DeltaVision OMX®

Operating Instructions

Original Instructions

Revision A

applied precision

A GE Healthcare Company

Legal Notices

DeltaVision OMX Operating Instructions. PN 04-720174-000, Revision A

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Contents

1 Introduction

Purpose of the Operating Instructions

The Operating Instructions provide you with the instructions needed to use the DeltaVision OMX Imaging System in a safe way.

Prerequisites

In order to operate the DeltaVision OMX safely and according to the intended purpose, the following prerequisites must be met:

- You should have a general understanding of the use of a personal computer running Microsoft® Windows® in the version provided with your product.
- You should be acquainted with the use of general laboratory equipment and with handling of biological materials.
- You must read “Chapter 2: Safety Instructions” of these Operating Instructions.
- The system should be installed according to the instructions in “Chapter 3: Installation” of these Operating Instructions.

In this chapter

This chapter contains important user information and a general description of the DeltaVision OMX and its intended use.

1.1 Important user information

Read this before using the DeltaVision OMX Imaging System

All users must read the Safety Instructions in *Chapter 2: Safety Instructions* of these Operating Instructions before installing, using or maintaining the system.

Do not operate the DeltaVision OMX in any other way than described in this user documentation. If you do, you may be exposed to hazards that can lead to personal injury and you may cause damage to the equipment.

Intended use

Use of the DeltaVision OMX assumes that you are familiar with the basics of fluorescence microscopy. In addition, an understanding of image processing basics will help you use the system to its full potential. To manage the computer systems, some familiarity with Linux workstations and Windows-based personal computers is helpful.

Safety notices

These Operating Instructions contain WARNINGS, CAUTIONS and NOTICES concerning the use of the product, with meanings as defined below.

WARNING
WARNING indicates a hazardous situation which, if not avoided, could result in serious personal injury. It is important not to proceed until all stated conditions are met and clearly understood.

CAUTION
CAUTION indicates a hazardous situation which, if not avoided, could result in potential damage to the equipment or software. It is important not to proceed until all stated conditions are met and clearly understood.

WARNING: RADIATION
WARNING: RADIATION indicates a hazardous situation which, if not avoided, could result is serious personal injury due to hazardous radiation. Do not proceed until all stated condition are met and clearly understood.

Notes and tips

Note: *A Note is used to indicate information that is important for trouble-free and optimal use of the product.*

Tip: *A Tip contains useful information that can improve or optimize your procedures.*

Typographical conventions

Software texts and commands are identified by **bold** text. A vertical bar is used to separate menu levels (e.g., **File | Open** refers to the **Open** option in the **File** menu).

1.2 Regulatory information

This section lists the directives and standards that are fulfilled by the DeltaVision OMX Imaging System.

Manufacturing information

Requirement	Content
Name and address of manufacturer	Applied Precision | A GE Healthcare Company 1040 12th Avenue Northwest Issaquah, WA 98027 USA
Place and date of declaration	Issaquah, WA, May 2011
Identity of person authorized to sign Declaration of Conformity	See CE Declaration of Conformity

CE Conformity

Directive	Title
2006/95/EC	Low Voltage Directive (LVD)
2004/108/EC	ElectroMagnetic Compatibility (EMC) Directive

International standards

Standard	Description	Notes
EN 61010-1, IEC 61010-1, CAN/CSA-C22.2 no. 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use	
EN 61326-1:2006	EMC emissions and immunity requirements for measurement, control and laboratory use	CISPR 11: 2009+ IEC 61000-4
EN-ISO 12100-1, 12100-2	Safety of machinery - Basic concepts, general principles for design	Harmonized with 2006/42/EC
EN-ISO 14121-1, 14121-2	Safety of machinery - Principles of risk assessment	Harmonized with 2006/42/EC
EN60825-1 2007, 2nd edition IEC60825-1 2007, 2nd edition	Safety of Laser Products - Base standard for safety of laser products	

CE marking

CE

The CE marking and the corresponding Declaration of Conformity is valid for the instrument when it is:

- used as a stand-alone unit, or
- connected to other CE-marked instruments, or
- connected to other products recommended or described in the user documentation, and
- used in the same state as it was delivered from Applied Precision, except for alterations described in the user documentation or explicitly authorized by Applied Precision.

Regulatory compliance of connected equipment

Any equipment connected to the DeltaVision OMX should meet the safety requirements of EN 61010-1/IEC61010-1 or relevant harmonized standards. Within the European Union, connected equipment must be CE-marked.

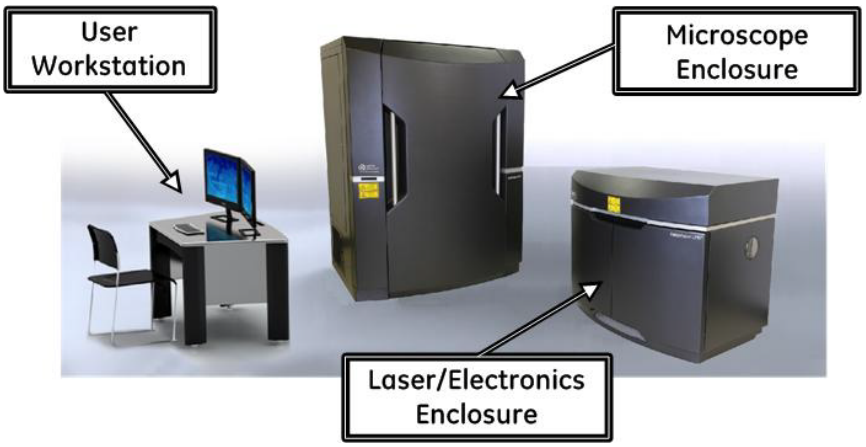
1.3 Instrument Hardware

The DeltaVision OMX Imaging System will often take up a small room. It consists of three major subsystems:

- a Laser/Electronics Enclosure
- a Microscope Enclosure
- and the User Workstation.

Main System Components

The following figure illustrates the system's most significant hardware components.



Main Components of the DeltaVision OMX

Laser/Electronics Enclosure

The Laser/Electronics Enclosure houses the laser heads and the optics that prepare the beams for delivery to the Microscope Enclosure. The optics include reflective notch filters for combining the beams and ND filters for adjusting the power level of the beams. Fast shutters control the exposures. The laser heads and attendant optics are all mounted on an optical table. As the user does not require access to these components, the work surface of this table is encased in a protective housing and secured for laser safety.

The lasers are all continuous wave lasers. All lasers can be used at the same time, so the maximum laser power available is the sum of all the individual laser powers.

Laser power supplies and controllers are rack-mounted in the cabinet beneath the Laser Table.

The Laser/Electronics Enclosure cabinet contains:

- Camera PCs
- DeltaVision OMX Instrument Controller (OMXIC)
- OMXIC PC
- Nanomotion 3 Chassis
- Piezo Controller for Z axis
- Primary and Secondary Laser Control Modules
- Network Switch
- System Power Supply
- Autofocus Hardware Board (for focus assist)

Generally, the Primary Laser Control Module houses the power and controllers for the 405nm, 445nm, and 488nm lasers, as well as the safety interlock and indicator light controls. If purchased with your system, the Secondary Laser Control Module houses additional lasers. No radiation is emitted from the cabinet.

Microscope Enclosure

The laser fibers deliver the beam to the Microscope Enclosure, which consists of an illumination system, high-speed cameras, and microscope housed within a protective enclosure. This enclosure is not easily moved, so it is very important to determine a permanent location for it before setting up the DeltaVision OMX system.

Optics guide the light into the microscope. The microscope is custom-designed for the DeltaVision OMX and includes:

- An objective lens to focus the light on the sample.
- A stage to hold the sample and move it to precise locations.
- One or more cameras to capture the fluorescent light emitted from the dyes.
- User-changeable (via the system software) polychroic drawers to guide the light or separate it into various channels.
- Emission filter wheels (depending on camera configuration)

Open laser beams are accessible at the illumination system and microscope. These include both collimated beams and light that is strongly divergent after it has passed through the objective (included angles of over 90 degrees). The entire microscope assembly is encased in a protective enclosure. Besides laser safety, this also provides a dark and dust-free environment for the system to function at peak performance. User access to the microscope and into the protective enclosure is through the big front door. This door is interlocked so that laser light cannot exit when the door is opened.

There are also service-only access doors on each side of the Microscope Enclosure. These doors are locked at all times except during service. *Users should not open these service doors at any time!*

Ionizing Air Gun

The TopGun™ ionizing air gun is included with the DeltaVision OMX system (attached to either the wall of the room or to the Microscope Enclosure) to provide an efficient method of cleaning system optics while simultaneously decreasing static charge.

WARNING
Always wear appropriate eye protection to keep your eyes safe from flying debris that may be disturbed by the air gun.

WARNING
The air gun should be used only as directed for cleaning. The air gun is not designed for any other purpose.

All functionality is built into the gun, including a flow control value for adjusting the airflow, a balance adjustment for calibration, and a two-level LED. The air gun has a filter at its exit to ensure that out-flowing air is clean.

User Workstation

The User Workstation is a computer desk and two computers from which the operator controls the DeltaVision OMX Imaging System. One computer runs software that controls hardware operation and image acquisition, while the other computer runs software that manages various post-imaging processing activities. The User Workstation is outside all protective housings, and no access to the beam is required to operate the DeltaVision OMX Imaging System from the workstation.

1.4 Control software

As described in the previous section, the DeltaVision OMX is controlled through the User Workstation, which consists of two computers. One of these computers controls all aspects of hardware operation and image acquisition, including stage motion, imaging, modes of operation, laser selection, and power. The other computer runs software that manages various post-imaging processing activities, such as deconvolution and reconstruction, calibration, animation, and storage. This software is described in additional detail throughout this book.

2 Safety Instructions

This chapter describes safety compliance, safety labels, general safety precautions, emergency procedures, power failure, and recycling of the DeltaVision OMX Imaging System.

2.1 Safety precautions

Before operating or maintaining the system, you must be aware of the hazards described in the user documentation. Follow these instructions carefully to avoid personal injury or damage to the equipment.

Introduction

The safety precautions in this section are grouped into the following categories:

- General Precautions
- DeltaVision OMX Lasers
- Laser Interlocks
- Safety Labeling
- Proper System Component Placement
- Chemical Safety
- Safety Goggles
- Wiring Diagram - Safety Interlock

General precautions

General precautions are described in the following warning statements.

WARNING
The operator of the DeltaVision OMX is assumed to be trained in the correct operation of the instrument and the safety issues associated with using the system.

WARNING
Using controls, making adjustments, or performing procedures other than those specified in these DeltaVision OMX Operating Instructions can result in hazardous exposure to high voltage or moving parts. Exposure to these hazards can cause severe personal injury.

2.2 DeltaVision OMX Lasers

The DeltaVision OMX Imaging System is a Class I laser system. No access to laser radiation is permitted during operation or maintenance. During service, however, Class IV radiation is accessible.

WARNING
Due to the potential for personal injury, particularly to the eyes, service on the DeltaVision OMX Imaging System should ONLY be performed by Applied Precision personnel or persons trained by Applied Precision specifically for this purpose. *Unauthorized service by any other personnel may violate the warranty.*

This section describes the lasers and associated radiation accessible during service. Note that all beams are continuous wave.

405nm laser - Vortran

The Vortran Stradus™ 405nm laser is a state-of-the-art diode laser from Vortran Laser Technology, Inc. Maximum power output is 100mW.

488nm laser - Coherent
568nm laser - Coherent
514nm laser - Coherent

The 488nm, 568nm, and 514nm lasers are optically pumped, frequency-doubled VECSEL (vertical external cavity surface emitting lasers). Semiconductor lasers at 808nm pump quantum well structures to emit at 976nm, which is frequency-doubled in an external cavity with a non-linear crystal to produce 488nm, 568nm, or 514nm. In a standard system configuration, the maximum power output for these lasers is 100mW.

Other fiber lasers - Vortran, Omicron & MPB

Three other lasers are also available for the DeltaVision OMX:

- 445nm, 100mW, Omicron LuxX®, Omicron Laserage Laserproduckte GmbH
- 642nm, 110mW, Vortran Stradus™, Vortran Laser Technology, Inc.
- 642nm, 300mW, MPB Communications

The visible light from each of these optional fiber lasers is emitted by a frequency-doubling crystal. The light source for the crystal is an optically pumped, proprietary, doped fiber. The desired IR wavelength is produced by stimulated Raman scattering and selected by Bragg gratings etched into the fiber.

Note: *The DeltaVision OMX system can support a maximum of six lasers.*

2.3 Laser Interlocks

The safety interlock system on the DeltaVision OMX Imaging System is designed to promote safe operation and service. The Class 1 system includes a protective housing that must be accessed for maintenance. In addition, the enclosures must be opened and the lasers enabled during service. Both enclosures include a safety interlock and both interlocks are activated by switches on the front door of the Microscope Enclosure.

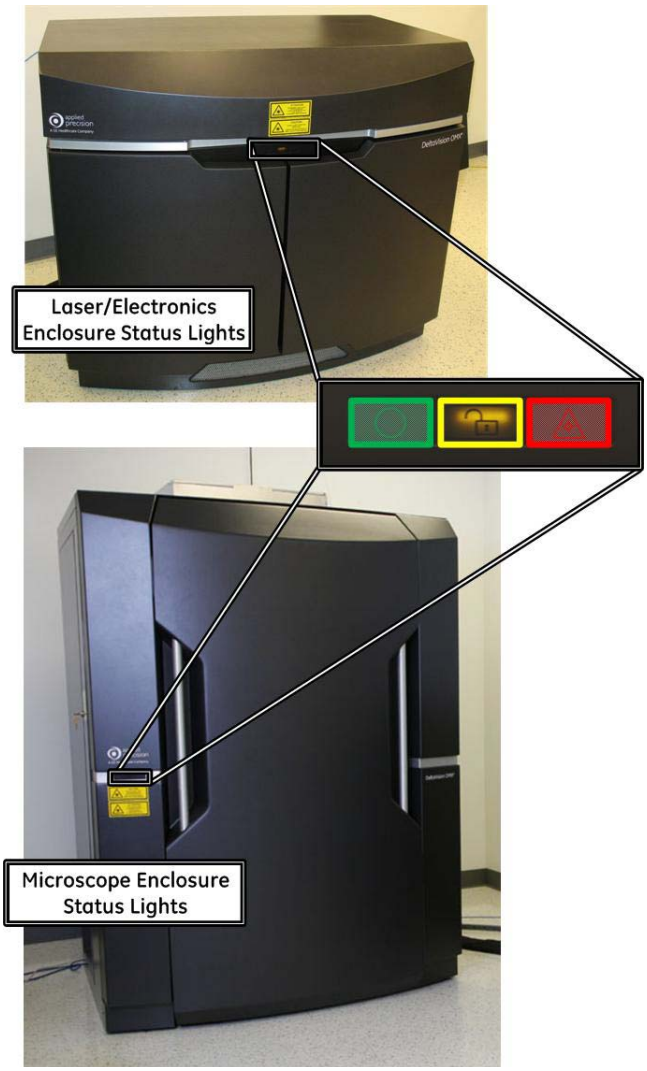
The interlock in the Microscope Enclosure is located on the UltimateFocus™ Module. It is activated when a switch on the front door of the Microscope Enclosure indicates that the door is open.

The interlock in the Laser/Electronics Enclosure is located on the laser table. (The laser table lid is bolted down during normal system operation to protect the user from the lasers.) The laser table safety interlock is open during normal operation. Two conditions can interrupt the current to the interlock, which closes the shutter and blocks all laser radiation:

- The door on the Microscope Enclosure is opened. A switch on the enclosure door senses this condition.
- The key switch on the Primary Laser Control Module is switched off. This permits service personnel additional control over laser operation, particularly when working within the Laser/Electronics Enclosure.

All of the circuitry in the interlock circuit is redundant and/or fail-safe to comply with safety requirements.

The interlock system also controls status indicator lights located on both the Laser/Electronics and Microscope Enclosures.



Laser/Electronics Enclosure Status Lights

The various colors indicate the following system status:

- GREEN - lasers are OFF.
- AMBER - laser power is ON and safety shutter is closed. No laser light can get through to the Microscope Enclosure.
- RED - lasers are ON and safety shutter is open. Laser light can get through to the Microscope Enclosure.

Refer to the figure titled “Wiring Diagram - Safety Interlock” at the end of this chapter to view a simplified view of the wiring for the safety interlock.

2.4 Safety Labeling

The following sections list and illustrate the laser safety labels attached at various locations to the DeltaVision OMX Imaging system.

Applied Precision labels

Safety Labels #1/English and #2/French (5 X 2") are attached to the front and back of the Laser/Electronics Enclosure. (Total locations: TWO)

Laser Safety Labels #1/English and #2/French on the Laser/Electronics Enclosure

Safety Labels # 3/English and #4/French (5 X 2") are attached to the front panel of the Microscope Enclosure, directly below the status indicator light panel, as shown in the following figure. They are also located on each of the two side access doors (by the locks) and on the back of the Microscope Enclosure. (Total locations: FOUR)

Laser Safety Labels #3/English and $4/French on the Microscope Enclosure

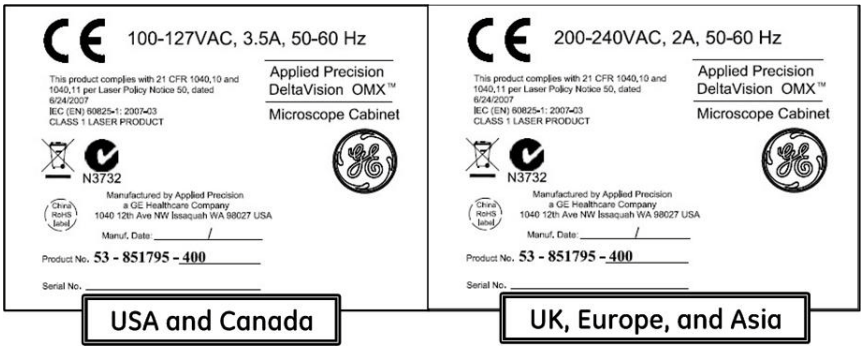
The following CE label (4 X 2.88"), containing system specific information, is attached to the side panel of the Laser\Electronics Enclosure, directly above the vent (as shown).

CE Label Location - Laser/Electronics Enclosure (side panel, above vent

The following CE label (4 X 2.88"), containing specific system information, is attached to the back of the Microscope Enclosure cabinet (as shown).

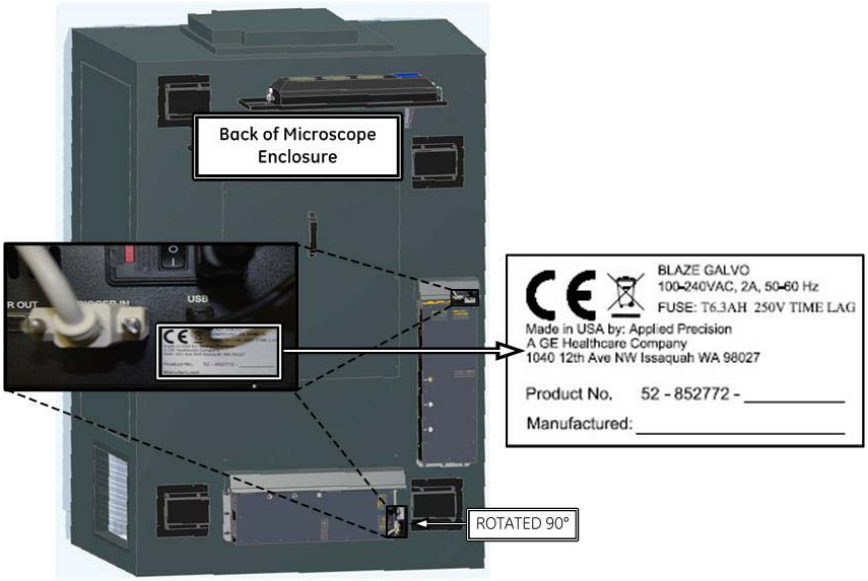
CE Label Location - Microscope Enclosure (rear view)

The Microscope Enclosure's CE label will be slightly different for installations in the UK, Europe, and Asia, as shown in the following figure.



Microscope Enclosure CE Label Varies Depending on Geographic Location

The following CE label (2.25 X 1.2"), containing system specific information regarding the galvos, is located in two places — on the control panels of each of the two galvo boxes mounted on the rear of the Microscope Enclosure, below the power switch for each box (as shown).



CE Label Location - Rear of Microscope Enclosure on Control Panel of Galvo Boxes

Fiber optic cable routing safety label

The following label is attached to the conduit that runs between the Laser/Electronics Enclosure and the Microscope Enclosure.

Fiber Optic Cable Routing Label

Low Clearance Label

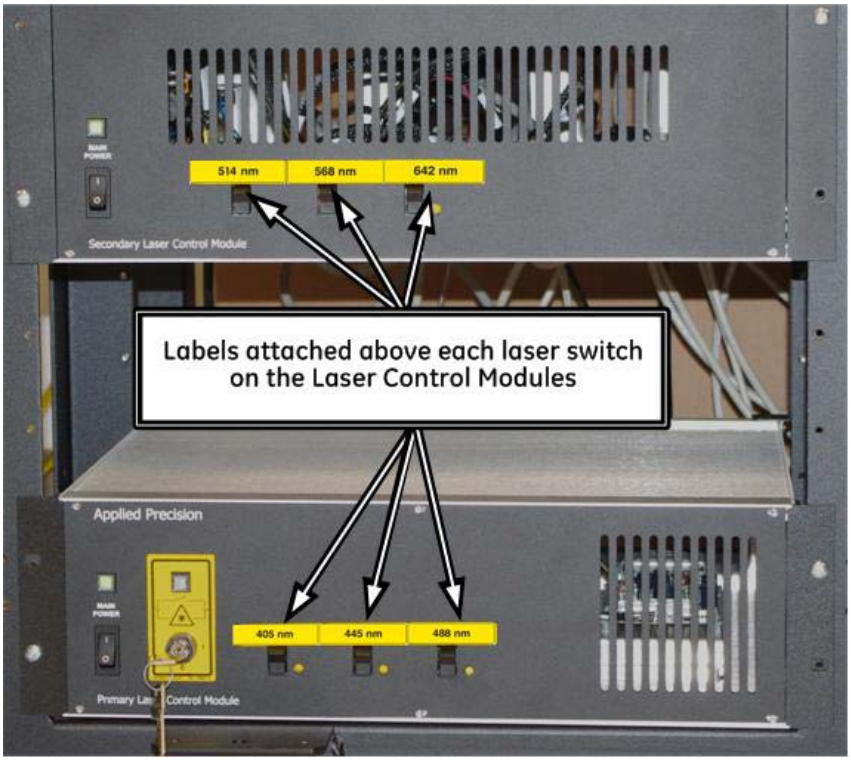
The triangular low clearance label is attached to the front panel and both side panels of the HEPA filter assembly located on the top of the Microscope Enclosure. These labels are only seen when the front and/or side doors of the Microscope Enclosure are open.

HEPA Filter (top of Microscope Enclosure) and Low Clearance Label

Individual laser switch labels

The following labels (2.0 X 0.5") are attached (as appropriate) above the individual laser switches on the Primary and Secondary Laser Control Modules (inside the Laser/ Electronics Enclosure cabinet). The labels applied will depend on which optional lasers are included in the system.

Laser Switch Labels (for specific lasers)



Laser Switch Label Locations (6 Lasers Maximum)

2.5 Proper System Component Placement

Recommendations in this section, regarding the appropriate placement of the system's power cabling and liquid cooling components, must be followed in order to minimize the risk of personal injury.

Power cables

DeltaVision OMX power cabling should always be arranged so that all system power can be easily and quickly disconnected in the event of an emergency.

Camera coolers

To reduce heat within the Microscope Enclosure cabinet and minimize the risk of electrical hazards, the camera coolers are located on shelves attached to the rear panel of the Microscope Enclosure.

Proper Placement of Camera Coolers

2.6 Chemical Safety

WARNING
Propylene Glycol (antifreeze/coolant) is a hazardous substance. Use caution when handling this chemical and adhere to the recommendations listed in this section and in the Material Safety Data Sheet (MSDS) handbook at your facility.

- Do not drink antifreeze or solution.
- Avoid eye and prolonged or repeated skin contact.
- Avoid breathing vapors or mists.
- Wash exposed skin thoroughly with soap and water after use.
- Do not store in opened or unlabeled containers.
- Keep container away from open flames and excessive heat.
- Do not reuse empty containers unless properly cleaned.
- Empty containers retain product residue and may be dangerous.
- Do not cut, weld, drill, etc. containers, even when empty.

Sudden release of hot organic chemical vapors or mists from process equipment operating at elevated temperature and pressure, or sudden ingress of air into vacuum equipment, may result in ignitions without any obvious ignition sources. Published "autoignition" or "ignition" temperatures cannot be treated as safe operating temperatures in chemical processes without analysis of the actual process conditions. Use of this product in elevated temperature applications should be thoroughly evaluated to assure safe operating conditions.

For complete MSDS information on the coolant provided with the DeltaVision OMX:

a) In your web browser, navigate to http://www.koolance.com.

b) Type “liq-702” into the Search field on the Koolance home page and press Enter on your keyboard.

c) In the displayed product list, click “Liquid Coolant Bottle, High-Performance, 700mL (UV Yellow).”

d) Click the **Manual** button to display the Koolance MSDS for the product.

2.7 Safety Goggles

Because the DeltaVision OMX is a Class 1 safety system, you are not required to wear safety goggles during regular system use. If, however, at any point the safety interlock is defeated (for example, while the system is being serviced), the appropriate safety goggles must be worn.

Safety goggles that protect your eyes from all laser wavelengths are the best type to use in a multi-laser environment. These may be difficult to obtain, so the next best practice is to be absolutely certain you wear the correct safety goggles for each laser type being used.

2.8 Emergency Procedures

This section describes how to perform an emergency shutdown of the DeltaVision OMX. It also describes what to do in the event of a power failure.

Emergency shutdown procedure

In an emergency situation, complete the following steps to shut down the system.

1 Turn off the key switch (located on the electronics rack in the Laser/Electronics Enclosure) for the interlock that disables the laser safety shutter.

2 Turn off all lasers.

3 Disconnect all system power cables from the power receptacles.

Power failure

In the event of a power failure, complete the following steps.

1 Turn off the key switch (located on the electronics rack in the Laser/Electronics Enclosure) for the interlock that disables the laser safety shutter.

2 Turn off all lasers.

3 Turn off the main power switch located in the upper-left corner of the electronics rack.

2.9 Recycling Procedures

The equipment shall be decontaminated before decommissioning and all local regulations shall be followed with regard to scrapping of the equipment.

Disposal, general instructions

When taking a DeltaVision OMX out of service, the different materials must be separated and recycled according to national and local environmental regulations.

Recycling of hazardous substances

DeltaVision OMX uses hazardous substances. Detailed information is available from your local Applied Precision representative.

Disposal of waste materials

All materials used in the instrument must be disposed of in the manner prescribed by national and local environmental regulations.

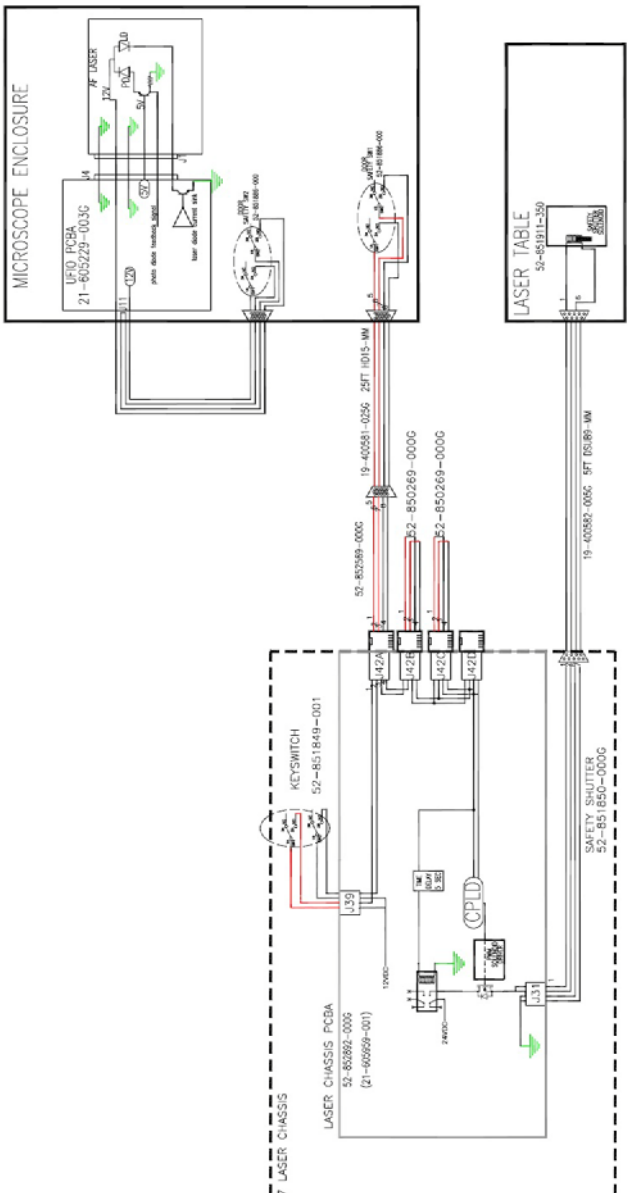
WARNING
Hazardous waste must be handled and disposed of properly.

Disposal of electrical components

Electrical and electronic equipment must not be disposed of as unsorted municipal waste and must be collected separately. Please contact an authorized representative of Applied Precision for information concerning the decommissioning of your equipment.

WARNING
The DeltaVision OMX Imaging System must not be disposed of as unsorted municipal waste and must be collected separately. Please contact an authorized representative of Applied Precision for information concerning the decommissioning of your equipment.

2.10 Wiring Diagram - Safety Interlocks



Wiring Diagram - Safety Interlocks

3 Installation

This chapter describes installation requirements for the DeltaVision OMX Imaging System, including site facility requirements, shipping container dimensions, and unpacking instructions.

3.1 Site Requirements

Parameter	Requirement
Electrical power	**Laser/Electronics Enclosure** – Primary AC Connection — 208V, single phase 20A 50-60Hz branch circuit (US/Canada), with enclosure rated 10A *or* — 230V, single phase 16 A 50-60Hz branch circuit (UK, Europe, and Asia), with enclosure rated 15A. 208V outlet located within 8 ft (2.5m) of Laser/Electronics Enclosure). NEMA L6-20P Plug (US, Canada, Japan, and other 110-120 V countries). EN60309 (332P6) 20 A rated plug (EU and other 220-240 V countries). **Microscope Enclosure** – Additional AC Connection — 100-127 V, single phase 15 or 20 A 50-60Hz branch circuit (US/Canada), with enclosure rated 10A, with NEMA Type 5-15P plug *or* — 200-240 V, single phase min 10 A 50-60Hz branch circuit (UK, Europe, and Asia), with enclosure rated 10 A, with standard minimum 10 A plug (appliance coupler with detachable power cord). **Workstations** – Additional AC Connection — 100-127 V, single phase 15 or 20 A 50-60Hz branch circuit (US/Canada), with enclosure rated 10A, with NEMA Type 5-15P plug *or* — 200-240 V, single phase min 10A 50-60Hz branch circuit (UK, Europe, and Asia), with enclosure rated 10 A, with standard minimum 10 A plug (appliance coupler with detachable power cord). Total power consumption estimated at 2 kW. Branch circuit protection: Cat II.

Parameter	Requirement
Approximate Minimum Room Size and Layout	220 sq ft (24 m2) - with a minimum wall width of 12 ft (3.66 m) for the Microscope Enclosure. 8 ft (2.5 m) minimum ceiling clearance. Microscope Enclosure to be located within 8 ft (2.5m) of the Laser/Electronics Enclosure. **IMPORTANT** Once the system has been installed, it is not meant to be lifted or moved. If it must be moved, contact Applied Precision for instructions.
Temperature	Operating temperature: Stable from 66-74°F (18-22°C). Fluctuation Rate: No more than +/- 2°C over four hours with an hourly variation of no more than 1°C. Fluctuations may introduce alignment drift into system.
Humidity	Stable under 50% (non-condensing).
Dry, clean air or nitrogen lines	Regulated at 50 PSI (345 kPa)@4.2CFM for de-ionized clean gun supplied with system. Regulated with pressure up to 80 PSI (550 kPa)@4CFM for table in Microscope Enclosure.

3.2 Transport

The DeltaVision OMX is shipped in five crates. Crate sizes and weights are described in the following tables. If installation requires an elevator, ensure that it is rated to carry the following weights.

Important Notes:
#1 *These crates are not waterproof and should not be stored outside.*
#2 *Size and weight measurements in the following table are approximate and may vary depending on system configuration.*

Crate #	Size	Weight
1 Microscope Table	44 x 38 x 62 inches (112 x 97 x 158 cm)	764 lbs (347 kgs)
2 Front Enclosure (Microscope)	64 x 36 x 82 inches (163 x 92 x 208 cm)	414 lbs (188 kgs)
3 Rear Enclosure (Microscope)	58 x 42 x 82 inches (147 x 107 x 208 cm)	776 lbs (352 kgs)
4 Laser Table and Enclosure	62 x 42 x 57 inches (158 x 107 x 145 cm)	917 lbs (416 kgs)

Crate #	Size	Weight
5 Workstation Table	64 x 42 x 70 inches (158 x 107 x 178 cm)	674 lbs (306 kgs)

A forklift or pallet jack capable of carrying up to 917 lbs (416 kgs) is required when moving the system while it is packed in its original crates.

If the system is purchased with the optional PersonalDV, an additional crate will be delivered. This crate will have one of the following specifications, depending on whether the PersonalDV is configured with or without the optional Weather Station.

Crate #	Size	Weight
PersonalDV	44 x 40 x 53 inches (112 x 102 x 135 cm)	555 lbs (252 kgs)
PersonalDV (with Weather Station)	57 x 38 x 55 inches (145 x 97 x 140 cm)	612 lbs (278 kgs)

3.3 Unpacking

CAUTION
An authorized Applied Precision representative must unpack and install the DeltaVision OMX system. Do NOT attempt to unpack the system on your own. Unpacking of the system by any person not authorized by Applied Precision may void the warranty!

When you receive the shipment, perform the following inspections:

- Check the packaging for any apparent damage.
- Inspect the Shock Watch and Tilt Sensors located on the crates. Note if any of the sensors have been tripped, but do not reject the system at this time.
- Document any damage carefully and contact Applied Precision Customer Service.

Uncrating the System

CAUTION
An authorized Applied Precision representative must unpack and install the DeltaVision OMX system. Do NOT attempt to unpack the system on your own. Unpacking of the system by any person not authorized by Applied Precision may void the warranty!

A staging area (either a large hallway or nearby room) will be necessary during installation.

Due to the size of some of the DeltaVision OMX components, moving them up or down stairs is not possible. If an elevator is not available at the installation facility, please contact Applied Precision and discuss options for installing the equipment.

Applied Precision may require customer assistance during the installation and setup process; if customer assistance cannot be provided, installation and subsequent service calls may be delayed and/or rescheduled.

Connections

Facility connections:

- One CAT5 cable for the network connection
- 3 AC branch circuits (1 for the Laser/Electronics Enclosure, 1 for the Microscope Enclosure, and 1 for the workstations)
- 6 mm (1/4 in) OD nylon or polyurethane tubing to air/nitrogen line
- 6 mm (1/4 in) OD nylon or polyurethane tubing to premixed CO_2 for Live Cell Systems

Internet access:

- Internet access is required for licensing and remote access.
- An appropriate length CAT5 cable is required to connect the system to the local facility's network.

3.4 Spare Parts and Accessories

For up-to-date information on spare parts and accessories, visit:

www.appliedprecision.com

4 Operation

This chapter describes the procedures required to operate the DeltaVision OMX system. It begins by describing the most basic operations required to operate the system, such as startup/shutdown, loading a sample, and replacing the dichroic drawer. These procedures are then followed by sections that describe the simplest acquisition and analysis procedures. For additional information regarding these procedures, refer to the standard DeltaVision OMX User Guide.

4.1 Basic Operations

The DeltaVision OMX Imaging System is a Class I laser system. No access to laser radiation is permitted during operation or basic maintenance procedures.

WARNING: RADIATION
Use of controls or performance of procedures other than those specified in this document may result in hazardous radiation exposure.

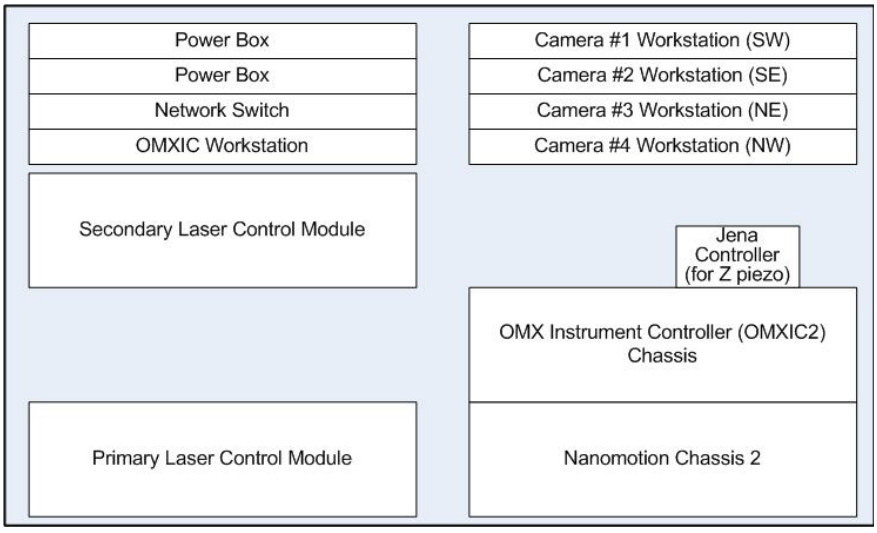
During service, however, Class IV radiation is accessible.

WARNING: RADIATION
Due to the potential for exposure to hazardous radiation, service on the DeltaVision OMX should ONLY be performed by Applied Precision personnel or by persons trained by Applied Precision specifically for this purpose. Unauthorized service by any other personnel may violate the warranty.

Electronics Rack

The Electronics Rack is located in the Laser/Electronics Enclosure, below the laser table. Many of the control switches used to start up and shut down the system are located on the components mounted in this rack. Refer to the following figures until you become familiar with the startup and shutdown procedures.

Electronics Rack - Photograph - Shown with Three Camera Workstations



Electronics Rack - Block Drawing - Shown with Four Camera Workstations

4.2 Startup/Shutdown

System Startup

1 Turn on the OMX Master Controller Windows Workstation (also called omxMaster).

User: <omxuser>
Password: <omxuser>

2 Turn on the OMX Image Processing Linux Workstation (also called omxSI).

User: <worx>
Password: <system id>

3 Turn on the camera cooler(s). Depending on the configuration of your system, there may be one or more coolers for the system cameras. The camera cooler(s) are located on shelves attached to the back panel of the Microscope Enclosure.

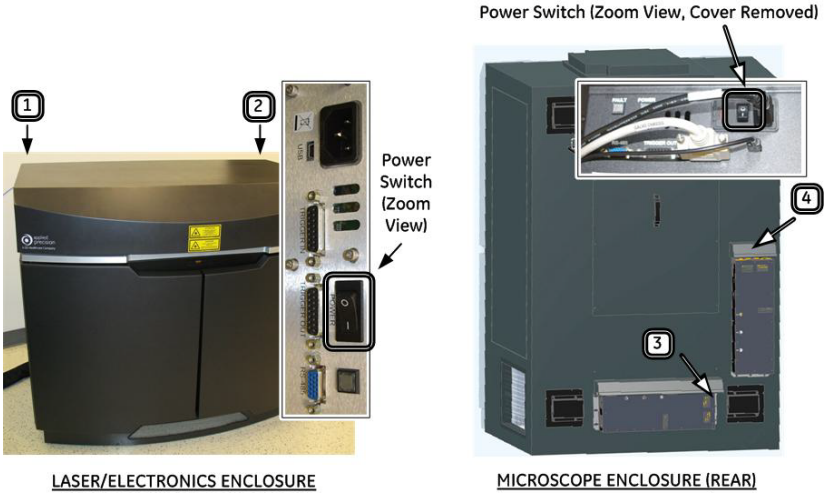
4 If necessary, turn on the power supplies for each camera. The PCO cameras do not have power supplies, but the Evolve cameras do. The Evolve camera power supplies are located on the floor outside of the Microscope Enclosure.

5 Turn on the cameras. The cameras are located inside of the Microscope Enclosure. Depending on the camera type installed on your system, the power switches will be located on either the back or top of the cameras.

6 On the electronics rack inside of the Laser/Electronics Enclosure, turn on the following:

- Main Power Switch (located on the top-left stack of electronics)
- OMXIC Workstation
- All Camera Workstations
- Nanomotion Chassis
- OMX Instrument Controller Chassis (OMXIC2)
- Primary Laser Control Module
- Secondary Laser Control Module (if installed)
- Jena Controller

7 Turn on the galvo controllers. Two galvo controllers are located on the back of the Microscope Enclosure and two are mounted on the sides of the laser table. The switches for the two mounted on the sides of the laser table are located on the back top left and back top right corners of the laser table.

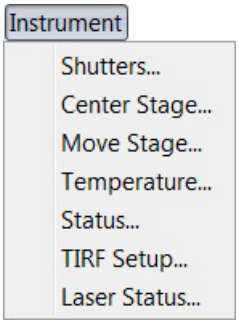


The Four Galvo Controller Power Switches

8 On omxMaster, click the DeltaVision OMX icon to open the software.

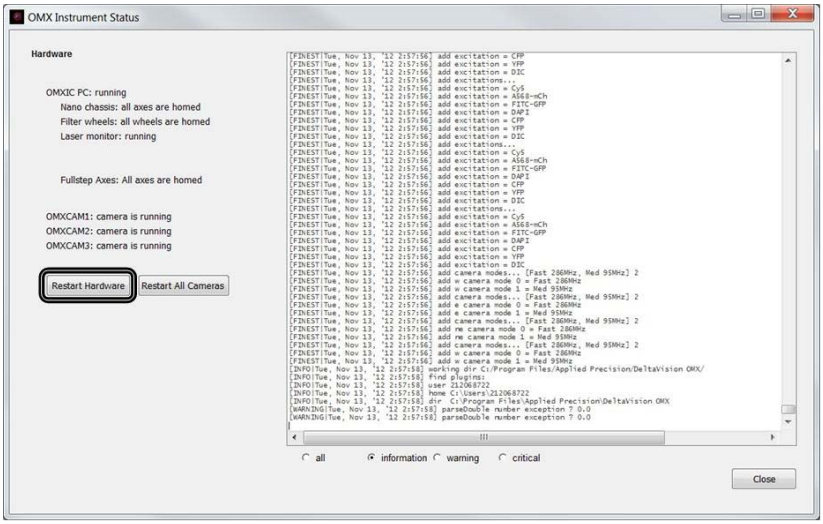
9 In the DeltaVision OMX software on omxMaster, click **Instrument | Status.**

Note: *If you just turned on the camera computers, wait for them to fully initialize (about five minutes) before you click the* ***Instrument | Status*** *command.*



Instrument Menu

The software will display the OMX Instrument Status dialog box.



OMX Instrument Status Dialog Box

10 In the OMX Instrument Status dialog box, click **Restart Hardware** to initialize the system hardware.

11 On the omxSI, click the Start softWoRx icon to open the softWoRx® Imaging Workstation software.

12 Once the hardware is fully initialized (about two minutes), the Status section of the main program window will change from displaying **HW: Restarting** to **HW: Running**.

13 In the OMX Instrument Status dialog box, click **Restart All Cameras** to initiate camera communication. Once the camera serial numbers have been reported in the logging section of the dialog box (about 30 seconds), the system will be ready to acquire images.

14 Turn on the lasers required for your experiments.

15 Turn on the key switch for the interlock that enables the laser safety shutter.

System Shutdown

1 Turn off the key switch for the interlock that disables the laser safety shutter.

2 Turn off any lasers that have been turned on.

3 On the electronics rack inside of the Laser/Electronics Enclosure, turn off the following:

- Jena Controller
- Secondary Laser Control Module (if installed)
- Primary Laser Control Module
- OMX Instrument Controller Chassis (OMXIC2)
- Nanomotion Chassis
- Two Galvo Controllers

4 In the DeltaVision OMX software on omxMaster, click **File | Quit**.

5 Use the Remote Desktop Connection folder shortcut on your desktop to remote into the OMXIC workstation.

User: <omxuser>
Password: <omxuser>

6 On omxMaster, use CTRL+ALT+END to display the Windows Security dialog box and then click **Shut Down...** to turn off the OMXIC workstation.

Note: *You must use CTRL+ALT+END to display the Windows Security dialog box for the OMXIC workstation, rather than CTRL+ALT+DELETE, which will display the Windows Security dialog for omxMaster.*

7 Repeat Steps 5 and 6 as needed to close each of the camera workstations.

8 Turn off the cameras.

9 If necessary, turn off the camera power supplies.

10 Turn off the camera cooler(s).

11 Turn off the two galvo controllers located on the back of the Microscope Enclosure.

12 Shut down omxMaster by clicking **Start** in the Windows task bar and then selecting the **Shut Down** command.

13 In the softWoRx® Imaging Workstation software on the omxSI workstation, click **File | Exit** and then click **OK** in the Question popup that asks "Are you sure?". The program will close.

14 Log out of and shut down the omxSI.

15 Turn off the main power switch located on the Laser/Electronics rack.

4.3 Loading a Sample onto the Slide Holder

1 Open the door to the Microscope Enclosure. The laser interlock will keep the safety shutter closed while the door to the enclosure is open.

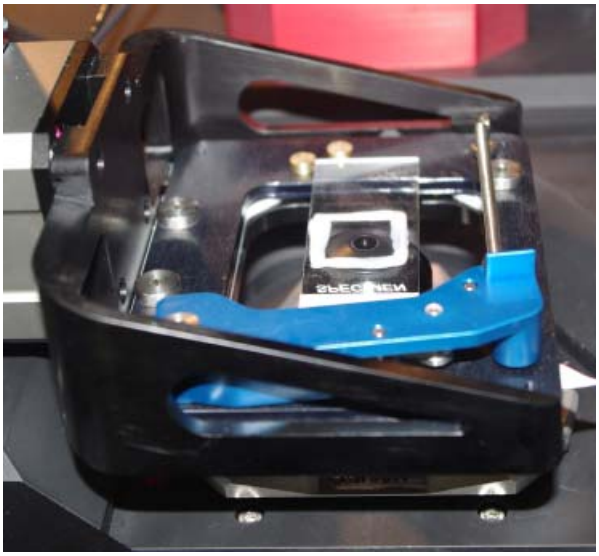
WARNING: RADIATION
Due to the potential for exposure to hazardous radiation, do NOT defeat the laser interlock.

2 Remove any sample currently in place and clean the objective.

Note: *The importance of proper cleaning methods is critical to the life of optical components. Applied Precision recommends using chloroform, clean swabs, and new, lint-free, lens-specific cleaning tissue to clean the objectives.*

3 Apply immersion oil to the objective.

4 Pull back the spring and gently place the slide in the desired position within the positioning pins or, if applicable, in the slide holder. Carefully release the spring so that it holds the slide in position.



OMX Slide Holder

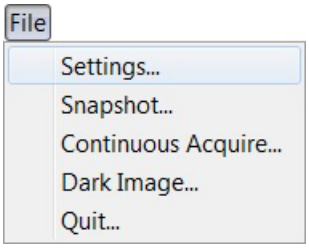
5 Close the door to the Microscope Enclosure. Once the laser interlock is activated by closing the door, the system will allow the laser safety shutter to reopen.

Changing the Polychroic Drawers

The Polychroic Changer command, located in the Settings dialog box, is used to change the drawers.

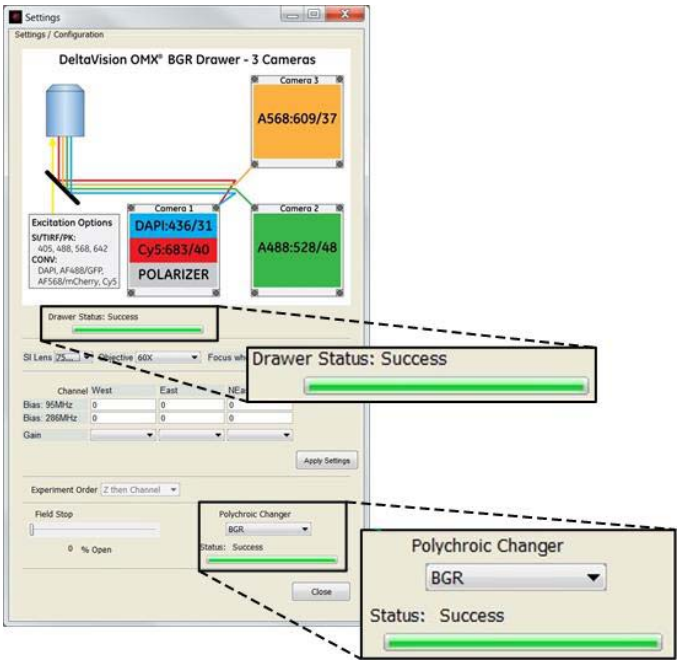
To change the polychroic/drawer

1 Click **File | Settings** to open the Settings dialog box.



Settings Command

2 Click **Polychroic Changer** and select either "BGR" or "CYR." After you make your selection, the system automatically changes the drawer. When the change is complete, the **Drawer Status** and **Polychroic Changer Status** messages will change to "Success."



Changing the Polychroic Drawer

3 Click **Close** to return to the main program window.

The system is ready to acquire an image.

4.4 Acquiring an Image

In order to acquire image data using the DeltaVision OMX, you must run an experiment. The following procedures describe the basic steps necessary for running experiments. Your process may be slightly different, depending on variables such as the type of images you wish to acquire and the hardware configuration of your system. In general, however, to acquire images you will complete these five procedures:

- Activate the lasers/cameras and mount the sample
- Define the imaging parameters
- Determine the acquisition parameters
- Define the experiment
- Run the experiment

Important! *The appearance of the user interface changes significantly depending on the configuration of your system and the settings defined in the DeltaVision OMX software. What you see on your screen may not match exactly what you see in this document.*

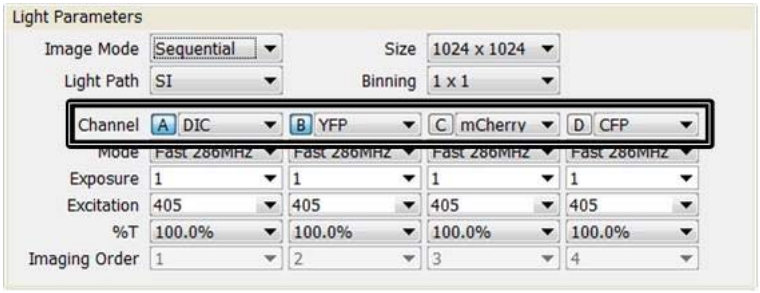
To activate the lasers/cameras and mount the sample:

1 Ensure the system has been turned on according to the startup procedure described in “System Startup”.

2 If you are running a TIRF or SI experiment, turn on the lasers you will be using to collect images. The switches are located on the Primary and Secondary Laser Control Modules located in the Laser/Electronics Enclosure cabinet. Ensure that the safety shutter key switch is turned on.

3 Verify that the correct objective is installed (SI or TIRF) and then click **File | Settings** to display the Settings dialog and ensure that the appropriate objective is selected in the Objective field.

4 On the main screen of the DeltaVision OMX software (on omxMaster), activate the desired cameras by clicking the appropriate **Channel** button(s). As you select a channel, note that a corresponding image window with the camera location and channel label appears on the right side of the main program window.



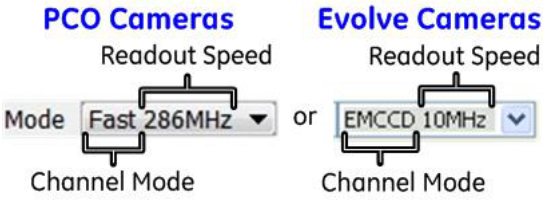
Select Channel(s)

5 Select the correct camera **Mode** for each active channel. Each mode setting consists of two values: channel mode and readout speed.

Note: *Mode settings will vary depending on the installed camera type.*

For systems with PCO cameras —
Channel Mode: Fast or Medium
Readout Speed: 286MHz or 95MHz

For systems with Evolve cameras —
Channel Mode: EMCCD (electron multiplication) or Conv (conventional)
Readout Speed: 20MHz, 10MHz, 5MHz, or 1MHz



Mode

6 If using an EMCCD mode, set the **EMCCD Gain**.

Note: *A good gain value would be about "170" for the Evolve cameras. Gain values are not specified for the PCO cameras.*

7 Using the stage controls and Z touchdowns (or DV Points if the coordinate mapping has been completed), move the stage into the imaging position.

8 Mount the sample onto the DeltaVision OMX stage. See "Loading a Sample onto the Slide Holder."

Note: *If using DV Points, the sample must be oriented in the same direction as it was on the personalDV.*

.To define the imaging parameters:

1 Select the **Image Mode**:

- *Simultaneous* for high speed conventional or TIRF imaging when crosstalk is not an issue. (Structured illumination (SI) experiments can not be run using Simultaneous mode.)
- *Sequential* when crosstalk is an issue, when you want to run an SI experiment, or when you are using filter wheels to add channels to the experiment. (Sequential mode must be used for SI experiments.)
- Mixed-FRET for sensitized emission FRET experiments or when combining simultaneous and sequential imaging.

2 Select the **Light Path**:

- *Conventional* for widefield imaging.
- *SI* for structured illumination imaging.
- *TIRF* for TIRF, PK, or localization experiments.

Note: *The available excitation channels will change based on the* ***Light Path*** *setting. For "SI" and "TIRF", the lasers and DIC will be available. For "Conventional", the SSI channels and DIC will be available.*

3 Select the **Image Size**. This setting defines the portion of the CCD chip surface from which to collect data. (512x512 is the maximum image size for the EMCCD cameras; 1024x1024 is the maximum image size for the PCO cameras.)

4 Set the **Binning** size. Select 1x1 for all SI imaging. Select higher values for lower signal samples and faster imaging of the full field of view.

To determine the acquisition parameters:

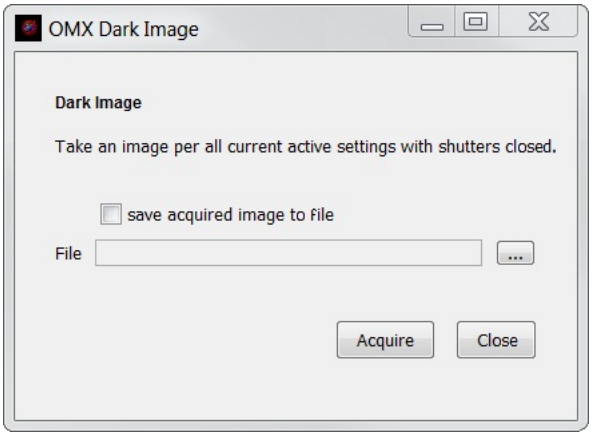
1 Focus on the sample using the Nano Positioning stage controls and, if applicable, **Z touchdown**.

2 Adjust the field of view using the stage controls.

3 Adjust **Exposure** time and **%T** settings.

4 *(Optional. This step is recommended if your system is configured with Evolve cameras but is not necessary if your system is configured with PCO cameras.)* Determine whether the camera bias (background) settings must be modified and change them if necessary.

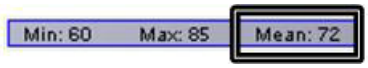
a) Click **File | Dark Image** to open the Dark Image tool.



Dark Image Dialog Box

b) Click **Acquire**.

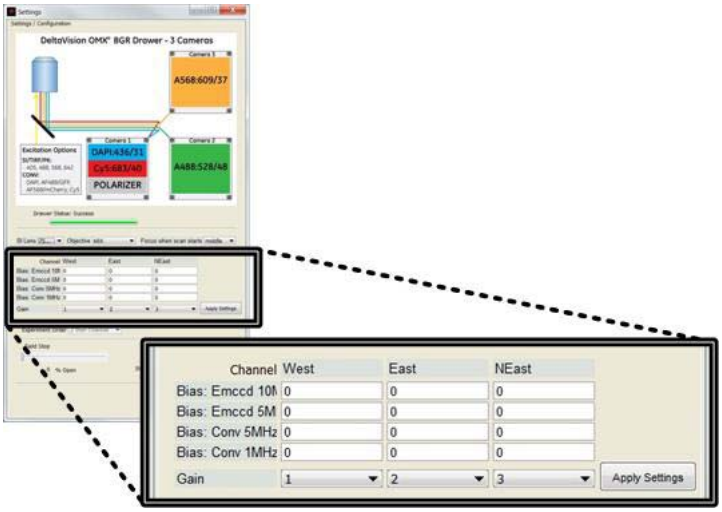
c) View the Min, Max, and Mean data values located at the bottom of the image window. (You will need to deactivate (uncheck) the **Histogram** check box in order to collapse the Histogram view and display the Mean values.) The Mean value should be between 50 and 100 counts.



d) If the Mean value of the dark image is between 50 and 100 counts, as shown above, skip to Step 4.h and continue the procedure from that step.

e) If the Mean value of the dark image is not between 50 and 100 counts, the background value needs to be changed. Click **File | Settings** to display the Settings dialog box.

f) Adjust the **Bias** (background) field values for the appropriate camera and mode and then click **Apply Settings**. For example, if the Mean value in the dark image displays a value of 800, enter a value of 750 into the appropriate **Bias** field on the Settings page.



Settings Dialog Box and Bias Fields

Note: *The camera/drawer image displayed in the Settings dialog box will vary depending on the camera configuration of your system and the filter drawer currently defined in the software. The image you see may or may not match the image shown in the previous figure.*

g) Acquire another dark image to test the new settings.

h) Repeat Steps 4.b through 4.g until acceptable background levels have been determined.

i) Close the Dark Image tool and click **Close** to return to the main program window.

5 Specify the desired thickness of the scan.

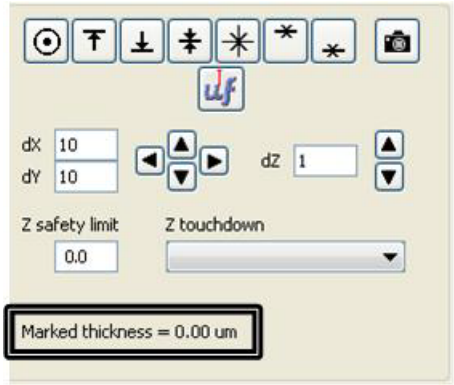
a) Use the Z-Slider or the Z up and down arrows to move the stage to the top of the image stack.

b) Click the **Mark Top** button to mark this position.

c) Use the Z-Slider or the Z up and down arrows to move the stage to the bottom of the image stack.

d) Click the **Mark Bottom** button to mark this position.

e) The sample thickness (stack height) you marked will be displayed directly below the **Z safety limit** and **Z touchdown** fields.



Marked thickness

Note: *Stack height (marked thickness) is limited to 30 µm, the range of the slide carrier's Z piezo.*

To define the experiment:

1 Ensure the Experiment tab options are displayed in the main program window and then select the experiment type to run from the drop-down **Type** list, usually either "Conv" (Conventional) or "SI" (Structured Illumination).

2 Ensure **Light Path** (in the Light Parameters section at the top of the main program window) is set to either "Conventional" or "SI" so that it matches the **Type** setting specified above.

3 Use the visit buttons to move the stage/sample so that it matches the **Focus point when scan starts** field.

4 Set **Optical section spacing** to the desired thickness value.

Note: *If you are running an "SI" experiment, set the* ***Optical section spacing*** *to 0.125.*

5 Set **Sample thickness** by choosing one of the following:

- Type in the **Number of optical sections**

  or

- type in the **Sample thickness**

  or

- click the **Get thickness button** (if the top and bottom of the sample were previously marked).

6 If a time-lapse experiment is desired, activate the **time-lapse** check box and then set the parameters as needed.

- Type the desired number of time points into the **Time points** field. (Note that changing this value automatically updates the **Total Time** field, and vice versa.)
- Type the length of time between each time point into the **Time-lapse Hours/ Minutes/Seconds/Msecs** fields.
- Type the total time for the experiment into the **Total time** field. (As noted above, changing this value automatically updates the **Time points** field.)
- If you wish to collect a subset of your time-lapse data and save it to a separate file, activate the **Subset Time-lapse** check box. Next, in the **Every _ time points** field, enter how often you want to collect the data and activate the **Image** check box for each channel you want the subset of data. (***Example:*** You define a two-channel time-lapse experiment that will collect a total of 10 time points. You activate the **Subset Time-lapse** check box and specify **Every 2 time points** for time-lapse images collected using channel A. For channel A, the software will collect time-lapse data for time points 1 (time point 1 is always collected during a time-lapse experiment), 3, 5, 7, and 9. The time-lapse data for channel A will be saved separately from the rest of the time-lapse data in a data file named **`filename_subset.dv`**.)

7 If you would like the system to automatically compensate for system drift during the experiment, activate the **HW Ultimate Focus** check box and then set the parameters as needed.

- In the **Move threshold (nm)** field, enter the desired maximum measured focus error (in nm) before a corrective action should be taken.
- In the **Maximum iterations** field, enter the maximum measure/move sequences for this action to reach the calibrated focus point.
- In the **Perform every _ time points** field, enter how often to run the HW Ultimate Focus routine.

8 If point visiting is desired, activate the **Visit Points** check box and enter the points to visit for this experiment. (For additional information, refer to the "Point Visiting" section later in this chapter.)

To run the experiment:

1 Enter the appropriate file name and path into the **Data File** field. If you would prefer to navigate to the folder in which you want to save the data file, click the **Save As** button to open a Windows browser window.

2 If desired, enter a short experiment description or title into the **Title** field. This description will be saved to the experiment log file.

3 Click **Run** to start the experiment.

As the experiment runs, the experiment progress will be shown. Once the experiment is complete, the stage controls will be reactivated and, if you wish, you can set up and run another experiment.

To save the experiment settings:

1 Click the **Save Exp** button to open a Windows browser window.

2 Navigate to the folder in which you want to save the experiment settings.

3 Enter a name for the experiment and click **Save**.

To open previously saved experiment settings:

1 Click the **Open Exp** button to open a Windows browser window.

2 Navigate to the folder in which you previously saved the experiment settings.

3 Select the name of the experiment and click **Open**.

Using Spiral Mosaic

Spiral Mosaic is used to quickly identify points of interest on a slide. The spiral pattern starts at the current location and "spirals" outward. As each mosaic tile or FOV (field-of-view) is defined, it is simultaneously displayed in the spiral mosaic window and the corresponding image/camera window(s) on the right side of the OMX main program window.

To use the Spiral Mosaic tool

1 Click the Spiral Mosaic tab to display the Spiral Mosaic tool.

2 Enter a maximum size value in the **XY max size FOVs** field.

Note: *If you enter an even value into the* ***XY max size FOVs*** *field, the system will automatically use the next higher odd value.*

3 Click **Start**.

4 Either wait for the mosaic to finish or, if you see the area you are looking for, click **Pause**.

5 Click **Go To Point** and then click on the mosaic in your area of interest to move the stage to that position.

6 Proceed with imaging.

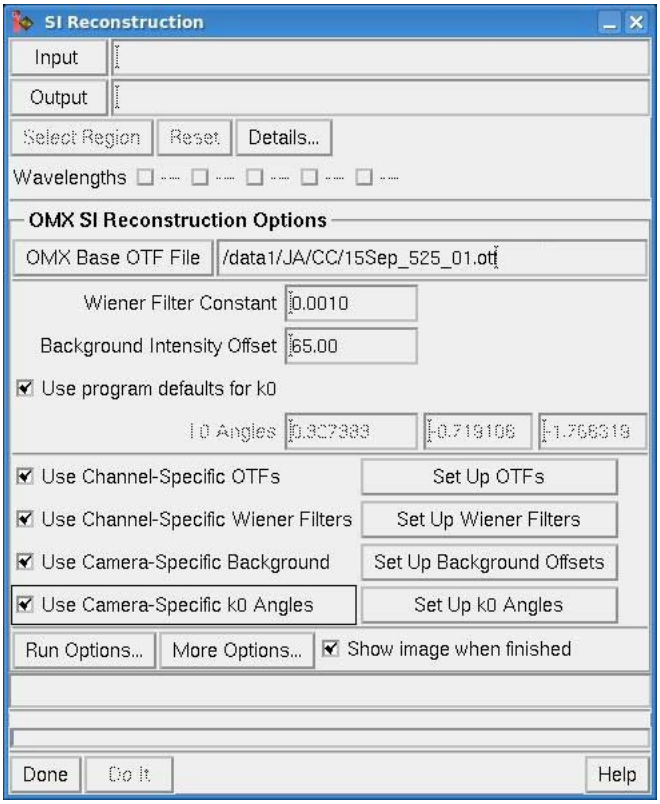
4.5 Analyzing an Image

After acquiring image data using the DeltaVision OMX, you will use softWoRx to reconstruct and analyze it. This section describes the primary tool used to reconstruct an image, the OMX SI Reconstruction tool.

The OMX SI Reconstruction Tool

This topic describes how to use the OMX SI Reconstruction tool to reconstruct SI images.

1 In softWoRx, click **Process | OMX SI Reconstruction** to open the SI Reconstruction dialog box.



SI Reconstruction Window

2 Specify an input file. Choose one of the following:

- Click the **Input** button and select a file from the displayed list. If necessary, use the **Directory** field and/or navigation icons in the Select File dialog box to navigate to the directory containing the desired file.

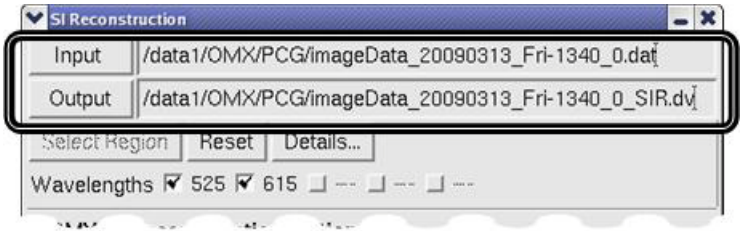
  or

- Drag-and-drop a file from the Konqueror file manager into the **Input** field.

  or

- Type the path and file name directly into the **Input** field.

Note: *The Output field will populate automatically once you specify an Input file name.*



Input and Output Fields

3 Ensure that the **OMX Base OTF File** field contains the appropriate file name or choose an OMX base OTF file using one of the following methods:

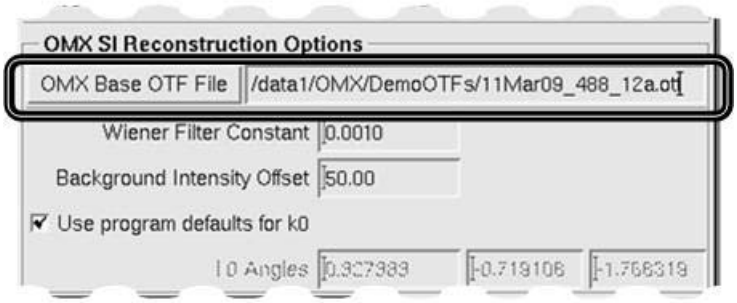
- Click the **OMX Base OTF File** button and select a file from the displayed list. If necessary, use the **Directory** field and/or navigation icons in the Select File dialog box to navigate to the directory containing the desired file.

  or

- Drag-and-drop a file from the Konqueror file manager into the **OMX Base OTF File** field.

  or

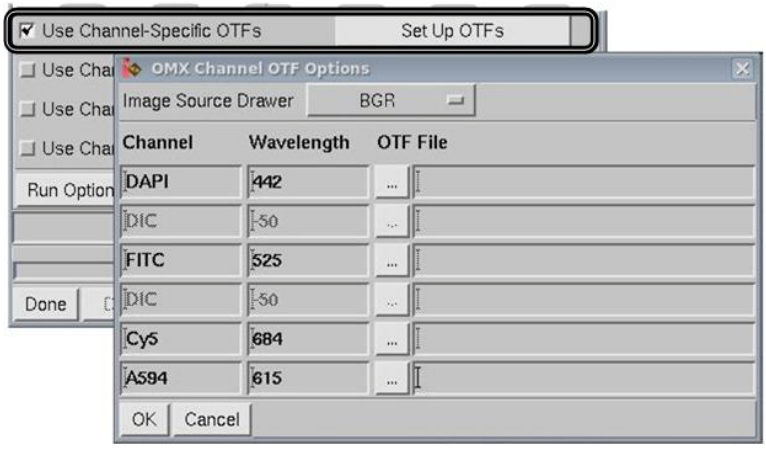
- Type the path and file name directly into the **OMX Base OTF File** field.



Select OMX Base OTF File

As shown in the previous figure, the default setting for OTF file selection uses a single OTF file for processing all channels; however, you can also choose to use channel-specific OTFs:

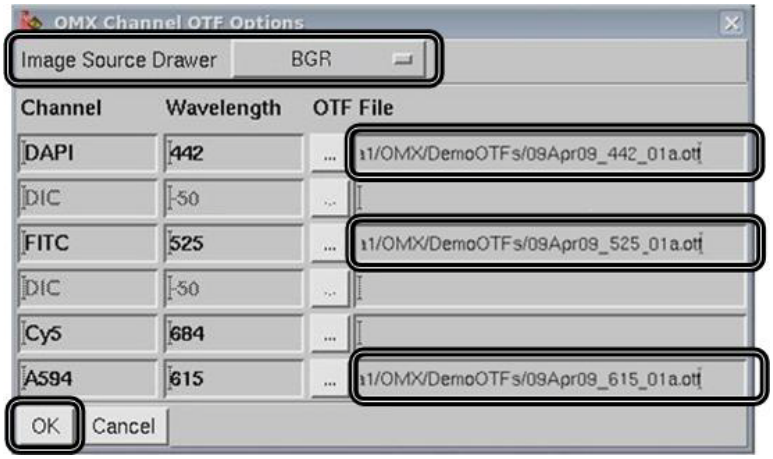
a) Click the check box for **Use Channel-Specific OTFs** to enable the setting and then click **Set Up OTFs** to open the OMX Channel OTF Options dialog box.



Displaying OMX Channel OTF Options

b) Select the correct **Image Source Drawer**.

c) Click the **...** button to select the OTF file to use for each channel.



Specifying Channel-Specific OTF Files

d) Click **OK**.

4 The process for entering a background subtraction value is similar to the process used to specify an OTF. You either enter one value that will be used with all channels or one for each individual channel. Choose one of the following:

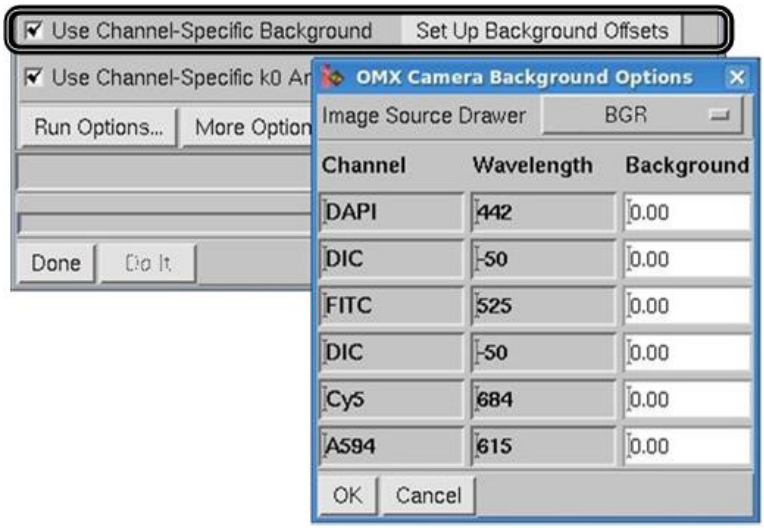
- To use the default background subtraction value ***for all channels***, leave the **Background Intensity Offset** field set to the default value and do not enable

the **Use Channel-Specific Background** field.

or

a) To specify background subtraction values ***for individual channels***, activate the **Use Channel-Specific Background** check box and then click **Set Up Background Offsets** to open the OMX Channel Background Options dialog box.

Note: *Channel-specific background subtraction values override the single value entered into the* ***Background Intensity Offset*** *field.*



Displaying Channel-Specific Background Options

b) Select the correct **Image Source Drawer**.

c) Enter the desired background values for each channel.

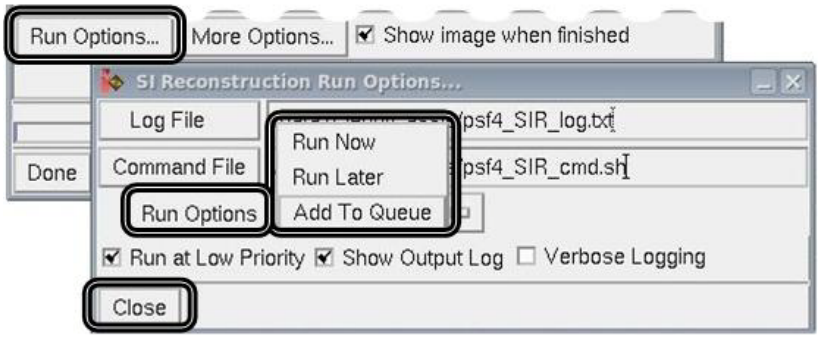
Specifying Channel-Specific Background Values

d) Click **OK**.

Note: *Channel-specific bias subtraction values also can be specified during the acquisition process using the DeltaVision OMX software. Refer to Step 4 of the procedure: "To determine the acquisition parameters".*

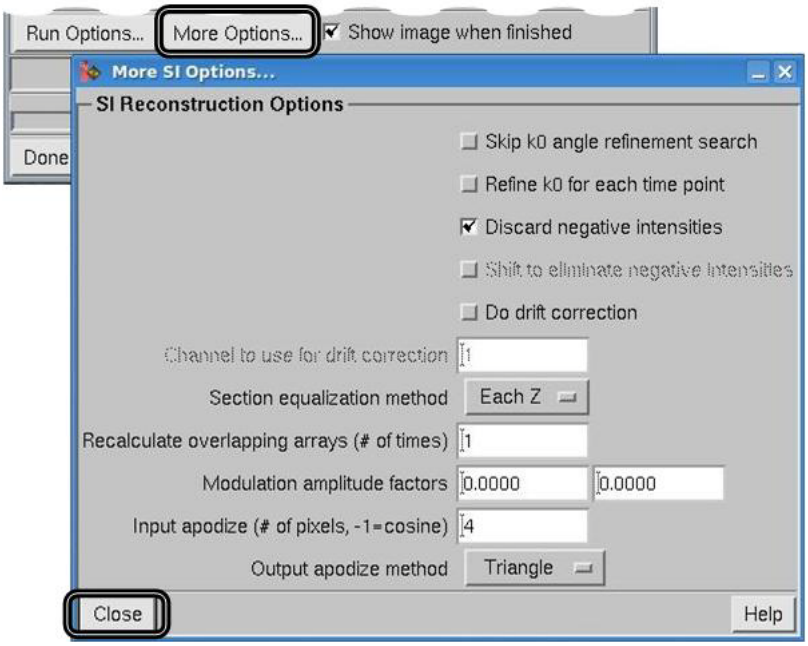
5 Many images can be reconstructed using the program default settings for k0; however, for the cleanest results, you will want to fine-tune these settings for each channel using the camera-specific k0 angles. To do so, disable (uncheck) the **Use program defaults for k0** check box and enable the **Use Channel-Specific k0 Angles** check box. Click the **Set Up k0 Angles** button, select the appropriate **Image Source Drawer**, and click **OK**.

6 SI image reconstructions can be run immediately or they can be added to an image processing queue. The default setting is to "Run Now." If you prefer, click **Run Options** to display the SI Reconstruction Run Options dialog box and select a different setting. Click **Close**.



Specifying Run Options

7 If necessary, click **More Options** to open the More SI Options dialog box. The More Options fields are described immediately after the following figure.



Specifying More Options

For most samples, it is not necessary to modify the More Options fields but, in some instances, they may assist in minimizing image artifacts.

More Options Fields

Field	Description
Skip k0 angle refinement search	Directs the reconstruction algorithm to assume the provided angles are correct and not to search for a better fit. If correct angles have been provided for all channels, activating this setting can improve reconstruction results for low signal data.
Refine k0 for each time point	Performs a k0 search for each time point. If disabled, the k0 search is performed only at the first time point for each channel and that value is used for all the remaining time points in that channel. Can increase the length of time required for reconstruction.
Discard negative intensities	At the end of reconstruction, sets all pixels with negative intensities to zero. This allows the default scaling in softWoRx to be more appropriate for the data sets.
Shift to eliminate negative intensities	At the end of reconstruction, increases all pixel values together so that the lowest intensity pixel is equal to zero.
Do drift correction	Prior to starting reconstruction, calculates and corrects for the sample drift between the first and second angles and the first and third angles. The drift values are calculated in one channel and the correction is applied to all channels. ***This setting should be disabled for all systems configured with Blaze illumination.***
Channel to use for drift correction	Defines the channel used to calculate the drift. (1 = first channel in image, 2 = second channel, etc.). The selected channel should have high signal-to-noise. If no channel has high signal-to-noise, the drift correction should be disabled because an incorrectly calculated drift value adversely affects the reconstruction,
Section equalization method	Defines how varying intensities across the data will be corrected for (primarily in sample bleaching). Select “None” when significant camera bias drift is encountered during imaging.
Recalculate overlapping arrays (# of times)	Defines the number of times overlapping arrays are calculated.

Field	Description
Modulation amplitude factors	Defines the first and second order modulation values. If these values are set to anything other than zero, the algorithm will not search for the modulation. Setting these values to "1.00, 1.00" instructs the software to use the given linespacing value from each channel.
Input apodize (# of pixels, -1=cosine)	Defines the input apodize method (used in managing edge data).
Output apodize method	Defines the output apodize method (used in managing edge data).

8 Set the More Options fields as needed and then click **Close**.

9 Click **Do It** in the main SI Reconstruction dialog box to start the reconstruction process.

5 Maintenance

With the exception of the objective lens, the DeltaVision OMX system requires minimal maintenance and cleaning.

5.1 Daily Checks and Routine Maintenance

The following should be checked and/or performed on a regular basis.

Data Back Up

We recommend that you back up the data files and programs on the DeltaVision OMX system in accordance with the procedures defined by your local data administrator.

Environmental Checks

Check that the room where the DeltaVision OMX is being used meets the environmental requirements described in the site preparation data sheets provided to you by Applied Precision prior to installation.

5.2 Cleaning

Most system components may be cleaned on an as-needed basis. Refer to the end of this topic for information on how to clean the objective lens.

WARNING
Chloroform is a hazardous substance. Use caution when handling this substance and be sure to follow the recommendations in your facility's MSDS guide for chloroform.

Objectives and Filter Wheels

TopGun can be used to blow dust or debris from the microscope components, such as the objectives and ND filter wheels. If a particular component has a stubborn fingerprint or any other oily particles on it that cannot be removed with air only, wipe it gently with a clean cotton swab or lens cleaning tissue and chloroform.

Camera Coolers

Every six months, use TopGun to blow dust and debris from the camera coolers. Direct the air flow through the fans on top of the coolers.

Objective Lens

The objective lens should be cleaned each time you finish running an experiment that requires immersion oil to be used on the lens (most experiments). If your experiments do not require the use of immersion oil, clean the lens on an as-needed basis.

Tools

- Cotton swabs (woven)
- Lens tissue
- Chloroform

WARNING
Chloroform in a hazardous substance. Use caution when handling this substance and be sure to follow the recommendations in your facility's MSDS guide for chloroform.

Procedure

1 Gently set a clean lens cleaning tissue down on top of the objective until all excess immersion oil has been absorbed.

CAUTION
The objective lens is fragile and can easily be scratched or permanently damaged during cleaning. Never rub or scrub a swab or lens cleaning tissue over the lens portion of the objective or reuse a swab or lens cleaning tissue.

2 Apply chloroform to a clean cotton swab. Very gently roll the swab over the lens portion of the objective once.

3 Using the same swab, gently swipe it over the metal portion of the objective that surrounds, and is flush with, the lens.

4 Immediately discard the used lens cleaning tissue and cotton swab.

5 Visually inspect the lens. If necessary, repeat Steps 2 through 4.

5.3 Refilling the Coolant Reservoir

If you find bubbles in the coolant line, check the coolant level. If it is low (more than 6mm, about 0.25 in, from the top of the reservoir), you will need to refill the reservoir using the coolant refill bottle shipped with the system.

CAUTION
The camera coolers are normally placed on the floor, just outside the Microscope Enclosure. To prevent coolant leakage due to gravity, you must lift the coolers to a position slightly higher than the cameras in the Microscope Enclosure ***before*** you open and refill the reservoir. Select a sturdy surface that will remain steady during the refill process.

To refill the coolant reservoir

1 Following site procedures, use a self-standing step ladder to access the camera coolers located on shelves mounted on the rear panel of the Microscope Enclosure.

2 Using a coin or large slot-headed screwdriver, remove the plug located on top of the reservoir.

Remove the plug using a slot-head screwdriver

WARNING
The liquid coolant is electrically conductive. Use caution when filling the coolers. Keep all liquids away from the system hardware and power cables. If coolant is accidentally spilled during the filling process, immediately unplug the system's main power cable. Thoroughly dry the area and all components before proceeding.

3 Using the coolant refill bottle shipped with the DeltaVision OMX system, fill the reservoir to 6mm (about 0.25 in) from the top of the reservoir.

CAUTION
Use only the coolant supplied with the DeltaVision OMX system. Use of alternative liquid coolants and additives may cause permanent damage to the camera coolers. If you need to order additional coolant, contact Applied Precision Customer Service.

4 Replace the metal reservoir plug. To avoid damage to the tank threading, do not overtighten the plug when screwing it back in.

5 Wait at least eight hours (or overnight) and then check the reservoir. If it has dropped from the refill point (6mm from the top of the reservoir), refill to that same point.

6 Choose one of the following:

- If there are no more bubbles in the line, proceed with normal system use.

  OR

- If the reservoir is full and there are still bubbles in the line, the line may have a leak. Contact Applied Precision Customer Service for additional instructions.