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# The XL FEG/SFEG/SIRION Scanning Electron Microscope Operating Manual

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Technical Author

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# PREFACE

## About this Manual

This *Manual* for your Standard XL Scanning Electron Microscope is divided into the following chapters:

- **SAFETY AND HANDLING** provides important information required during operation and maintenance for product safety and personal safety.
- **SYSTEM OVERVIEW** gives the basics about your system's capabilities.
- **SYSTEM ON/OFF** gives procedures for several system on/off modes, including Startup with no Bakeout, Standby Mode, Overnight Mode, Complete Shutdown, and Emergency Shutdown.
- **USER INTERFACE** describes the interface that controls system operation, giving the function of each menu item and control area.
- **OPERATIONS** gives task-oriented procedures for how to use the system.
- **ALIGNMENT** explains how to align the column.
- **STAGES** gives a full description of functionality for each stage.
- **MAINTENANCE** step by step cleaning procedures.
- **XL HARD AND SOFTWARE OPTIONS** relevant options that are integrated into the XL system control.
- A **GLOSSARY** explains words used in this manual as well as industry terminology.

This *Manual* for your Standard XL Scanning Electron Microscope is divided into the following chapters:

- **SAFETY AND HANDLING** provides important information required during operation and maintenance for product safety and personal safety.
- **SYSTEM OVERVIEW** gives the basics about your system's capabilities.
- **SYSTEM ON/OFF** gives procedures for several system on/off modes, including Startup with no Bakeout, Standby Mode, Overnight Mode, Complete Shutdown, and Emergency Shutdown.
- **USER INTERFACE** describes the interface that controls system operation, giving the function of each menu item and control area.

# How to Use this Manual

At the beginning of each chapter you will find a contents of the subjects covered in the chapter, including specific tasks or sets of related tasks. In addition there are easy-to-read tables outlining task-oriented procedures.

## Notes, Cautions, and Warnings

Boxed information in the left column provides important messages in three categories:

| | |
|---|---|
| NOTE | A Note emphasizes information requiring special attention. |

| | |
|---|---|
| CAUTION | A Caution message appears when special handling is necessary to prevent product damage. |

| | |
|---|---|
| WARNING | A WARNING MESSAGE APPEARS WHEN SPECIAL HANDLING IS NECESSARY TO PREVENT PERSONAL INJURY OR DEATH. |

**More explicit information on Safety issues can be found in Chapter 1.**

## Conventions for Controls

References to specific knobs, buttons, or labelled functions on the system or software are labelled in small capitals. A sentence such as: "Click on the MEASUREMENT button to start this function" refers to the software button itself.

three categories:

| | |
|---|---|
| NOTE | A Note emphasizes information requiring special attention. |

| | |
|---|---|
| CAUTION | A Caution message appears when special handling is necessary to prevent product damage. |

# Finding What You Need

This manual has been organized so you can find information in several ways. You can read the manual from beginning to end (highly recommended but rarely done). Be sure to read the safety section, before operation, in Chapter 1.

Once your system is up and running, you can search for information in the main contents or the individual contents preceding each chapter.

Major headings have been hung in the left column to help you scan for the basics within a chapter. That column provides space for your own notes as well.

Tables and Figures are numbered within each chapter and are listed in the main contents.

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# 1 SAFETY AND HANDLING

## Site Requirements

Verify that the safety and environmental requirements of the workstation site, which are the responsibility of the customer, are satisfied. In particular, the pump exhaust requirements, the electrical supply and grounding (earthing) requirements, floor loading, and any local codes regarding earthquake safety are important safety issues.

If applicable, install a drip pan to collect potential oil spills and drips from the vacuum pumps.

Verify that the safety and environmental requirements of the workstation site, which are the responsibility of the customer, are satisfied. In particular, the pump exhaust requirements, the electrical supply and grounding (earthing) requirements, floor loading, and any local codes regarding earthquake safety are important safety issues.

If applicable, install a drip pan to collect potential oil spills and drips from the vacuum pumps.

# Electron Column Precautions

The Whole system conforms to:

- Rö-Verordnung-Röv (Jan, 1987) as Storstrahler und Vollschutzlast.
- EN55011 Group I Class A for EMC emission, industrial, scientific and medical equipment (March 1991).
- EN50082-1 for EMC immunity, residential, commercial and light industry (January 1992).
- EN61010-1 (1993) for Safety requirements for electrical equipment for measurement, control and laboratory use.
- X-ray emission below 1 µSv/h at 10 cm distance from the surface.

**Never attempt maintenance or service of any kind on the electron column other than that described in this User Manual.**

# Trained Service Personnel

Before starting any service task on an FEI Company product, such as an electron microscope or ion beam equipment, or any related accessories or third party equipment, the service engineer concerned must first have read and understood the relevant sections of the FEI Service Safety Manual.

The FEI Service Safety Manual, order code number 4022 190 50058, contains explicit instructions on safe working methods, descriptions of the various warning symbols and labels used on FEI equipment, and Material Safety Data Sheets for all toxic gases and materials which may be present.

A hardcopy of the FEI Service Safety Manual is shipped with every FEI Company electron microscope or ion beam instrument, and it is also present in electronic form on the FEI Customer Service CD-ROM.

industry (January 1992).
- EN61010-1 (1993) for Safety requirements for electrical equipment for measurement, control and laboratory use.
- X-ray emission below 1 µSv/h at 10 cm distance from the surface.

**Never attempt maintenance or service of any kind on the electron column other than that described in this User Manual.**

# Trained Service Personnel

Before starting any service task on an FEI Company product, such as

# User Maintenance

There may be additional limitations to safety and handling not mentioned in this manual.

Allow only trained personnel to perform maintenance procedures.

Always observe appropriate safety practices in dealing with electronic circuitry. Read and understand the safety precautions in this chapter and throughout the manual. Observe industry-approved safety methods and procedures.

If you have any doubt regarding approved safety procedures, contact safety personnel at your company, or representatives of your state, territory or province, or federal government.

and throughout the manual. Observe industry-approved safety methods and procedures.

If you have any doubt regarding approved safety procedures, contact safety personnel at your company, or representatives of your state, territory or province, or federal government.

# Terms and Symbols

## Symbols and messages

**Messages:**

The following messages are used throughout the manuals to highlight information.

**NOTE:** Text of the note.....

A note emphasizes information requiring special attention.

**CAUTION!** Text of the caution....

A Caution message appears where special handling is required to prevent product damage.

WARNING! Text of the warning...

A Warning message appears where special handling is required to prevent personal injury or death.

DANGER! Text of the danger message....

A Danger message identifies an immediate personal risk of injury or death and gives appropriate precautions.



DANGER! High Voltage



Protective ground (earth) terminal



ATTENTION! Refer to manual

**NOTE:** Text of the note.....

A note emphasizes information requiring special attention.

**CAUTION!** Text of the caution....

A Caution message appears where special handling is required to prevent product damage.

WARNING! Text of the warning...

A Warning message appears where special handling is required to prevent personal injury or death.

# Voltages

**WARNING**

COMPONENTS MAY HAVE POTENTIALLY LETHAL VOLTAGES (UP TO 30 KV).

According to the American National Standards Institute (ANSI) guidelines, a shock hazard exists when voltage levels are present which are 30 V rms or 42.4 V peak. Use extreme caution whenever a shock hazard is present. As a good safety precaution, always expect a hazardous voltage in an unknown circuit before measuring.

Operators and service personnel must be trained on potential safety hazards and safe techniques, and must observe all warnings and cautions encountered on the system and in the manuals. No person should perform any operations without prior training.

## Interlocks

Components include safety interlocks to minimize high voltage hazards. Safety interlock circuitry is provided to protect system users. Overriding interlocks is dangerous and should never be done by untrained personnel.

After completing procedures for which an interlock was disconnected, always reset (or reconnect) and test the interlock before proceeding. Cover interlocks reset automatically when the covers are replaced.

## Line Voltage

Line voltage (120 to 240 V AC) may be present in various locations within the system, even when the system or instrument is turned off. Completely disconnect the unit from line voltage by disconnecting the AC plug from the AC power source before performing service or maintenance.

**Service or troubleshooting in these areas is performed only by Service engineers.**

## Cords/Cables

Never connect or disconnect any cables or connections while power is applied to the system or components. Doing so is potentially hazardous to service personnel and could cause damage to the system or its components.

### DC Cable Color-Coding System

Internal DC power wiring in the main console is colour-coded according to Table 1-1.

TABLE 1-1 DC POWER WIRE CODING

| Color | Voltage |
|---|---|

cautions encountered on the system and in the manuals. No person should perform any operations without prior training.

## Interlocks

Components include safety interlocks to minimize high voltage hazards. Safety interlock circuitry is provided to protect system users. Overriding interlocks is dangerous and should never be done by untrained personnel.

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## Line Voltage

Line voltage (120 to 240 V AC) may be present in various locations

### AC Cords

Plug the unit AC cords only into an approved power source. Use only power cords that are in good condition. If replaced, use AC cords rated to at least the rating of the original AC cord.

Each power cable is labelled with a destination and origin and are colour-coded according to Table 1-2.

TABLE 1-2 AC CABLE CODING

| North American Color | International Color | Meaning |
|---|---|---|
| Solid Green | Green with Yellow Stripe | Ground |
| Black | Brown | Line |
| White | Blue | Neutral |

### Miscellaneous Cables

Check cables periodically for possible wear, cracks, or breaks. If any defects are found, contact service personnel.

### Main Power

The system main power should only be plugged into the approved power receptacle, as identified by system documentation.

## Ground (Earth)

**WARNING**

DO NOT EXCEED 30 VOLTS RMS BETWEEN THE INPUT CONNECTOR AND GROUND.

DURING TESTING, DO NOT TOUCH ANY OBJECT WHICH COULD PROVIDE A CURRENT PATH TO THE COMMON SIDE OF THE CIRCUIT BEING TESTED OR TO GROUND.

Some components must be grounded to operate safely. Do not defeat grounding or use an ungrounded power source. In the event of loss of a protective ground connection, all accessible conductive parts (including knobs and controls that may appear as insulating) can render an electric shock.

## Cover/Panels

Do not operate or plug in any electrical unit without the protective covers or panels installed. Only qualified persons aware of the electrical hazards should perform maintenance or service operations.

## Fuses

Only trained service personnel should replace fuses. Replace fuses

| North American Color | International Color | Meaning |
|---|---|---|
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| Black | Brown | Line |
| White | Blue | Neutral |

### Miscellaneous Cables

Check cables periodically for possible wear, cracks, or breaks. If any defects are found, contact service personnel.

# Chemicals

Before using any chemicals, obtain and read a Material Safety Data Sheet relating to the substance. Be aware of hazards and how to avoid them, before using or handling any chemical.

## Solvents

Use solvents carefully and in sparing quantities. Before using any solvent, read the Material Safety Data Sheet. Avoid hazards listed on the Material Safety literature, and avoid spillage, skin contact, eye contact, and vapour inhalation.

**Volatile and corrosive substances can diffuse through contact lenses despite reasonably well ventilated conditions.** Moreover, contact lenses are difficult to remove when an irritant chemical enters the eye, making irrigation ineffective. Care must be taken to address the issue of contact lens worn by those coming into contact with such solvent fumes.

## Nitrogen

Nitrogen may be used to vent the system. Nitrogen is not poisonous, but is a potential asphyxiant.

WARNING

SUFFOCATION IS POSSIBLE IF NITROGEN OR LIQUID NITROGEN IS RELEASED IN AN ENCLOSED ROOM WITHOUT ADEQUATE VENTILATION.

## Liquid Nitrogen

Liquid nitrogen, used in the EDX system, has the potential to cause frostbite if direct contact with skin occurs.

On standing, liquid nitrogen picks up oxygen from the air and forms liquid oxygen in solution. Treat any liquid nitrogen that is not fresh as though it had all the hazards of liquid oxygen.

## Sulphur Hexafluoride

A very small amount of sulphur hexafluoride ($SF_6$) is used as an insulating gas between the electron column feedthrough and the connector that fits the feedthrough. Contact occurs only during Philips performed service that includes this connector. Small concentrations are not hazardous but high concentrations displacing the available oxygen present potential asphyxiant hazards.

the Material Safety literature, and avoid spillage, skin contact, eye contact, and vapour inhalation.

**Volatile and corrosive substances can diffuse through contact lenses despite reasonably well ventilated conditions.** Moreover, contact lenses are difficult to remove when an irritant chemical enters the eye, making irrigation ineffective. Care must be taken to address the issue of contact lens worn by those coming into contact with such solvent fumes.

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NING

SUFFOCATION IS POSSIBLE IF NITROGEN OR LIQUID NITROGEN IS RELEASED IN AN

## Liquid Nitrogen

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# Miscellaneous Precautions

## CRT (Monitor)

The system may include a CRT (Cathode Ray Tube) for display. If the front (screen portion) of the CRT is broken, a high-velocity scattering of glass fragments results. Use care when handling the CRT. Avoid striking it with any object which may cause it to crack. If the CRT is stored, place it in protective packaging.

## Electric Fans

Some instruments in the system may be air-cooled. Do not block the air flow to or from the fans. Do not operate fans with the protective covers or filters removed. Keep fingers, loose clothing, etc. away from fans. Periodic filter maintenance may be required to prevent overheating.

## Pump Exhaust

Failure to provide proper exhaust filtering may discharge oil mist into the environment. Such oil mist may be an environmental hazard as well as a health hazard in an enclosed room.

## Corrosion

Components are painted, plated, or otherwise treated to resist corrosion. However, the components must be handled and stored properly to prevent corrosion. Observe precautions carefully.

## Electric Fans

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# Chapter 2 SYSTEM OVERVIEW

**The FEI XL FEG/SFEG SEM . . . . . 2-1**
System Capabilities . . . . . 2-1

**How the SEM Works . . . . . 2-1**
Image Viewing and Recording . . . . . 2-2
System Vacuum . . . . . 2-3
Positioning of the stage . . . . . 2-3
User Interface . . . . . 2-3

**System Options . . . . . 2-4**
Software . . . . . 2-4
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Software . . . . . 2-4
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# 2 SYSTEM OVERVIEW

## The FEI XL FEG/SFEG SEM

### System Capabilities

The FEI XL FEG or SFEG Scanning Electron Microscope (FEGSEM) produces enlarged images of a variety of specimens, achieving magnifications of over 300,000x. This important and widely used analytical tool provides exceptional depth of field, minimal specimen preparation, and the ability to combine the technique with X-ray microanalysis.

Designed to image samples ranging from biological specimens to entire wafers for the semiconductor industry, the XL FEG/SFEG provides ultra high resolution imaging and image enhancement capabilities not found in other SEM microscopes or Transmission Electron Microscopes (TEMs).

The Sirion version of the SFEG provides higher current density in smaller spotsizes for ultra-high resolution low voltage investigation.

## How the SEM Works

Four main components combine to produce the images from the sample: an electron gun, a demagnification unit, a scan unit and a detection unit. The electron gun, which is the source emitter, produces electrons within a small spatial volume with a small angular spread and a selectable energy. This beam enters the demagnification unit, consisting of several electromagnetic lenses, and exits to arrive at the specimen surface with a much smaller diameter than that produced by the gun.

Electrons striking the specimen react with the atoms of the sample surface and produce three types of signals: X-rays, electrons, and photons. The main detector system picks up the electrons, amplifies them and converts them into electrical voltage.

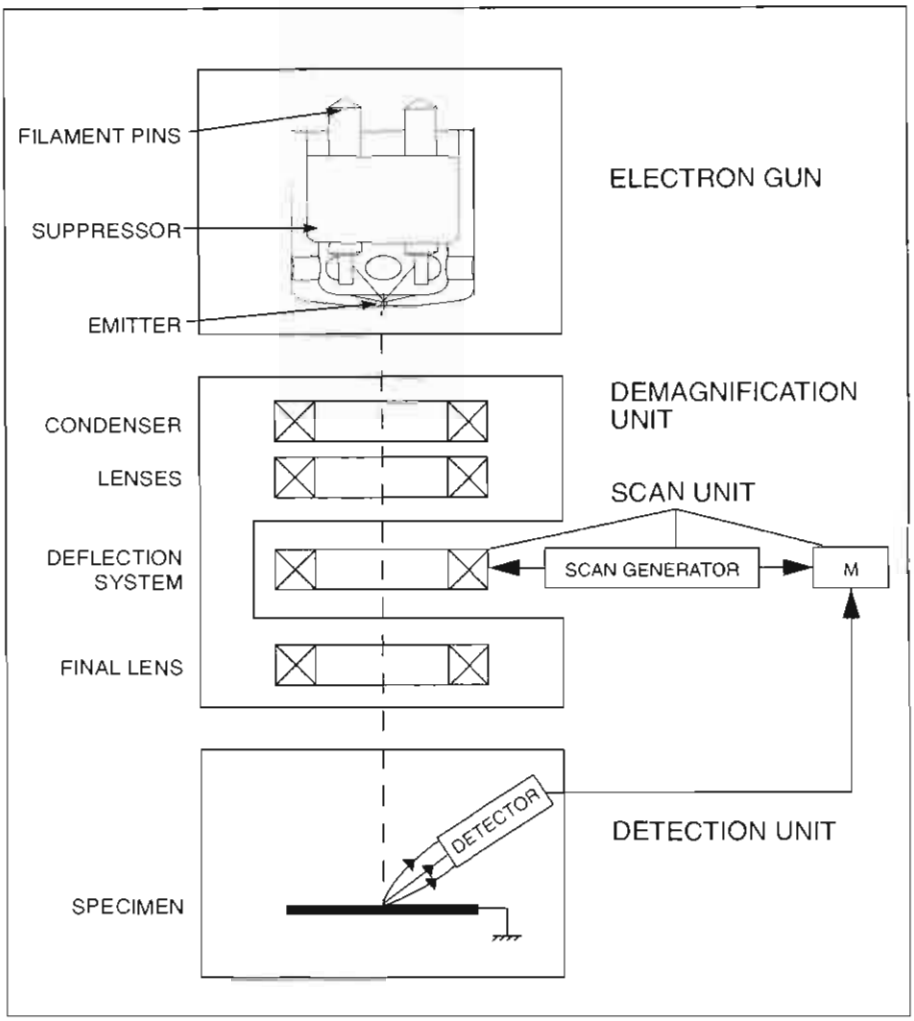
### System Capabilities

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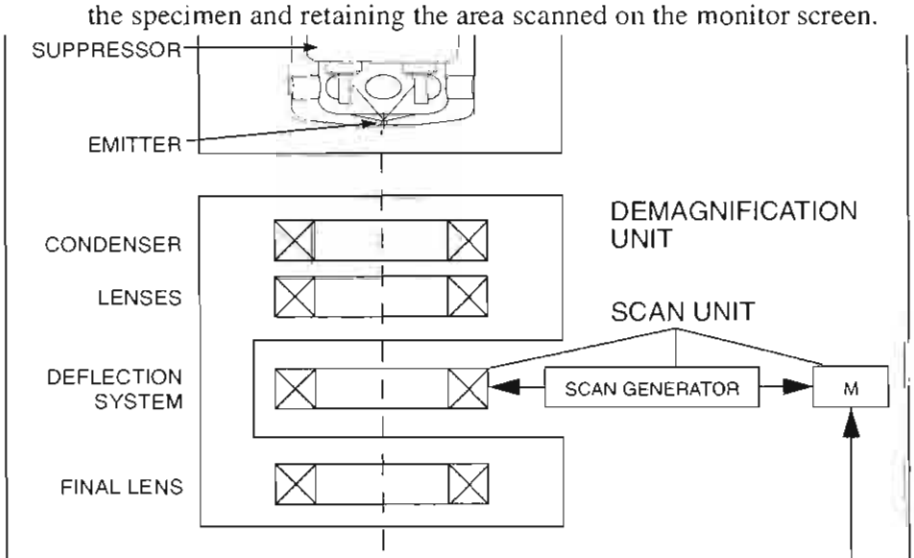
*FIGURE 2-1 SEM SCHEMATIC OVERVIEW*




## Image Viewing and Recording

Because the beam is scanning the specimen in synchronism with the signal from the detector, there is a correspondence between the brightness of an image point on the Monitor and the number of secondary electrons emitted by a point on the specimen.

Magnification is the ratio of the size of the viewing monitor screen and the size of the area scanned on the specimen. Increased magnification is achieved by reducing the size of the area scanned on the specimen and retaining the area scanned on the monitor screen.



## System Vacuum

The entire electron path from gun to specimen must be under vacuum so the electrons won't collide with air molecules and be absorbed. Various levels of vacuum are necessary: ion-getter pumps obtain the highest vacuum in the source region and above the column isolation valve, while an oil diffusion or turbomolecular pump backed by a rotary pre-vacuum pump obtains the necessary specimen chamber vacuum.

Specimen exchanges take place through a chamber door, when opened it exposes the specimen stage. Exchange time takes a few minutes.

Vacuum/software interlocks ensure that the system is fully protected against operating failures.

## Positioning of the stage

A choice of computer-controlled multi-axis stages offer precision specimen manipulation for overall spatial orientation on highly repetitive or extremely irregular samples.

## User Interface

The user interface consists of a single high-level user shell employing applications programs within a Windows™ operating environment.

Vector parameter files defining specific instrument settings for particular applications ensure reproducibility of complex procedures.

An intermediate software layer, acting on instructions from the application layer controls the column, detector(s), stage, EDX and vacuum functions. This layer also provides management of framestore, and data output devices.

Specimen exchanges take place through a chamber door, when opened it exposes the specimen stage. Exchange time takes a few minutes.

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## Positioning of the stage

A choice of computer-controlled multi-axis stages offer precision specimen manipulation for overall spatial orientation on highly repetitive or extremely irregular samples.

## User Interface

The user interface consists of a single high-level user shell employing applications programs within a Windows™ operating environment.

# System Options

## Software

Software options include:

- Metrology software
- Convolution function
- Color imaging
- Image Analysis
- Image database management.

## Hardware

Hardware options include:

- Sample and wafer holders
- Optional detectors such as:
  - The Solid State BSE detector
  - The STEM detector
- CCD camera
- EDX (X-ray analysis) equipment

- Image database management.

## Hardware

Hardware options include:

- Sample and wafer holders
- Optional detectors such as:
  - The Solid State BSE detector
  - The STEM detector
- CCD camera
- EDX (X-ray analysis) equipment

**Overview** . . . . . **3-1**

**Choosing the On/Off Procedure** . . . . **3-2**

**Startup with No Bake Out** . . . . . **3-3**

**Standby Mode** . . . . . **3-6**
Going Into Standby Mode . . . . . 3-6
Startup After Standby . . . . . 3-7

**Overnight Mode** . . . . . **3-8**

**Complete Shutdown** . . . . . **3-9**

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**Emergency Shutdown** . . . . . **3-10**

# 3 SYSTEM ON/OFF

## Overview

This chapter describes how to startup the column to obtain an adequate high vacuum for the emission chamber. The level of the vacuum is extremely important for the lifetime of the filament in the FEG or SFEG instruments.

There are several on/off conditions for the system:

- Startup with No Bakeout
- Standby Mode
- Overnight Mode
- Complete Shutdown
- Emergency Shutdown

Before starting the system, check for the presence of electrical power, compressed air, cooling water, and nitrogen for venting and cooling. With the exception of nitrogen, interlocks prevent the vacuum system from operating if the others are not present.

If the system vacuum cannot be obtained from the following procedure then the system has been at very poor vacuum for too long and will need a bakeout sequence to be initiated. This is a service function and FEI service should be called to perform this operation.

This chapter describes how to startup the column to obtain an adequate high vacuum for the emission chamber. The level of the vacuum is extremely important for the lifetime of the filament in the FEG or SFEG instruments.

There are several on/off conditions for the system:

- Startup with No Bakeout
- Standby Mode
- Overnight Mode
- Complete Shutdown
- Emergency Shutdown

Before starting the system, check for the presence of electrical power,

# Choosing the On/Off Procedure

TABLE 3-1 A COMPARISON OF ON/OFF PROCEDURES

| Procedure Name | When to Use | Condition System Left In | Steps to Return to Full Operation |
|---|---|---|---|
| **Startup with No Bakeout** | After Complete Shutdown or Emergency Shutdown if bakeout not required. | Server and Microscope Control loaded. Electronics operational. | Startup with No Bakeout procedure. |
| **Standby Mode** | If not using the system >1 week or during service. | IGPs pumping. Filament off. Specimen chamber vented. | Click on STBY button on system control panel. It takes about 1 day to achieve stable emission current. |
| **Overnight Mode** | If not using the system overnight or < 5 days. | High tension (kV) off. (Increases filament lifetime) | Click on high tension (kV) button. |
| **Complete Shutdown** | During transportation. | Totally off. | Startup with No Bakeout procedure. |
| **Emergency Shutdown** | During power failure. | Totally off. | Startup with No Bakeout procedure. |


| | if bakeout not required. | operational. | |
|---|---|---|---|
| **Standby Mode** | If not using the system >1 week or during service. | IGPs pumping. Filament off. Specimen chamber vented. | Click on STBY button on system control panel. It takes about 1 day to achieve stable emission current. |
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| **Complete Shutdown** | During transportation. | Totally off. | Startup with No Bakeout procedure. |

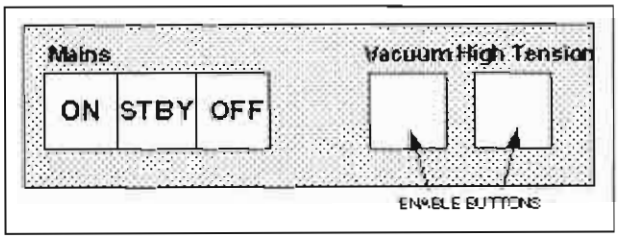
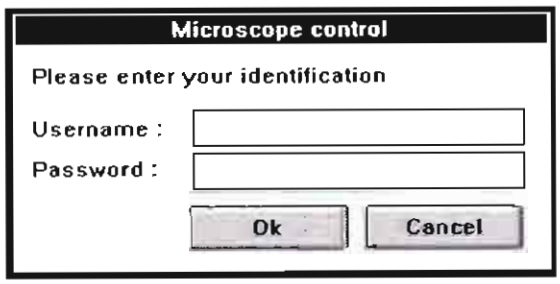
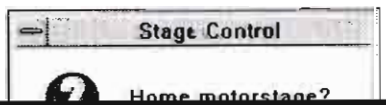
# Startup with No Bake Out

| NOTE | A Startup cycle may take several hours. |
|---|---|

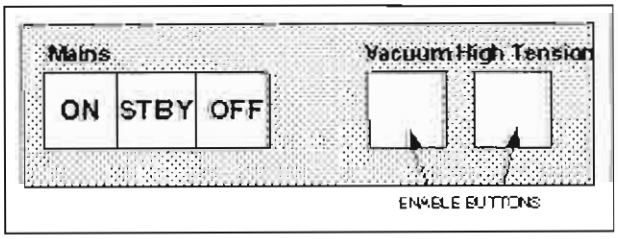
| NOTE | Bakeout is required if vacuum pressures are too high for system operation. A dialog box will display telling you to call Service. |
|---|---|

The startup cycle depends on the initial vacuum status of the system. The procedure is fully automatic, but observe the system for the first 30 minutes to confirm that the IGPs show sufficient vacuum to continue and complete the procedure.

TABLE 3-2 STARTUP PROCEDURE (NO BAKE OUT)

| Step | Action |
|---|---|
| 1a | Press the illuminated ON button on the system control panel. The ON button light goes off while the STBY and OFF buttons light up.<br> |
| 2 | Program Manager displays onscreen.<br>Double-click on the software icon.<br>The VACUUM button lights up on the control panel. |
| 3 | If AccountLog Software is installed, the Microscope Control dialog box displays onscreen:<br><br>Type in your Username and Password and click on OK. |
| 4 | The main window opens with the Stage control dialog box onscreen.<br> |

| 2 | A dialog box will display telling you to call Service. |
|---|---|

| Step | Action |
|---|---|
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| 2 | Program Manager displays onscreen.<br>Double-click on the software icon.<br>The VACUUM button lights up on the control panel. |

1b : Turn on control PC by pressing ON button.
Log into Windows
U: general user
P: feiSEM1850E

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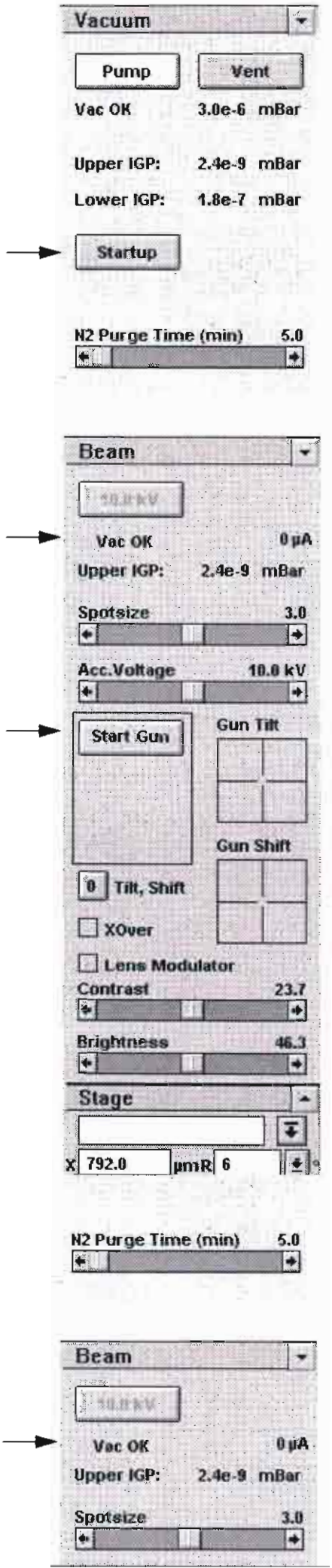



TABLE 3-2 STARTUP PROCEDURE (NO BAKE OUT)

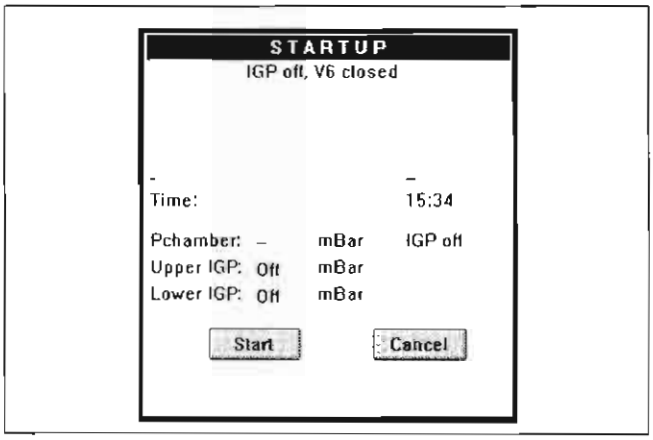
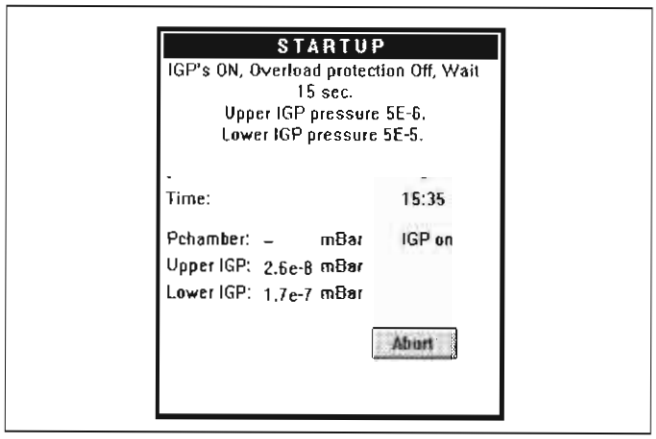
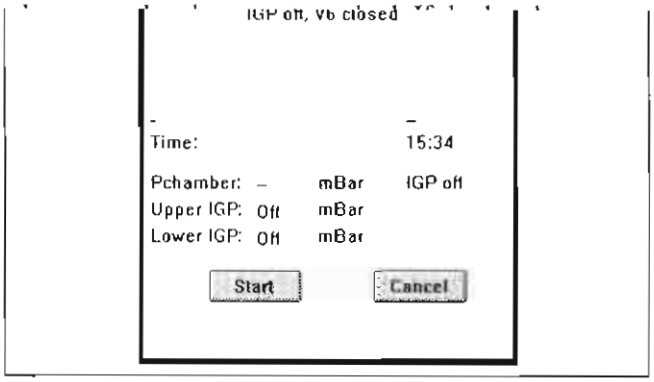
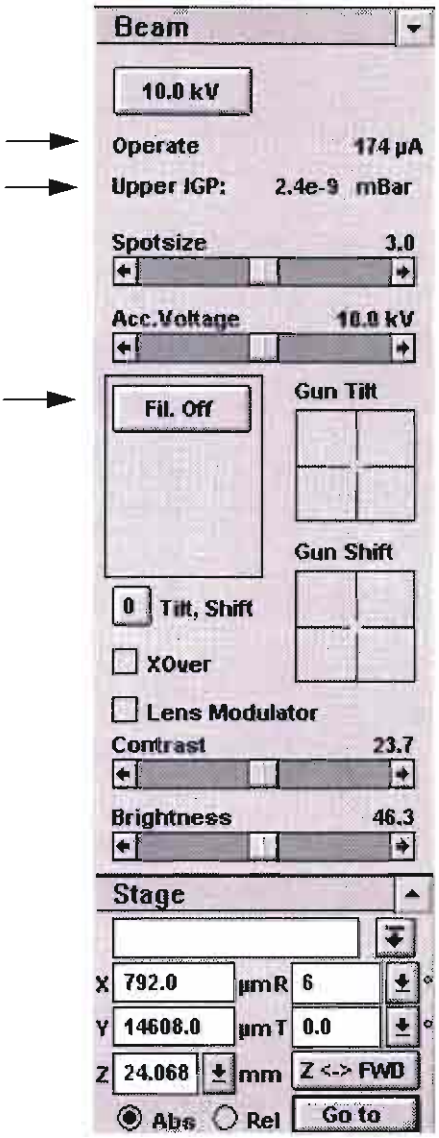
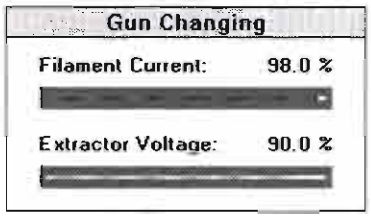
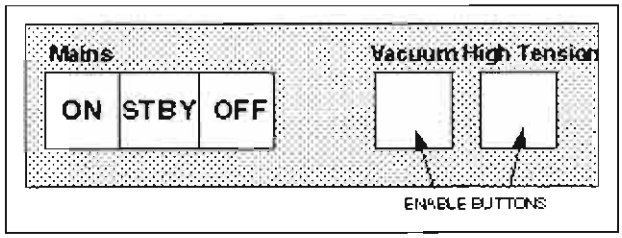
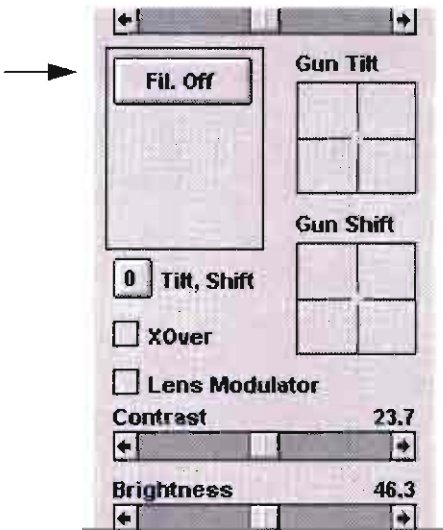
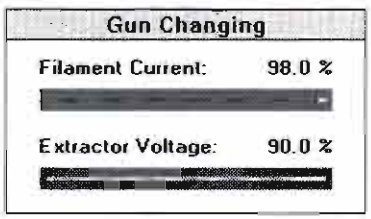
| Step | Action |
|---|---|
| CONTINUED | |
| 5 | Maximize the Vacuum control group of the Settings control area. Click on STARTUP. The Startup dialog box displays onscreen.<br><br>Click on the START button in the dialog. |
| 6 | The dialog box displays the IGP status. After 15 seconds, the ABORT button changes to OK.<br><br>Click on the OK button. |
| 7 | If the proper vacuum levels cannot be reached, the process should be repeated up to 5 times from 5 - 6. The message "GunVacNotOK" will display below the high tension (kV) button on the Beam control group if<br><br>Click on the START button in the dialog. |
| 6 | The dialog box displays the IGP status. After 15 seconds, the ABORT button changes to OK. |

TABLE 3-2 STARTUP PROCEDURE (NO BAKE OUT)

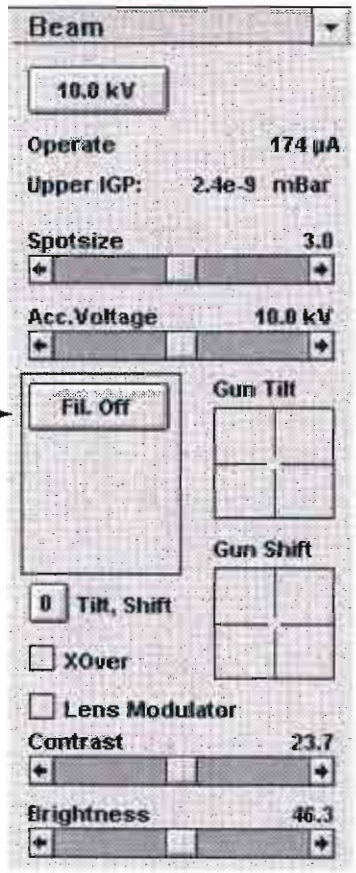



| Step | Action |
|---|---|
| CONTINUED | |
| 8 | The sample can now be loaded into the specimen chamber. |
| 9 | Once the Upper IGP pressure reads < 4 x $10^{-9}$ mbar, maximize the Beam control group of the Settings control area. |
| 10 | The Gun Changing dialog box appears on screen.<br><br><br>When both values reach 100%, the dialog box goes away and OPERATE appears below the kV button. The START GUN button is replaced with the FIL. OFF button. |
| 11 | Press the mechanical HIGH TENSION enable button on the system control panel.<br><br><br>The button lights up. |




| | |
|---|---|
| | control area. |
| 10 | The Gun Changing dialog box appears on screen.<br><br><br>When both values reach 100%, the dialog box goes away and OPERATE appears below the kV button. The START GUN button is replaced with the FIL. OFF button. |
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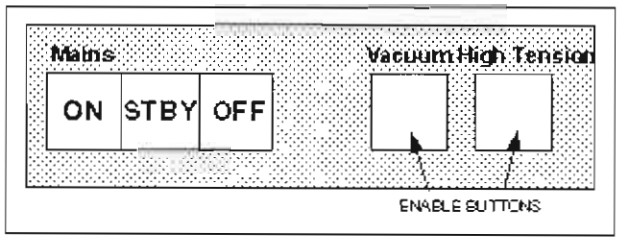
# Standby Mode




## Going Into Standby Mode

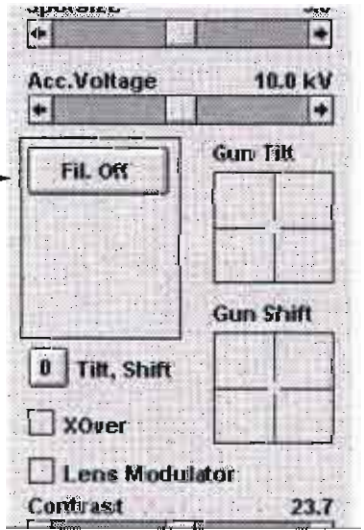
Standby Mode is a system shutdown process used when the system will not be used for a period longer than one week or during service. Also, an error message may appear telling you to switch to Standby Mode if there is a problem with the processor or computer.

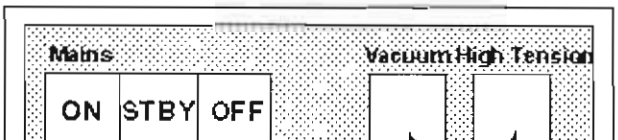
TABLE 3-3 GOING INTO STANDBY MODE

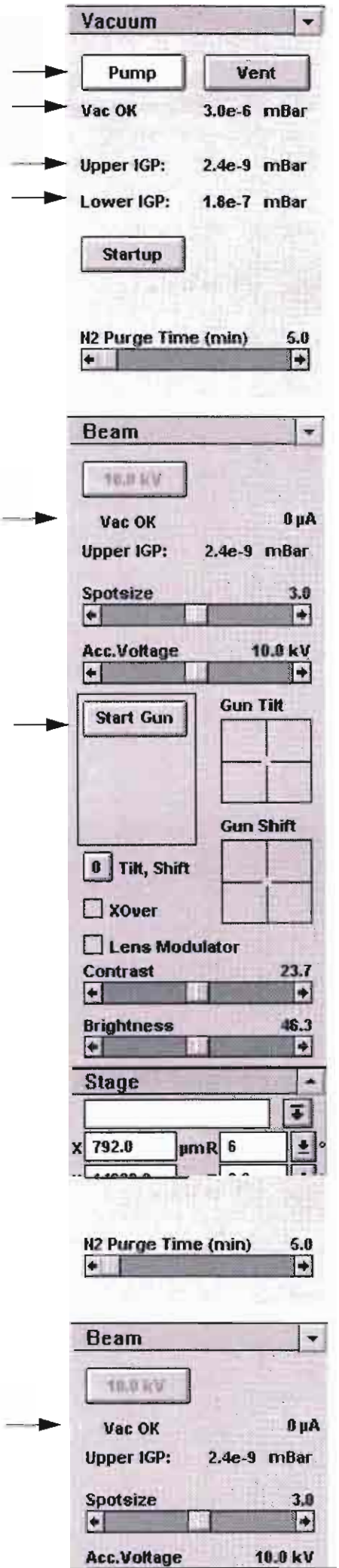
| Step | Action |
|---|---|
| 1 | To turn off the electron source, click the FIL OFF button on the maximized Beam control group of the Settings control area. It takes about 30 seconds to ramp down. |
| 2 | Close Microscope Control and Windows. |
| 3 | Push the STBY button on the system control panel.<br><br><br>The STBY button light goes out, the microscope and computer turn off, and the ON button lights up (a cue to restart). |

Standby Mode is different from the system being completely turned off. The gun chamber and the intermediate chamber in the electron column are already under vacuum and the IGPs are still running. The rest of the system is switched off. Assuming that the vacuum in the emission chamber is correct, the time involved to "VacOK" is about 20 minutes.

The system can be left in this state if utilities (water, air, nitrogen), other than electrical, need to be disconnected.




| Step | Action |
|---|---|
| 1 | To turn off the electron source, click the FIL OFF button on the maximized Beam control group of the Settings control area. It takes about 30 seconds to ramp down. |
| 2 | Close Microscope Control and Windows. |
| 3 | Push the STBY button on the system control panel.<br><br> |




## Startup After Standby

It is assumed here that all external supplies are present and that only the specimen chamber is vented. The startup procedure is fully automatic. Observe the startup for the first 30 minutes to confirm that the IGPs are showing sufficient vacuum to continue and complete the procedure.

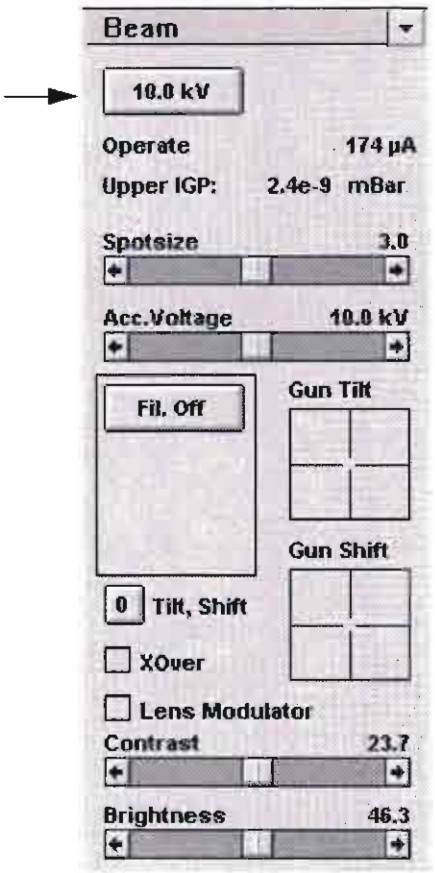
TABLE 3-4 STARTUP AFTER STANDBY

| Step | Action |
|---|---|
| 1 | Press the system control panel ON button to restart the system. |
| 2 | Double-click on the software icon. |
| 3 | Check the IGP readouts on the Vacuum control group to verify that the IGPs are on and pressure is OK. |
| 4 | Click on the PUMP button in the Vacuum control group. The "VacOK" message appears below the PUMP button after about 20 minutes. |
| 5 | Maximize the Beam control group. Click on START GUN. |

After 1 hour the system is operational.

| Step | Action |
|---|---|
| 1 | Press the system control panel ON button to restart the system. |
| 2 | Double-click on the software icon. |
| 3 | Check the IGP readouts on the Vacuum control group to verify that the IGPs are on and pressure is OK. |
| 4 | Click on the PUMP button in the Vacuum control group. The "VacOK" message appears below the PUMP button after about 20 minutes. |

# Overnight Mode




Overnight Mode is a system shutdown process used when the system will not be used overnight or for less than two days. High tension is switched off and the filament current left on, as in daily operation during specimen exchange. In this way, getting back to an operating state is achieved within a few minutes.

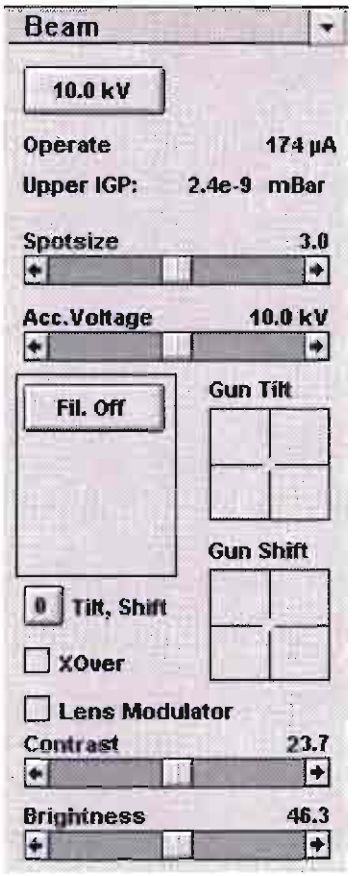
TABLE 3-5 LEAVING THE SYSTEM OVERNIGHT

| Step | Action |
|---|---|
| 1 | Turn off the high voltage by clicking on the high tension (kV) button in the Beam control group of the Settings control area. |
| 2 | Exit Microscope Control and quit Windows. |




| Step | Action |
|---|---|
| 1 | Turn off the high voltage by clicking on the high tension (kV) button in the Beam control group of the Settings control area. |
| 2 | Exit Microscope Control and quit Windows. |

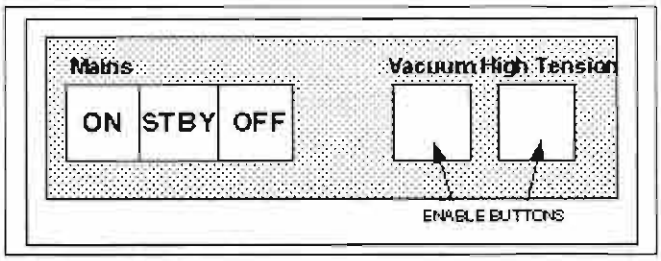
# Complete Shutdown




Complete shutdown should be performed only if absolutely necessary and for the shortest possible time, so as to recover the column vacuum without the necessity of a bakeout. Normally, you would only do a complete shutdown for transportation of the system.

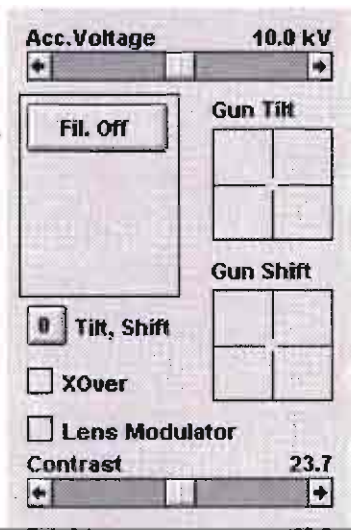
The shutdown procedure also takes into account a cool down period for the FEG tip where the current and extraction voltage are brought to zero. The shutdown procedure brings the system to the no-power situation, where the vacuum at the column area is no longer supported by running IGPs. All valves are closed and the column area is not vented.

TABLE 3-6 COMPLETE SHUTDOWN PROCEDURE

| Step | Action |
|---|---|
| 1 | To turn off the electron source, click the FIL OFF button on the maximized Beam control group of the Settings control area. It takes about 30 seconds to ramp down. |
| 2 | Close Microscope Control and quit Windows. |
| 3 | Press the OFF button on the system control panel to shutdown the entire system.  |



Use the procedure in *Table 3-2 (STARTUP WITH NO BAKEOUT)* to restart the system.




situation, where the vacuum at the column area is no longer supported by running IGPs. All valves are closed and the column area is not vented.

TABLE 3-6 COMPLETE SHUTDOWN PROCEDURE

| Step | Action |
|---|---|
| 1 | To turn off the electron source, click the FIL OFF button on the maximized Beam control group of the Settings control area. It takes about 30 seconds to ramp down. |
| 2 | Close Microscope Control and quit Windows. |
| 3 | Press the OFF button on the system control panel to |

# Emergency Shutdown

The system is protected against power failures in the sense that the different components of the system are not damaged. However a power failure, especially with a filament in Operating mode is never good for the system. It might affect the brightness of the tip, the ultra-high vacuum levels of the column and the stability of the system. Therefore sufficient measures must be taken to avoid power failures as much as possible.

If a power failure occurs during normal operation of the system, it comes down to a safe status and the following happens:

- The specimen chamber vents.
- The column valves close so the high vacuum in the emission chamber is not completely destroyed. However, the filament is switched off abruptly and the cooling down is much faster than a normal shutdown procedure.
- The momentary adjustments of all the system parameters (high voltage, magnification, stage positions) are lost if they were not saved.

Use the procedure in *Table 3-2 (STARTUP WITH NO BAKEOUT)* to get the system back in operation.

If a power failure occurs during normal operation of the system, it comes down to a safe status and the following happens:

- The specimen chamber vents.
- The column valves close so the high vacuum in the emission chamber is not completely destroyed. However, the filament is switched off abruptly and the cooling down is much faster than a normal shutdown procedure.
- The momentary adjustments of all the system parameters (high voltage, magnification, stage positions) are lost if they were not saved.

Use the procedure in *Table 3-2 (STARTUP WITH NO BAKEOUT)* to get the system back in operation.

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# 4 USER INTERFACE

## Overview

This chapter gives an overview of the Microscope Control software and describes the functionality of each part of the user interface. It takes you from the first main window and menu bar through each item on the pulldown menus. Graphics illustrating most of the choices help you locate specific features.

The software interface controls most system functions including detection and analysis, scanning, image gathering, manipulation and output, magnification and vacuum.

**See the Operations Chapter for a task-oriented approach to using the software.**

For more detailed information about Windows, refer to the *Microsoft® Windows™ Users' Guide* shipped with your system.

### Other Software and Hardware

Call Customer Service for advice before installing software or hardware that is not required for system operation. Other software, such as screen savers, or hardware network cards may corrupt the Microscope Control software under some circumstances.

This chapter gives an overview of the Microscope Control software and describes the functionality of each part of the user interface. It takes you from the first main window and menu bar through each item on the pulldown menus. Graphics illustrating most of the choices help you locate specific features.

The software interface controls most system functions including detection and analysis, scanning, image gathering, manipulation and output, magnification and vacuum.

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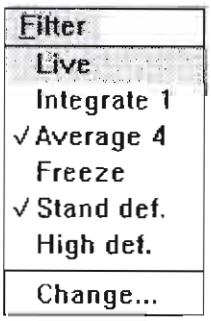
# Interface Elements




## Icon

A small symbol indicating a specific software application. For example, the software can be shrunk to an icon at the bottom of the screen (as shown at left). An application shown as an icon is running in the background of the computer memory. Double-click on the icon to restore the program. For more details, see *Microsoft Windows Users' Guide*.

There are also icons in the tool bar for selecting system functions quickly.




## Pulldown Menus

The XL FEG uses menu-oriented software; you perform functions by choosing items from the menu bar. The menu bar selections contain pulldown menus that display group listings of available commands or settings. Some menu items are shown in grey and cannot be selected. You might also get a beeping noise if you try to select unavailable functions.

### Selecting with the Mouse

To select a pulldown menu, click on the menu item in the menu bar, then drag the cursor down to the desired selection and release the left mouse button.

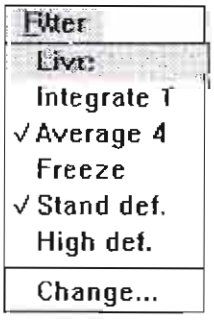
Pulldown menu selections followed by an ellipsis (...) indicate a dialog box will display. Selections with a right arrow indicate an additional submenu of choices will display.

If the selected setting is a parameter value, the new value is updated immediately and a check mark appears in the pulldown menu. If the selected setting is a command, a new popup menu or dialog box appears.

### Selecting with Keyboard Commands

To use keyboard commands for selecting top level menu items, press ALT plus the underlined letter (for example, ALT + F for the Filter menu), and then select from the choices with the left mouse button or with the up or down arrow keys.

There are also icons in the tool bar for selecting system functions quickly.




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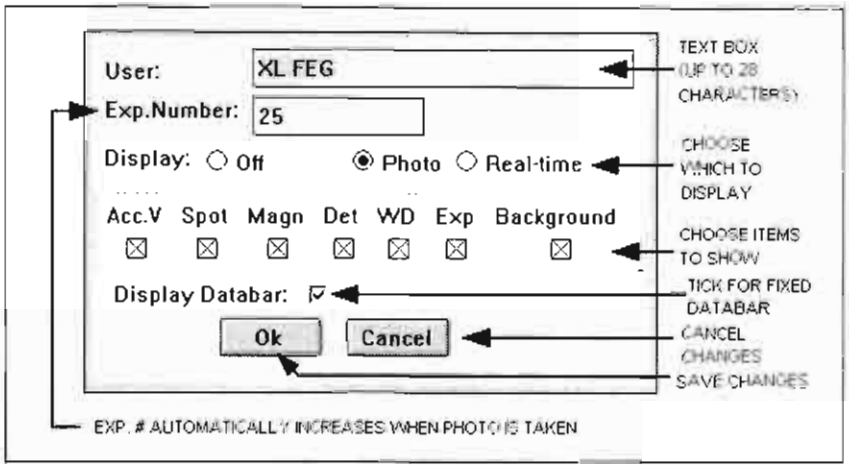
### Selecting with the Mouse

To select a pulldown menu, click on the menu item in the menu bar, then drag the cursor down to the desired selection and release the left mouse button.

## Dialog Boxes

A dialog box appears when the system needs more information from you before it can carry out a command. You can input information using text boxes, option buttons and command buttons.

Some dialog boxes do not let you access other functions until you exit the box. Other dialog boxes let you perform other tasks while they remain onscreen and active. For example, the contrast and alignment dialog boxes can remain open while you do other tasks.




### Text Boxes

Type information in a text box. This direct keyboard input is used to produce text such as filenames, user labels in the data bar, and specified values of certain parameters.

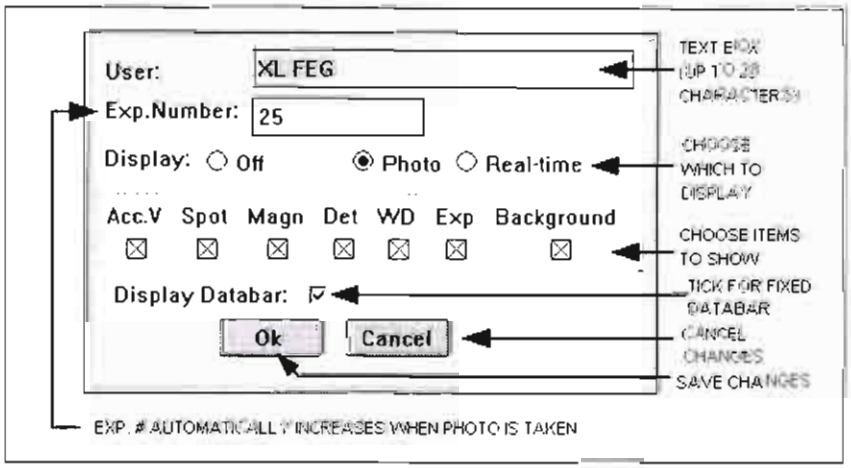
### Option Buttons

Use round option buttons to make selections. Within a group of related option buttons, only one selection can be active at a time.

### Command Buttons

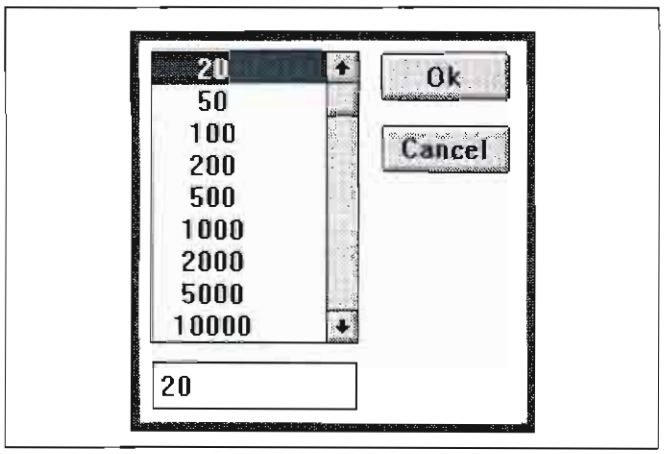
Rectangular command buttons carry out or cancel a function. Command buttons have labels that describe the action. Examples: OK, CANCEL, RESET.

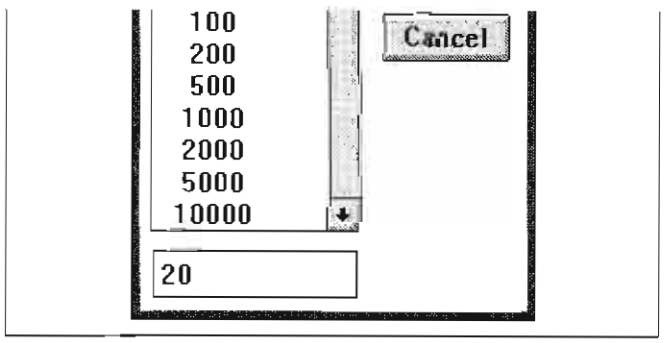
Click on OK to close the dialog box. The software updates all information shown in the dialog box. Click on CANCEL to quit the dialog box without updating the information.



## List Boxes

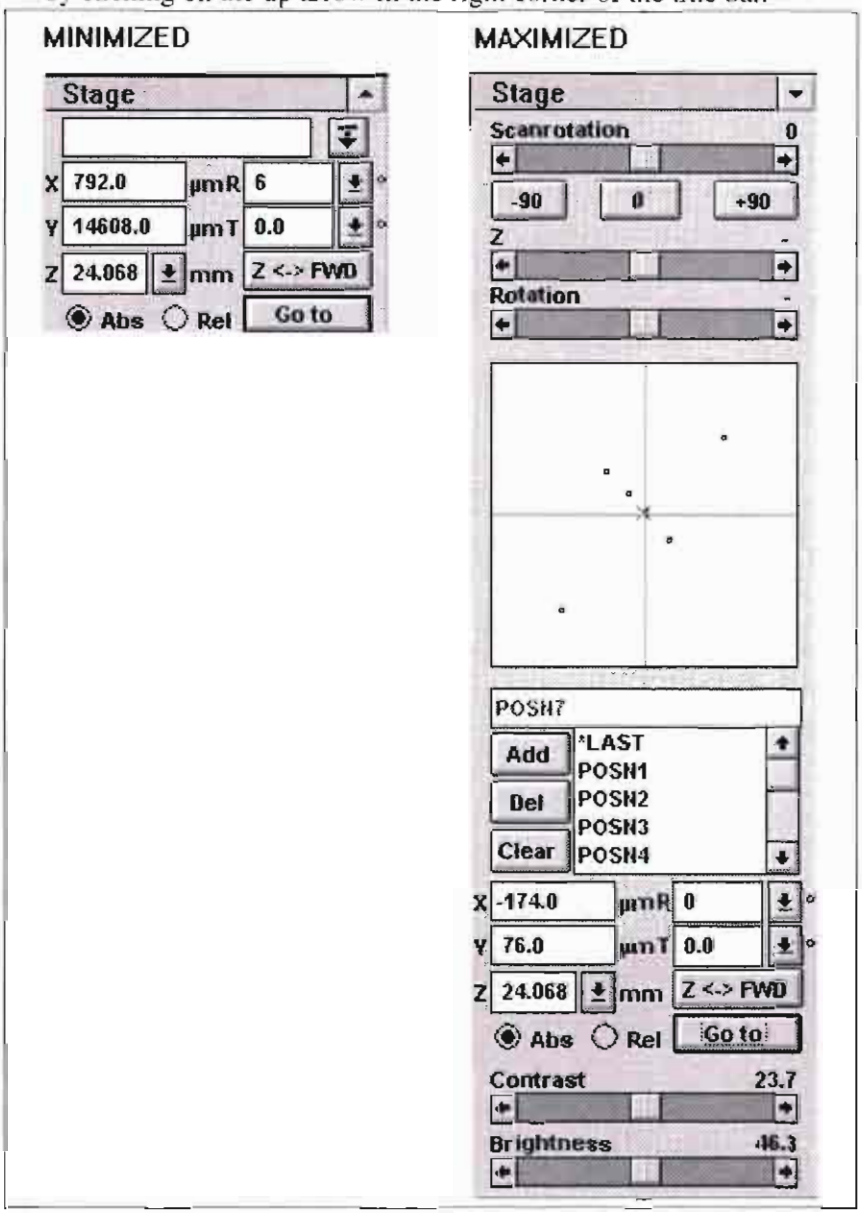
List boxes contain available choices, such as magnification settings. If a list box is too small to show all the selections, click on the up or down arrow in the vertical scroll bar or click and drag the slider to see more of the list.



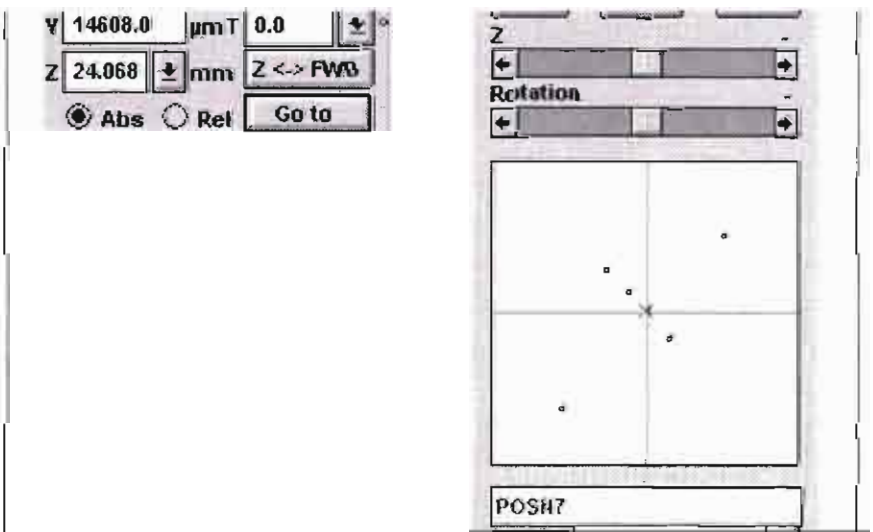



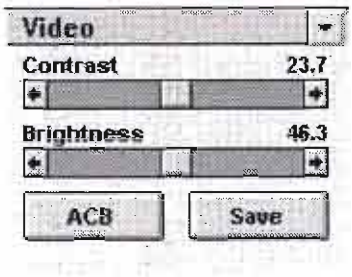
## Minimize/Maximize Buttons

You can expand control groups to access additional control functions by clicking on the up arrow in the right corner of the title bar.




Click on the down arrow to minimize.






## Continuous Control Adjusters

A continuous control adjuster allows you to change parameters, such as contrast, brightness and scan rotation, in a continuous way by clicking and dragging the middle slider or clicking in the grey bar.

- **middle slider**—for large or small adjustments, depending where you release it. The further from centre the middle slider is pulled, the larger the change. Unlike a scroll bar, the middle slider always snaps back to the centre of the adjuster.
- **grey bar**—for larger adjustments, single step increments.
- **end arrow**—for finer adjustments, single step increments.

These adjusters always have a label in the upper left and right corners for readout information. There is no similar keyboard functionality for these continuous control adjusters.




## Two-Dimensional X-Y Controls

These two-dimensional continuous controls are represented by an X-Y box. The position of the crosshair is related to the actual settings, the full range of the parameters being represented by the perimeter of the box.

Click and hold down the left mouse button in the grid to display a crosshair in the image area. The cursor changes to a hand and can be moved in two directions that correspond to the X, Y screen values. To fix the values, release the mouse button and the position of the crosshair updates.

The sensitivity of the X-Y control can depend on the magnification chosen. At higher magnification, you may have to drag and release a number of times more for the same adjustment than you would at lower magnification levels.

## User Access Privileges

Two levels of user access are defined in the microscope software: User and Supervisor. Supervisor may have access to functions that User does not, including the entire Adjustments control area.

- **grey bar**—for larger adjustments, single step increments.
- **end arrow**—for finer adjustments, single step increments.

These adjusters always have a label in the upper left and right corners for readout information. There is no similar keyboard functionality for these continuous control adjusters.

Stigmator

Two-Dimensional X-Y Controls

These two-dimensional continuous controls are represented by an X-Y box. The position of the crosshair is related to the actual settings, the full range of the parameters being represented by the perimeter of the box.

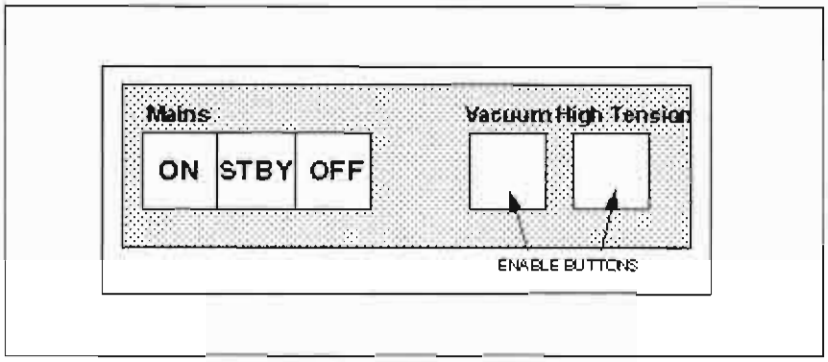
Click and hold down the left mouse button in the grid to display a crosshair in the image area. The cursor changes to a hand and can be

## Monitor

The control facilities and data are displayed graphically on the monitor and are superimposed on the image.

## The System Control Panel

*FIGURE 4-1 SYSTEM CONTROL PANEL*



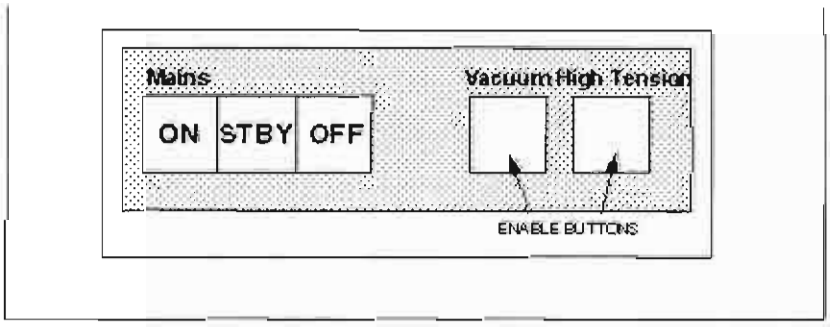

The control panel on the left side of the table top contains five push buttons: ON, STBY (Standby), OFF, VACUUM and HIGH TENSION. The ON and OFF buttons are used to switch the entire system on or off. Use Standby mode for partial system shutdown.

The VACUUM and HIGH TENSION buttons are hardware enable buttons. On startup from powerup, the software turns on the VACUUM button if everything proceeds normally. Some functions can't be performed with the buttons off and warnings are issued, therefore you need to enable them.

If you turn off the VACUUM button, or if an internal error occurs, you must push the VACUUM button to turn it back on and re-enable the vacuum system.

## Stage Controls

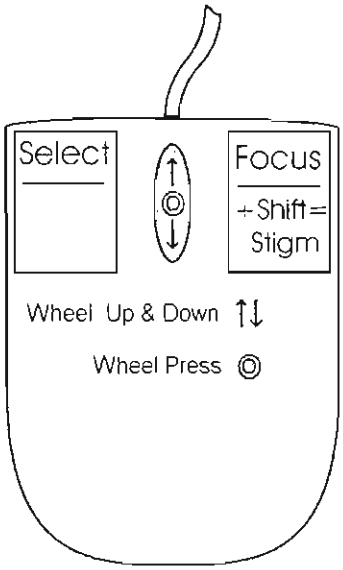
The stage is software/hardware controlled upto five axes: X, Y, Z, rotation and tilt depending on the stage type.




The control panel on the left side of the table top contains five push buttons: ON, STBY (Standby), OFF, VACUUM and HIGH TENSION. The ON and OFF buttons are used to switch the entire system on or off. Use Standby mode for partial system shutdown.

The VACUUM and HIGH TENSION buttons are hardware enable buttons.

# Entering Commands




## Using the Mouse

The mouse buttons control imaging and selecting. Mouse buttons are activated by a click or double-click.

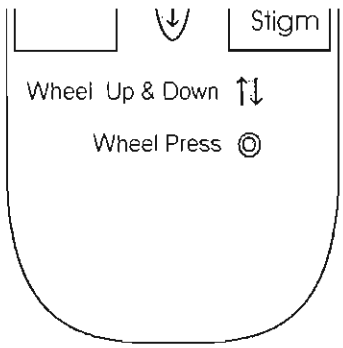
TABLE 4-1 MOUSE BUTTON FUNCTIONS

| Button | Function |
|---|---|
| **Left** | Makes selection |
| **Right** | Focuses image |
| **Shift+Right** | Activates stigmator control |
| **Left** | Zoom Magnification only in the centre of Track mode with + or - |

To focus with the mouse, press the right mouse button and move the mouse to the left or right. Release the button to set the focus.

## Using the Keyboard

To make selections of top level menu items with the keyboard, press ALT followed by the underlined letter in the item or group name. Press TAB to scroll through groups; use the arrow keys to select between items in a group.





| | |
|---|---|
| **Left** | Makes selection |
| **Right** | Focuses image |
| **Shift+Right** | Activates stigmator control |
| **Left** | Zoom Magnification only in the centre of Track mode with + or - |

To focus with the mouse, press the right mouse button and move the mouse to the left or right. Release the button to set the focus.

## Using Dedicated Windows Keys

Some keys are dedicated Windows keys:

TABLE 4-2 DEDICATED WINDOWS KEYS

| Key | Function |
|---|---|
| ENTER | Equivalent of OK in a dialog box. |
| ESC | Equivalent for the CANCEL button. |
| TAB | Step key to highlight items in a dialog box. |
| ARROWS | Use to select between items in a group when in an edit box.<br>See Table 4-3 for other functions within Microscope Control software. |
| ALT | Use ALT in combination with a character (underlined characters in the menu items) to open the pulldown menu in the active application.<br>For example, pressing ALT and M at the same time brings up the Magnification pulldown menu. |
| ALT-TAB **(simulta-neously)** | Use these keys to show the last used program. Continue to press the TAB key (while holding down the ALT key) and applications that are resident are shown one by one. When the application you want is shown, release the ALT key and it becomes active again. |
| ALT-F4 **(simulta-neously** | Exit Microscope Control software and Windows. |
| DEL | Deletes an item in an edit box. |


| | |
|---|---|
| ESC | Equivalent for the CANCEL button. |
| TAB | Step key to highlight items in a dialog box. |
| ARROWS | Use to select between items in a group when in an edit box.<br>See Table 4-3 for other functions within Microscope Control software. |
| ALT | Use ALT in combination with a character (underlined characters in the menu items) to open the pulldown menu in the active application.<br>For example, pressing ALT and M at the same time brings up the Magnification pulldown menu. |

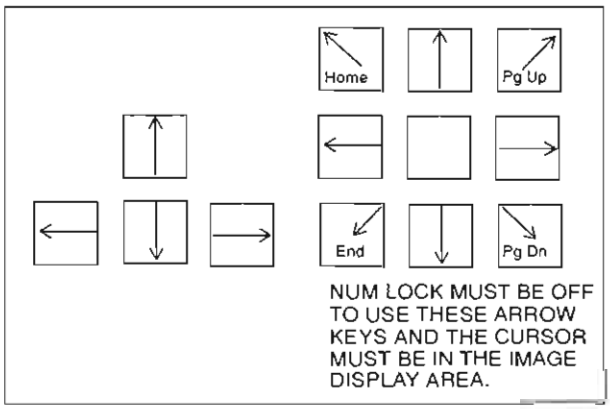
## Using Function Key Shortcuts

The following keys have dedicated system functions:

TABLE 4-3 DEDICATED SYSTEM FUNCTION KEYS

| Key | Function |
|---|---|
| F1 | On/off toggle for tool bar |
| SHIFT-F1 | On/off toggle for F keys graphic |
| F2 | Activates the present set Singlescan + Integrate 1. |
| SHIFT-F2 | Activates the present set Photoscan (analogue) |
| F3 | On/off toggle for VScope—Displays the videoscope, showing the video intensity along a horizontal line. |
| F4 | Dbar—Data bar three-way toggle:<br>• display of photo data bar<br>• display of real time data bar<br>• no data bar display |
| F5 | XHD start scan |
| SHIFT-F5 | Activates the Beam Shift to Zero value |
| F6 | Blank—Blanks the beam |
| F7 | Meas—Displays measurement dialogue box |
| F8 | TV-SS—toggles TV with last selected Slowscan |
| F9 | ACB—Autocontrast and brightness |
| SHIFT-F9 | Activates the Modulator (Beam page) |
| F10 | AStig—Autostigmator |
| F11 | AFocus—Autofocus |
| F12 | Toggles between Get, Shift, Track, No Position. |
| SHIFT-F1 | On/off toggle for F keys graphic |
| F2 | Activates the present set Singlescan + Integrate 1. |
| SHIFT-F2 | Activates the present set Photoscan (analogue) |
| F3 | On/off toggle for VScope—Displays the videoscope, showing the video intensity along a horizontal line. |
| F4 | Dbar—Data bar three-way toggle:<br>• display of photo data bar<br>• display of real time data bar<br>• no data bar display |

TABLE 4-3 DEDICATED SYSTEM FUNCTION KEYS

| Key | Function |
|---|---|
| + | • **Unchecked** in Configuration dialog box—Increases magnification by default factor of 2X.<br>• **Checked** in Configuration dialog box—Increases magnification according to the pulldown menu presets, but adds extra steps between. |
| SHIFT + | Increases through magnification menu presets. |
| - | • **Unchecked** in Configuration dialog box—Decreases magnification by default factor of 0.5.<br>• **Checked** in Configuration dialog box—Decreases magnification according to the pulldown menu presets, but adds extra steps between. |
| SHIFT - | Decreases through magnification menu presets. |
| CTRL -/+ | Toggles between current mag and 100X current mag. |
| SHIFT, ARROW | Half field shift (instead of full field shift). User configurable in Configuration Control dialog box. |
| ARROW | Stage movement in full field shift.<br> |


| SHIFT + | Increases through magnification menu presets. |
|---|---|
| - | • **Unchecked** in Configuration dialog box—Decreases magnification by default factor of 0.5.<br>• **Checked** in Configuration dialog box—Decreases magnification according to the pulldown menu presets, but adds extra steps between. |
| SHIFT - | Decreases through magnification menu presets. |
| CTRL -/+ | Toggles between current mag and 100X current mag. |

## Using Accelerator Keys

Accelerators are shortcut keystrokes used to perform functions. Some use a combination of keystrokes. For example, press the Control (CTRL) and the X key at the same time to display a small red crosshair in the centre of the screen.

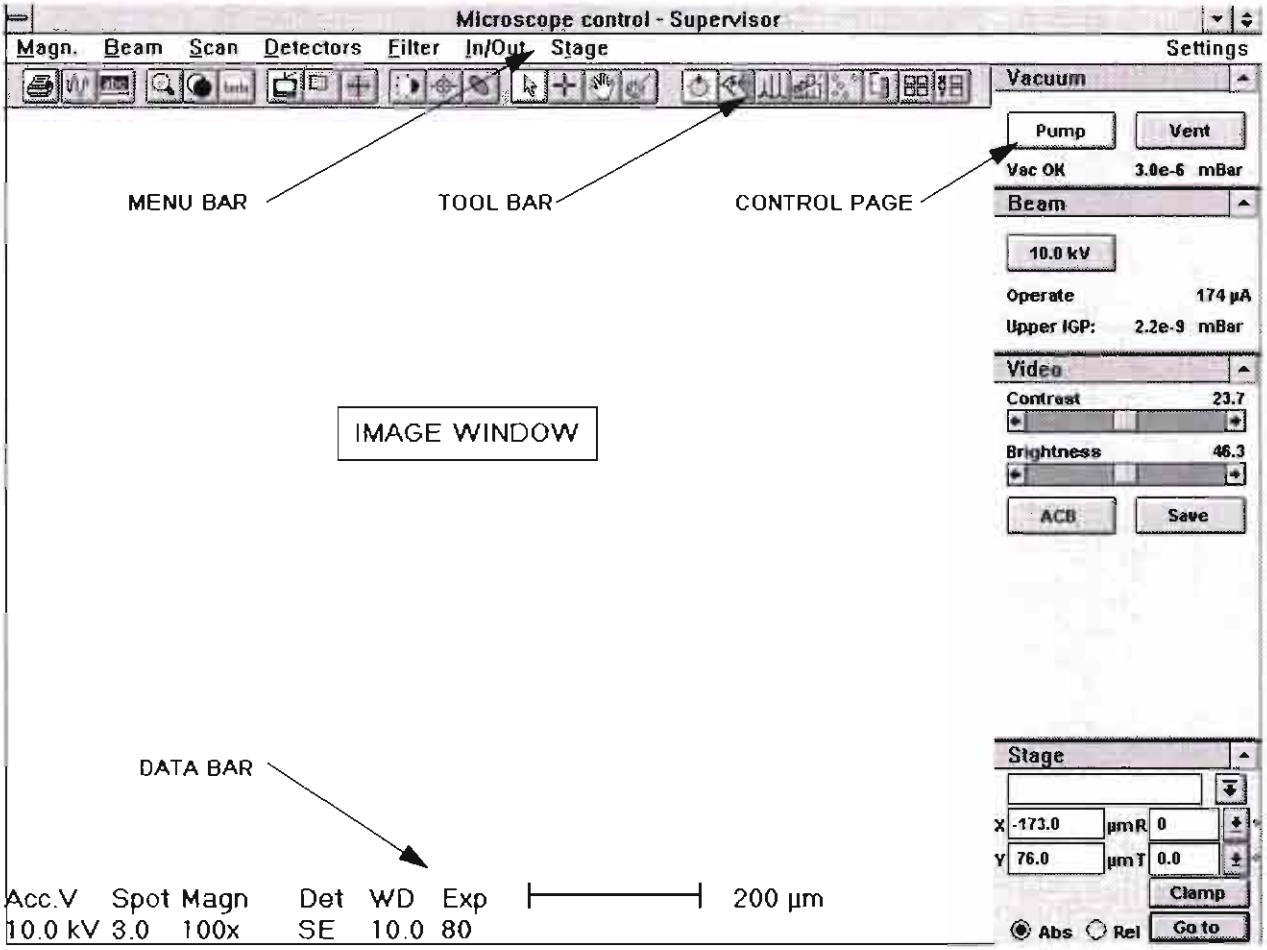
TABLE 4-4 ACCELERATOR KEYSTROKES

| Key Sequence | Function |
|---|---|
| CTRL-X | Toggles between show/hide a small red crosshair in the centre of the monitor. |
| CTRL-E | Toggles between blank/unblank the beam. |
| CTRL-Z | Brings the WD value to that of the Z value. |
| CTRL-HOME | Resets microscope parameters in case of a lock up. (Or, close Microscope Control software and Windows, then restart both.) |


| Sequence | Function |
|---|---|
| CTRL-X | Toggles between show/hide a small red crosshair in the centre of the monitor. |
| CTRL-E | Toggles between blank/unblank the beam. |
| CTRL-Z | Brings the WD value to that of the Z value. |
| CTRL-HOME | Resets microscope parameters in case of a lock up. (Or, close Microscope Control software and Windows, then restart both.) |

# The Main Window

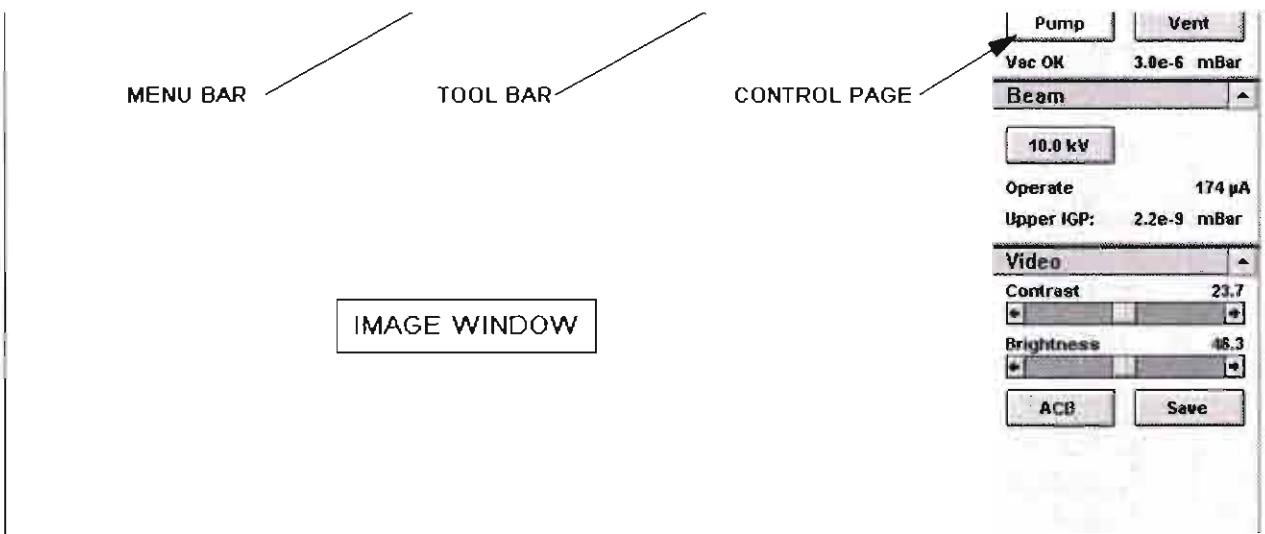
The main window displays status and control features for Microscope Control, including the image window, menu bar, tool bar, data bar and control area.




## The Image Window

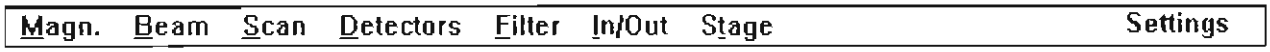
The image window displays images, including:

- Real time images
- Frozen images
- Stored images



## The Menu Bar

The menu bar displays pulldown menu names across the top of the screen.




### Menu Bar Functions

The following menus are available:

TABLE 4-5 MENUS

| Menu Item | Use |
|---|---|
| **Magn.** | Select from a list of magnifications. |
| **Beam** | Select accelerating voltages and spotsize. |
| **Scan** | Choose scan time and scan mode. |
| **Detectors** | Select detector(s). |
| **Filter** | Select the type of filter to be applied to the image. |
| **In/Out** | Store images, stage data and vectors. |
| **Stage** | Control movement of stage and beam to correct position of specimen. |
| **Settings** | Selects control area. (Settings is default.) |

Select pulldown menus from the menu bar by using either the left mouse button or keyboard.

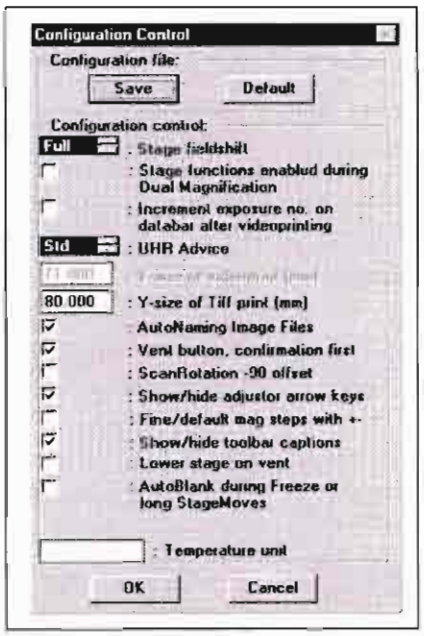
TABLE 4-5 MENUS

| Menu Item | Use |
|---|---|
| **Magn.** | Select from a list of magnifications. |
| **Beam** | Select accelerating voltages and spotsize. |
| **Scan** | Choose scan time and scan mode. |
| **Detectors** | Select detector(s). |
| **Filter** | Select the type of filter to be applied to the image. |

## The Tool Bar.

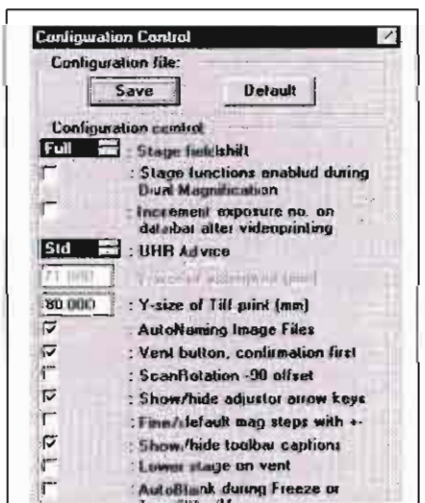


The tool bar, displayed below the menu bar, lets you select system functions by their icons. Rest the cursor on the icon for two seconds without clicking on it to see its highlighted caption. If the captions are a distraction, they can be hidden by unchecking the box in the Configuration Control dialogue box.




Whenever you select a function or control area, the corresponding icon is highlighted. Icons that activate an automated procedure are not highlighted. The number of icons available depends on the configuration of the system. For instance, when EBSP is installed, the relevant buttons are displayed and the order may be changed.

The tool bar can be different in content depending on the FEG system, stage and facilities purchased.



# Tool Bar Functions

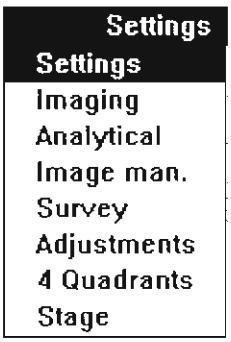
TABLE 4-6 TOOL BAR FUNCTIONS

| Icon | Caption | Function |
|---|---|---|
| | **Print Function** | Saves the Image and then prints the image to the printer. |
| | **Videoscope** | Toggles the display of the videoscope on or off, showing the video intensity along the currently scanned horizontal line. |
| | **Data bar Mode** | Toggle button operates in three modes:<br>• No display<br>• Display of photo data bar (button highlighted)<br>• Display of real time data bar (button highlighted) |
| | **HR/UHR/EDX toggle button (SFEG only)** | HR Mode.....UHR Mode ready.....UHR Mode in use.....EDX Mode |
| | **Power Zoom** | Starts and stops the powerzoom function. |
| | **Blank Beam** | Blanks and unblanks the beam. |
| | **Measurement** | Toggles the display of the measurement dialog box on or off for doing onscreen measurements. |
| | **TV Scan/Slow Scan** | Toggles scan rate: TV (button highlighted) or previously selected slow scan. |
| | **Reduced Area** | Activates the reduced area (window). It is variable in size and can be moved over the total image area. Same function as Window on the 'Imaging' page. |
| | **Freeze Image** | Toggle, freezes (button highlighted) or unfreezes contents of the microscope framestore. |
| | **Auto Contrast Brightness** | Activates the automatic contrast and brightness routine. |
| | **Auto Focus** | Activates the autofocus routine. |
| | **Data bar Mode** | Toggle button operates in three modes:<br>• No display<br>• Display of photo data bar (button highlighted)<br>• Display of real time data bar (button highlighted) |
| | **HR/UHR/EDX toggle button (SFEG only)** | HR Mode.....UHR Mode ready.....UHR Mode in use.....EDX Mode |
| | **Power Zoom** | Starts and stops the powerzoom function. |
| | **Blank Beam** | Blanks and unblanks the beam. |

TABLE 4-6 TOOL BAR FUNCTIONS

| Icon | Caption | Function |
|---|---|---|
|  | **Get Mode** | Brings selected image detail to the center of the screen by double-clicking. |
|  | **Shift Mode** | Performs an onscreen image shift, using beam shift coupled to magnification. This does not move the stage. |
|  | **Track Mode** | Allows continuous stage movement in any direction. Centre has +/- Zoom magnification function. |
|  | **Stage Clamp (100 & 150)** | Toggles ON and OFF the stage Clamp mechanism. (100 x 100 and 150 x 150 stages) |
|  | **Control Area: Settings** | Selects the Settings control area. |
|  | **Control Area: Imaging** | Selects the Imaging control area. |
|  | **Control Area: Analytical** | Selects the Analytical control area. Not as DEFAULT from version 5.90 on. Can be activated via the Mctrl.ini file. |
|  | **Control Area: Image Manipulation** | Selects the Image Manipulation control area. |
|  | **Control Area: Survey** | Selects the Survey control area. Not as DEFAULT from version 5.90 on. Can be activated via the Mctrl.ini file. |
|  | **Control Area: Adjustments** | Selects the Adjustments control area. |
|  | **Control Area: 4 Quadrants** | Selects the 4 Quadrants control area. Not as DEFAULT from version 5.90 on. Can be activated via the Mctrl.ini file. |
|  | **Control Area: Stage** | Selects the Stage control area. |

| | | |
|---|---|---|
|  | | Zoom magnification function. |
|  | **Stage Clamp (100 & 150)** | Toggles ON and OFF the stage Clamp mechanism. (100 x 100 and 150 x 150 stages) |
|  | **Control Area: Settings** | Selects the Settings control area. |
|  | **Control Area: Imaging** | Selects the Imaging control area. |
|  | **Control Area: Analytical** | Selects the Analytical control area. Not as DEFAULT from version 5.90 on. Can be activated via the Mctrl.ini file. |
| | **Control Area:** | Selects the Image Manipulation control area. |




## Control Areas

The software controls on the right side of the screen are organized into control areas. Several control areas are divided into smaller control groups that can be maximized to access additional functions. The most frequently used controls appear in the minimized control groups.

The name of the active control area shows in the menu bar. Select the control area from the tool bar or the pulldown menu.

TABLE 4-7 CONTROL AREAS

| Control Area | Functions |
|---|---|
| **Settings** | Controls Vacuum, Beam, Video and Stage. |
| **Imaging** | Controls Magnification, Focus, Video and Stage. |
| **Analytical** | Allows data collection and analysis for the EDX option. |
| **Image man.** | Controls manipulation of images: crisp, gamma curves, etc., color coding, and computer memory management. |
| **Survey** | Allows a survey of the specimen surface to be easily made and stores specimen positions with their associated microscope parameters. |
| **Adjustments** | Performs electronic alignments of the electron column. |
| **4 Quadrant** | Allows viewing the image in four quadrants onscreen, using up to four different detectors. |
| **Stage** | Controls movement of the stage and the beam, and positioning of the specimen. |

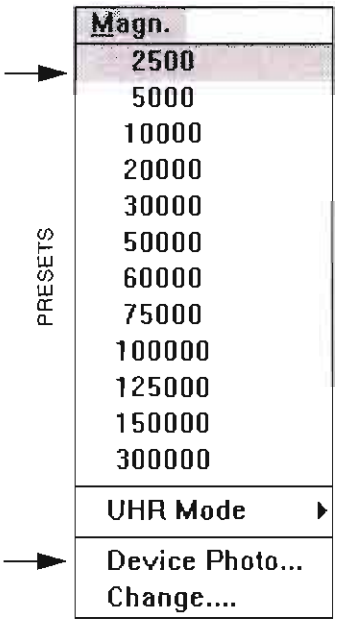
Analytical, Survey and 4 Quadrants control areas are switched out of the user interface from software version 5.8 on. They can be activated by making the items 'FALSE' in the XLCUI.INI file. They are defaulted to 'TRUE' on first loading of the software.

**NOTE:** It is recommended that before changing the content of files,

TABLE 4-7 CONTROL AREAS

| Control Area | Functions |
|---|---|
| **Settings** | Controls Vacuum, Beam, Video and Stage. |
| **Imaging** | Controls Magnification, Focus, Video and Stage. |
| **Analytical** | Allows data collection and analysis for the EDX option. |
| **Image man.** | Controls manipulation of images: crisp, gamma curves, etc., color coding, and computer memory management. |

# Magn. Menu



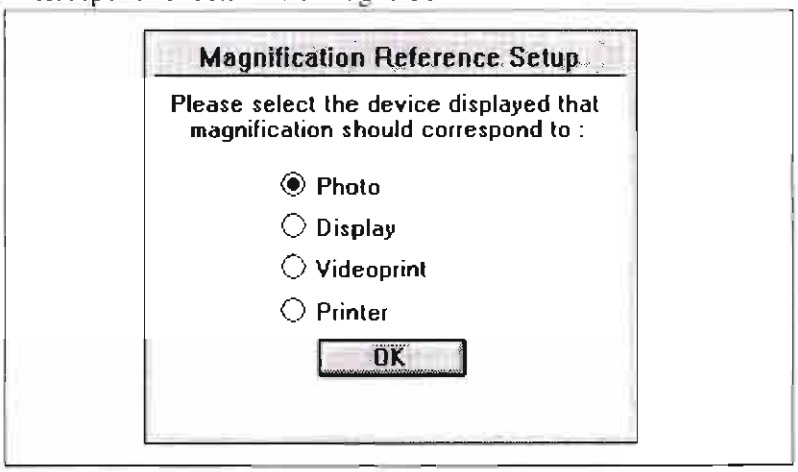

Use the Magn. menu to select a magnification value from a list of presets, to choose the device displayed that magnification corresponds to, and to change the presets.

## Presets

Choose from a range of 12 preset magnifications to change magnification onscreen. The current value is indicated with a check mark.

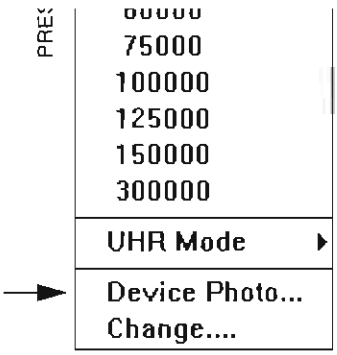
## Device Photo

Choose the desired display device that magnification should correspond to from this dialogue box.




The menu item will read Device Photo, Device Display, Device Videoprint or Device Printer, depending on which of these four you choose.

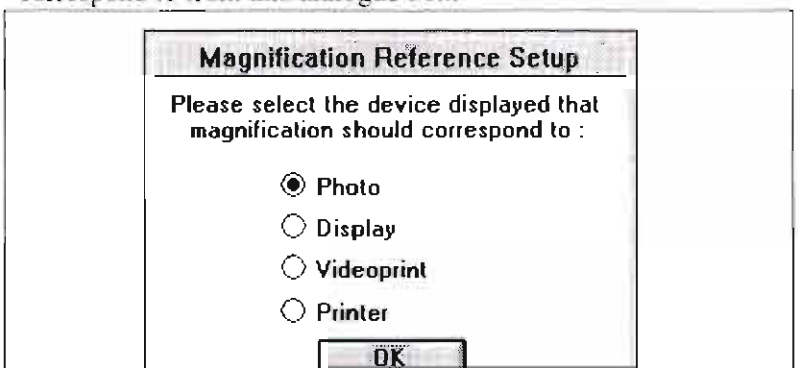
This will affect the magnification value in the data bar of the image and the magnification adjuster on the Imaging control area. When you print an image, the magnification will be corrected automatically for the device selected. For example, if you have Device Photo selected and print to the videoprinter from the In/Out menu, the Magn. value shown in integers will be calibrated to the videoprinter during the printing process. This automatic recalibration will not take place if you simply press PRINT on the videoprinter.

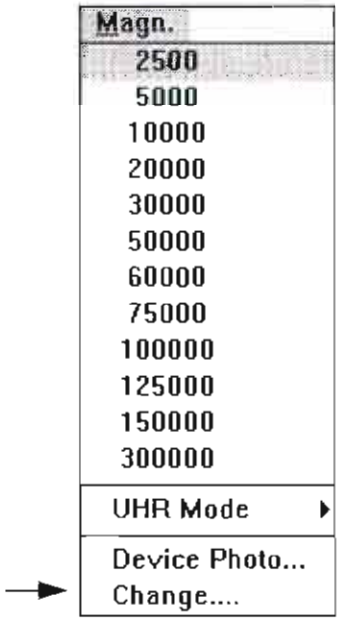



mark.

## Device Photo

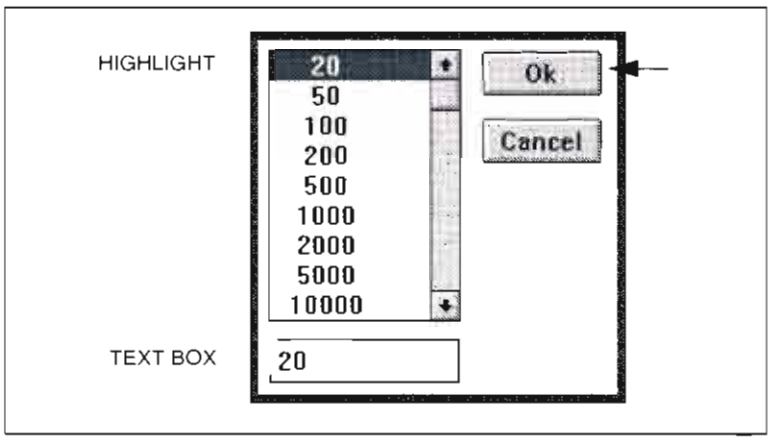
Choose the desired display device that magnification should correspond to from this dialogue box.





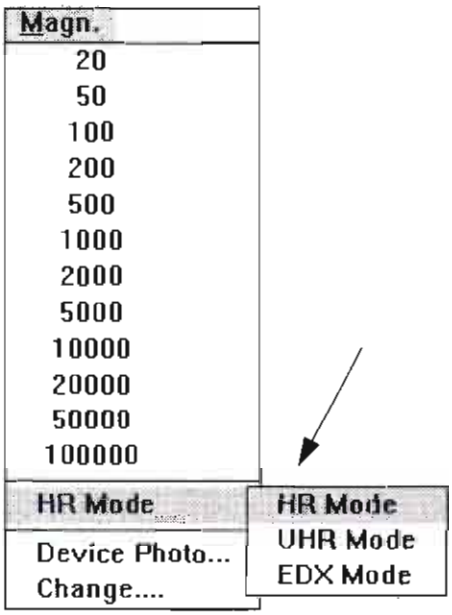

## Change

Select Change to modify the presets. The following dialogue box displays. Click on (highlight) the preset you want to customize, type in the new value in the text box, and click OK:




The new preset appears on the list, replacing the one you modified and the dialogue box goes away. To make multiple changes to presets without leaving the dialogue box, make all changes before clicking OK.

Magnification can also be changed with the + and - keys on the numeric keypad and with the Magnification adjuster on the Imaging control area.

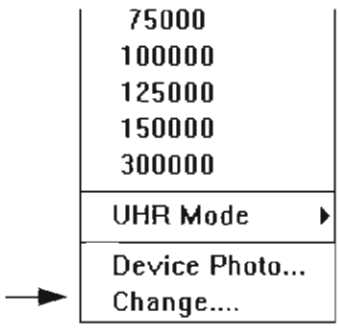


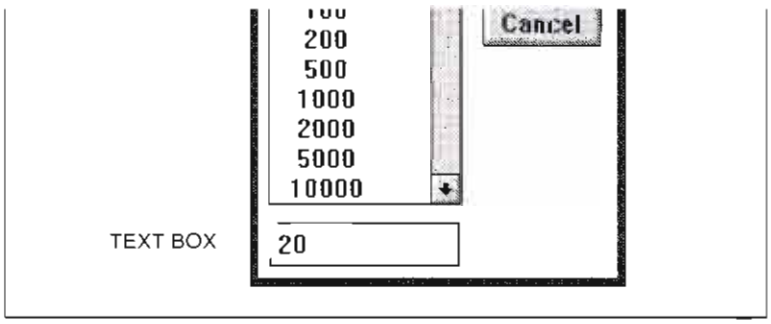

## HR / UHR / EDX Modes (SFEG only)

These switching modes can be found only on SFEG systems. Which ever is clicked-on updates in the readout position in the Magn. menu and becomes the active mode of operation.

If the mode of operation is not possible due to other parameter conditions such as kV, FWD, magnification, etc. the label will be greyed out or if the help dialogue for UHR Mode is active it will provide assistance to proceed indicated by ...

When the EDX mode is active the Tool Bar will show the UHR mode toggling with the EDX Mode on the Icon button.

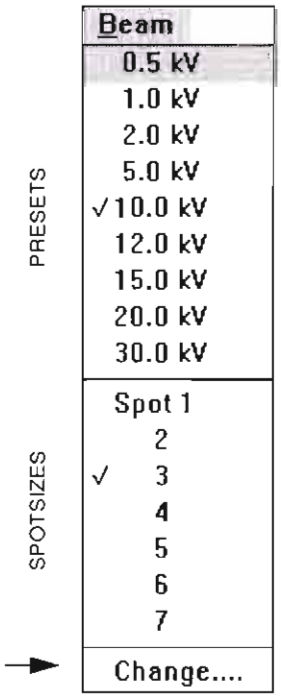



The new preset appears on the list, replacing the one you modified and the dialogue box goes away. To make multiple changes to presets without leaving the dialogue box, make all changes before clicking OK.

Magnification can also be changed with the + and - keys on the

# Beam Menu




The Beam pulldown menu is used to select one of the preset accelerating voltages (kV) and corresponding spotsizes and to change the presets.

## Presets

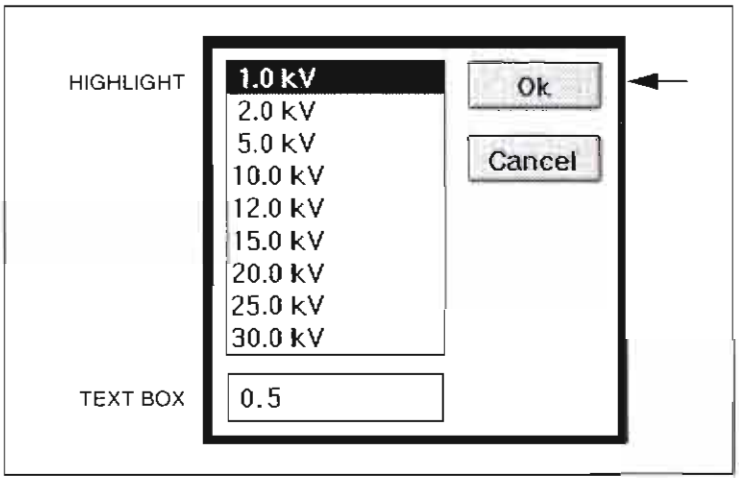
Choose from a range of nine preset accelerating voltages. The current value is indicated with a check mark.

## Spotsizes

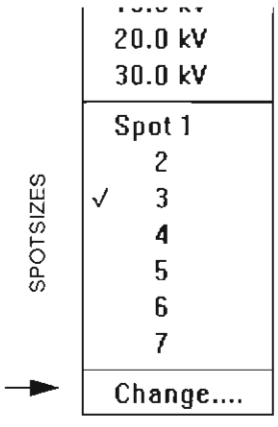
The spotsizes are numbered from 1 to 7; 1 being the smallest. The numbers also correspond to beam currents from high to low. The present value is indicated with a check mark.

## Change

Click on Change to access the dialog box for modifying the presets. Highlight the one you want to customize, type in the new value in the text box, and click OK.




The new preset appears on the list, replacing the one you changed.

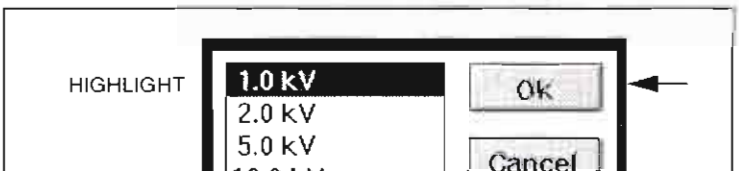



## Spotsizes

The spotsizes are numbered from 1 to 7; 1 being the smallest. The numbers also correspond to beam currents from high to low. The present value is indicated with a check mark.

## Change

Click on Change to access the dialog box for modifying the presets. Highlight the one you want to customize, type in the new value in the text box, and click OK.



# Scan Menu

## Overview

Use the Scan menu to choose scan speed and mode for imaging. For better signal-to-noise ratio, use one of the three slow scan speeds or photo scan.

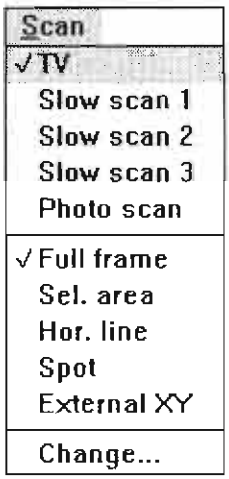
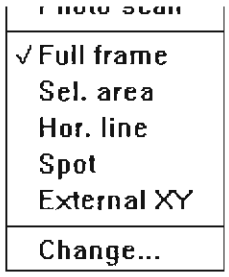


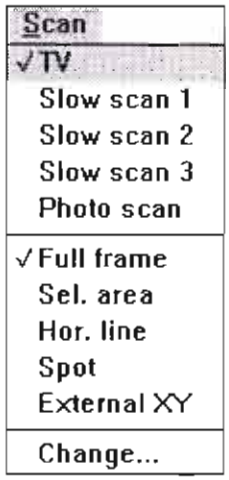

TABLE 4-8 SCAN FUNCTIONS

| Scan Type | Function |
|---|---|
| **TV** | TV speed, the fastest scan speed, most typical for general navigation. |
| **Slow scan 1** | First preset slow scan speed. Change slow scan presets using the Change menu item. Preset the fastest scan speed (0.21 ms linetimes and 484 lines per frame) for Slow scan 1. |
| **Slow scan 2** | Second preset slow scan speed. Change slow scan presets using the Change menu item. |
| **Slow scan 3** | Third preset slow scan speed. Change slow scan presets using the Change menu item. |
| **Photo scan (or Slow scan 4)** | Defines a scan rate to be used for photographing images. Photo scan speeds should use at least one minute of acquisition time to be fully functional. Change photo scan presets using the Change menu item.<br>If there is no photo-monitor and camera present the Photo scan mode reverts to a Slow scan 4, which is then defined in the same way as the other slow scans. Slow scan 4 replaces Photo scan in the menu. |
| **Full frame** | Full frame used for scan. This is the normal scanning mode, typical for general navigation. |
| **Sel. area** | Reduced area used for scan, resulting in a smaller image updated much faster. |
| **Hor. line** | A horizontal line on the image area moveable by dragging with the left mouse button. |





| Scan Type | Function |
|---|---|
| **TV** | TV speed, the fastest scan speed, most typical for general navigation. |
| **Slow scan 1** | First preset slow scan speed. Change slow scan presets using the Change menu item. Preset the fastest scan speed (0.21 ms linetimes and 484 lines per frame) for Slow scan 1. |
| **Slow scan 2** | Second preset slow scan speed. Change slow scan presets using the Change menu item. |
| **Slow scan 3** | Third preset slow scan speed. Change slow scan presets using the Change menu item. |




## Selected Area

When Sel. area is chosen, the reduced area appears in the middle of the screen. It has a default size of 25% of normal X & Y deflection, so screen refreshing is about 16 times faster. The surrounding image is the actual image in the framestore.

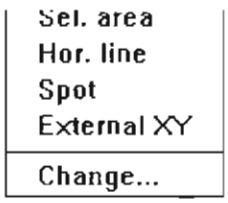
### Moving the Sel. Area

Click and hold the left mouse button in the selected area. The arrow changes to a hand. This will take some time, depending on the actual scan speed. Now drag the selected area to the desired position and release the mouse button.

### Changing the Size of the Sel. Area

Place the cursor outside of the selected area and make sure Get or Shift are not activated. The cursor should be the normal arrow symbol.

Move the cursor to where you want the left upper corner of the selected area to be. Click the left mouse button and drag the cursor until the rectangle onscreen includes the area you want to select. Release the left mouse button.

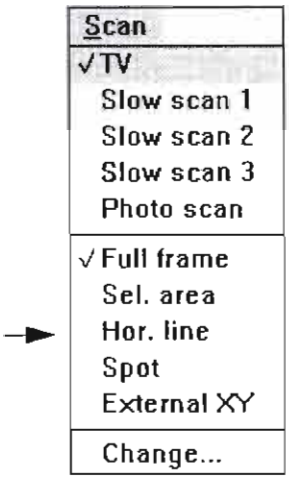



scan speed. Now drag the selected area to the desired position and release the mouse button.

### Changing the Size of the Sel. Area

Place the cursor outside of the selected area and make sure Get or Shift are not activated. The cursor should be the normal arrow symbol.

Move the cursor to where you want the left upper corner of the selected area to be. Click the left mouse button and drag the cursor until the rectangle onscreen includes the area you want to select. Release the left mouse button.

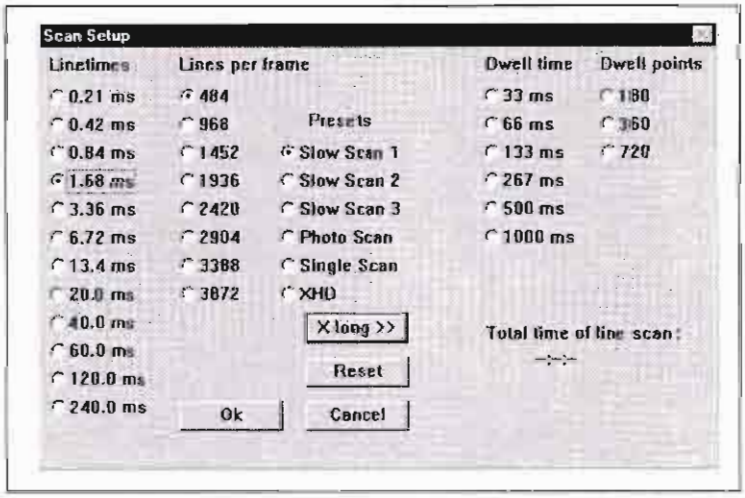



## Horizontal Line

When Horizontal Line is selected from the Scan menu, the image freezes and a horizontal line displays on the screen. The beam scans along this line, using the line time defined for the selected slow scan speed.

When you choose Hor. line, the cursor changes from a hand to an arrow. Move the cursor to the desired vertical position and click the left mouse button.

If Change is selected while Hor. line is active, the X LONG button on the Change dialogue box is no longer greyed. Click on X LONG to expand the dialogue box to include settings for Dwell time and Dwell points.




All other linetime and lines per frame settings are ignored. Dwell time x dwell points = linetime.

### Dwell Time

Used only in EDX operations.

### Dwell Points

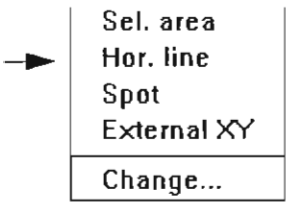
Used only in EDX operations.

### Reset

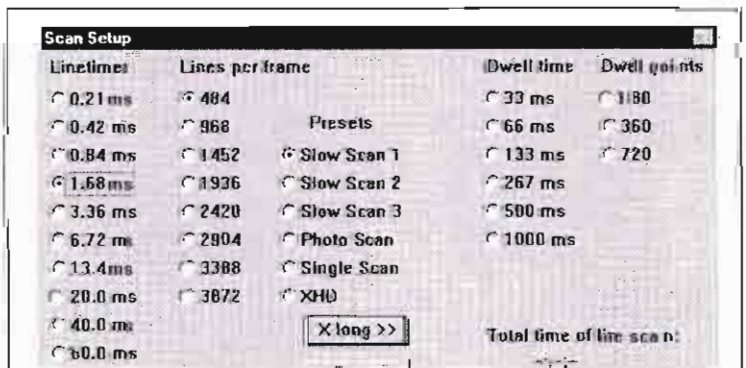
Click on RESET to reset preset scan parameters to the last used settings. This doesn't affect the dwell time and dwell point settings.

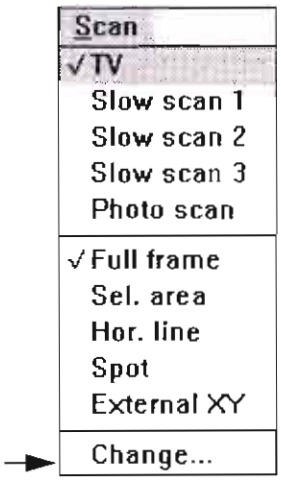
### OK

Use the OK button to save the new scan parameters as the default until



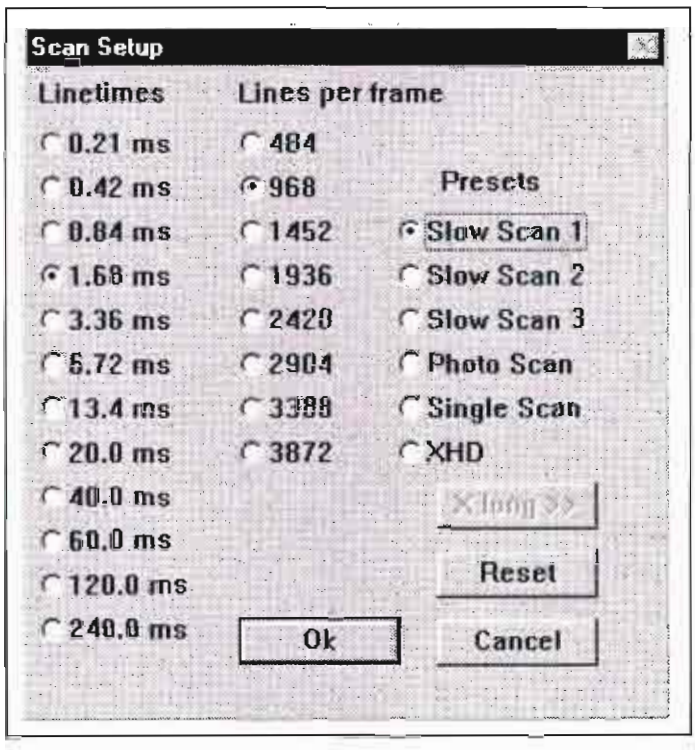

If Change is selected while Hor. line is active, the X LONG button on the Change dialogue box is no longer greyed. Click on X LONG to expand the dialogue box to include settings for Dwell time and Dwell points.






## Change Scan Settings

Select Change to access this dialog box for changing preset slow scan settings:




The X LONG button is greyed out unless Hor. Line is selected on the Scan pulldown menu.

### Linetimes

Choose Linetimes for best signal-to-noise range for image.

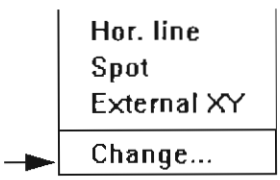
### Lines per frame

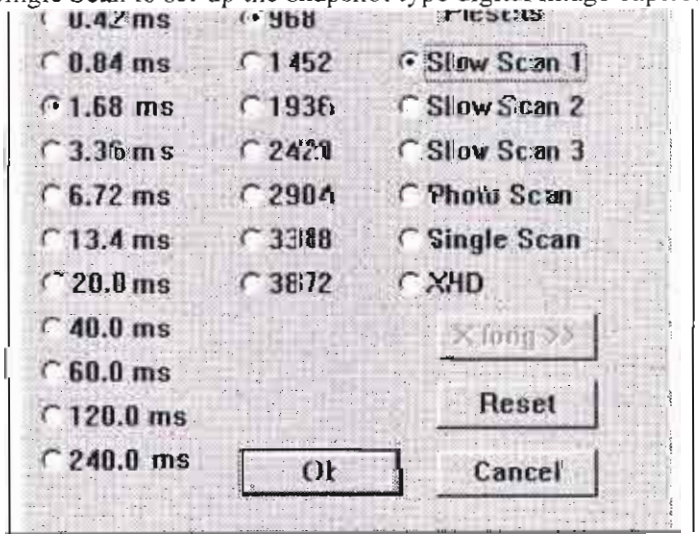
Choose Lines per frame for the output device used or for the specific application.

### Presets

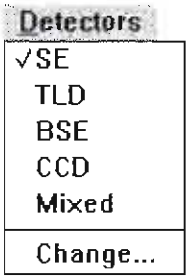
Choose one of the Presets:

- Slow Scan 1 - 3 for preselected slowscans.
- Photo Scan to preselect the slow speed for photographic recording to the Photo CRT.
- Single Scan to set-up the snapshot type digital image capture. This



# Detectors Menu




THE PULLDOWN MENU WILL SHOW ONLY THE DETECTOR(S) INSTALLED ON YOUR SYSTEM

The Detectors pulldown menu shows the detector(s) installed on your system. Select the detector signal to be used for imaging.

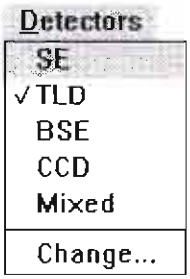
When you select a detector, the contrast and brightness adjusters in the Video control group of the Settings control area default to the settings last used for that detector.

## SE

The SE detector, which is a scintillator type, uses secondary electrons generated by the primary beam to produce an image. It is mounted in the chamber over the sample. The SE detector does not operate in UHR Mode in SFEG systems.

When SE is selected, the Secondary Electron detector is activated and contrast and brightness adjusters control the SE detector parameters. The SE switches off during venting of the specimen chamber.

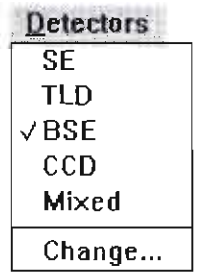
The biasing capability is from -150V for only backscattered electrons to +300V for secondary collection. This is activated via the 'Change' function at the end of the menu.




## TLD (SFEG only)

The TLD detector, which is a scintillator type, uses secondary electrons generated by the primary beam to produce an image. It is mounted within the lens and therefore collects secondary electrons from immediately over the scanned area of the sample. The electrons have to pass though the lens pole piece into the collector, hence the name Through the Lens Detector. The detector operates in HR and UHR Modes.

## BSE




The BSE is a two segment solid-state backscatter detector. It is mounted underneath the pole piece to obtain maximum detector efficiency. When not in use, the BSE can be positioned in a special holder at the bottom of the specimen chamber. Since the detector is mounted underneath the final lens, it will cause some limitation in the tilt range when working at the eucentric working distance.

The two segments can be switched independently, enabling the enhancement of either atomic number contrast (A+B) or topographic contrast (A-B). Operation is fully integrated in the main software.

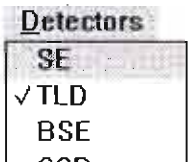
The BSE has a resolving power of better than 0.1 DeltaZ at a Z value

THE PULLDOWN MENU WILL SHOW ONLY THE DETECTOR(S) INSTALLED ON YOUR SYSTEM

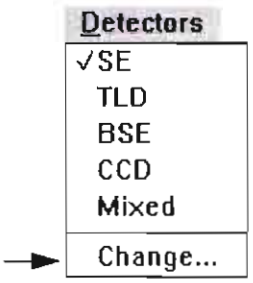
The SE detector, which is a scintillator type, uses secondary electrons generated by the primary beam to produce an image. It is mounted in the chamber over the sample. The SE detector does not operate in UHR Mode in SFEG systems.

When SE is selected, the Secondary Electron detector is activated and contrast and brightness adjusters control the SE detector parameters. The SE switches off during venting of the specimen chamber.

The biasing capability is from -150V for only backscattered electrons to +300V for secondary collection. This is activated via the 'Change' function at the end of the menu.




## TLD (SFEG only)




THE PULLDOWN MENU WILL SHOW ONLY THE DETECTOR(S) INSTALLED ON YOUR SYSTEM

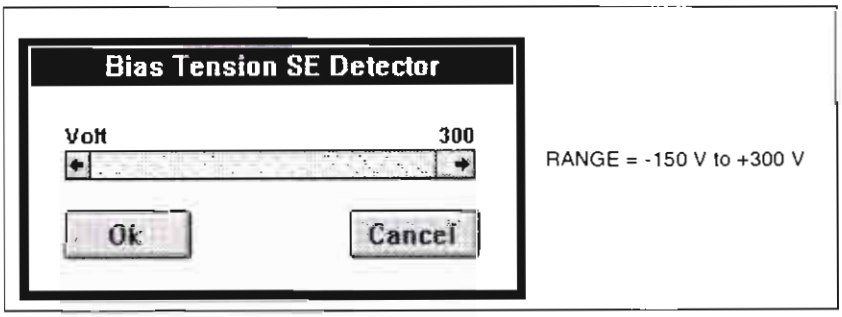
## Change

When you select Change, a dialogue box specific to the selected detector displays, allowing you to adjust the settings to collect secondary electrons. These settings are ordinarily preset at the factory but you may need to adjust them for optimum imaging on individual specimens.

### Change SE

The Bias Tension SE Detector dialogue box contains an adjuster to control grid bias voltage. When grid bias is negative, secondary electrons are repelled from the SE detector and only back-scattered electrons are detected. Use a range of -25 to -150 V to obtain backscattered electrons.

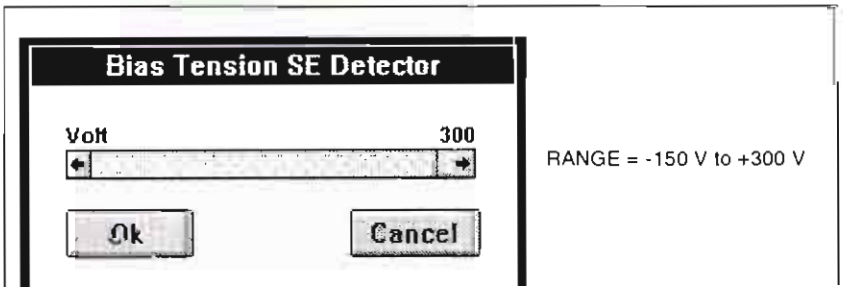
The range for grid bias voltage is from -150 V to + 300 V. The normal operating setting for imaging is 300 V.



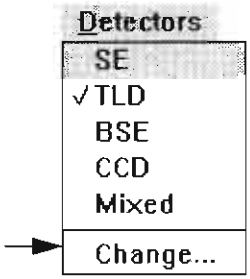

MENU WILL SHOW ONLY THE DETECTOR(S) INSTALLED ON YOUR SYSTEM

control grid bias voltage. When grid bias is negative, secondary electrons are repelled from the SE detector and only back-scattered electrons are detected. Use a range of -25 to -150 V to obtain backscattered electrons.

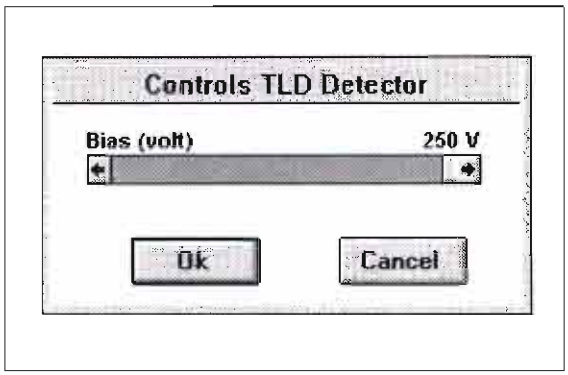
The range for grid bias voltage is from -150 V to + 300 V. The normal operating setting for imaging is 300 V.



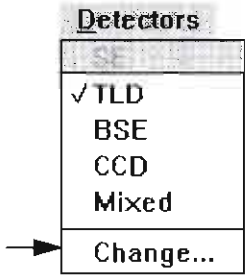
## Change TLD HR Mode




This is for SFEG only. In HR Mode the biasing of the TLD is similar to the SE detector with -250V for restricting collection to backscattered electrons to +250V for secondary collection. This is activated via the 'Change' function at the end of the menu.




## Change TLD UHR Mode

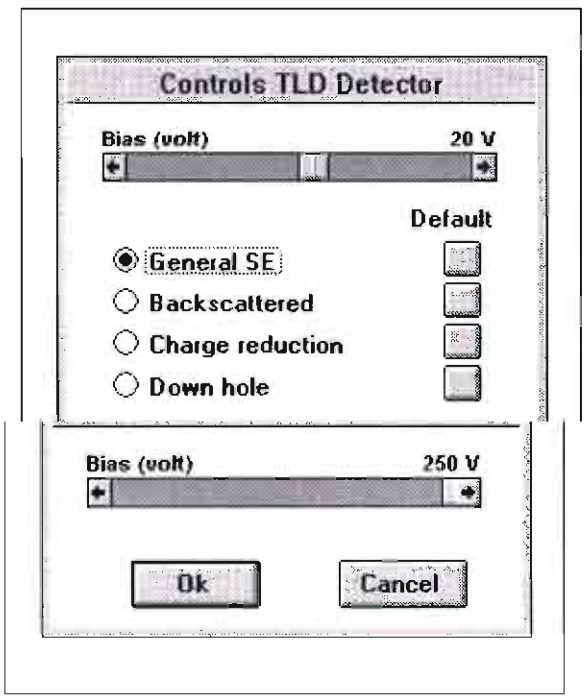



This is for SFEG only.The TLD has different functionality when operated in the UHR Mode. It has 4 preset bias conditions which can be changed by the user or defaulted to factory setting when necessary and is capable of the same bias voltage range as in HR Mode. The presets are:

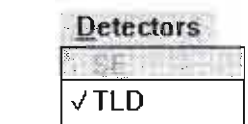
General SE, Backscattered, Charge reduction, Down hole.

These can be controlled via the 'Change' function at the end of the menu. Once the contrast and brightness values have been set in any preset mode it is remembered until changed, therefore one can switch



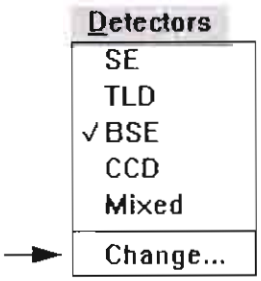

## Change TLD UHR Mode




This is for SFEG only.The TLD has different functionality when operated in the UHR Mode. It has 4 preset bias conditions which can be changed by the user or defaulted to factory setting when necessary and is capable of the same bias voltage range as in HR Mode. The

## Change BSE

The Diode Switching BSE dialogue box contains option buttons to select how the two detector segments A and B are switched.



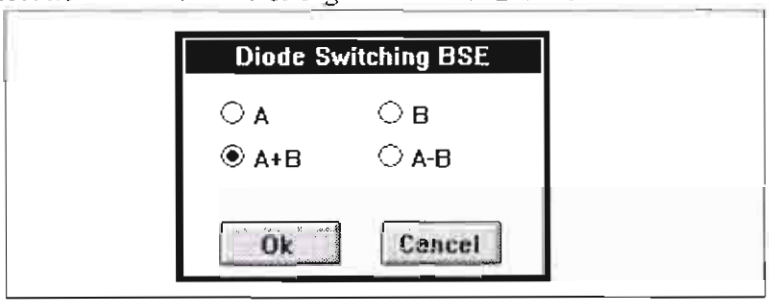




TABLE 4-9 DIODE SWITCHING BSE

| Option | Use |
|---|---|
| A | Left segment—uses shadows to create strong topographic and atomic number contrast. |
| B | Right segment—uses shadows to create strong topographic and atomic number contrast. |
| A+B | Use for normal BSE image. Gives suppressed topographic contrast with maximum atomic number contrast. |
| A-B | Use for a pseudo-topographical (shadow) image with atomic number contrast suppressed. |

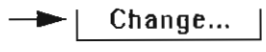


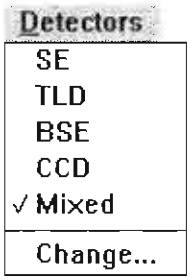




TABLE 4-9 DIODE SWITCHING BSE



| Option | Use |
|---|---|
| A | Left segment—uses shadows to create strong topographic and atomic number contrast. |
| B | Right segment—uses shadows to create strong topographic and atomic number contrast. |

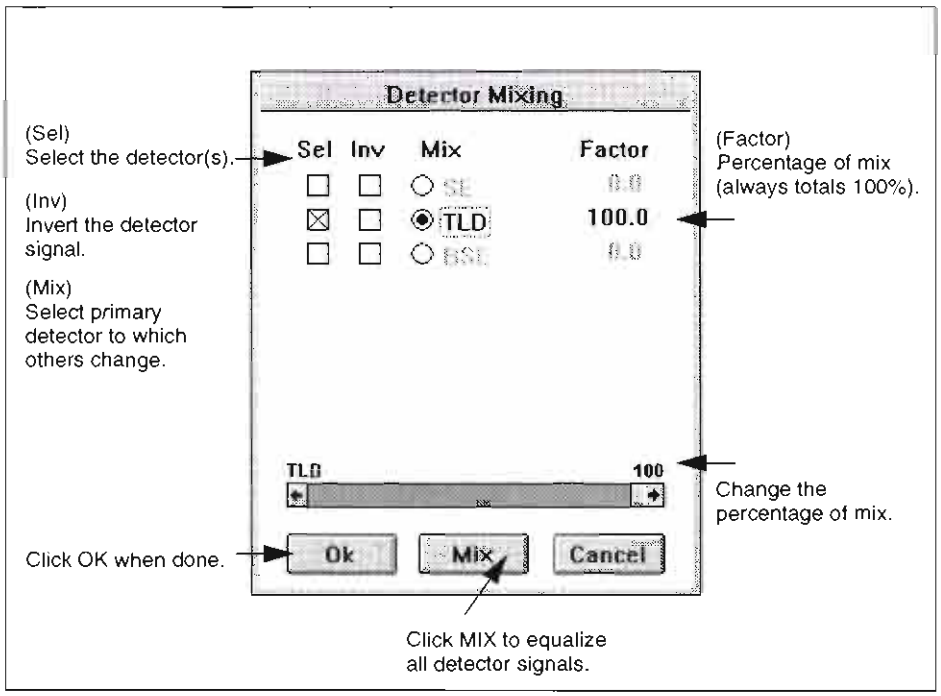



THE PULLDOWN MENU WILL SHOW ONLY THE DETECTOR(S) INSTALLED ON YOUR SYSTEM

## Mixed

Mixed appears as an option on the Detectors pulldown menu if more than one detector is installed on your system. After setting the mixing ratio, an image is formed by mixing data from two or more detectors. Before starting the Mix procedure, optimise the image for spotsize and focus and confirm that the signal is in the proper range of black to white for all relevant detectors.

Selecting Mixed brings up the Detector Mixing dialogue box. The list of available detectors for mixing will reflect what is installed on your system.




## Using Mixed

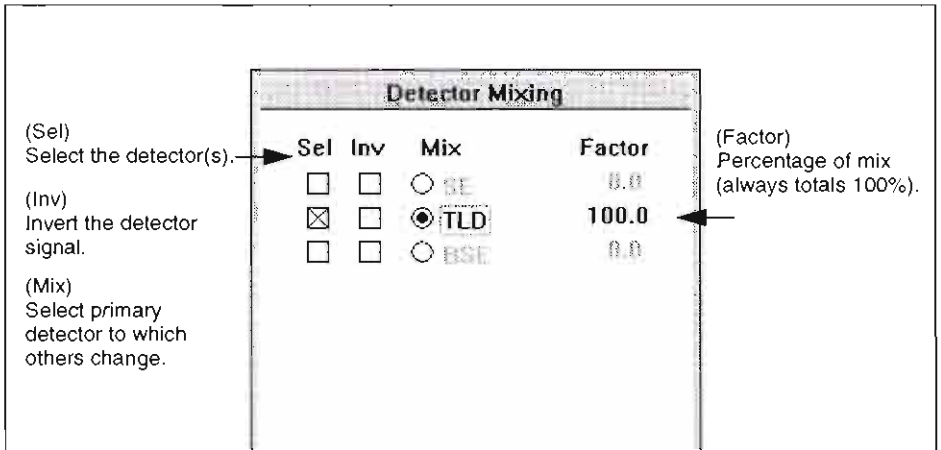
Select the detector by checking the Sel checkbox opposite the name. Detectors that cannot be mixed are greyed. Each detector signal can be inverted by selecting the Inv checkbox. By mixing a noninverted signal with an inverted signal, you can subtract signals.

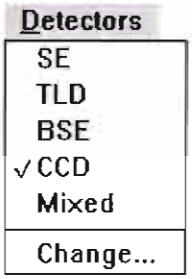
Use the option button under the Mix heading to select the detector signal ratio to which all other detectors are going to be changed. For example, if SE is set to 50%, and you select two other detectors, their mix factors of 25% each will total 100% for all three detectors.

The sum of the mixing detectors is always 100. If more than two signals are mixed, the mixing ratio of the nonactive signals is kept

MENU WILL SHOW ONLY THE DETECTOR(S) INSTALLED ON YOUR SYSTEM

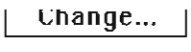
of available detectors for mixing will reflect what is installed on your system.



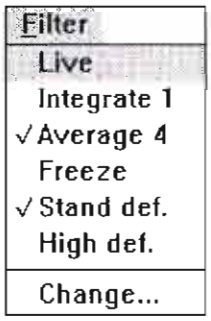



## CCD

The Charge-Coupled Detector (CCD) is an infrared camera used to give a low magnification view of the inside of the chamber. If CCD is selected, TV scan mode begins and an image taken by the CCD appears on the monitor. No Change options are available and some operation modes, such as Slow Scan, are greyed out and not selectable.



# Filter Menu




Use the Filter menu to select a framestore noise filter to apply to the image and to change Integrate and Average settings.

## Live

With Live format selected, the image remains unfiltered for photographing images, mostly in Live/Slow scan.

## Integrate (n)

This feature allows accumulative noise reduction by true integration over a number of frames, and freezes the final image.

During and after image accumulation, you cannot change the focus or perform other image-influencing actions. **n** indicates the number of accumulated frames.

## Average (n)

Select Average (n) to continuously average a specified number of frames, resulting in a better signal-to-noise ratio. This is used mostly in TV mode to reduce noise in TV images.

During averaging, the image is updated continuously and actions such as focusing, moving the stage, etc. can still be performed.
**n** indicates the number of averaged frames.

## Freeze

Use this function to freeze the image.

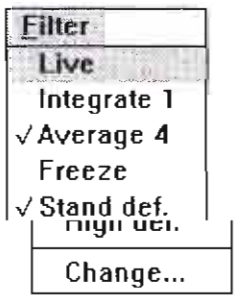
## Stand def.

Choose Stand def. to select a standard resolution image of 702 x 484 pixels. When you load a high definition image with the system in standard mode, a dialog box allows you to load the image as a standard image instead of a high definition image.

A standard definition image on the hard disk cannot be loaded into the system's framestore in high definition mode.

**CAUTION**

If you try to load a standard definition image as high definition or vice versa, the screen displays the message, "Image has other definition."




## High def.

Selecting High def. switches framestore to high definition mode if your system has the full framestore memory option. In this mode, the image is built up of 1404 x 968 pixels to allow high resolution imaging. You cannot use this mode in TV speed.

When the column is operated in high definition mode, the images are [illegible] as high definition images. If these are standard

This feature allows accumulative noise reduction by true integration over a number of frames, and freezes the final image.

During and after image accumulation, you cannot change the focus or perform other image-influencing actions. **n** indicates the number of accumulated frames.

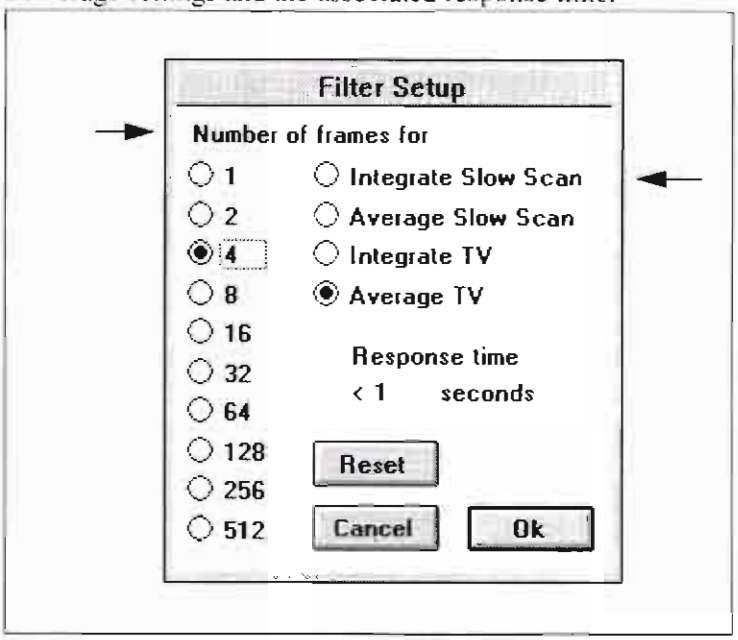
## Average (n)

Select Average (n) to continuously average a specified number of frames, resulting in a better signal-to-noise ratio. This is used mostly in TV mode to reduce noise in TV images.

During averaging, the image is updated continuously and actions such as focusing, moving the stage, etc. can still be performed.
**n** indicates the number of averaged frames.

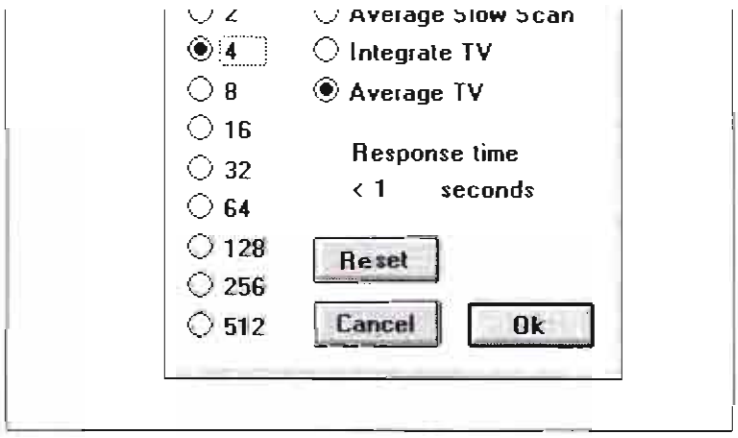
## Change

Select Change to access the dialogue box for modifying the Integrate and Average settings and the associated response time.



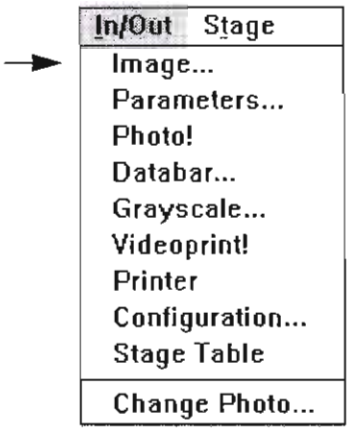

Select the noise filtering mode, Integrate Slow Scan/TV or Average Slow Scan/TV. Choose the number of frames to be used. The response time will reflect the change. The 4 modes can be individually setup and work independent of each other.

Total response time helps in judging the delay that will be seen when moving the stage or focusing, or the total time needed for an image integration.




Select the noise filtering mode, Integrate Slow Scan/TV or Average Slow Scan/TV. Choose the number of frames to be used. The response

# In/Out Menu




The In/Out menu allows all input and output actions, such as saving and retrieving images, system conditions, and taking pictures.

## Image

This option allows storage of images on any storage device of the system's computer. File names and directories are in agreement with MS-DOS conventions. The default directory for storing images is *\xl\usr\user name*.

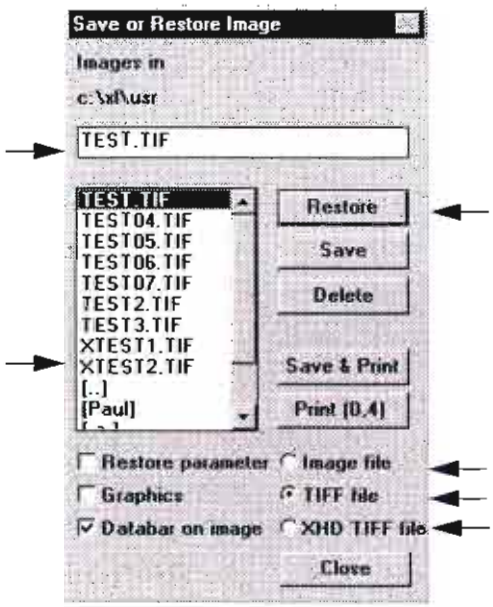
Images can be saved in two ways, characterized by their extension. Make your selection from the option buttons below the DELETE button.

### Image file (*.img )

This format is the system's internal format and is a direct byte-by-byte copy of the contents of the framestore. It is the only way to store High def. images. It contains the actual image information but also some additional column information, such as the column parameter file.

### TIFF file (*.tif )

This is a conventional file format for images, recognized by other word processing or desktop publishing software. Compared with the IMG format, redundant information is removed and the specified TIFF header is added to the image. TIFF files can be loaded back into the system's framestore. Only standard definition images can be stored as TIFF files.




### XHD TIFF file

Activation of this radio button brings the dialogue under extended format control. Images can then be saved to the list in the same way as lower resolutions via entering a label in the top text area and then pressing the 'Save' button.

### Edit Box

To save a new file, type the file name in the edit box.

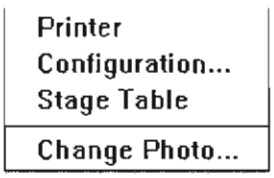
### List Box

File names can be selected from the list box. Only files with the extension **.img* or **.tif* are visible in the selected list.

### Restore

Use RESTORE to read an image from disk and load it back into the framestore where all image enhancement functions can be applied.

*\xl\usr\user name*.




Images can be saved in two ways, characterized by their extension. Make your selection from the option buttons below the DELETE button.

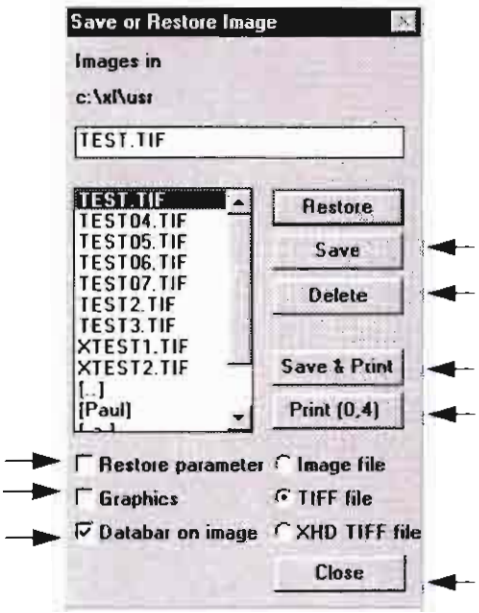
### Image file (*.img )

This format is the system's internal format and is a direct byte-by-byte copy of the contents of the framestore. It is the only way to store High def. images. It contains the actual image information but also some additional column information, such as the column parameter file.

### TIFF file (*.tif )

This is a conventional file format for images, recognized by other word processing or desktop publishing software. Compared with the IMG format, redundant information is removed and the specified TIFF header is added to the image. TIFF files can be loaded back into






## Delete

The DELETE button can be used to delete a file from the list and from the computer hard disk.

## Restore Parameter

If the Restore parameter checkbox is selected, the column is reconfigured according to the parameter file, except for the stage position.

## Graphics

Click on the Graphics checkbox to save or restore any graphics (text) associated with the image. Choosing not to save graphics results in a faster save time.

## Databar on Image

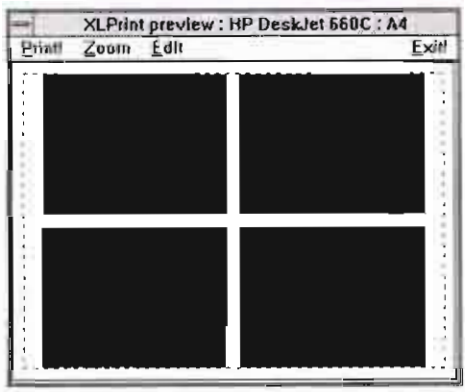
Click on the checkbox, if required, to 'burn-in' the databar details when saving the image. This is a permanent feature and cannot be reversed.

## Save

Click on the SAVE button to save the file after choosing whether or not to save the graphics associated with the file.

## Save & Print

Click on this button to save the file and print out the image.

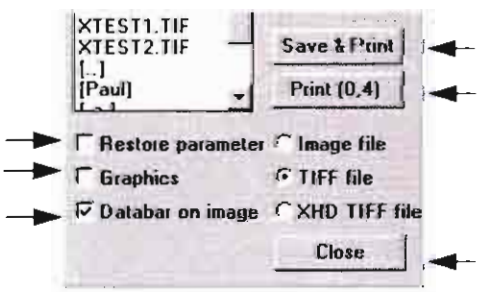



## Print (0,4)

Click on this button to go to the Print Preview dialog.The first number in brackets (**0**,4) shows the number of images in the print buffer, the second shows the formatted choice, either 1, 2, or 4 images. By highlighting images one by one in the list, and clicking on the Print preview quads, the buffer can be filled with the desired images for printing. Editing facilities (1, 2, 4) for the print layout can be found under Printer in the In/Out menu. When the right number of images are present the preview can be printed.

## Close

Click on CLOSE to exit the dialog box.




## Graphics

Click on the Graphics checkbox to save or restore any graphics (text) associated with the image. Choosing not to save graphics results in a faster save time.

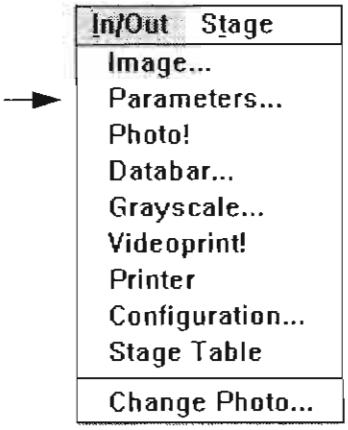
## Databar on Image

Click on the checkbox, if required, to 'burn-in' the databar details when saving the image. This is a permanent feature and cannot be reversed.

## Save

Click on the SAVE button to save the file after choosing whether or not to save the graphics associated with the file.

## Save & Print



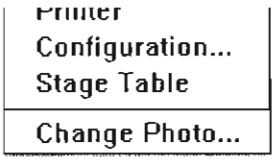

## Parameters

This option lets you choose the file and directory in which to store most microscope settings. The parameter list is indicated as a multidimensional vector file with an extension.*vct*. When a microscope setting is retrieved, the parameters, including accelerating voltage, spotsize, magnification, etc. are set to the condition of the microscope on saving this parameter file.

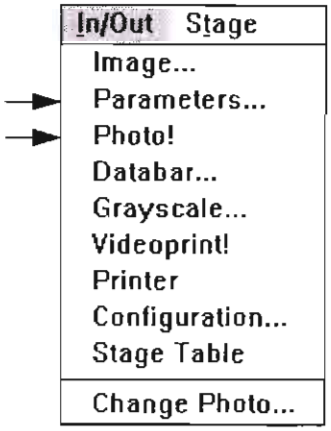
Parameters include:

- Parameter name
- Stage positions
- Tilt value as given in control area
- Magnification
- High tension
- Working distance (= focus)
- Scan rotation value
- Beam shift X, beam shift Y
- Spotsize
- Stigmator X, stigmator Y
- Detector type and mix factors
- Contrast and brightness of detector(s)
- Line time and lines per frame for all 4 scan modes
- Actual scan mode
- Size and position of selected area
- Average frames for TV and for SS
- Resolution of the framestore (SD or HD)
- Internal file data about column type, serial number, etc.

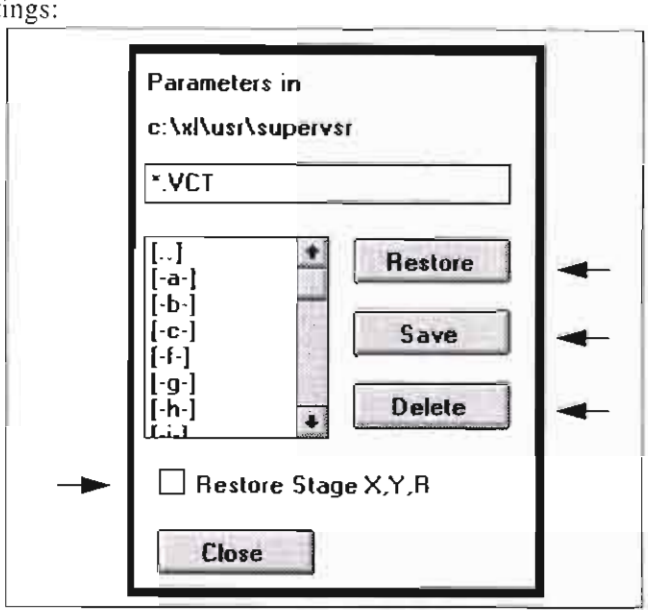
Column alignment settings are not stored in these files because they are instrument adjustments and not parameter settings. The default settings of the scan speeds (including photo scan) are stored and reloaded when the parameter file is loaded into the column.




- Parameter name
- Stage positions
- Tilt value as given in control area
- Magnification
- High tension
- Working distance (= focus)
- Scan rotation value
- Beam shift X, beam shift Y
- Spotsize
- Stigmator X, stigmator Y
- Detector type and mix factors
- Contrast and brightness of detector(s)




Choosing Parameters brings up a dialog box for storing column settings:




### Restore

Use RESTORE to read a condition from a disk. The parameters will be loaded into the column.

### Save

Use SAVE to store a condition on a disk.

### Delete

Delete files from a disk with the DELETE button.

### Restore Stage X, Y, R

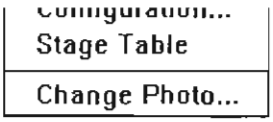
Click on the checkbox to restore stage parameters for X, Y, R.

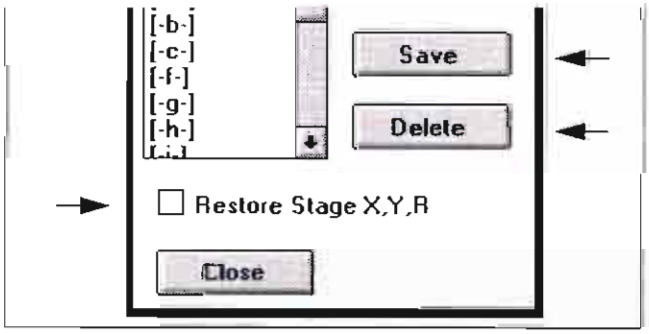
### Close

Click on CLOSE to exit the dialog box.

## Photo!

Use this menu item to photograph the current image. If an image is frozen, that frozen image is recorded on film. If the framestore is in live mode, a live photograph is taken. Before you use the Photo! function, set contrast and brightness using the videoscope and remove the protective metal sheet before exposing the film.

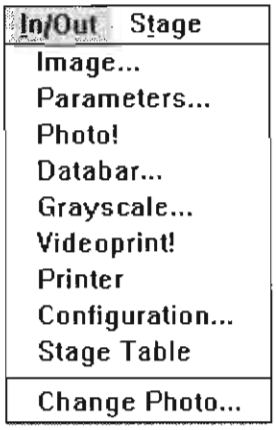



### Restore

Use RESTORE to read a condition from a disk. The parameters will be loaded into the column.

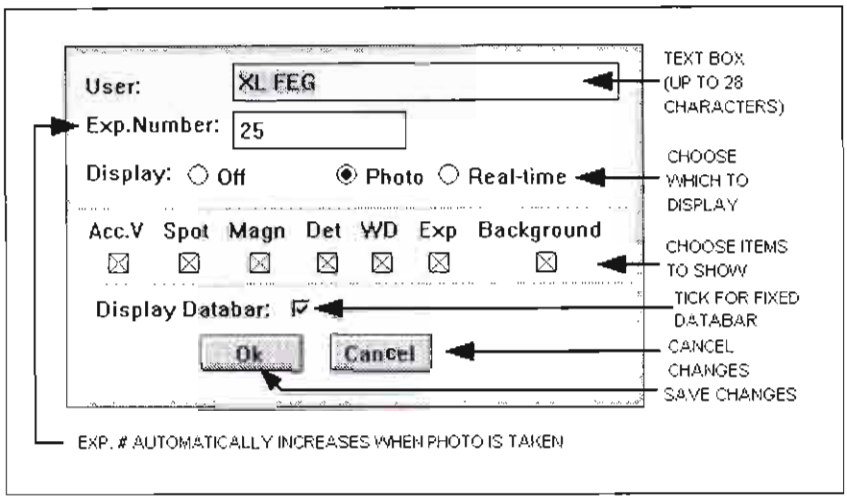
### Save




## Data bar

Two data bars are available, photo and real time. The photo data bar appears automatically at the lower edge of the screen.

Select Databar from the In/Out pulldown menu to display a dialogue box for choosing which data bar to display, if any, and which items to show.

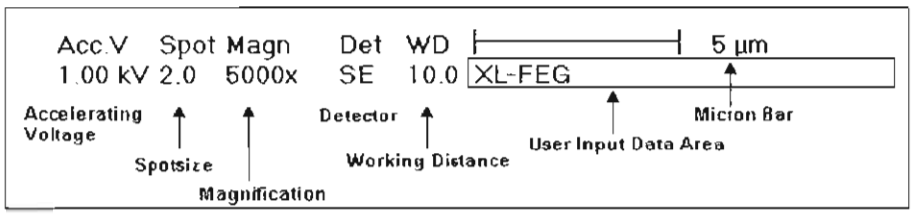


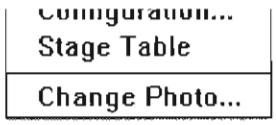

The data bar is saved with the image.

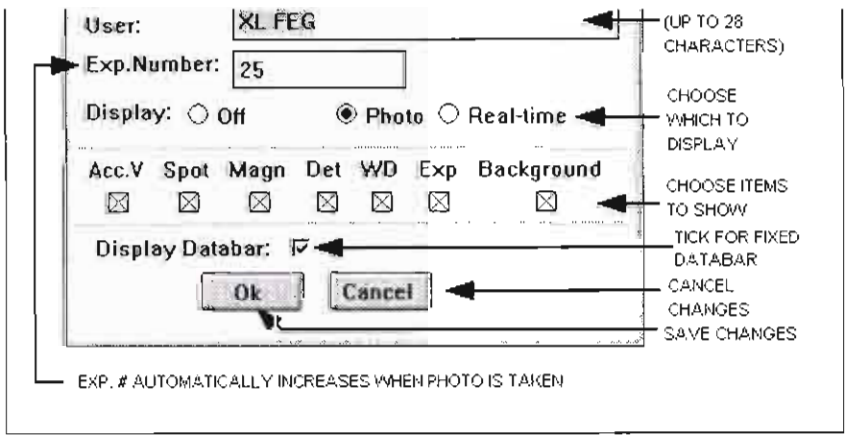
### Photo Data Bar

The photo data bar, displays the applied high tension, spotsize, magnification, detector, working distance and exposure number. Each item can individually be switched on or off in the data bar dialogue box.

*FIGURE 4-2 PHOTO DATA BAR*




The data bar is saved with the image.

The full photo data bar shows the following data:

TABLE 4-10 PHOTO DATA BAR COMPONENTS

| Item | Significance |
|---|---|
| **Accelerating Voltage** | kV, three relevant digits. Below 1 kV, the unit scales to V and the value is again given in three digits. |
| **Spotsize** | Spotsize in the range 1 to 7 |
| **Magnification** | Magnification shown in integers. The magnification value relates to the output medium, if output is made using menu items in the In/Out menu. |
| **Detector** | Selected detector, e.g. SE, BSE, CCD |
| **Working Distance** | Free working distance in mm equals the distance between the specimen surface and the final lens. The number is correct only when the image is in focus. |
| **Exposure** | Exposure number given in a range of 0 to 9999 and incremented each time the Photo! procedure is started. |
| **User Input Section** | Used to input sample labels or data. |

### Background

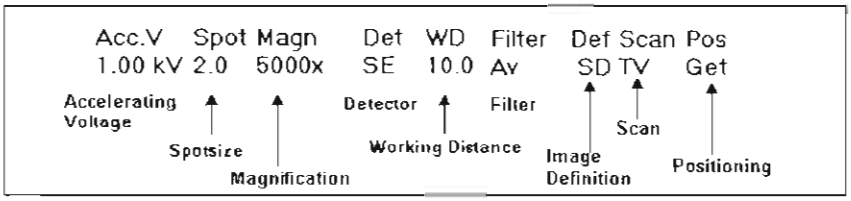
This check-box is for the choice of white text on a black background or on the image if you have the extended graphics option. Without the option the data bar text is superimposed on the image as white letters.

| | |
|---|---|
| **Spotsize** | Spotsize in the range 1 to 7 |
| **Magnification** | Magnification shown in integers. The magnification value relates to the output medium, if output is made using menu items in the In/Out menu. |
| **Detector** | Selected detector, e.g. SE, BSE, CCD |
| **Working Distance** | Free working distance in mm equals the distance between the specimen surface and the final lens. The number is correct only when the image is in focus. |
| **Exposure** | Exposure number given in a range of 0 to |

## Real Time Data Bar

The real time data bar gives more status information about the column. This data bar shows the status of the framestore and indicates whether the image is live or frozen, what scan rate is currently used and stage positioning information.

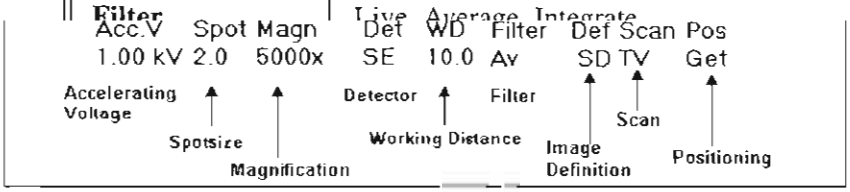
*FIGURE 4-3 REAL TIME DATA BAR*




No matter which data bar is active, the micrograph and/or the videoprint shows the photo data bar.

TABLE 4-11 REAL TIME DATA BAR COMPONENTS

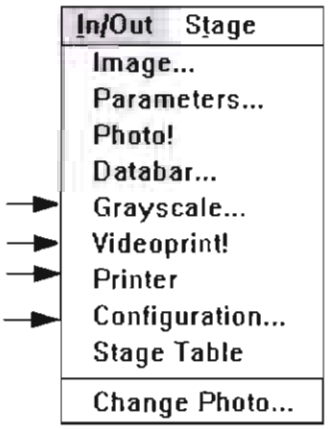
| Item | Significance |
|---|---|
| **Accelerating Voltage** | Accelerating Voltage in kV, three relevant digits. Below 1 kV, the unit scales to V. |
| **Spotsize** | Spotsize in the range 1 to 7 |
| **Magnification** | Magnification shown in integers |
| **Detector** | Selected detectors, e.g. SE, CEM, CCD |
| **Working Distance** | Free working distance in mm equals the distance between the specimen surface and the final lens. The number is correct only if the image is in focus. |
| **Filter** | Type of filter applied |
| **Image Definition** | Standard or high definition |
| **Scan** | Scan speed |
| **Positioning** | Shift, Get, Track or Off |
| **Filter** | Live, Average, Integrate |




No matter which data bar is active, the micrograph and/or the videoprint shows the photo data bar.

TABLE 4-11 REAL TIME DATA BAR COMPONENTS

| Item | Significance |
|---|---|
| **Accelerating Voltage** | Accelerating Voltage in kV, three relevant digits. Below 1 kV, the unit scales to V. |




## Grayscale

Grayscale is only active if you are in Standard def. image resolution. Use this function to generate a greyscale test image on the screen. It can be used to calibrate the photo camera, monitor, or the videoprinter. To remove the image from the screen, select Live, Average, or Integrate from the Filter menu or grab another frame.

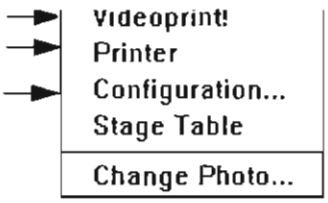
## Videoprint! (Optional)

Use this optional function to initialize the videoprinter to print a copy of the image, including the data bar, with the proper magnification. If you manipulated the image, other graphic overlays can also be printed.

Videoprints are different from photographs. Videoprints default to a width of 7.56 cm. The photograph value defaults to output with a horizontal width of 12.0 cm.

## Printer

Click on this to open control for the configuration of images, reprint buffer, print preview, page setup and print setup functions. further information can be found in chapter 5 on 'Operation'.




Use this optional function to initialize the videoprinter to print a copy of the image, including the data bar, with the proper magnification. If you manipulated the image, other graphic overlays can also be printed.

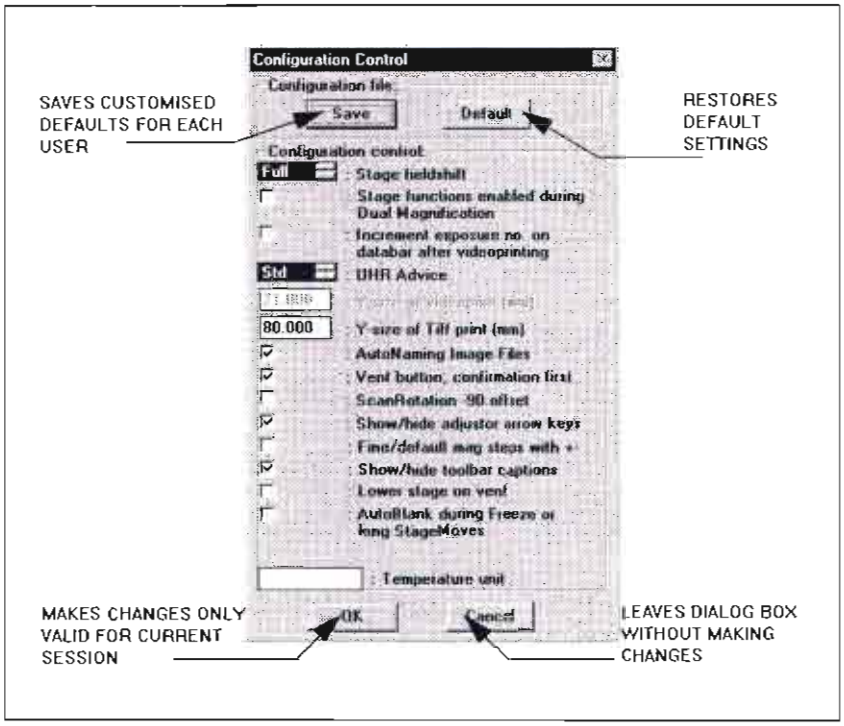
Videoprints are different from photographs. Videoprints default to a width of 7.56 cm. The photograph value defaults to output with a horizontal width of 12.0 cm.

## Printer

Click on this to open control for the configuration of images, reprint buffer, print preview, page setup and print setup functions. further information can be found in chapter 5 on 'Operation'.

## Configuration

This dialog box contains default settings for some aspects of the user interface that can be customized. Changes are saved for each user.



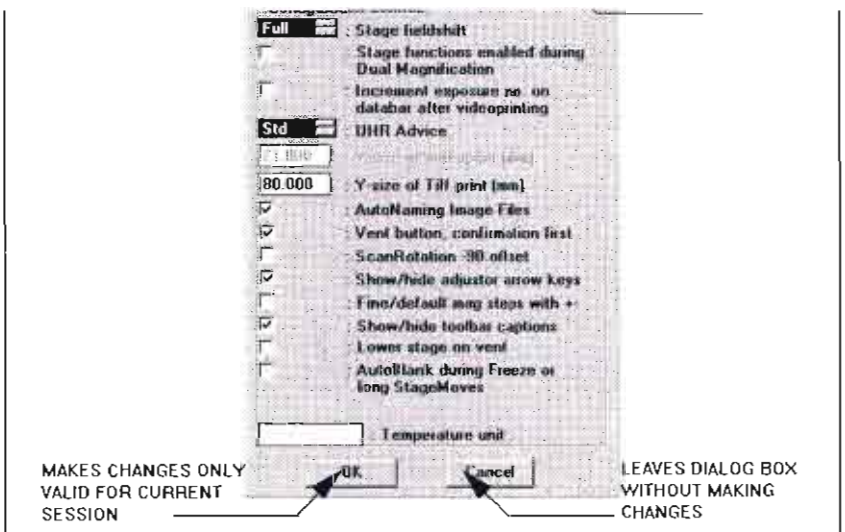
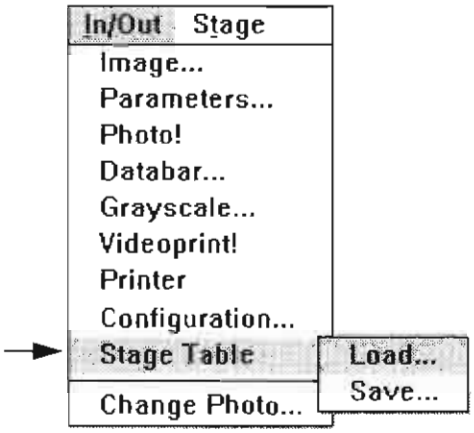



TABLE 4-12 CONFIGURATION CONTROL

| Control Option | How it Works |
|---|---|
| **Stage fieldshift** | Arrow keys move the stage by a full or half screen width.<br>**Full** = arrow key moves full screen; Shift arrow moves half screen.<br>**Half** = arrow key moves half screen; Shift arrow moves full screen.<br>**None** = no stage fieldshift |
| **Stage functions enabled during Dual Magnification** | **Unchecked** = disabled<br>**Checked** = enabled, use the arrow keys for stage field shift. |
| **Increment exposure no. on data bar after videoprinting** | **Unchecked** = disabled **Checked** = automatically increments |
| **UHR Advice (SFEG only)** | Full / Std / Off: Different levels of guidance for the UHR Mode |
| **Y size of videoprint (mm)** | Display only, specific to installed device |
| **Y size of Tiff print (mm)** | Changeable Y size depending on printer in use |
| **AutoNaming Image Files** | **Unchecked** = disabled **Checked** = Consecutive naming (numbering) of Image files. Used with the Printing function. |
| **Vent button, confirmation first** | **Unchecked** = disabled **Checked** = enabled |
| **Scan Rotation -90 offset** | Makes scan vertical to the tilt axis instead of parallel to it. For use with stereo pairs, color option.<br>**Unchecked** = disabled **Checked** = enabled |
| **Show/hide adjuster arrow keys** | Adds arrow keys to the ends of the adjusters for incremental changes. Change takes affect after choosing a different control area.<br>**Unchecked** = disabled (Hides) **Checked** = enabled (Shows) |
| **Fine/default mag steps with +-** | Modifies the step sizes when using the + - keys on the keyboard for changing magnification.<br>**Unchecked** = disabled (Default Presets)<br>Increases magnification by default factor of 2X.<br>**Checked** = enabled (Adds Fine Steps)<br>Increases magnification according to the pulldown menu presets, but adds extra steps between. |
| **Show/hide tool bar captions** | Shows/hides captions on tool bar icons.<br>**Unchecked** = disabled (Hides)**Checked** = enabled (Shows) |
| **Stage functions enabled during Dual Magnification** | **Unchecked** = disabled<br>**Checked** = enabled, use the arrow keys for stage field shift. |
| **Increment exposure no. on data bar after videoprinting** | **Unchecked** = disabled **Checked** = automatically increments |
| **UHR Advice (SFEG only)** | Full / Std / Off: Different levels of guidance for the UHR Mode |
| **Y size of videoprint (mm)** | Display only, specific to installed device |
| **Y size of Tiff print (mm)** | Changeable Y size depending on printer in use |
| **AutoNaming Image Files** | **Unchecked** = disabled **Checked** = Consecutive naming (numbering) of Image files. Used with the Printing function. |
| **Vent button, confirmation first** | **Unchecked** = disabled **Checked** = enabled |

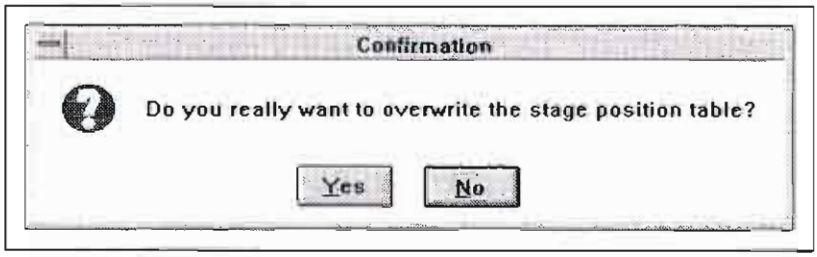



## Stage Table

Use this function to retrieve or store stage files from the list of stored stage position that include settings for stage alignment.

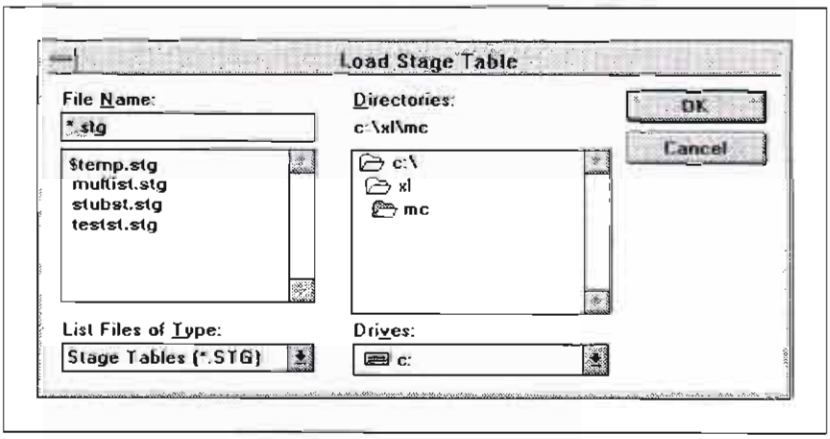
### Load

Choose Load from the Stage Table submenu to open a stage position file. If you have a prestored stage position table, a Confirmation dialogue box appears:



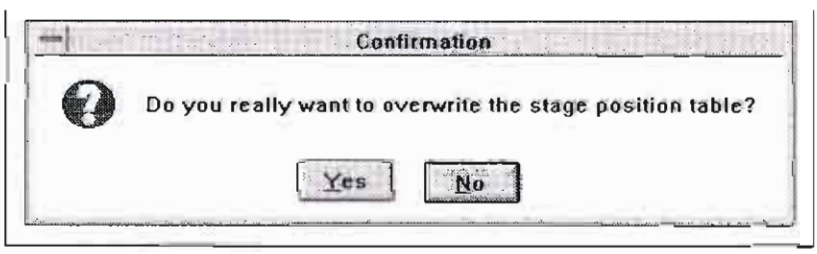

Also, if you have an existing Specimen Alignment defined, a dialog box will say "The stage table file includes Specimen Alignment information. Do you want to overwrite?

If you click on YES the Load Stage Table dialog box appears:




Select a stage file and click OK.

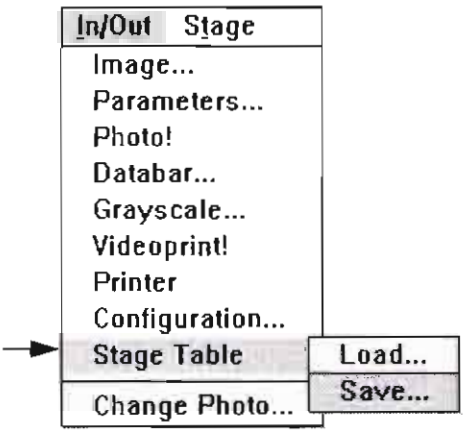



Also, if you have an existing Specimen Alignment defined, a dialog box will say "The stage table file includes Specimen Alignment information. Do you want to overwrite?

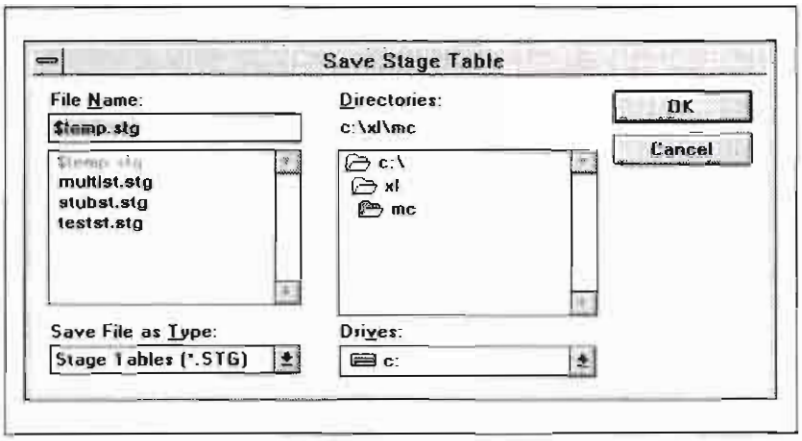
If you click on YES the Load Stage Table dialog box appears:



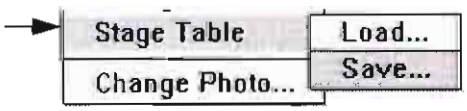


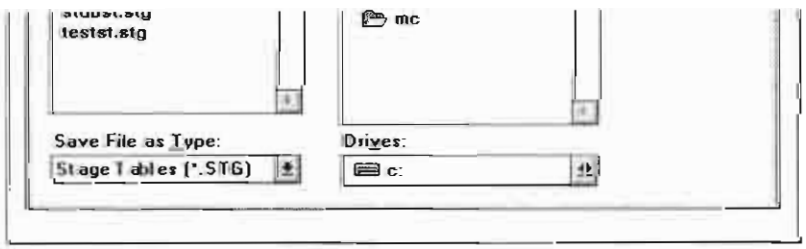

## Save

If you choose Save from the Stage Table submenu, a similar dialog box appears.

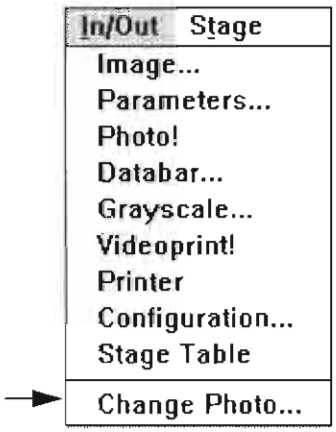



The saved stage file will include all preset stage locations at the time you saved.



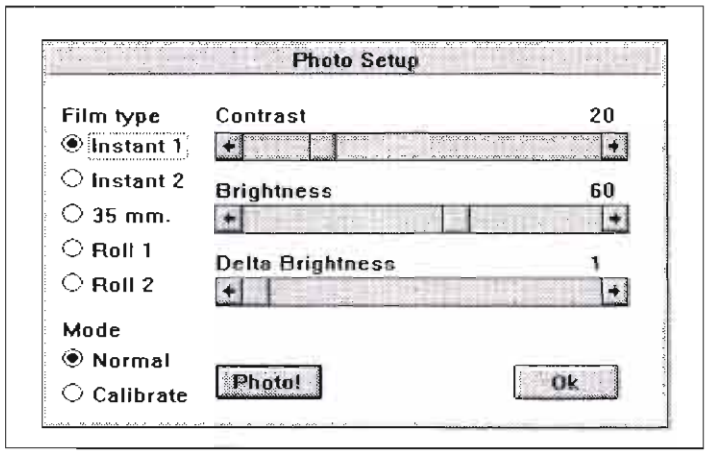




The saved stage file will include all preset stage locations at the time you saved.




## Change

Select Change to calibrate the photo monitor. Use the dialog box with contrast, brightness and delta brightness adjusters for different film types.




### Film type

Choose the film type to be loaded into the camera.

### Mode

Normal mode is the default. See Operations for Calibrating the Camera.

### Contrast and Brightness

If contrast and brightness are out of range, set contrast to 30 and brightness to 50.

### Delta Brightness

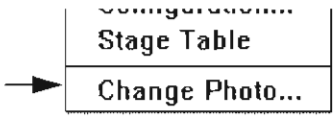
Delta brightness is the increment by which brightness is changed for each step in the photo calibrate routine.

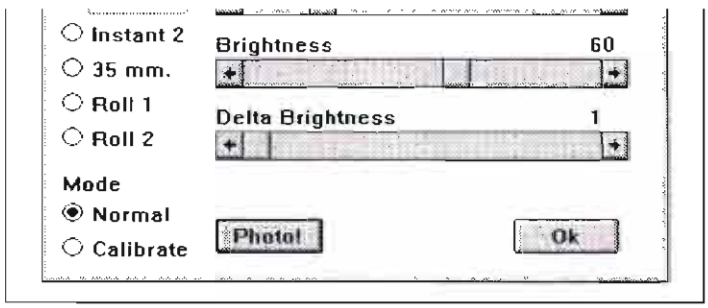
### Photo

Click on PHOTO to take the photo for calibration purposes.

### OK

Click on OK to exit the dialogue box.



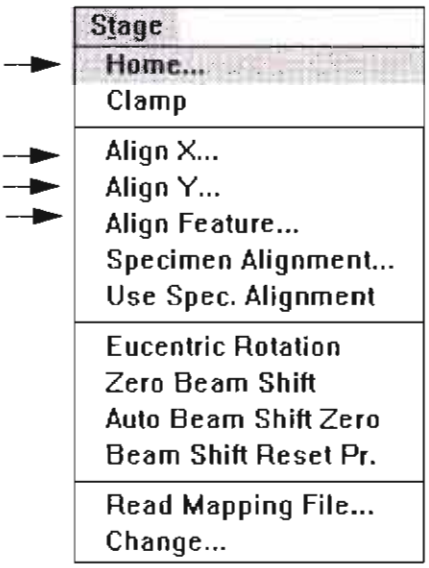

### Film type

Choose the film type to be loaded into the camera.

### Mode

Normal mode is the default. See Operations for Calibrating the

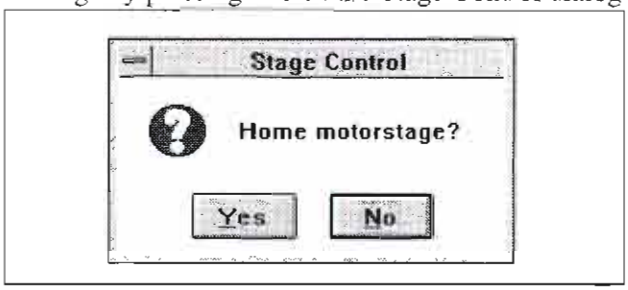
# Stage Menu




The Stage menu functions control movement of the stage and the beam to correct the position of the specimen.

## Home

Home the stage by pressing YES on the Stage Control dialog box.




The Homing the Stage Active dialog box flashes onscreen.

When the stage is homed correctly, all five coordinates will be 0.

## Clamp

This is found only on the stages with a pneumatic clamp, and can activated from this menu.

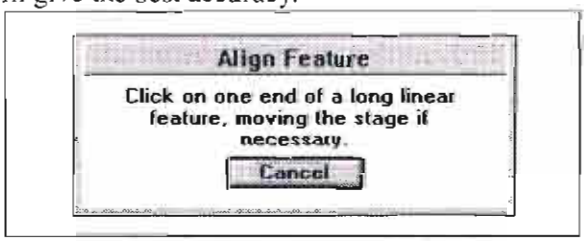
## Align X/Align Y

Use Align X or Align Y to align rows or columns on the sample with the vertical or horizontal axes on the screen. Use Slow Scan for greater accuracy.

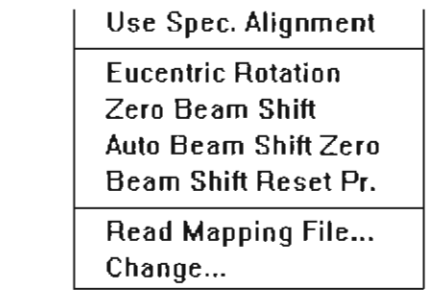
See the Operations chapter for procedural information. Use Align Wafer for greatest accuracy.

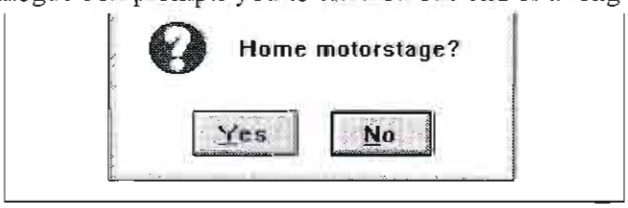
## Align Feature

This feature allows you to align the vertical axis of an entire feature over a long distance. **You must use the arrow tool.** Although the alignment can be performed using TV rate scan speed, slow scan speed will give the best accuracy.




The dialogue box prompts you to click on one end of a long linear



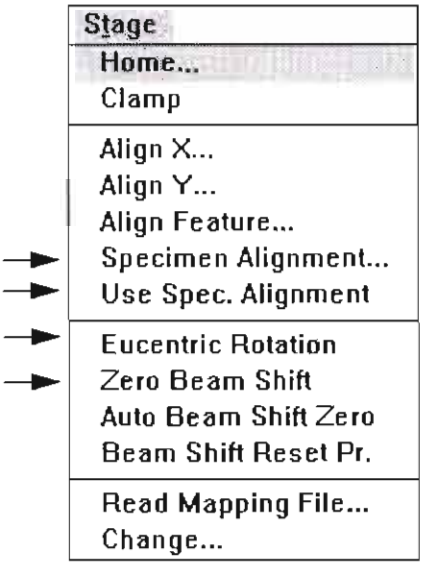

The Homing the Stage Active dialog box flashes onscreen.

When the stage is homed correctly, all five coordinates will be 0.

## Clamp

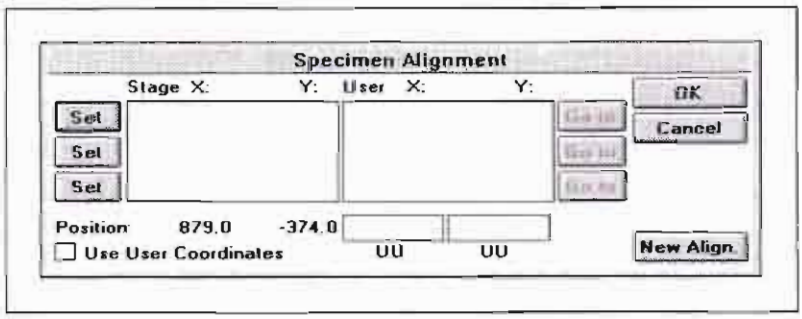
This is found only on the stages with a pneumatic clamp, and can activated from this menu.

## Align X/Align Y




## Specimen Alignment

Specimen alignment is a navigation aid. It can be used to convert alignment points from microns to user units and to further increase stage accuracy. Use the arrow tool or Get moves to select the alignment points.




The complete step-by-step procedure for using Specimen Alignment is in the Operations chapter.

## Use Specimen Alignment

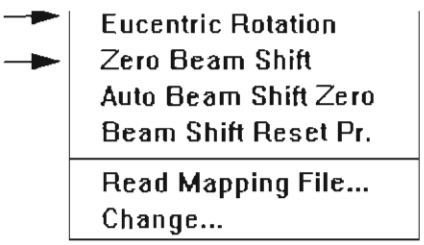
This selection is a toggle for using an established Specimen Alignment.

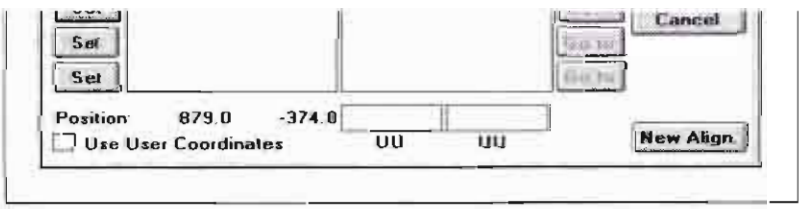
## Eucentric Rotation

Select Eucentric Rotation to make all stage moves eucentric. Computer calculations make adjustments for changes in position that would move the area of interest out of view. This shifts the centre point from the stage centre to the field-of-view centre.

## Zero Beam Shift

When beam shift has reached maximum limits, choose Zero Beam Shift to restore X and Y beam shifts to zero values. The computer beeps when maximum limits are reached.



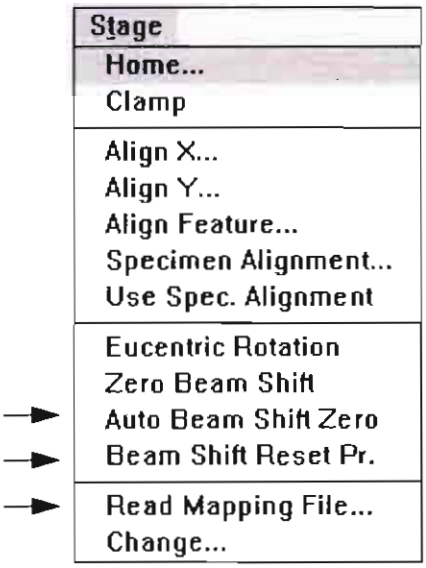




The complete step-by-step procedure for using Specimen Alignment is in the Operations chapter.

## Use Specimen Alignment

This selection is a toggle for using an established Specimen Alignment.

## Eucentric Rotation

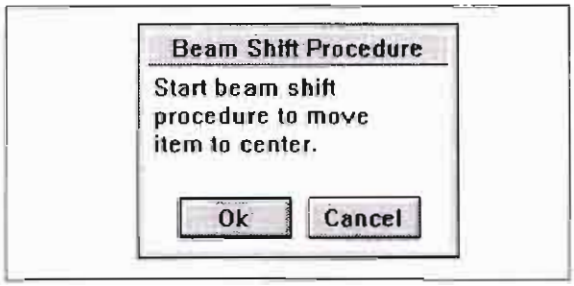



## Auto Beam Shift Zero

Select Auto Beam Shift Zero to automatically set beam shift to zero after a stage move. This also prevents Get moves from using beam shift.

## Beam Shift Reset Procedure

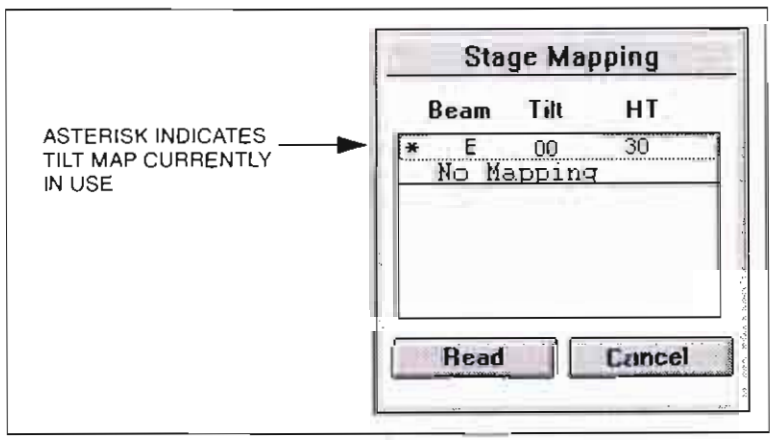
Use this function to begin the beam shift procedure to zero beam shift and move the feature to the center of the field of view with the stage.



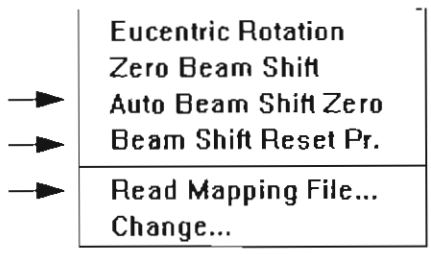

A powerzoom procedure begins that combines a preset zoom rate with autofocus and autocontrast/brightness. You set the parameters in advance in the Position Setup dialogue box. If you have chosen the auto-functions. this will extend the time the procedure takes.

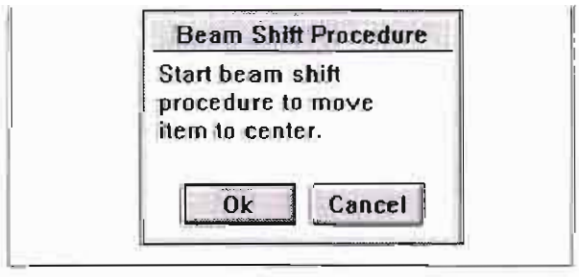
## Read Mapping File

When selected, the Stage Mapping dialog box displays a list of mapping files that can be used to make stage movement more accurate at various tilts and high tensions.




The asterisk indicates which map file is currently being used by the software. You can also select no mapping, but none of the stage moves will be eucentric.

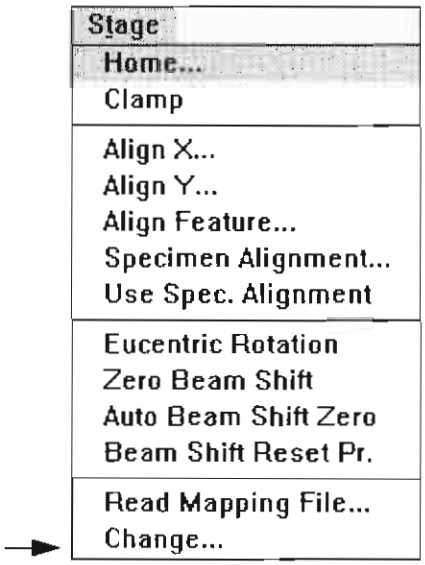



A powerzoom procedure begins that combines a preset zoom rate with autofocus and autocontrast/brightness. You set the parameters in advance in the Position Setup dialogue box. If you have chosen the auto-functions. this will extend the time the procedure takes.

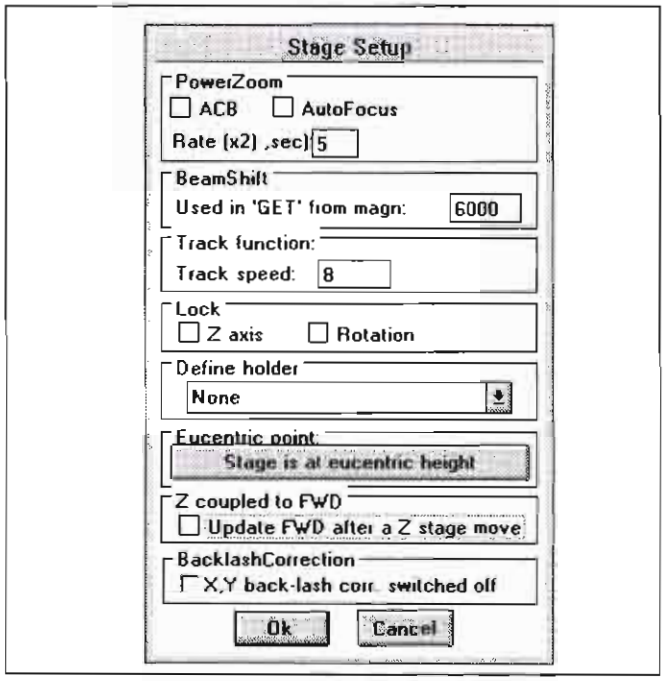
## Read Mapping File

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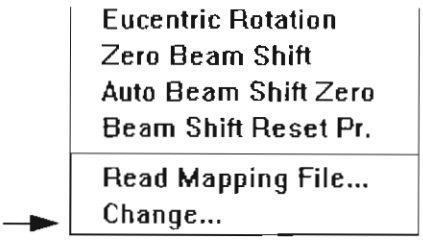


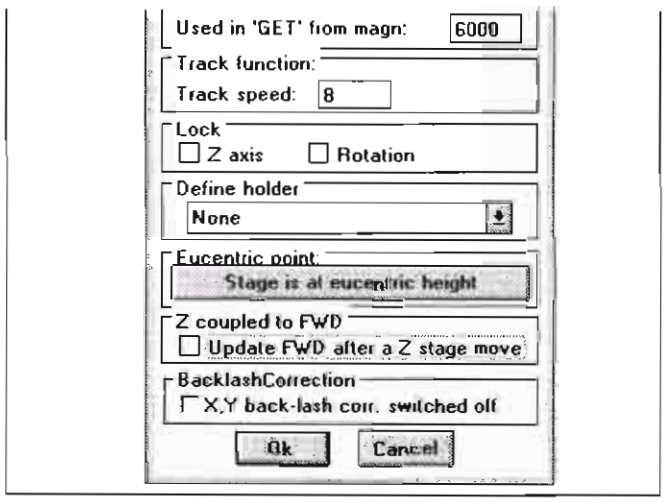

## Change

Use this dialogue box to set parameter inputs for positioning functions.




**NOTE:** The PowerZoom function was discontinued in this dialogue from Ver.5.9 on



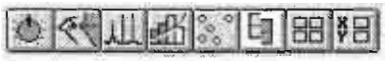



# Position Setup Functions

TABLE 4-13 POSITION SETUP FUNCTIONS

| Item | Function |
|---|---|
| **PowerZoom ACB (only prior Ver. 5.9)** | Performs contrast and brightness at the end of the powerzoom operation. |
| **PowerZoom Autofocus (only prior Ver. 5.9)** | Performs autofocus at the end of the PowerZoom operation. Extends the time the procedure takes. |
| **PowerZoom Rate (x2) (only prior Ver. 5.9)** | Determines the time in seconds it takes to increase the PowerZoom magnification by a factor of 2. The larger the number, the more time you will have to find detail. |
| **Beam Shift used in GET from magn** | The maximum magnification setting used with the Get function to move the stage if Auto Beam Shift Zero is not selected; beyond that, image shift is used. |
| **Track speed** | Sets the ratio between the minimum and maximum speed. The minimum default value is 4, the maximum is 10. The ratio only influences maximum speed at a given magnification. The minimum speed is always coupled with the magnification value. |
| **Lock Z axis** | Lock/unlock function (stage type dependant) |
| **Lock Rotation** | Lock/unlock function |
| **Lock Tilt** | Lock/unlock function (stage type dependant) |
| **Define holder** | Contains list box to choose holder. |
| **Eucentric Point** | Defines the eucentric position for tilt and Z safety. Depending on the tilt, Z is limited to some distance above the eucentric point.<br>By pressing the large button the stage moves to the Eucentric point. |
| **Z coupled to FWD** | If the check box is active the FWD is updated to the Z value chosen, therefore retaining focal condition.<br>If the check box is non-active moving Z will result in no change to the FWD value. This can be overcome by pressing Ctrl-Z. |
| **Backlash Correction** | Default is unticked and is ON. Tick to switch stage backlash |
| **PowerZoom Autofocus (only prior Ver. 5.9)** | Performs autofocus at the end of the PowerZoom operation. Extends the time the procedure takes. |
| **PowerZoom Rate (x2) (only prior Ver. 5.9)** | Determines the time in seconds it takes to increase the PowerZoom magnification by a factor of 2. The larger the number, the more time you will have to find detail. |
| **Beam Shift used in GET from magn** | The maximum magnification setting used with the Get function to move the stage if Auto Beam Shift Zero is not selected; beyond that, image shift is used. |
| **Track speed** | Sets the ratio between the minimum and maximum speed. The minimum default value is 4, the maximum is 10. The ratio only influences maximum speed at a given magnification. The minimum speed is always coupled with the magnification value. |

# The Control Area






The software control areas are located on the right side of the screen. Each control area consists of smaller control groups. For most operations there is no need to maximize the control groups. The most used functions are available in the minimized versions. Maximize the control groups to access functionality needed only once and awhile.

Select the control areas by clicking on the icons in the tool bar or by using the mouse to pulldown the Control Area menu.

## Settings

When you start up the software, the screen defaults to the Settings control area. The main functions of Settings are specimen exchange, including switching the beam on and off, and allowing venting and pumping down of the specimen chamber.

## Imaging

Imaging is one of the main control areas used when operating the system. It contains all of the basic functions for magnification, focusing, and video.

## Analytical

The Analytical control area allows data collection and analysis for the EDX option.

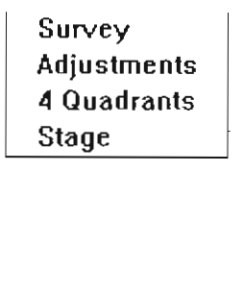
## Image Manipulation

This control area is used to manipulate images, including crisp, gamma curves, colour coding, and framestore memory management.

## Survey

The Survey control area is used for storing specimen positions with their associated microscope parameters. **This mode is non-operative in UHR Mode.**

## Adjustments



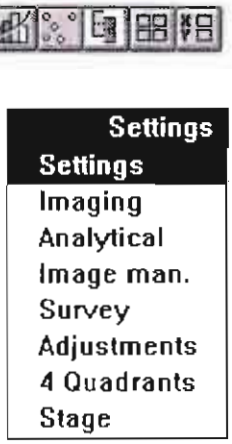

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## 4 Quadrants

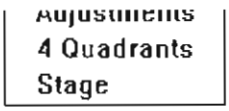
The 4 Quadrant control area allows viewing the microscope image in four quadrants of the screen, using up to four different detectors. **This mode is non-operative in UHR Mode.**

## Stage

The Stage positioning control area controls movement of the stage and the beam and positioning of the specimen. It is the same as the maximized Stage control group that appears at the bottom of all the other control areas.

**NOTE:** Analytical, Survey and 4 Quadrants control areas are switched out of the user interface from software version 5.8 on. They can be activated by making the items 'FALSE' in the XLCUI.INI file. They are defaulted to 'TRUE' on first loading of the software.

**NOTE:** It is recommended that before changing the content of files, that the files be backed-up.



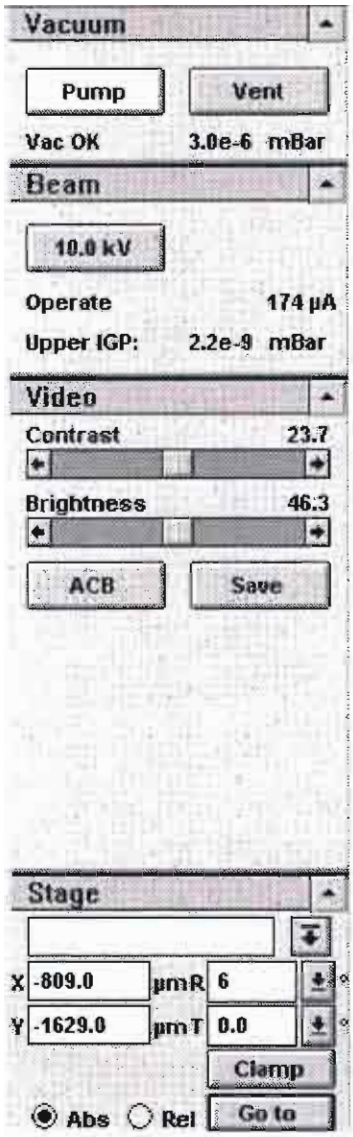

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# Settings



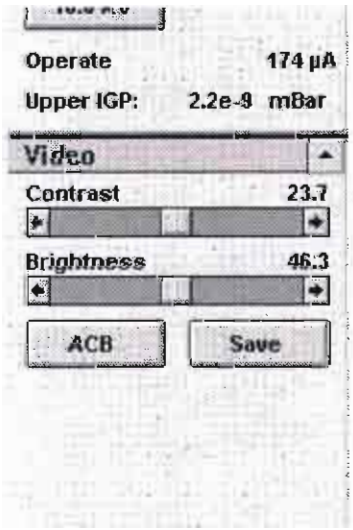

## Overview

The Settings control area is divided into four control groups:

- Vacuum
- Beam
- Video
- Stage

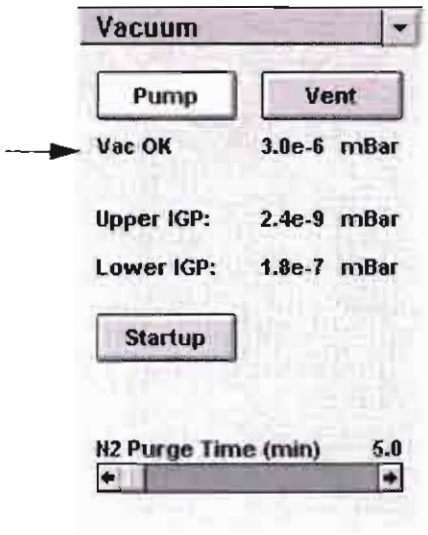
Active settings are indicated in the data bar. The control groups contain the basic functions and parameter adjustments. When maximized, they contain parameters that have to be changed occasionally, such as the emission current settings.

The control area settings allow specimen exchange, switching the beam on and off, venting, and pumping the specimen chamber.




Active settings are indicated in the data bar. The control groups contain the basic functions and parameter adjustments. When maximized, they contain parameters that have to be changed occasionally, such as the emission current settings.

The control area settings allow specimen exchange, switching the beam on and off, venting, and pumping the specimen chamber.




NOTE

The system has a safety interlock that prevents operation until the Vac OK message is displayed.

# Vacuum

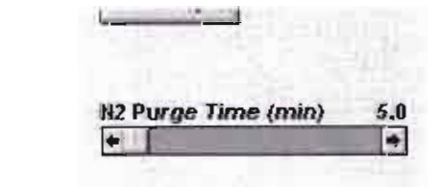
Use Vacuum settings during specimen exchange and system start-up to pump and vent the specimen chamber, and control shutdown and nitrogen purge time. The vacuum status of the specimen chamber and the column chamber are also shown.

## Vacuum Status Messages

Several messages may be displayed below the PUMP button indicating the status of the vacuum system.

TABLE 4-14 VACUUM PUMP STATUS MESSAGES

| Message | Meaning |
|---|---|
| **Pumping** | Indicates that the pump down cycle has started. |
| **PreVac** | Indicates that the vacuum cycle is proceeding. |
| **VacSpec OK** | Indicates that the vacuum level in the specimen chamber is greater than $10^{-4}$ mbar, the correct operating pressure for the specimen chamber. |
| **Vac OK** | Indicates that the vacuum level in the specimen chamber and the vacuum levels as measured by the two IGPs are in acceptable operating range. |
| **Idle** | Displays after venting the chamber. |
| **Fil. wait** | Displays if the chamber is vented without first switching off HT. The system slowly reduces the HT to zero prior to venting the chamber. |

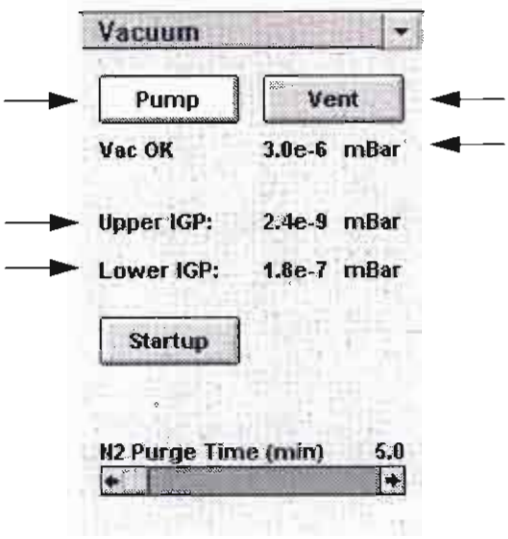



NOTE

The system has a safety interlock that prevents operation until the Vac OK message is displayed.

TABLE 4-14 VACUUM PUMP STATUS MESSAGES

| Message | Meaning |
|---|---|
| **Pumping** | Indicates that the pump down cycle has started. |
| **PreVac** | Indicates that the vacuum cycle is proceeding. |
| **VacSpec OK** | Indicates that the vacuum level in the specimen chamber is greater than $10^{-4}$ mbar, the correct operating pressure for the specimen chamber. |
| **Vac OK** | Indicates that the vacuum level in the specimen chamber and the vacuum levels as measured by |




## Specimen Chamber Status

The display below the VENT button shows the pressure in the specimen chamber, expressed in mbar. Pressures in between $10 \times 10^{-3}$ mbar and $5 \times 10^{-7}$ mbar are measured and displayed.

## Pump

This button starts the pumpdown procedure for the specimen chamber. For Turbomolecular Pump (TMP) systems evacuating the specimen chamber is immediately through this pump. For Oil Diffusion Pump (ODP) systems first the Rotary pump pre-evacuates the chamber followed by the ODP. When the chamber is evacuated, the system allows high tension to be switched on when pressure in the chamber and the column are ready for operation. When you click on PUMP, the button changes from grey to yellow.

## Vent

Click on VENT to slowly switch off the high tension and the pumping system of the specimen chamber. The column valves close and the specimen chamber vents. The parameters of the column are not affected; only high tension is set to zero. Venting the chamber opens the specimen chamber valve for a period of time, specified as the "Nitrogen purge time," and then closes. If the valve is closed again before the chamber is at ambient pressure, another click on VENT repeats the procedure.

**NOTE**

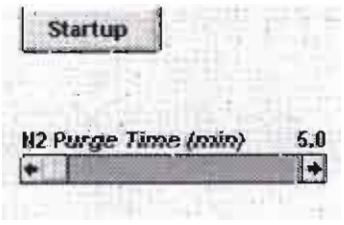
Whenever a new emitter is used for the first time it is highly recommended to monitor the Upper IGP pressure for the first few hours of operation. Due to outgassing, the pressure might temporarily (for a few hours) be a bit higher than $10^{-8}$ mbar.

## Upper IGP Status

This refers to the pressure in the tip area (source region). For a running system, it is approximately $5 \times 10^{-9}$mbar, and may drop to a lower value of about $1 \times 10^{-9}$mbar when the filament is not heated. If the pressure is higher than $5 \times 10^{-7}$ mbar, the filament switches off. In that case, the IGPs continue to pump, but you have to wait until the vacuum is better than $2 \times 10^{-8}$ mbar again before being able to switch on the filament.

## Lower IGP Status

This refers to the pressure at the differential pump area, just above the column valve. Its value for a running system is approximately $2 \times 10^{-8}$ mbar. Pumping and venting of the specimen chamber and hence the switching of the column valve, should not have an influence on this level. If the pressure is higher than $5 \times 10^{-6}$ mbar, the system switches off the column.

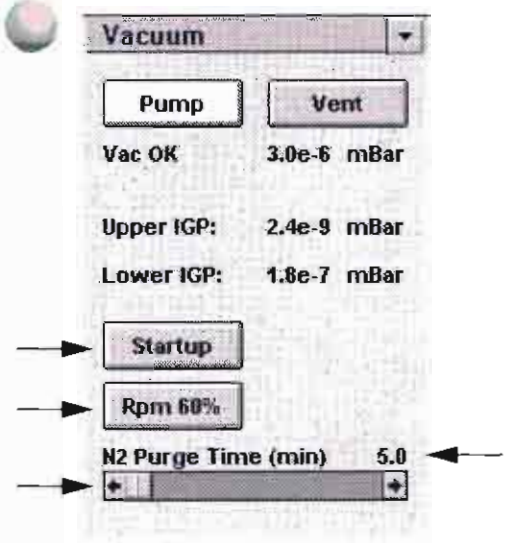



the chamber followed by the ODP. When the chamber is evacuated, the system allows high tension to be switched on when pressure in the chamber and the column are ready for operation. When you click on PUMP, the button changes from grey to yellow.

## Vent

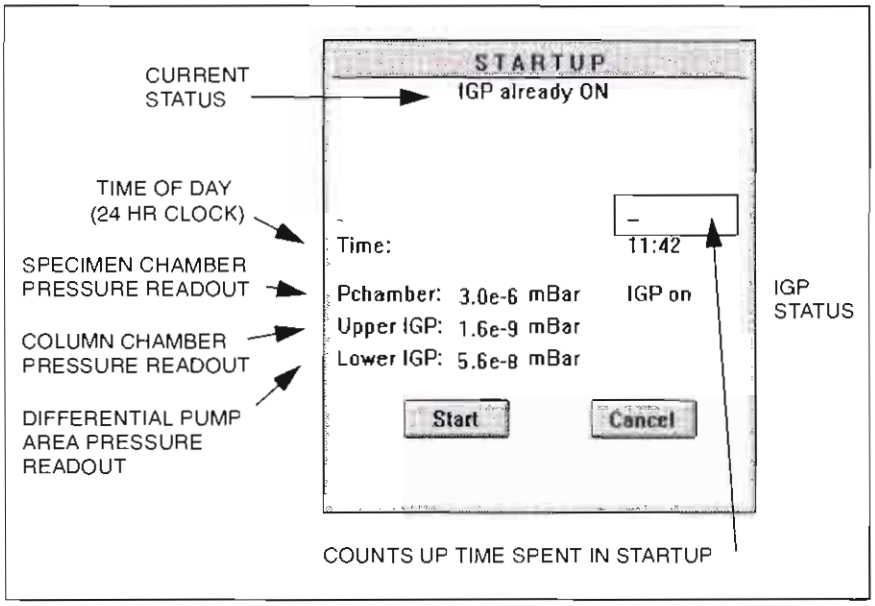
Click on VENT to slowly switch off the high tension and the pumping system of the specimen chamber. The column valves close and the specimen chamber vents. The parameters of the column are not affected; only high tension is set to zero. Venting the chamber opens the specimen chamber valve for a period of time, specified as the "Nitrogen purge time," and then closes. If the valve is closed again before the chamber is at ambient pressure, another click on VENT repeats the procedure.

## Upper IGP Status




## Startup

Click on STARTUP to display the Startup dialogue box and begins the startup procedure after power failure or from Standby mode.




If the power has been off, including the ion pumps, this dialogue box prompts you to turn them on. In this procedure the column chamber is evacuated using the two IGPs of the system, resulting in an ultra high vacuum level ($5 \times 10^{-9}$ mbar). the dialogue box remains onscreen During the startup procedure.

### Start

Click on the START button to begin the startup procedure. The emission chamber will be evacuated using the IGP. The current status on the dialogue box should indicate that the column vacuum is acceptable.

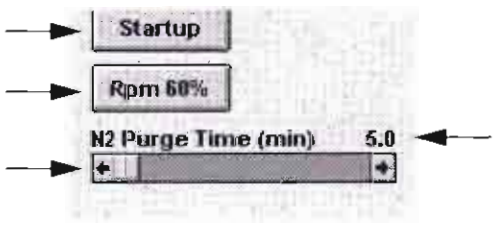
### Cancel

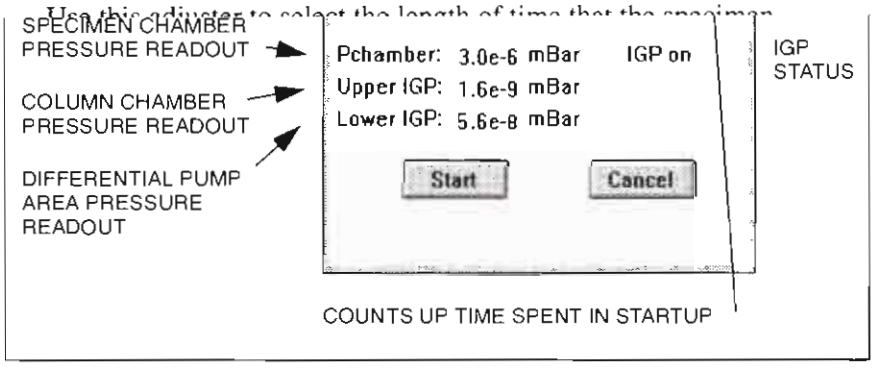
The Startup operation can be interrupted at any time by clicking on CANCEL. After a cancel, you must begin a new startup procedure.

## RPM 60% (TMP only)

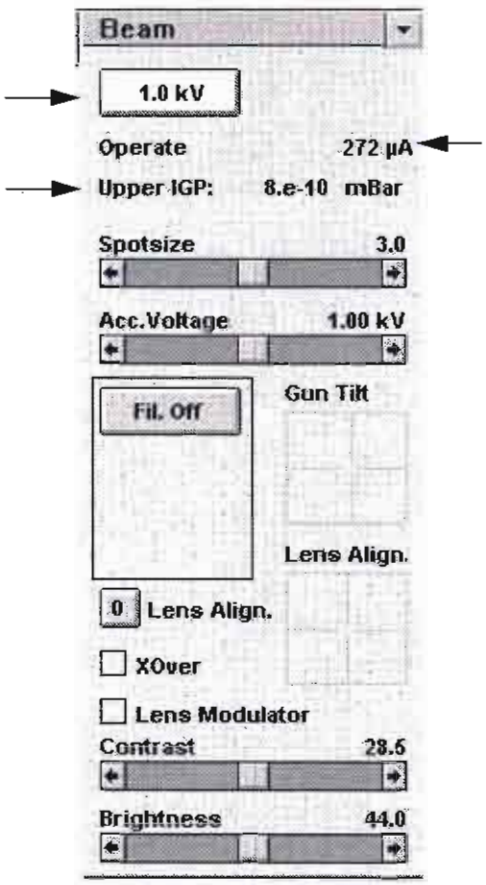
Click on this button to reduce the speed of the turbopump, to increase its lifetime and lower vibration frequencies. It takes one hour to reach good vacuum pressure after using RPM 60%. *Not valid with magnetically levitated pumps.*

## $N_2$ Purge Time




If the power has been off, including the ion pumps, this dialogue box prompts you to turn them on. In this procedure the column chamber is evacuated using the two IGPs of the system, resulting in an ultra high vacuum level ($5 \times 10^{-9}$ mbar), the dialogue box remains onscreen




## Beam

Beam settings let you control spotsize, accelerating voltage, filament current, column tilt, crossover, imaging, and switching on the high tension. Use these settings to make adjustments of the accelerating voltage, necessary for optimising the image. Column electronics provide currents and voltages for various parts of the column. The Upper IGP vacuum level, the Emission current and the Accelerating voltage is the most important information about the column displayed in this control area.

### kV (High Tension)

Click on kV to ramp up the high tension and set the column parameters to the values saved during column alignment. When activated, the button changes from grey to yellow. If you click on kV when it is yellow, the high tension is ramped down and the button changes back to grey. Note that the filament and column settings are not affected

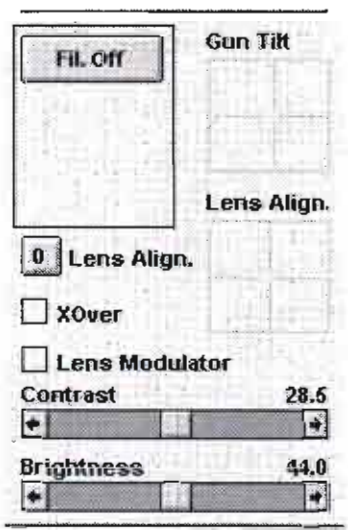
### Emission Current (µA)

The emission current is displayed continuously at the top of the Beam control area. It can be used as a check on the column procedures (Warm or Cold Start) and also during normal operation of the system.

The actual value depends on the emitter so this value should be considered as a guideline.

### Upper IGP

This refers to the pressure in the tip area (source region). For a system running in Operate mode, it is around $5 \times 10^{-9}$mbar, and may drop to a lower value of about $1 \times 10^{-9}$ mbar when the filament is not heated. If the pressure is greater than $5 \times 10^{-7}$ mbar, the filament switches off.




### kV (High Tension)

Click on kV to ramp up the high tension and set the column parameters to the values saved during column alignment. When activated, the button changes from grey to yellow. If you click on kV when it is yellow, the high tension is ramped down and the button changes back to grey. Note that the filament and column settings are not affected

### Emission Current (µA)

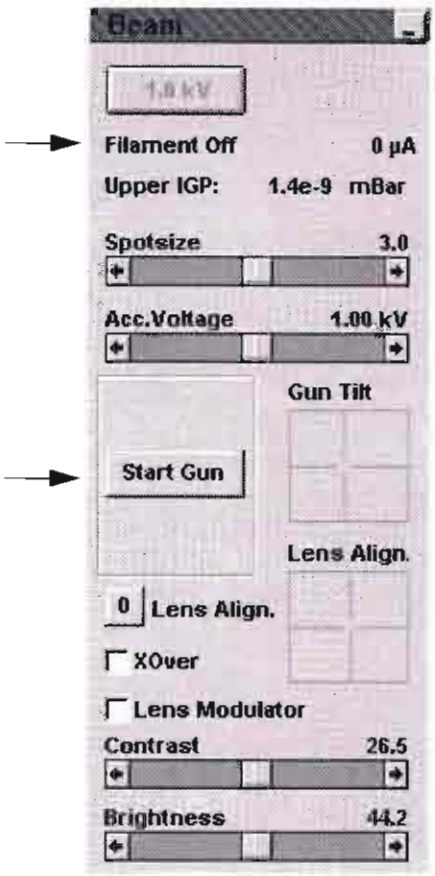
The emission current is displayed continuously at the top of the Beam control area. It can be used as a check on the column procedures (Warm or Cold Start) and also during normal operation of the system.

The actual value depends on the emitter so this value should be considered as a guideline.

### Upper IGP

## Column Status Messages

The status of the column is displayed below the kV button and in the maintenance/service area to the left of Gun Tilt..



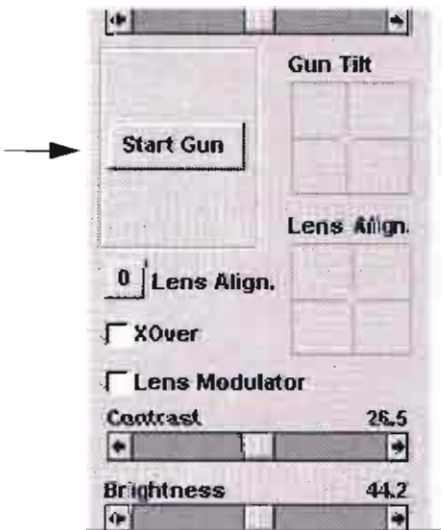
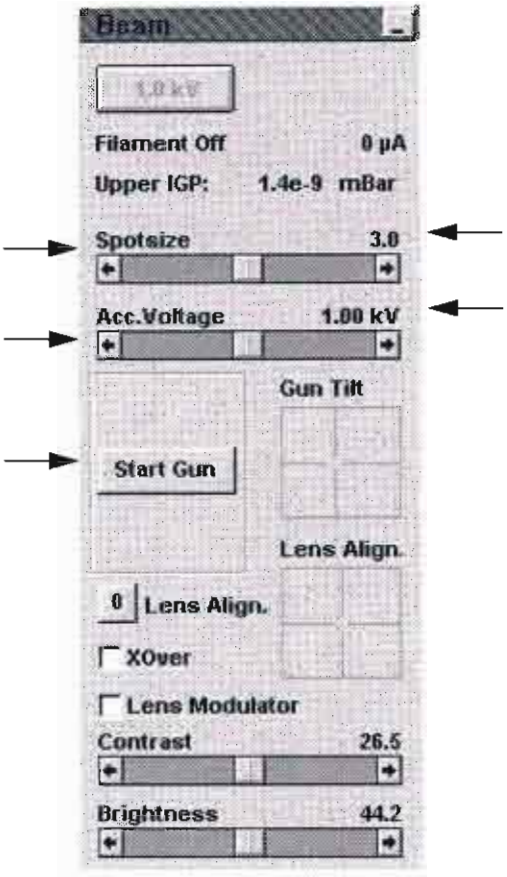




TABLE 4-15 COLUMN STATUS MESSAGES

| Status Message | Meaning |
|---|---|
| **Gun Off** | Initial startup state from off.<br>Also displays if no current/voltage is available for the gun supplies, which may happen if you operate the gun at inadequate vacuum pressure for a prolonged period.<br>Once vacuum is restored, click on the FIL OFF button to resume operation. |
| **Filament Off** | Displays if the internal power supplies for the column are switched on, which happens only if vacuum levels in the column are good. The filament is not switched on. Extraction voltage is not present. |
| **Start Gun** | Displays when the vacuum is ready to start the gun. Clicking on this initiates the startup routine for the column. Start Gun lasts for about 1 hour. When the procedure is complete, the system is in Operation mode and the emission current should be in the range of 65 - 95 µA. The status message reads "Operate." The column is now ready for operation. |
| **Service** | Displays only when the Customer Service engineer uses the Service key. |
| **Operate** | Indicates the normal column mode. All currents and voltages are at a level to allow column operation. When the HT is applied, the electron beam interacts with the specimen. |
| **Unknown** | Displays when communication with the column power supplies is interrupted. If vacuum levels are still correct (upper IGP better than $2 \times 10^{-8}$ mbar and lower IGP better than $5 \times 10^{-7}$ mbar), press the STBY button on<br>Also displays if no current/voltage is available for the gun supplies, which may happen if you operate the gun at inadequate vacuum pressure for a prolonged period.<br>Once vacuum is restored, click on the FIL OFF button to resume operation. |
| **Filament Off** | Displays if the internal power supplies for the column are switched on, which happens only if vacuum levels in the column are good. The filament is not switched on. Extraction voltage is not present. |
| **Start Gun** | Displays when the vacuum is ready to start the gun. Clicking on this initiates the startup |




## Spotsize

This adjuster allows a change of the spotsize in integral values from 1 to 7. The selected spotsize is displayed above the adjuster and in the data bar.

When using the adjuster, the built-in correction mechanism results in an almost continuous update of related parameters.

## Acc. Voltages

Use this adjuster to change the applied accelerating voltage. The actual value of the high tension displays above the adjuster and in the data bar. A preset value can be chosen by selecting one of the voltages from the Beam pulldown menu.

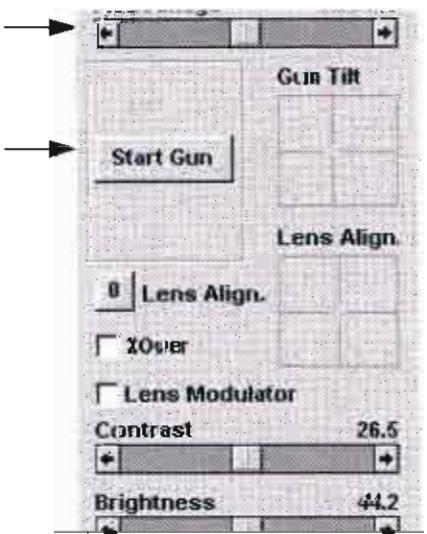
The built-in correction mechanisms result in an almost continuous update of related parameters (e.g., focus, column bias, scan rotation). As a result, the image might appear to change briefly when you quickly change the high tension.

## Start Gun

Click on START GUN if proper vacuum levels have been reached during the Startup procedure. The status message GunVacOK will display below the kV button.

Instances where START GUN displays include

- after the system has been entirely off
- after the gun has been vented
- after Service
- when the gun vacuum has become so bad that the vacuum control system has decided that the gun should be switched off.




Use this adjuster to change the applied accelerating voltage. The actual value of the high tension displays above the adjuster and in the data bar. A preset value can be chosen by selecting one of the voltages from the Beam pulldown menu.

The built-in correction mechanisms result in an almost continuous update of related parameters (e.g., focus, column bias, scan rotation). As a result, the image might appear to change briefly when you quickly change the high tension.

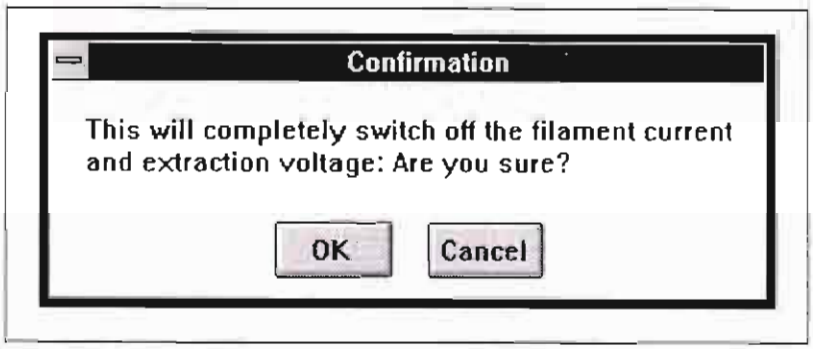
## Start Gun

Click on START GUN if proper vacuum levels have been reached during the Startup procedure. The status message GunVacOK will display below the kV button.

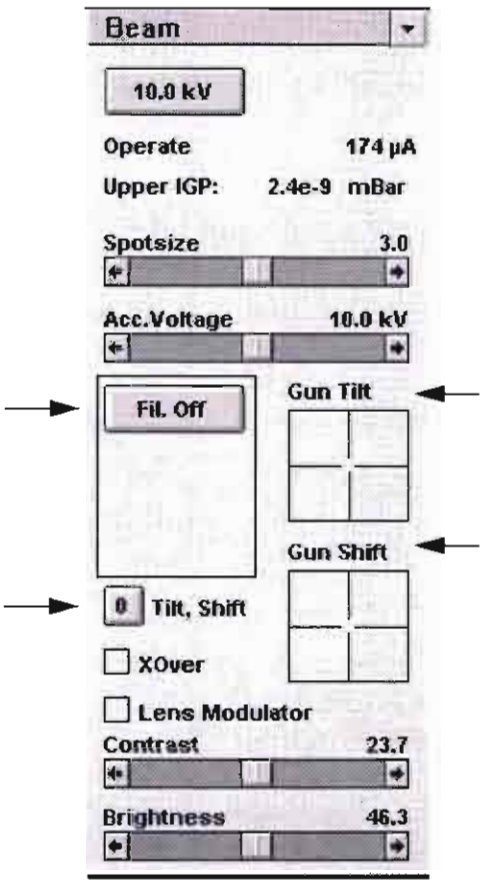
Instances where START GUN displays include

## Fil Off

Click on FIL OFF to switch off the filament current and extraction voltage. The following Confirmation dialogue box displays.




If you click on OK, the FIL OFF button is replaced with the WARM and COLD START buttons.




## Gun Tilt

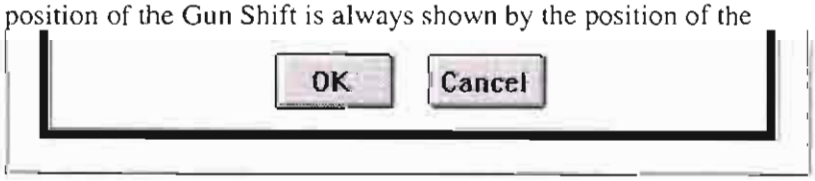
This X-Y control indicates the actual setting of the electronic Gun Tilt with respect to its extreme settings. Gun Tilt changes the effective angle of illumination of the beam coming from the gun area of the electron column. Use it to manually centre the illumination (maximize beam brightness) on the Beam Defining Aperture (BDA) in the crossover (XOver) mode. This adjuster is a manual override of the setting predefined in the alignment procedure.

Click with the mouse on the Gun Tilt area. The hand cursor is shown on the full screen. Move the cursor left/right and up/down, to control the Gun Tilt X and Y. If more tilt is required, move to the extreme of the image plane and repeat. The actual position of Gun Tilt is always shown by the position of the crosshair in the X-Y control.

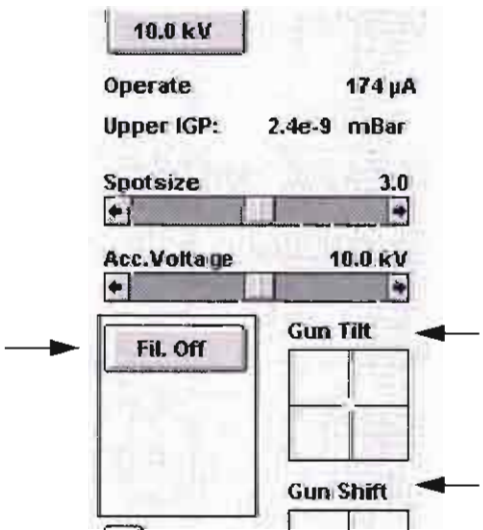
## Gun Shift (FEG)

This X-Y control indicates the actual setting of the electronic Gun Shift with respect to its extremes. Gun Shift changes the effective lateral position of the beam coming from the gun area of the electron column. Use it to manually centre the beam position to the centre of the field in the crossover mode. This adjuster is a manual override of the setting predefined in the alignment procedure.

The cursor is shown on the full screen when clicking with the mouse button on the Gun Shift area. By moving left/right and up/down, you can control Gun Shift X and Y positions. If more shift is required, move to the extreme of the image plane and repeat. The actual position of the Gun Shift is always shown by the position of the

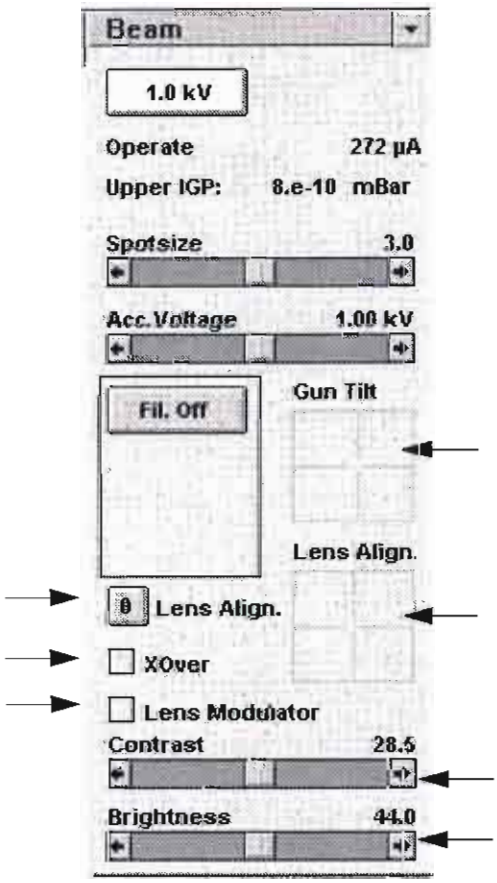



If you click on OK, the FIL OFF button is replaced with the WARM and COLD START buttons.




## Gun Tilt

This X-Y control indicates the actual setting of the electronic Gun Tilt with respect to its extreme settings. Gun Tilt changes the effective angle of illumination of the beam coming from the gun area of the electron column. Use it to manually centre the illumination (maximize beam brightness) on the Beam Defining Aperture (BDA) in the crossover (XOver) mode. This adjuster is a manual override of the




## Lens Align (SFEG)

This X-Y control moves the beam relative to the Final Aperture to remove shift during focus. For SFEG columns this is used instead of physically moving the Final Aperture to the beam as found in FEG columns. This may have to be used during daily operation and can be easily corrected in conjuction with the Lens Modulator.

## 0 Lens Align (SFEG)

Click on this button to set Lens Align to zero. The zero value plays a major role in mechanical alignment and is a reference value for the optimal setting for Lens Align.

## XOver

Crossover (XOver) mode is available only when the system is in operation mode.

Crossover mode allows imaging of the tip and is useful during the alignment procedure. Also, if the column aperture is severely misaligned, the image of the crossover can be very helpful. The crossover is visible in slow scan mode, and as a help, the centre of the screen is marked with a cross. The crossover should be in close vicinity to the cross. It can be set to the correct position by manipulation of the aperture. If, in this condition, the crossover mode is switched off, an image will appear on the screen.

## Lens Modulator

The final lens modulator switches on an automatic modulation of the focus. From the actual focus setting, it generates a focus range with a minimum and a maximum focus. The range is dependent on the applied magnification.

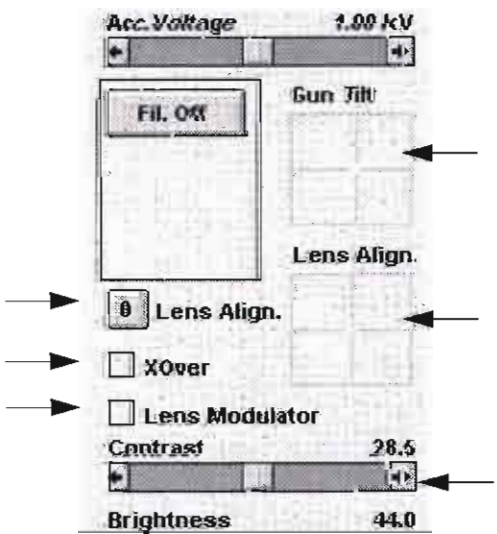
Use this function at TV rate scanning to view the immediate response of the system on the modulation of the focus. If the system is well aligned, the rotation centre is at the centre of the image (at low magnification, 200X). At higher magnification (>20,000X), the image does not move from the rotation centre during modulation of the focus and during normal focusing actions. If out of centre the X,Y controls of the variable aperture are use to centre the rotating modulation.

## Contrast

Use this adjuster to control the contrast (gain) of the active detector. The contrast range is from 0 to 100.

## Brightness

Use this adjuster to control the brightness of the active detector. The

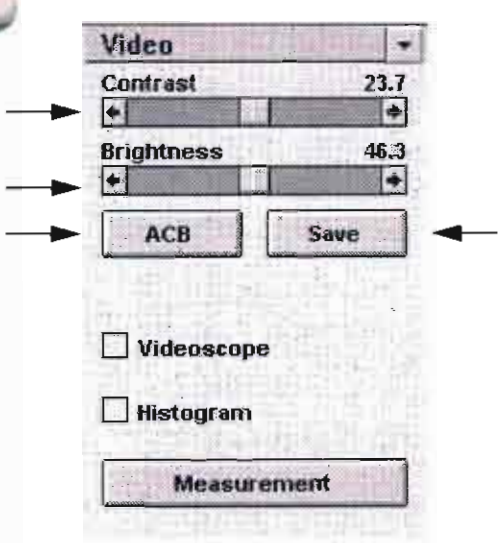



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Crossover (XOver) mode is available only when the system is in operation mode.

Crossover mode allows imaging of the tip and is useful during the alignment procedure. Also, if the column aperture is severely misaligned, the image of the crossover can be very helpful. The crossover is visible in slow scan mode, and as a help, the centre of the screen is marked with a cross. The crossover should be in close vicinity to the cross. It can be set to the correct position by manipulation of the aperture. If, in this condition, the crossover mode is switched off, an image will appear on the screen.




## Video

Video settings let you control contrast and brightness of the image, use Videoscope, develop a Histogram, take X and Y measurements, and store a favourite image greylevel distribution.

### Contrast

This adjuster controls the contrast (gain) of the selected detector, which shows up onscreen as change in contrast of the image. If you select another detector, the software switches the adjuster and updates the current actual values for that detector. The contrast range is from 0 to 100.

This is the same as the adjuster on the Beam control group.

### Brightness

This adjuster controls the brightness (offset or zero gain) of the selected detector, which shows up onscreen as change in brightness of the image. If you select another detector, the software switches the adjuster and updates the current actual values for the selected detector. The brightness range is from
0 to 100.

This is the same as the adjuster on the Beam control group.

### ACB (Auto Contrast Brightness)

Click on ACB to perform an autocontrast/brightness routine.

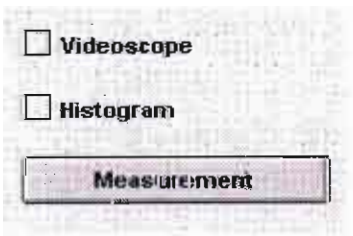
### Save

This function allows you to store a favourite setting for the total greylevel of the image (i.e., contrast and brightness). The general impression of the image can be stored and used later, which is convenient when making equal-looking images of a homogeneous specimen surface at different positions.

Video parameters are stored in RAM memory, not on the hard disk. If your system is switched off completely, these values are lost.

Selecting SAVE does the following:

- Sets scan mode to TV rate, Live filter mode.
- Stores one frame in memory and makes a histogram of it.
- Analyses the histogram, calculates, and stores the values for the most important parameters (4 in total).
- If the scan mode was changed, restores it to the former setting.




the current actual values for that detector. The contrast range is from 0 to 100.

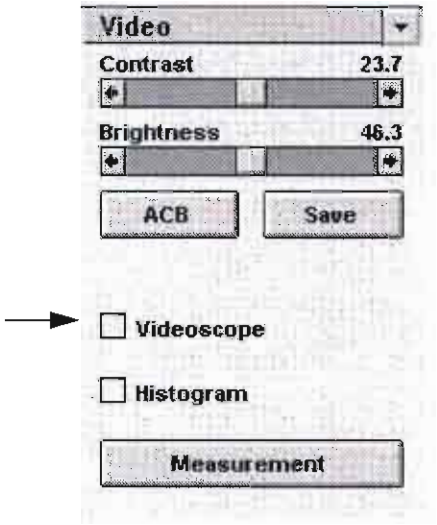
This is the same as the adjuster on the Beam control group.

### Brightness

This adjuster controls the brightness (offset or zero gain) of the selected detector, which shows up onscreen as change in brightness of the image. If you select another detector, the software switches the adjuster and updates the current actual values for the selected detector. The brightness range is from
0 to 100.

This is the same as the adjuster on the Beam control group.

### ACB (Auto Contrast Brightness)




## Videoscope (Optional)

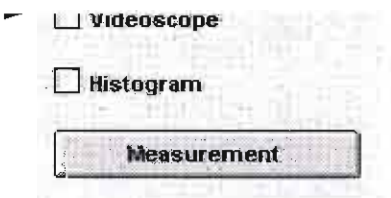
Click on this checkbox to turn on the videoscope display. With videoscope on, the intensity profile along a line is overlaid on the image. The upper (white) dashed line indicates the maximum level and the lower (black) dashed line indicates the minimum level. Videoscope is useful when checking or adjusting contrast and brightness settings just before a micrograph is made.

Videoscope can also be switched on using the F3 key on the keyboard or the videoscope icon in the tool bar.

## Videoscope Image Options

TABLE 4-16 VIDEOSCOPE IMAGE OPTIONS

| Type of Image | Effect of Options |
|---|---|
| **Live image** | **TV Rate**: Displays and updates the intensity profile of one image line continuously. This line can be moved up and down with the mouse.<br>**SlowScan**: Indicates the actual position of the scan with a small white line on the left and shows the relationship of image line and intensity profile. |
| **Frozen image** | **TV Rate**: Shows the intensity profile of one horizontal line in the stored image. Change the line to be profiled by either clicking on another line or drag over an area by holding down the left mouse button, allowing you to see the intensity profile of several lines in a quick succession.<br>**Slow Scan**: Shows the horizontal intensity profile of the frozen image as the beam continuously scans at a slow rate.<br>**Horizontal Line Scan**: Shows the fixed intensity profile along a selectable horizontal line. |
| **Live video profile on a fixed image** | **Horizontal Line Scan**: Freezes the image and displays a horizontal line. Shows the fixed intensity profile of the frozen image. Click on the vertical position of the horizontal line and select either Live or Freeze from Filter menu.<br>**Live**: The videoscope will show the actual (Live) |

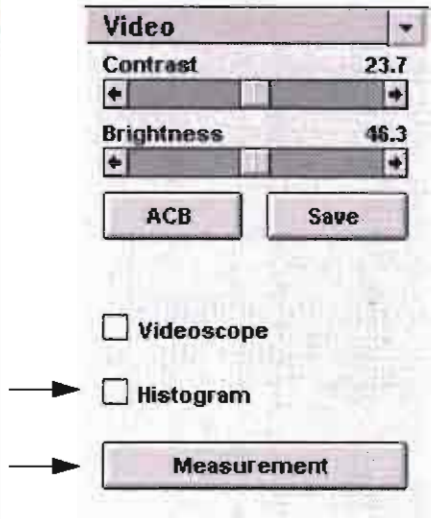



or the videoscope icon in the tool bar.

## Videoscope Image Options

TABLE 4-16 VIDEOSCOPE IMAGE OPTIONS

| Type of Image | Effect of Options |
|---|---|
| **Live image** | **TV Rate**: Displays and updates the intensity profile of one image line continuously. This line can be moved up and down with the mouse.<br>**SlowScan**: Indicates the actual position of the scan with a small white line on the left and shows the relationship of image line and intensity profile. |




## Histogram (Optional)

This optional function generates a display of the histogram of the complete image. Viewed from left to right, the histogram indicates:

- Video levels from black to white
- A normalized number of pixels for each greylevel on the displaced vertical axis.

The computer displays the histogram in overlay with the image. Use it to analyse the greylevel distribution of the image.

## Measurement

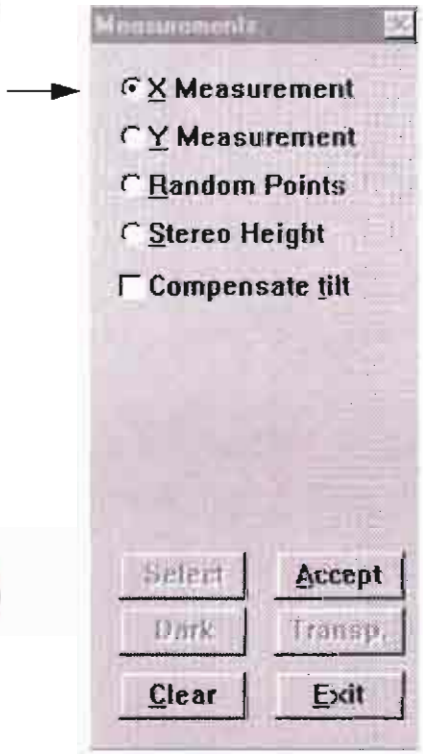
Click on the MEASUREMENT button to display a dialogue box to start the measurement function.

The screen displays measurement calculations in the top left corner of the screen. Measurement data can also be used by other software programs, such as Excel®, using Dynamic Data Exchange (DDE) links and the remote function call library.

As you take more measurements, the first measurements roll off the list (last in, first out). The list always contains three relevant digits by adapting the unit and position of the decimal point. Each time you select another measurement type, the green graphical data on the screen disappears.

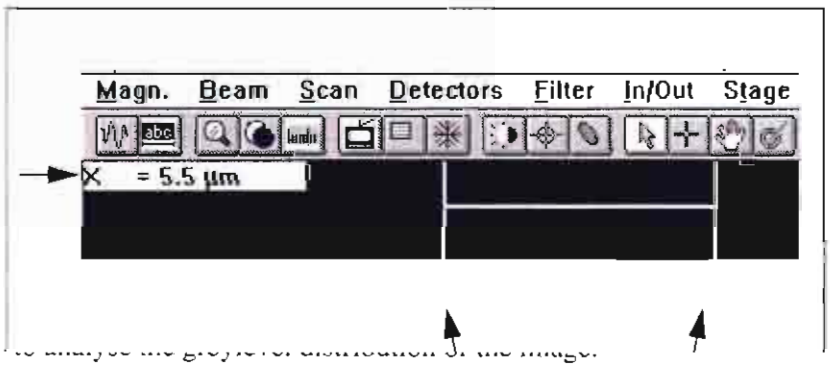
Move the mouse slowly so the computer has time to update the graphical information onscreen.

Choose from the four types of measurements.




## X Measurement

Use the cursor to select the first position on the image. Press the left mouse button and move the mouse. A fixed vertical line appears, and another line follows the mouse pointer. Active values display in the top left corner of the screen.





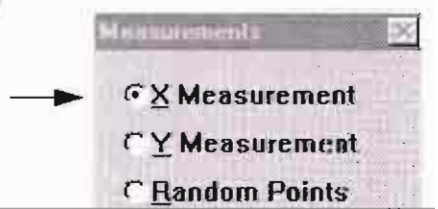


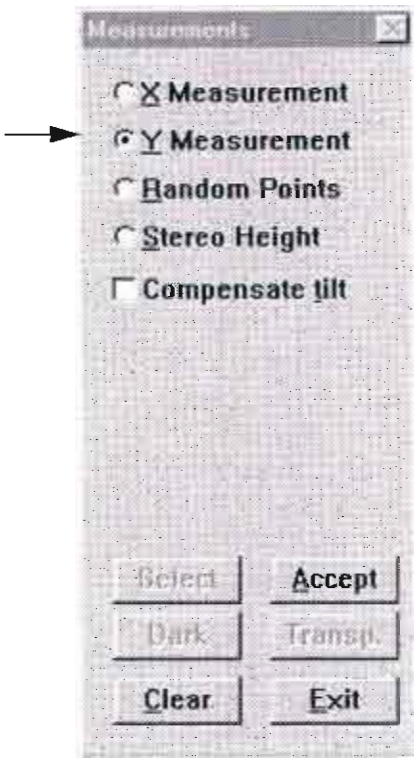
## Measurement

Click on the MEASUREMENT button to display a dialogue box to start the measurement function.

The screen displays measurement calculations in the top left corner of the screen. Measurement data can also be used by other software programs, such as Excel®, using Dynamic Data Exchange (DDE) links and the remote function call library.

As you take more measurements, the first measurements roll off the list (last in, first out). The list always contains three relevant digits by adapting the unit and position of the decimal point. Each time you select another measurement type, the green graphical data on the screen disappears.



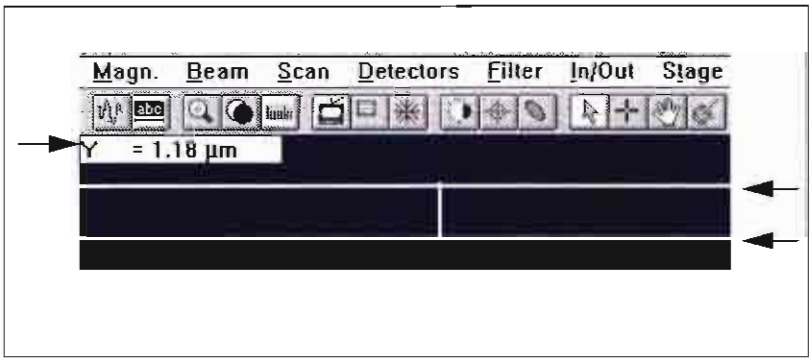



## Y Measurement

When you choose Y Measurement a checkbox for Compensation tilt displays. Compensate tilt is similar to tilt correction. It compensates for foreshortening due to specimen tilt or image tilt (but not stage tilt).

Click on the checkbox and a tilt edit box appears with the last updated tilt value shown. This value should match the actual value since it is used as an automatic correction of the length in the Y direction.

Move the cursor on the image area and select the first position. Press the left mouse button and move the mouse. One fixed horizontal line appears and another line follows the mouse pointer. The active value displays in the top left corner of the screen.



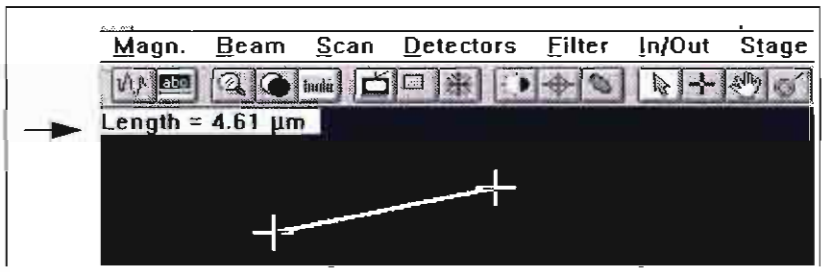

When you release the left mouse button, the value is fixed and the second horizontal green line becomes stable.



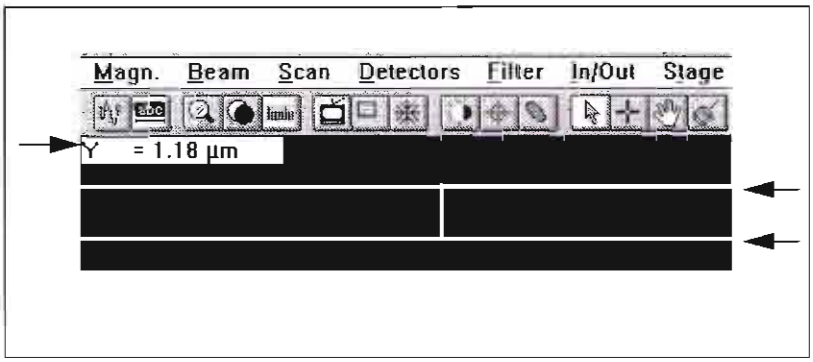

## Random Points

The Compensate tilt checkbox is again available when Random Points is selected. Move the cursor to an image detail on the screen. Press the left mouse button and move the mouse to the next detail to measure the distance. The value is displayed in the top left corner of the screen.

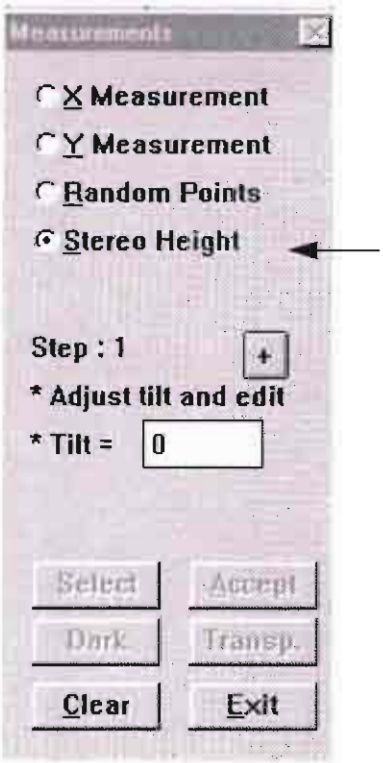
The first point is indicated by a small green cross; a second cross is at the position of the mouse pointer. When you release the mouse button, the new value is displayed as Length in the top left corner of the screen.




the left mouse button and move the mouse. One fixed horizontal line appears and another line follows the mouse pointer. The active value displays in the top left corner of the screen.




When you release the left mouse button, the value is fixed and the




## Stereo Height

Use Stereo Height to measure the height of a specimen using two measurements of different tilt angles on the same specimen feature.

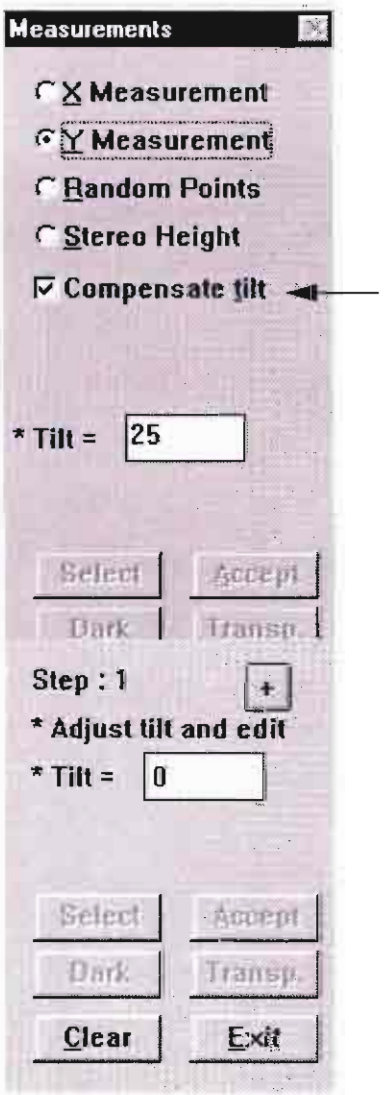
For best accuracy:

- Use a magnification where the detail to be measured is large enough onscreen and preferably along the direction of the Y axis.
- Use a large difference in the tilt angle of the two images (at least 30°).
- Make sure that the same feature can easily be selected for measurement at both tilt angles.
- Work at the eucentric working distance.

Measurements are made in a fixed order using a sequence of steps.

TABLE 4-17 STEREO HEIGHT MEASUREMENTS

| Step | Action |
|---|---|
| 1 | Click on the + button to move through the steps. |
| 2 | The current tilt value automatically displays in the text box. Click on the + button. |
| 3 | Make the first measurement using the details of the feature. Click on the + button. |
| 4 | Change the tilt to the new value and verify that the same details are visible onscreen. The new tilt value will enter the text box. Click on the + button. |
| 5 | Make the second measurement following the same steps as for the first one and click on the (+ )button. The measurement results display in the top left corner of the screen with some intermediate projection lengths (5 total). |




## Compensate Tilt

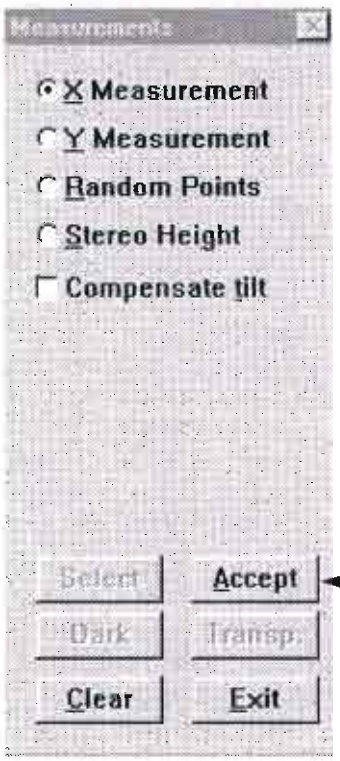
When this is ticked the angle of tilt operated by the stage is registered by the software as the angle to use in calculations for distances measured on the image. It will show in the white text box provided. The white text box can be overwritten to suit sample angle. The Tilt

- Make sure that the same feature can easily be selected for measurement at both tilt angles.
- Work at the eucentric working distance.

Measurements are made in a fixed order using a sequence of steps.

TABLE 4-17 STEREO HEIGHT MEASUREMENTS

| Step | Action |
|---|---|
| 1 | Click on the + button to move through the steps. |
| 2 | The current tilt value automatically displays in the text box. Click on the + button. |




### Accept

With this button the measurement is accepted and the line is drawn on screen with a tag showing the dimension. The next two buttons Dark and Transp. (transparent) become active.

### Dark / Bright

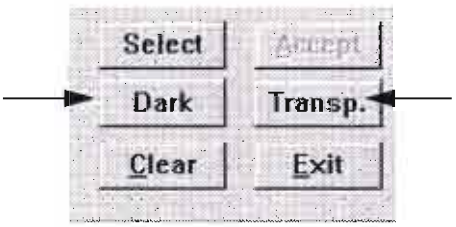
This button toggles the background to the tag between black and white with opposite text and line tone.

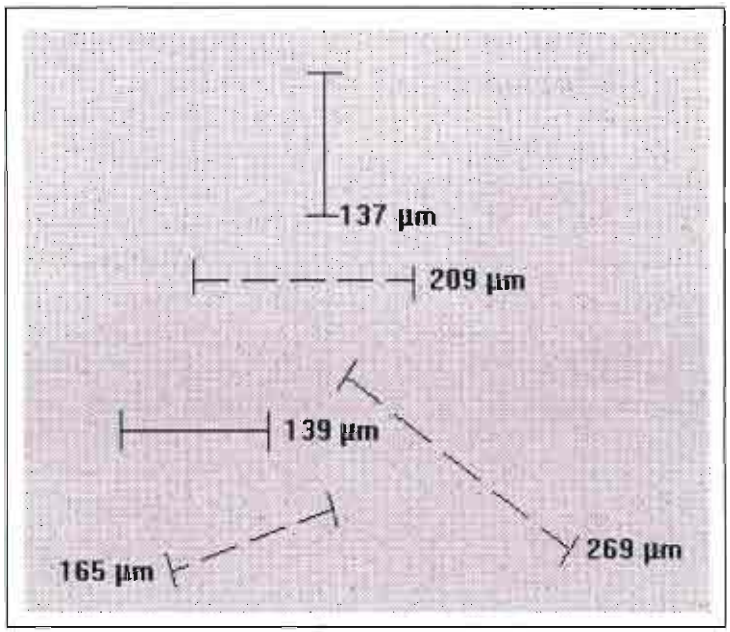
### Transp. / Opaque

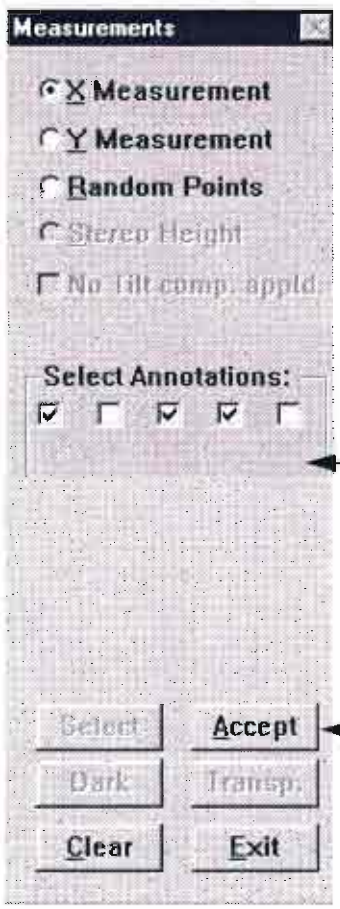
This button toggles the density of the tone for the whole text and measurements, white for a dark background (Opaque) and black for a light background (Transp.).

### Select

Pressing Select will display an array of check boxes depending on the number of measurements. These can be selected by ticking the repective boxes to correspond with the measurements.The annotations ticked will be present on the stored image. The measurements can be from X, Y or Random points.




### Reset

This button resets the selections of annotations and closes Select.

### Delete

### Transp. / Opaque

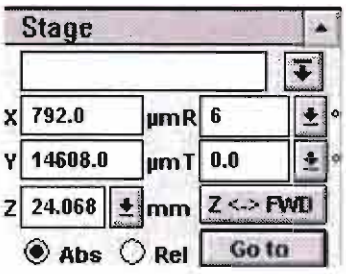
This button toggles the density of the tone for the whole text and measurements, white for a dark background (Opaque) and black for a light background (Transp.).

### Select

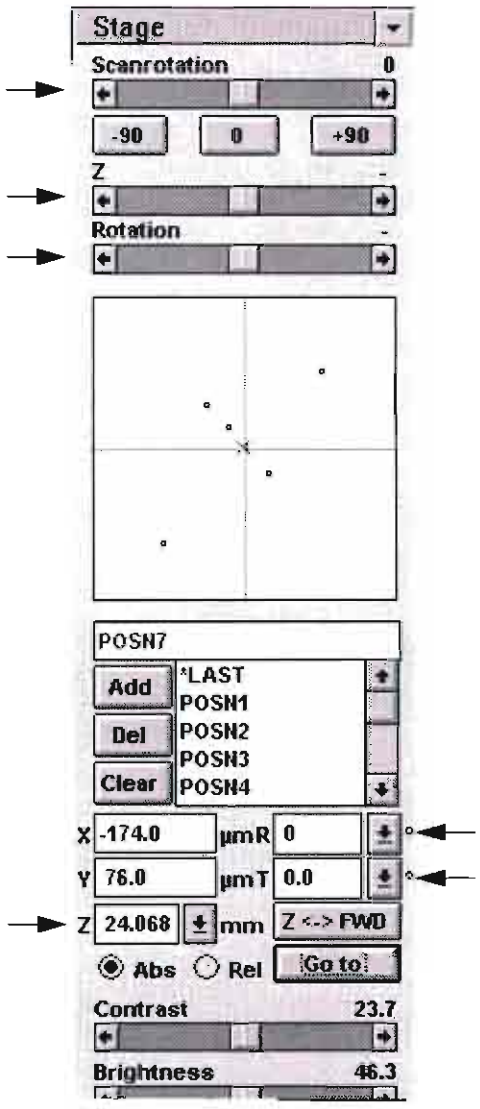
Pressing Select will display an array of check boxes depending on the number of measurements. These can be selected by ticking the repective boxes to correspond with the measurements.The annotations ticked will be present on the stored image. The measurements can be from X, Y or Random points.



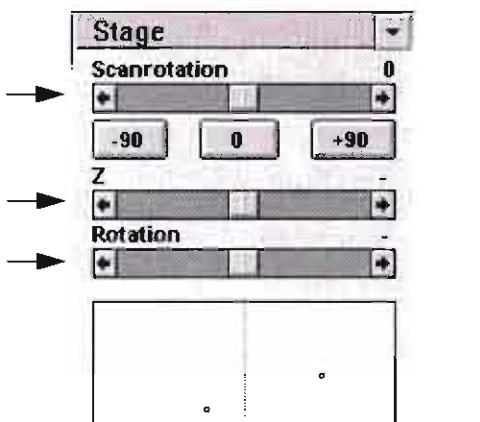
MINIMIZED




MAXIMIZED




MAXIMIZED




## Stage

The maximized Stage control group is the same as the Stage control area. Its functions control movement of the stage and the beam to correct the positioning of the specimen. Use the minimize/maximize toggle button, in the top right of the Stage page, to change the size of the area.

### Scanrotation

Use this adjuster to rotate the scan and align the image onscreen. Shadowing and other charged particle optical and geometrical effects can only be modified by changing the orientation of the specimen with stage rotation. Clockwise moves are positive; counterclockwise moves are negative.

TABLE 4-18 ROTATING A SCAN

| Option | Result |
|---|---|
| -90 | Results in an additional - 90° scan rotation. |
| 0 | Sets the scan rotation to zero. |
| +90 | Results in an additional + 90° scan rotation. |

### Z (XL30 only) and Rotation

The Z (specimen height) and Rotation adjusters control the amount and direction of those functions. The farther from centre you drag the middle slider, the faster the movement. The longer you hold it down, the farther the amount of movement. These adjusters trap the cursor within them and can only be adjusted with the middle slider, not by clicking within the grey bar.

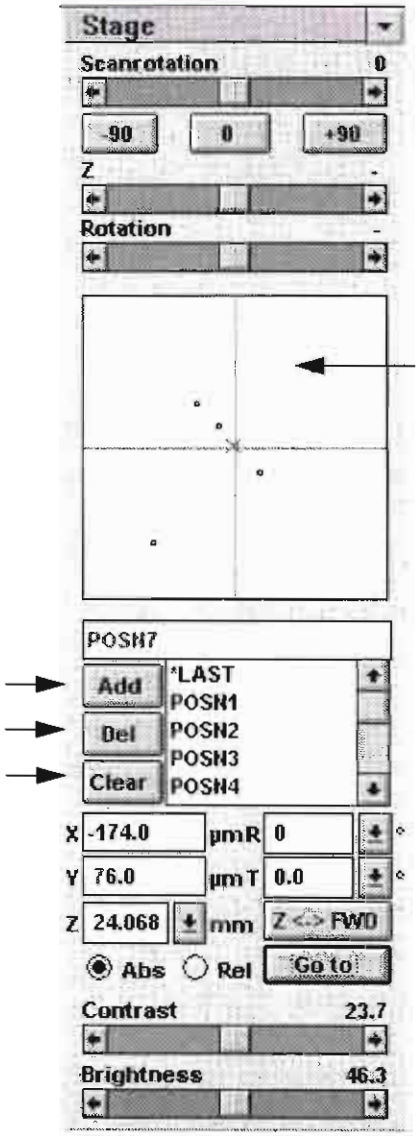
You can also type numbers directly in the Z and R edit boxes and press ENTER or GOTO to move in those directions.

Type in the tilt text box to set the degree of stage tilt corresponding to real tilt.

Use this adjuster to rotate the scan and align the image onscreen. Shadowing and other charged particle optical and geometrical effects can only be modified by changing the orientation of the specimen with stage rotation. Clockwise moves are positive; counterclockwise moves are negative.

TABLE 4-18 ROTATING A SCAN

| Option | Result |
|---|---|
| -90 | Results in an additional - 90° scan rotation. |
| 0 | Sets the scan rotation to zero. |
| +90 | Results in an additional + 90° scan rotation. |




STAGE MAP

## Stage Map

The stage map function shows an X-Y control with a crosshair. The axes represent the total X and Y range for the stage; the position of the crosshair represents the actual position of the stage with respect to the stage limits. A green outline reflects the shape of the selected holder, when chosen, as defined in the Position Setup dialogue box. The multiple stub holder doesn't display.

When the stage has just been homed, the crosshair is in the centre of the grid (0, 0 coordinates). As a reference, the detector is positioned at the centre of the upper horizontal line of the grid and the stage door is located at the left side of the grid.

Double-clicking in the grid causes the computer to calculate stage coordinates and move to the new position. The function is used to move over long distances, for example, when going from one specimen to another mounted on the multiple stub holder. You have to estimate the location of each stub.

Stage rotation is not affected by this function; movement is only in X and Y.

## Stored Stage Positions

You can store stage positions that you want to use routinely. Use the list box to view the list of stage positions. Highlight the position you want to work with, and double-click to select it.

## Add

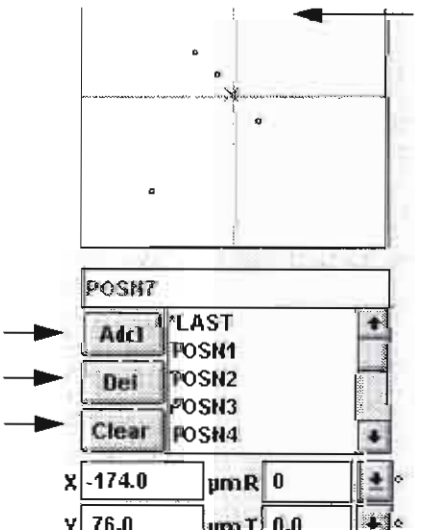
To add the current stage position to the list, type the label in the edit box and click the ADD button.

## Del

To delete a stage position from the list, highlight the name of the position and click the DEL button.

## Clear

Use the CLEAR button to delete all stored stage positions from the list. A confirmation dialogue box appears.




MAP

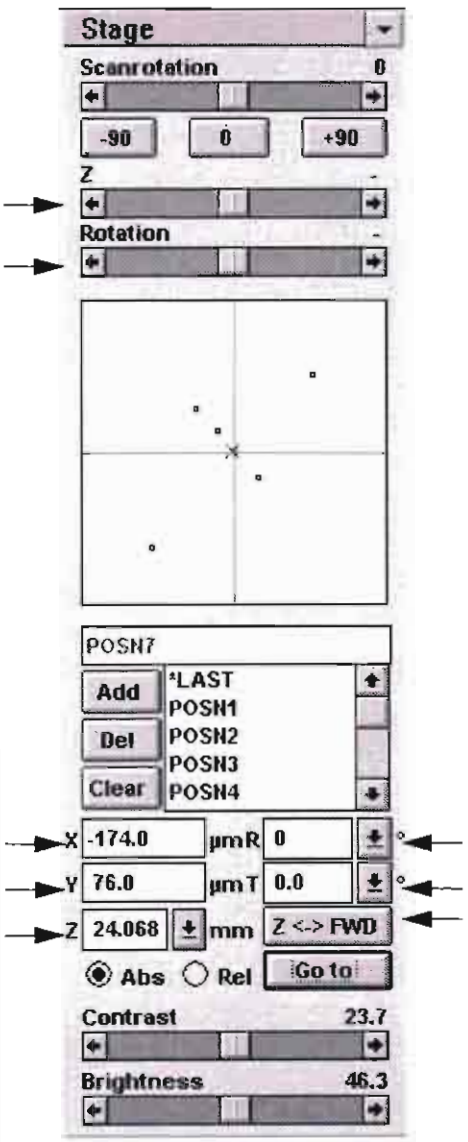
the grid (0, 0 coordinates). As a reference, the detector is positioned at the centre of the upper horizontal line of the grid and the stage door is located at the left side of the grid.

Double-clicking in the grid causes the computer to calculate stage coordinates and move to the new position. The function is used to move over long distances, for example, when going from one specimen to another mounted on the multiple stub holder. You have to estimate the location of each stub.

Stage rotation is not affected by this function; movement is only in X and Y.

## Stored Stage Positions

You can store stage positions that you want to use routinely. Use the list box to view the list of stage positions. Highlight the position you want to work with, and double-click to select it.




## X, Y

Use these text boxes to view existing coordinates and to enter desired coordinates to position the stage on the X and Y axes. Values are entered in microns. After you press ENTER or GO TO, the stage will move to the value entered.

## Z

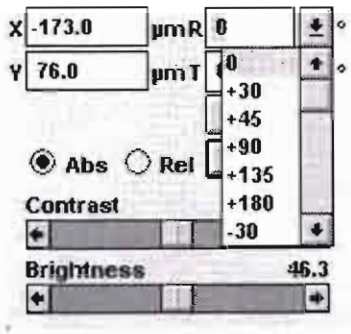
Enter the height of the specimen in the Z text box or choose from the list, accessed by clicking on the down arrow. After you press ENTER or GO TO, the stage will move to the value entered.

After you have found the eucentric height for a particular sample and clicked the GET button in the Position Setup dialogue box, this number appears in the Z pulldown list.

You can also use the Z adjuster for immediate visual feedback and continuous control.

## R

Enter degrees of rotation in this text box or choose from the list, accessed by clicking on the down arrow.

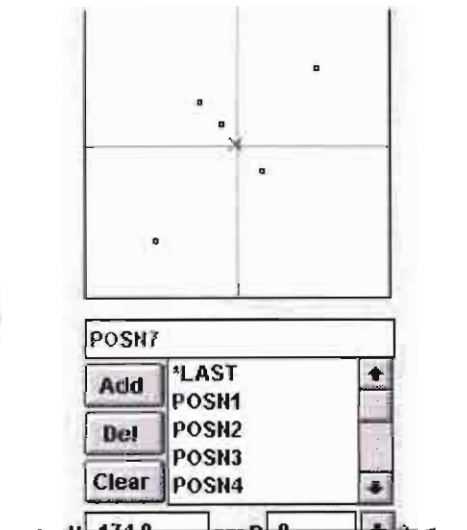



After you press ENTER or GO TO, the stage will move to the value entered.

If a rotation value is the only thing you have changed and Eucentric Rotation is checked on the Stage pulldown menu, you will be operating with eucentric rotation and X and Y will change accordingly.

You can also use the Rotation adjuster for immediate visual feedback and continuous control.

## Z <-> FWD



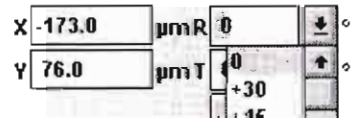

GO TO, the stage will move to the value entered.

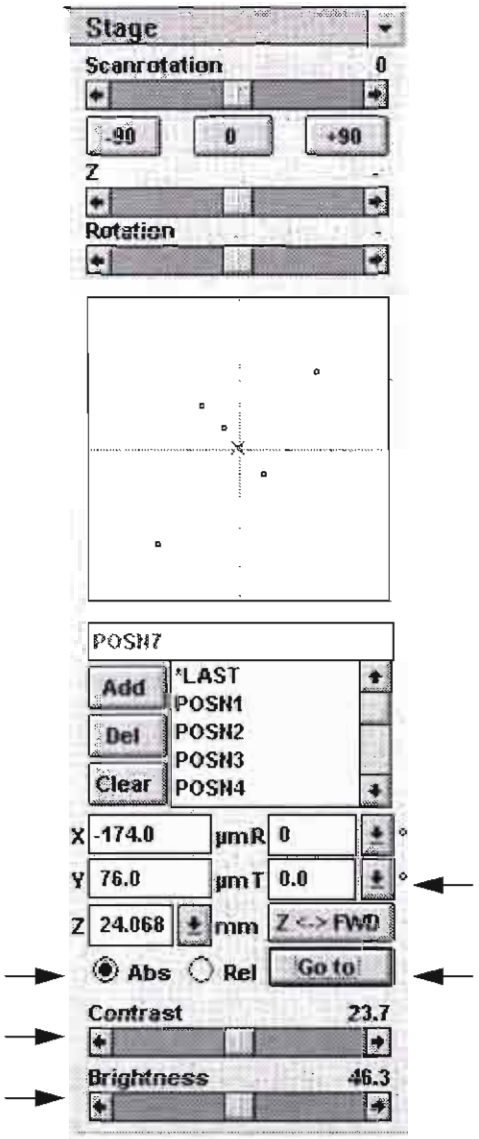
After you have found the eucentric height for a particular sample and clicked the GET button in the Position Setup dialogue box, this number appears in the Z pulldown list.

You can also use the Z adjuster for immediate visual feedback and continuous control.

## R

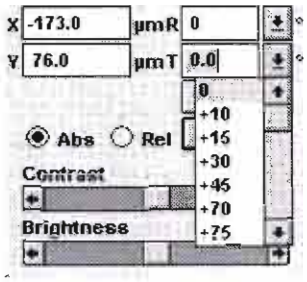
Enter degrees of rotation in this text box or choose from the list, accessed by clicking on the down arrow.






## T

Enter degrees of tilt in this text box or choose from the list, accessed by clicking on the down arrow. This value should correspond with true tilt of the specimen.




## Abs/Rel

Choose either absolute or relative stage movements. Absolute coordinates are measured from the absolute zero (0,0,0,0,0) of the stage. Relative coordinates are measured from the present location on the stage.

## Go To

Click on this button after setting X, Y, Z, and R parameters to move the stage to the value entered. You can also use the ENTER key on the keyboard.

## Contrast

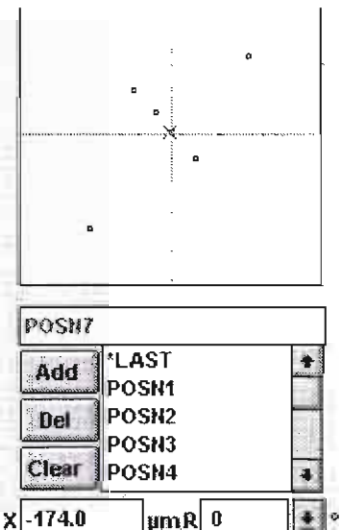
Use this adjuster to control the contrast displayed in the image.

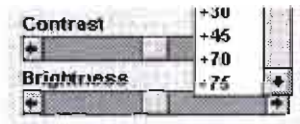
This has the same functionality as the contrast adjuster on the Beam and Video control groups.

## Brightness

Use this adjuster to control the brightness displayed in the image.

This has the same functionality as the brightness adjuster on the Beam and Video control groups.



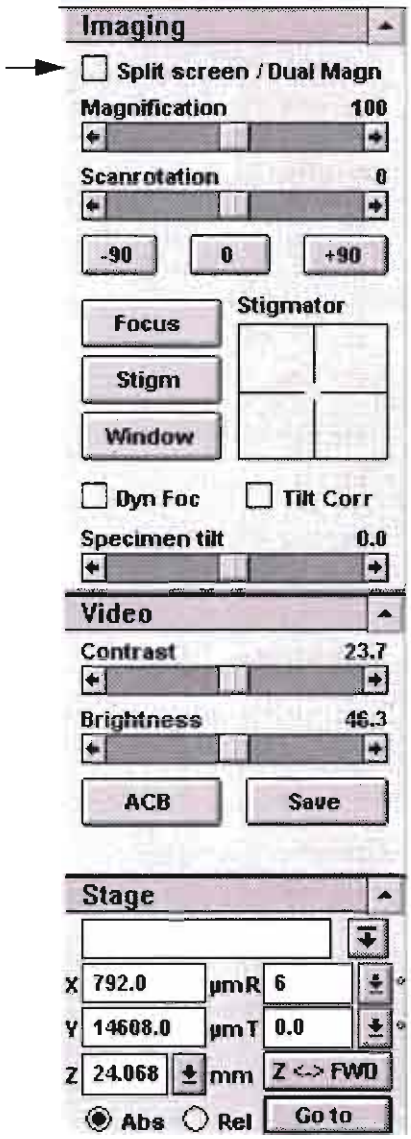

## Abs/Rel

Choose either absolute or relative stage movements. Absolute coordinates are measured from the absolute zero (0,0,0,0,0) of the stage. Relative coordinates are measured from the present location on the stage.

## Go To

Click on this button after setting X, Y, Z, and R parameters to move the stage to the value entered. You can also use the ENTER key on the keyboard.

# Imaging




The Imaging control area is divided into three control groups:

- Imaging
- Video
- Stage

Each control group can be expanded to show all the options by clicking on the maximize button to the right of the group name.

The last two control groups are an exact copy of the Video and Stage groups in the Settings control area.

## Split Screen / Dual Magnification

Before using this mode, make sure that the correct image area is visible on the full screen and it is well focused, with optimum contrast and brightness.

Click on this checkbox to turn on Split Screen mode. The image will be frozen, if necessary. The middle 50% of the image is transferred to the left image part and will be available for selection of the higher magnification image on the right. Slow scan 1 will be selected and the following items will not be accessible: magnification (pulldown menu, +/- keys on keypad, and adjuster), automatic functions (contrast, focus, and stigmator) and TV scan mode.

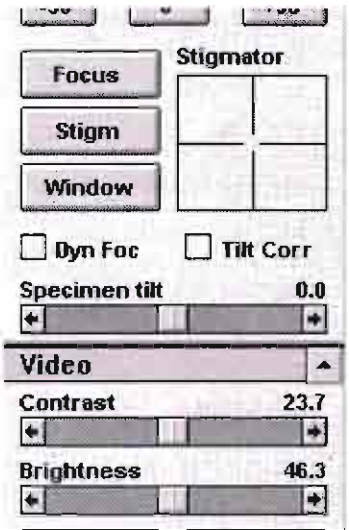
Immediately after you select this mode, the magnifications of the left and right sides of the screen are equal. Define the area of interest on the left side of the screen by dragging a box with the mouse over the image, similar to defining a selected area. The aspect ratio of the box is fixed; only the size can be determined. Release the mouse button to fix the box and scan the corresponding area with the beam.

The resulting image displays on the right side of the screen. Now the green box on the left side of the image can be picked up and repositioned (similar to displacing the selected area).

You can also change the detector settings or select another detector.

When you have selected the area you want and optimised the image, it can be printed on the videoprinter or with the photo monitor. The image on the right side freezes and the software sends the complete image to the photo monitor or the videoprinter.

Split Screen / Dual Magnification functions are non-operative in UHR Mode with the SFEG system.

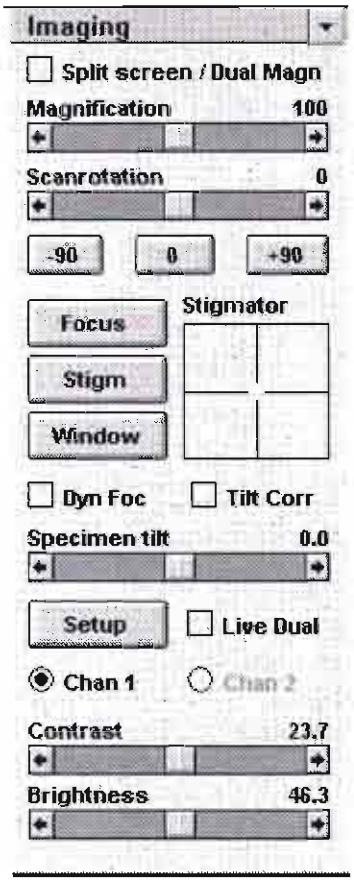



The last two control groups are an exact copy of the Video and Stage groups in the Settings control area.

## Split Screen / Dual Magnification

Before using this mode, make sure that the correct image area is visible on the full screen and it is well focused, with optimum contrast and brightness.

Click on this checkbox to turn on Split Screen mode. The image will be frozen, if necessary. The middle 50% of the image is transferred to the left image part and will be available for selection of the higher magnification image on the right. Slow scan 1 will be selected and the following items will not be accessible: magnification (pulldown menu, +/- keys on keypad, and adjuster), automatic functions (contrast, focus, and stigmator) and TV scan mode.




## Magnification

This adjuster allows continuous change of the magnification. With this type of zoom, the spotsize is not changed. Any magnification between minimum and maximum is possible. Magnification limits are indicated by audible computer beeps. The actual value is presented just above the adjuster. With a frozen image, the adjuster can be changed but the actual magnification is not modified until you start imaging.

You can also use the +/- keys on the keypad or in the centre of the Track function withe left button of the mouse.

## Scanrotation

Use this adjuster to rotate the scan and align the image onscreen. It has the same functionality as the adjuster on the Stage control area.

## Focus

Click on the FOCUS button to activate the autofocus function, also accessed from the F11 function key. Autofocus uses parameters set in the Position Setup dialogue box..

The software performs the following:

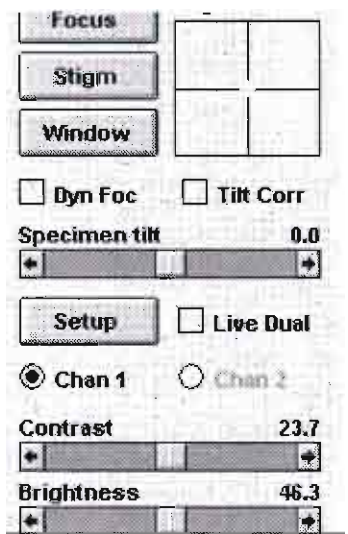
- Notes the scan rate and switches to TV rate, if necessary
- Adapts contrast and brightness levels
- Integrates the image, using many pixels of the image and several numbers of frames
- Calculates an overall absolute contrast value from the integrated part of the image, adjusting the optimal focus point.

The software changes magnification if no focus point around the actual setting is found. It also adjusts magnification to ensure a correctly adjusted focus at the moment you click on the button.

Autofocus also takes into account the selected spotsize. It compensates for a decreased signal-to-noise ratio by increasing the image integration time. The focusing process may take from about three seconds to half a minute.

The focus routine can be interrupted by clicking on the CANCEL button in the autofocusing dialogue box that appears during operation. At the end of the autofocus routine, the column switches back to the scan mode and contrast/brightness values it had before the routine was started.

The AutoFocus function is non-operative in UHR Mode with the You can also use the +/- keys on the keypad or in the centre of the Track function withe left button of the mouse.




## Scanrotation

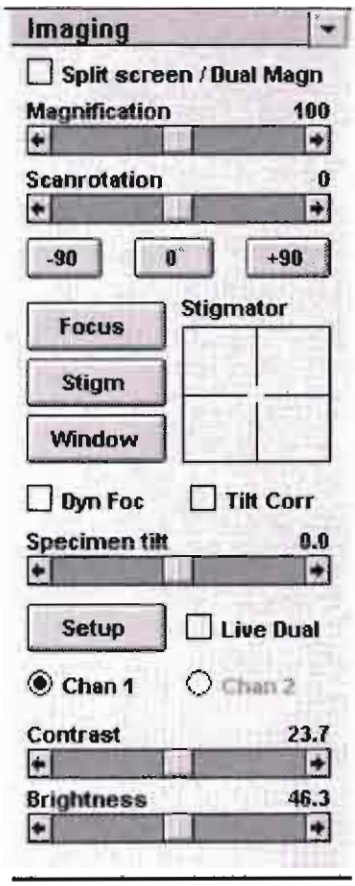
Use this adjuster to rotate the scan and align the image onscreen. It has the same functionality as the adjuster on the Stage control area.

## Focus

Click on the FOCUS button to activate the autofocus function, also accessed from the F11 function key. Autofocus uses parameters set in the Position Setup dialogue box..

The software performs the following:

- Notes the scan rate and switches to TV rate, if necessary
- Adapts contrast and brightness levels




## Stigm

Click on STIGM to activate the autostigmator function, also accessed from the F10 function key.

The operation of this control is the same as that for the autofocus routine, only the absolute contrast value is calculated differently and the stigmator controls are affected instead of the final lens current.

Click on CANCEL in the dialogue box that comes up to stop the autostigmator routine.

At the end of the autostigmator routine, the system automatically switches back to scan mode and the contrast/brightness values it had before the routine was started.

The AutoStigmator function is non-operative in UHR Mode with the SFEG system. This button and the Icon on the Tool Bar are greyed out.

## Window

Click on WINDOW to quickly help judge the setting of the focus point. The scan mode is changed to Slow scan 1 and Selected Area is activated in Average 4 mode. The image is presented in Slow scan, showing a noise-free image at any spotsize, to help judge the focus setting.

## Stigmator

This is a two-dimensional X-Y control that allows you to change the stigmator setting. The crosshair indicates the actual setting of the stigmator. Click the left mouse button in the X-Y control. The hand-cursor appears onscreen. Move the mouse left to right to modify the X-stigmator. Move the mouse up and down to change the Y-stigmator. Note that the stigmator range is coupled with the magnification. When the stigmator has been adjusted correctly, release the left mouse button. The position of the cross in the reserved adjustment area updates.

The stigmator range is limited. At very low magnifications (where stigmator adjustment is not useful), these limits are quickly reached and the computer beeps to alert you.

You can also use the SHIFT + right mouse button for stigmation.

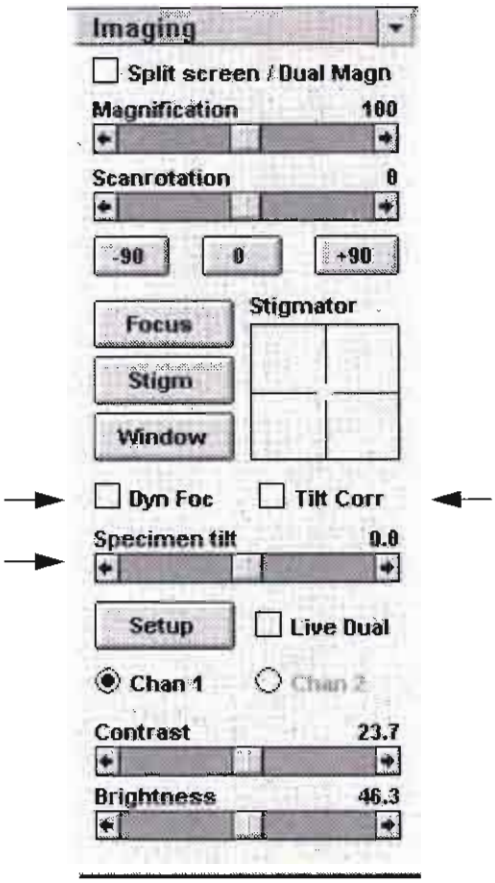



At the end of the autostigmator routine, the system automatically switches back to scan mode and the contrast/brightness values it had before the routine was started.

The AutoStigmator function is non-operative in UHR Mode with the SFEG system. This button and the Icon on the Tool Bar are greyed out.

## Window

Click on WINDOW to quickly help judge the setting of the focus point. The scan mode is changed to Slow scan 1 and Selected Area is activated in Average 4 mode. The image is presented in Slow scan, showing a noise-free image at any spotsize, to help judge the focus setting.




## Dynamic Focus

Click in the checkbox to switch Dynamic Focus on and off. When it is on, the scan slowly proceeds from top to bottom and the focus point is automatically changed according to the positive tilt of the specimen. The focus should be sharpest in the middle of the image.

Dynamic focus can only be used with slow scan and scan rotation at zero. You must enter tilt for the calculations to be accurate.

Dynamic focus can be used for a strongly tilted specimen (either by the specimen surface itself or by stage tilt), when the depth of focus is not sufficient. It results in an image with overall sharpness.

The dynamic focus is usually used usually at low magnification.

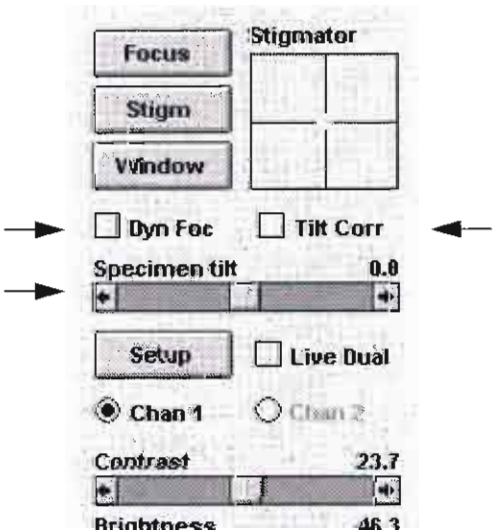
## Tilt Corr

Because the image is a two-dimensional representation of a three-dimensional object, certain projection distortions occur. The more highly tilted the specimen is, the more foreshortened its image will be. Applying a tilt correction will compensate for foreshortening in one direction on a flat specimen at a known tilt angle (an 80° range) and when the tilt axis is parallel to the scan line.

Tilt correction can only be used with slow scan and scan rotation at zero. You must enter tilt for the calculations to be accurate. For example, a square grid image will appear rectangular when you tilt the specimen. Applying tilt correction will correct the aspect ratio and restore the square appearance.

## Specimen tilt

Use this adjuster only in conjunction with tilt correction and/or dynamic focus. Enter the specimen tilt angle and then check the Tilt Corr or Dynamic Focus checkbox.



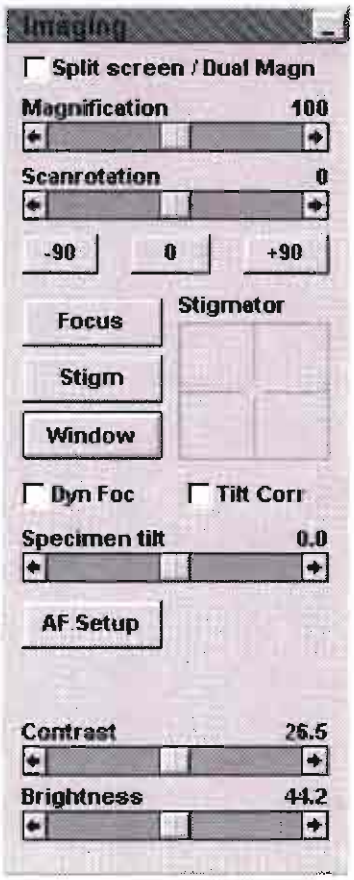

the specimen surface itself or by stage tilt), when the depth of focus is not sufficient. It results in an image with overall sharpness.

The dynamic focus is usually used usually at low magnification.

## Tilt Corr

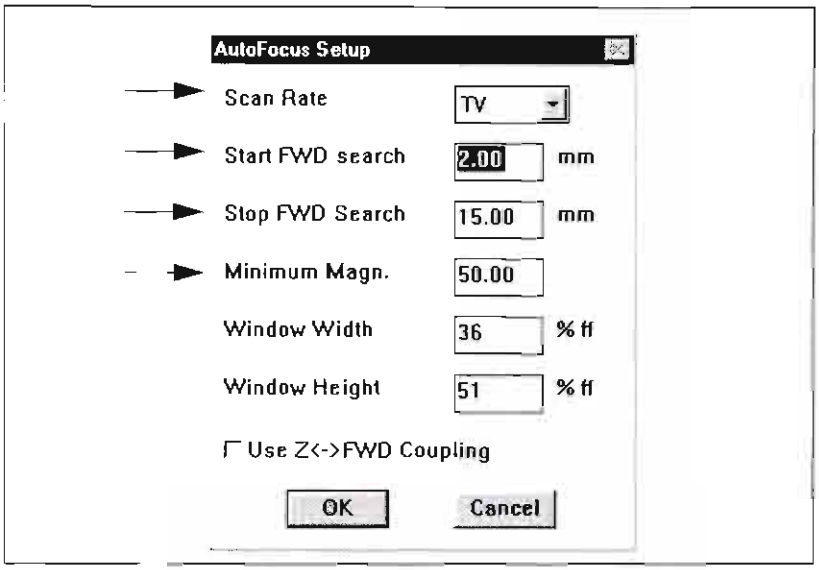
Because the image is a two-dimensional representation of a three-dimensional object, certain projection distortions occur. The more highly tilted the specimen is, the more foreshortened its image will be. Applying a tilt correction will compensate for foreshortening in one direction on a flat specimen at a known tilt angle (an 80° range) and when the tilt axis is parallel to the scan line.

Tilt correction can only be used with slow scan and scan rotation at zero. You must enter tilt for the calculations to be accurate. For example, a square grid image will appear rectangular when you tilt the




## AF Setup

Click on AF SETUP to display the Setup dialogue box, allowing you to change the default parameters of the autofocus routine.




### Scan Rate

Choose from this list box the Scan Rate to be used during each image collection of the autofocus process. The computer selects the number of scan frames to integrate automatically, depending on the spotsize. Choosing slower scan rates can improve the success rate of the autofocus where the signal-to-noise ratio is poor.

### Start / Stop FWD Search

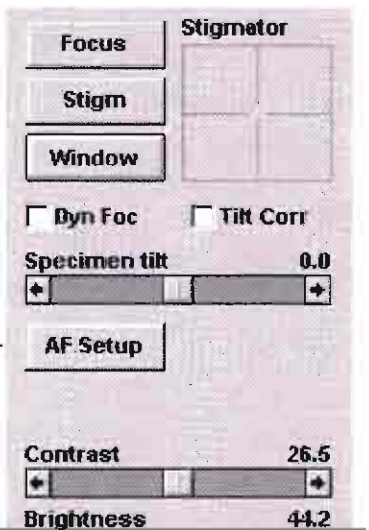
Type in these text boxes the limits of the free working distance from which the search function of the autofocus starts/stops if no focus was found around the starting point. When working on flat specimens, restrict the search range to enhance the speed of the autofocus process.

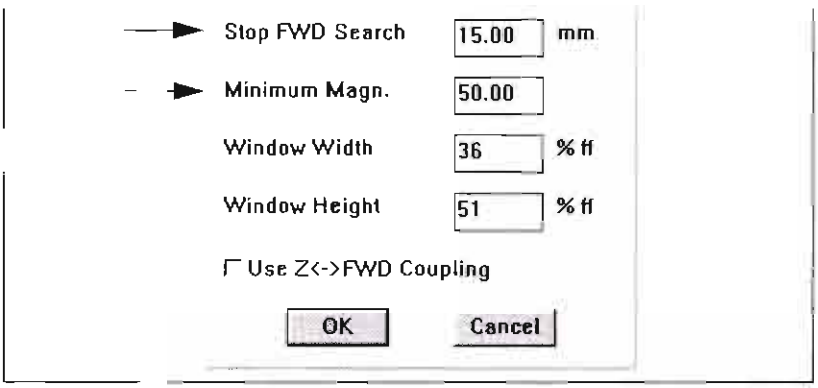
### Minimum Magn.

Type in this text box a value for the minimum magnification when no focus is found around the starting point. When a specimen is used that shows no detail at a certain low magnification, this option allows the focus algorithm to increase the success rate considerably.

NOTE

The speed of the autofocus process can be influenced considerably by limiting the range between the start and stop point. If a flat sample is used at the eucentric position, often a range of 0.5 mm is sufficient.




### Scan Rate

Choose from this list box the Scan Rate to be used during each image collection of the autofocus process. The computer selects the number

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