
ORIOUS™ SC 1000 CCD Camera User's Guide

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March 2006

832.MANUAL
Revision 1.03



Preface

About this Guide

This *ORIOUS™ User's Guide* is written to provide a brief description of the camera's operating principles, instructions on how to install the camera, and an introduction to imaging in DigitalMicrograph. For additional discussion of image processing, refer to the DigitalMicrograph User's Guide.

Preview of this Guide

The *ORIOUS™ User's Guide* includes the following chapters:

Chapter 0, "Warning", summarizes proper use and risk of damage to the camera when doing diffraction analysis

Chapter 1, "Quick Reference," is a brief summary of the steps necessary to operate an *ORIOUS™* CCD camera.

Chapter 2, "Introduction," summarizes the features of the *ORIOUS™* family cameras.

Chapter 3, "Getting Started," shows the first steps necessary to start the DigitalMicrograph software and prepare for the acquisition of an image (Gain Normalization and Magnification Calibration).

Chapter 4, "Image Acquisition," shows the user the most often used floating windows in DigitalMicrograph and a brief description on how to use them to view, acquire and save an image.

Chapter 5, "Care and Maintenance," contains some general tips on the care and maintenance of the *ORIOUS™* camera. It also contains a list of questions that are often asked by users.

Appendix

- Hardware description provides the system requirements and a checklist. A brief description of the basic working principles of a CCD camera is also given. The pictures of different parts of the camera (camera head, back and front of the controller, etc.) are shown.

- CE Requirement.

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0. WARNING

As with any CCD camera or the viewing screen in the TEM it is possible to permanently burn the scintillator material with the electron beam.

To avoid an expensive service visit, recoating of the scintillator and down time please read the following guidelines and avoid the stated conditions that could produce damage. User damage due to mis-use or by not following these warnings is not covered by the Warranty.

Conditions to avoid:

- **Diffraction patterns with bright central spots**
Before going into diffraction mode dramatically reduce the intensity of the electron beam. If you start to see streaking or require exposures of less than 50ms you have too much beam. On a thin film (for example carbon) 99.9% or more of the beam will be in the center spot. This could be as much as 100nA on a typical TEM. Reduce this by going to a smaller spot size, smaller condenser aperture, use of a selected area aperture and reducing the emission current of the gun.
A diffraction pattern taken for 1 second with a lower intensity will look better on the camera (and will not damage the scintillator) than one taken for 1ms at a higher intensity.
If you find yourself using camera exposures of 1 to 50ms in diffraction mode you are going to burn the scintillator.
If the diffraction pattern is very easy to see on the TEM viewing screen using your eyes, it is MUCH TOO BRIGHT to be viewed or captured with the digital camera.
- **Leaving the beam at cross-over at low magnification.** If you have an image on the camera and you need to leave the beam focused on one point, lower the TEM screen or retract the camera to avoid exposure to the electron beam, hence protecting your scintillator.
- **Any condition that places a very bright spot in a single place on the scintillator** and shows streaking in the background of the image.

1 Quick Reference

The steps necessary for operating an ORIUS™ CCD camera are summarized here.

- Make sure that the viewing/camera chamber is at the proper vacuum for TEM operation.
- Make sure the water and the pressure lines are correctly connected to the camera and proper water pressure is maintained.
- Switch on the CCD camera controller. Allow the controller time to “boot” to its operating condition.
- Turn the computer on (if it is not on yet) and double click on the DigitalMicrograph icon to launch the application. It is important to wait for the camera controller to boot fully before starting DM.
- Under the camera menu of DM, set or confirm the camera is set to cool to 10C.
- Check the TEM session information by clicking on the Global Info button on the Image Info palette (Figure 3-3a, 3-3b).
- Prepare a dark reference image by choosing Prepare Dark Reference under the Camera menu (Section 2-3).
- Prepare a gain reference image by choosing Preparing Gain Reference under the Camera menu (Figure 2-3).
- Click on “Start View” on the Camera View palette in Search mode (Figure 3-1) to position sample area of interest. (exposure mode set to User).
- If desired, click on Focus Loupe on the View palette (Figure 3-1) to check the final focus. Make sure Auto Survey is checked.

- Click on Start Acquire button in the Camera Acquire palette (Figure 3-4). (exposure mode set to User).
- Click on Print Preview button on the Toolbar (Figure 3-4) to view image in print preview mode.
- Click on Save button (or Save Numbered) icon on the Toolbar (Figure 3-4) to save image in the designated folder.
- Click on Print (Figure 3-4) button (printer icon on the Toolbar) to send image directly to the printer.



Fig. 3-4

Quick Help:

A DigitalMicrograph session would typically follow a procedure similar to the following:

1. Acquire your data.

DigitalMicrograph allows you to acquire data from many different sources such as CCD cameras, EELS systems, or imaging filters. Your data may be an image, a spectrum, or something totally different. You may be analyzing data that already exists in a file. Acquisition would then consist of simply loading the file into DigitalMicrograph.

2. Visualize your data.

DigitalMicrograph can display data and images in many ways. You can display images in a format similar to a photograph, as a surface plot, as a numerical spreadsheet display, or as a one-dimensional line plot.

3. Analyze your data.

You can measure areas and lengths, perform various statistical and mathematical calculations, and analyze particles present in your image.

4. Process your data.

You can enhance your image by performing Fourier filtering, sharpening, or other types of image processing.

5. Present your data.

The most important result of the entire process is the presentation of your data. You can arrange multiple images on a page and annotate your images and page through the use of text, lines, boxes, ovals, or clip-art imported from other applications. DigitalMicrograph makes it easy to arrange multiple images and other annotations on a page to produce the layout you desire.

6. Archive your data.

At each part of this process, you should be saving your data to disk. The beauty of digital processing is that if you do this at each step of the process, you can always return to a previous step and try again.

In the end, however, you will want to save your data to a long-term storage medium where it can be found and retrieved in the future. DigitalMicrograph gives you many choices and formats for saving data to disk.

2 *Getting Started*

The following steps will enable the first-time user to switch on the digital camera, launch DigitalMicrograph and prepare for the acquisition of an image.

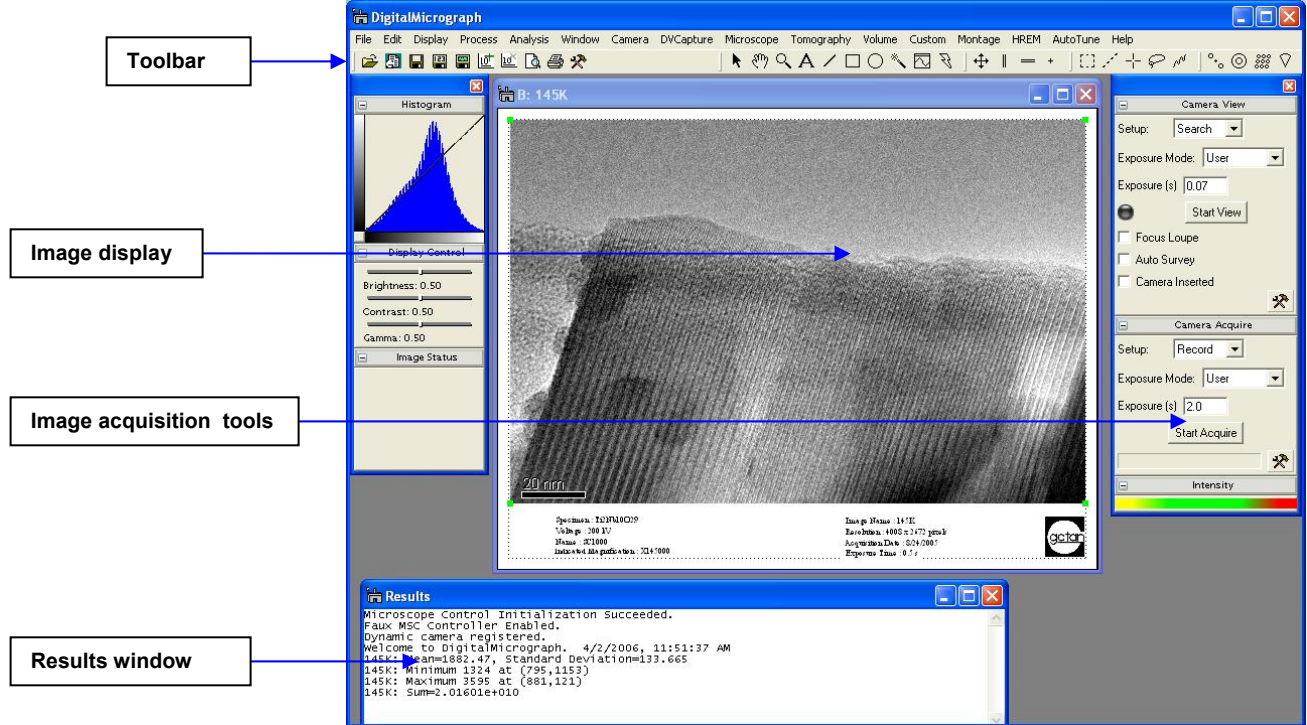
- Make sure that the viewing chamber is at the proper vacuum.
- Make sure the water and the pressure lines are correctly connected to the camera and proper water pressure is maintained.
- Switch on the CCD camera controller.
- Wait for the lights on the front of the controller to change to the first three on, the rest off. (Power, Ready and Camera lit green)
- Turn the computer on (if it is not on yet) and double click in the DigitalMicrograph icon to launch the application.
- Set the camera to cool by picking the option “Temperature” under the camera menu. Next, select a temperature of 10C. The camera temperature will stabilize in about 2-5 minutes, then the camera controller cooler indicator light will go from yellow to green.

2.1 **The Workplace**

When DigitalMicrograph is launched, you will see the commonly used tools on the Toolbar at the top of the main window, the Image Viewing and Acquisition tools (right side), and the Result window as shown in Figure 2-1. The windows seen are composed as “floating” windows which are dockable to allow customization.

Figure 2-1

DigitalMicrograph Workplace



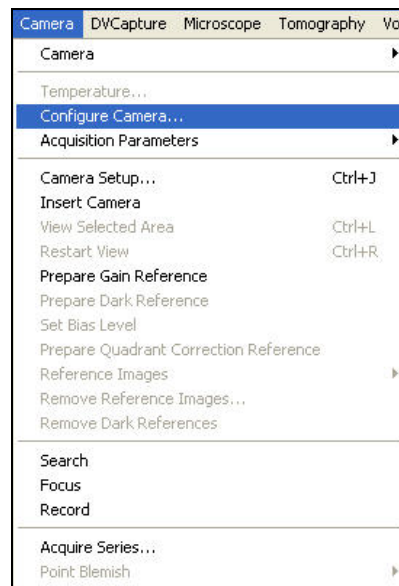
2.2 Camera configuration

If the camera is already configured by a Gatan service engineer, this section can be ignored.

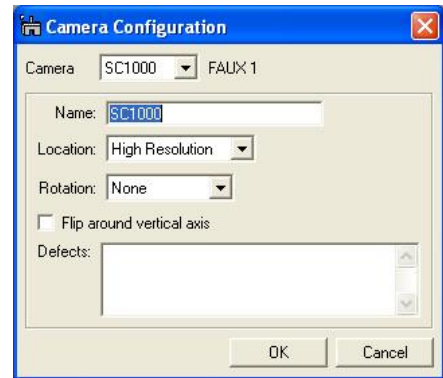
Before starting acquiring images, it is necessary to configure the camera. This process is shown in Figure 2-2.

Figure 2-2

(a) Camera Menu



(b) Camera configuration



- Select Configure Camera in the Camera menu (Figure (2-2a)).
- In the Camera configuration dialog box (Figure 2-2b), you can change the name of the camera by typing in the Name field.
- Image rotation can be specified in the Rotation pull-down menu.
- The shutter state should only be setup IF the camera was configured with the optional shutter for this camera

2.3 Dark Correction

- After the camera has cooled to its operating temperature of 10°C, a calibration of the bias or thermal counts is required. This is often referred to as the “dark image”.

Quick tip: A dark reference imageset must be taken before preparing a gain reference.

- To prepare a dark reference image obscure the camera, either by lowering the TEM screen, retracting the camera or turning off the TEM beam.
- Under the camera menu select “Prepare dark reference”.
- Wait about 5 minutes for the procedure to complete.
- It should not be necessary to repeat this more than once per week and may be good indefinitely.

2.4 Gain Normalization

It is important to prepare a new gain reference image after the CCD has reached the equilibrium temperature (normally this takes less than 5 minutes). The gain reference image should be checked regularly.

To prepare gain reference image, remove specimen from the field of view, evenly spread the illumination across the CCD sensor.

Under the Camera menu (Figure 2-3), choose Prepare Gain Reference. Set the target intensity to the value of 5000-7000. Normally it is sufficient to set the frames to average to 4. Then simply follow the instructions on the screen.

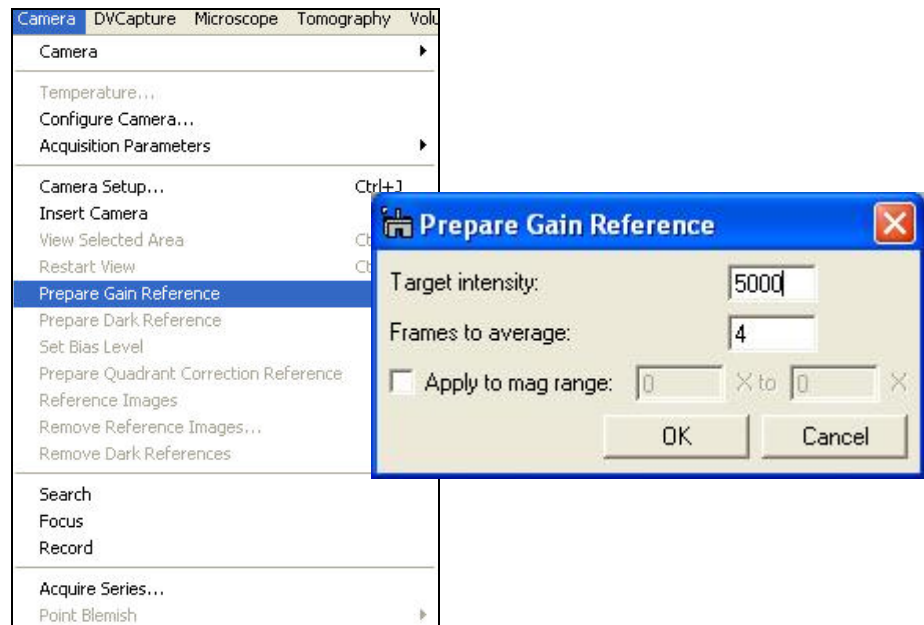
Quick Tip: *Multiple gain references* can be collected and assigned to magnification ranges on the TEM. This is usually done to accommodate slight beam profile differences on the TEM when magnification is changed. When your application need requires large ranges in magnification, the single gain reference image might not be sufficient and a new one will need to be re-acquired. This new *multi-gain* feature allows a gain reference image to be assigned for a particular mag. range. This feature is used often on cameras mounted in the 35mm port. If you would like to use this feature make sure to select the checkbox “Apply to mag range....” (Figure 2-3) and enter the range. The correct gain reference image will then be used depending on the magnification selected on the TEM (either by RS-232 connection or user entry).

It is recommended to perform all gain reference collection(s) when

- The camera temperature is stable (after at least 5 minutes of cooling),
- Every time the camera is switched on,
- Once a week if the camera is always on, or
- Before acquiring any important images.

Figure 2-3

Camera menu



2.5 Magnification Calibration

The displayed nominal magnification on TEM is for photographic film and has an accuracy of 5-10%. The CCD camera is located on a different plane (height wise) respect to the film camera. As a consequence, the magnification must be calibrated. The calibration is done using standard calibration samples.

At “Low” magnifications:

- Use “cross grating sample” or any sample having known spacing

At “High” magnifications:

- Use “graphite” or any crystalline samples having known lattice spacing
- Use the FFT method.

It is very important to make sure DigitalMicrograph software correctly reads the TEM magnification. If the communication between the computer and the TEM is established, the magnification is read automatically. Otherwise, please make sure DigitalMicrograph is set to prompt the user to enter a value for TEM magnification every time an image is to be acquired. This can be set by choosing the “Global Microscope Info” window shown in Figure 2-4 under the Microscope menu (Figure 2-5).

Figure 2-4

Global Microscope Info window

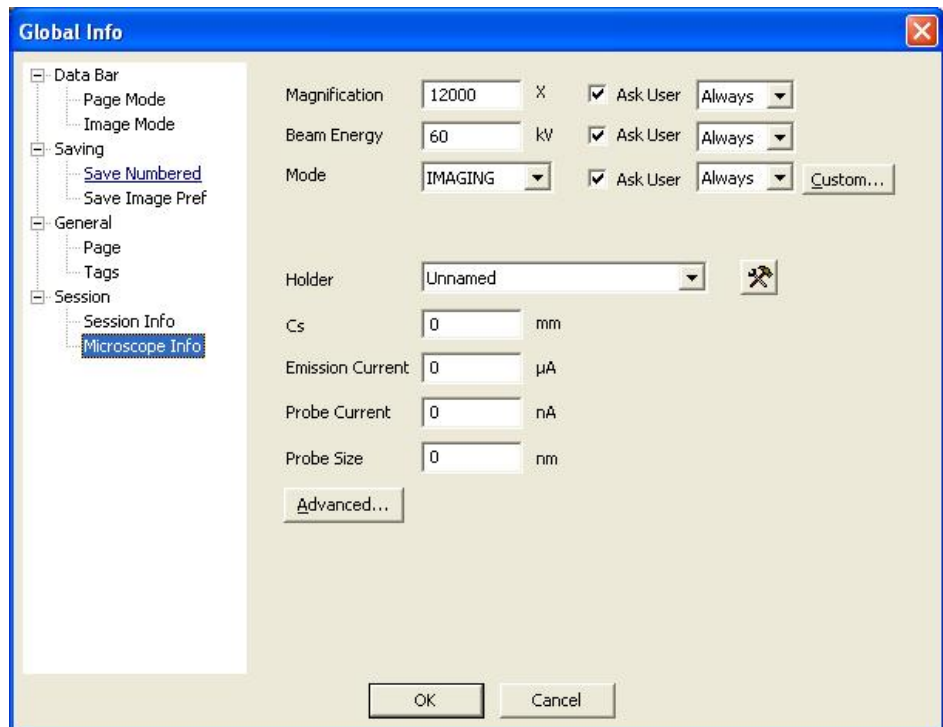
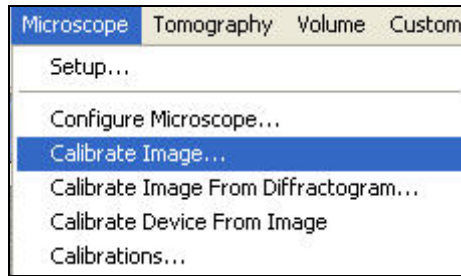


Figure 2-5

Microscope menu



In the “Magnification” section in the “Global Microscope Info” window (Figure 2-4) choose:

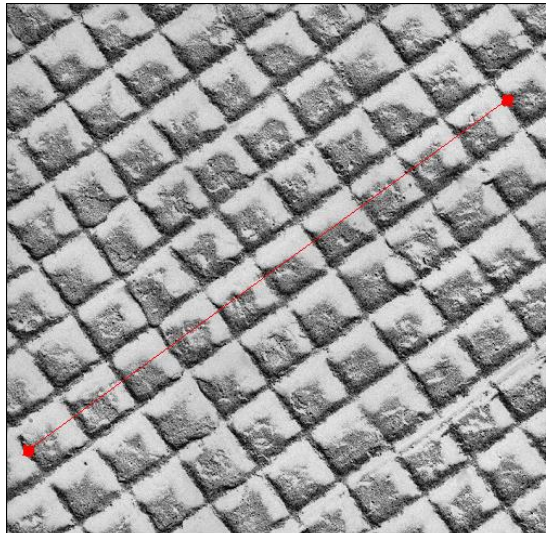
- Select the checkbox ‘Ask User’ next to Magnification
- Pull down the menu and select “Always”
- Click OK

2.5.1 Low magnification

- Record an image of a cross grating sample (Figure 2-6)

Figure 2-6

Cross grating sample



- Choose “Calibrate image...” under the “Microscope” menu (Figure 2-5)
- Follow the on screen instructions (Figure 2-7)

Figure 2-7

Instructions window

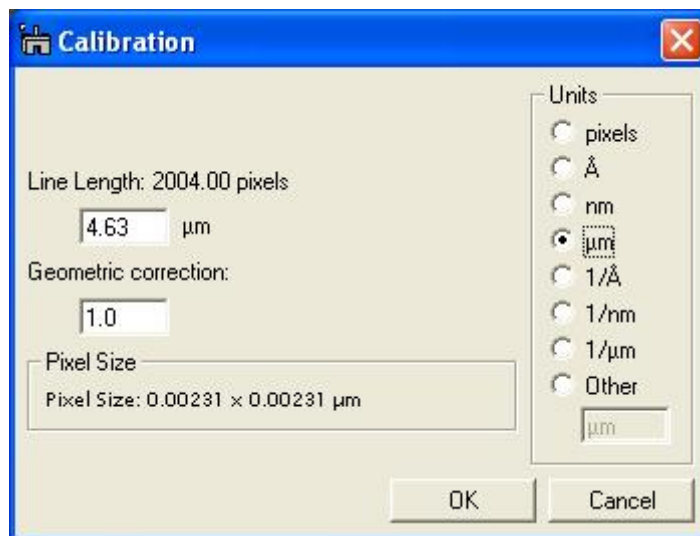


A red line will appear on the image.

- Position it on a feature of known size.
- Press OK on the “Calibrate image” window.
- Enter the correct distance for the selected feature (for example 10 line pairs of cross grating sample where the distance = $10 \times 0.463\mu\text{m}$) in the “Calibration” window and select the units (see Figure 2-8).

Figure 2-8

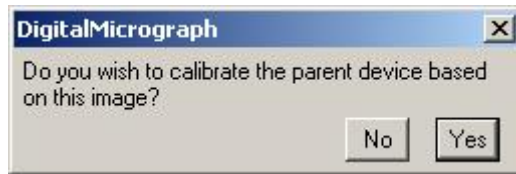
Calibration window



- Press OK.
- Choose YES in the next window (see Figure 2-9) to complete the magnification calibration.

Figure 2-9

Choose YES to complete the calibration

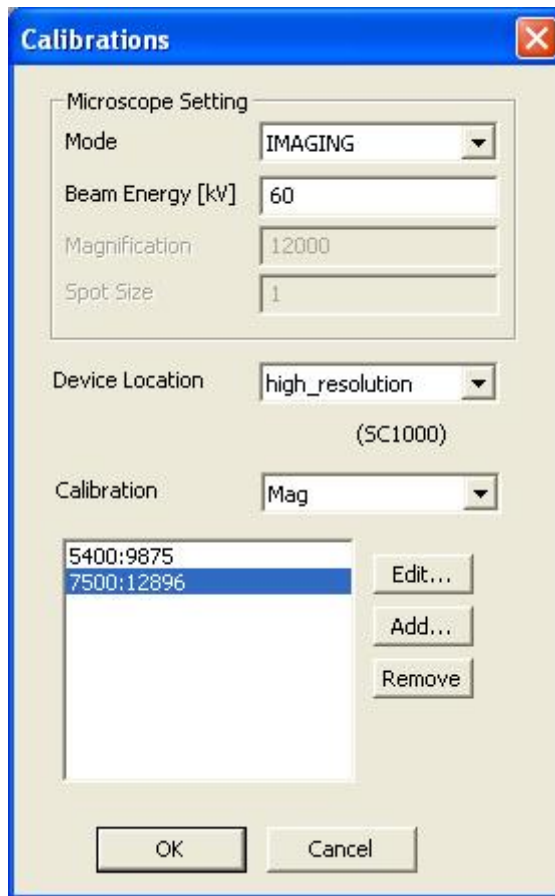


The calibration can be checked by viewing the calibration table. It should contain pairs of value: the nominal microscope magnification and the calibrated value. To view the magnification table:

- Select “Calibrations” from the “Microscope” menu (Figure 2-5).

Figure 2-10

Magnification table



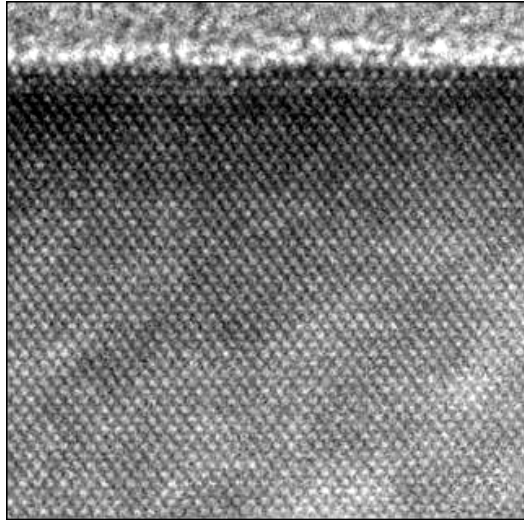
The first number entry represents the nominal TEM magnification and the second entry is the actual magnification at the CCD (Figure 2-10)

2.5.2 High magnification

- Record a lattice image of the crystalline sample (Figure 2-11).

Figure 2-11

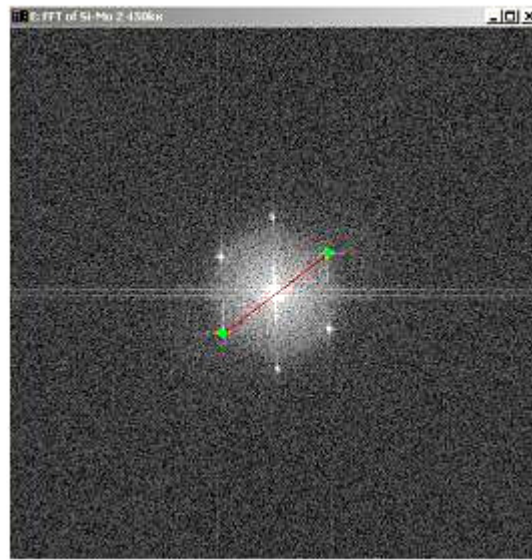
High-resolution image of a crystalline sample



- Choose “Calibrate image from Diffractogram...” under the “Microscope” menu (Figure 2-5). A diffractogram will be calculated after placing a FFT ROI on the image (Figure 2-12).

Figure 2-12

Diffractogram



- Follow the on screen instructions (Figure 2-13)
- A red line will appear on the diffractogram.
- Position the endpoints of the red line on two symmetrical diffraction peaks (Figure 2-12).

- Press OK to specify the reciprocal unit and the d-spacing (in the corresponding real units) in the next window that appears (Figure 2-14).

Figure 2-13

High magnification calibration instructions

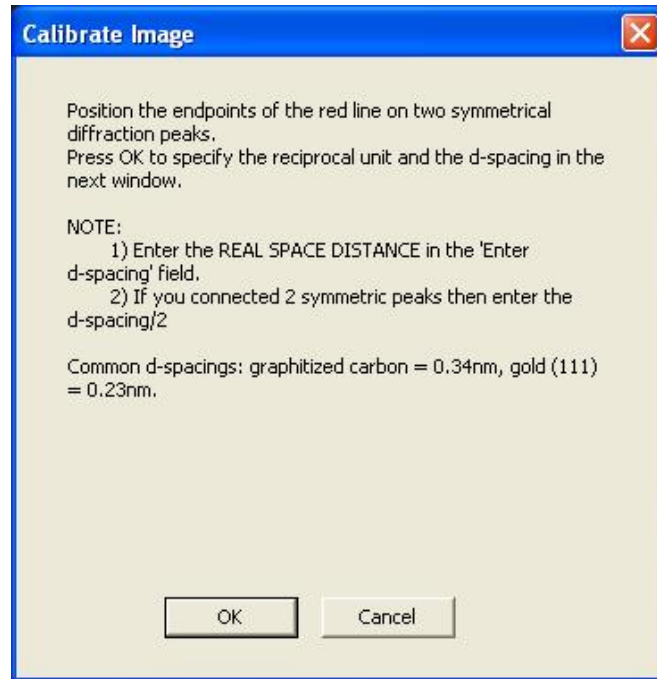
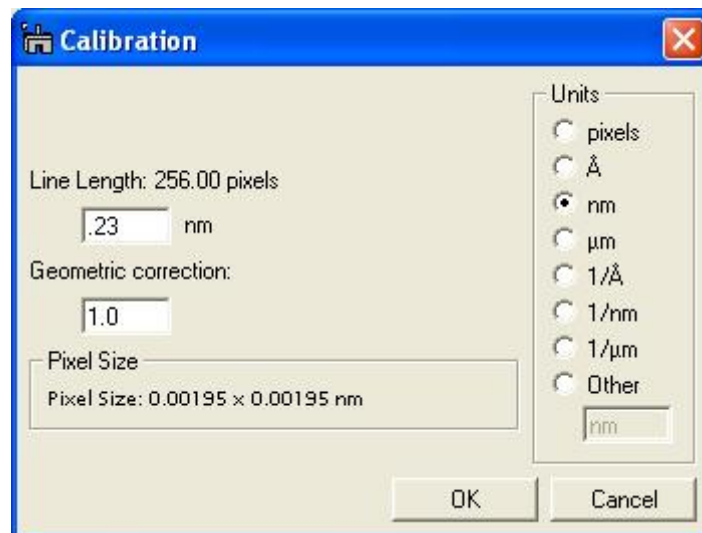


Figure 2-14

Calibration window



3 *Image Acquisition*

This chapter contains some instructions on how to acquire an image and a description of the most frequently used floating windows.

Now you are ready to:

- Insert the sample
- Find a region of interest
- Start using the CCD camera to view your specimen.

3.1 View

The Camera View mode (shown in Figure 3-1) window allows the user to observe Live (continuous) images on the monitor. The setup has two operation modes which are preset for easy use:

- The Search mode displays a continuous (low resolution) image with the entire CCD field of view. This is to allow the user to quickly conduct a sample search using the CCD camera. On this camera setting of 4x binning, 0.065 seconds exposure and quality mode set to Fast will give an approximate 14 frames per second view. A quick way to get the fastest frame rate with the longest exposure is to select the exposure as “Optimized” rather than giving an actual exposure.
- The Focus mode displays a continuous image at higher resolution than the Search image. Fine adjustment of focus setting can be done with this operation mode.

In addition, there is another way to adjust the image focus. Click on the Focus Loupe. This allows the user to focus the image by using a small image area with high speed. The size of the box can be resized by dragging its

corner and its location can be easily changed by putting the pointer inside the box and dragging it. The Auto Survey updates the image display (brightness and contrast) in real time.

Auto Exposure is enabled and disabled by clicking on the Auto Exposure selection box. When the checkbox is not selected the user is in control of the exposure time. Type in the exposure time desired and then press the Enter key. **Quick Tip:** Using the keyboard up and down arrow keys will respectively double or halve the exposure time.

To view a continuous image of the sample:

- Select the Camera Inserted checkbox to insert the camera.
- Setup: Search mode (full CCD and bin x4 selected)
- Press Start View button to start the image acquisition

If you need to adjust the microscope focus of the sample:

- Click Focus Loupe in the Camera View window.

Only the selected area (see Figure 3-2) will be imaged at a very fast rate allowing to set a more precise focus on the area of interest.

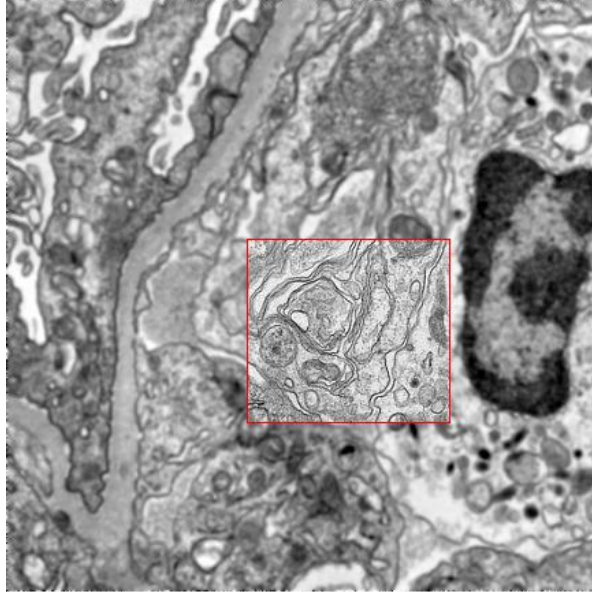
Figure 3-1

Image window



Figure 3-2

Focus Loupe



The acquisition can be stopped by:

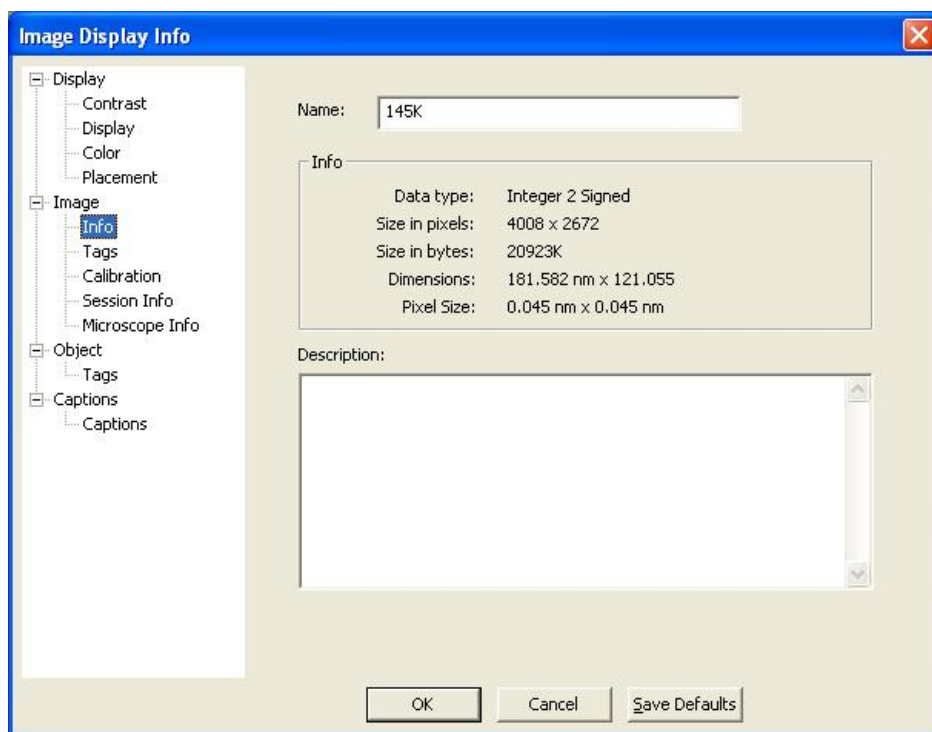
- Pressing Stop View, or
- Pressing the Spacebar.

3.2 Image Notes

The user can type in notes about the image in the Info area of the ImageDisplay window shown in Figure 3-3. To access this window, right click on the image and select ImageDisplay from the menu. On the left pane of the window select “Image Info”. The right pane will be refreshed with the information regarding the image. You can alter the name of the image and enter pertinent info in the “Description” area. This information will automatically be saved with the image file.

Figure 3-3a

Image Info



3.3 TEM Session Information (Global Info)

Before acquiring any images, it is recommended to enter the correct information about the sample, operator, TEM name, etc. On the Image Display Info window (Figure 3-3a) select “Session Info” in the left hand panel to refresh the right panel with the entry areas for sample, operator, TEM, etc... This function can also be accessed under the File, Global Info menu (Figure 3-3b). The global information is saved automatically with every image that is acquired.

In addition to the standard information fields, the user can create custom fields such as ID#, Lot#, etc.. This is done by clicking on the “Tool” icon button. The following dialog window will appear in which you can input the custom field that you want to create:

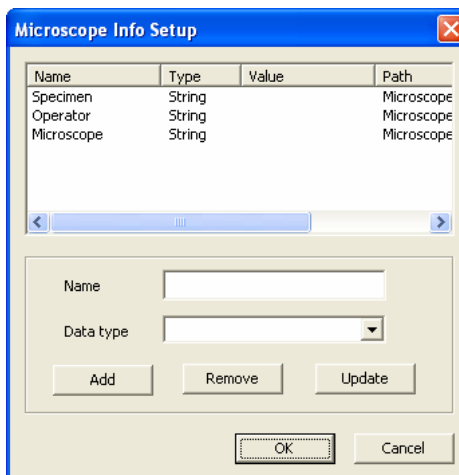
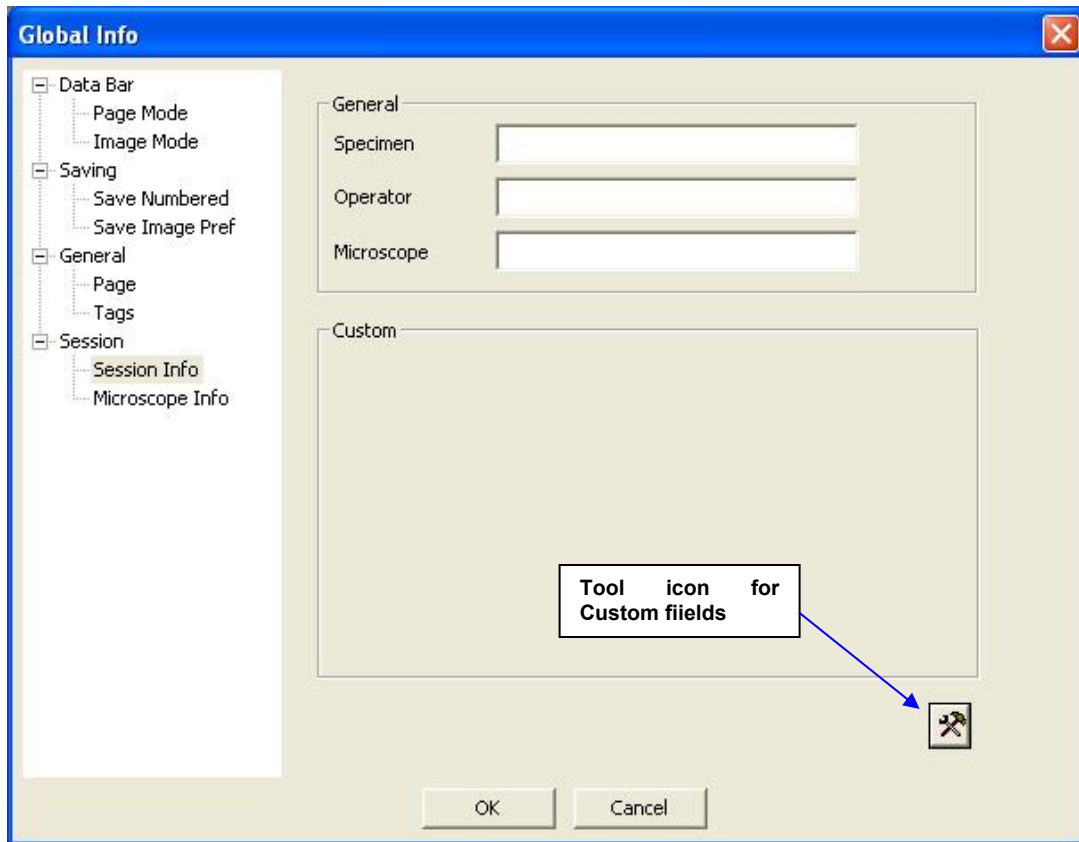


Figure 3-3b

Global Info



3.4 Image Acquisition

To record the final image, click on the Start Acquire button in the Camera Acquire palette shown in Figure 3-4. This mode is preset to acquire a full resolution CCD image.

Figure 3-4

Camera Acquire window



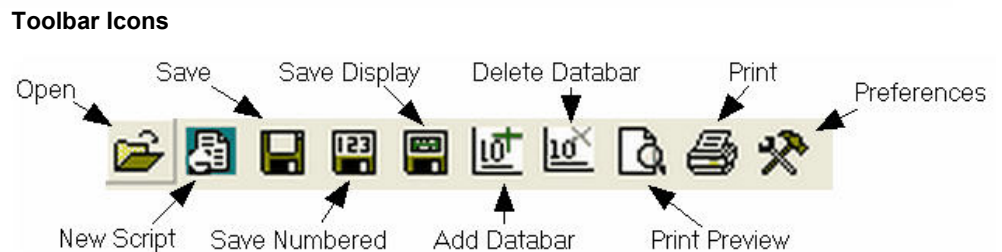
3.5 Image Saving and Printing

Images that have been acquired can be saved and printed using the toolbar icons located at the top of the screen (Figure 3-4). If you would like to save a series of images during your session and have them automatically named/numbered, chose “Save Numbered” icon. Use the Preferences icon button to open the dialog window to select which method you want to use to name and number your images. After setting your preferences up, simply click the “Save Numbered” icon to save your image(s).

Assuming that a printer has been defined on your computer, clicking the Print icon will send the selected front image directly to the printer.

Quick Tip: Clicking on the DigitalMicrograph Help icon will allow you to learn more about the other methods of Saving. Numerous image formats are supported and a unique feature of batch conversion from Gatan .dm3 format to other formats is available.

Figure 3-4



3.5.1 Save Numbered and file storage path

Click on the Preferences button located on the Toolbar (Figure 3-4). The Global Info dialog box will be displayed as shown in Figure 3-5.

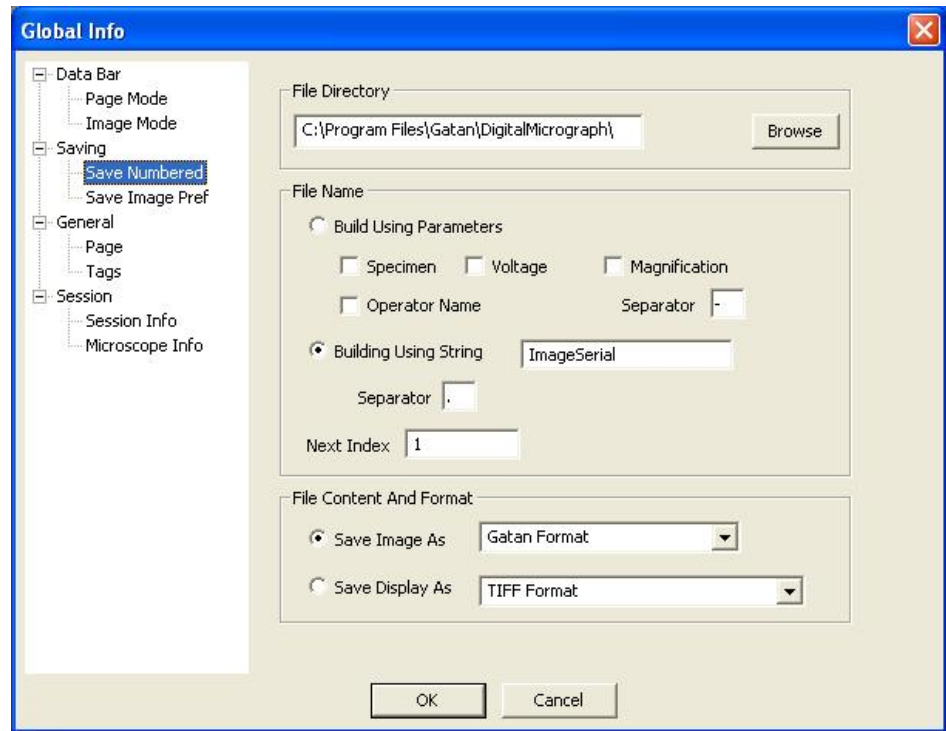
Click on Save Numbered in the left pane (Figure 3-5). To select the file path click the browse button and chose the file directory to save your images.

3.5.2 Construct Image File Naming

You can chose the method you want to use to automatically name/number your images series. Two methods are available, build using parameters or building using string. In the File Name area, specify the way you want the image file name to be constructed.

Figure 3-5

Save Numbered Info pane

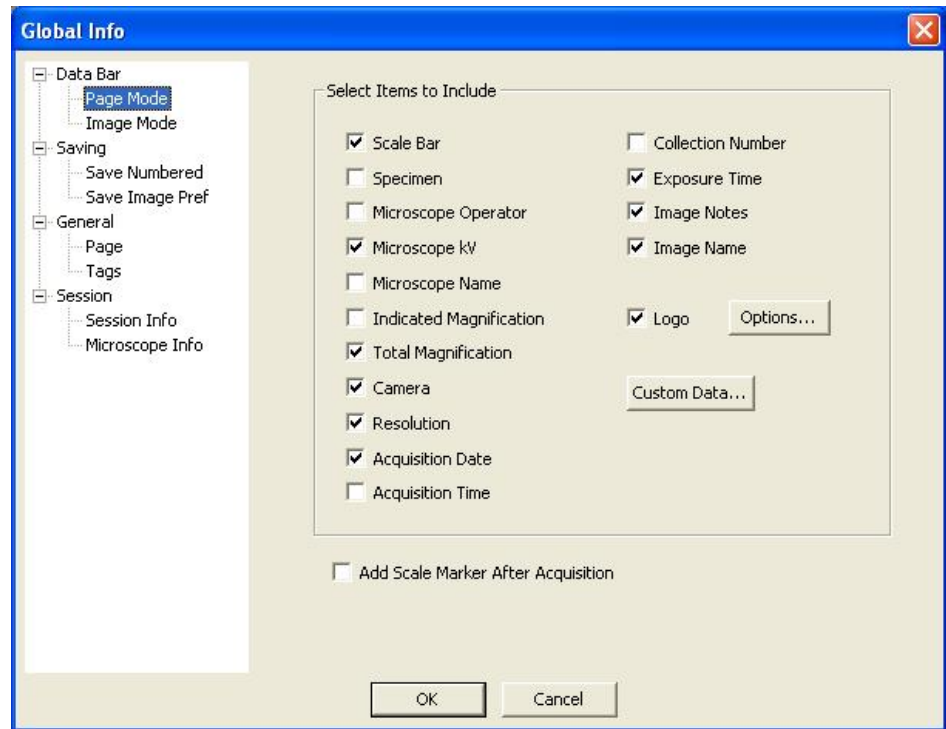


3.5.3 Page Mode (Report) Options

In the Global Info dialog, under Databar you can chose Page mode and Image mode in the left pane. Select Page Mode to view the checkbox items that can be selected in the right pane. Any items selected will be available in the Page Mode Report format (Figure 3-6). You can also add a logo file and image notes to the report.

Figure 3-6

Data Bar – Page Mode Report parameters



Custom Data button allows the user to add additional custom fields that were previously created to also be included in your report. This feature is useful to add the name of your institution, ID#'s, or the name of your TEM lab (Figure 3-7).

Figure 3-7

Custom Data



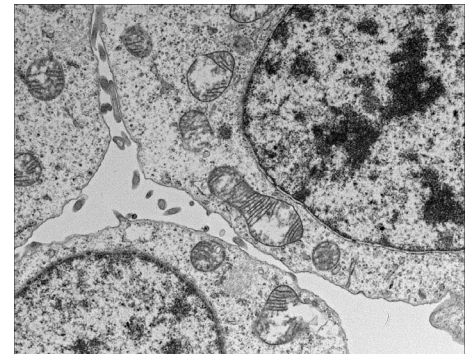
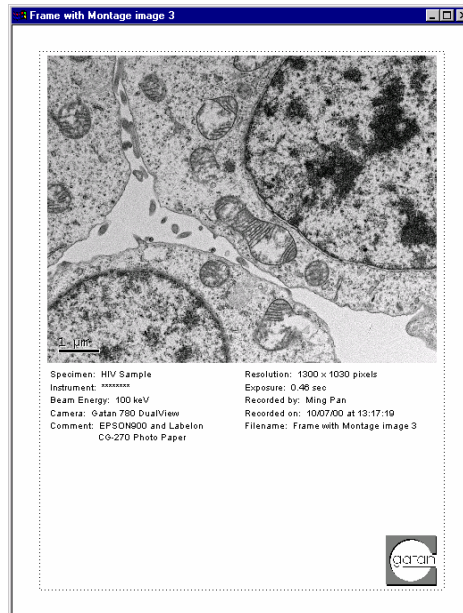
3.5.4 Report (Print Preview)

The Print Preview button (the one with a page and a magnifier on the Save palette in Figure 3-4) will toggle between report view (Figure 3-10 a) and image view (Figure 3-10 b). In the report view, an image is displayed of the print preview mode with parameters as specified in the Databar Page Mode parameters.

Figure 3-10

(a) Report view

(b) Image view



Users can customize the layout and selection of parameters on the page (for example, using pointer to move the text around) and then save the setting as a report template. This is done by navigating via Edit, Databar, Save as Global Default in the Menu bar at the top of the main screen (Figure 3-10 c).

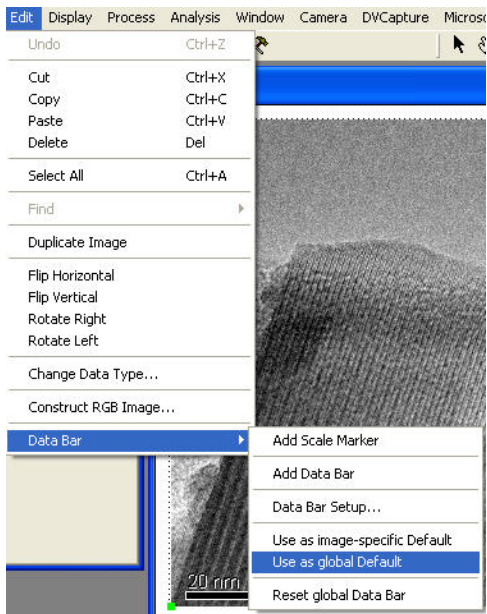


Figure 3-10 (c)

4 *Care and Maintenance*

This chapter contains some general tips on the care and maintenance of your ORIUS™ camera. It also contains a list of questions that are often asked by users.

4.1 General Precautions

The following are some general precautions users should adhere to in the care and maintenance of their camera.

4.1.1 Peltier cooler maintenance

- The Peltier cooler should not be switched on if the cooling water is not flowing.

The Peltier cooler consumes about 12 W of power. If this heat is not removed by the cooling water, there is a possibility that damage to the Peltier cooler and/or the CCD may occur. The system should protect itself against this but it is not recommended to test this functionality.

- Check the flow of cooling water periodically.

If the flow rate of the cooling water deviates significantly from the value originally set, make sure the lines are not obstructed and adjust the pressure regulator to bring the flow back to the original level. Remember, if the water flow stops while the Peltier cooler is on, damage to the camera head may result.

- The Peltier cooler should not be left on when the TEM cooling water is turned off or fails.

The Peltier cooler is cooled by water from the TEM chiller. If the Chiller is turned off or fails for a long period, there could be severe damage to the camera. Be aware that for some microscopes the cooling system turns off in the Stand By mode. Be sure the cooler of the camera is also turned off in that situation.

-
- Turn off the Peltier cooler if the microscope viewing chamber is to remain at air pressure for a long period (more than 30 minutes to an hour).
 - Turn the Peltier cooler off if the room the TEM has a dew point above 10C when the TEM is vented.

4.1.2 Scintillator maintenance and precautions

- Minimize exposing the scintillator to the electron beam when the camera is not in use.

It is particularly important to protect the camera from being unnecessarily exposed to an intense unscattered beam. As a general rule, if you avoid conditions which would saturate any part of the sensor area in less than 0.1 sec (about 10 nA/cm² at the sensor), the scintillator lifetime will probably exceed the lifetime of the rest of the system. On the other hand, each time any CCD pixels are intensely saturated, the scintillator efficiency may be permanently impaired for those pixels, resulting in a variation of the scintillator efficiency across the image field. If you are not using the camera, keep the viewing screen down or retract the camera to protect the scintillator from beam damage. Also, a retracted camera will not collect debris or abrasive particles that may fall down from the TEM's film-transport mechanism.

- Minimize exposing the scintillator/CCD to high beam intensity when acquiring diffraction patterns.

There is no defined cutoff where the scintillator will be damaged. Rather, damage can result from prolonged exposure of the scintillator to a very high beam intensity (above 15,000 counts in binned by 1 mode, exposure of 10ms). If you have no saturation with a short exposure, then there is no danger. You can then increase the exposure time and still not harm the scintillator as it is the beam intensity on the scintillator that causes the problem and not the accumulated signal in the CCD.

It is recommended to use beam stop to block the central spot when acquiring SAED diffraction patterns.

If you think you have damaged the scintillator, take an unprocessed image of uniform illumination. If the spot turns out dark, you have damaged the scintillator! If it is bright, spread out the beam and set the illumination so you have about 10,000 counts/sec (in binned by 2 mode). Expose the scintillator for 3 min, and take another picture. The bright area should be gone and the scintillator should operate normally.

- Warm the scintillator to 35 degrees periodically.

If you have a clean vacuum in the camera chamber area, warm the scintillator once or twice a month. But if you have backstreaming from your diffusion pump, you will need to do it more frequently. The camera should only be warmed for 15 hours or overnight, but not longer. If the camera is used sufficiently without warming, the electron beam can harden the trapped oil making the scintillator difficult to clean.

Use the normal temperature control but instead of a target temperature of 10C give it a target of 35C.

It is OK to run the Peltier cooler in the warm position overnight, but do not run it when the camera is at air pressure or if the cooling water is not flowing.

Check vacuum system.

If oil accumulates even with regular warming of the scintillator, it is recommended that the vacuum system be checked. If no leak exists then installing a foreline trap on the rotary pump is recommended.

Examine the surface of the scintillator.

If the surface of the scintillator becomes dirty or scratched, ship the camera to Gatan for service. Do not attempt to clean the scintillator yourself as damage can result.

4.2 Most Often Asked Questions

The following are some of the questions most frequently asked by camera users. If you are having a problem with your camera, check and see if the tips listed below are helpful.

1. Why do I see a line in the middle of the image in the view mode but not in the acquire mode

- When viewing on the camera in the “Fast Mode” we readout the camera from 2 output amplifiers and at 30Mhz. In the High quality mode we use one amplifier and only 5MHz. The slower readout give less readout noise.

2. There is no image on the CCD, what should I do?

Check the “Camera View” floating window to see if the “Camera Inserted” box is checked (camera inserted).

Check the camera really inserted and is not stuck out. With the ORIUS™ camera you can see the can move in and out.

Check if the beam has drifted.

Check if the TEM viewing screen is lifted.

Check if you have a film plate stuck above the camera in the TEM.

You may have an image and not being able to see it. Move the pointer around to get an idea of the counts. If the value is over 10,000 counts (in 1x binning mode) the CCD is saturated. Reduce the beam intensity or shorten the exposure time.

3. How often do I have to acquire a gain reference?

Whenever the image quality seems to be deteriorating. The most reliable way to see if a new gain reference is advisable is to take a gain normalized image of uniform illumination with no specimen in the beam and look for any spurious pattern. If you see one, update the gain reference.

4. What is the shortest and/or the longest exposure time I can use?

The shortest time is 0.001 sec. Exposures over 1 minute are unusual for this camera under normal imaging conditions

5. My images are noisy, what can I do?

Try increasing the exposure or current density of the beam.

6. My images are slowly deteriorating, what should I do?

Determine if the CCD is warming up. Check that the water lines are not clogged. Check the water temperature of the chiller- should be approximately 20-23 °C. Be sure to acquire a new gain-reference image.

7. The image is brighter (or darker) on the top than on the bottom, what should I do?

Check that the CCD has been cooled for at least 5 minutes.

It could be a bad gain reference image. Retake another one.

8. When viewing, the image sometimes gets suddenly bright/dark, what is happening?

Sudden changes in the contrast may be due to stray x-ray photons that saturate some of the pixels.

9. How long is the lifetime of the CCD?

None of Gatan's CCDs has failed due to old age so it is hard to answer. So far, there are no known mechanisms for aging.

10. How often and for how long should the camera be warmed?

If you have a clean vacuum in the camera chamber area, between once or twice a month is enough. But if you have backstreaming from your diffusion pump, you will need to do it more frequently. The camera should only be warmed for several hours or overnight, but not longer. A quick way to see if oil is accumulating is to take a uniform illuminated image at 40 or 60 kV. At a lower accelerating voltage, you will have greater diffraction contrast which makes viewing the contamination more readily.

11. The camera takes a long time to insert/retract, what should I do?

Check your compressed-air pressure. It should be between 30-60 N/cm² .

12. I see a ghost image that won't go away, what should I do?

It is possible that the dark or gain reference has a ghost image. Try clearing and re-acquiring the reference images. You can remove the dark reference image by choosing *Remove dark references* under the Camera menu.

Appendix 1

Hardware description

A1 System Requirements

To use the ORIUS™ CCD cameras, the following hardware and software systems are required:

Windows 2000 Professional or Windows XP Professional

Minimum 512 MB RAM (1GB RAM preferred), 100GB, Hard-drive or better

Pentium 4 1Ghz or higher

Available microscope bottom port or 35mm port

Water and air connections

Gatan Microscopy Suite (GMS) software 1.6 or later

FireWire 800 also called 1394b capability (will run from 1394a but it is not recommend)

A2 Description

An ORIUS™™ CCD camera acquires an electron microscope image into a computer in four stages. First a scintillator converts the electron image into a high-resolution light image. Then a fused fiber-optic plate captures the light from each point in the image and channels it to the CCD. The CCD then converts the transferred light image into a second electron image. Finally, the CCD shifts that image charge row by row to the low-noise output amplifier, readout electronics and digitizer.

Sensitivity is achieved by maintaining high efficiency at each stage of the image signal chain: light generation in the scintillator, optical coupling by the fiber optic plate, image detection by the CCD pixel and also by cooling and low-noise readout. Resolution is achieved by minimizing light scatter in the scintillator and light leakage amongst fibers in the fiber optic plate and by optimized proximity focus at the end of the fiber plate through ultra-thin bonding technology. In addition, since the signal chain contains no moving or flexible parts the detection efficiency has very high stability over time. These techniques together constitute the HCR™ technology, which is at the heart of the UltraScan™ and ORIUS™ family.

Figure A1 shows the placement of an ORIUS™™ camera on a TEM column. The camera is mounted below the viewing and film chamber. The camera controller shown in Figure A2 (front panel view) and Figure A3 (back panel view) and an image-acquisition computer are linked to the camera by supplied cables. Compressed air for controlling the camera insertion and retraction is taken from the microscope as is the cooling water.

Figure A1

ORIUS™™ camera mounted on a TEM column.



Figure A2

Controller's front panel



Figure A3

Controller's back panel

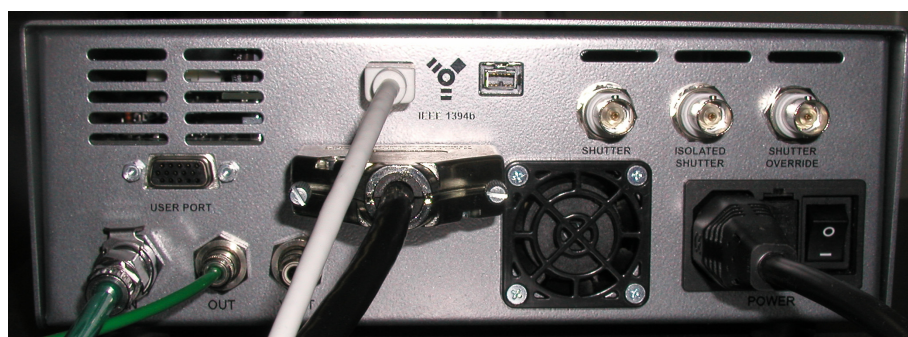
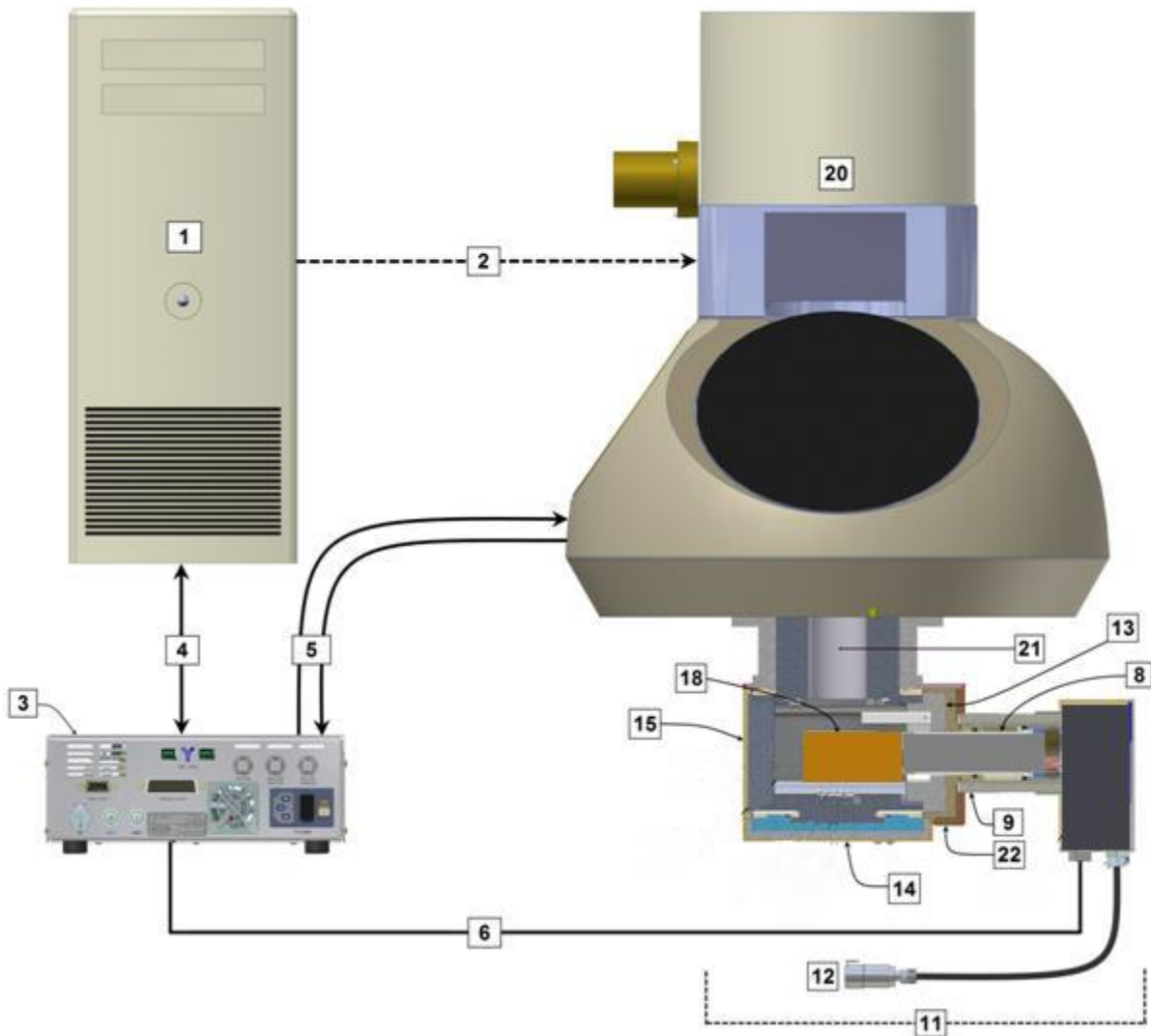


Figure A4 is a schematic illustrating the ORIUS™ system. The system is composed of a retractable CCD camera coupled to an electron scintillator through a fiber optic plate, a controller/digitizer unit, a computer for image storage and processing, cables, and application software. The camera can be cooled down to 10 °C and can be inserted into or retracted from the electron beam by a software command (Figure A4).

Figure A4

ORIOUS™ block diagram.



ORIOUS™ System

- 1. Computer
- 2. TEM-interface cable (optional)
- 3. Controller
- 4. IEEE 1394b cable
- 5. Shutter-interface cable (option)
- 6. Camera-interface cable
- 8. Drive assembly
- 9. Pneumatic inlets
- 11. ORIOUS™ camera assy.
- 12. water line
- 13. X-ray shielding
- 14. Blanking flange
- 15. Accessory port
- 18. Electron scintillator
- 20. Electron microscope
- 21. Microscope vacuum
- 22. ORIOUS™ flange

A3 Installation

If you have not been trained by Gatan then you must not attempt to install the camera. Installation by an untrained person will invalidate the warrantee and may cause damage to the equipment and injury to the installer.

Below are figures showing the connections on the system incase something is accidentally disconnected, this must not be used as an installation guide.

Figure A5

Camera Pneumatic Interface Details

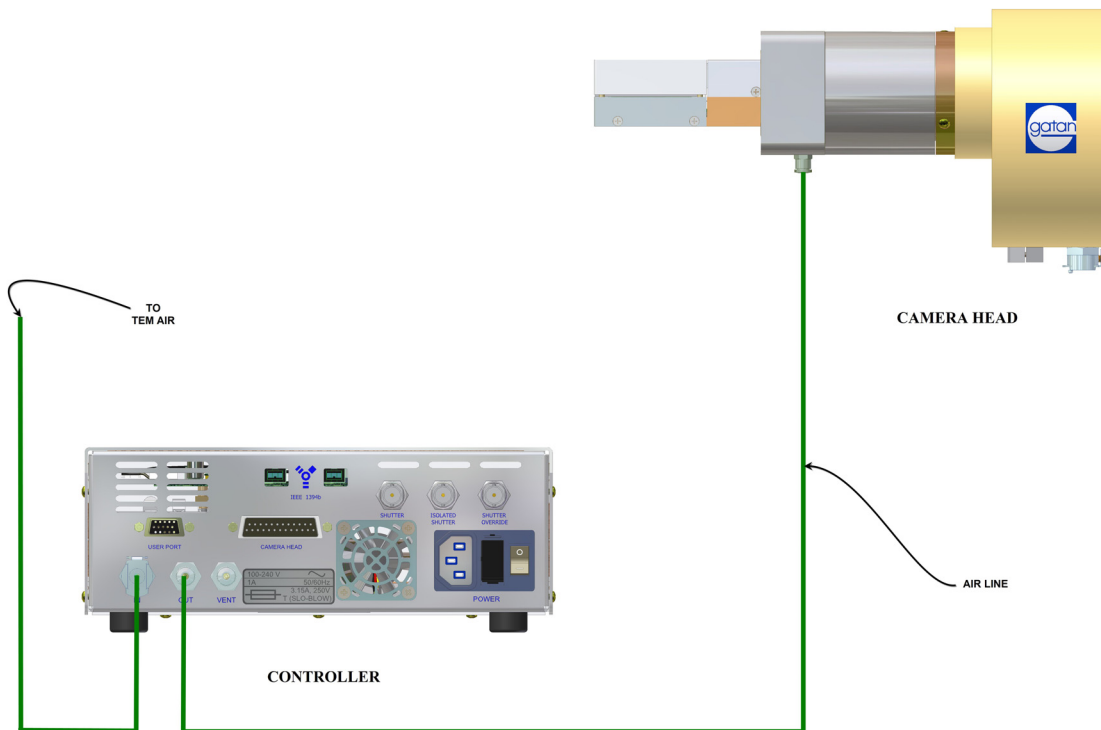
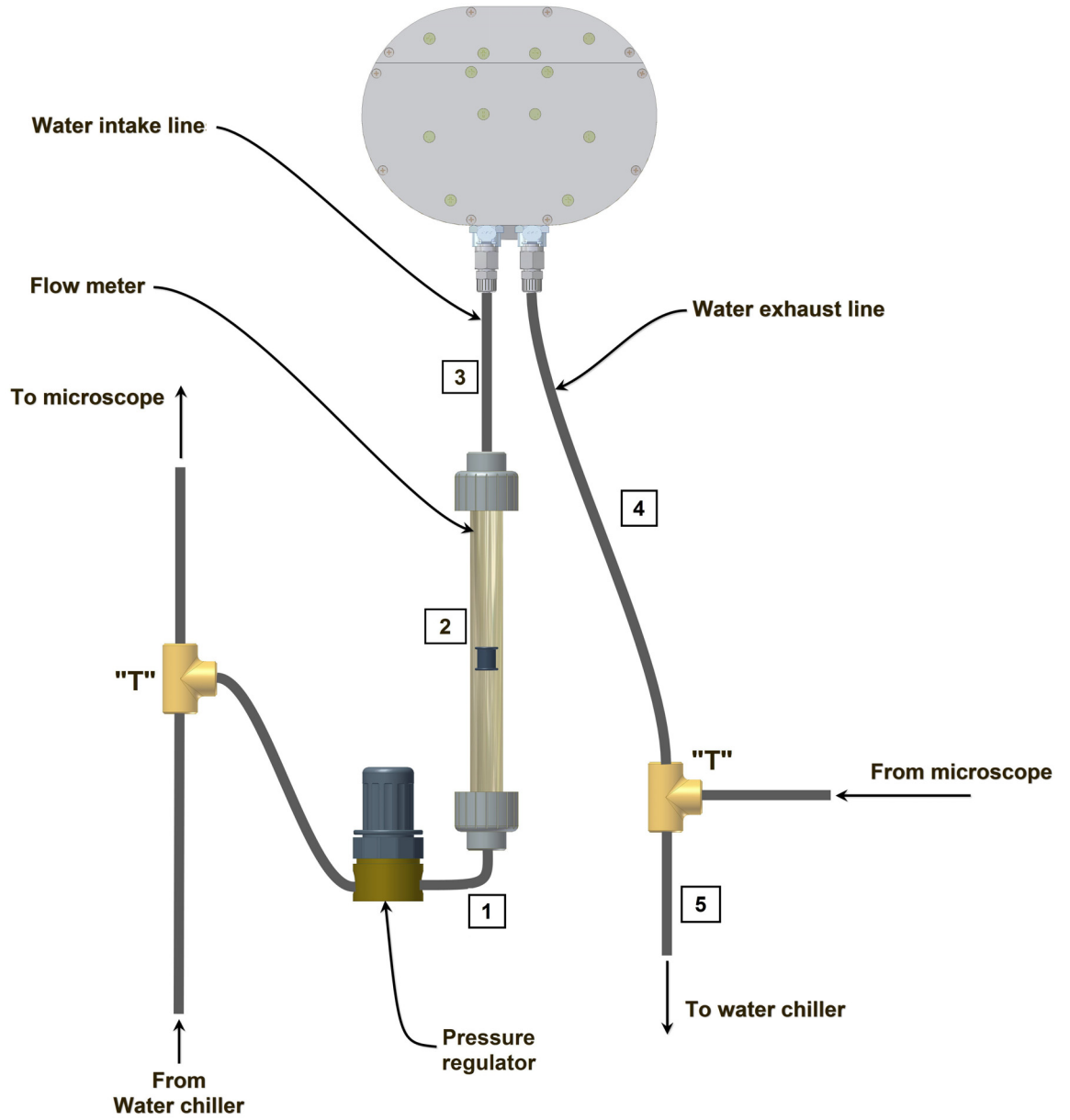


Figure A6

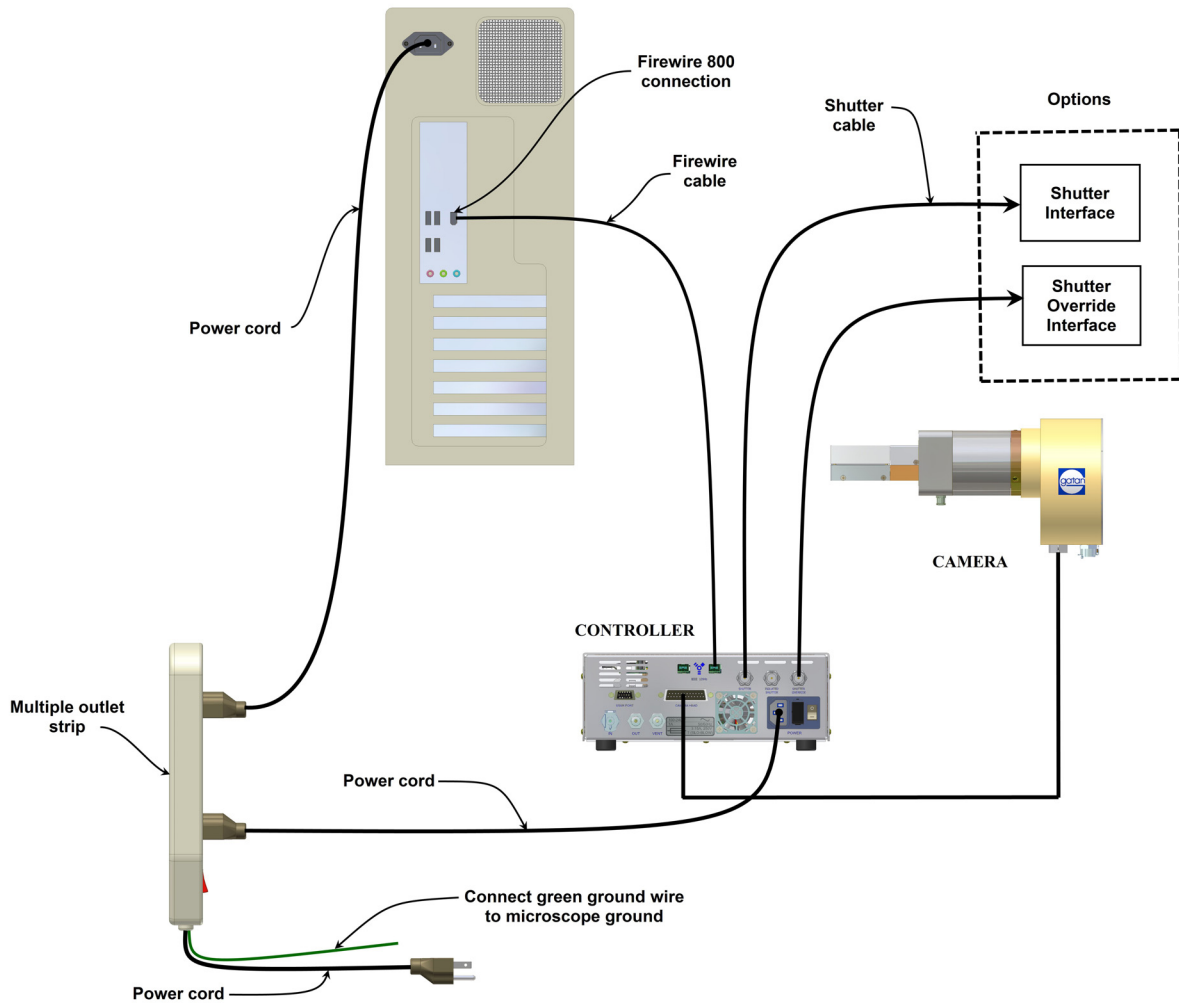
Water lines



A3.4 Electrical connections

The diagram in Figure 2-7 shows the electrical connections in the system.

Figure A7 Electrical diagram.



Appendix 2

Environmental specifications and safety requirements

TEM Requirements

The ORIUS™ camera should only be used with the TEM's listed on Gatan's compatibility chart or specifically approved in writing by Gatan Engineering.

The camera should only be used in a manor described in this manual, all other uses could cause system failures and or dangerous conditions.

Operation requirements

Ambient temperature 10-30° C

Ventilation The camera controller requires an unrestricted air supply for proper operation. Care should be taken not to restrict the supply.

Water cooling 0.2 – 0.5 l/min at 15 to 25° C
3kgf/cm² (or 3 bar) inlet pressure
no restriction on outlet flow

Pressurized air 60-90 psi or 4-6 kgf/cm²

Electrical and power requirements

Fuses 3A 250V slow blow

Voltage 100-240V

Frequency 50-60Hz

Power <100W

Power cords Only use the one supplied by Gatan.

Ground for the camera power must be the same as for the TEM power. All items, the camera, the computer and the monitor must be plugged into the Gatan supplied power strip and this MUST be grounded to the TEM, see installation instructions.

Power requirements for the computer and monitor are supplied with the computer and monitor

Appendix 3

Camera specifications

Gatan ORIUS SC1000 series CCD Camera Specification

SC1000

Camera construction	Retractable CCD sensor fiber optically coupled to high-resolution phosphor scintillator (HCR™ technology)
Operating voltage	Up to 400kV (bottom mount) 200kV (side mount)
CCD sensor	Progressive interline device 4008 x 2672 pixels (9µm each)
CCD active area	36mm x 24mm
Anti-blooming	On-chip (100x full well)
Scintillator	High-resolution phosphor
Coupling	Fiber optics (1:1)
Binning	1x, 2x, 3x, 4x
CCD readout	Full or sub area
Magnification with respect to film	About 1/3 for 35mm port and 1.3-1.5x for bottom mount
Readout speed	30MHz / 5 MHz
Dynamic range	14-bit
Frame rate	> 14 fps @ 4x binning full CCD area (1002 x 668 pixels) 30MHz dual port CCD readout
Readout time	~ 2.5 sec full frame @ 1x binning 5MHz single CCD readout
Peltier cooling	+10C regulated
Dark current	< 2 counts /pixel/sec (1x binning)
Readout noise	7- 10 counts
Mounting position	On-axis TEM bottom port or 35mm port
Gain uniformity	Transparent gain correction and dark subtraction; better than 10% r.m.s. in uncorrected images; better than 0.5% r.m.s. in gain corrected image
Conversion efficiency	2-8 counts/primary e- @100kV
Resolution (Nyquist frequency)	> 0.5 @ 100kV at 1x binning
Saturation (1x binning)	> 50,000 CCD e-
Non-linearity	< 1%
Exposure setting	1 ms – 30 min
Water connection	YES
Water failure protection	YES
TEM shutter	Not required
Computer platform	Windows 2000 Professional and XP
Computer-camera interface	IEEE 1394b (Firewire 800). Compatible with IEEE 1394a (slower frame rate)
Power requirement	< 100W. 100-240V, 50/60HZ
X-ray radiation safety	PTB standard
Regulatory compliance	CE
Camera dimensions	Depends on TEM configuration and mounting position.
Average shipping weight	30 - 90 kg depending on configuration

Appendix 4

CE certification

DECLARATION OF CONFORMITY

(According to ISO/IEC GUIDE 22 and EN 45014)

Manufacturer's Name: **Gatan Inc.**
Manufacturer's Address: **5933 Coronado Lane
Pleasanton, CA 94588 U.S.A.**

DECLARES THAT THE PRODUCT

Product Name: **Orius**
Model Number: **832(W) / 831**

CONFORMS TO THE FOLLOWING EUROPEAN DIRECTIVES

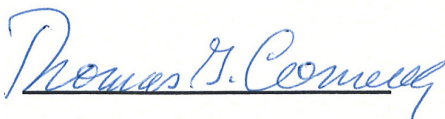
***Low Voltage Directive 73/23/EEC
EMC Directive 89/336/EEC
As Modified by Directive 93/68/EEC
Ionizing Radiation 96/29/EURATOM***

In accordance with the following standards:

Safety : **EN 61010-1:2001**
EMC: **EN 61326-1: 2002**

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directives and Standards.

Place: Pleasanton, CA

Signature: 

Date: March 08, 2006

Full Name: Thomas Connelly

Position: President and CEO

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