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57-053-001 Rev B3

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Roper Scientific, Inc. ("Roper Scientific," us," "we," "our") makes the following limited warranties. These limited warranties extend to the original purchaser ("You", "you") only and no other purchaser or transferee. We have complete control over all warranties and may alter or terminate any or all warranties at any time we deem necessary.

Basic Limited One (1) Year Warranty

Roper Scientific warrants this product against substantial defects in materials and / or workmanship for a period of up to one (1) year after shipment. During this period, Roper Scientific will repair the product or, at its sole option, repair or replace any defective part without charge to you. You must deliver the entire product to the Roper Scientific factory or, at our option, to a factory-authorized service center. You are responsible for the shipping costs to return the product. International customers should contact their local Roper Scientific authorized representative/distributor for repair information and assistance, or visit our technical support page at www.roperscientific.com.

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Roper Scientific does not warrant certain items against defect due to normal wear and tear. These items include internal and external shutters, cables, and connectors. *These items carry no warranty, expressed or implied.*

VersArray (XP) Vacuum Chamber Limited Lifetime Warranty

Roper Scientific warrants that the cooling performance of the system will meet our specifications over the lifetime of the VersArray (XP) detector or Roper Scientific will, at its sole option, repair or replace any vacuum chamber components necessary to restore the cooling performance back to the original specifications at no cost to the original purchaser. *Any failure to "cool to spec" beyond our Basic (1) year limited warranty from date of shipment, due to a non-vacuum-related component failure (e.g., any components that are electrical/electronic) is NOT covered and carries NO WARRANTIES EXPRESSED OR IMPLIED.* Responsibility for shipping charges is as described above under our Basic Limited One (1) Year Warranty.

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Vacuum Integrity Limited 24 Month Warranty

Roper Scientific warrants the vacuum integrity of all our products for a period of up to twenty-four (24) months from the date of shipment. We warrant that the detector head will maintain the factory-set operating temperature without the requirement for customer pumping. Should the detector experience a Vacuum Integrity failure at anytime within twenty-four (24) months from the date of delivery all parts and labor needed to restore the vacuum integrity will be covered by us. Responsibility for shipping charges is as described above under our Basic Limited One (1) Year Warranty.

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Owner's Manual and Troubleshooting

You should read the owner's manual thoroughly before operating this product. In the unlikely event that you should encounter difficulty operating this product, the owner's manual should be consulted before contacting the Roper Scientific technical support staff or authorized service representative for assistance. If you have consulted the owner's manual and the problem still persists, please contact the Roper Scientific technical support staff or our authorized service representative. *See Item 12 in the following section of this warranty ("Your Responsibility") for more information.*

Your Responsibility

The above Limited Warranties are subject to the following terms and conditions:

1. You must retain your bill of sale (invoice) and present it upon request for service and repairs or provide other proof of purchase satisfactory to Roper Scientific.
2. You must notify the Roper Scientific factory service center within (30) days after you have taken delivery of a product or part that you believe to be defective. With the exception of customers who claim a "technical issue" with the operation of the product or part, all invoices must be paid in full in accordance with the terms of sale. Failure to pay invoices when due may result in the interruption and/or cancellation of your one (1) year limited warranty and/or any other warranty, expressed or implied.
3. All warranty service must be made by the Roper Scientific factory or, at our option, an authorized service center.
4. Before products or parts can be returned for service you must contact the Roper Scientific factory and receive a return authorization number (RMA). Products or parts returned for service without a return authorization evidenced by an RMA will be sent back freight collect.
5. These warranties are effective only if purchased from the Roper Scientific factory or one of our authorized manufacturer's representatives or distributors.

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6. Unless specified in the original purchase agreement, Roper Scientific is not responsible for installation, setup, or disassembly at the customer's location.
7. Warranties extend only to defects in materials or workmanship as limited above and do not extend to any product or part which has:
    - been lost or discarded by you;
    - been damaged as a result of misuse, improper installation, faulty or inadequate maintenance or failure to follow instructions furnished by us;
    - had serial numbers removed, altered, defaced, or rendered illegible;
    - been subjected to improper or unauthorized repair; or
    - been damaged due to fire, flood, radiation, or other "acts of God" or other contingencies beyond the control of Roper Scientific.
8. After the warranty period has expired, you may contact the Roper Scientific factory or a Roper Scientific-authorized representative for repair information and/or extended warranty plans.
9. Physically damaged units or units that have been modified are not acceptable for repair in or out of warranty and will be returned as received.
10. All warranties implied by state law or non-U.S. laws, including the implied warranties of merchantability and fitness for a particular purpose, are expressly limited to the duration of the limited warranties set forth above. With the exception of any warranties implied by state law or non-U.S. laws, as hereby limited, the forgoing warranty is exclusive and in lieu of all other warranties, guarantees, agreements, and similar obligations of manufacturer or seller with respect to the repair or replacement of any parts. In no event shall Roper Scientific's liability exceed the cost of the repair or replacement of the defective product or part.
11. This limited warranty gives you specific legal rights and you may also have other rights that may vary from state to state and from country to country. Some states and countries do not allow limitations on how long an implied warranty lasts, when an action may be brought, or the exclusion or limitation of incidental or consequential damages, so the above provisions may not apply to you.
12. When contacting us for technical support or service assistance, please refer to the Roper Scientific factory of purchase, contact your authorized Roper Scientific representative or reseller, or visit our technical support page at www.roperscientific.com.

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Declaration of Conformity

Roper Scientific, Inc. declares that the equipment described in this document is in conformance with the requirements of the European Council Directives, listed below:

89/336/EEC	EMC Directive
93/68/EEC	EMC Directive
73/23/EEC	Low Voltage Directive

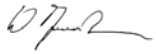
on the approximation of the laws of Member States relating to Electromagnetic Compatibility and Product Safety.

This declaration is based upon compliance of the product to the following standards:

EN 55022, CISPR 22	RF Emissions Control
EN 50082-1, IEC 801	Immunity to Electromagnetic Disturbances
EN 60950, IEC 950	Product Safety

Product Description: CCD Camera System
Model: Quantix Air-Cooled and Liquid-Cooled Camera Systems

Authorized Signature Date 9/27/96



Wilhelm Pfanhauser, Managing Director

Photometrics, Ltd.
Sollner Str. 61
D-81479 München
Germany

CE

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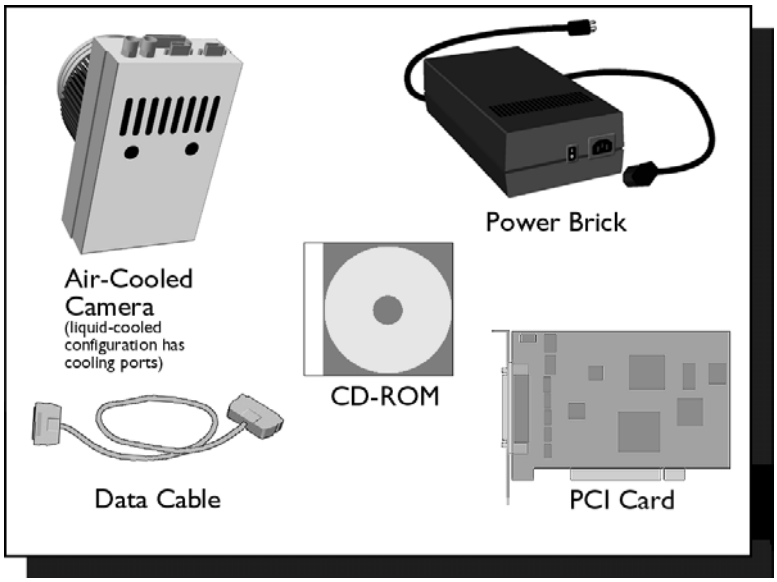
Chapter 1. Introduction

Quantix® is an F-mount or C-mount, air- or liquid-cooled imaging system for acquiring digital scientific data. The system provides a fast focus, fast frame rate, and fast readout rate, while still providing the ability to acquire low-light images by integrating over long periods of time.

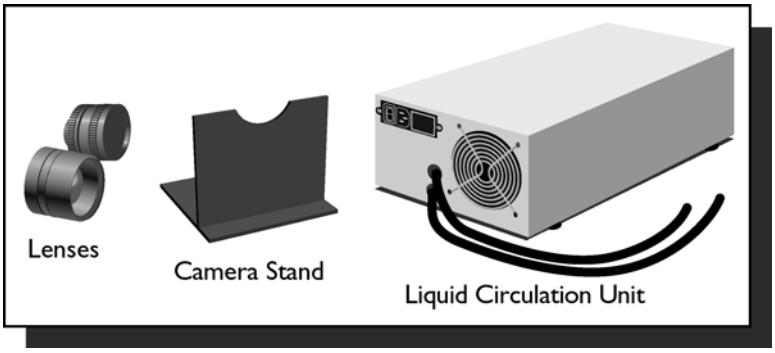
Quantix System Components

All Quantix systems consist of standard hardware and software as well as the appropriate interface hardware (discussed in the *Installation Guide*) for your computer system. Some Quantix systems also include optional hardware.

Standard Components



Optional System Hardware



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About this Manual

The *Quantix User Manual* is divided into six chapters. It is suggested that you read the entire manual before operating the camera to ensure proper usage. The chapters that follow this introduction are:

- **System Installation —** Instructions for installing the camera system's hardware and software
- **LCU Maintenance —** Instructions for maintaining the liquid circulation unit
- **Component Descriptions —** Functional description of each camera system component
- **Troubleshooting —** Answers to camera hardware problems
- **Specifications —** Specifications for each camera system component

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Note: To install a new camera, follow the instructions in the *System Installation* chapter of this *User Manual*.

Environmental Requirements

The Quantix camera system and its optional liquid circulation unit should be operated in a clean, dry environment. The camera system requires that an easily accessible electrical outlet be available near the equipment.

The camera system's ambient operating temperature is 0°C to 30°C with a relative humidity of 0%–80% noncondensing.

Storage Requirements

Store the Quantix camera system and the LCU in their original containers. To protect the system from excessive heat, cold, and moisture, store at an ambient temperature between -20°C and 60°C with a relative humidity of 0%–90% noncondensing.

Precautions

The charge-coupled device (CCD) and other system electronics are extremely sensitive to electrostatic discharge (ESD) and the optional liquid circulation unit requires periodic maintenance.

Camera

To avoid permanently damaging the system, please observe the following precautions:

- If you are using high-voltage equipment (such as an arc lamp) with your camera system, be sure to turn the camera power *on last* and power the camera *off first*.
- Always switch off and unplug the power brick before changing your system configuration in any way.
- Use caution when triggering high-current switching devices (such as an arc lamp) near your system. The CCD can be permanently damaged by transient voltage spikes. If electrically noisy devices are present, an isolated, conditioned power line or dedicated isolation transformer is highly recommended.
- Never connect or disconnect *any* cable while the camera system is powered on. Reconnecting a charged cable may damage the CCD.

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- Never impede airflow through the equipment by obstructing the air vents.
- If your system is equipped with an LCU, power the LCU on before powering on the camera.

Optional LCU

To prevent damage to the LCU:

- Keep the seals lubricated by running the LCU 45 minutes at least once a month.
- Always keep the pump primed by operating LCU in the upright position.
- When disconnecting the coolant hoses from the camera, it is important to prevent any coolant from spilling into the camera. When disconnecting the hoses, hold the camera over an absorbent material, such as paper towels, with the connectors facing down.
- Never impede airflow through the LCU by obstructing the air vents.

Repairs

Other than repairs described in this manual, all repairs must be done by Roper Scientific. Should your system hardware need repair, contact Roper Scientific Customer Service. Please save the original packing materials so you can safely ship the camera system to another location or return it for repairs if necessary.

Cleaning

Clean exterior surfaces of the camera system with a dry, lint-free cloth. To remove stains, contact Roper Scientific Customer Service.

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Roper Scientific Customer Service

If you have any questions about your camera system, contact Roper Scientific Customer Service. When you call, please have your Roper Scientific job number or equipment serial numbers available.

- Tel: 800. 874.9789/ 520.889.9933 between 8:00 am and 5:00 pm MST
- Fax: 520.295.0299
- E-mail: cservice@roperscientific.com
- Mail: Roper Scientific
  3440 East Britannia Drive
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  Mihama-ku, Chiba-shi
  Japan 261-8501

General product information and answers to some customer service questions can be found on our website: http://www.roperscientific.com

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Chapter 2. System Installation

Carefully review the *Precautions* section on page 2 before performing any of the procedures outlined here. Again, use only a Quantix cable and a Quantix PCI card with your Quantix camera. Using a different cable or PCI card may result in permanent damage to your system.

Introduction

Your Quantix camera system has the following hardware components:

- Camera Head
- PCI Card
- Data Cable
- Power Brick
- Power Cord
- Optional LCU

Quantix system components are linked by the data cable and controlled by your host computer system via the application software. Power to the camera is supplied by the power brick. All of these hardware and software components should be included with your shipment. Refer to the information and figures in *System Components* on page 1.

The CCD you selected is installed in your camera.

Keep all the original packing materials so you can safely ship the Quantix system to another location or return it for service if necessary.

If you have any difficulty with any step of the instructions, call Roper Scientific Customer Service.

Software Compatibility Requirements

The Quantix package includes the RS Image™ capture software program designed for use with your Quantix camera.

All other imaging software must also be PVCAM® -compatible. For full access to imaging software functions, PVCAM must be version 2.5.2 or higher.

Host Computer Requirements

The host computer for your Quantix camera must have the following:

- Windows® 95, Windows® 98, Windows® ME, Windows NT®, Windows® XP, or Windows® 2000 operating system
- 200 MHz Pentium® II (or greater)
- 64 MB RAM (or greater)
- CD-ROM drive
- At least one unused PCI card slot
- 16-bit color display (or greater)

**To store images to a local hard disk, up to 8 MB of free disk space is needed per file.*

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If you are a Mac® user, the host computer for your Quantix camera must have the following:

- Macintosh® OS 8.X, OS 9.X, or OS X
- 64 MB RAM (or greater)
- CD-ROM drive
- At least one unused PCI card slot
- Video adapter that supports 24-bit color (millions of colors)

**To store images to a local hard disk, up to 8 MB of free disk space is needed per file.*

Multiple Cameras

PVCAM supports multiple open cameras. In order to use this function, your imaging software must also support it. The RS Image capture software program included with your system supports multiple cameras, as do many other imaging packages.

If your imaging software supports multiple cameras, there must be a separate PCI card for each camera. Multiple cameras can only be open simultaneously if all use PCI interfaces.

Software Installation

An Installation Guide appropriate to your system is included as an insert in the CD-ROM case. This guide provides step-by-step instructions for installing the camera interface software and the application software for Windows-based and Macintosh-based PCs. Additional instructions are included for installing a PCI card in your computer and capturing images.

The CD-ROM contains the following files.

- **Readme text files —** these files contain the latest information on the software installations and should be read before you run the PVCAMSetup program.
- **PVCAMSetup software program —** this software installs the camera interface software.
- **RSImageSetup software program —** this software installs the RS Image application program.
- **MacOS directory —** this directory contains the files required for installing on a Macintosh computer.
- **Acrobat directory —** this directory contains subdirectories containing installation programs for Acrobat® Reader®.
- **Manuals directory —** this directory contains user manuals in PDF format.

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Installing the PCI Card

You will be using a Quantix PCI card to allow the camera to communicate with your computer.

Refer to the Readme text files on the CD-ROM and to the Installation Guide supplied with the CD-ROM before installing the PCI card. Please follow the instructions when installing the card.

After installing the PCI card, go to *Connecting the Data Cable.*

Connecting the Data Cable

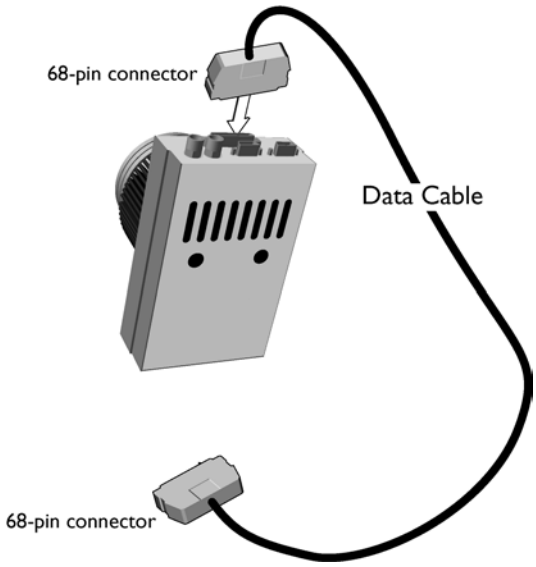
The Data cable connects your Quantix camera to the PCI card installed in your computer.



Data Cable

To connect your Quantix camera:

1. Connect either end of the Data cable to the AIA port on the camera (see the figure below).



2. Connect the other end of the Data cable to the PCI card in the host computer.

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Connecting the Power Brick

The power brick is a switched supply that is shipped with a power cord.

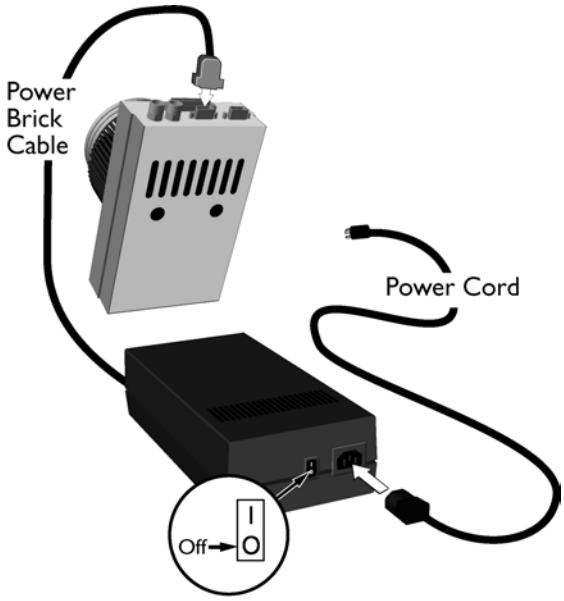
Caution: Connecting or removing a live power cable to or from the Quantix camera can damage the camera's electronic components. Do not attach or remove any cables while the power brick is switched on (On = |, Off = 0) and plugged into an electrical outlet.

To connect the power brick to the camera:



Power Brick Cable with 15-Pin, D Connector

1. Connect the power brick cable's 15-pin, D connector to the power port on the back of the camera. Secure by tightening the connector screws. **Do not extend this cable.**
2. With the power brick switched off and the power cord unplugged from an electrical outlet, connect the power cord to the power brick (and later to an electrical outlet).



Instructions for powering on and powering off the camera system are provided in the *Installation Guide* supplied with the CD-ROM. After 15 to 30 minutes of operation, the camera will reach its default operating temperature.

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Connecting the Optional Liquid Circulation Unit

The liquid-cooled camera can be operated with or without the LCU. If you choose to operate the camera without the LCU, the default operating specifications will be slightly different. For operating specifications, see *Chapter 6. Specifications*.

In order to operate properly, the reservoir in the LCU must be at least 3/4 full:

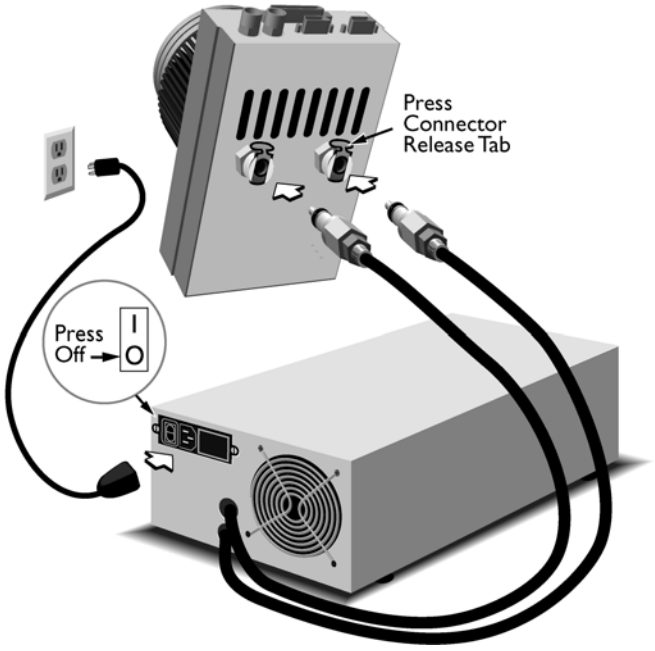
- If you are installing a newly shipped LCU, the reservoir is filled with the proper amount of coolant. Follow connection instructions below.
- If you are not installing a newly shipped LCU, check to see if either of the following conditions apply:
  - Low coolant level because you have lost coolant while disconnecting and reconnecting the hoses.
  - You have not checked the coolant level in 3 months.

If either condition applies, see *Refilling the Reservoir* on page 14 to check the coolant level in the reservoir.

To connect the LCU:

With the power switch in the *off* position (Off = 0), connect:

- LCU hoses to camera
- LCU power cord to LCU (and later to an electrical outlet)



Caution: Do not allow the reservoir to drain below half full. To keep the pump primed, always operate the LCU in the upright position.

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When disconnecting the LCU from the camera, it is important to keep any coolant from spilling into the camera. Make sure to see *Disconnecting the Coolant Connectors* on page 13 for instructions on disconnecting the LCU.

You have completed installing the LCU.

If, during operation, the camera does not appear to be cooling properly:

- Check to see if coolant is moving through the liquid circulation unit.
- Check the fluid level in the reservoir. To add more coolant to the reservoir, see *Refilling the Reservoir* on page 14.
- If the coolant is clouded with many tiny bubbles, your coolant level may be low. See *Removing Air Bubbles* on page 15.
- Check the hose and power cord connections.
- Check the LCU line entry module fuse. For instructions on accessing and changing the fuse, see *Changing LCU Line Entry Module Fuses and Voltages* on page 28.

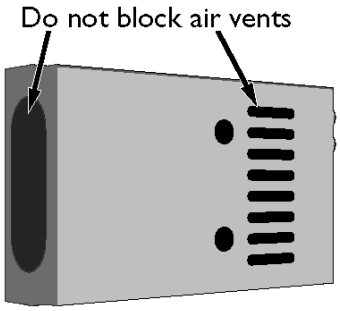
If the camera still does not cool, contact Roper Scientific Customer Service.

If you are connecting other equipment such as lenses, scientific equipment, triggering equipment, peripherals, or camera stands go to the next section, *Connecting to Other Equipment.*

Connecting to Other Equipment

The camera can be operated in any orientation, allowing it to be adapted to many configurations. The F-mount configuration has a Nikon® bayonet mount with a standard F-mount flange focal distance. The C-mount configuration is a standard threaded video mount with a standard C-mount flange focal distance. The camera has mounts that accommodate a standard tripod mounting bolt.

Note: When mounting the camera on an instrument, do not block any air vents. Blocking the airflow through the camera can damage the CCD. Make sure to allow at least one inch of air space in front of all vents.



Lenses

With the F-mount camera, you can install any lens that is compatible with a standard Nikon bayonet mount. With the C-mount camera, you can install any lens that is compatible with a standard threaded video mount as long as the objective does not extend farther than .27 inches behind the flange of the lens. A C-mount lens with optics that protrude a long distance into the camera may interfere with the shutter blades. For specifications on calculating acceptable flange focal distances, see *F-Mount Camera* on page 32 or *C-Mount Camera* on page 38. Photometrics offers compatible C- and F-mount lenses.

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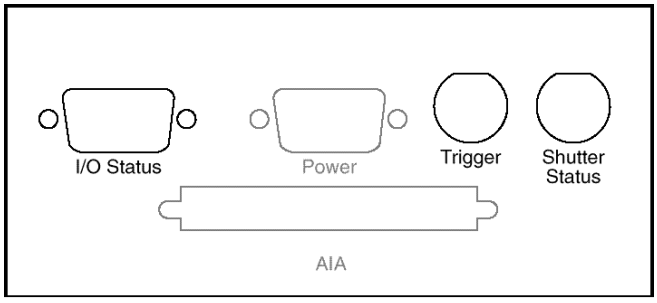
To install a lens, remove the camera aperture cover. Insert the lens into the lens mount. C-mount lenses screw in. F-mount lenses should be turned until they lock in place.

Scientific Instruments

The F-mount camera can be mounted to any instrument that is compatible with a standard Nikon bayonet mount. The C-mount camera can be mounted to any instrument that is compatible with a standard threaded video mount. If you need to adjust your Quantix focal distance for parfocal adjustment, use standard optical shims. (Shims are precision washers that are placed over the threading of the C-mount of the instrument in order to increase the distance between the CCD plane and the instrument.) If your instrument requires a mount adapter, contact your instrument supplier.

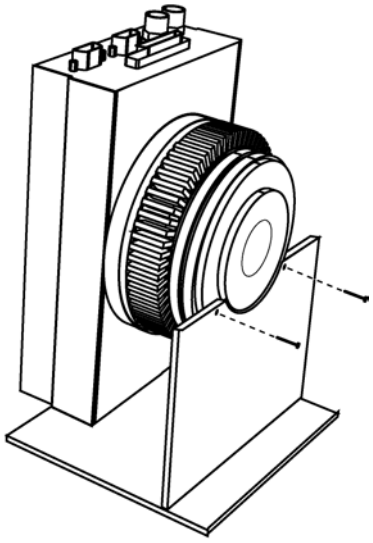
Trigger Equipment

You can connect the camera to trigger equipment through the I/O Status, Trigger, or Shutter Status connectors on the camera. For pin-out specifications for each connector, see *Connector/Cable Pinouts* starting on page 43.



Quantix Camera Stand

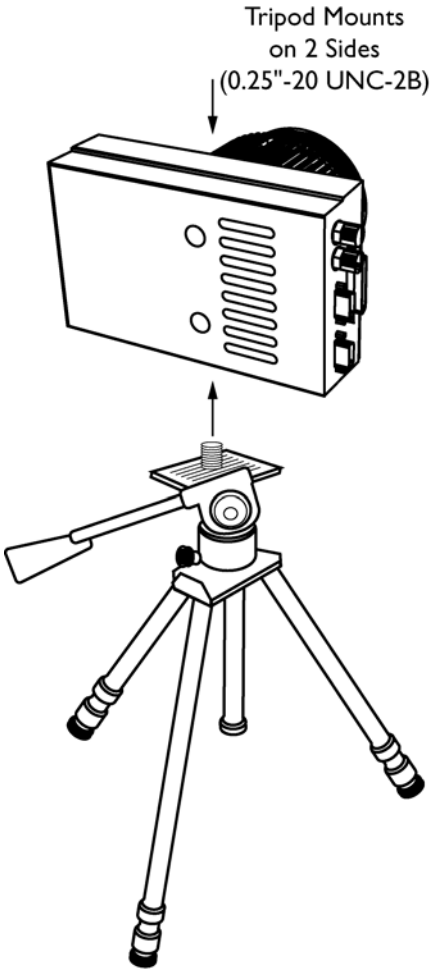
Roper Scientific offers an optional Quantix camera stand. Since the camera can be operated in any position, the camera can be attached to the stand with the connectors facing up or to either side. To install the camera stand, thread the two bolts into the camera frontplate.



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Tripod Camera Stand

If you use a tripod camera stand, make sure the stand is large enough and stable enough to securely support the camera's weight. The camera has two mounts that will accommodate a standard tripod mounting bolt.



Focusing Your Camera

After you have finished system installation and have started the application software, you can focus the camera for the best image. Using the instructions from your software program, bring your software into focus loop mode. For instructions on using *RS Image* to focus, see the on-line help.

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Chapter 3 LCU Maintenance

Precautions

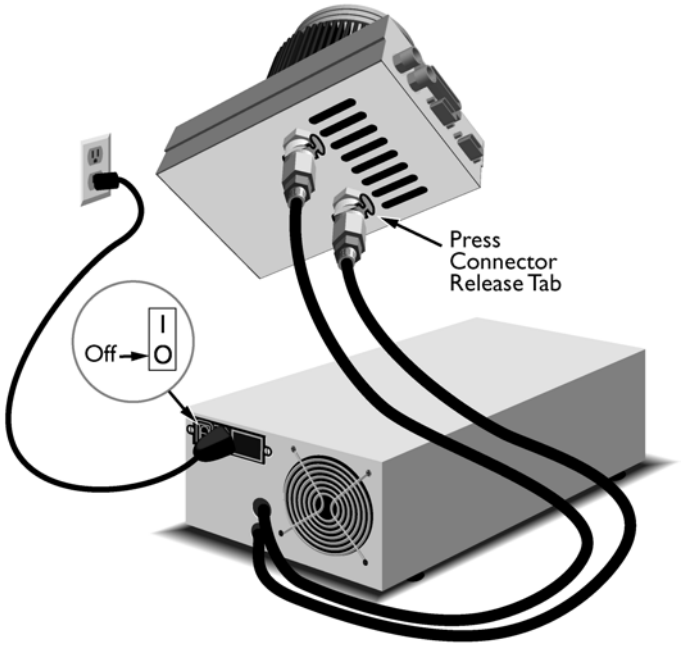
To prevent damage to the LCU please observe the following precautions:

- Keep seals lubricated by running LCU 45 minutes at least once a month.
- Always keep pump primed by operating LCU in the upright position.
- When disconnecting the coolant hoses from the camera, it is important to prevent any coolant from spilling into the camera. When disconnecting the hoses, hold the camera over an absorbent material, such as paper towels, with the connectors facing down.
- Never impede airflow through the LCU by obstructing the air vents.

Disconnecting the Coolant Connectors

Caution: When disconnecting the coolant hoses, excess coolant will spill from the hoses and connectors. It is important to prevent coolant from spilling into the camera.

1. Turn off the LCU power (Off = 0).
2. To keep excess coolant from spilling into the camera, position the camera over absorbent material with the coolant connectors facing down.
3. Press the connector release tabs and disconnect the hoses from camera.



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Refilling the Reservoir

Check the reservoir every three months to see if coolant needs to be added to the system. (To check the reservoir level, remove the cover as shown on the next page.)

WARNING: Use only the fluorescent pink coolant mixture supplied by Roper Scientific (part number 24-071-001), which is a mixture of DOWTHERM SR-1 and de-ionized water. Use of any other coolant mixture may lead to instrument failure (see Coolant section on page 1 of the LCU user manual for further explanation). Do not combine mixtures (see Compatibility with Traditional Ethylene Glycol in Appendix A of the LCU user manual (57-058-001) for more information).

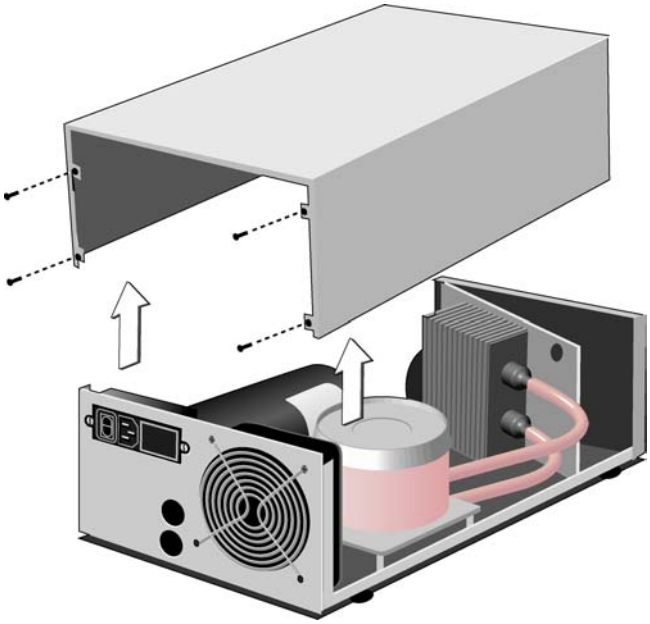
Add coolant if the reservoir is less than 3/4 full.

- Required coolant mixture: mixture of DOWTHERM SR-1 and de-ionized water (mixture supplied by Roper Scientific)
- Liquid coolant capacity: 27 fluid ounces (800 cc)

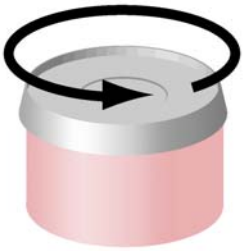
Caution: Do not allow the reservoir to drain below 1/2 full.

To refill the LCU:

1. Turn off the LCU power (Off = 0), and disconnect the power cord.
2. Remove the four screws on the back panel of the LCU. Remove cover.



3. Remove the cap from the coolant reservoir.



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4. Fill the reservoir to approximately 1/4″ from the top with the coolant mixture supplied by Roper Scientific.

WARNING: Use only the fluorescent pink coolant mixture supplied by Roper Scientific (part number 24-071-001), which is a mixture of DOWTHERM SR-1 and de-ionized water. Use of any other coolant mixture may lead to instrument failure (see Coolant section on page 1 of the LCU user manual for further explanation). Do not combine mixtures (see Compatibility with Traditional Ethylene Glycol in Appendix A of the LCU user manual (57-058-001) for more information).

5. Replace the reservoir cap, LCU cover, and screws.
6. Reconnect the power cord.

Removing Air Bubbles

Normally, air bubbles that have formed in the tubing due to low coolant level will work their way out after the reservoir is filled. However, if the fluid level in the reservoir has become exceptionally low or if the LCU was operated on a slanted surface, bubbles may remain in the tubing even after refilling the reservoir. In order to clear these bubbles, it may be necessary to watch the coolant flow through the tubing inside the LCU.

- First fill the reservoir to the proper level and then reinstall the cover securely on the reservoir.
- With the LCU connected to a camera head and turned on, look for any tube inside the LCU that is not completely filled with coolant.

WARNING: Use extreme caution while working inside an operating LCU. There is a cooling fan that could cause physical injury, and voltages up to 240V, which could cause electrical shock.

- If you find a tube with air in it, lift the LCU and tilt and rotate it so the air bubble works its way back to the reservoir inlet. The goal is to have the LCU pump air bubbles back into the reservoir. Air always moves up in relation to fluids, so you should tilt and rotate the LCU so air bubbles can move up through the liquid. The air bubbles may have to travel all the way through the tubing and the camera head on their way back to the reservoir.
- Keep in mind that the reservoir outlet is at the bottom of the reservoir. Be sure the reservoir outlet is completely submerged at all times. If you tilt the LCU so the reservoir outlet is higher than the fluid level, the pump will introduce more air into the tubing.
- Coolant will eventually displace all air bubbles in the tubing. Once the bubbles have been worked out of the tubing, the reservoir may need to be filled since coolant formerly in the reservoir is now in the tubing in place of the air bubbles.

Attaching the Coolant Connectors

See *Connecting the Optional Liquid Circulation Unit* on page 9.

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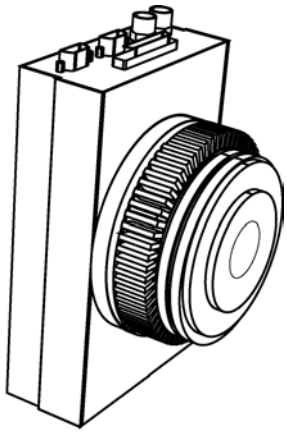
Changing Line Entry Module Fuses and Voltages

The voltage selector card and fuse configuration on the AC line entry module is set to the correct voltage for your country. If your voltage needs to be changed, you will need to change the voltage selector card, and you may need to change the fuse configuration. To change the voltage and the fuse configuration see *Changing LCU Line Entry Module Fuses and Voltages* on page 28.

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Chapter 4. Component Descriptions

The Quantix camera system consists of the F-mount or C-mount camera, power brick, PCI card, and an optional liquid circulation unit.



Quantix C-mount Camera

Camera

The camera body houses the CCD cooling system and the camera electronics. The CCD is inside a vacuum-sealed chamber. All of the components inside the camera body are sensitive electronic components and are not user accessible. *Opening the camera body voids the camera warranty.*

CCD

When you order a Quantix camera, you choose from a range of CCDs that differ in size and grade. All Quantix CCDs are scientific-grade, grades with fewer defects than commercial grades. Scientific-grade CCDs image with better resolution, have low noise so they can detect weak signals, and are linear over the dynamic range so you can accurately judge intensity differences between objects.

Dark Charge Reduction Modes

All Quantix cameras have either Multi-Pinned Phase (MPP) or Advanced Inverted Mode Operation (AIMO) CCDs. These CCDs are built to have less thermally generated noise for a given exposure time, a property useful when trying to detect weak signals.

Metachrome® II

Metachrome II is a proprietary, optional, permanent CCD coating that is available on all Quantix CCDs. This coating extends the CCD's sensitivity to below 200 nm and is transparent from 400 to 1100 nm wavelength light. The coating requires no maintenance and does not degrade over time.

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Certificate of Performance

Each Quantix camera has a Certificate of Performance. This certificate states the CCD grade that has been designated by the CCD manufacturer. The certificate also provides the camera performance information needed to effectively measure photon flux with repeatable, scientific accuracy. A copy of the information contained in the Performance Certificate is kept on file at Roper Scientific Customer Service.

CCD Chamber

The vacuum-sealed CCD chamber protects the CCD from contamination as well as insulating it from the warmer air in the camera body. The low humidity also reduces the chance of condensation forming on the CCD when the temperature is lowered. If any gasses are trapped in the vacuum chamber, they are absorbed by a sieve located inside the chamber.

The vacuum also isolates the window from the cooled CCD. This thermal barrier keeps the window from cooling below the dew point, thereby preventing condensation on the window.

Window

The camera has one window in the optical path. The CCD does not have a window. Compared to a multiple-window design, a single window reduces the chance of image degradation due to multiple reflections, stray light, and interference patterns.

The standard Photometrics window is made of fused silica (quartz) with a broadband antireflective coating. Fused silica has better ultraviolet transmission than crown glass. The antireflective coating increases the light transmitted through the window from 92% to 99%, further decreasing light loss.

Optional infrared-blocking (IR) windows are available. The IR window blocks optical radiation above 650 nm, providing a sharper image.

Thermoelectric Cooler

While the CCD accumulates charge, thermal activity releases electrons, generating dark current. Cooling the CCD helps enhance the low-light sensitivity by reducing the thermally generated charge.

Cooled CCD cameras produce less dark current than cameras operating at ambient temperature. When the ambient temperature is between 0°C and 30°C, the CCD in the Quantix camera is cooled to a minimum of -25°C for the air-cooled cameras and a minimum of -35°C for liquid cooled.

The CCD is cooled by a two- or three-stage Peltier cooler, a thermoelectric cooler (TEC) that pulls heat away from the CCD and into a heat exchanger. The heat exchanger transfers the heat into the camera body, where it is passively radiated to the environment. In certain situations, a separate liquid cooling unit removes additional heat from the heat exchanger.

Shutter

The camera has a high-speed shutter. For shutter specifications, see *Chapter 6, Specifications*.

The shutter is a mechanical component that has a limited life with heavy use. Instructions for testing and replacing the shutter are in *Chapter 5. Troubleshooting*.

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Electronics

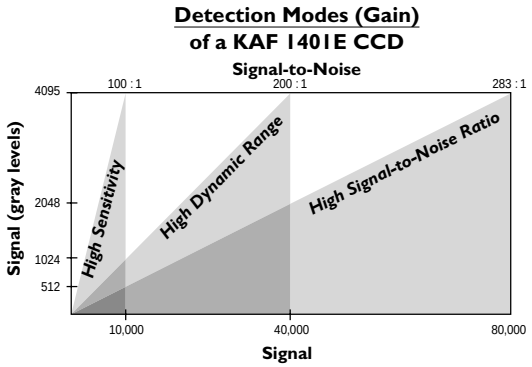
The CCD produces an analog signal. The camera electronics convert the analog signal into a digital signal, data that can be received by the host computer.

Several factors influence what portion of the analog signal translates into digital data. One factor is the noise in the camera system. The system noise includes the thermal noise produced by the camera components and the read noise determined in part by how far the analog signal must travel. The farther an analog signal has to travel, the more the signal degrades.

To reduce signal degradation, Quantix has low-noise electronics and primary point digitization (PPD™). The PPD design positions the analog-to-digital converter (ADC) as close to the CCD as possible thereby reducing the distance the analog signal must travel.

Another determining factor is the quality of the signal received by the ADC. If the ADC receives a high-quality signal, the 12-bit ADC digitizes the analog signal into 12-bit data. With a lesser quality signal, the ADC produces data with a lower effective bit depth.

The Quantix camera produces an analog signal that uses the full range of the 12-bit ADC (up to 4096 gray levels). Through software, the camera can be set to the detection modes (gains) listed below.

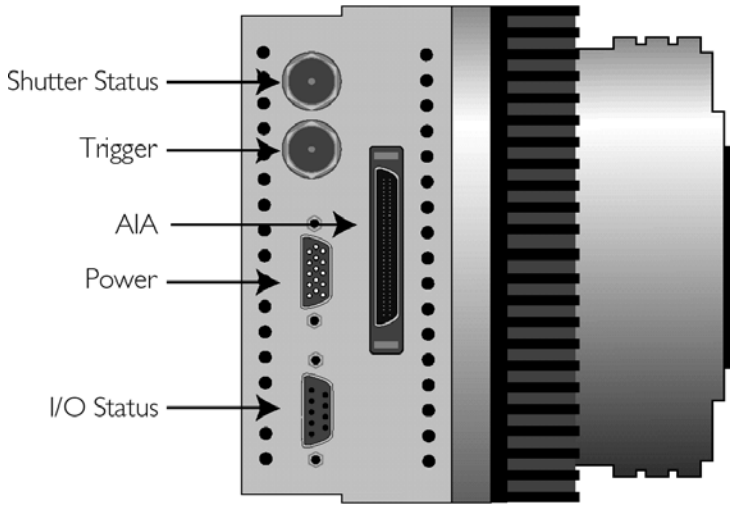


- **Gain 1 — High Signal-to-Noise Mode —** when binning, this mode takes advantage of the output node's maximum full-well capacity, a requirement when measuring small changes on bright backgrounds. In this mode (1/2x), the full well of a normal pixel maps to 1/2 of the maximum ADC count. For a KAF 1401E, with a 2x2 bin, the maximum number of electrons is ≈80,000.
- **Gain 2 — High Dynamic Range Mode —** suitable for measuring bright and dim signals in a field of view. In this mode (1x), the full well of a normal pixel maps to the maximum ADC count. For a KAF 1401E, the maximum number of electrons is ≈40,000.
- **Gain 3 — High Sensitivity Mode —** takes advantage of the CCD's low read noise, a requirement for low-light imaging. In this mode (4x), 1/4 full well of a normal pixel maps to the maximum ADC count. For a KAF 1401E, the maximum number of electrons is ≈10,000.

Data transfers from the CCD to the ADC at the same rate it is transferred from the ADC to the interface. This rate is the ADC conversion rate. The conversion rate of your Quantix camera is stated on the Certificate of Performance.

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Connectors



Shutter Status — Shutter Status is a BNC connector that gives access to an output signal that indicates if the shutter is open or in motion. For specifications on this connector see *Shutter Status Connector* on page 44.

Trigger — Trigger is a BNC connector that gives access to an unfiltered, fast response trigger. A trigger input allows you to synchronize the camera trigger signal with external equipment. The signal provided into this input must be clean, or you may get false triggers. For information on a filtered trigger input, see I/O Status (below). For specifications on this connector see *Trigger Connector* on page 44.

AIA — Digital data is transmitted to the host computer through the AIA connector. The AIA connector is a 68-pin, high-density, I/O connector with a standard AIA format. The pinout for the parallel cable that mates to the AIA port connector is located in *Data Cable Pinout* on page 46.

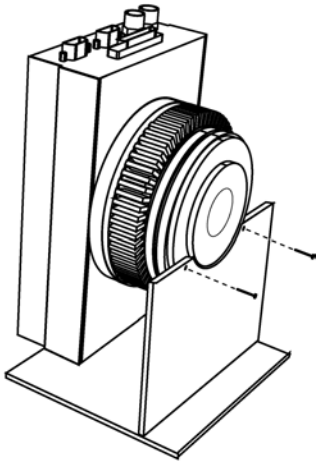
Power — The power connector is a 15-pin, female, D connector that connects the camera to the power supply. For power connector pinout specifications see *Power Connector Pinout* on page 45.

I/O Status — The Input/Output Status is a 9-pin connector that gives access to a filtered trigger input, trigger input configuration, and camera status outputs. Pinout specifications are located in *Input/Output Status Connector Pinout* on page 43.

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Quantix Stand Mount

Roper Scientific offers an optional Quantix camera stand. Since the camera can be operated in any position, the camera can be attached to the stand with the connectors up or facing to either side.



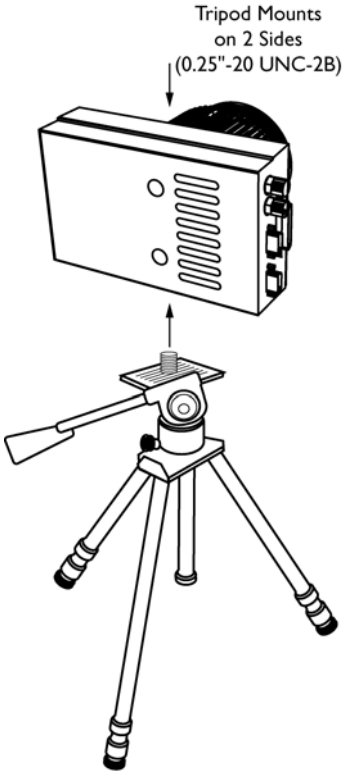
Lenses

Roper Scientific sells lenses that are compatible with the Quantix F-mount and C-mount cameras. The F-mount camera is compatible with any lens that fits a standard Nikon bayonet mount. The C-mount camera is compatible with any lens that fits a standard threaded video mount.

A C-mount lens with a long flange focal distance may interfere with the shutter blades. For specifications for calculating acceptable flange focal distances, see *F-Mount Camera* on page 32 and *C-Mount Camera* on page 35.

Tripod Mount

The camera has two tripod camera stand mounting holes (0.25"-20UNC-2B with a 1/4" depth). A tripod camera stand is available through Roper Scientific.

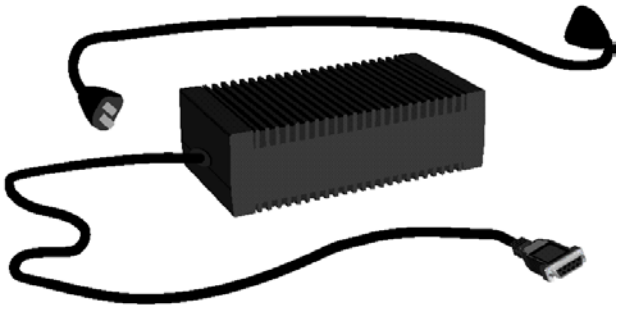


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Power Brick

The power brick is a switched, multiple-output-voltage supply with a detachable power cord. The camera system is powered on (|) and off (0) by a switch on the supply. More detailed specifications are available in *Chapter 5. Specifications*.

Caution: Connecting or removing a live power cable can damage the camera's electronic components. Do not attach or remove *any* cables while the power brick is switched on and plugged into an electrical outlet.



Power Brick with Integrated Cable and Power Cable

Liquid Circulation Unit

The LCU is an optional circulation unit that supplements the air cooling in the Quantix. The LCU cools the CCD by pumping a mixture of DOWTHERM-SR ethylene glycol and distilled water through the camera's heat exchanger. For LCU specifications see *Liquid Circulation Unit* on page 42.

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Chapter 5. Troubleshooting

If you have any difficulty while troubleshooting, or do not see your camera system's symptoms listed here, contact Roper Scientific Customer Service.

The following issues have corresponding troubleshooting sections in this chapter.

System Does Not Boot Normally	page 23
New Hardware Found Dialog Box Does Not Appear (Windows 95/98/2000/ME/XP)	page 24
Image is Smeared or Camera Will Not Reach Saturation	page 24
Images Not Displayed Properly	page 24
Camera Does Not Respond to Light	page 24
Camera Does Not Focus	page 24
Camera Not Cooling	page 27
PVCAM Error Message Appears	page 27
Lengthy Pauses During Imaging	page 27
Changing LCU Line Entry Module Fuses and Voltages	page 28

Caution: Do not attach or remove any cables while the camera system is powered on.

System Does Not Boot Normally

If your operating system does not boot normally after you have installed a PCI card, try installing the new card in another open PCI slot. If this does not work:

1. *Turn off your computer* and remove the newly installed PCI card.
2. Turn your computer back on. If your system boots normally, there is probably an interrupt conflict between a previously installed expansion card and the PCI card that you are installing.
3. If you need assistance resolving the interrupt conflict, contact Roper Scientific Customer Service.

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New Hardware Found Dialog Box Does Not Appear (Windows 95/98/2000/ME/XP)

If the New Hardware Found dialog box does not appear after installing a new PCI card to your computer and booting Windows 95/98/2000/ME/XP:

- Check to make sure that the new PCI card is inserted in a PCI slot according to your computer manufacturer's instructions and that the Quantix system's CD-ROM is in the host computer's CD drive.
- It is possible that there is a conflict between the new PCI card and a previously installed expansion card. *With the computer's power turned off,* remove any previously installed expansion cards that your system does not need to function. (If you are unsure which cards can be safely removed, call Roper Scientific Customer Service.) Then turn your computer back on and boot Windows 95/98/2000/ME/XP again.
- If the New Hardware Found dialog box still does not appear, contact Roper Scientific Customer Service.

Image is Smeared or Camera Will Not Reach Saturation

If the image is smeared (especially in high-intensity areas of the image) or the camera will not reach saturation (4095 ADU) and the camera is set to gain state 1, make sure you use binning factors of at least 2 x 2. Because of the camera's design, it only saturates at gain state 1 if binning factors of at least 2 x 2 are defined.

Alternatively, if the light level is low enough, or you are unable to define binning factors greater than 1 x 1, you could use gain state 2 or gain state 3.

If you have a frame-transfer CCD and you are imaging with the shutter open continuously, make sure you select Frame Transfer as the Clocking Mode in your imaging software.

Images Not Displayed Properly

If no images appear:

- Confirm that the red LED on the back of the camera is illuminated, indicating that the camera is powered on.
- Confirm that the correct Quantix camera is selected in your imaging software application.
- Power off the camera and the host computer and check all system connections (particularly both ends of the Quantix data cable). Restart. If no images appear:
  - Confirm that Windows is set for at least 16-bit colors.
  - Confirm that the camera is operational by taking an image with a standard C-mount lens attached to your Quantix.

  Using normal room lighting, place the camera on a table about 3 meters away from an object and acquire an image using your system's Brightfield settings.

If the problem persists, contact Roper Scientific Customer Service.

Camera Does Not Focus

If your Quantix camera is not focusing, see the focusing instructions in your imaging software and lens documentation.

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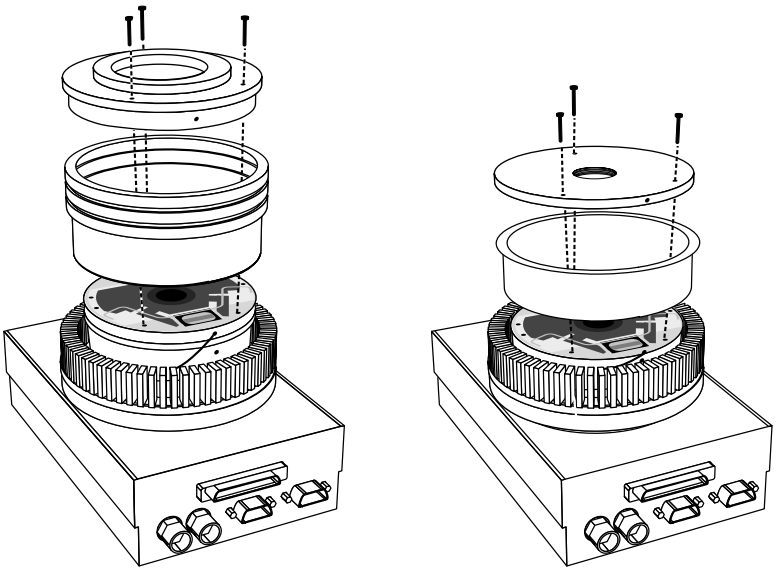
Camera Does Not Respond to Light

If your camera has no response to light, a faulty camera shutter may be causing the problem. To test for a faulty shutter:

1. Turn on the power to the camera.
2. As the camera is powering up:
   - If you hear 2 clicks separated by 1 second (shutter opening then closing), the shutter is working. Call Roper Scientific Customer Service for further instructions.
   - If you hear 0, 1, or more than 2 clicks, check the voltage between I/O port pins 3 (exposing) and 9 (ground) while you are powering up the camera. (See *Input/Output Status Connector Pinout* on page 43.)
     If the TTL logic level goes from 0 (low) to 1 (high), stays high for 1 second then drops to 0, the shutter signal is working, but the mechanical shutter is not working. Follow the procedures in *Replacing Camera Shutter* below.

If the TTL logic levels do not indicate a working shutter signal, call Roper Scientific Customer Service.

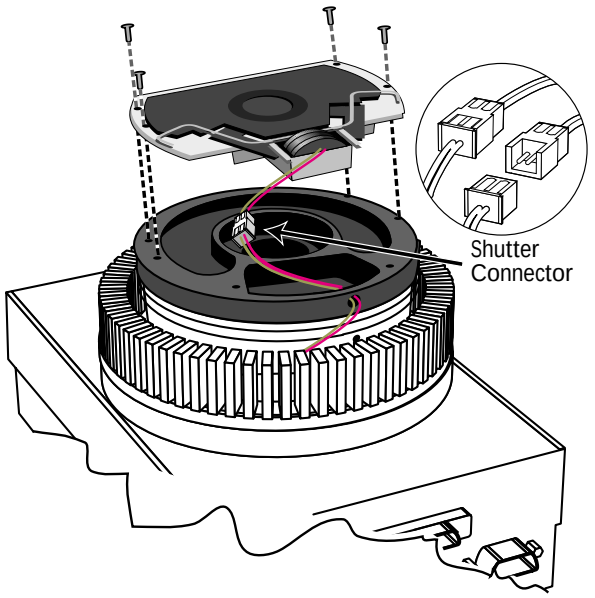
Replacing Camera Shutter



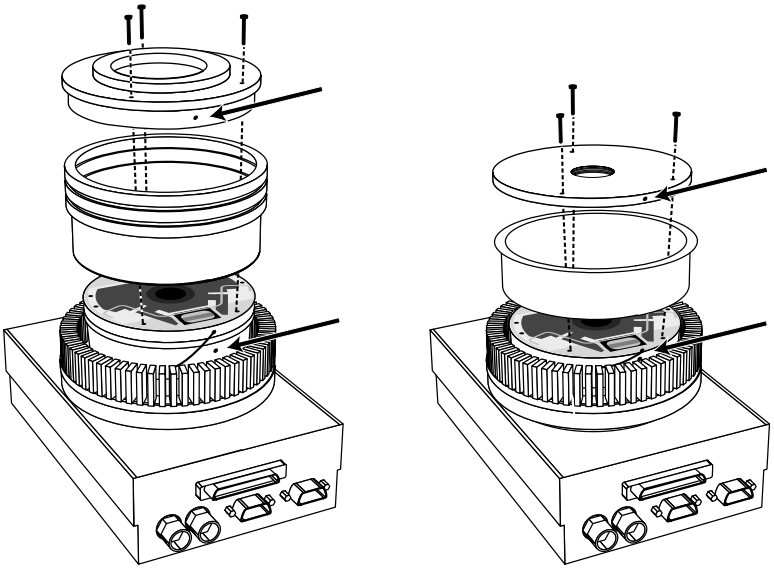
F-Mount Camera C-Mount Camera

1. To access the shutter:
   - Remove the screws holding the mount adapter in place.
   - Remove the mount adapter and slide the canister from the camera.

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2. To replace shutter:
   - Remove the screws holding the shutter in place.
   - Remove the shutter and disconnect the shutter connector.
   - Connect the new shutter connector.
   - Place the connector in the well below the shutter, making sure the connector does not interfere with shutter operation when the shutter is completely open.
   - Fasten down the new shutter.



F-Mount Camera C-Mount Camera

3. To reassemble the camera:
   - Position the shutter wires so they will not be pinched during reassembly.
   - Line up the dots on camera and mount the adapter.
   - Fasten the mount adapter in place.

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Camera Not Cooling

If after 15 minutes of operation the software indicates that the camera has not reached its operating temperature, make the following checks based on your system configuration.

Air-Cooled or Liquid-Cooled Camera without LCU:

- Check the temperature setpoint in the software. Cameras operated without an LCU should be set to regulate at -25°C.
- If the camera still does not cool, call Roper Scientific Customer Service.

Liquid-Cooled Camera with LCU:

- Check to see if coolant is moving through the unit.
- If the coolant becomes clouded with many tiny bubbles, your coolant level may be low. Fill the coolant reservoir. See *Refilling the Reservoir* on page 14. If bubbles persist, see *Removing Air Bubbles* on page 15
- Check the hose and power cord connections.
- Check the LCU line entry module fuse. For instructions on accessing and changing the fuse, see *Changing LCU Line Entry Module Fuses and Voltages* on page 28.
- If the camera still does not cool, call Roper Scientific Customer Service.

PVCAM Error Message Appears

If a PVCAM error message appears, note the message's number code and contact Roper Scientific Customer Service.

Lengthy Pauses During Imaging

If you notice lengthy pauses marked by a lot of disk activity while imaging:

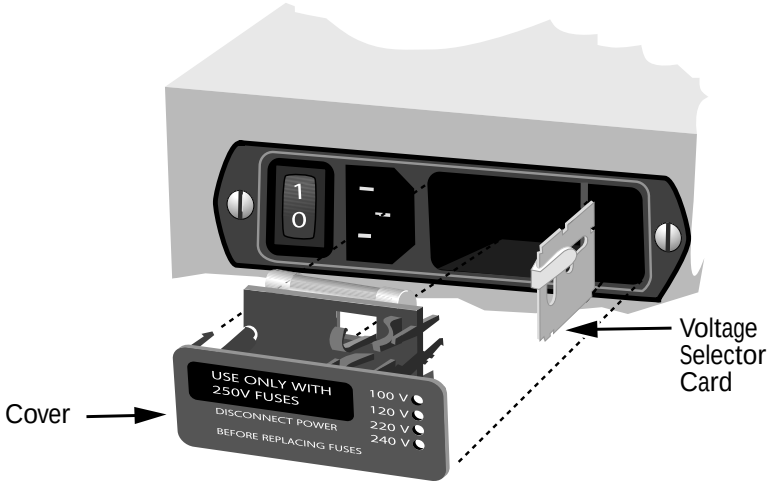
- Close any other programs that may be running.
- Install more physical memory to your computer system.

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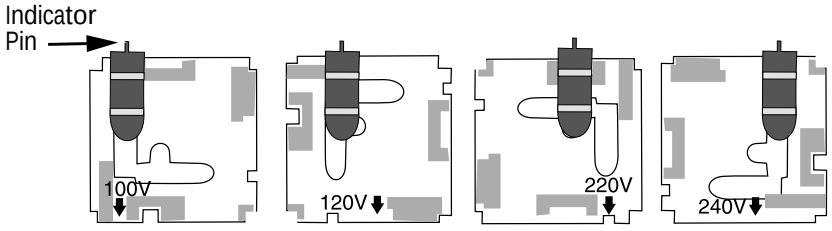
Changing LCU Line Entry Module Fuses and Voltage

The voltage selector card and fuse configuration on the AC line entry module are set to the correct voltage for your country. If your voltage source changes, you will need to change the voltage selector card, and you may need to change the fuse configuration.

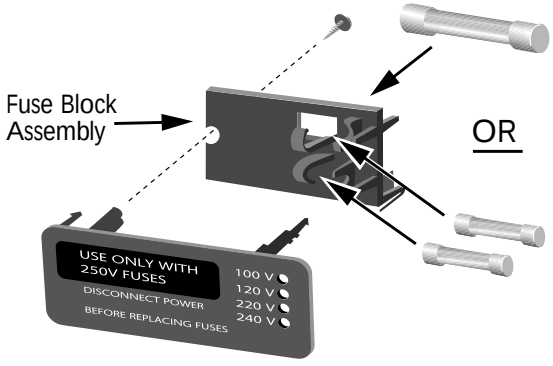
To change voltage and fuse configuration:



1. With the LCU powered off (Off = 0), remove cover by prying off with a tool such as a small blade screwdriver.
2. Using a tool such as a needle nose pliers, pull voltage selector card straight out.



3. Position the indicator pin so it is pointing up while the arrow associated with the correct voltage points down.
4. With the indicator pin facing out and the printed side facing the powercord socket, replace the voltage selector card.

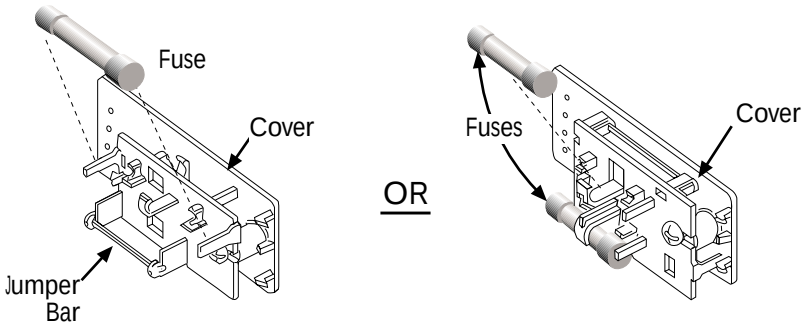


5. Remove screw and slide fuse block assembly from cover.

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6. Insert one or two fuses:

Volts	# of Fuses	Amperes
110-120V	1	2A
220-240V	2	1A



7. Making sure that the fuse or fuses being used are facing away from the back of the cover (that is, toward the inside of the unit), replace the fuse block assembly.
8. Replace the cover and verify that the indicator pin is showing through the cover and marking the desired voltage.

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Chapter 6. Specifications

Camera (General)

Specifications	F-Mount Camera		C-Mount Camera	
	Air Cooled	Liquid Cooled	Air Cooled	Liquid Cooled
Weight (without lens)	≈ 5 lbs	≈ 5 lbs	≈ 5 lbs	≈ 5 lbs
Power dissipation*	85 Watts	85 Watts	85 Watts	85 Watts
Maximum ambient operating temperature**	30°C (86°F)	30°C (86°F)	30°C (86°F)	30°C (86°F)
Minimum ambient operating temperature**	0°C (32°F)	0°C (32°F)	0°C (32°F)	0°C (32°F)
Default operating temperature**	-25°C (-13°F)	-35°C(-31°F)*** w/o LCU -25°C(-13°F)	-25°C (-13°F)	-35°C(-31°F) w/o LCU -25°C(-13°F)

* During "steady state" (whenever the shutter is not firing: while the shutter is fully opened, closed, or closing) the power dissipation is 44 Watts.

** Some ambient conditions, combined with an ambient temperature below 0°C or above 30°C, may result in the camera not stabilizing at the default operating temperature.

***The **Quantix:7899** cools to -25°C(-13°F) with liquid. It is not rated for operation without the LCU, and it is **NOT** available with air cooling

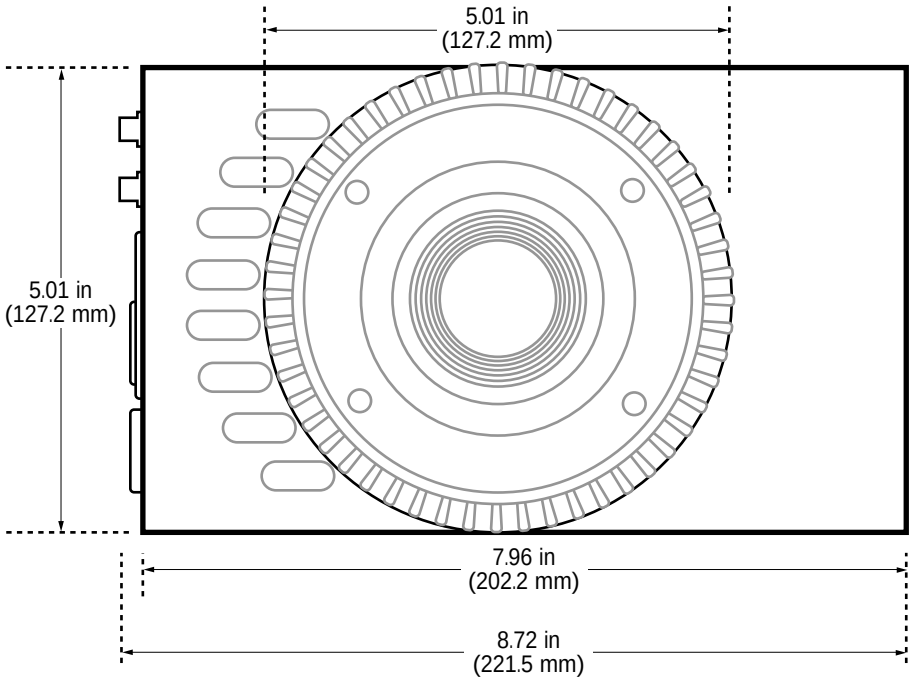
Shutter

Shutter			
Type: Aperture (mm)	Uniblitz: 14	Uniblitz: 25	Uniblitz: 35
Open time (msec)	4	6	18
Close time (msec)	8	10	25
Minimum cycle time (fps) *	12	12	6
* Frames per second (fps) while fully opening and closing.			

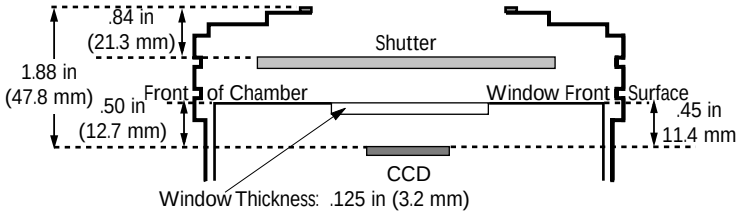
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F-Mount Camera

(KAF 1401E, KAF 1602E, CCD57-10)



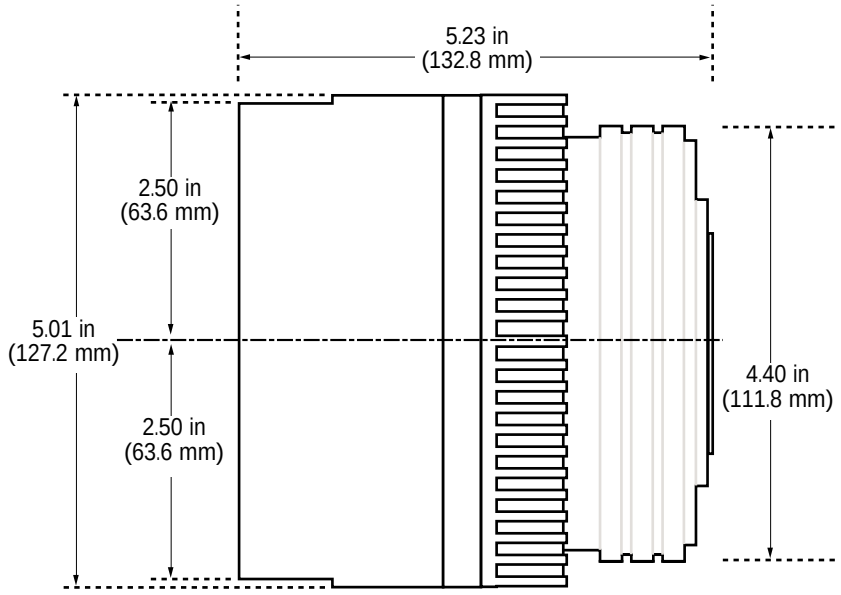
Front View — F-Mount Camera



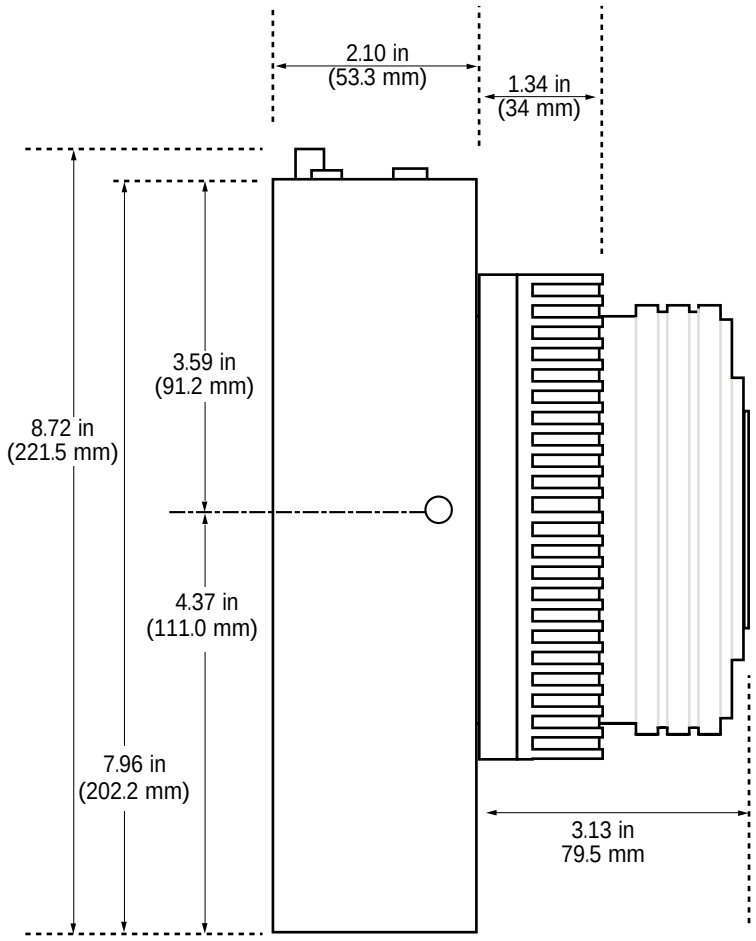
Cross Section Side View — F-Mount Camera

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F-Mount Air-Cooled Camera



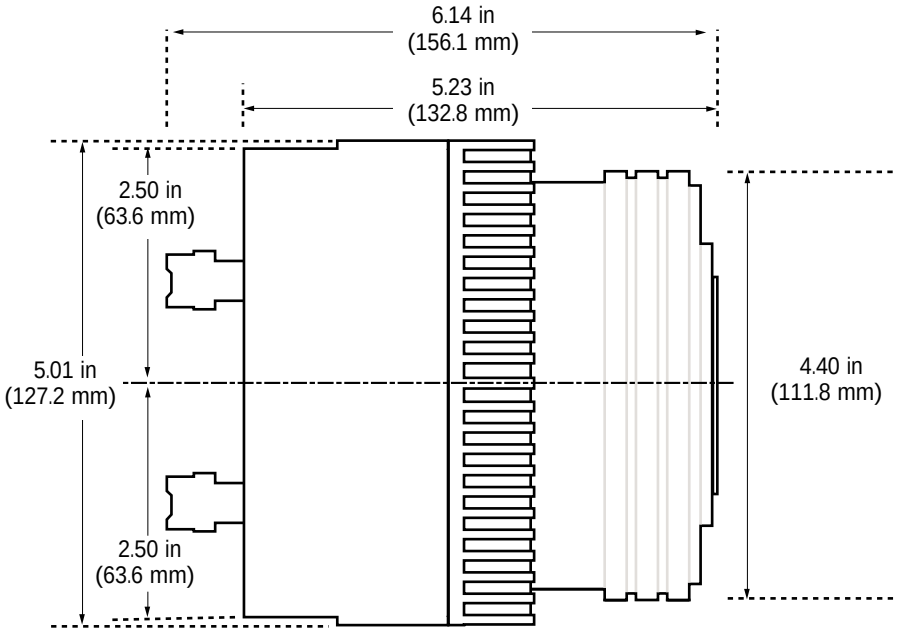
TopView — F-Mount Air-Cooled Camera



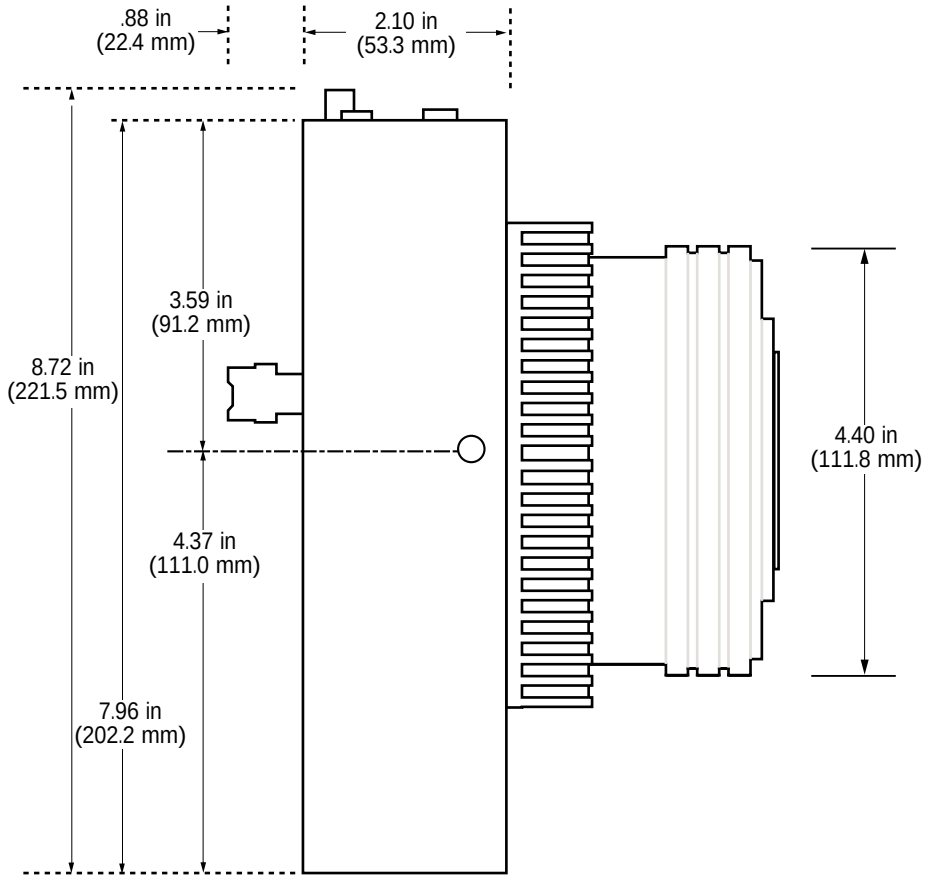
SideView — F-Mount Air-Cooled Camera

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F-Mount Liquid-Cooled Camera



Top View — F-Mount Liquid-Cooled Camera

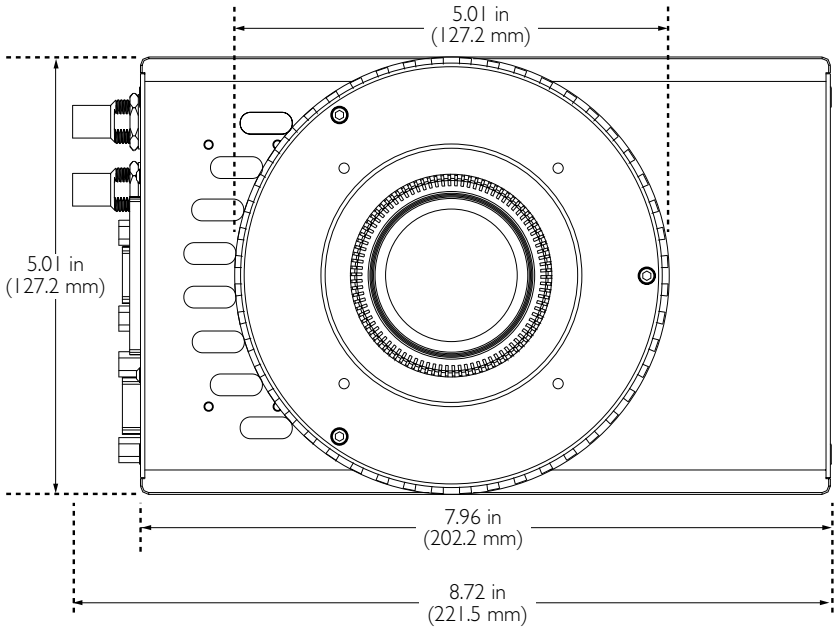


Side View — F-Mount Liquid-Cooled Camera

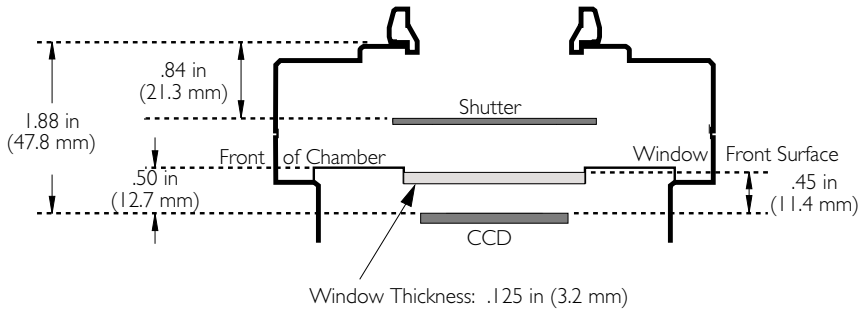
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F-Mount Camera

(KAF 6303E, TH 7899M)



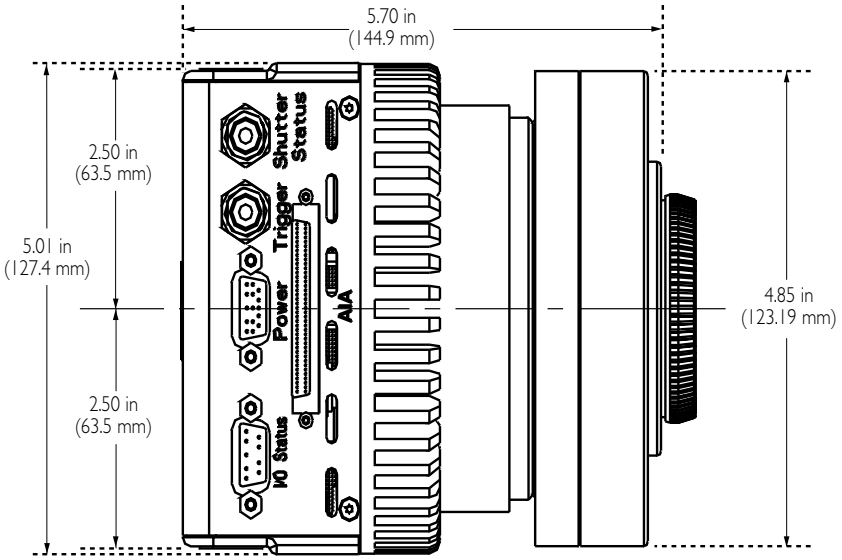
Front View — F-Mount Camera (KAF 6303E & TH 7899M)



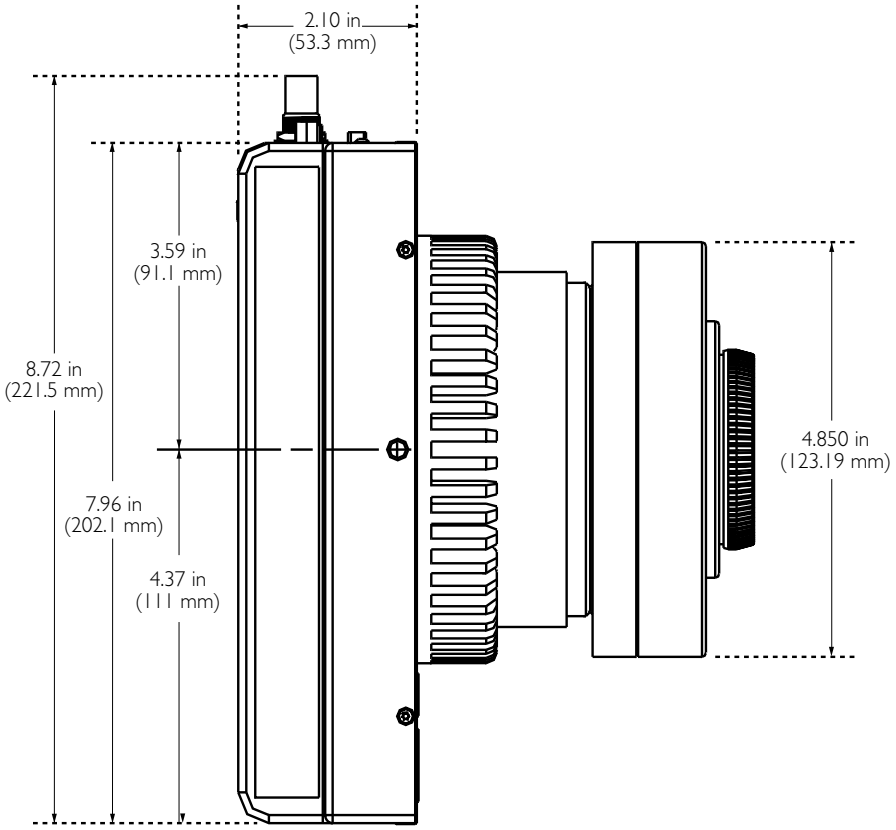
Cross Section Side View — F-Mount Camera (KAF 6303E &TH 7899M)

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F-Mount Air-Cooled Camera (KAF 6303E)



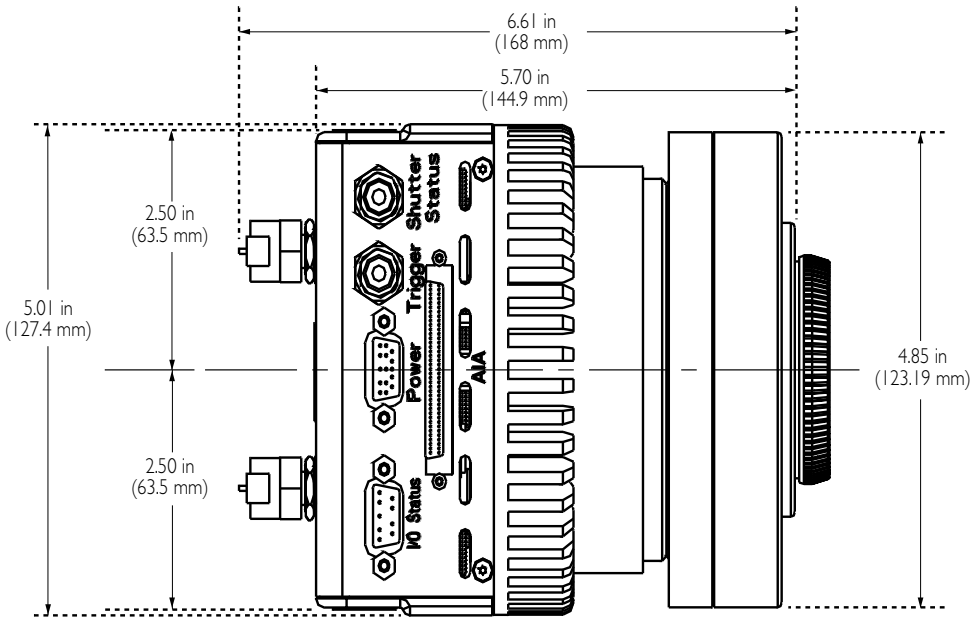
TopView — F-Mount Air-Cooled Camera (KAF 6303E)



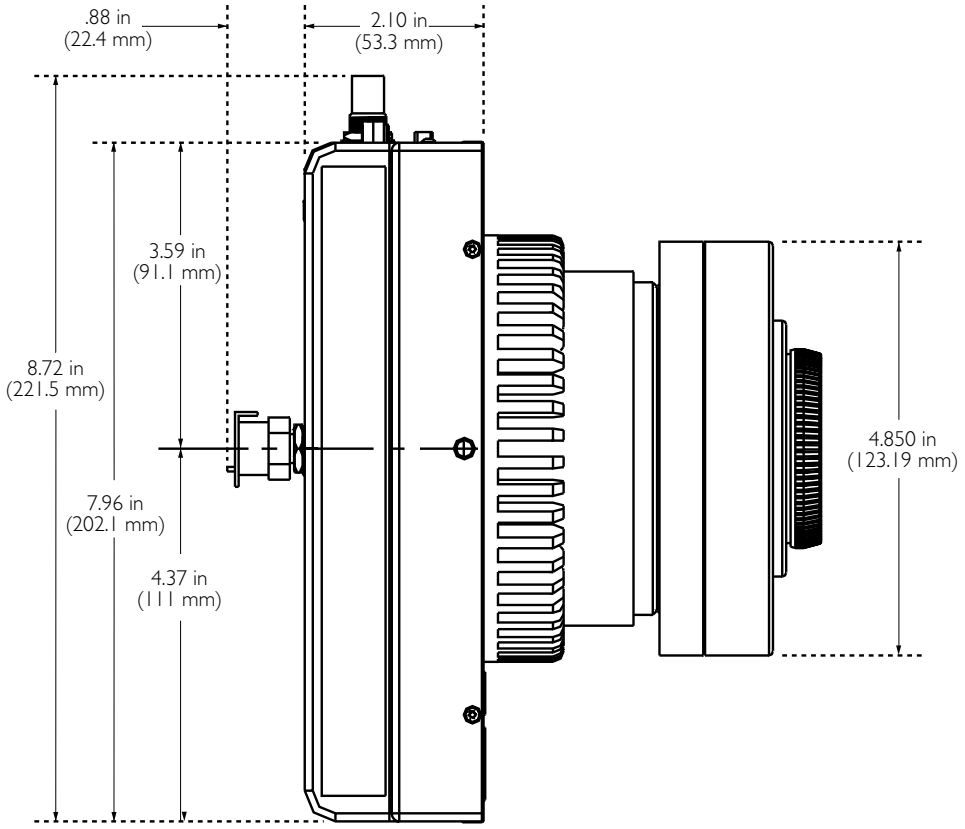
SideView — F-Mount Air-Cooled Camera (KAF 6303E)

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F-Mount Liquid-Cooled Camera (KAF 6303E , TH 7899M)



Top View — F-Mount Liquid-Cooled Camera (KAF 6303E & TH 7899M)

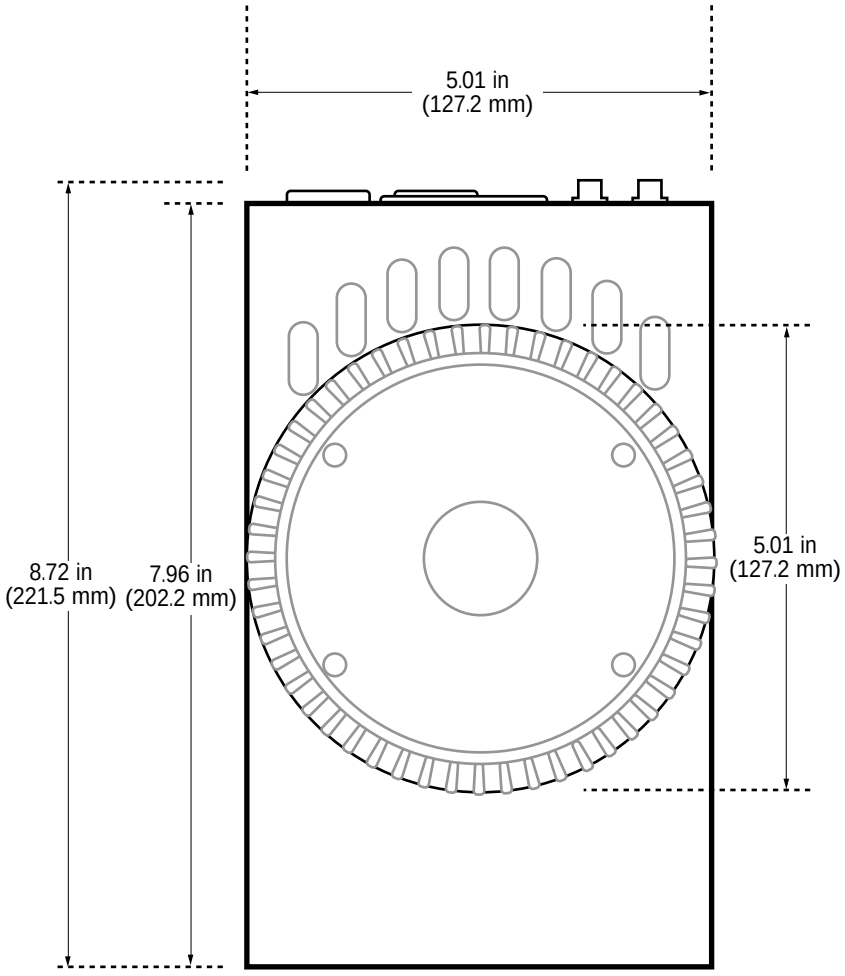


Side View — F-Mount Liquid-Cooled Camera (KAF 6303E & TH 7899M)

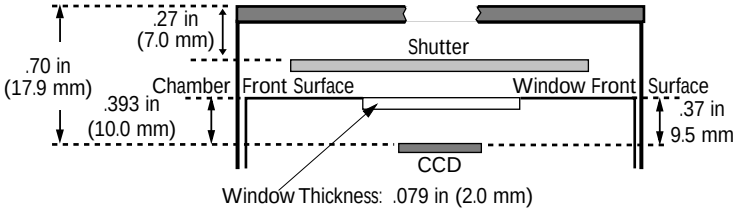
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C-Mount Camera

(KAF 1401E, KAF 1602E, CCD57-10)



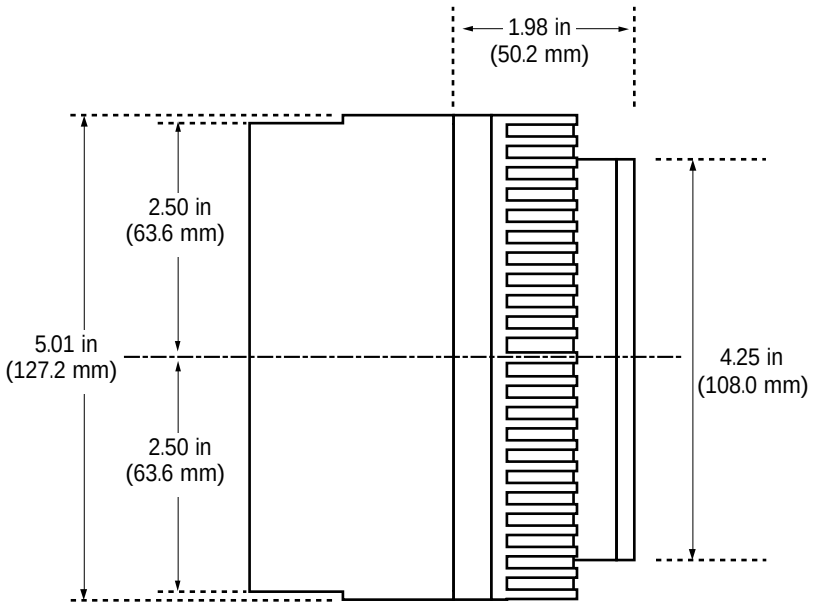
Front View — C-Mount Camera



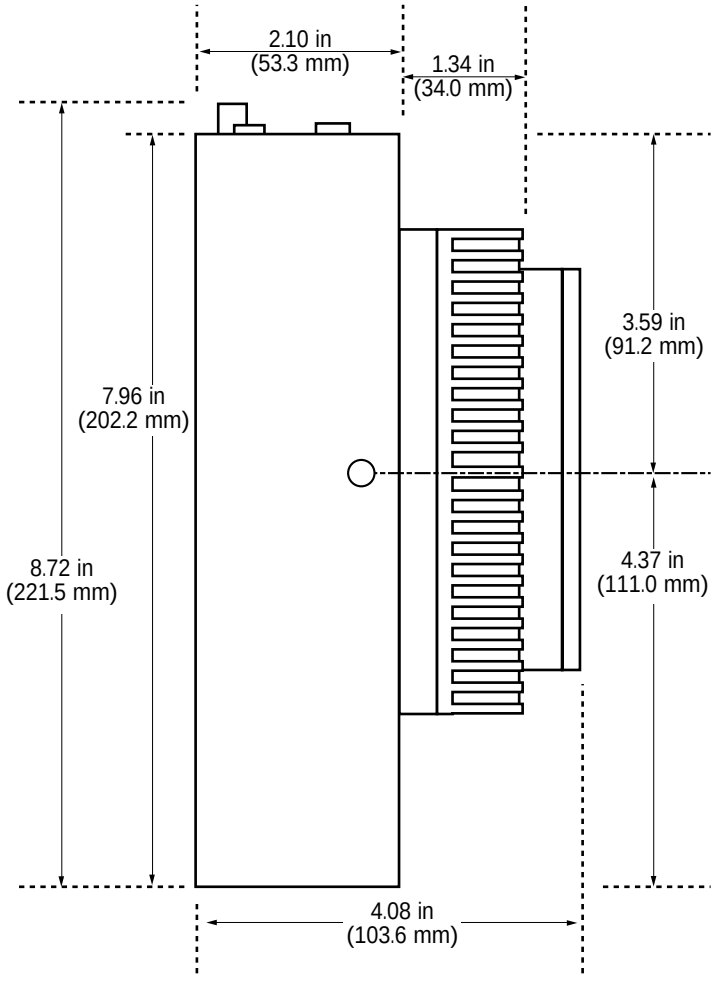
Focal Plane — C-Mount Camera

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C-Mount Air-Cooled Camera



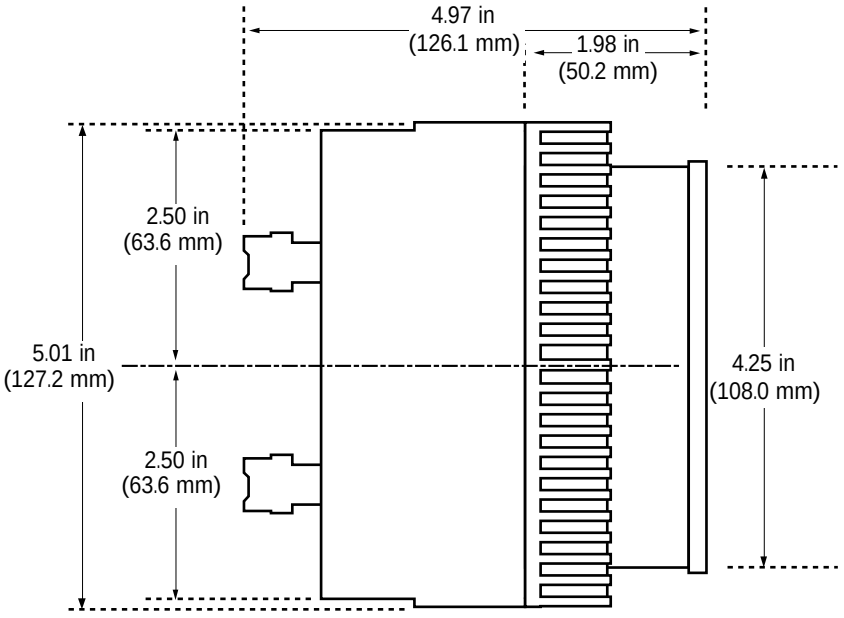
Top View — C-Mount Air-Cooled Camera



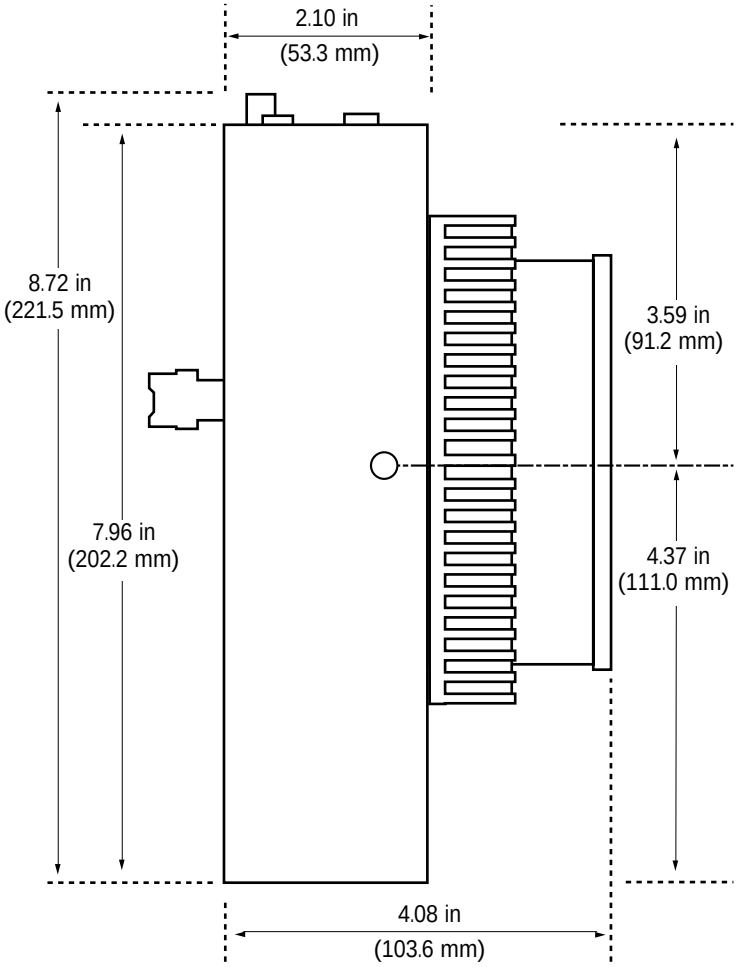
Side View — C-Nount Air-Cooled Camera

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C-Mount Liquid-Cooled Camera



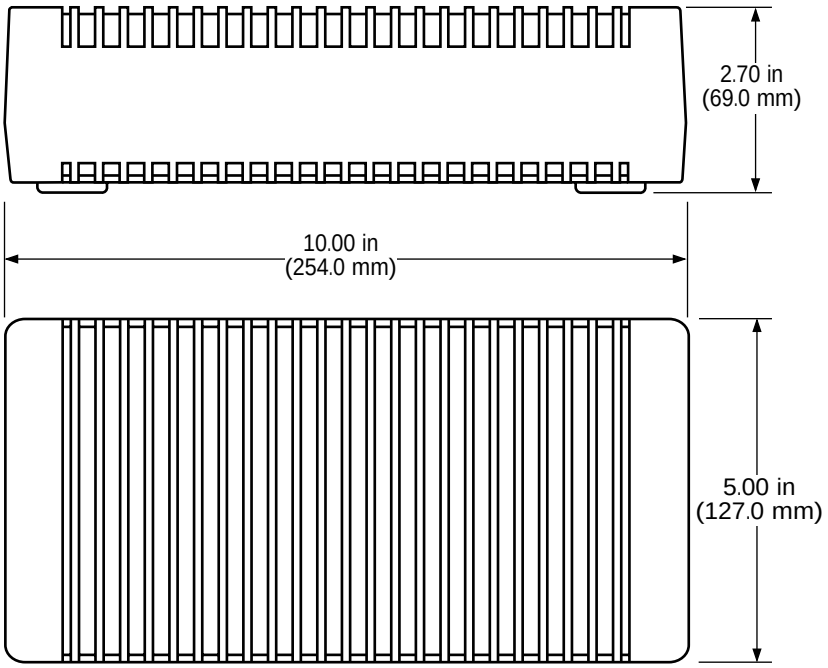
Top View — C-Mount Liquid-Cooled Camera



Side View — C-Mount Liquid-Cooled Camera

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Power Brick

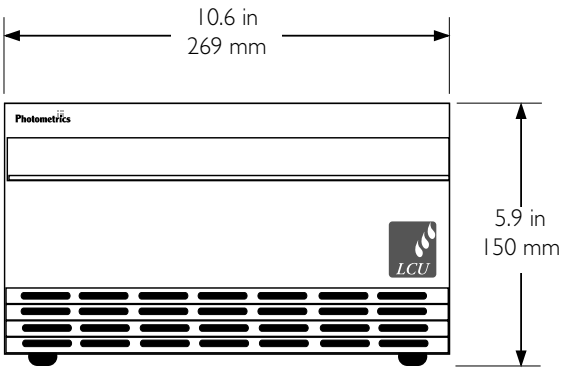


The power brick is a +6.5V DC, ±16.5V DC, and +24 V DC supply with 100-240V AC input at 47-63-60 Hz. The maximum power output is 110 W. The power brick weighs 3.87 lbs (1.76 kg).

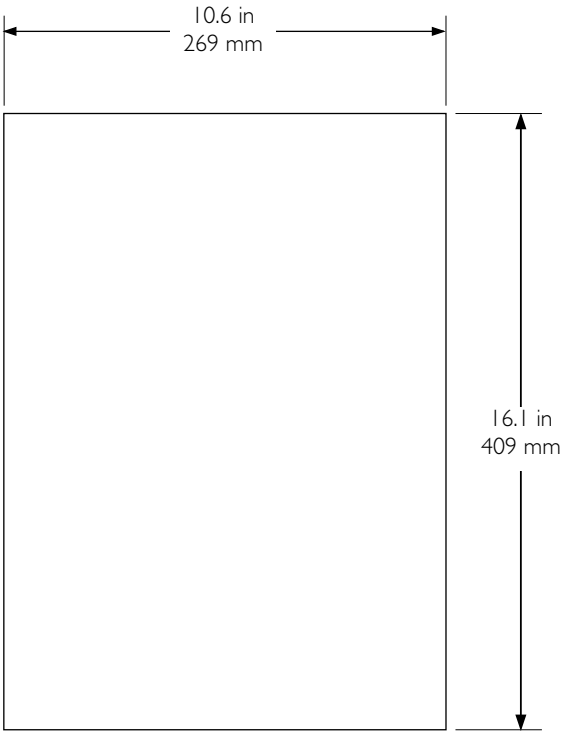
DC Voltage	Maximum Current Draw
+6.5 (system power)	1.9 A
+6.5 (TEC power)	3.4 A
+16.5	150 mA
-16.5	320 mA
+24	1.8 A during shutter firing 50 mA after shutter is fully opened and when shutter is closed.

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Liquid Circulation Unit



Front View



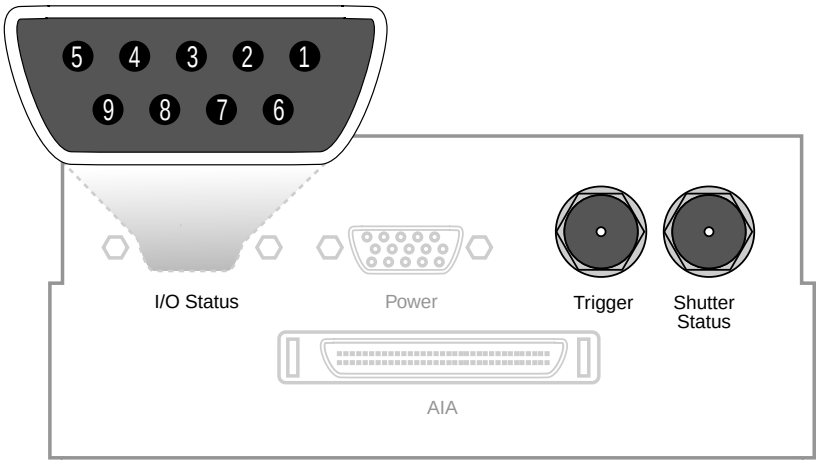
Top View

Characteristic	Specification
Liquid Coolant Capacity	27 fluid ounces (800 cc)
Required Coolant Mixture	30% DOWTHERM SR-1 and 70% de-ionized water (supplied by Roper Scientific)
Flow Rate (approx.)	6 gal/hr (0.38 liters/min)
Weight	27 lbs (12.3 kg)
Voltage Input	100-240 V AC at 50-60 Hz
Power Draw	96 W

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Connector/Cable Pinouts

The Input/Output Status, Trigger, and Shutter Status connectors provide information about trigger function and shutter status.



Input/Output Status Connector Pinout

All inputs are pulled up to +5V through 10k ohm resistors. Outputs are driven by a 74HCT244 driver. Inputs must be at least 3.15V for a high and less than 0.9V for a low. The minimum trigger pulse width through this port is 5.5 µsec (5500 nsec).

The numbers on the trigger connector diagram correspond to the numbers given to the definition of each of the pins. The I/O connector is a female, D-subminiature 9-pin connector.

1 WAIT FOR TRIGGER OUTPUT
Active high. A high level on this output indicates that the camera is waiting for a trigger input.

2 SHUTTER MOVING OUTPUT
Active high. A high level on this output indicates that the shutter is opening or closing. The output is low when the shutter is completely open or completely closed. The length of time this signal is held high is specified in PVCAM? or by the Shutter Open Delay and Shutter Close Delay functions in the software program.

3 CAMERA EXPOSING OUTPUT
Active high. A high level on this output indicates that the camera is exposing (integrating).

4 FLASH OUTPUT
This pin is an output that can be controlled in PVCAM with the FLASH_MODE constant.

5 FACTORY SETUP
This pin is reserved for factory setup.

6 FILTERED TRIGGER INPUT
This input has an RC filter inline to reduce noise on the trigger input. The input is pulled low to initiate a trigger (default). If nothing is connected to the input, it is pulled high to prevent the system from getting false triggers. To change the state of this input see TRIGGER INVERT INPUT (8). (The inputs are internally pulled up, therefore it is recommended to drive them with an open collector driver.)

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7 TRIGGER INHIBIT INPUT
This input inhibits all trigger signals. If the input is pulled low, trigger activity is disabled. By default, the input is pulled high so the trigger circuitry is enabled. (The inputs are internally pulled up, therefore it is recommended to drive them with an open collector driver.)

8 TRIGGER INVERT INPUT
Active low. A low on this input inverts the state of FILTERED TRIGGER INPUT (6) and TRIGGER CONNECTOR (see below), causing a high level to cause a trigger. (The inputs are internally pulled up, therefore it is recommended to drive them with an open collector driver.)

9 GROUND
System digital ground. Any external circuitry intended to interface with the trigger control signals must reference this ground connection.

Trigger Connector

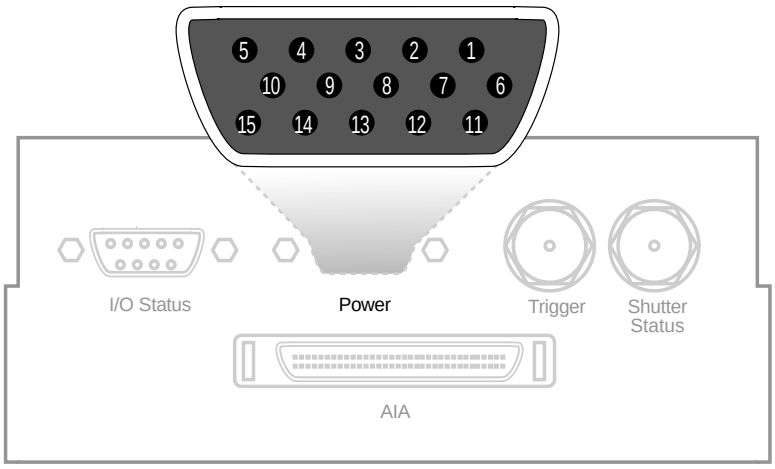
This input uses a TTL voltage level to trigger the camera. The input is pulled low to initiate a trigger (default). If nothing is connected to the input, it is pulled high to prevent the system from getting false triggers. To change the state of this input see TRIGGER INVERT INPUT (I/O Status 8). (The inputs are internally pulled up, therefore it is recommended to drive them with an open collector driver.) The minimum trigger pulse width through this port is 0.5 µsec (500 nsec).

Shutter Status Connector

Active high. A high level on this output indicates that the shutter is completely open. A low-level output indicates that the shutter is closed or in motion.

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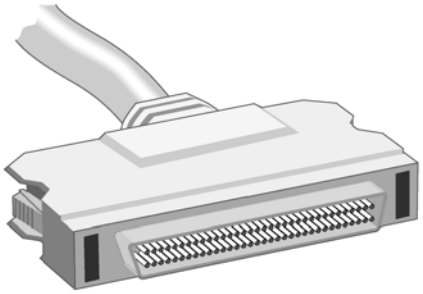
Power Connector Pinout

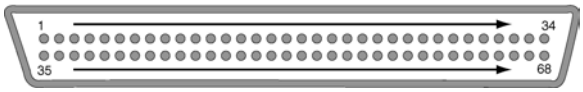


Pin #	Signal Name
1	+6.5V
2	+6.5V
3	-16.5V
4	+16.5V
5	+6.5V
6	Ground
7	Ground
8	Ground
9	Ground
10	+6.5V
11	+24V
12	+24V
13	Ground
14	Ground
15	+6.5V

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Data Cable Pinout





Pin #	Signal Name	Pin #	Signal Name	Pin #	Signal Name
1	Ground	24	N/C	47	VD5-
2	Ground	25	FEN+	48	VD4-
3	Ground	26	LEN+	49	VD3-
4	Ground	27	N/C	50	VD2-
5	Ground	28	N/C	51	N/C
6	VD11+	29	PIX+	52	N/C
7	VD10+	30	N/C	53	VD1-
8	VD9+	31	N/C	54	VD0-
9	VD8+	32	N/C	55	N/C
10	VD7+	33	N/C	56	TX-
11	VD6+	34	Ground	57	RX-
12	Ground	35	Ground	58	N/C
13	VD5+	36	VCC	59	FEN-
14	VD4+	37	VCC	60	LEN-
15	VD3+	38	VCC	61	N/C
16	VD2+	39	VCC	62	N/C
17	N/C	40	VD11-	63	PIX-
18	N/C	41	VD10-	64	N/C
19	VD1+	42	VD9-	65	N/C
20	VD0+	43	VD8-	66	N/C
21	N/C	44	VD7-	67	N/C
22	TX+	45	VD6-	68	Ground
23	RX+	46	Ground		

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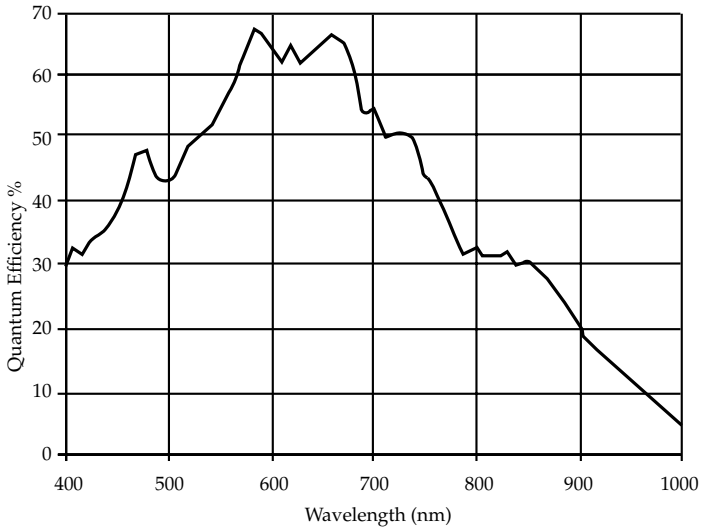
KAF 1401E CCD

The following specifications are for a typical KAF 1401E CCD. The actual measurements for your camera are listed on the Certificate of Performance that was shipped with your camera.

CCD Specifications	
H x V	1317 x 1035
Pixel Size	6.8 µm x 6.8 µm

1 MHz					
Detection Mode	**Gain Setting**	**Relative Gain**	**Typical Noise**	**System Gain**	**Typical Maximum ADC Signal**
High Signal to Noise	1	≈1/2x	24e⁻	≈20e⁻/ADU	80Ke⁻ (binned full well*)
High Dynamic Range	2	≈1x	18e⁻	≈10e⁻/ADU	40Ke⁻ (single pixel full well)
High Sensitivity	3	≈4x	16e⁻	≈2.5e⁻/ADU	10Ke⁻ (high sensitivity)
* Binning must be a minimum of 2 pixels in the parallel and serial direction to reach the maximum ADC signal.					

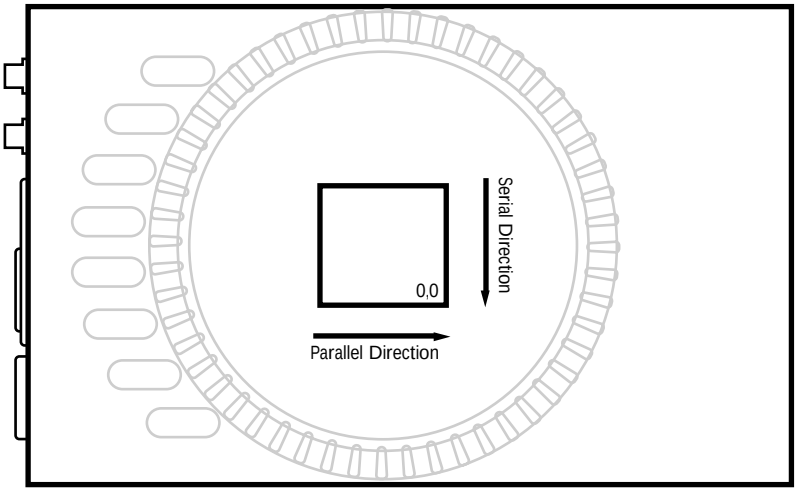
5 MHz					
Detection Mode	**Gain Setting**	**Relative Gain**	**Typical Noise**	**System Gain**	**Typical Maximum ADC Signal**
High Signal to Noise	1	≈1/2x	28e⁻	≈20e⁻/ADU	80Ke⁻ (binned full well*)
High Dynamic Range	2	≈1x	23e⁻	≈10e⁻/ADU	40Ke⁻ (single pixel full well)
High Sensitivity	3	≈4x	20e⁻	≈2.5e⁻/ADU	10Ke⁻ (high sensitivity)
* Binning must be a minimum of 2 pixels in the parallel and serial direction to reach the maximum ADC signal.					



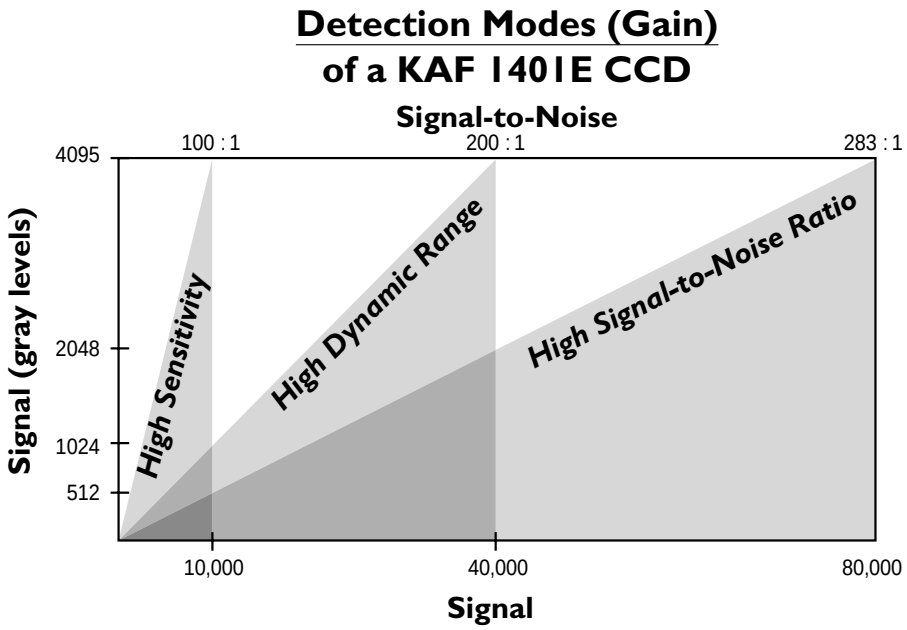
Typical QE Curve (not installed in camera)

QE response in the 200-400 nm range can be enhanced with Photometrics' proprietary Metachrome II coating.

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Camera Front View — KAF 1401E CCD Orientation



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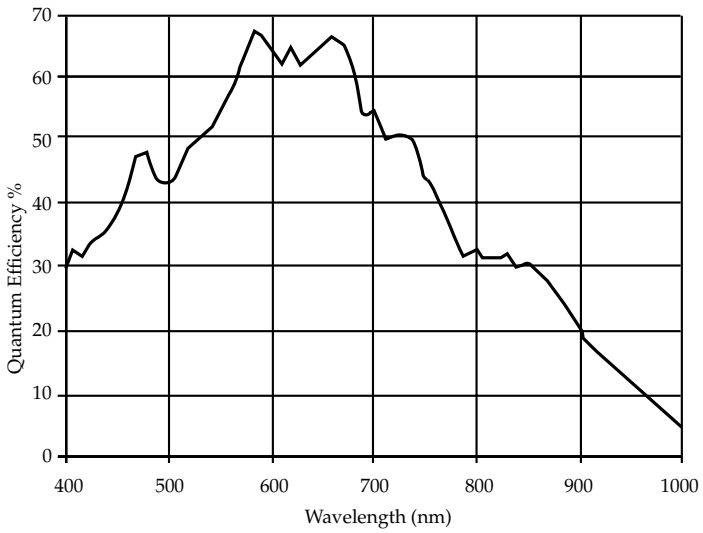
KAF 1602E CCD

The following specifications are for a typical KAF 1602E CCD. The actual measurements for your camera are listed on the Certificate of Performance that was shipped with your camera.

CCD Specifications	
H x V	1536 x 1024
Pixel Size	9 µm x 9 µm

1 MHz					
Detection Mode	**Gain Setting**	**Relative Gain**	**Typical Noise**	**System Gain**	**Typical Maximum ADC Signal**
High Signal to Noise	1	≈1/2x	37e⁻	≈20e⁻/ADU	160Ke⁻ (binned full well*)
High Dynamic Range	2	≈1x	21e⁻	≈10e⁻/ADU	80Ke⁻ (single pixel full well)
High Sensitivity	3	≈4x	12e⁻	≈2.5e⁻/ADU	20Ke⁻ (high sensitivity)
* Binning must be a minimum of 2 pixels in the parallel and serial direction to reach the maximum ADC signal.					

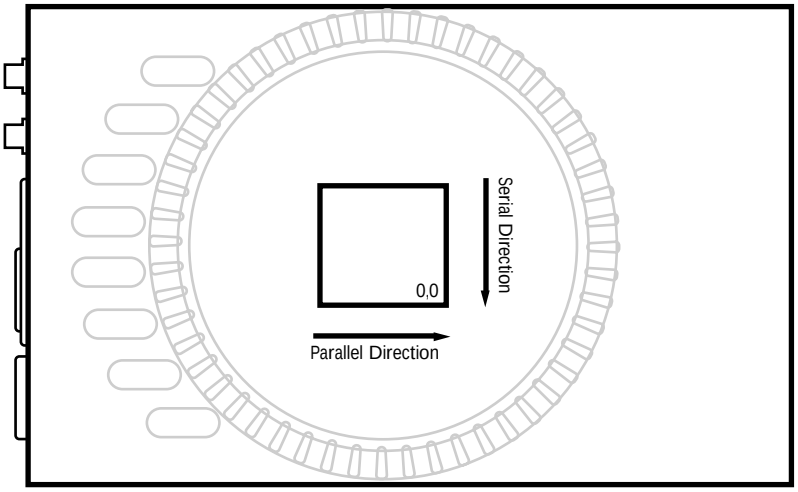
5 MHz					
Detection Mode	**Gain Setting**	**Relative Gain**	**Typical Noise**	**System Gain**	**Typical Maximum ADC Signal**
High Signal to Noise	1	≈1/2x	48e⁻	≈20e⁻/ADU	160Ke⁻ (binned full well*)
High Dynamic Range	2	≈1x	32e⁻	≈10e⁻/ADU	80Ke⁻ (single pixel full well)
High Sensitivity	3	≈4x	20e⁻	≈2.5e⁻/ADU	20Ke⁻ (high sensitivity)
* Binning must be a minimum of 2 pixels in the parallel and serial direction to reach the maximum ADC signal.					



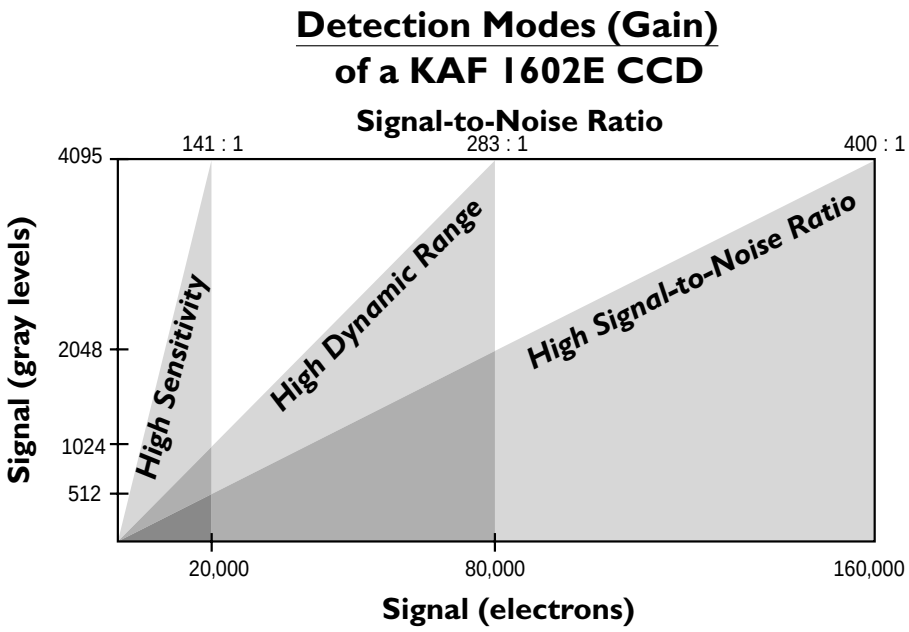
Typical QE Curve (not installed in camera)

QE response in the 200-400 nm range can be enhanced with Photometrics' proprietary Metachrome II coating.

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Camera Front View — KAF 1602E CCD Orientation



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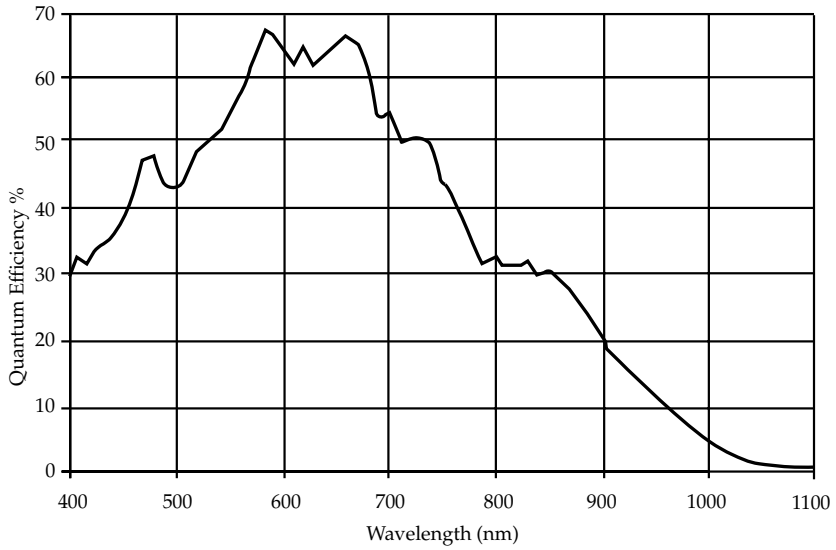
KAF 6303E CCD

The following specifications are for a typical KAF 6303E CCD. The actual measurements for your camera are listed on the Certificate of Performance that was shipped with your camera.

CCD Specifications	
H x V	3072 x 2048
Pixel Size	9 µm x 9 µm

1 MHz					
Detection Mode	**Gain Setting**	**Relative Gain**	**Typical Noise**	**System Gain**	**Typical Maximum ADC Signal**
High Signal to Noise	1	≈1/2x	35e⁻	≈42e⁻/ADU	170Ke⁻ (binned full well*)
High Dynamic Range	2	≈1x	21e⁻	≈20e⁻/ADU	85Ke⁻ (single pixel full well)
High Sensitivity	3	≈4x	13e⁻	≈4.5e⁻/ADU	18Ke⁻ (high sensitivity)
* Binning must be a minimum of 2 pixels in the parallel and serial direction to reach the maximum ADC signal.					

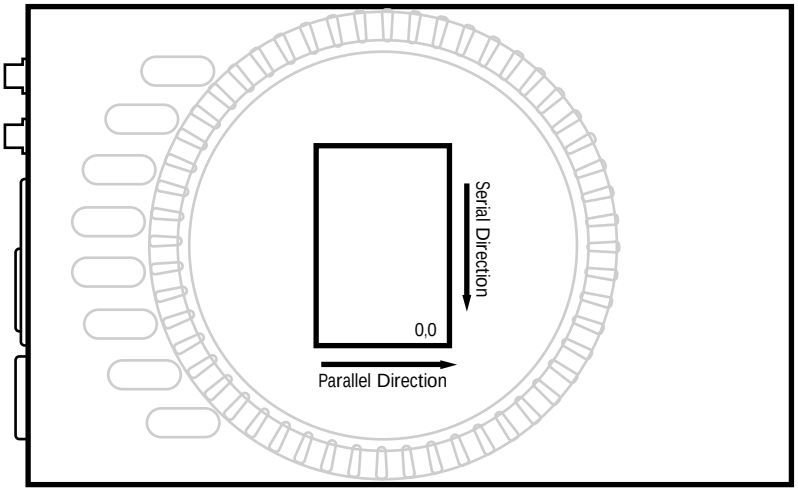
5 MHz					
Detection Mode	**Gain Setting**	**Relative Gain**	**Typical Noise**	**System Gain**	**Typical Maximum ADC Signal**
High Signal to Noise	1	≈1/2x	41e⁻	≈42e⁻/ADU	170Ke⁻ (binned full well*)
High Dynamic Range	2	≈1x	29e⁻	≈20e⁻/ADU	85Ke⁻ (single pixel full well)
High Sensitivity	3	≈4x	17e⁻	≈4.5e⁻/ADU	18Ke⁻ (high sensitivity)
* Binning must be a minimum of 2 pixels in the parallel and serial direction to reach the maximum ADC signal.					



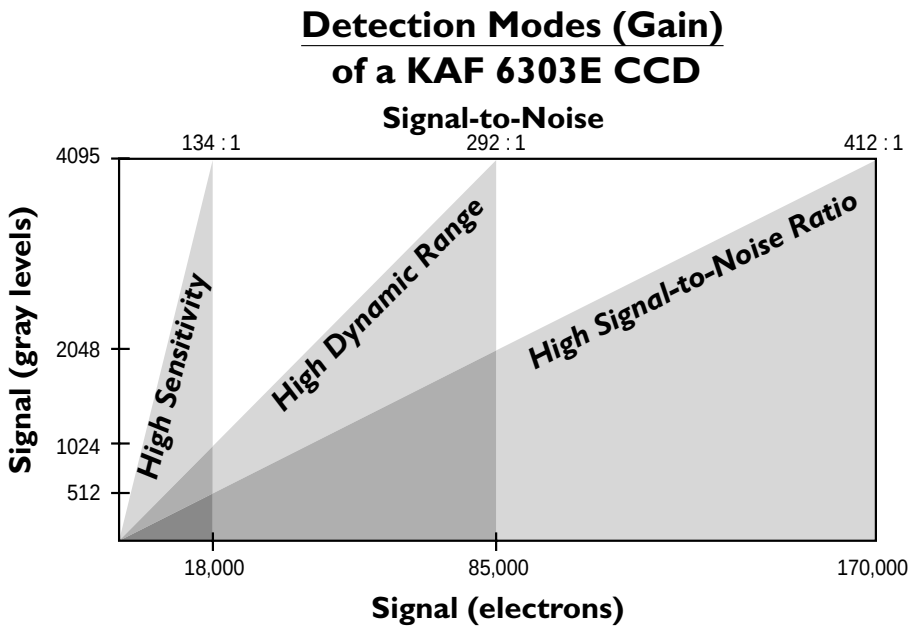
Typical QE Curve (not installed in camera)

QE response in the 200-400 nm range can be enhanced with Photometrics' proprietary Metachrome II coating.

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Camera Front View — KAF6303E CCD Orientation



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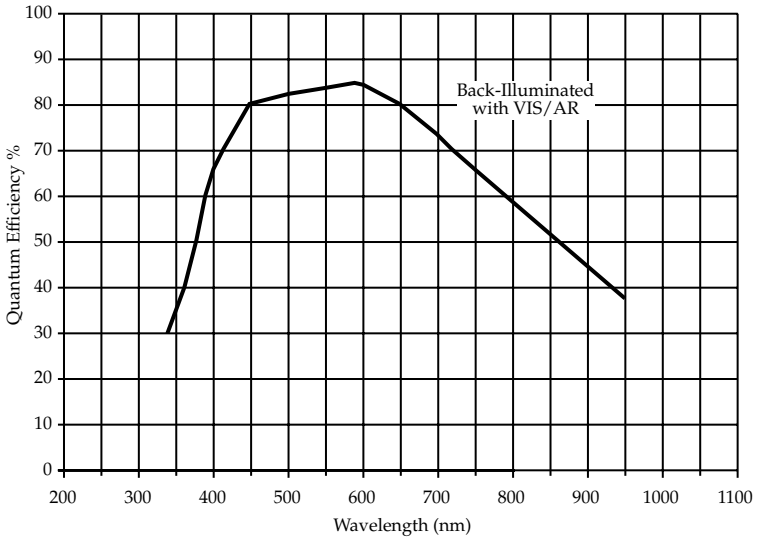
CCD57-10

The following specifications are for a typical CCD57-10. The actual measurements for your camera are listed on the Certificate of Performance that was shipped with your camera.

CCD Specifications	
H x V	535 x 1040 [(535 x 512) + (535 x 528)]
Pixel Size	13.0 µm x 13.0 µm

1 MHz					
Detection Mode	**Gain Setting**	**Relative Gain**	**Typical Noise**	**System Gain**	**Typical Maximum ADC Signal**
High Signal to Noise	1	≈1/2x	48e⁻	≈60e⁻/ADU	350Ke⁻ (binned full well*)
High Dynamic Range	2	≈1x	30e⁻	≈30e⁻/ADU	190Ke⁻ (single pixel full well)
High Sensitivity	3	≈4x	14e⁻	≈7.5e⁻/ADU	50Ke⁻ (high sensitivity)
* Binning must be a minimum of 2 pixels in the parallel and serial direction to reach the maximum ADC signal.					

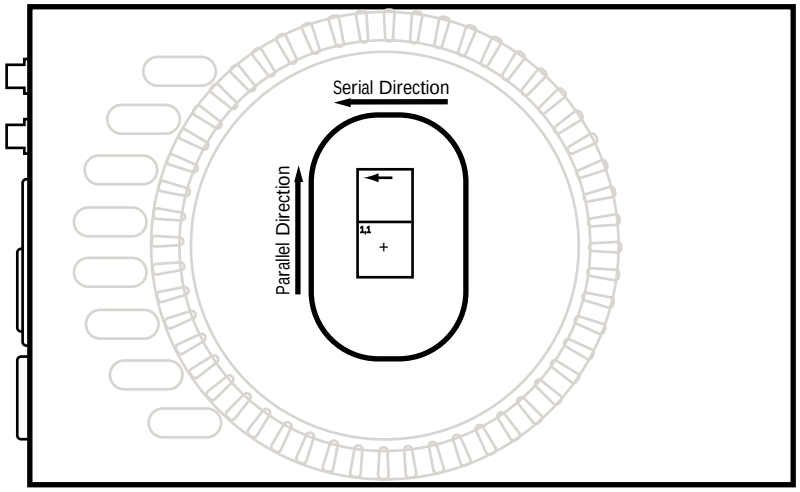
3 MHz					
Detection Mode	**Gain Setting**	**Relative Gain**	**Typical Noise**	**System Gain**	**Typical Maximum ADC Signal**
High Signal to Noise	1	≈1/2x	55e⁻	≈60e⁻/ADU	400Ke⁻ (binned full well*)
High Dynamic Range	2	≈1x	52e⁻	≈30e⁻/ADU	200Ke⁻ (single pixel full well)
High Sensitivity	3	≈4x	16e⁻	≈7.5e⁻/ADU	50Ke⁻ (high sensitivity)
* Binning must be a minimum of 2 pixels in the parallel and serial direction to reach the maximum ADC signal.					



Typical QE Curve (not installed in camera)

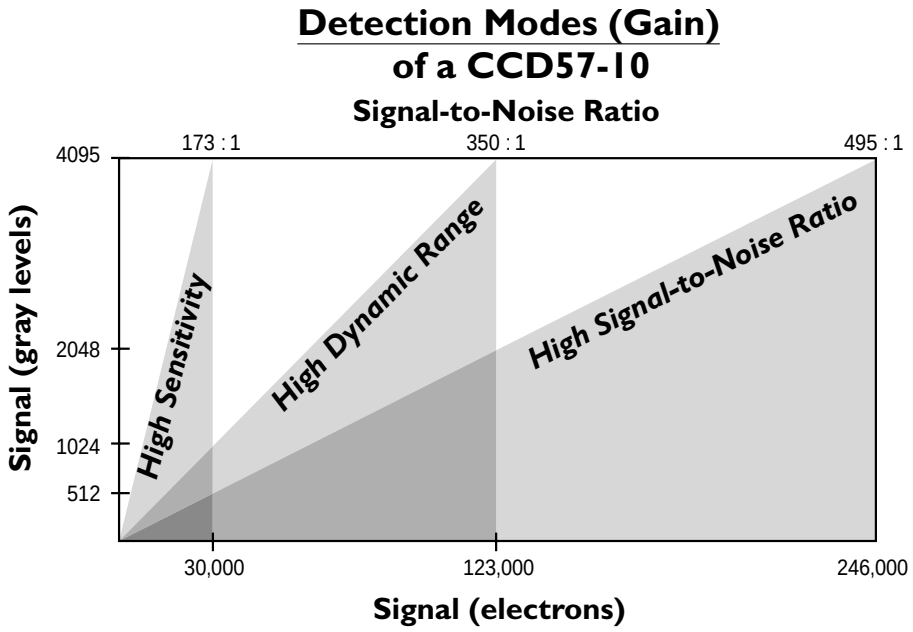
QE response in the 200-400 nm range can be enhanced with Photometrics' proprietary Metachrome II coating.

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Camera Front View — CCD57-10 Orientation

The CCD57-10 is a back-illuminated, frame-transfer device, with a single storage array equal to one half the total size of the CCD. Frame-transfer devices shift the image from an image array to a storage array. The image array then recollects light while the image is read out of the storage array. This process limits the minimum exposure time to the time it takes to read out an image. In a sequence, the exposure time starts after the previous frame has been read out. See the *Advanced Camera Operation Manual* for a general description of frame-transfer devices.



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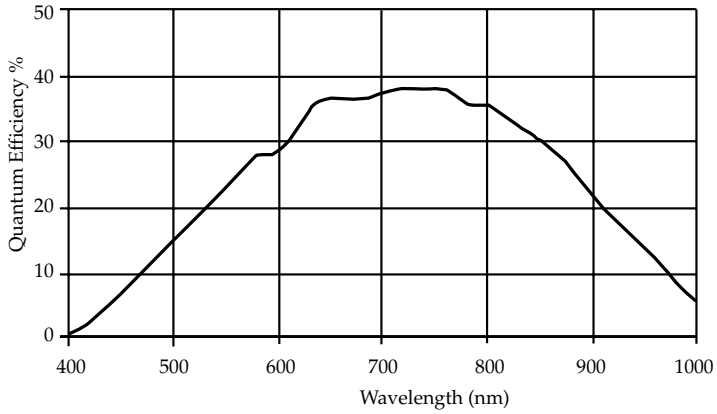
TH 7899M CCD

The following specifications are for a typical TH 7899M CCD. The actual measurements for your camera are listed on the Certificate of Performance that was shipped with your camera.

CCD Specifications	
H x V	2048 x 2072
Pixel Size	14 µm x 14 µm

3 MHz					
Detection Mode	**Gain Setting**	**Relative Gain**	**Typical Noise**	**System Gain**	**Typical Maximum ADC Signal**
High Signal to Noise	1	≈1x	47e⁻	≈58e⁻/ADU	237Ke⁻ (high signal to noise)
High Dynamic Range	2	≈2x	27e⁻	≈28e⁻/ADU	114Ke⁻ (high dynamic range)
High Sensitivity	3	≈4x	20e⁻	≈14e⁻/ADU	57Ke⁻ (high sensitivity)

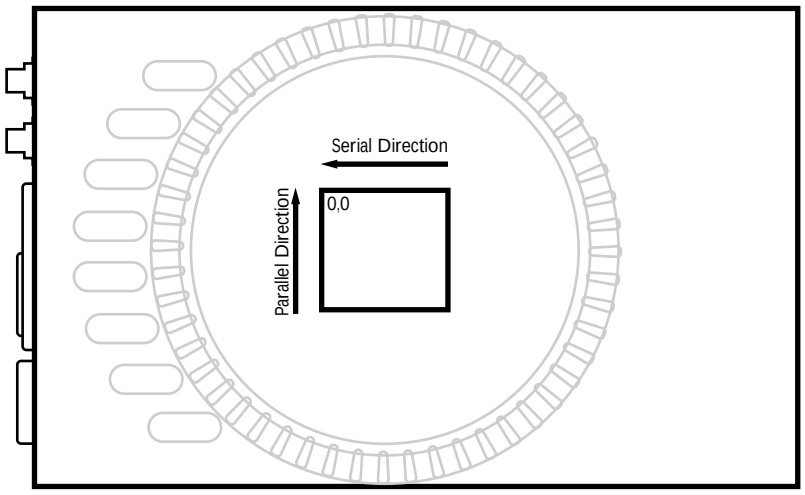
5 MHz					
Detection Mode	**Gain Setting**	**Relative Gain**	**Typical Noise**	**System Gain**	**Typical Maximum ADC Signal**
High Signal to Noise	1	≈1x	55e⁻	≈60e⁻/ADU	245Ke⁻ (high signal to noise)
High Dynamic Range	2	≈2x	35e⁻	≈30e⁻/ADU	122Ke⁻ (high dynamic range)
High Sensitivity	3	≈4x	30e⁻	≈15e⁻/ADU	61Ke⁻ (high sensitivity)



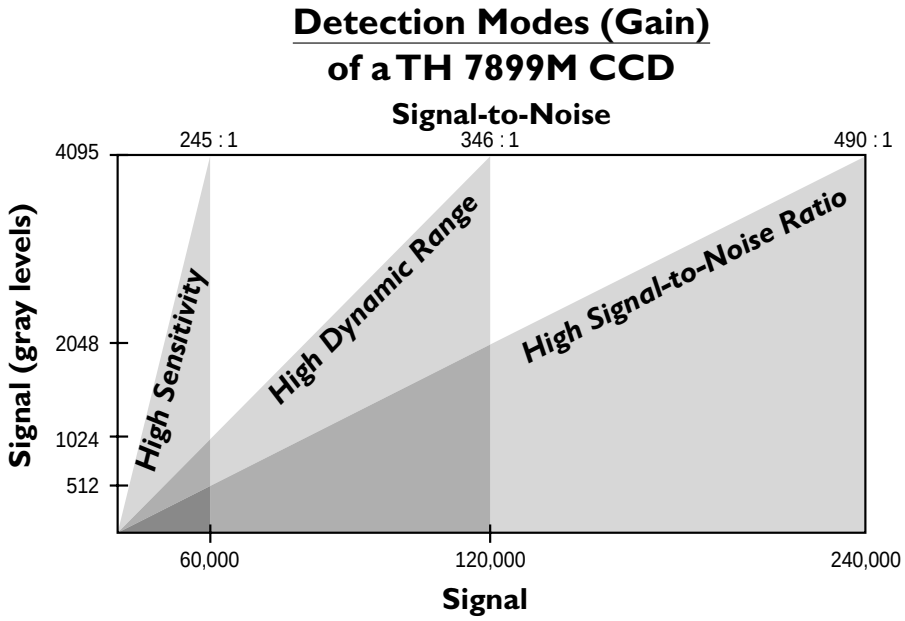
Typical QE Curve (not installed in camera)

QE response in the 200-400 nm range can be enhanced with Photometrics' proprietary Metachrome II coating.

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Camera Front View — TH 7899M CCD Orientation



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Appendix A Trigger Modes

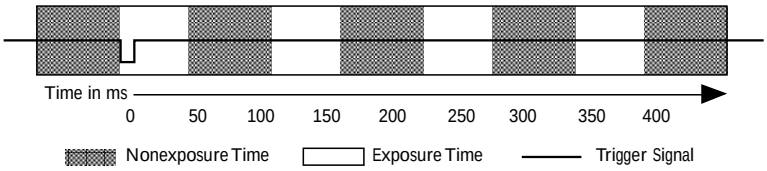
Quantix offers several methods of integration with external trigger sources, such as delay generators or laser pretriggers. The camera has a 9-pin, D-subminiature connector on the back for trigger-in and various TTL input and output operations (see page 42 for the pinout specifications).

In the default mode, the camera triggers on the falling edge of a TTL signal. To invert the triggering polarity, the "Trigger Invert" must be grounded. The minimum trigger pulse width is 1.1 µsec.

The Quantix camera supports the following trigger modes: Trigger-First, Strobe, and Bulb. These modes are described in the paragraphs that follow.

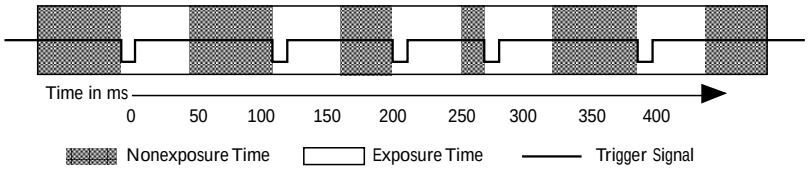
Trigger-First Mode

In this mode, the camera requires only one trigger to acquire a sequence of frames. Each frame is exposed for a length of time entered into the software and read out. Once the trigger is received, the camera is inhibited from taking any further triggers until the entire sequence is completed (see diagram below).



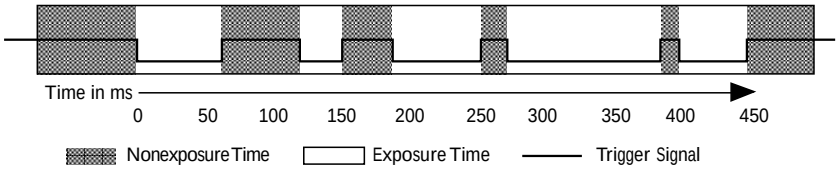
Strobe Mode

In this mode, each frame in a sequence requires a trigger. Each frame is exposed for a length of time entered into the software and is then read out. If the trigger arrives during the exposure-readout of the previous frame, it is ignored (see diagram below). For a sequence of one frame, strobe mode and trigger-first mode are the same.



Bulb Mode

In this mode, exposure time for each frame is determined by the trigger pulse width. Exposure time entered into the software is not used in this mode (see diagram below).



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