, Ha, SII, OIII and UBVRI.
- Threaded shutter cover available for all ProLine cameras.

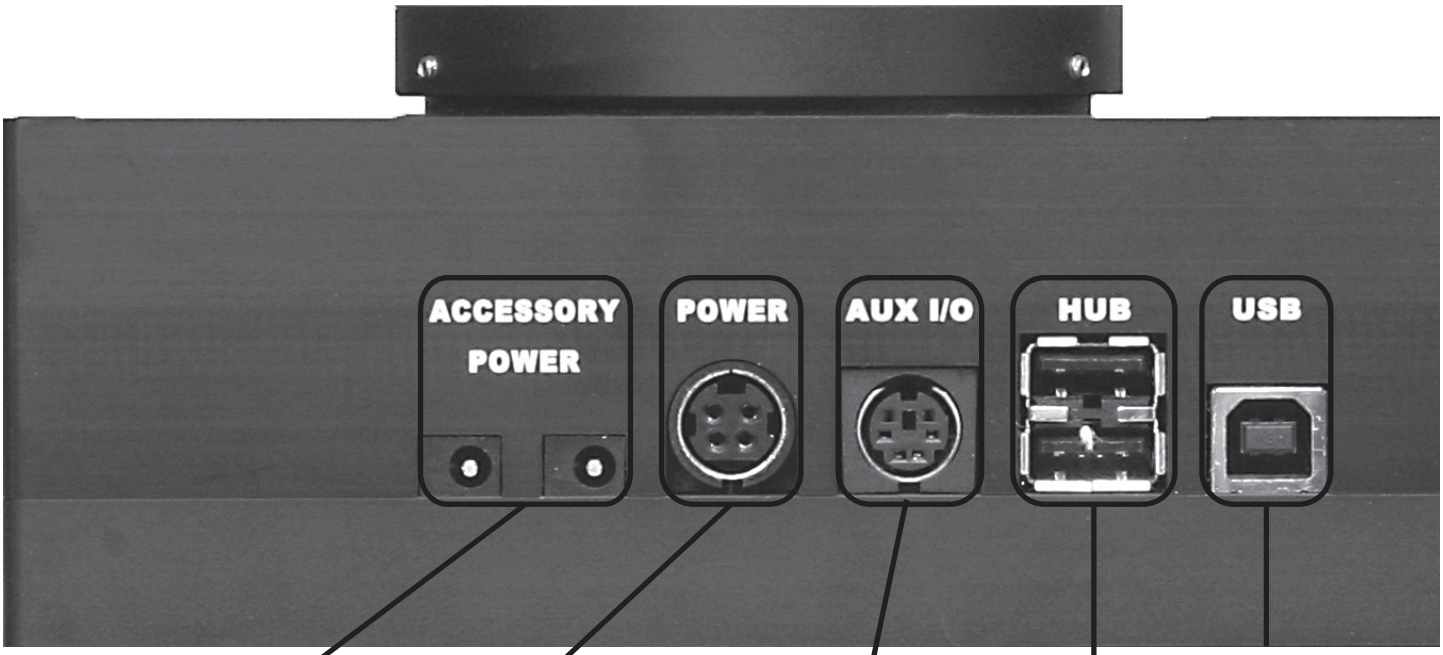
Liquid Cooling Information

As a standard, all FLI cameras incorporate a TEC (Peltier) that enables the camera to cool the sensor. The actual cooling for any given camera will depend on the sensor size and ambient temperatures. The ProLine Liquid Cooler can accept a flow rates up to 0.5 gallon/minute (1.91 liter/min). Please contact FLI with your custom cooling requirements for either air, liquid, or un-cooled system. Please see Appendix G for all available ProLine liquid cooling configurations.

Warning: Using flow rates above the recommended flow rates may cause the liquid cooling system to leak and will void the warranty.

Note: Maximum ProLine Liquid Cooler inlet pressure is 50 psig. Ensure tubing selected has the proper pressure rating. To avoid undesired pressure build up in Liquid Cooler shut off flow on the inlet side before detaching or closing outlet connections.

ProLine LDR Imaging System Connections



12V accessory power out
(not populated on LDR systems)

12V power supply in

6 pin DIN Auxillary I/O
(See Appendix D for External Triggering)

USB 2.0 Hub
(not populated on LDR systems)

USB 2.0 Interface

Setting-up and Powering Your System

Assemble all System components in one area before beginning this set up procedure. The image below depicts an assembled System.

Note: Run the FLI Software Installation Kit before you set up and power your system to ensure the system recognizes and correctly initialized the camera.

Setup the components as described in the procedure below.

1. Attach the USB cable between your ProLine camera and your PC.
2. Connect the 12-volt power supply between the camera's 4-pin "DC Power Jack" connector and a wall socket or switched AC power strip. The camera's fans will start running. Your computer should display a screen indicating that the system has found new hardware.
3. To connect a focuser or a color filter wheel to the camera you will need a short cable. A short cable kit is available from FLI. Install the power cable from the camera to the focuser or from the camera to the color filter wheel. If both are accessories were ordered, two sets of cables are provided.

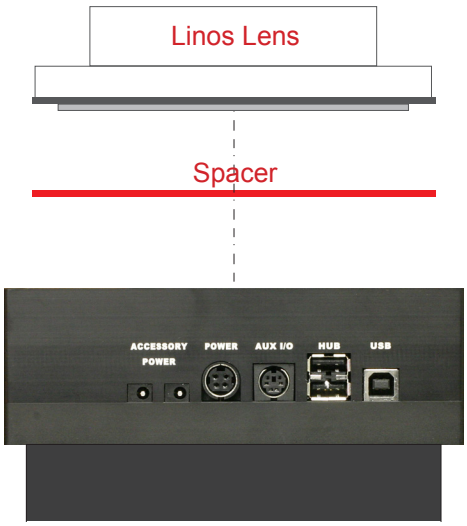
Note: Refer to Appendix A for information about external triggering using the 6 pin DIN Auxiliary I/O connector.

Camera, Spacer, Lens Configuration

Several cameras, CCD sensors and lenses are available to fit your custom application. A camera unit consists of a camera body with a CCD sensor, a Linos lens and, if necessary, a black aluminum spacer(s). Figure 3 shows the relationship of these components and Table 1 provides information on the specific configurations. In summary:

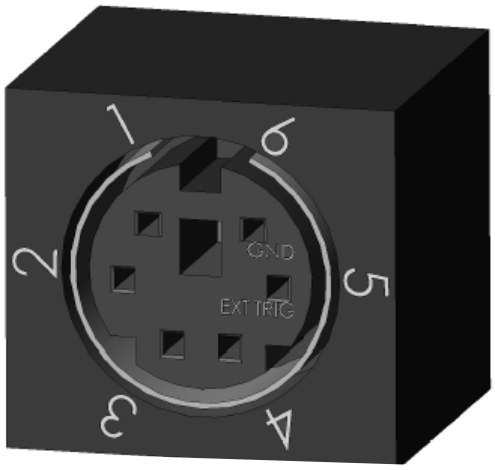
- The 3801 series camera body can contain one of two different CCD sensors and can accommodate two different types of lenses. Spaces are not required with any 3801 camera body-lens configuration.
- The two PL series camera bodies contain different CCD sensors, yet each can accommodate the three available lenses. Depending on the lens, you will either need no spacer, or you will need one or three spacers stacked on top of each other to ensure the proper back focus distance. If you order camera body-lens unit that requires a spacer(s), it (they) will be installed in the camera body prior to shipping. If you subsequently order a 3801-382 lens, you will be shipped two additional spacers that are required.

Camera	CCD	# of Spacers	Lens
3801-453-20	09000	0	3801-437-000-20-0102c
3801-453-21	16803	0	3801-437-000-20-0102c
3801-453-22	09000	0	3801-438-000-20-0001a
3801-453-23	16803	0	3801-438-000-20-0001a
PL09000	09000	3	3801-382-000-21_az_d
PL09000	09000	0	3801-437-000-20-0102c
PL09000	09000	1	3801-438-000-20-0001a
PL16803	16803	3	3801-382-000-21_az_d
PL16803	16803	0	3801-437-000-20-0102c
PL16803	16803	1	3801-438-000-20-0001a



Appendix A - External Triggering

The ProLine Imaging Systems has a six pin connector shown in the image below.



Pin 6 is the electrical ground. Pin 5 is the logic input for the external trigger. (This input has a 22.1K pullup resistor to +3.3V). The external trigger can be setup for either rising edge or falling edge trigger.

To externally trigger the camera using FLIGrab

1. Select the Shutter Control.
2. Select the desired triggering on the pull down menu:
3. Select “External trigger on LOW” for low edge triggering.
4. Select “External trigger on HIGH” for high edge triggering.
5. Select “Done”.
6. Open the Grab Menu.
7. Select desired frame and exposure settings.
8. Click the Grab button.
9. The camera will now wait for an external trigger.

A camera waiting for an external trigger “HIGH” will initiate a frame grab when a 0V transition to +3.3V signal or equivalent LVTTL signal is applied to pin 5.

A camera waiting for an external trigger “LOW” will initiate a frame grab when a +3.3V transition to 0V signal or equivalent LVTTL signal is applied to pin 5.

Exposure Active Indicator

Pin 1 is an exposure active indicator. It becomes an LVTTL high with respect to the ground (pin6) when the camera exposure starts and it becomes an LVTTL low when the camera exposure is finished. It will remain low until the next exposure. It has a 332 Ohm source impedance.

Shutter Open Indicator

Pin 2 on the AUX I/O connector provides an LVTTL compatible signal for shutter open indication. When the shutter is opened, pin 2 is pulled to +3.3V through an internal 22.1Kohm resistor. When the shutter is closed, pin 2 is pulled down to ground through a 332-ohm resistor within the camera. Pin 6 is the ground reference for this signal.

Pins 3 and 4 are uncommitted camera I/O signals.

Notes:

The mating part for the external trigger connection is a 6-pin male (CUI MD-60).

The Digi-Key part number for this part is CP-2060-ND.

Appendix B – Troubleshooting

Issue	Remedy
The fan on the camera does not turn.	Check that the camera is plugged into a suitable power supply and that power is available.
The fan turns but when I use FLIGrab, but 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.	Please turn off your computer and camera and leave them switched off for two to three minutes, this will flash the USB chips. Try again.
I get a Windows “Communication” error.	Please turn off your computer and camera and leave them switched off for two to three 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 locate the camera during installation is likely to create problems. Uninstall FLIGrab and install it again following the installation process.
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. Check the settings in the software.

Appendix C - Camera Specifications

ProLine PL09000LDR LINOS System

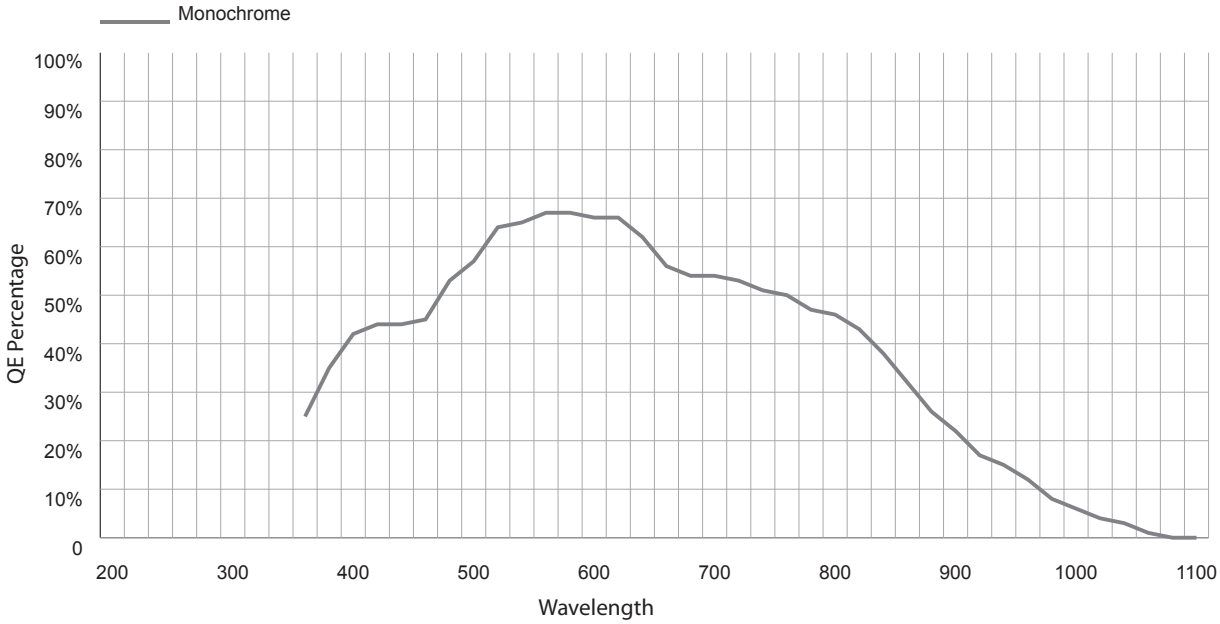
CCD Specifications	
Sensor (Kodak)	KAF-09000
Grade	Standard
CCD Format	3056 (H) x 3056 (V) = 9.3 Mp
Chip Size	38.6 mm (H) x 37.76 mm (V)
Pixel Size	12 µm (H) x 12 µm (V)
Linear Full Well	110,000 e-
Dark Current Doubling Temp	7° C
Camera Electrical Performance	
Typical Download Speed @ 16-bit	8 MHz
Typical Maximum Cooling	45° C Below Ambient
Typical System Noise	13-15 electrons RMS
Typical Dark Current	0.2 e-/pixel/sec. @ 45° C Below Ambient
I/O Control	External Trigger Control is LVTTL
Non-Linearity	<1% of signal
Anti-dew	Standard
Camera Physical Characteristics	
Weight	6 lbs.
Dimensions	4" x 6.2" x 6.2"
Sealed Chamber	CCD
Power Requirements	12V
Window	1 mm quartz
Back Focus Distance (CCD to Lens)	6.59 mm
Mounting Method	4-40 UNC

ProLine PL16803LDR-LINOS System

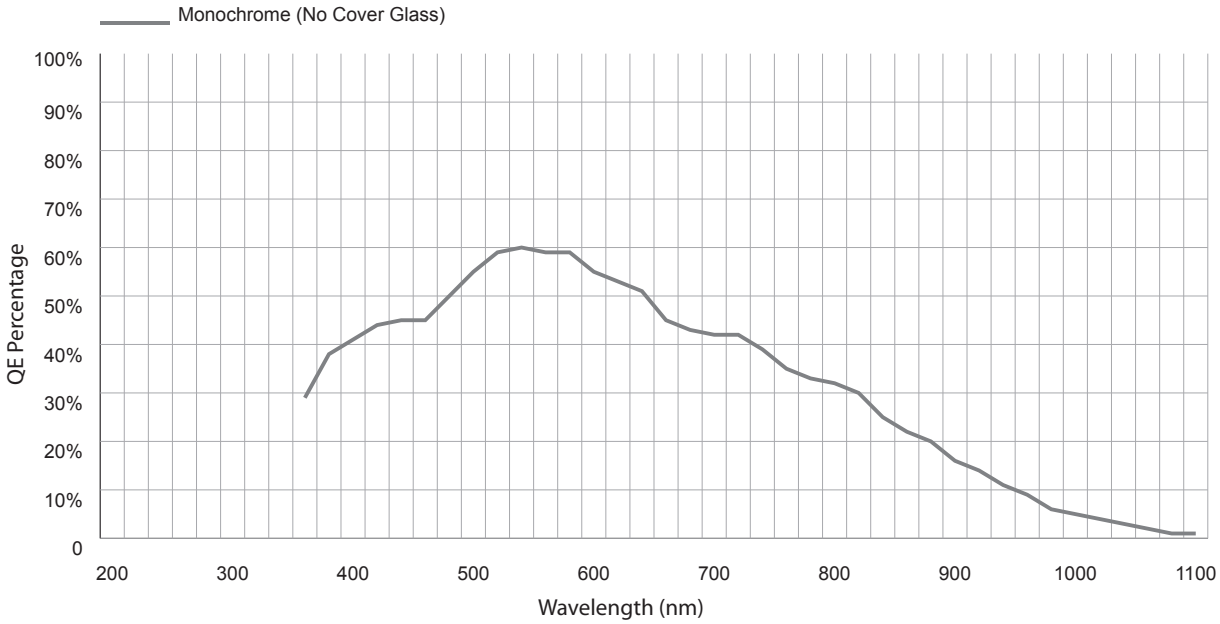
CCD Specifications	
Sensor (Kodak)	KAF-16803
Grade	Standard
CCD Format	4096 (H) x 4096 (V) = 16.8 Mp
Chip Size	36.8 mm (H) x 36.8 mm (V)
Pixel Size	9 µm (H) x 9 µm (V)
Linear Full Well	100,000 e-
Dark Current Doubling Temp	6.3° C
Camera Electrical Performance	
Typical Download Speed @ 16-bit	8 MHz
Typical Maximum Cooling	45° C Below Ambient
Typical System Noise	13 - 15 e- RMS @ 8 MHz
Typical Dark Current	0.2 e-/pixel/sec. @ 45° C Below Ambient
I/O Control	External Trigger Control is LVTTL
Non-Linearity	<1% of signal
Anti-dew	Standard
Camera Physical Characteristics	
Weight	6 lbs.
Dimensions	4” x 6.2” x 6.2”
Sealed Chamber	CCD
Power Requirements	12V
Window	1 mm quartz
Back Focus Distance (CCD to Lens)	6.59 mm
Mounting Method	4-40 UNC

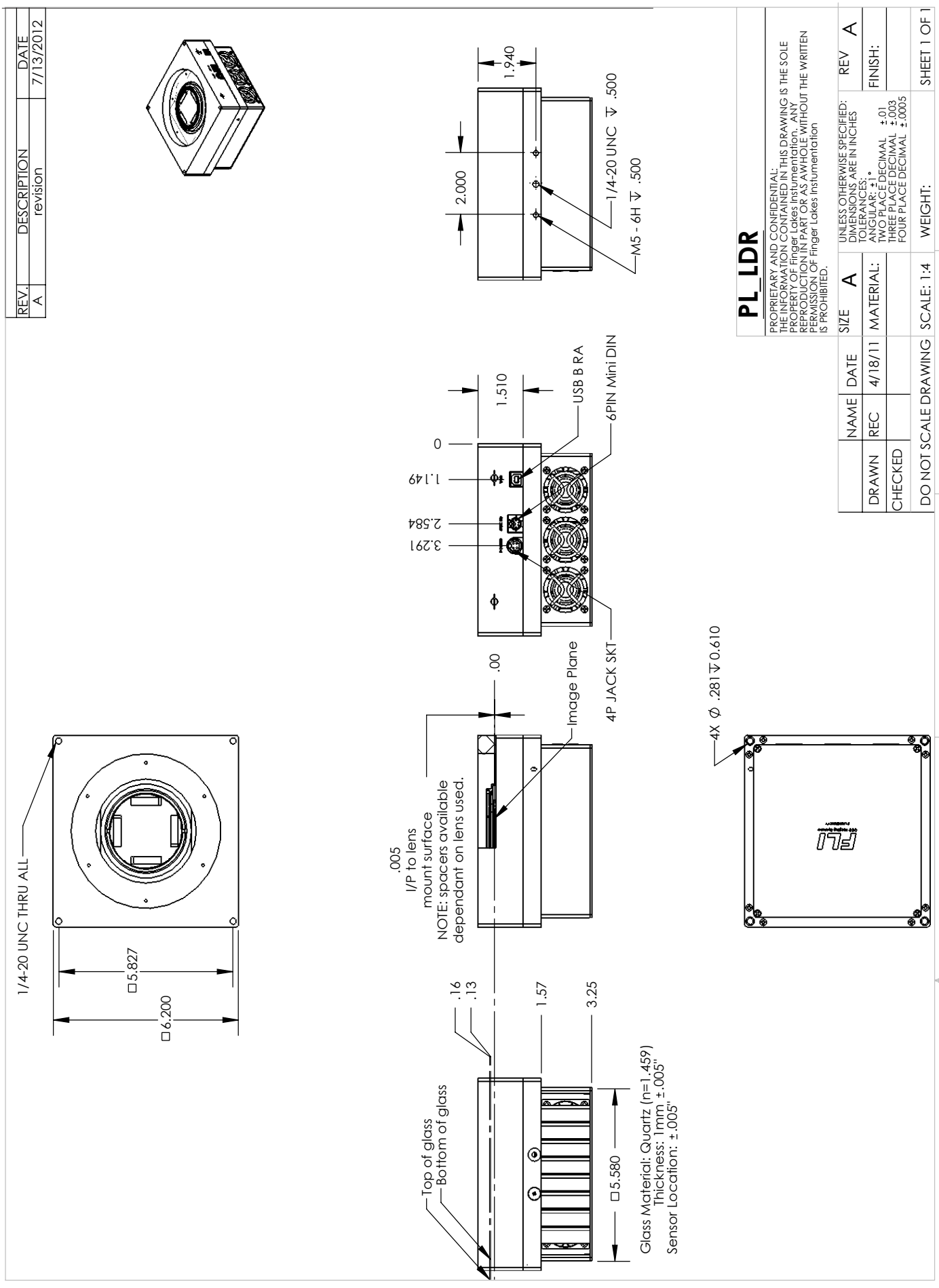
Appendix D - Quantum Efficiency Curves & Drawing

Kodak KAF-09000



Kodak KAF-16803




REV. DESCRIPTION DATE
A revision 7/13/2012
1.940
2.000
1/4-20 UNC ↧ .500
M5 - 6H ↧ .500
PL_LDR
PROPRIETARY AND CONFIDENTIAL:
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF Finger Lakes Instrumentation, . ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF Finger Lakes Instrumentation IS PROHIBITED.
SIZE A
MATERIAL:
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
ANGULAR: ±1°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.003
FOUR PLACE DECIMAL ±.0005
REV A
FINISH:
NAME DATE
DRAWN REC 4/18/11
CHECKED
DO NOT SCALE DRAWING
SCALE: 1:4
WEIGHT:
SHEET 1 OF 1
1/4-20 UNC THRU ALL
□5.827
□6.200
.005
I/P to lens
mount surface
NOTE: spacers available
dependant on lens used.
.00
Image Plane
4P JACK SKT
0
1.149
2.584
3.291
1.510
USB B RA
6PIN Mini DIN
4X ⌀ .281 ↧ 0.610
.16
.13
1.57
3.25
Top of glass
Bottom of glass
□5.580
Glass Material: Quartz (n=1.459)
Thickness: 1mm ±.005"
Sensor Location: ±.005"

Appendix E - Warranty for FLI Products

Unless otherwise noted, the standard statement of warranty described below applies to customers who purchase this product. This warranty may not apply in special circumstances in which prior arrangements have been made and separate documentation has been supplied prior to, or with, the product.

This warranty applies to all FLI Products.

1. All products and services are FOB Lima, N.Y.. The customer is responsible for shipping and insurance to and from FLI.
2. The product is warranted against defects in materials and workmanship for a period of one (1) year after delivery to the original purchaser.
3. A CCD array is warranted by the CCD manufacturer for one (1) year.
4. In the event of a CCD array failure or malfunction, FLI will assist in testing, replacement, shipping and required communications with the CCD manufacturer in order to facilitate a resolution of the problem.
5. The internal environment of a camera is warranted to remain moisture free for a period of one (1) year when used under normal conditions.
6. Damage arising from ESD (electrostatic discharge) events, exposure to the elements, mechanical shock, over-voltage, reverse polarity connections, or other environmental hazards is not covered under warranty.
7. FLI will be the sole judge of what constitutes defects vs. normal performance.
8. FLI application software is supplied for demonstration purposes only. The software carries no warranty of fitness for any purpose. FLI supplies the necessary information, drivers, and libraries, for users and 3rd party vendors to develop software for their specific purposes.
9. FLI works to maintain compatibility with many 3rd party software vendors, however FLI cannot guarantee operation with non-FLI software. FLI is not responsible for changes, upgrades, or errors in 3rd party programs.
10. Incidental and consequential damages resulting from the use of FLI products, malfunction or failure to perform, or lack of fitness for a particular purpose, are not the responsibility of FLI and are hereby excluded both for property damage and to the extent permitted by law, for personal injury damage.
11. FLI products are not authorized for use as critical components in life support or medical diagnostic applications where failure to perform could result in injury, faulty diagnosis, or other risk to patients or personnel.
12. FLI products are not authorized for use in robotic control systems where malfunction or failure could cause system motions hazardous to personnel.
13. This warranty applies to the original purchaser.

Appendix F - FLI Return Procedure

If you need to return a product, please follow the instructions outlined below.

1. Contact FLI by phone or email to obtain authorization to return the camera/product and:
    a. If you are outside the United States, contact your Customs Authority to register the merchandise to be returned to the United States for warranty repair or refund. Use the Harmonized Code number 9801.00.1012 on your shipping documentation. The monetary value you place on the item should be stated for insurance purposes. Clearly state that the "Value is for Customs purposes ONLY." When FLI returns the repair item to you, we will use the same monetary value.
    b. For all customers, prepare a Pro Forma invoice to accompany the shipment with the following statement:
        - For Equipment not covered under warranty: "American goods returned for repair only with NO Commercial Value. Temporary return only"
        - For Equipment covered under warranty: "American goods returned for Warranty Repair only with NO Commercial Value. Temporary return only"
    c. For all customers, if you are requesting service under warranty or a return, a copy of your original receipt.
    d. For you records, make a copy of these documents.
    e. Prepare a large shipping label with the appropriate return address (FLI or distributor) and for shipments from outside the U.S., include the Harmonized Code number.
2. Locate the original shipping boxes in which your item(s) was packaged. These boxes are designed to protect the products.

    OR:

    If you do not have the original shipping boxes, obtain a rigid box that is at least 3" (7.5 cm) larger in all dimensions than the items. A smaller box will not allow appropriate cushioning. Tape the side and bottom seams to secure the box.
3. If you have the original packing materials, place the item(s) in the original plastic bag(s) and place the bagged item in the appropriate foam cutout in the proper orientation. Insert other items into their appropriate compartments.

    OR:

    If you do not have the original bag, place the item(s) in a plastic bag and seal it. Wrap the bagged item(s) with at least two layers of bubble wrap or two bubble wrap bags. Wrap other items in the same manner. Into the bottom of the box, place two inches of packing material (Styrofoam peanuts or additional bubble wrap). Place the item(s) on the bottom layer with space around each. Add additional packing material around the sides of each item(s) and on top of the item(s).
4. Write a letter that includes the following: reason the item is being returned to FLI or distributor, your complete contact information (name, phone number(s), email address, return shipping address), and if appropriate, payment method and information. On top of the item(s) in the box, add the required paperwork described in step 1 and the letter described in step 4. Seal the box with packing tape. Tape the top flaps and label the box with the shipping label prepared in step 1.
5. Contact a shipper for pickup or bring it to a reliable carrier. As noted in step 1, use the appropriate value on shipping forms. FLI is not responsible for damage to any item or items when they are in the possession of a carrier.

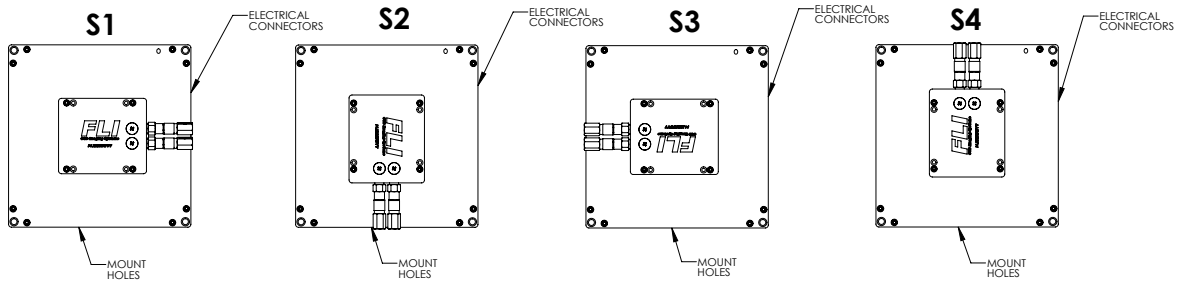
Return Address

Finger Lakes Instrumentation LLC
200 Tech Park Drive
Rochester NY 14623 USA
Tel USA 585-624-3760
https://www.flicamera.com

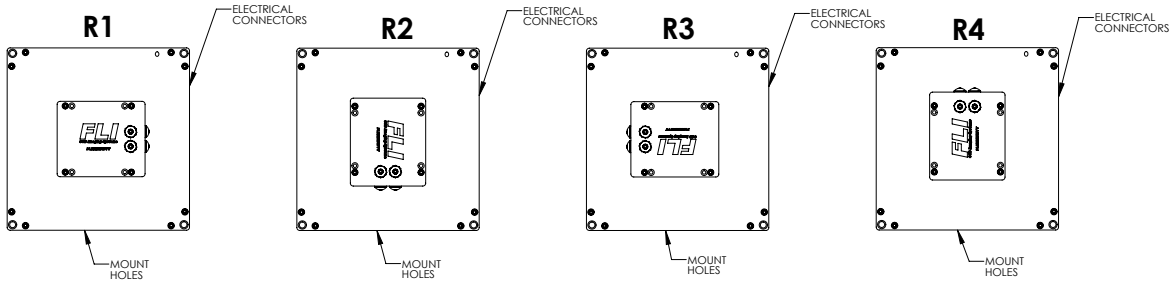
Appendix G - Liquid Cooling Options

Listed below are the available connector configurations for ProLine LDR cameras as viewed from the bottom. When ordering the liquid cooling option please reference the desired configuration using the numbers (Sx or Rx) below.

SIDE MOUNT CONFIGURATIONS:



REAR MOUNT CONFIGURATIONS:



The following connection fittings are currently available:

Connector	Standard User Interface	Additional Information
1/8” ID Hose Barb	1/8” ID Tubing	FLI recommends use of hose clamps. User supplies tubing and clamps with appropriate pressure rating for their application
Quick Connect Double Shutoff	#10-32 UNC male coupling	FLI supplies both female and male connectors, User supplies the interface
Quick Connect Dry Break	#10-32 UNC male coupling	FLI supplies both female and male connectors, User supplies the interface
Custom	Per Customer Requirements	FLI is able to plumb to interfaces not listed. Please contact FLI with your connection requests.