VIEW
MICRO-METROLOGY

VIEW Engineering, Inc.

VIEW Benchmark™ 250
Service Manual

VIEW™
VIEW Engineering, Inc.
A Quality Vision International Company

VIEW Engineering, Inc.

VIEW Benchmark™ 250
Service Manual

Part No. 799015, Revision A, 06/07

VIEW Benchmark equipment is made in the U.S.A.

Table of Contents

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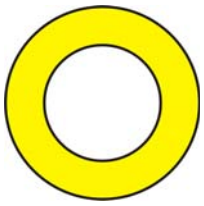
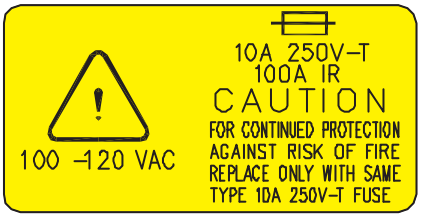
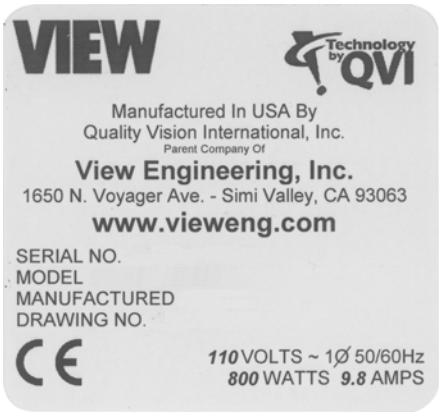
Important System Labels

Label:	Location:	Definition:
	Around the remote E-Stop switch	(Yellow ring around red switch) Emergency stop
	Left and right sides of the stage, on the substage	Do not lift
	Front surface of the electronics tower Z-axis slide, near Z-axis ball screw	Pinch hazard
	Rear panel of the electronics tower Right side of the electronics tower, next to the interconnection plate	Dangerous voltage present; disconnect power before servicing to avoid electrical shock

Label:	Location:	Definition:
	Right side of the electronics tower, next to the interconnection panel	Electrical specifications
	Lower-left corner of Main System ID label	System meets the requirements of the European Union (EU)
	Front surface of the electronics tower	System model and serial number
	Right side of the electronics tower, next to the interconnection panel	Main system ID
	Front surface of the electronics tower Z-axis slide, near Z-axis ball screw	Exercise caution near this area

Label:	Location:	Definition:
	Right side of the laser (if equipped)	International laser symbol
	Right side of the laser (if equipped)	Indicates that the laser meets Class 2 requirements of the IEC-825 European standard
	Right side of the laser (if equipped)	Indicates that the laser meets Class II requirements of the CFR 21 standard
	Right side of the laser (if equipped)	Identifies the laser emitting aperture

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About This Manual

Chapter 1

1.1 What This Chapter Contains

This chapter explains:

- Who Should Read This Manual
- Required Knowledge
- What's in This Manual?
- Where to Read More
- Where to Get Help

1.2 Who Should Read This Manual

Read this manual if you will perform any of the following tasks on the Benchmark 250 system:

- Installation
- Preventive maintenance
- Troubleshooting
- Service adjustments
- Parts replacement

For information on programming and configuring, refer to the *VMS Fast Start Guide* (P/N 790438) and *VMS Reference Guide* (P/N 790411).

1.3 Required Knowledge

To use this manual, you should be familiar with:

- How to maintain and service inspection or industrial automation equipment
- How to use, troubleshoot, and repair a PC
- Basic electrical and mechanical terminology and inspection equipment terminology

Note: We recommend that the procedures in this manual be performed by trained and authorized personnel.

1.4 What's in This Manual?

Chapter	Title	Contents
2	General Description	Defines what the Benchmark 250 system is and familiarizes you with the system's basic hardware components
3	Safety Information	Describes the remote Emergency Stop switch and covers other safety issues
4	Installation	Describes how to: • choose an installation site • unpack, move and install the Benchmark 250 system • start up the system, perform verification, and shut down the system
5	Principles of Operation & System Interconnections	Describes subsystems and the interconnections within the Benchmark 250 system
6	Preventive Maintenance	Lists actions you should take to keep the Benchmark 250 system in good operating order
7	Troubleshooting	Helps you identify the cause of possible problems with the Benchmark 250 system, the CPU, and the user components

Chapter	Title	Contents
8	Service Adjustments	Describes how to calibrate and align the Benchmark 250 system
9	Parts Repair & Replacement	Describes how to replace imaging, transport, and electrical parts
A	VMS System Certification & Verification 7.02	Describes how to certify and verify the Benchmark 250 system
B	Accessing Parameters	Describes how to access VMS and Basic-X related parameters
C	Software Installation	Describes how to install the VMS software, the Basic-X software, and the Elements software

1.5 Where to Read More

For information about using the Benchmark 250 system, refer to the software manual(s), software release notes, and OEM manuals that shipped with your system.

1.6 Where to Get Help

If you are faced with a situation you cannot resolve using this manual, contact the Customer Support HelpDesk, at:

1650 N. Voyager Avenue
Simi Valley, CA 93063, USA

Phone:	805-578-5000 Toll free: 877-SOS-VIEW (877-767-8439)
Fax:	805-578-5249
E-mail:	viewsupport@vieweng.com
Website:	www.vieweng.com

Please be prepared with the following information when contacting us:

- Model and serial number of your system
- Nature of problem
- Steps you have taken
- Your phone and fax numbers
- Case number if you are calling about an issue you have already reported

General Description

Chapter 2

2.1 What This Chapter Contains

This chapter covers:

- What is the Benchmark 250 System?
- Benchmark 250 System Main Components
- Coaxial Light, Programmable Ring Light, & Backlight
- Dual Magnification Optical System
- Computer & User-Interface Components

2.2 What is the Benchmark 250 System?

The Benchmark 250 system is a non-contact, three-dimensional measurement system with a full range of vision-based measurement tools and software. It has 300 mm x 150 mm x 150 mm (12" x 6" x 6") XYZ travel—200 mm (8") Z travel is optional.

The system has precision dual magnification optics, coaxial and backlight illumination, and patented autofocus circuitry for high-accuracy Z-axis measurements over a variety of surface textures, finishes, and colors. The patented LED Programmable Ring Light (PRL) is optional.

No upgrades are necessary to achieve full automatic inspection.

Note: See the *VIEW Benchmark 250 Technical Data Sheet* (part number 799002) for more technical information.

2.3 Benchmark 250 System Main Components

The Benchmark 250 is a benchtop machine. Parts are measured by mounting them on the measuring stage, which moves in both the X and Y directions. An optional workstation is available for the system computer, flat panel display, 3-axis joystick, keyboard, mouse, and remote E-Stop switch.

Figure 2-1 Benchmark 250 System Main Components

2.4 Coaxial Light, Programmable Ring Light, & Backlight

The LED coaxial light, LED Programmable Ring Light (PRL), and LED backlight assemblies are used to illuminate the part on the stage.

The following table describes each feature.

Feature	Description
LED Coaxial light (through the lens)	Projects the light straight down through the lens itself—it is also used in conjunction with the Ronchi grid (the Ronchi grid is used to focus on very flat, non-textured parts)
LED Programmable Ring Light (PRL)	Allows you to control illumination via four quadrants at various angles
LED Backlight	Projects the light upward through the stage glass, from below the part under inspection

2.5 Dual Magnification Optical System

The dual magnification optical system uses two monochrome cameras on two separate optical paths to provide instant magnification switching under software control. A third optical path is included to provide coaxial (through the lens) illumination and grid pattern for autofocus.

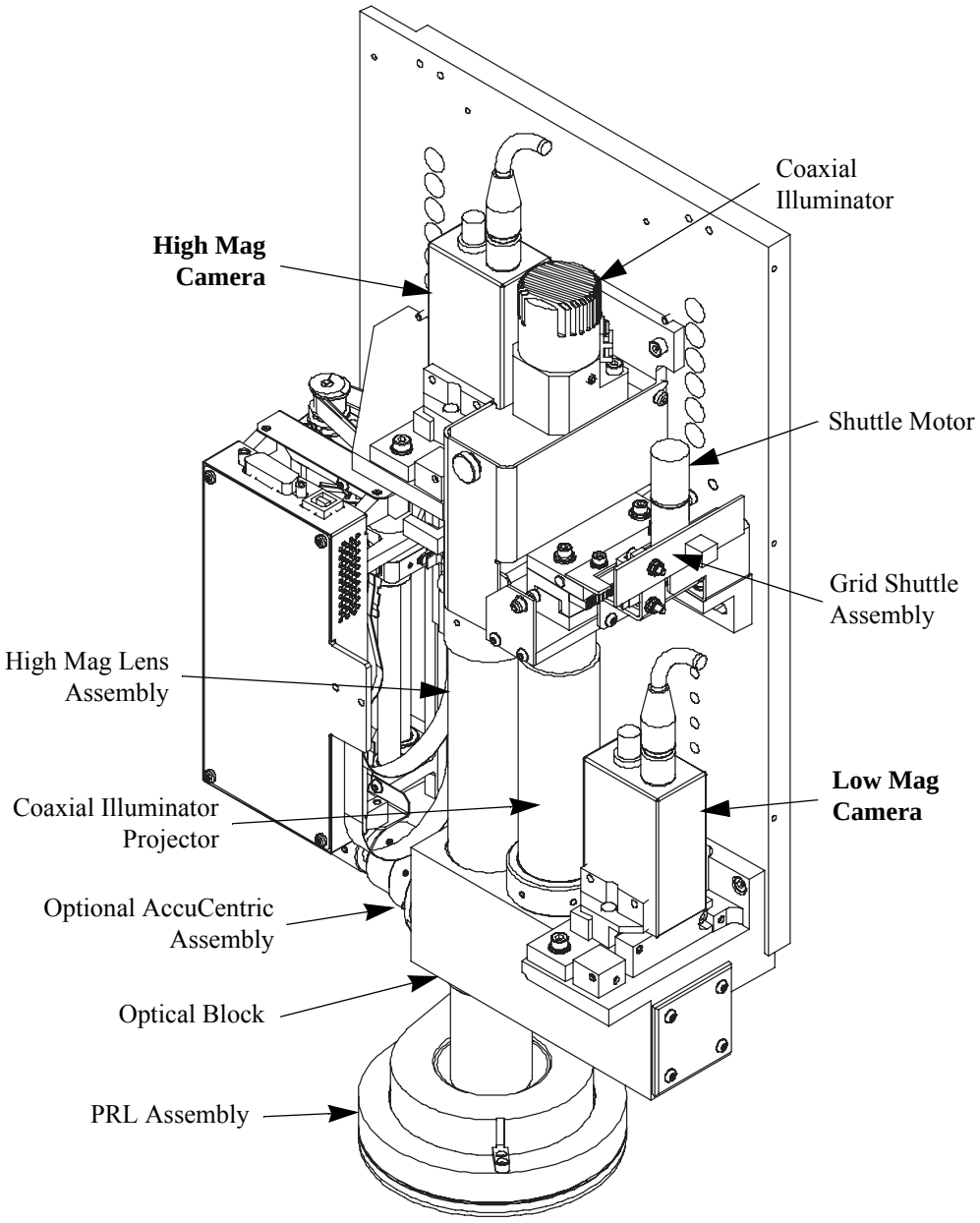

Figure 2-2 Optics Components

2.6 Computer & User-Interface Components

The Benchmark 250 system operates on an Intel-based computer. The system comes with a joystick, mouse, keyboard and flat-panel display, and runs theVMS metrology software on the Windows™ XP (or 2000) operating system.

The following is a summary of additional information you should know about the user-interface components provided as part of the Benchmark 250 system.

2.6.1 Mouse

Unless specified otherwise, the left mouse button is used for most actions. The right mouse button is used for special actions (for example, to display a context menu in a specific window).

2.6.2 Keyboard

- The [F1] key is usually reserved for Help; press it to display the Help menu.
- The [Tab] key will move the mouse cursor from one field to another in a dialog box.
- In the VMS Feature window, pressing the left mouse button and the [Ctrl] key will perform a move to where the mouse cursor is in the Feature window.

2.6.3 Joystick

Use the joystick to move the:

- stage in the X and Y directions
- camera/lens assembly in the Z direction

To move	You must
the stage along the X-axis	move the joystick left and right (east and west)
the stage along the Y-axis	move the joystick forward and backward (north and south)
the optics along the Z-axis	twist the joystick knob clockwise (to raise the optics) and counterclockwise (to lower the optics)

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Safety Information

Chapter 3

3.1 What This Chapter Contains

This chapter describes the following:

- Emergency Stop Switch
- System Power
- System Lockout
- Safety Guidelines

Also, be sure to review the information about important system labels on page vii.

3.2 Emergency Stop Switch

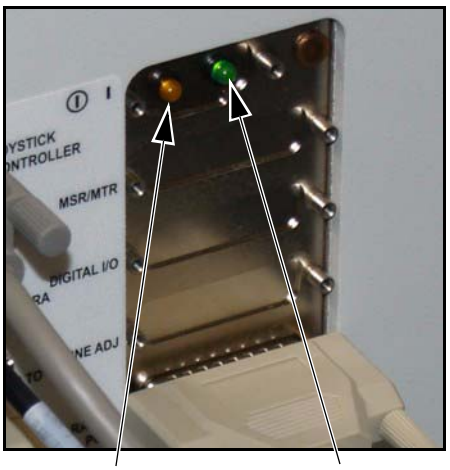
Activate the emergency off (EMO) circuit by pressing the remote E-Stop switch on the workstation.

Figure 3-1 Remote E-Stop Switch

The EMO circuit is responsible for disabling system motion in case of an emergency. The EMO circuit places the system in a safe (shutdown) condition, which cuts power to the motors.

3.3 System Status LEDs

The system status LEDs are located on the interconnection panel on the right-hand side of the machine. The green LED is the Power On LED and the yellow LED is the Stop LED.



The following table includes information regarding the status of the Stop LED and provides instructions for recovering from different Stop conditions.

Stop LED Status	Description	Cause	How to Recover
Off	System is in normal operation	—	—
On	Recoverable stop	Occurs during the normal power-up sequence until the Stop/ Start button on the joystick is pressed	When prompted, press the Stop/Start button on the joystick.
		Occurs when the XY stage or Z-axis transport encounters an end-of-travel limit	Move the axis off of the limit, and then press the Stop/Start button on the joystick
		Occurs when servo parameter settings are incorrect	Check LED DS7 on the DSP Multi Axis PCBA for the source of the E-Stop (see ***Diagnostic LED DS7 E-Stop Codes*** on page 66).
		Occurs when the remote E-Stop switch is pressed	Reset the remote E-Stop switch by twisting the knob in the direction of the arrows, and then press the Stop/Start button on the joystick.

3.4 System Power

The system comes with an IEC power strip (P/N 037545) and three identical power cords (P/N 019978) that connect the monitor, system PC, and machine to the power strip. An external power cord connects the power strip to the external power source (outlet). External power cord characteristics vary depending on the country of installation, as outlined in the table below.

Warning: Always use the IEC power strip and the external power cords provided with the system. Use of an inappropriate power connection could lead to equipment damage and/or electrical shock.

Country	Power	Part Number	Type	AWG (US)	Wire Cross Section (CE)
United States	120 VAC, 50/60 Hz	019938	3-Conductor	18	0.82 mm^2
Japan	100 VAC, 50 Hz	019938	3-Conductor	18	0.82 mm^2
United Kingdom	240 VAC, 50 HZ	019971	3-Conductor	18	1.00 mm^2
Italy	220 VAC, 50 HZ	019972	3-Conductor	18	1.00 mm^2
Denmark	220 VAC, 50 HZ	019974	3-Conductor	18	1.00 mm^2
Switzerland	220 VAC, 50 HZ	019975	3-Conductor	18	1.00 mm^2
Other European Countries	220 VAC, 50 HZ	019973	3-Conductor	18	1.00 mm^2

3.5 System Lockout

Before servicing the system, you must unplug the power cord and lock out the system. This will protect you and others from unintended machine operation, which could result in personal injury. No one should attempt to defeat a lockout while the machine is being serviced.

Most companies have a safety department and written procedures for locking out the system. These procedures typically have the following features as a minimum:

- Each operator, supervisor, and maintenance person who may be required to work on the machine shall have a key operable padlock.
- If more than one key exists for the padlock, the owner of the lock shall have possession of all of the keys.
- Each lock shall be labeled with the owner's name, or the owner shall be supplied with an identity tag that may be attached to the lock when it is applied to the machine.

To lock out the system:

1. Exit all programs and shut down Windows.
2. Turn off the monitor.
3. Press the remote E-Stop switch.
4. Unplug the main power cord from the power source and lock the plug into an appropriate energy isolating device.
5. Perform the required service/maintenance.

Note: Each person performing maintenance or making adjustments to the system should have their own lock attached to the energy isolating device. There are commercially available multi-lock devices to allow this.

To resume normal operation:

1. After determining it is safe, have each person remove his/her own padlock.
2. When all padlocks are removed, reconnect the power cord to the main power source.
3. Reset the remote E-Stop switch by turning the knob in the direction of the arrows.
4. Power up the system and resume normal operation.

3.6 Safety Guidelines

For your personal safety, observe the following safety precautions and guidelines. They are provided for your protection and to help prevent damage to the system.

General Precautions:

- The system is intended to be used by personnel who recognize the hazards associated with electrical shock and computer-controlled mechanical motion.
- The system is intended to be used for metrology applications only; other use may void your warranty.
- To prevent the accidental pinching of your hands, do not approach or touch the machine during operation.
- To avoid personal injury, never attempt to manually move the Z-axis slide with power applied to the machine.
- To avoid personal injury, always mount the part(s) you are measuring/ inspecting in a fixture that is secured to the stage.
- Always power down and lock out the system before servicing it.

Power and Grounding:

- Ensure that the source of power connected to the system does not apply more then the rated voltage (specified by VIEW Engineering, Inc.) between the supply conductors or between either supply conductor and ground.
- The system is grounded through the power cord. To avoid electrical shock, connect the power cord to a properly wired receptacle with an earth ground connection.
- Connect the system to a dedicated circuit.

Power Cord:

- Only use the power cord and connector specified for the system.
- Do not operate the system if the power cord is damaged.
- Position the power cord so it will not be a trip hazard, or come in contact with a hot surface.

Miscellaneous:

- To avoid a fire hazard, only use fuses that meet all type, voltage, and current requirements as specified by VIEW Engineering, Inc.
- Do not operate the system without all covers and panels installed properly.
- Keep water and other liquids away from the system to reduce the risk of spillage and electrical shock.
- Do not use any accessory attachments other than those provided or approved by VIEW. Improper accessories can cause fire, electrical shock, and/or personal injury.
- Do not drop anything on the stage glass.

Unsafe Operating Environments:

- Do not operate the system in hospitals, clinics, or laboratories where sensitive patient monitoring equipment may be affected.
- Do not operate the system in a radioactive environment because the electronics in the machine are not radiation-hardened.
- Do not operate the system in environments where flammable gases and vapors or explosive dust are present. These could be ignited by the heat or sparks which may be generated by the system.

Installation

Chapter 4

4.1 What This Chapter Contains

This chapter covers:

- Choosing an Installation Site
- Benchmark 250 System Layout
- Receiving, Unpacking, & Inspecting the Benchmark 250 System
- Moving & Installing the System
- Connecting the System
- Powering Up the System & Launching the Metrology Software
- Operation Checks
- Post Installation Checklist
- Shutting Down the System
- Installing the X, Y, & Z Shipping Restraints
- Stage Fixture Mounting Holes

4.2 Choosing an Installation Site

Before installing the system, choose a site that meets the following criteria:

Specification	Requirement:
Temperature	Recommended operating range: 17° to 33°C Rated environment: 18° to 22°C
Humidity	30% to 80% non-condensing Condensation can cause corrosion
Vibration	<0.0015g below 15Hz In order to maintain system accuracy, do not locate the system close to production equipment susceptible to vibration (for example: stamping presses, mills, or lathes).
Weight	Crated: 286 kg (630 lbs) Uncrated: 155 kg (340 lbs)
Electrical Requirements	115/230 VAC, 50/60 Hz, 700 W
Workbench Requirements	Weight: 240 kg (535 lbs)—must be capable of fully supporting the weight of the machine, system PC, monitor, test fixtures, accessories, parts being measured, and everything else on its surface Dimensions: (W x D): 183 x 92 cm (72" x 36")
Dimensions (W x D x H)	Machine: 72.0 x 77.5 x 87.3 cm (28.3" x 30.5" x 38.3") Workstation (optional): 76 x 74 x 152 cm (30" x 29" x 60") Make sure there is adequate space for an operator to spread out materials and use the system comfortably.
Service access	Allow 31 cm (12") on each side and 61 cm (24") in the rear of the machine for cables and service access.

The Benchmark 250 system does not require air, steam, or exhaust. Vacuum and/or air may be required for special fixtures only.

4.3 Benchmark 250 System Layout

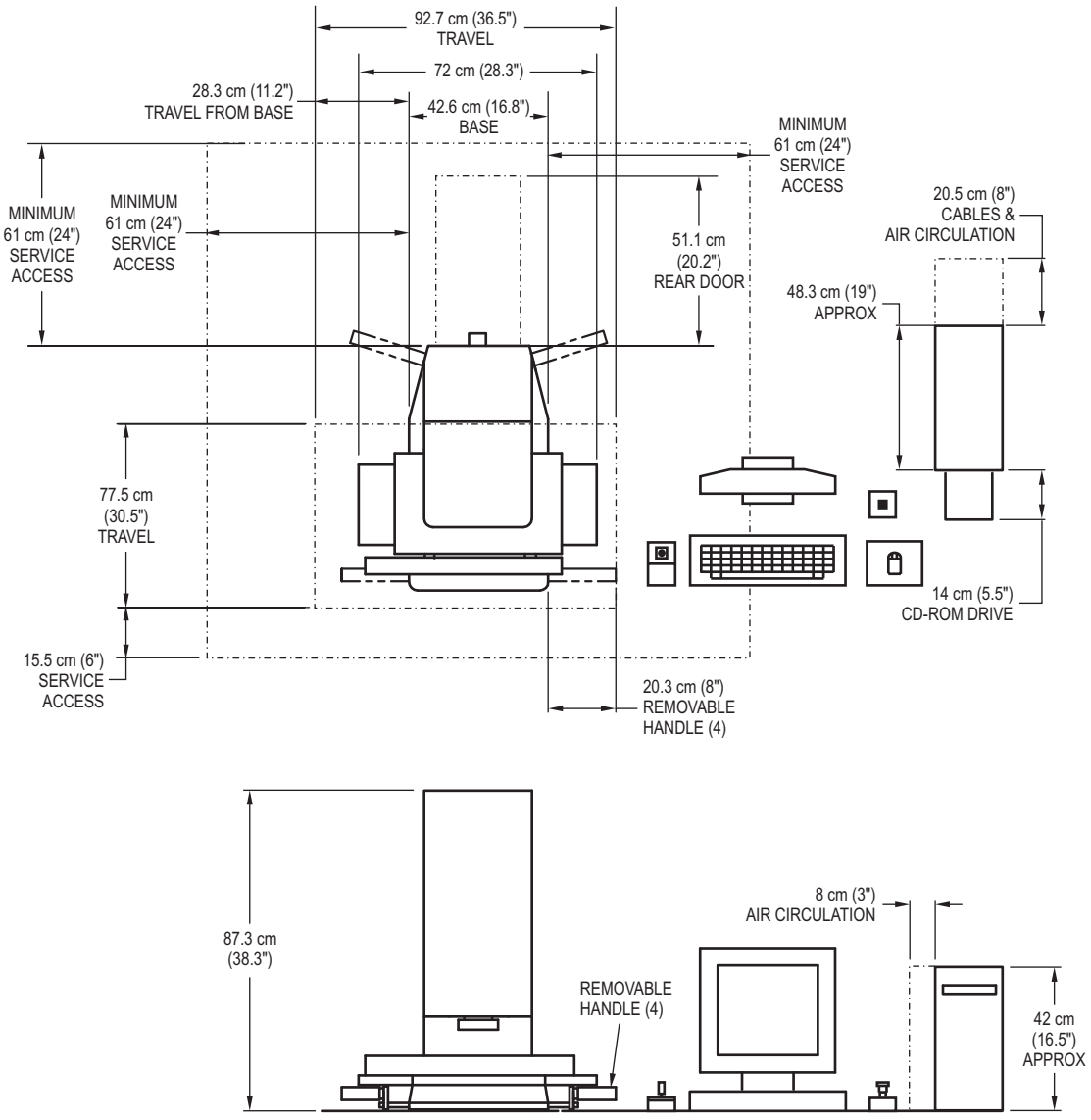


Figure 4-1 Benchmark 250 System Layout

4.4 Receiving, Unpacking, & Inspecting the Benchmark 250 System

When you receive the system, the shipment will include a pallet that contains the machine, computer equipment, and any optional accessories.

Note: The following procedure provides general unpacking instructions. See the *Benchmark 250 Installation Manual* (P/N 799030) for detailed instructions.

Note: Before unpacking the machine, be sure to review the table at the beginning of this section for information about equipment dimensions, space requirements, workbench requirements, and environmental considerations.

Tools Required
Fork lift or pallet jack
Large diagonal cutters
Phillips-head screwdriver

1. Inspect the shipping crate for damage.
2. Note the condition of the shipping crate. If any damage is found, STOP! Contact the Customer Support HelpDesk; see ***Where to Get Help*** on page 4.
3. Disassemble the crate and remove the external packing material.

4.5 Moving & Installing the System

Note: The following procedure provides general installation instructions. See the *Benchmark 250 Installation Manual* (P/N 799030) for detailed instructions.

1. Remove the front cover by lifting it straight up.

2. Screw the provided lifting eyebolts into the base of the machine (see Figure 4-2). **Make sure the eyesbolts are tightened completely.**

Warning: Before lifting the machine, be sure to insert the metal plate attached to the wooden stabilizer into the slot on top of the machine. This helps prevent the machine from tipping over while it is being lifted.

3. Use a power or manual hoist and the provided lifting straps to slowly lift the machine off of the pallet, steadying it manually at all times.

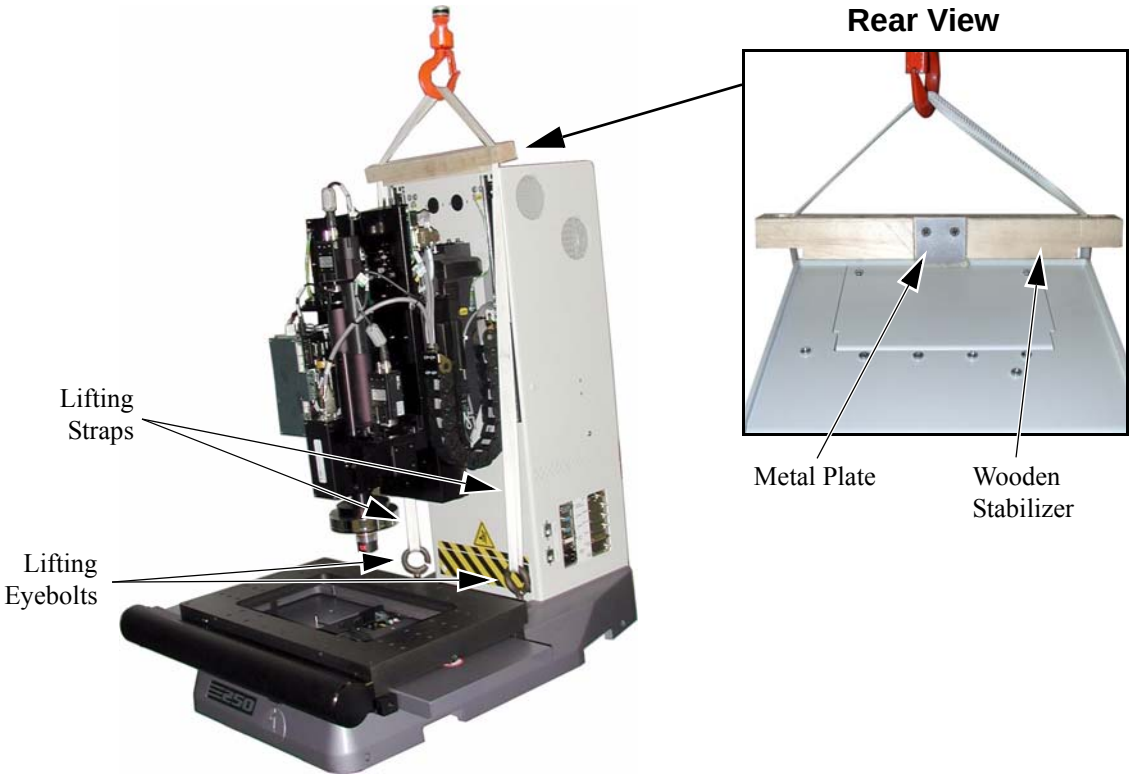


Figure 4-2 Lifting the Machine

4. Move the machine to the final operating location, and slowly lower it into position on a workbench capable of bearing the full weight of the machine.

5. Remove the lifting materials and store them for future use.

6. Remove the X, Y, and Z restraints.

7. Unpack and install the stage glass.

8. Unpack the system PC, monitor, joystick, mouse, keyboard, remote E-Stop switch, and any other system components and accessories. Place everything in their respective areas on the workbench.

4.6 Connecting the System

Figure 4-3 illustrates Benchmark 250 system cabling and the table on the next page provides further detail. All cables are clearly marked regarding function and which end connects to which system connector.

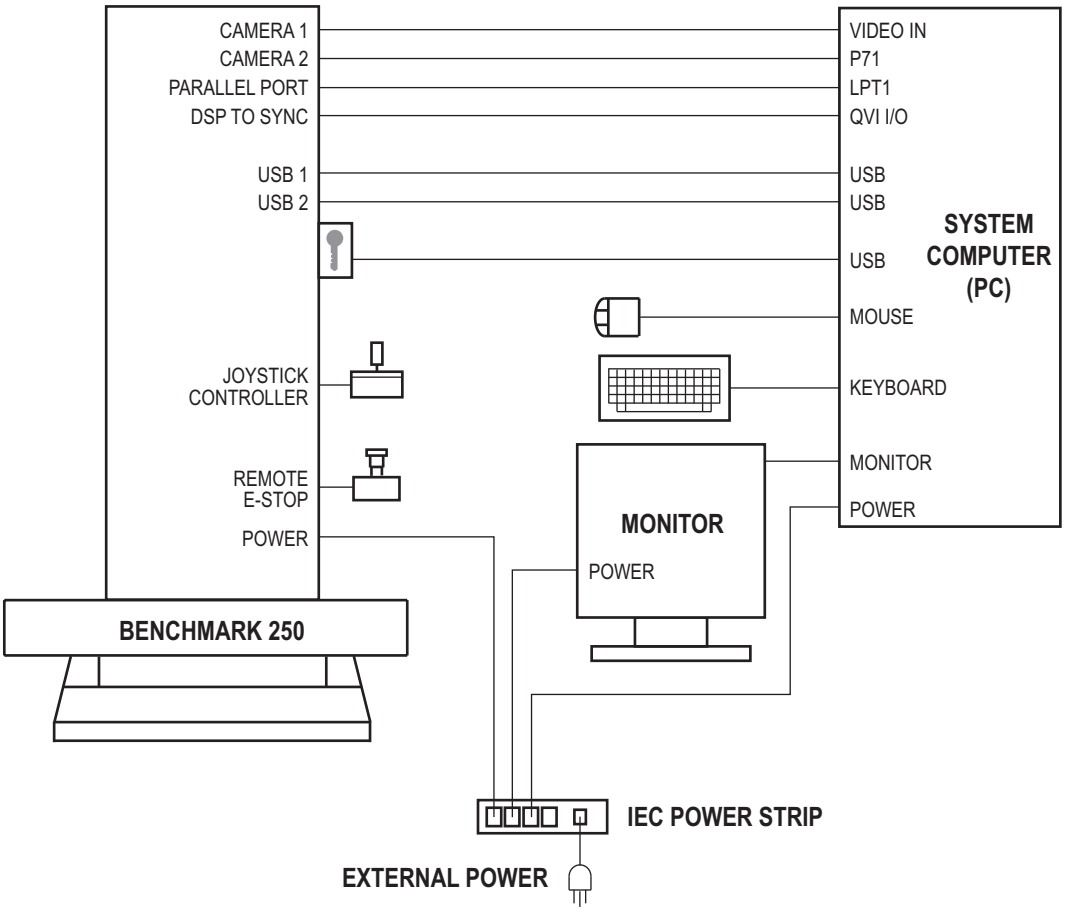


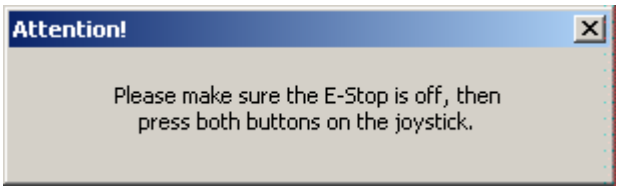
Figure 4-3 Benchmark 250 System Cabling Diagram

Connect the...	to the...	and the...
Joystick (P/N 039037)	**JOYSTICK CONTROLLER** connector on the machine	—
Remote E-Stop switch (P/N 039836)	**REMOTE E-STOP** connector on the machine	—
Keyboard (P/N 036821)	Purple keyboard connector on the system PC	—
Mouse (P/N 035136)	Green mouse connector on the system PC	—
Monitor	**MONITOR** connector on the system PC	—
Software key box (P/N 060161.01)	USB connector on the system PC	—
QVI I/O cable (P/N 061919.02)	**QVI I/O** connector on the system PC	**DSP TO SYNC** connector on the machine
USB cable	USB connector on the system PC	**USB 1** connector on the machine
USB cable (P/N 060151.01)	USB connector on the system PC	**USB 2** connector on the machine
Parallel cable (P/N 049082.01)	**LPT1** connector on the system PC	**PARALLEL PORT** connector on the machine
Camera 1 cable (P/N 060155-1)	**VIDEO IN** connector on the system PC	**CAMERA 1** connector on the machine
Camera 2 cable (P/N 060131.01)	**P71** connector on the system PC	**CAMERA 2** connector on the machine
Monitor power cord	Monitor	IEC power strip
System PC power cord	System PC	IEC power strip
Machine power cord	Machine	IEC power strip
IEC power strip power cord	IEC power strip	Power outlet

4.7 Powering Up the System & Launching the Metrology Software

1. Make sure the system components are connected and the main power cord is plugged into an appropriate power source (outlet).
2. Make sure the remote E-Stop switch on the workbench is pulled out.
3. Turn on the monitor, system PC, and any optional accessories.
4. Wait for the operating system to load.
5. Double-click on the VMS icon on the Windows Desktop.

   The following prompt appears:



6. Verify that the remote E-Stop switch is not pressed in.
7. Press the **Stop/Start** button on the joystick.

   The system initializes the stage and optics (this may take a few minutes).

4.8 Operation Checks

After powering up the system and launching the metrology software, you should verify that it performs as expected. If the system fails any of the following operation checks, verify all connections are correct and secure. If the system still does not perform as described below, contact the View Engineering, Inc., Customer Support HelpDesk; see ***Where to Get Help*** on page 4.

Caution: Before performing any of the following operation checks, verify that no parts, fixtures, or other obstructions are on the stage.

Action	Result
Press the remote E-Stop switch.	• The system enters E-Stop Mode—the yellow LED on the right side of the machine turns on. • A software message appears on the screen. • The stage does not move when you move the joystick lever. To resume normal operation: 1. Clear the software message. 2. Reset the E-Stop switch by turning the knob in the direction of the arrows. 3. Press the **Stop/Start** button on the joystick.
Move the joystick lever in any direction.	The stage moves in the same direction.
Twist the joystick knob CW.	The Z-axis assembly moves up.
Twist the joystick knob CCW.	The Z-axis assembly moves down.
Press both buttons on the joystick simultaneously.	• The system enters Stop Mode—the yellow LED on the right side of the machine turns on. • A software message appears on the screen. • The stage does not move when you move the joystick lever. To resume normal operation: 1. Clear the software message. 2. Press the **Stop/Start** button on the joystick.
Adjust the illumination levels in the software.	The intensity of the selected illuminator should change as expected.

4.9 Post Installation Checklist

1. Focus Comparison

   Adjust the Surface Focus and Ronchi Focus to a minimum difference when the system is installed for the first time or when the camera or optics are removed or adjusted; see ***Camera Parfocal Adjustment*** on page 123.

2. Lens Calibration

   Create all related lens files by calibrating all magnification lenses; see ***Lens Calibration*** on page 132.

3. System Certification

   Perform a full XYZ system certification and verification; see ***VMS System Certification & Verification 7.02*** on page 201. For more information, contact the Customer Support HelpDesk; see ***Where to Get Help*** on page 4.

4. System Backup

   Backup all important operating files used by the Benchmark 250 system. All files are backed up via an option within the VMS software installation routine.

4.10 Shutting Down the System

Warning: The system must be shut down in an orderly fashion to prevent data loss.

Note: If Windows locks up and you cannot shut down the system as described below, press the remote E-Stop switch. Then press (approximately six seconds) the On/Off button on the computer. This will shut down the computer and turn off the system.

To exit the metrology software, do either of the following:

- Click on the **X** in the top right corner of the screen
- Select **File / Exit** from the main menu

To shut down Windows and turn off the system, do the following:

1. Exit all programs.
2. Perform the standard Windows shutdown procedure.
3. Turn off the monitor and any optional accessories.

4.11 Installing the X, Y, & Z Shipping Restraints

If you need to move the Benchmark 250 system, even a short distance, we recommend that you attach the shipping restraints. These will prevent the stage and optics from moving, reducing the chance of equipment damage.

Before powering down the system and installing the shipping restraints, position the XY stage and Z-axis transport as follows:

- Position the XY stage in the center of its XY travel.
- Position the Z-axis transport so the top of the Z-axis slide is flush with the top of the Z-axis housing (see Figure 4-6 on page 31).

Caution: Do not attempt to move the XY stage or the Z-axis transport with the X, Y, and Z shipping restraints installed.

The X-axis shipping restraint attaches to the left side of the stage, as shown in Figure 4-4 below. To install the X-axis shipping restraint, do the following:

1. Use a 3 mm Allen wrench to remove the X-axis end stop screw.

Caution: If the small, black X-axis ball retainer falls out, put it back in place before installing the shipping restraint.

2. Attach the shipping restraint to the machine with the X-axis end stop screw and the X-axis shipping screw. Use a 3 mm Allen wrench to install the end stop screw and a 4 mm Allen wrench to install the shipping screw.

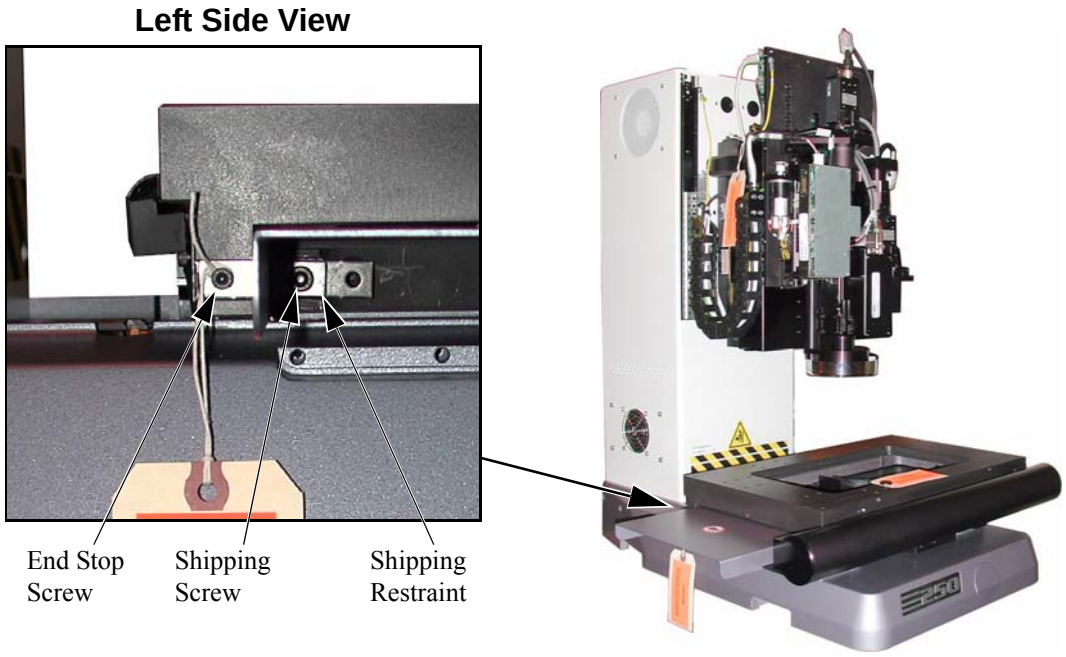


Figure 4-4 X-Axis Shipping Restraint

The Y-axis shipping restraint attaches to the front of the machine, as shown in Figure 4-5. To install the Y-axis shipping restraint, do the following:

1. Use a large, flat-head screwdriver to remove the left Y-axis end stop screw.

Caution: If the small, black Y-axis ball retainers fall out, put them back in place before installing the shipping restraint.

2. Screw the end stop screw into one of the fixture holes in the top of the stage.

3. Attach the Y-axis shipping restraint to the machine with the two Y-axis shipping screws. Use a 5 mm Allen wrench to install the left shipping screw and a 4 mm Allen wrench to install the right shipping screw.

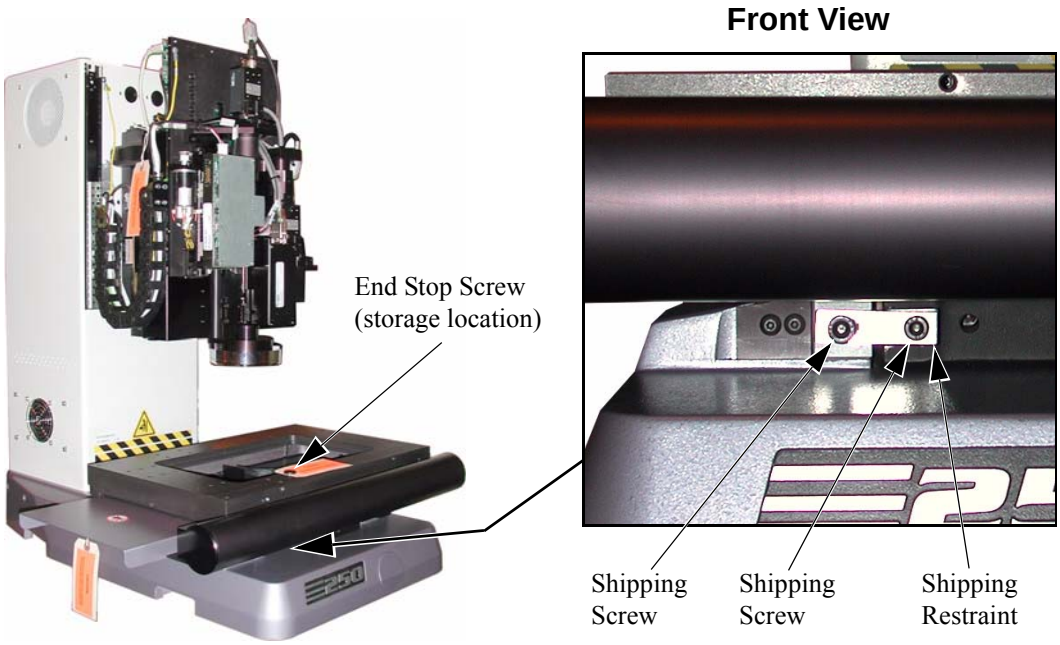


Figure 4-5 Y-Axis Shipping Restraint

Two Z-axis shipping restraints attach to the top of the Z-axis slide assembly, as shown in Figure 4-6. To install the Z-axis shipping restraints, do the following:

1. Raise or lower the Z-axis assembly so the top of the Z-axis slide is flush with the top of the Z-axis housing.

2. Attach the two Z-axis shipping restraints to the top of the Z-axis slide assembly with the four Z-axis shipping screws. Use a 4 mm Allen wrench.

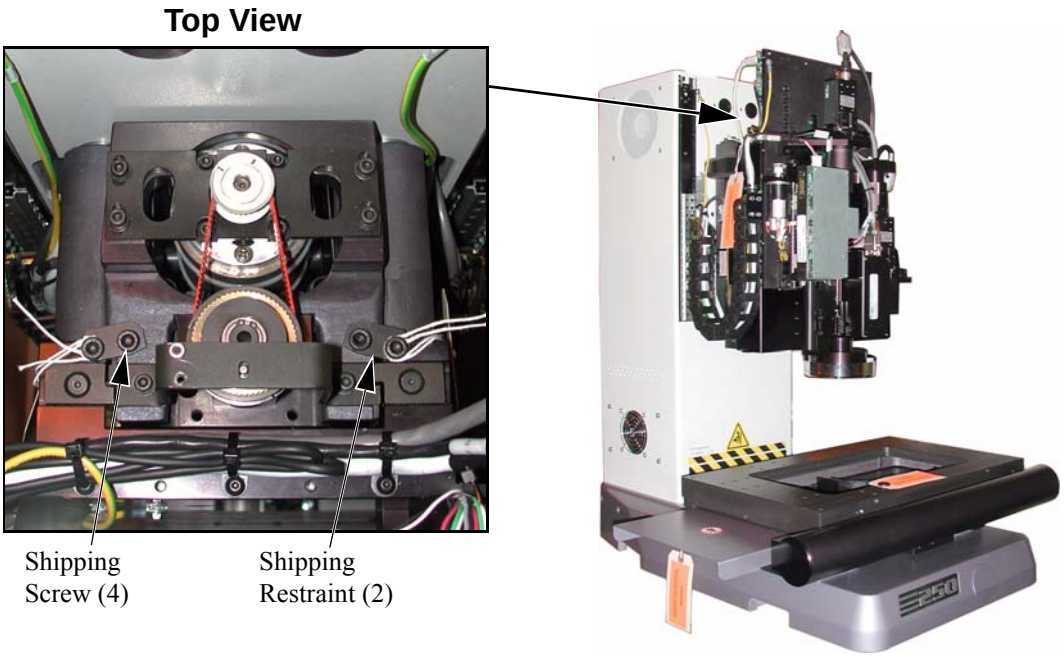


Figure 4-6 Z-Axis Shipping Restraints

4.12 Stage Fixture Mounting Holes

Use the tapped holes along the each side of the stage to mount fixtures to the stage for securing and orientating parts. Any combination of holes can be used to attach a variety of fixtures.

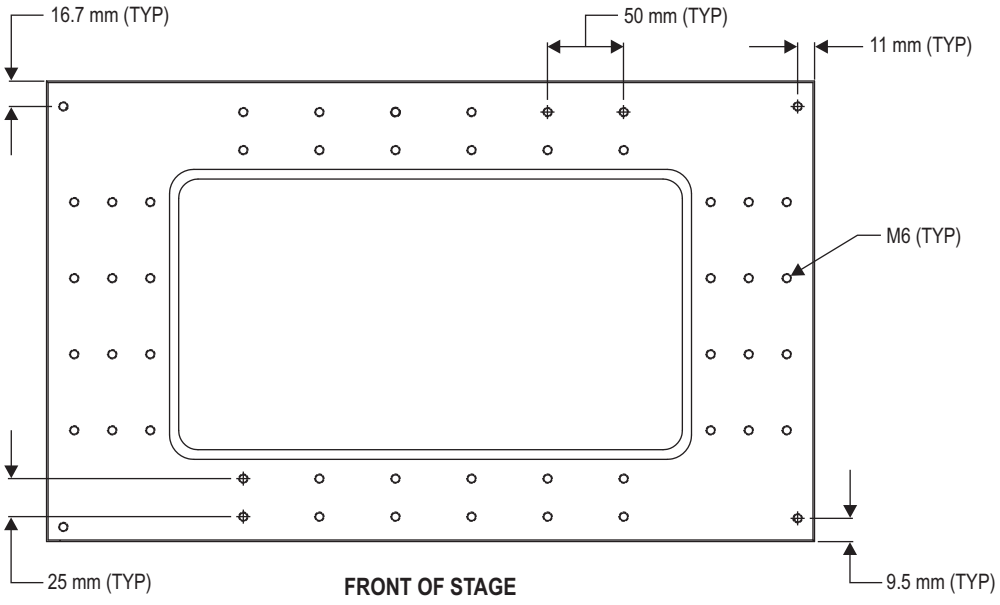


Figure 4-7 Benchmark 250 Stage Fixturing Holes

Principles of Operation & System Interconnections

Chapter 5

5.1 What this Chapter Contains

This chapter describes the subsystems and interconnections that make up the Benchmark 250 system.

- Overview of Operation
- Image Acquisition, Processing, & Display
- Motion Control
- Illumination Sources
- Zeroing the Stage
- Benchmark 250 Schematic Diagram

5.2 Overview of Operation

When a user creates a program to inspect a part, the resulting **part program** is actually a sequential list of instructions to the Benchmark 250 system.

The instructions include X, Y, and Z stage positions, lighting and their intensities, and tool parameters. The Benchmark 250 system moves the stage, sets the lights, and runs the tools according to the part program. Measurements are made using finders and image processing software within the Benchmark 250 system.

The software then looks at the next part program step and continues to each step until complete. During the execution of a program, calculations are made and the resulting data is either stored, printed, or sent to another type of I/O device.

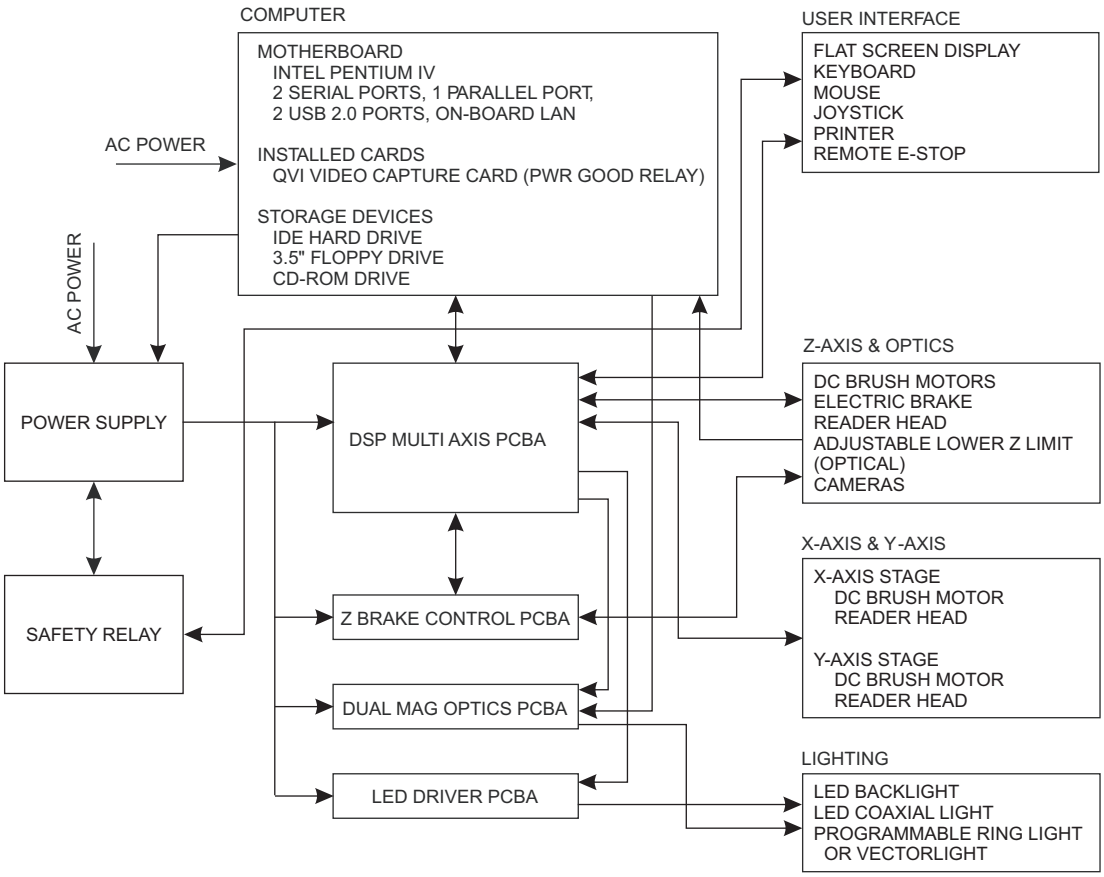


Figure 5-1 Benchmark 250 System Block Diagram

5.3 Image Acquisition, Processing, & Display

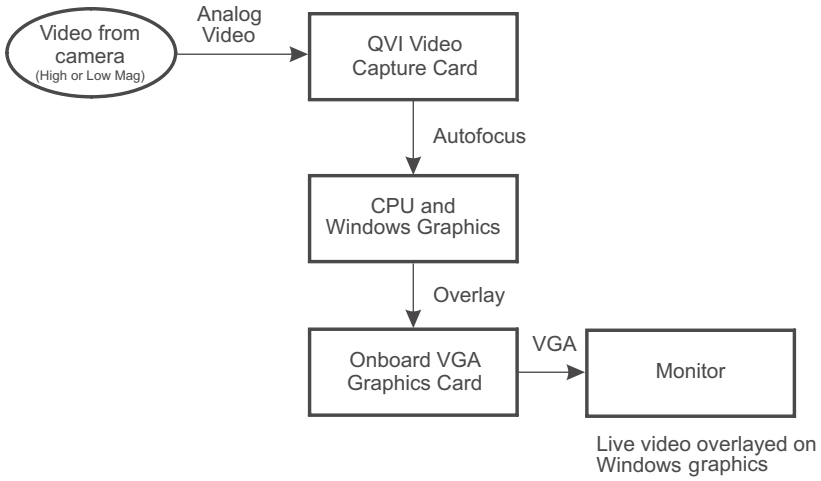


Figure 5-2 Image Acquisition

Note: The QVI video capture card is pre-installed in the system computer.

Here is a description of these components and how they function in conjunction with other system elements to create images:

1. The High and Low Mag CCD video cameras provide real-time video to the system.
2. The video is routed to the QVI video capture card.
3. Windows graphics are overlayed onto the live video by the on-board VGA graphics card and sent to the attached monitor.

The QVI video capture card gets its video from the cameras. This video is used to control Z-axis focus processing and lighting.

The system is capable of performing two types of focus processing: Ronchi or Surface. Surface focus and Ronchi focus types are very similar and work almost the same way.

When performing a surface focus, an out-of-focus image will be more gray than an in-focus image. The sharper image will have better contrast. The video signal is converted to a digital number so the host CPU can monitor each value. During an auto-focus, the CPU monitors these values and scale readings, and keeps the scale value for the highest contrast value incurred.

When performing a Ronchi focus, a projected grid is used and a band-pass filter of the same frequency as the projected grid is placed in the circuit. The more in focus the grid is, the higher the contrast value of the video.

5.4 Motion Control

This section describes the subsystems used in motion control and the motion control process.

5.4.1 X- & Y-Axis Motion

The X and Y motor assemblies and scale reader heads are mounted directly on the Benchmark 250 stages. The motor assemblies position the stage, and the feedback from each reader head (and scale) aid in positioning the stage and holding the actual position once it has been achieved.

The scales have a separate index flag mounted away from the reader heads to keep the stage coordinates the same each time the system is powered up and/or re-zeroed.

The scales and reader heads produce digital pulses every 0.5 micron (optional 0.1 micron scale is available). The pulses are used by the motion controller to determine stage position. The reader heads have LED indicators that are green when the reader head is properly aligned to the tape scale. Once properly aligned, no further adjustments to the signals are required.

There are magnetic limit switches at each end of stage travel. The limit switches allow the user to move the stage freely with the joystick without worrying about moving beyond the active measurement area of the system.

5.4.2 Z-Axis Motion

The Z-axis DC motor is mounted at the top of the Z-axis assembly and positions the Z-axis transport. Feedback from the reader head and tape scale aids in positioning the stage and holding the actual position once it has been achieved.

The tape scale and reader head produce digital pulses every 0.5 micron (optional 0.1 micron scale is available). The pulses are used by the motion controller to determine stage position. The reader head has an LED indicator that illuminates green when the reader head is properly aligned to the tape scale. Once properly aligned, no further adjustment to the signal is required.

The Z-axis motion system contains upper and lower magnetic limit switches and an adjustable lower optical limit switch. The adjustable lower limit can be set to limit the Z-axis travel in the down direction when required.

The electric brake assembly is mounted to the bottom of the Z-axis ball screw. While the system is in use, the brake is energized and the Z-axis transport is free to move. Once power is removed from the brake, however, it activates and prevents Z-axis movement.

In addition to the electronic E-Stop devices, the Z-axis slide on the Benchmark 250 system is designed to separate mechanically ("break away") from the Z-axis drive if a physical obstruction prevents the stage from continuing its downward motion; the Z-axis drive bracket disengages from the drive nut, which causes the Z-axis slide to stop moving down even if the Z-axis drive continues to drive.

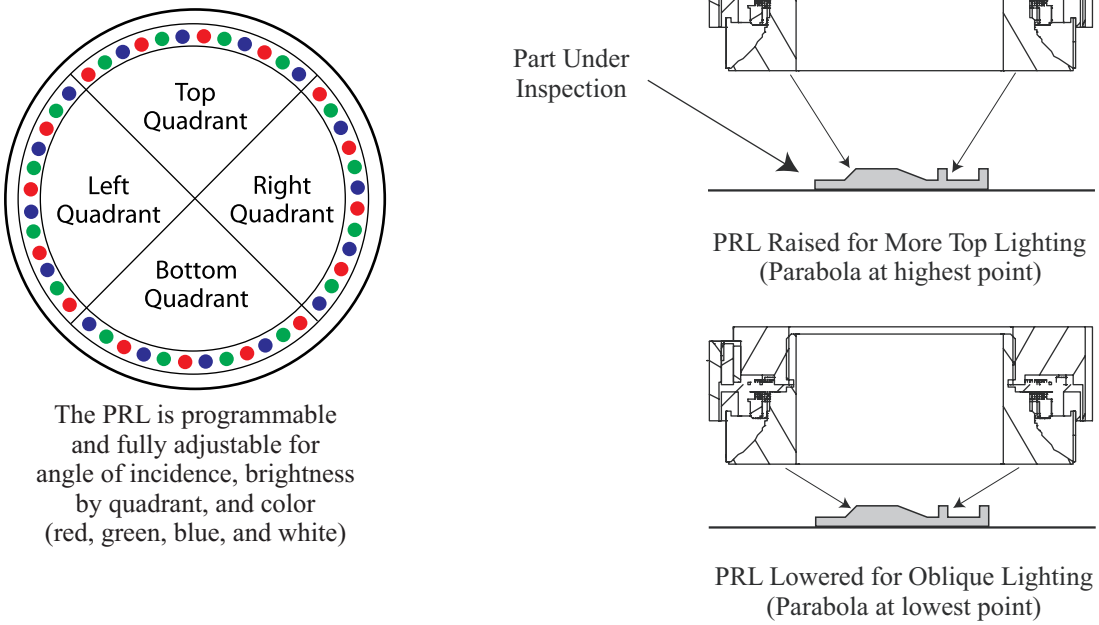
Warning: NEVER ATTEMPT TO MANUALLY MOVE THE Z-AXIS BY TURNING THE BALL SCREW WITH POWER APPLIED TO THE MACHINE. Doing so could result in personal injury.

Warning: In the event of an unexpected Z-axis contact, see ***Recovering from Unexpected Z-Axis Contact*** on page 113 for information about returning the system to normal operation.

5.5 Illumination Sources

The Benchmark 250 system has the following illumination (light) sources:

- [Standard] The **LED backlight** provides light from below the part, through the stage glass, to create a contour or profile shadow image of the part. The backlight should be aligned to be concentric with the camera optics.
- [Standard] The **LED coaxial illuminator** provides direct, “square on” light onto the surface of the part where it is reflected up into the optics. The assembly has a diffuser inside the housing where the LED is located that assists in making the light more evenly distributed across the field of view. The illuminator has a beam splitter, which is placed in the optical path.
- [Optional] The **LED surface illuminator/grid projector** mounts in place of the standard LED coaxial illuminator and adds the ability to project contrast onto surfaces that have little or no contrast, such as glass, when using high magnification.
- [Optional] The **programmable LED ring light** (PRL) has different color LEDs (red, green, and blue) and provides an oblique top light. A cone of light projected onto the surface of the part creates a three-dimensional image that highlights heights, depths, and surface imperfections. The PRL can be positioned up or down on the lens tube depending on the illumination angle required.



The PRL is programmable and fully adjustable for angle of incidence, brightness by quadrant, and color (red, green, blue, and white)

Figure 5-3 Video Path - PRL Optics

- [Optional] The **VectorLight** provides oblique surface illumination. The assembly consists of six concentric rings that can be split up into eight 45° sectors. You can turn on/off individual rings or sectors as well as adjust the intensity of the illumination to effectively illuminate staged parts with varying incidence and directionality.

5.6 Optional Ronchi Grid Assembly

The **Ronchi grid assembly** consists of a motorized, three position shuttle and two chrome-on-glass reticles: one for High Mag and another for Low Mag. When Ronchi Focus is selected in the VMS software, the shuttle automatically moves the appropriate grid reticle into position under the coaxial illuminator. Light from the coaxial illuminator passes through the reticle, projecting a shadow onto the point of focus and creating artificial contrast where none may actually exist. The Ronchi focus is aligned to the video focal plane. When Surface Focus is selected, the shuttle moves to the center position (no grid). In this case, coaxial light passes through the opening in the shuttle and no shadow is projected onto the part under inspection.

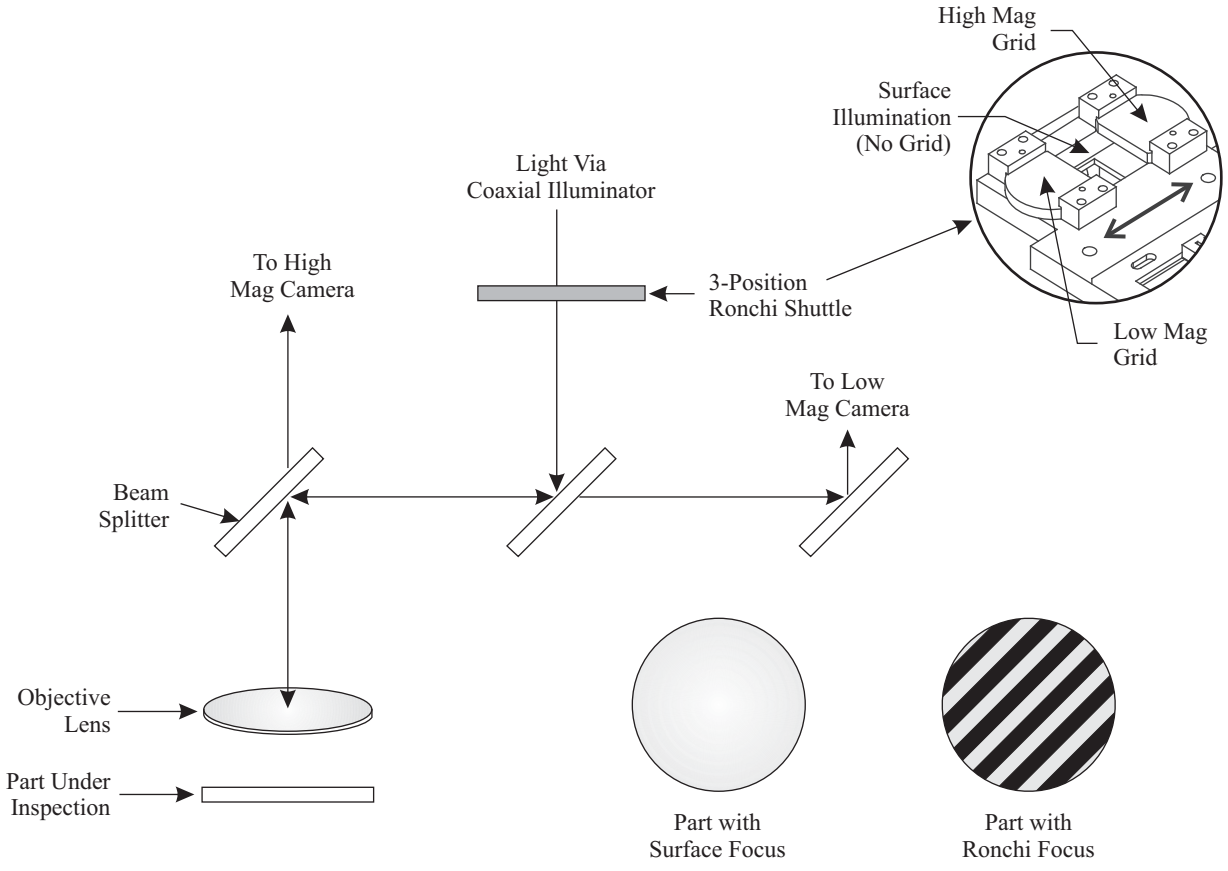


Figure 5-4 Video Path - Ronchi Grid Optics

5.7 Optional AccuCentric Assembly

The **AccuCentric assembly** inserts a reticle image into the optical path. This image is used to re-calibrate the optical system whenever you switch from High Mag to Low Mag, and vice-versa. As you switch magnification, the image is remeasured to automatically calibrate the position of the optical axis.

5.8 Zeroing the Stage

When the stage is zeroed, each axis is driven to one side until the magnetic limit switch is triggered. The stage then reverses direction and finds the index pulse. At this index pulse the stage counter is set to zero. The stage is then set to the same location each time the system is reset or powered up.

5.9 Benchmark 250 Schematic Diagram

Note: A copy of the latest revision of the system interconnect is available for every machine. If there are any discrepancies between this section and the Benchmark 250 system interconnect (P/N 031768-2), always refer to the system interconnect.

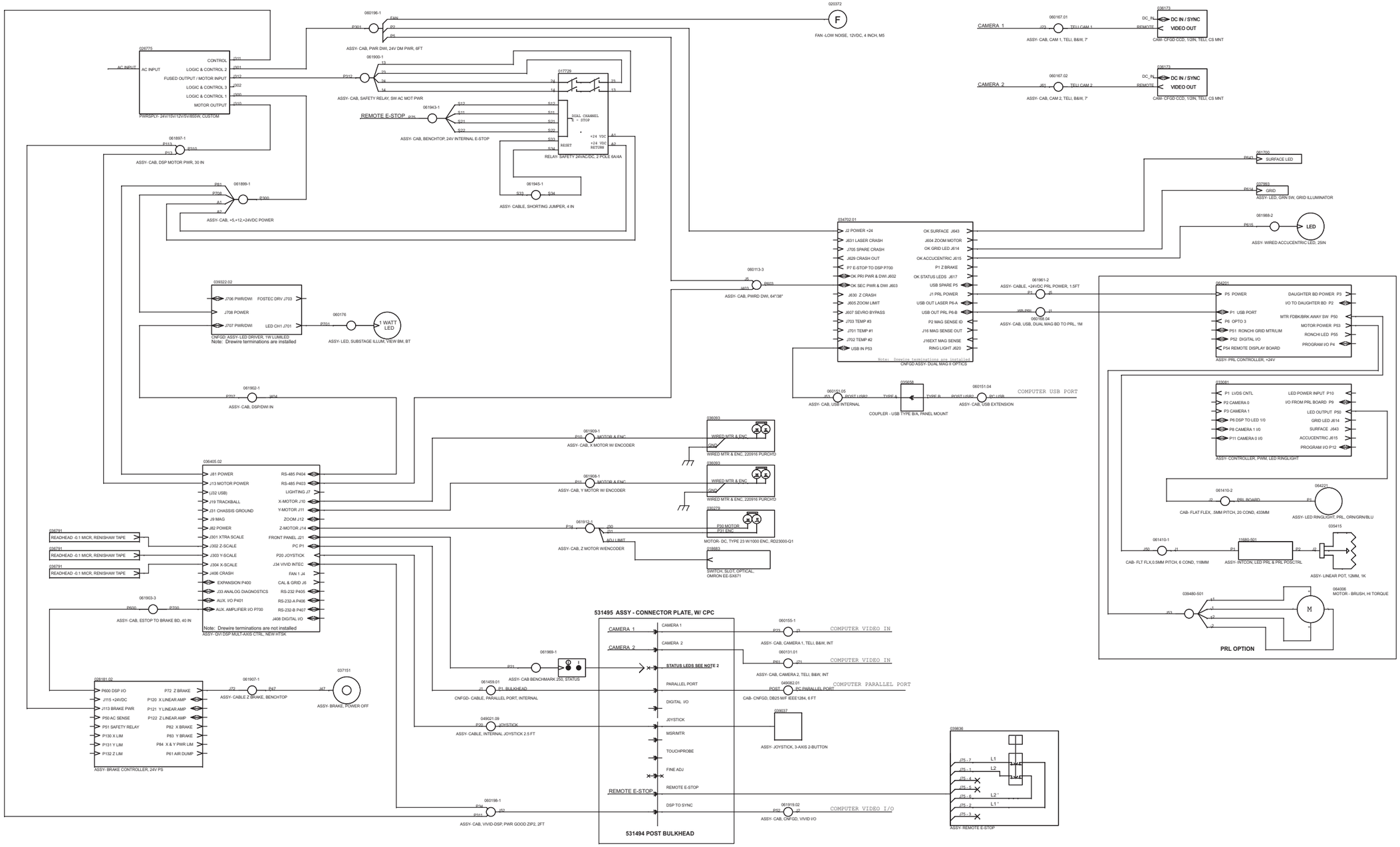


Figure 5-11 Overall System Interconnect

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Preventive Maintenance

Chapter 6

6.1 What This Chapter Contains

This chapter covers:

- Preventive Maintenance Schedule
- Cleaning the User Components
- Cleaning the Stage, External Surfaces, & Stage Glass
- Cleaning & Lubricating the XY Stage Guide Rails
- Lubricating the X-Axis Drive Rod
- Lubricating the Z-Axis Ball Screw
- Cleaning the Magnification Lens
- Cleaning the Optional LED Programmable Ring Light (PRL)
- Checking for Dirt in the Images of Both Cameras
- Checking the System for Proper Function

Warning: Unless instructed otherwise, always turn off the system and disconnect it from the main power supply while performing preventive maintenance; see ***System Power*** on page 13.

Warning: The risk of electrical shock is present anytime the covers are removed from the machine. To avoid exposure to high voltage, never remove the covers from the flat-panel display or system power supply.

6.2 Preventive Maintenance Schedule

Below is a summary of the Benchmark 250 preventive maintenance tasks and their recommended frequencies.

Note: You may need to perform the preventive maintenance tasks more or less frequently, depending on the environment in which the system is used. For example, some tasks may need to be performed more often if the system is located in a harsh environment. Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4) for specific recommendations.

Caution: Failure to perform preventive maintenance tasks may void your warranty and additional support services may result in charges for those services.

Preventive Maintenance Task	Frequency	Where to Find Procedure
Clean the user components	Every six months	See ***Cleaning the User Components*** on page 45.
Clean the stage, external surfaces of the machine, and stage glass	Every six months	See ***Cleaning the Stage, External Surfaces, & Stage Glass*** on page 46.
Clean and lubricate the XY stage guide rails	Every six months	See ***Cleaning & Lubricating the XY Stage Guide Rails*** on page 48.
Lubricate the X-axis drive rod	Every six months	See ***Lubricating the X-Axis Drive Rod*** on page 53.
Lubricate the Z-axis ball screw	Every six months	See ***Lubricating the Z-Axis Ball Screw*** on page 55.
Clean the magnification lens	As needed	See ***Cleaning the Magnification Lens*** on page 57.
Clean the programmable ring light (PRL)	As needed	See ***Cleaning the Optional LED Programmable Ring Light (PRL)*** on page 59.
Check for dirt in the images of both cameras	As needed	See ***Checking for Dirt in the Images of Both Cameras*** on page 60.
Check system for proper function	As needed	See ***Checking the System for Proper Function*** on page 60.

6.3 Cleaning the User Components

Materials Required
Soft, lint-free toweling
Pure, compressed air
Alcohol-based cleaner
Non-solvent glass cleaner
Vacuum cleaner
Swabs

Caution: Never connect or unplug the mouse or keyboard from the PS2 port on the system computer while the system is energized. Doing so could damage the motherboard in the system computer.

6.3.1 Cleaning the Joystick

Use swabs moistened with alcohol or a water-based cleaner to remove buildup from the point where the stick enters the housing.

6.3.2 Cleaning the Mouse

Shut down the computer and unplug the mouse. Then use alcohol or a water-based cleaner to remove the buildup from the bottom of the mouse. Remove and clean the ball if needed.

6.3.3 Cleaning the Flat Panel Display

Vacuum the vent slots so they are free of dust and clean the screen with a non-solvent glass cleaner and soft, lint-free toweling.

6.3.4 Cleaning the Keyboard

Shut down the computer and unplug the keyboard. Then use compressed air to remove any dust from between the keys. If necessary, use swabs moistened with alcohol.

6.4 Cleaning the Stage, External Surfaces, & Stage Glass

Materials Required
Soft, lint-free cloth
Pure, compressed air
Alcohol-based cleaning solution
Warm water mixed with a mild detergent or commercial surface cleaner
Commercial glass cleaner

6.4.1 Cleaning the Stage

Caution: Do not use water to clean the stage.

Wipe all external surfaces of the stage with an alcohol-dampened, lint-free cloth. Then wipe dry with a clean, dry, lint-free cloth. Use pure, compressed air to clean the fixturing holes in the stage.

6.4.2 Cleaning External Surfaces

Warning: Do not allow cleaning solution to get into the machine while cleaning it. This can cause internal damage to the machine and can cause electrical shorts and/or fires with the subsequent risk of personal injury. Always apply the cleaning solution to the cloth; do not apply the cleaning solution directly to the machine.

Caution: Do not use paint thinners to clean the external surfaces of the machine.

Clean the external surfaces of the machine with warm water and a mild detergent or with a commercial surface cleaner.

6.4.3 Cleaning the Stage Glass

Caution: Do not spray the stage glass with cleaner while it is mounted within the stage. If you do not plan to remove the stage glass before cleaning it, spray a soft, lint-free towel with glass cleaner and wipe the glass.

1. Use a 2 mm Allen wrench to loosen (do not remove) the two set screws on the front of the stage that hold the stage glass in place (see Figure 6-1).

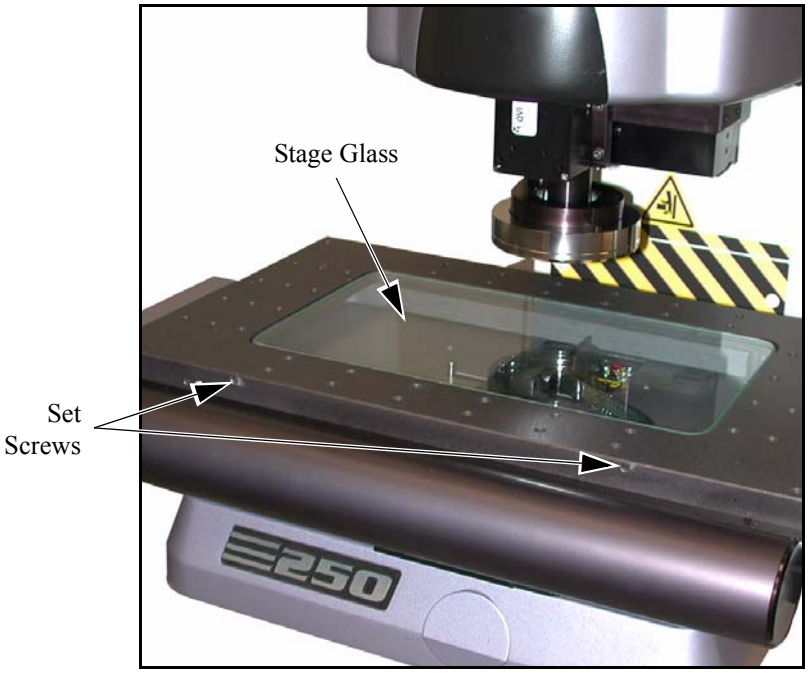


Figure 6-1 Location of the Stage Glass Set Screws

2. Carefully lift the stage glass out of the stage and clean both sides with glass cleaner and soft, lint-free toweling.

3. After cleaning the stage glass, gently set it back into the recessed opening in the stage, in accordance with the orientation markings on the edge of the glass.

4. Tighten the stage glass set screws to secure the glass in place.

6.5 Cleaning & Lubricating the XY Stage Guide Rails

Note: It is important to clean the X-axis and Y-axis rails periodically to remove contaminants and grease buildup. It is also important to apply the proper amount of lubricant; **do not over-lubricate**.

Lubricating the stage rails consists of two tasks:

- Cleaning the rails
- Applying the lubricant in the prescribed manner

Materials Required

NYE Synthetic Oil 176H
NSK #2 lubricant
Soft, lint-free cloth

6.5.1 Cleaning & Lubricating the X-Axis Guide Rails

1. With the system powered up, use the joystick to drive the stage to either the left or right limit of travel, so the ends of the outboard X-axis rails are exposed (see Figure 6-2).

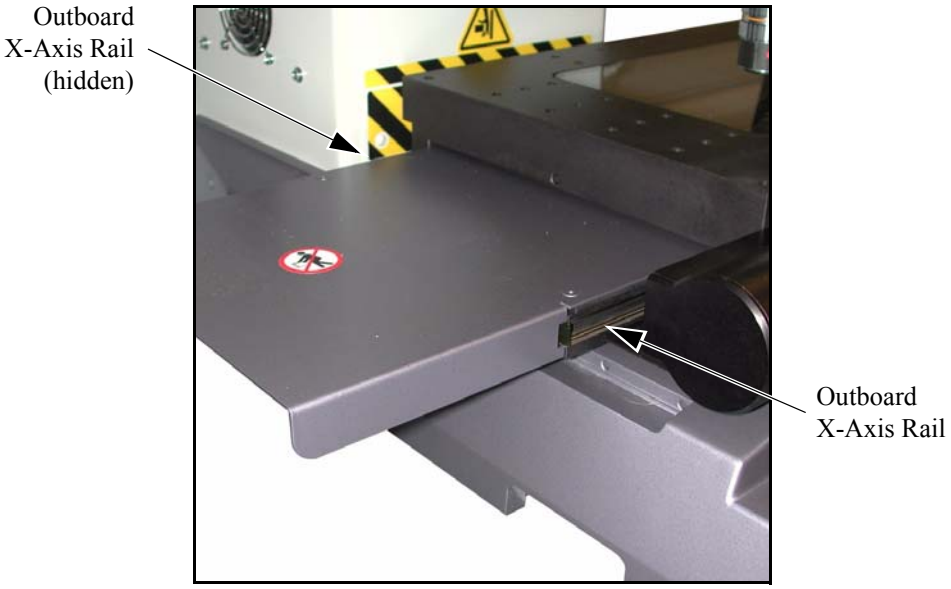


Figure 6-2 Accessing the Outboard X-Axis Rails

2. Press the remote E-Stop switch to cut power to the motors.

3. Wipe out the exposed X-axis rails with a clean, soft, lint-free cloth.

Caution: Only apply NYE Synthetic Oil 176H to the X-axis rails. Applying anything else could permanently damage the ball slides.

Caution: Apply NYE Synthetic Oil 176H sparingly to the rails. If too much oil is applied, it will trap dust and may permanently damage the ball slides.

4. Apply a small amount of NYE Synthetic Oil 176H to each outboard rail.

5. Locate the inboard rails on the opposite side of the stage (see Figure 6-3).

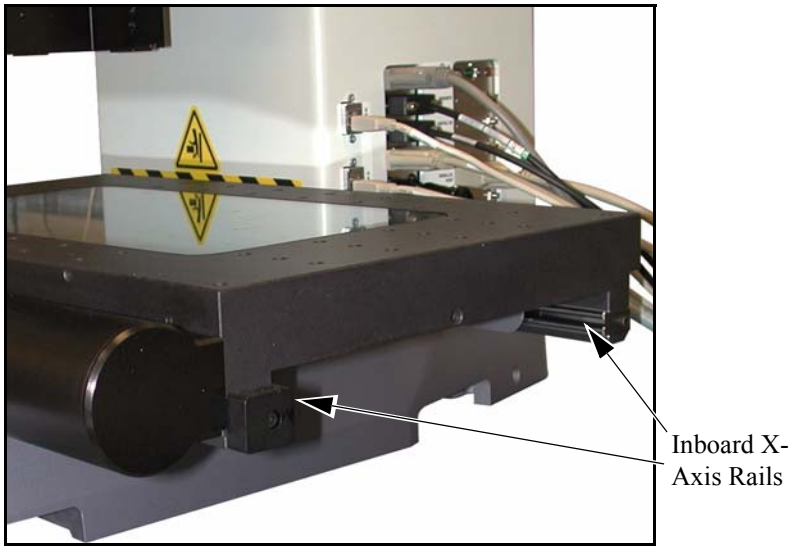


Figure 6-3 Accessing the Inboard X-Axis Rails

6. Repeat Step 3 and Step 4 to clean and lubricate the inboard X-axis rails. Be sure to comply with the caution notes listed before Step 4.

7. Reset the remote E-Stop switch by turning the knob in the direction of the arrows.

8. Clear the software message.

9. Press the **Stop/Start** button on the joystick.

10. Use the joystick to drive the stage along the full length of the X-axis several times to distribute the oil evenly along the rails and ball slides.

6.5.2 Cleaning & Lubricating the Y-Axis Guide Rails

1. With the system powered up, use the joystick to drive the stage to the front limit of travel, so the ends of the outboard Y-axis rails are exposed (see Figure 6-4).

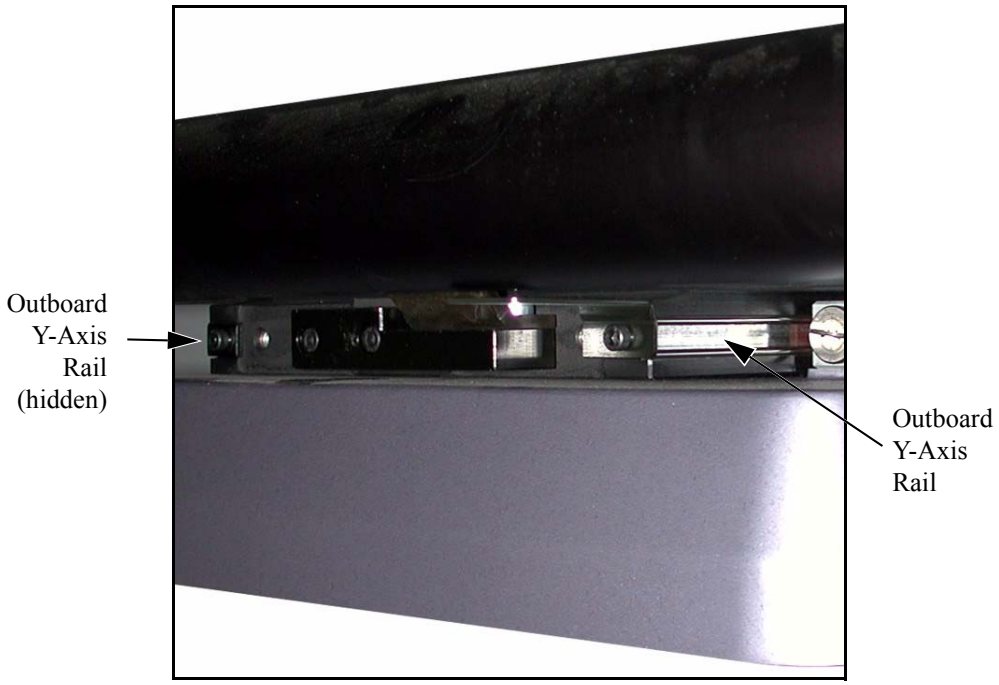


Figure 6-4 Accessing the Outboard Y-Axis Rails

2. Press the remote E-Stop switch to cut power to the motors.
3. Wipe out the exposed Y-axis rails with a clean, soft, lint-free cloth.

Caution: Only apply NYE Synthetic Oil 176H to the Y-axis rails. Applying anything else could permanently damage the ball slides.

Caution: Apply NYE Synthetic Oil 176H sparingly to the rails. If too much oil is applied, it will trap dust and may permanently damage the ball slides.

4. Apply a small amount of NYE Synthetic Oil 176H to each outboard rail.
5. Reset the remote E-Stop switch by turning the knob in the direction of the arrows.
6. Clear the software message.
7. Press the **Stop/Start** button on the joystick.

8. Use the joystick to drive the stage to rear limit of travel, so the inboard Y-axis rails are exposed.

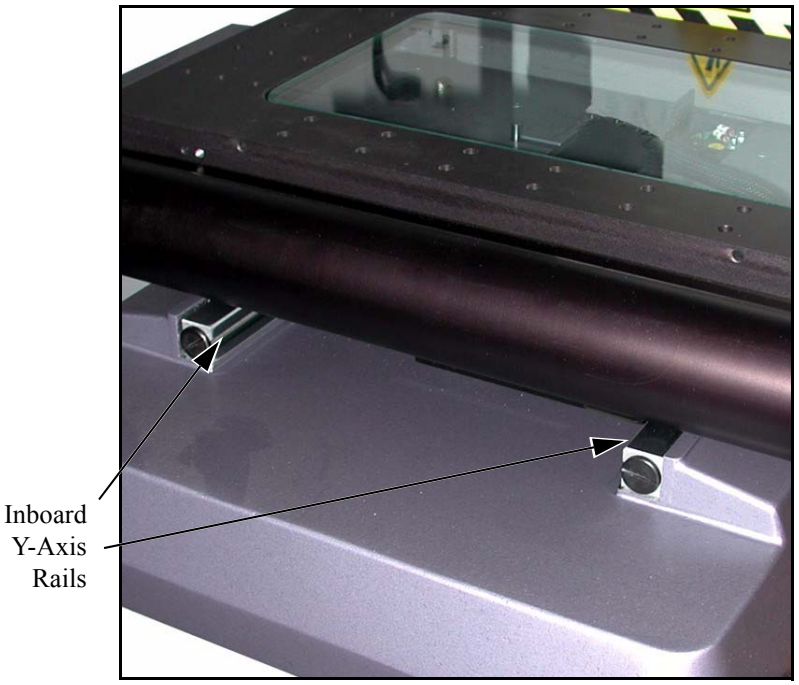


Figure 6-5 Accessing the Inboard Y-Axis Rails

9. Press the remote E-Stop switch to cut power to the motors.

10. Repeat Step 3 and Step 4 to clean and lubricate the inboard Y-axis rails. Be sure to comply with the caution notes listed before Step 4.

11. Reset the remote E-Stop switch by turning the knob in the direction of the arrows.

12. Clear the software message.

13. Press the **Stop/Start** button on the joystick.

14. Use the joystick to drive the stage along the full length of the Y-axis several times to distribute the oil evenly along the rails and ball slides.

6.6 Lubricating the X-Axis Drive Rod

Materials Required
NSK grease
Set of Metric Allen wrenches

1. Press the remote E-Stop switch to cut power to the motors.
2. Use a 5 mm Allen wrench to remove the two X-axis drive rod cover screws.

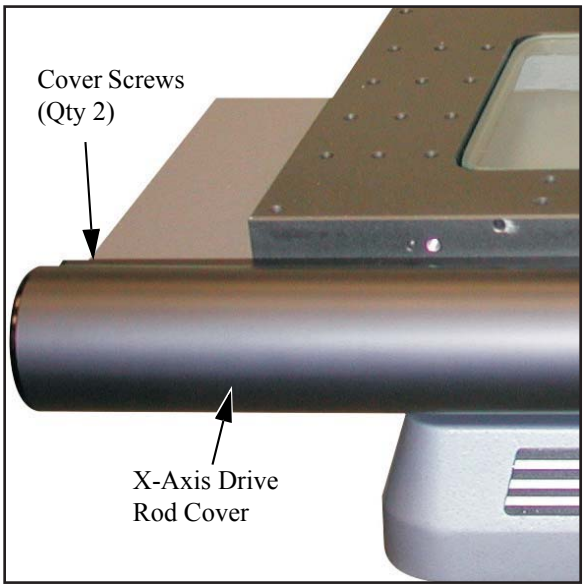


Figure 6-6 Removing the X-Axis Drive Rod Cover

3. Remove the cover by sliding it to the left.

Caution: Only apply NSK grease to the X-axis drive rod. Applying anything else could permanently damage the X-axis transport.

Caution: Apply a thin coat of NSK grease to the X-axis drive rod. Applying too much grease could damage the X-axis transport.

4. Apply a very small amount (approximately 0.5 mm) of NSK grease evenly to the X-axis drive rod.

Figure 6-7 Visual Reference of Grease Applied to the X-Axis Drive Rod

5. Re-install the X-axis drive rod cover by sliding it over the X-axis drive rod and re-installing the two cover screws.

6. Reset the remote E-Stop switch by turning the knob in the direction of the arrows.

7. Clear the software message.

8. Press the **Stop/Start** button on the joystick.

9. Use the joystick to drive the stage from side to side along the full length of the X-axis several times to spread the grease evenly along the X-axis drive rod.

6.7 Lubricating the Z-Axis Ball Screw

Materials Required

NSK #2 grease

Warning: NEVER ATTEMPT TO MANUALLY ROTATE THE Z-AXIS BALL SCREW WITH POWER APPLIED TO THE MACHINE. Doing so could result in personal injury.

Note: This procedure assumes that there are no parts, fixtures, or other obstructions on the stage.

1. With the system powered up, use the joystick to lower the Z-axis assembly to the lower limit of travel.
2. Turn off the system and disconnect the power cord from the power source.
3. Remove the front cover by lifting it straight up. This reveals the Z-axis ball screw (see Figure 6-8).

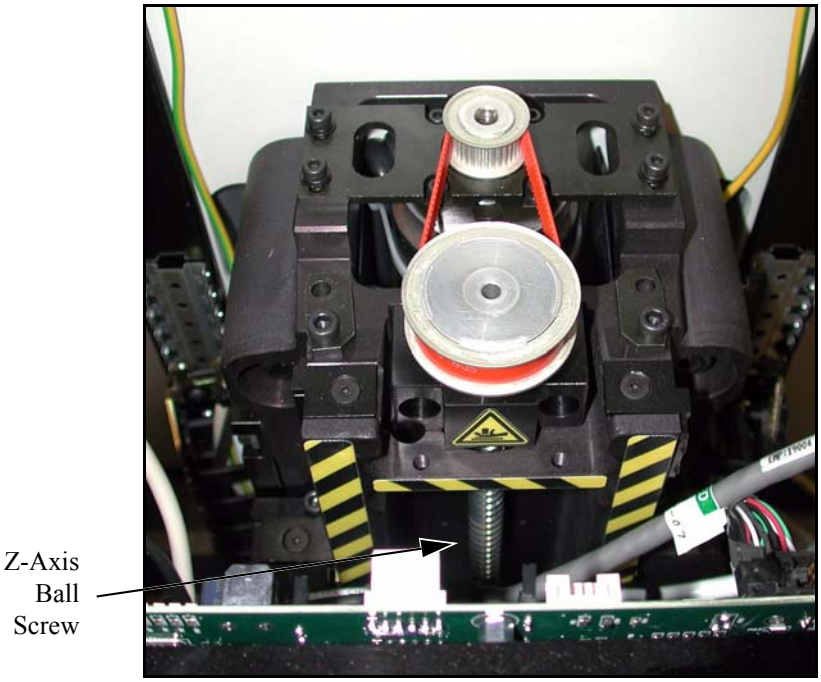


Figure 6-8 Lubricating the Z-Axis Ball Screw

Caution: Do not apply anything heavier than NSK #2 grease to the Z-axis ball screw. Also, apply the NSK #2 grease sparingly to the Z-axis ball screw. If too much grease is used, or if the viscosity of the grease is too heavy, the Z-axis transport may be permanently damaged.

4. Apply a small amount of NSK #2 grease to the Z-axis ball screw.

5. Re-install the front cover.

6. Power up the system and launch the metrology software.

7. Use the joystick to raise and lower the Z-axis assembly along the full length of Z travel to distribute the grease evenly along the Z-axis transport mechanism.

6.8 Cleaning the Magnification Lens

Materials Required
Non-solvent lens cleaner
Clean, soft, lint-free cloth

1. If the system is equipped with the Programmable Ring Light (PRL), move the assembly to the **0** setting (from within the metrology software). This provides access to the magnification lens.

2. Unscrew (CCW) the magnification lens from the lens tube (see Figure 6-9).

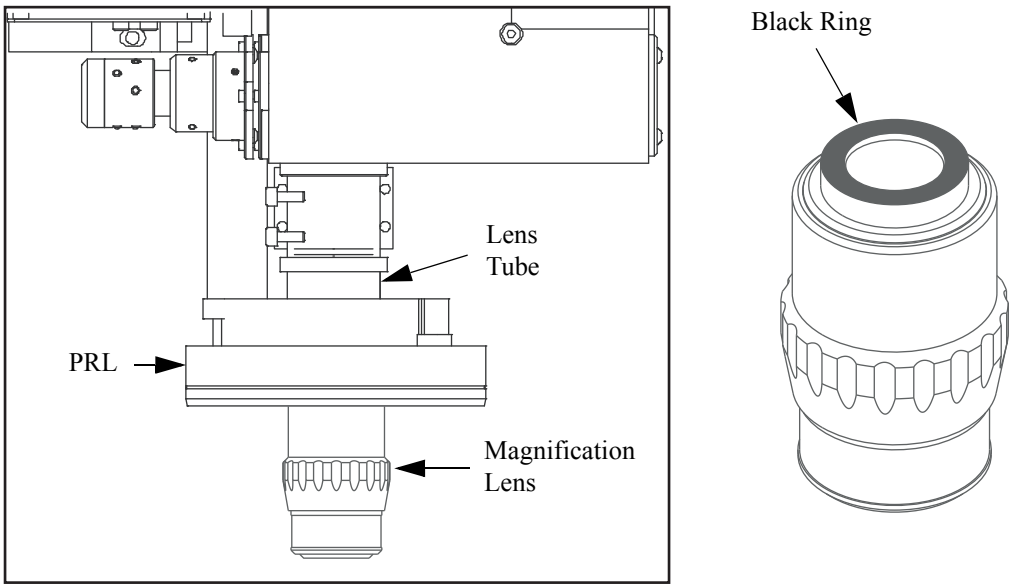


Figure 6-9 Removing the Magnification Lens

3. Check the threaded end of the magnification lens and verify that the black ring is intact. There should be no shiny surfaces between the outer diameter of the glass lens and the outer diameter of the threads showing when looking into the threaded end of the lens. Replace the black ring if necessary.

4. Use a cotton swab to lightly moisten the lens glass at one end of the magnification lens with non-solvent lens cleaner. Make sure the lens cleaner does not enter the magnification lens.

5. Using a clean, soft, lint-free cloth, wipe the lens glass to remove any residual dirt, starting from the center of the lens and working toward the edges. Repeat as necessary until the lens is clean.

6. Repeat Step 4 and Step 5 to clean the lens glass at the other end of the magnification lens.

7. Carefully re-install the magnification lens by screwing (CW) it into the threaded opening in the lens tube.

8. Repeat the above procedure to check and clean all other magnification lenses.

6.9 Cleaning the Optional LED Programmable Ring Light (PRL)

Materials Required

Non-solvent lens cleaner
Clean, soft, lint-free cloth

1. Move the Programmable Ring Light (PRL) assembly to the **0** setting (from within the metrology software). This provides access to the magnification lens.
2. Unscrew (CCW) the magnification lens from the lens tube (see Figure 6-9 on page 57).
3. Use a clean, soft, lint-free cloth moistened with lens cleaner to clean the outer mirror (see Figure 6-10).

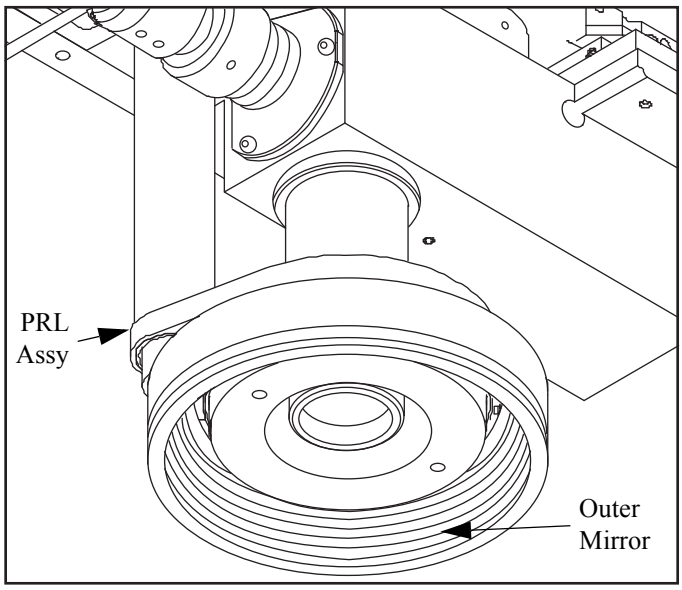


Figure 6-10 Cleaning the Programmable Ring Light

4. Gently wipe the surface dry.
5. Being careful not to touch cleaned surfaces of the PRL, screw (CW) the magnification lens into the threaded opening in the lens tube.

6.10 Checking for Dirt in the Images of Both Cameras

1. Move the Ronchi Shuttle to the center position (between grids).
2. Install a 1X lens, and focus on a mirror (dirt or scratches).
3. Set the light level for a reasonably light image, and look for “dark blobs” caused by dust in the optical system. Use the following rules to locate the dust:
   - If the dust moves when you move the stage in X and Y, the dust is on the mirror.
   - If the dust does not go out of focus when you move in Z, they are on the camera sensor. You must remove the cameras in a dust-free environment, clean them, and perform the dual magnification optical system adjustments; see ***Dual Magnification Optical System Adjustments*** on page 117.
   - By moving in Z below the focus position, you will be able to focus on dirt on the coaxial illuminator (above the shuttle). Clean the illuminator, if necessary.
   - By moving in Z above the focus position, you will be able to focus on dirt on the coaxial illumination projector lens. If it is on the upper surface, blow clean air inside the tube to get rid of it.

6.11 Checking the System for Proper Function

Run an inspection program on the system to ensure that it is functioning properly. If it is not, proceed to troubleshooting.

Troubleshooting

Chapter 7

7.1 What This Chapter Contains

This chapter helps you identify the cause of system problems. Use this chapter only to **diagnose** problems. Refer to Chapters 8 and 9 to make required adjustments and to replace parts.

This chapter covers:

- DSP Multi Axis PCBA Diagnostic LEDs & Test Points
- Dual Mag Optics PCBA Diagnostic LEDs & Test Points
- Z Brake Control PCBA Diagnostic LEDs & Test Points
- LED Driver PCBA Diagnostic LEDs & Test Points
- Measuring the Resistance of the Drewire Terminations
- Power Supply Diagnostic LEDs
- Identifying Problems With the Benchmark 250 System
- Identifying Problems with the PC & User-Interface Components
- Troubleshooting the Power Supply
- Recovering from Unexpected Z-Axis Contact

7.2 Before You Begin

Warning: Unless instructed otherwise, always turn off equipment and disconnect it from the main power supply while troubleshooting (see ***System Lockout*** on page 14).

Warning: The risk of electrical shock is present anytime the covers are removed from the machine. To avoid exposure to high voltage, never remove the covers from the flat-panel display or system power supply.

Caution: Protect the Benchmark 250 system from electrostatic damage. Perform these procedures at a static-safe workstation and wear a ground strap. If a ground strap is not available, follow these guidelines:

- Work in an uncarpeted area.
- Before touching electronic components, discharge static electricity by touching a known-grounded object.
- Do not touch components on printed circuit boards, except as directed.

Before you begin troubleshooting, note that:

- If you find a problem you cannot address on your own, contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
- The phrase “not connected” and the term “disconnected” can signify that the connector is not fully seated. A wire can be broken inside its insulator due to crimping, pinching, or over-flexing.
- **This manual does not provide information on the repair of faulty PCBAs, and we strongly suggest that you do not attempt to repair them.** Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4) for replacement boards.

7.3 DSP Multi Axis PCBA Diagnostic LEDs & Test Points

The DSP Multi Axis PCBA has several diagnostic LEDs and test points that are useful in diagnosing system problems.

7.3.1 DSP Multi Axis PCBA Diagnostic LEDs

The illustration below and the table on the next page provide an overview of the diagnostic LEDs on the DSP Multi Axis PCBA.

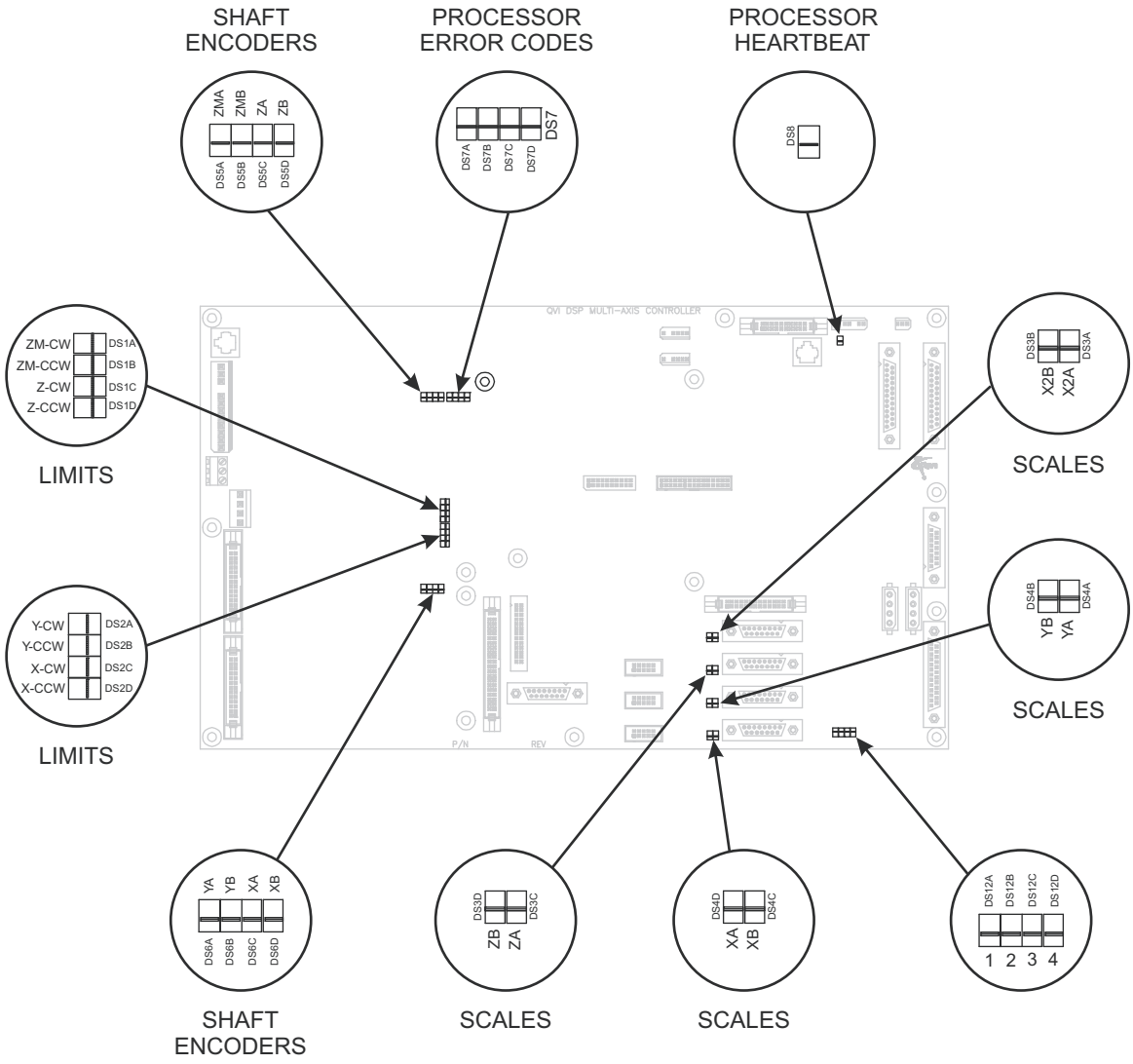


Figure 7-1 Location of Diagnostic LEDs on the DSP Multi Axis PCBA

LED(s)	What It Monitors	Description
DS1 and DS2	X-, Y-, and Z-Axis Limits	• **LED lit:** indicates limit not encountered • **LED not lit:** indicates limit encountered
DS3 and DS4	X-, Y-, and Z-Axis Scales (A and B channel input states)	Indicates whether or not the scales are operating properly: • LEDs should indicate quadrature (see ***Quadrature*** on page 65)
DS5	Z-Axis Shaft Encoders (A and B channel input states)	Indicates whether or not the Z-axis shaft encoders are operating properly: • LEDs should indicate quadrature (see ***Quadrature*** on page 65)
DS7	E-Stop Codes	See ***Diagnostic LED DS7 E-Stop Codes*** on page 66.
DS8	Processor Heartbeat	Indicates whether or not the software is running and the CPU is processing data: • **LED lit (solid):** indicates power on, but no mini-booter loaded • **LED lit (fast blink):** indicates mini-booter loaded • **LED lit (slow blink):** `DSP.OUT` loaded and running

7.3.1.1 Quadrature

The diagnostic LEDs that normally indicate quadrature signals include:

- **DS3** for the Z-axis and extra scales (A and B channels)
- **DS4** for the X- and Y-axis scales (A and B channels for each axis)
- **DS5C** and **DS5D** for the Z-axis shaft encoders (A and B channels)

In general, quadrature signal is displayed on these LEDs in the following ways:

- An appropriate A/B channel pair (like X2A and X2B on DS3) exhibits a constantly changing On/Off pattern as the stage or Z-axis is moved in one direction or the other, as indicated below.

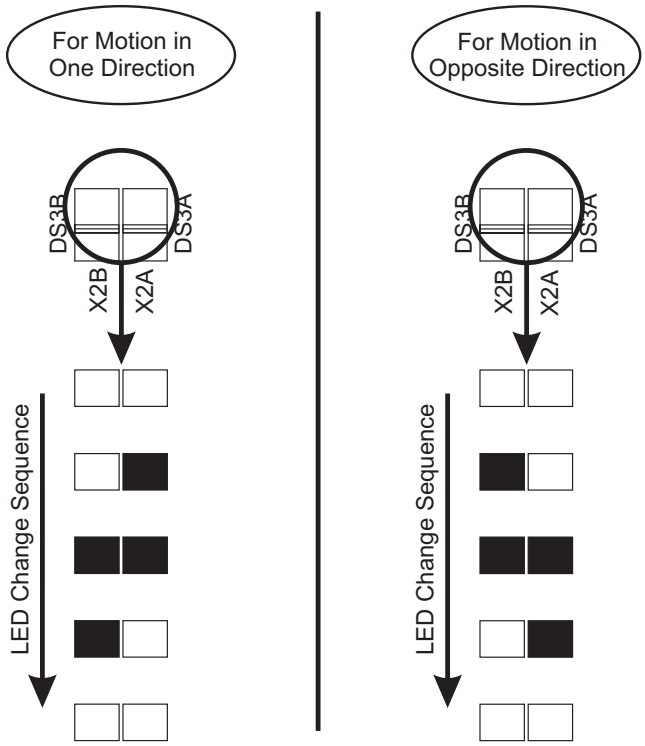


Figure 7-2 An Example of Quadrature Signal

- Depending on the direction of motion, the A/B channel LEDs will appear to "roll" in one direction or the other.

- If the A/B channel LEDs **do not track** with axis motion as described above (for example, if one or both remain fixed On/Off, or if both come on or go off suddenly when the stage is moved) this indicates a problem.

- Remember that the LEDs change with **each least count of motion** at the scale or shaft.

7.3.1.2 Diagnostic LED DS7 E-Stop Codes

Diagnostic LED DS7 can be useful in diagnosing system anomalies and serves two purposes:

- If the system enters E-Stop, DS7 indicates the source of E-Stop.
- DS7 indicates when specific scale limits have been encountered.

Note: Be prepared to provide the status of LEDs DS7 and DS8 (heartbeat) whenever contacting the Customer Support HelpDesk.

In its normal “monitoring” state, the four LEDs within DS7 roll rapidly back and forth. If the machine has entered E-Stop for any reason, the individual LEDs will flash in a specific pattern, as indicated on the next page.

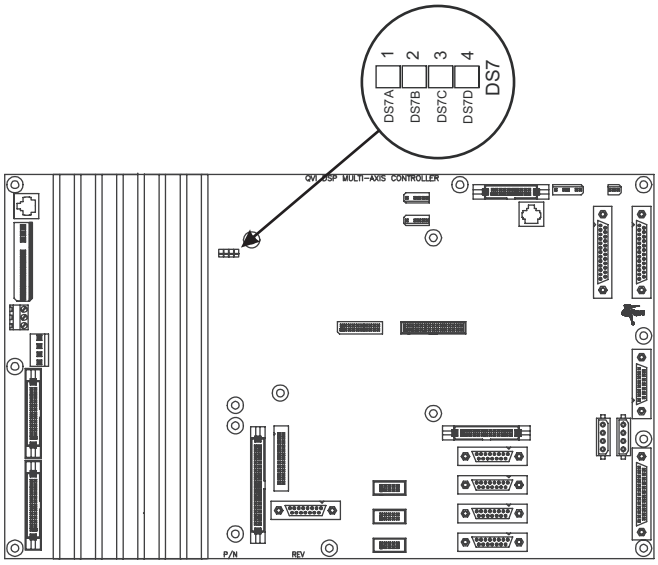
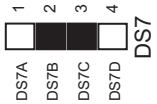
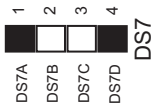
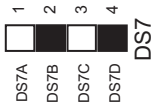


Figure 7-3 Approximate Location of Diagnostic LED DS7

Flashing LED Pattern	Source of E-Stop
	Initial power-up
	Excess position error, X-axis
	Excess position error, Y-axis
	Excess position error, Z-axis
	Loss of motor power (connector J13)
	Start/Stop button on the joystick has been pressed
	Loss of continuity between pins 1 and 2 on P401 or XY amp fault

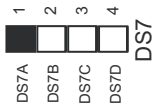
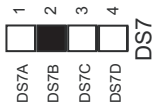
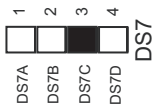
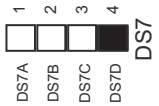
■ Indicates LED is lit

□ Indicates LED is off

7.3.2 Magnetic Limit Codes (DS7)

Again, in its normal “monitoring” state, the four LEDs within DS7 roll rapidly back and forth. If an integral magnetic scale limit is encountered, the system will not usually enter E-Stop. However, magnetic limits will cause individual LEDs to light up in a specific pattern, as indicated below.

Note: If multiple magnetic scales are encountered, more than one LED will light up concurrently.

Steady LED Pattern	Error
	Encountered magnetic limit, X-axis
	Encountered magnetic limit, Y-axis
	Encountered magnetic limit, Z-axis
	Encountered magnetic limit, extra scale

■ Indicates LED is lit

□ Indicates LED is off

7.3.3 DSP Multi Axis PCBA Test Points

The illustration below and the table on the next page provide an overview and approximate location of the test points on the DSP Multi Axis PCBA.

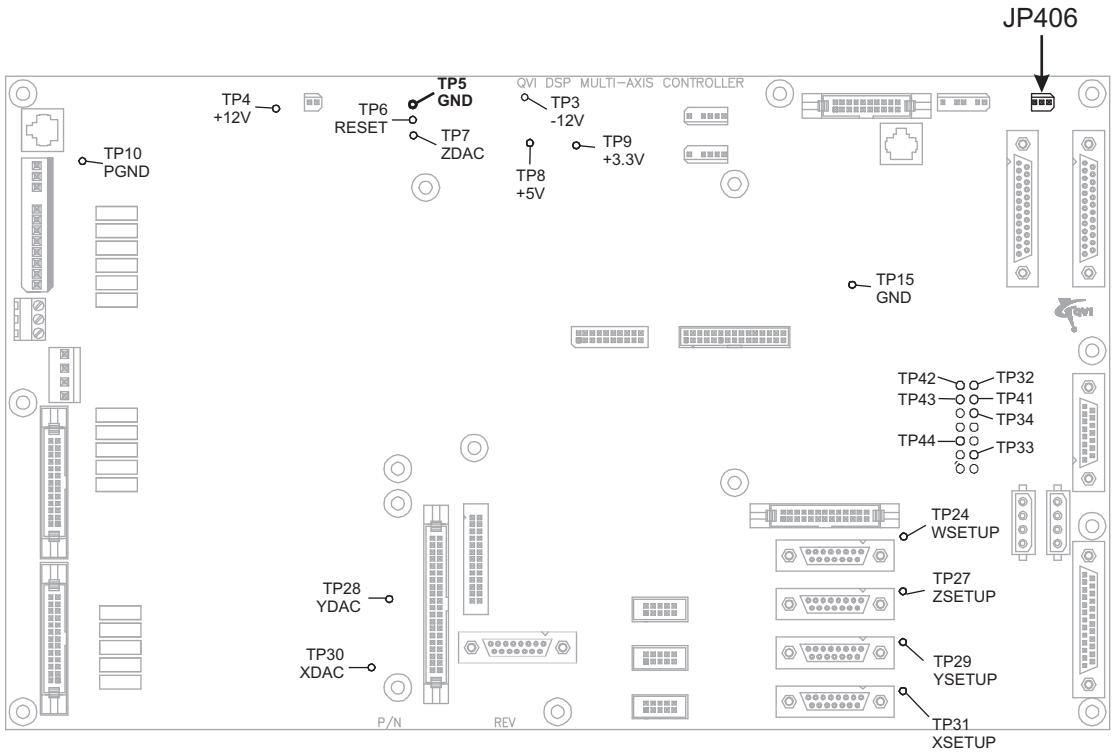


Figure 7-4 Location of Test Points on the DSP Multi Axis PCBA

Test Point(s)	What Does It Test?	Function
TP3	-12VDC	Test voltage
TP4	12VDC	Test voltage
TP5	—	Ground
TP10	—	Z-axis motor power ground
TP6	—	Reset
TP7	Z-Axis Digital/Analog Converter	Test Z-axis DAC
TP8	5VDC	Test voltage
TP9	3.3VDC	Test voltage
TP15	—	Ground
TP24	Extra Scale	Test extra scale setup
TP27	Z-Axis Scale	Test Z-axis scale setup
TP28	Y-Axis Digital/Analog Converter	Test Y-axis DAC
TP29	Y-Axis Scale	Test Y-axis scale setup
TP30	X-Axis Digital/Analog Converter	Test X-axis DAC
TP31	X-Axis Scale	Test X-axis scale setup
TP32	X Potentiometer Input to DSP	Useful in troubleshooting system anomalies. For more information, contact the Customer Support HelpDesk
TP33	Z Potentiometer Input to DSP	
TP34	Y Potentiometer Input to DSP	
TP41	—	
TP42	X Potentiometer Input to A/D Converter	
TP43	Y Potentiometer Input to A/D Converter	
TP44	Z Potentiometer Input to A/D Converter	

7.4 Dual Mag Optics PCBA Diagnostic LEDs & Test Points

The Dual Mag Optics PCBA has several diagnostic LEDs and test points that are useful in diagnosing system problems.

7.4.1 Dual Mag Optics PCBA Diagnostic LEDs

The illustration below and the table on the next page provide an overview of the diagnostic LEDs on the Dual Mag Optics PCBA.

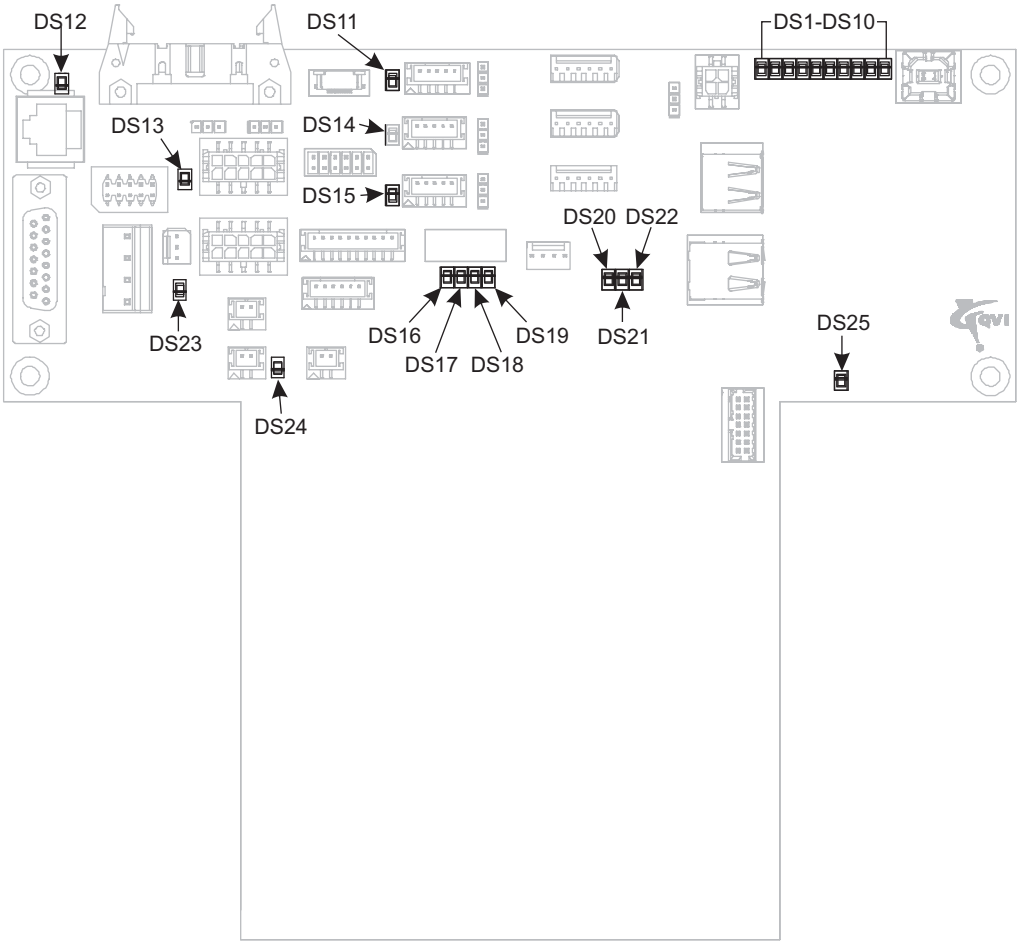


Figure 7-5 Location of Diagnostic LEDs on the Dual Mag Optics PCBA

LED(s)	What It Monitors	Description
DS1 & DS2	USB micro processor	• **DS1 lit** (green)**:** indicates the USB micro processor is functioning properly • **DS2 lit** (amber)**:** indicates the USB micro processor is not functioning properly and there is a problem with the board
DS3 & DS4	USB device connected to P5	• **DS3 lit** (green)**:** indicates the USB device connected to P5 is functioning properly • **DS4 lit** (amber)**:** indicates the USB device connected to P5 is not functioning properly
DS5 & DS6	USB device connected to P6B	• **DS5 lit** (green)**:** indicates the USB device connected to P6B is functioning properly • **DS6 lit** (amber)**:** indicates the USB device connected to P6B is not functioning properly
DS7 & DS8	USB device connected to P6A	• **DS7 lit** (green)**:** indicates the USB device connected to P6A is functioning properly • **DS8 lit** (amber)**:** indicates the USB device connected to P6A is not functioning properly
DS9	USB micro processor heartbeat	LED should blink at approximately 1 flash/second
DS10	USB micro processor	If LED is lit, there is a problem with the USB micro processor
DS11	—	Reserved for future use
DS12	5VDC	• **LED lit:** indicates 5VDC is present • **LED not lit:** indicates 5VDC is not present
DS13	12VDC	• **LED lit:** indicates 12VDC is present • **LED not lit:** indicates 12VDC is not present
DS14	—	Reserved for future use

LED(s)	What It Monitors	Description
DS15	—	Reserved for future use
DS16	—	Reserved for future use
DS17	—	Reserved for future use
DS18	—	Reserved for future use
DS19	—	Reserved for future use
DS20	Reserved for Engineering use	—
DS21	Reserved for Engineering use	—
DS22	Reserved for Engineering use	—
DS23	—	Reserved for future use
DS24	Surface Illuminator/ Grid Projector LED intensity	The intensity of the LED tracks the illumination changes made in the software
DS25	Heartbeat	LED should blink at approximately 1 flash/second

7.4.2 Dual Mag Optics PCBA Test Points

The illustration below and the table on the next page provide an overview of the test points on the Dual Mag Optics PCBA.

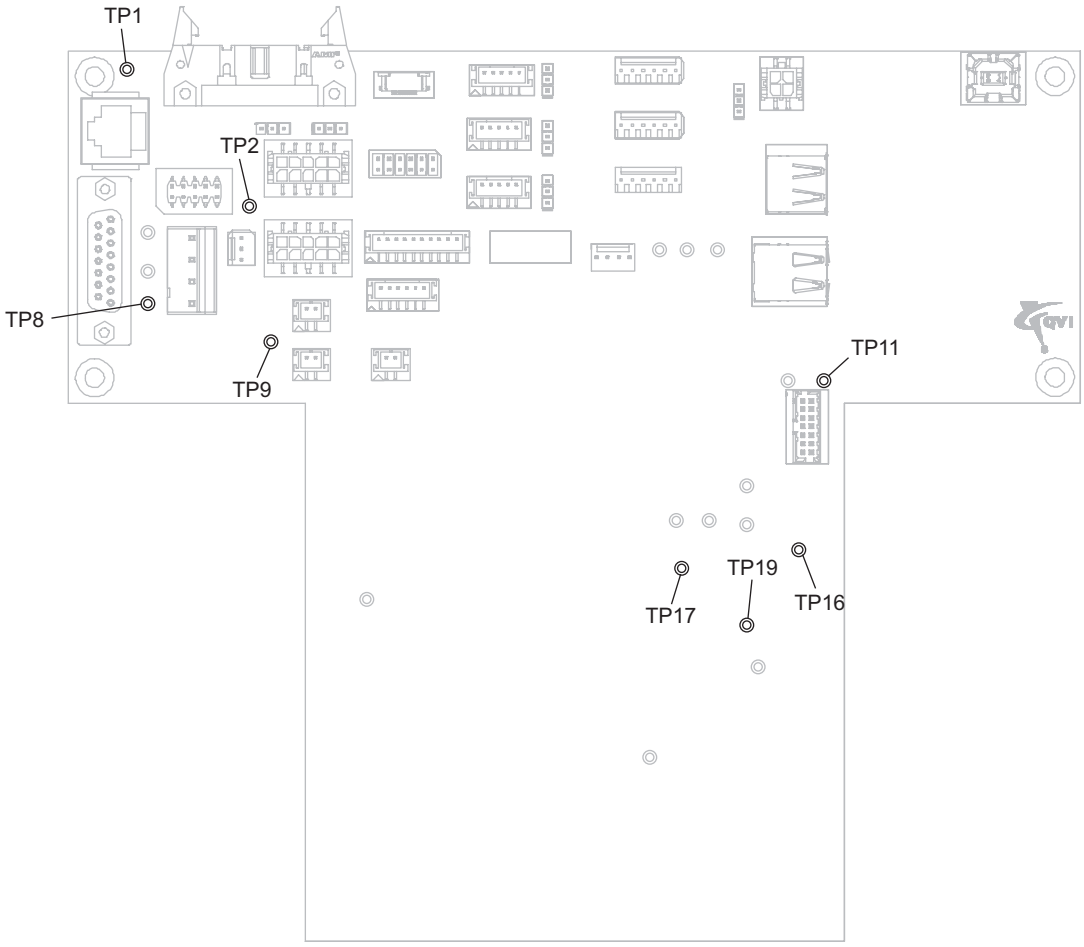


Figure 7-6 Location of Test Points on the Dual Mag Optics PCBA

Test Point(s)	What Does It Test?	Function
TP1	5VDC (±5%)	Test voltage
TP2	12VDC (±10%)	Test voltage
TP8	15VDC (±10%)	Test voltage
TP9	-15VDC (±5%)	Test voltage
TP11	3.3VDC (±5%)	Test voltage
TP16	—	Ground
TP17	24VDC (±10%)	Test voltage
TP19	2.5VDC (±5%)	Test voltage

7.5 Z Brake Control PCBA Diagnostic LEDs & Test Points

The Z Brake Control PCBA has several diagnostic LEDs and test points that are useful in diagnosing system problems.

7.5.1 Z Brake Control PCBA Diagnostic LEDs

The illustration below and the table on the next page provide an overview of the diagnostic LEDs on the Z Brake Control PCBA.

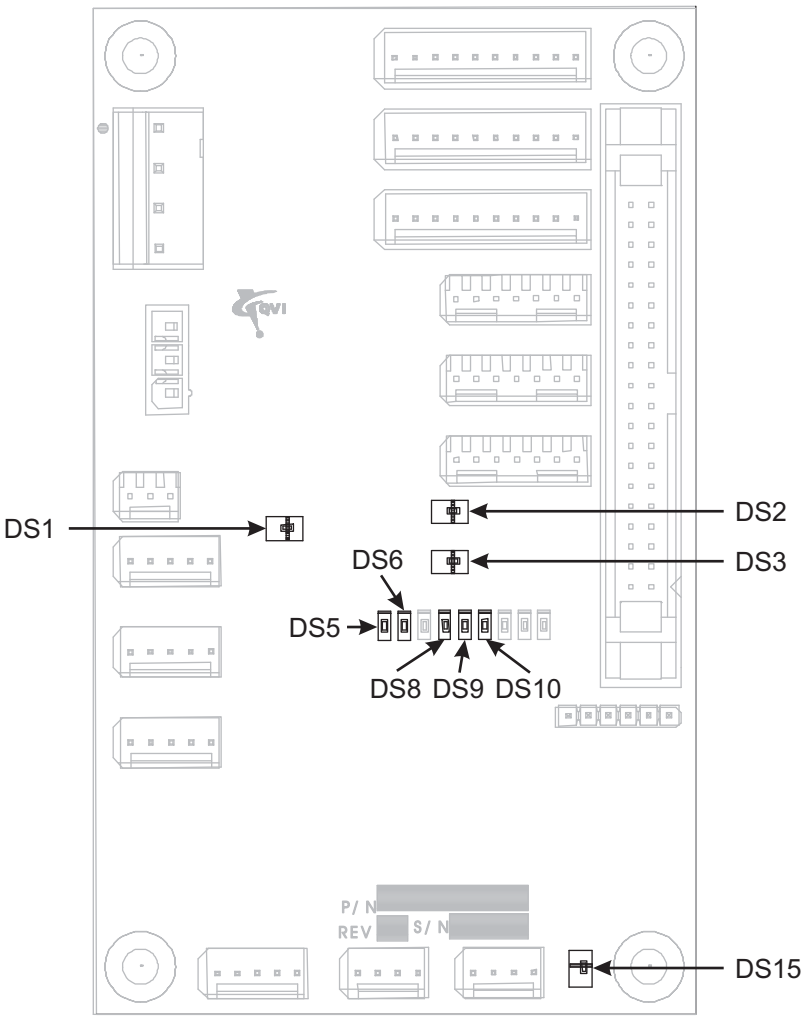


Figure 7-7 Location of Diagnostic LEDs on the Z Brake Control PCBA

Caution: The jumpers on the Z Brake Control PCBA (not shown in Figure 7-7) have been set at the factory for your particular system. Do not adjust these jumper settings without consulting the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).

LED(s)	What It Monitors	Description
DS1	24VDC	• **LED lit:** indicates 24VDC is present • **LED not lit:** indicates 24VDC is not present
DS2	5VDC	• **LED lit:** indicates 5VDC is present • **LED not lit:** indicates 5VDC is not present
DS3	3.3VDC	• **LED lit:** indicates 3.3VDC is present • **LED not lit:** indicates 3.3VDC is not present
DS5	Stop signal from Z Brake Control PCBA to DSP Multi Axis PCBA	• **LED lit:** indicates stop signal has been sent from the Z Brake Control PCBA to the DSP Multi Axis PCBA • **LED not lit:** indicates stop signal has not been sent from the Z Brake Control PCBA to the DSP Multi Axis PCBA
DS6	Stop signal from DSP PCBA	• **LED lit:** DSP Multi Axis PCBA is in Stop Mode • **LED not lit:** DSP Multi Axis PCBA is not in Stop Mode
DS8	AC Power	• **LED lit:** indicates AC sense circuit does not detect AC power • **LED not lit:** indicates AC sense circuit detects AC power
DS9	Brake Power	• **LED lit:** indicates the power supply connected to J113 on the Z Brake Control PCBA has dropped more than 5VDC below its expected value • **LED not lit:** indicates the power supply connected to J113 on the Z Brake Control PCBA has not dropped more than 5VDC below its expected value
DS10	Safety Relay	• **LED lit:** indicates E-Stop switch has been pressed • **LED not lit:** indicates E-Stop switch has not been pressed

LED(s)	What It Monitors	Description
DS15	Heartbeat	• **LED blinking:** indicates CPLD is functioning properly • **LED lit (not blinking):** indicates CPLD is defective • **LED not lit:** indicates less than 4.6VDC is present (in this case, DS5 and DS6 will be lit)

7.5.2 Z Brake Control PCBA Test Points

The illustration below and the table on the next page provide an overview of the test points on the Z Brake Control PCBA.

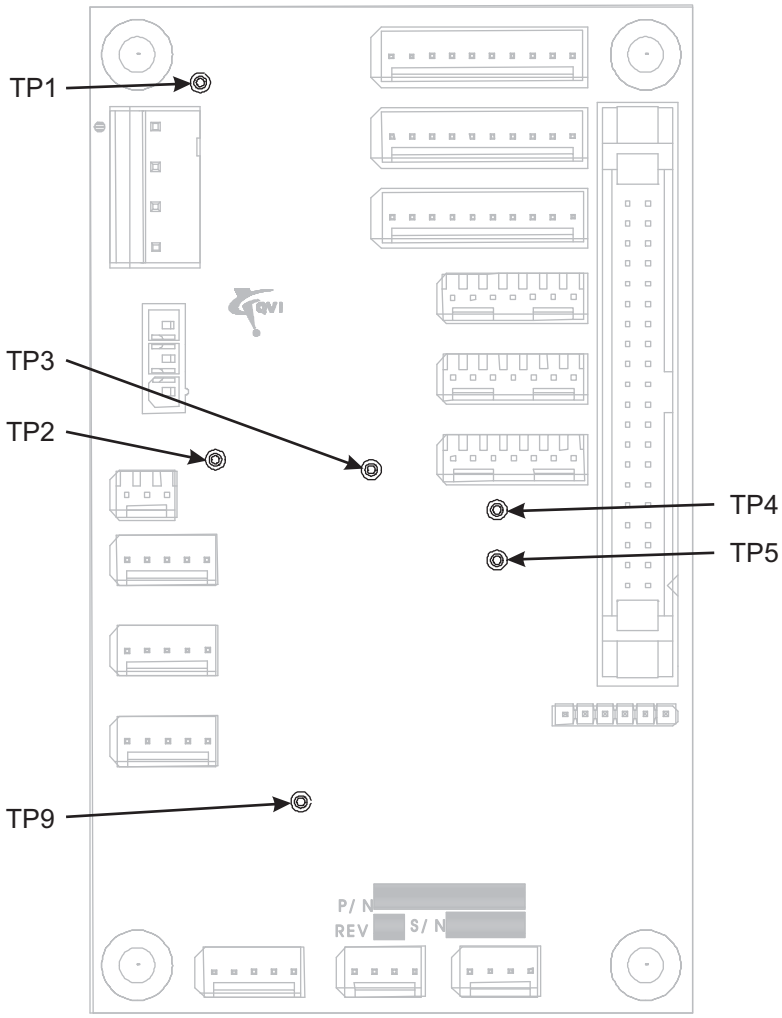


Figure 7-8 Test Points on the Z Brake Control PCBA

Test Point(s)	What Does It Test?	Function
TP1	Brake Power (48VDC)	Test voltage
TP2	24VDC (switched)	Test voltage
TP3	—	Ground
TP4	5VDC	Test voltage
TP5	3.3VDC	Test voltage
TP9	—	Ground

7.6 LED Driver PCBA Diagnostic LEDs & Test Points

The LED Driver PCBA has several diagnostic LEDs and test points that are useful in diagnosing system problems.

7.6.1 LED Driver PCBA Diagnostic LEDs

The illustration below and the table on the next page provide an overview of the diagnostic LEDs on the LED Driver PCBA.

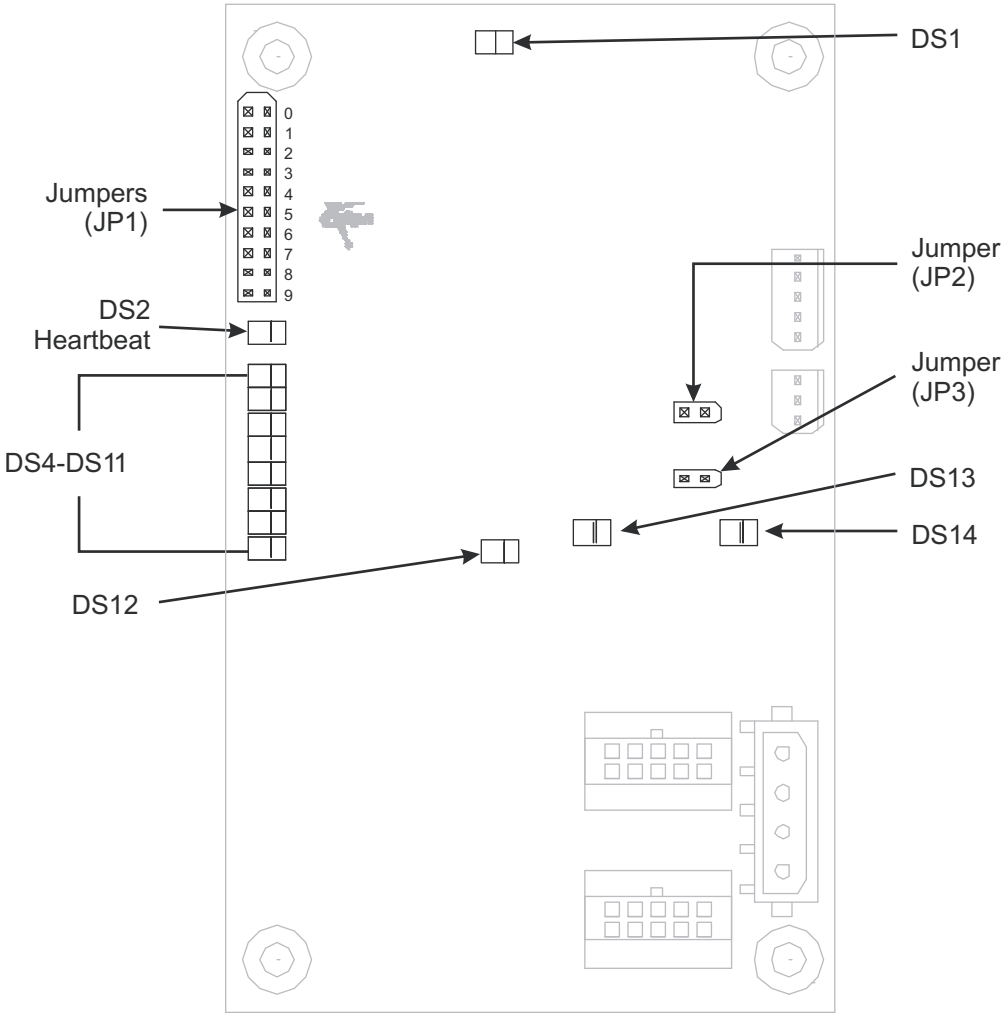


Figure 7-9 Location of Diagnostic LEDs on the LED Driver PCBA

Caution: The jumpers on the LED Driver PCBA have been set at the factory for your particular system. Do not adjust these jumper settings without consulting the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).

LED(s)	What It Monitors	Description
DS1	Substage LED Intensity	The intensity of the LED tracks the illumination changes made in the software
DS2	Heartbeat	LED should blink at approximately 1 flash/second
DS1, DS4-DS11	Diagnostic LED Functions	Used to troubleshoot system anomalies; contact the Customer Support HelpDesk; see ***Where to Get Help*** on page 4 for more information.
DS12	3.3VDC	• **LED lit:** indicates 3.3VDC is present • **LED not lit:** indicates 3.3VDC is not present
DS13	5VDC	• **LED lit:** indicates 5VDC is present • **LED not lit:** indicates 5VDC is not present
DS14	12VDC	• **LED lit:** indicates 12VDC is present • **LED not lit:** indicates 12VDC is not present

7.6.2 LED Driver PCBA Test Points

The illustration below and the table on the next page provide an overview of the test points on the LED Driver PCBA.

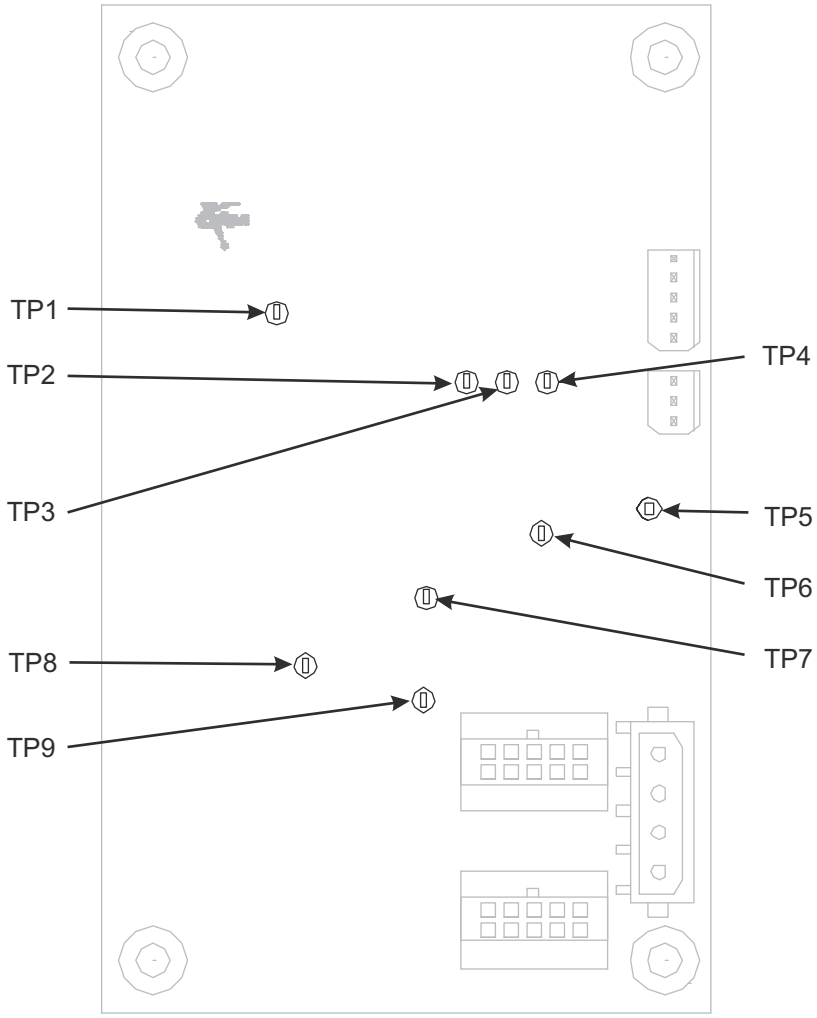


Figure 7-10 Location of Test Points on the LED Driver PCBA

Test Point(s)	What Does It Test?	Function
TP1	Reserved for engineering use	—
TP2	DWI SYNC RX	—
TP3	DWI DATA RX	—
TP4	DWI DATA TX	—
TP5	12VDC	Test voltage
TP6	5VDC	Test voltage
TP7	3.3VDC	Test voltage
TP8	—	
TP9	-15VDC	Test voltage

7.7 Measuring the Resistance of the Drewire Terminations

Caution: Whenever handling electrical or electronic components, take the necessary precautions to prevent the discharge of static electricity.

1. Turn off the system and disconnect the power cord from the power source. The machine must be off when measuring the resistance of the terminations.

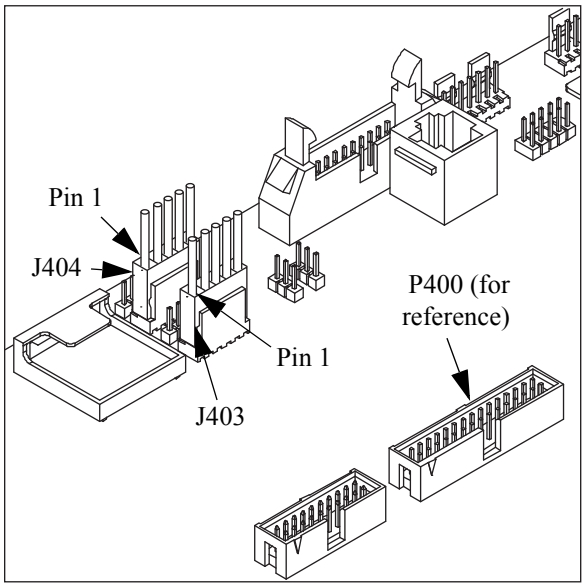
Caution: Do not let the rear door drop. Support it while gently lowering it into position.

2. Use a flat-head screwdriver to loosen the six rear door fasteners and slowly lower the door until it is perpendicular to the electronics tower and is supported by the rear door retainer.

Caution: Do not disconnect the cables that are connected to P403 and P404 on the DSP Multi Axis PCBA.

3. Use a Digital Multimeter (DMM) to measure the resistance between pins 1 and 3 on connector J403 (connects to P403) or J404 (connects to P404). Record this reading.

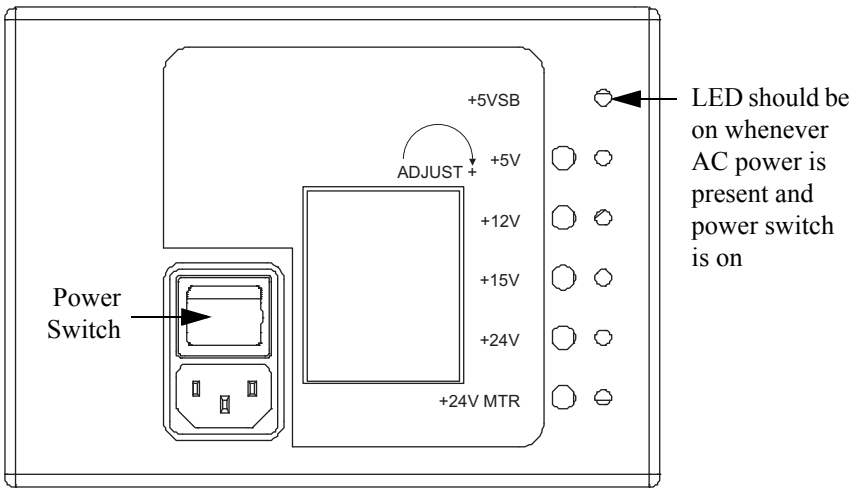
4. Repeat Step 3 to measure the resistance between pins 4 and 5 on connector J403 or J404. Again, record this reading.



5. Be prepared to provide this information when contacting the Customer Support HelpDesk.

7.8 Power Supply Diagnostic LEDs

The power supply diagnostic LEDs are visible through the lower-rear panel.



7.9 Identifying Problems With the Benchmark 250 System

This section is intended to assist in diagnosing system problems. It is only intended as a reference, and it is recommended that the steps taken to resolve the problem be performed by a factory trained individual within your facility.

Please contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4) for assistance and/or training information.

7.9.1 Start-Up Troubleshooting

Symptom	Possible Causes	Possible Solutions
System does not power up when you power up the computer.	Power switch on the power supply is in the OFF position.	Power up the power supply.
	Machine power cord is disconnected from the machine or the main power source.	Verify that the power cord is connected to the machine and the main power source.
	Computer power cord is disconnected from the computer or the main power source.	Verify that the power cord is connected to the computer and the main power source.
	No AC power present.	Determine the reason why there is no AC power and fix the problem.
	QVI I/O cable is disconnected from the machine or the computer.	Verify that the QVI I/O cable is connected to the machine and computer.
	Computer BIOS not configured to power on after a power failure.	Contact the Customer Support HelpDesk; see ***Where to Get Help*** on page 4.
All axes are functional, but there is no coaxial and/or backlight illumination.	—	Refer to the Illumination Troubleshooting section on page 88.
Illumination is OK, but there is no stage movement.	—	Refer to the Motion Troubleshooting section on page 92.

Symptom	Possible Causes	Possible Solutions
No illumination or stage movement.	The remote E-Stop switch has been pressed (+24V MTR LED on the power supply is off).	1. Reset the remote E-Stop switch by turning the knob in the direction of the arrows. 2. Clear the software message. 3. Press the **Stop/Start** button on the joystick. 4. Re-zero the stages.

7.9.2 Illumination Troubleshooting

Symptom	Possible Causes	Possible Solutions
Dim or no coaxial illumination.	Dirty magnification lens.	Clean the magnification lens; see ***Cleaning the Magnification Lens*** on page 57.
Coaxial illuminator or optional LED grid projector/surface illuminator is not operational.	System is not configured correctly.	Select **Setup | Options | System** and verify that all options are correct. If necessary, contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
	System parameter settings are incorrect (only applies to optional LED grid projector/ surface illuminator).	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
	Loose or faulty cabling to the Dual Mag Optics PCBA.	• Observe LED DS24 on the Dual Mag Optics PCBA as you adjust the light level in the software. If the intensity of the LED **does not track** the illumination changes made in the software, there may be a problem with the cabling to the board. • Verify that all cable connections (and interconnecting cables) to the Dual Mag Optics PCBA are secure. • Reconnect or replace any disconnected or damaged cables.

Symptom	Possible Causes	Possible Solutions
Coaxial illuminator or optional LED grid projector/surface illuminator is not operational (continued).	Loose or faulty cabling to the illuminator.	• Observe LED DS24 on the Dual Mag Optics PCBA as you adjust the light level in the software. If the intensity of the LED **tracks** the illumination changes made in the software, there may be a problem with the cabling to the illuminator. • Verify that all cable connections (and interconnecting cables) to the illuminator are secure. • Reconnect or replace any disconnected or damaged cables.
	Defective Dual Mag Optics PCBA.	• Check LED DS25 (heartbeat) on the Dual Mag Optics PCBA—if the system is powered up, the LED should blink at approximately 1 flash/second. • Observe LED DS24 on the Dual Mag Optics PCBA as you adjust the light level in the software. If the intensity of the LED **does not track** the illumination changes made in the software and cabling is not the problem, the Dual Mag Optics PCBA is defective. • Check voltages on the Dual Mag Optics PCBA; see ***Dual Mag Optics PCBA Test Points*** on page 74. • Replace the Dual Mag Optics PCBA if necessary; see ***Replacing the Dual Mag Optics PCBA*** on page 189.
	Defective coaxial illuminator.	Contact the Customer Support HelpDesk; see ***Where to Get Help*** on page 4.
	Improper Drewire terminations (very rare).	• Measure the resistance of the Drewire terminations; see ***Measuring the Resistance of the Drewire Terminations*** on page 85. • Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
Dim or no backlight illumination.	Dirty stage glass.	Clean the stage glass; see ***Cleaning the Stage Glass*** on page 47.

Symptom	Possible Causes	Possible Solutions
Substage illuminator is not operational.	System is not configured correctly.	Select **Setup | Options | System** and verify that all options are correct. If necessary, contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
	Loose or faulty cabling to the LED Driver PCBA.	• Observe LED DS1 on the LED Driver PCBA as you adjust the light level in the software. If the intensity of the LED **does not track** the illumination changes made in the software, there may be a problem with the cabling to the board. • Verify that all cable connections (and interconnecting cables) to the LED Driver PCBA are secure. • Reconnect or replace any disconnected or damaged cables.
	Loose or faulty cabling to the substage illuminator.	• Observe LED DS1 on the LED Driver PCBA as you adjust the light level in the software. If the intensity of the LED **tracks** the illumination changes made in the software, there may be a problem with the cabling to the substage illuminator. • Verify that all cable connections (and interconnecting cables) to the substage illuminator are secure. • Reconnect or replace any disconnected or damaged cables.

Symptom	Possible Causes	Possible Solutions
Substage illuminator is not operational (continued).	Defective LED Driver PCBA.	• Check LED DS2 (heartbeat) on the LED Driver PCBA—if the system is powered up, the LED should blink at approximately 1 flash/second. • Observe LED DS1 on the LED Driver PCBA as you adjust the light level in the software. If the intensity of the LED **does not track** the illumination changes made in the software and cabling is not the problem, there may be a problem with the LED Driver PCBA. • Check voltages on the LED Driver PCBA; see ***LED Driver PCBA Test Points*** on page 83. • Replace the LED Driver PCBA if necessary; see ***Replacing the LED Driver PCBA*** on page 187.
	Defective substage illuminator.	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
	Improper Drewire terminations (very rare).	• Measure the resistance of the Drewire terminations (see ***Measuring the Resistance of the Drewire Terminations*** on page 85). • Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
Ronchi grid is not operational.	Loose or faulty cabling between the PC and the machine.	• Verify that all cable connections are correct and secure. • Reconnect or replace any disconnected or damaged cables.

7.9.3 Motion Troubleshooting

Symptom	Possible Causes	Possible Solutions
Joystick causes wrong or multiple axes to move.	Loose joystick connection to the machine.	Verify that the joystick is properly connected to the machine.
	VMS is not the only program in the Windows Start-Up menu.	Verify VMS is the only program in the Start-Up menu.
	Loose or faulty motion related cable connections.	• Verify that all motion related cables are properly connected and secure. • Reconnect or replace any disconnected or damaged cables.
	Defective joystick.	Perform the joystick troubleshooting procedure on page 104.
Axis drifts on power-up.	Low +12VDC or -12VDC.	• Check power supply voltage. • Perform the power supply troubleshooting procedure on page 110.
	Defective joystick.	Perform the joystick troubleshooting procedure on page 104.
	DSP Multi Axis PCBA is not configured correctly.	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
All axes will not initialize.	Stop/Start button on the joystick has been pressed.	Press the **Stop/Start** button on the joystick.
	Remote E-Stop switch has been pressed.	1. Clear the software message. 2. Reset the remote E-Stop switch by turning the knob in the direction of the arrows. 3. Press the **Stop/Start** button on the joystick. 4. Re-zero the stages.
	Loose remote E-Stop connection to the machine.	Verify that the remote E-Stop switch is properly connected to the machine.
	Faulty remote E-Stop switch.	Replace the remote E-Stop switch.
	Loose or faulty cabling to the DSP Multi Axis PCBA.	• Check and secure all cable connections to the DSP Multi Axis PCBA. • Reconnect or replace any disconnected or damaged cables.

Symptom	Possible Causes	Possible Solutions
All axes will not initialize (continued).	Loose or faulty cabling between the power supply and the DSP Multi Axis PCBA.	• Verify that the power supply is properly connected to the DSP Multi Axis PCBA. • Verify that the +24V MTR LED on the back of the power supply is on. • Verify that +24V is present on the DSP Multi Axis PCBA—check between the outermost pins on connector J13 on the DSP Multi Axis PCBA. • Reconnect or replace any disconnected or damaged cables.
	Defective power supply.	• Check the power supply LEDs and voltages. • Perform the power supply troubleshooting procedure on page 110. • Replace the power supply if necessary; see ***Replacing the Power Supply*** on page 195.
	Defective DSP Multi Axis PCBA.	• Check LED DS8 (heartbeat) on the DSP Multi Axis PCBA—LED should be on (solid or blinking). • Check LED DS7 on the DSP Multi Axis PCBA for error codes; see ***Diagnostic LED DS7 E-Stop Codes*** on page 66. • Check power supply LEDs and voltages. • Replace the DSP Multi Axis PCBA if necessary; see ***Replacing the DSP Multi Axis PCBA*** on page 183.
X- or Y-axis will not initialize.	Axis may be stuck at the end of travel.	1. Press the remote E-Stop switch. 2. Manually position the XY stage to the center of travel. 3. Clear the software message. 4. Reset the remote E-Stop switch by twisting the knob in the direction of the arrows. 5. Press the **Stop/Start** button on the joystick. 6. Re-zero the stages.

Symptom	Possible Causes	Possible Solutions
X- or Y-axis will not initialize (continued).	Loose or faulty cabling to the DSP Multi Axis PCBA.	• Check and secure all cable connections to the DSP Multi Axis PCBA. • Reconnect or replace any disconnected or damaged cables.
	Defective motor.	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
Axis does not move in any direction.	Remote E-Stop switch has been pressed.	1. Clear the software message. 2. Reset the remote E-Stop switch by twisting the knob in the direction of the arrows. 3. Press the **Stop/Start** button on the joystick. 4. Re-zero the stages.
	Loose remote E-Stop connection to the machine.	Verify that the remote E-Stop switch is properly connected to the machine.
	Faulty remote E-Stop switch.	Replace remote E-Stop switch.
	`DSP.OUT` was not downloaded during startup.	Reboot the metrology software.
	Loose or faulty motion related cable connections.	• Verify that all motion related cables are properly connected and secure. • Reconnect or replace any disconnected or damaged cables.
	Loose or faulty scale cables.	• Check for lost scale counts by zeroing the affected axis, moving a known distance along the axis, and comparing the reading displayed in the DRO to the nominal distance. • Check for proper scale operation by observing the corresponding diagnostic LEDs on the DSP Multi Axis PCBA as you *slowly* move along the affected axis—the LEDs should indicate quadrature (see ***Quadrature*** on page 65). • Check and secure all cable connections. • Reconnect or replace any disconnected or damaged cables.

Symptom	Possible Causes	Possible Solutions
Axis does not move in any direction (continued).	Defective safety relay or faulty cabling.	Perform the *Safety Relay Troubleshooting* procedure on page 112.
	Loose or faulty cabling between the power supply and the DSP Multi Axis PCBA.	• Verify that the power supply is properly connected to the DSP Multi Axis PCBA. • Verify that the +24V MTR LED on the back of the power supply is on. • Verify that +24V is present on the DSP Multi Axis PCBA—check between the outermost pins on connector J13 on the DSP Multi Axis PCBA. • Reconnect or replace any disconnected or damaged cables.
	Misaligned scale reader head.	• Isolate problem axis and check the scale reader head alignment along the full length of travel. • Re-align the scale reader head if necessary.
	Defective motor.	Isolate the problem axis and replace the defective motor. • If the X-axis or Y-axis motor is defective, contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4). • If the Z-axis motor is defective, see ***Replacing the Z-Axis Motor*** on page 178.

Symptom	Possible Causes	Possible Solutions
Axis does not move in any direction (continued).	Defective scale reader head or reader head cable on the affected axis—LED DS7 on the DSP Multi Axis PCBA indicates an excess position error.	• Check for lost scale counts by zeroing the affected axis, moving a known distance along the axis, and comparing the reading displayed in the DRO to the nominal distance. • Check for proper scale operation by observing the corresponding diagnostic LEDs on the DSP Multi Axis PCBA as you *slowly* move along the affected axis—the LEDs should indicate quadrature (see ***Quadrature*** on page 65). • Replace the scale reader head if necessary; see ***Replacing the Scale Reader Heads*** on page 161.
	Defective power supply.	• Check the power supply LEDs and voltages. • Perform the power supply troubleshooting procedure on page 110. • Replace the power supply if necessary; see ***Replacing the Power Supply*** on page 195.
	Defective DSP Multi Axis PCBA.	• Check LED DS8 (heartbeat) on the DSP Multi Axis PCBA—LED should be on (solid or blinking). • Check LED DS7 on the DSP Multi Axis PCBA for error codes; see ***Diagnostic LED DS7 E-Stop Codes*** on page 66. • Check power supply voltages. • Replace the DSP Multi Axis PCBA if necessary; see ***Replacing the DSP Multi Axis PCBA*** on page 183.
	Incorrect or missing tuning parameters.	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
Axis only moves in one direction.	Loose or faulty cabling to the DSP Multi Axis PCBA.	• Check and secure all cable connections. • Reconnect or replace any disconnected or damaged cables.
	Defective joystick.	Perform the joystick troubleshooting procedure on page 104.

Symptom	Possible Causes	Possible Solutions
Axis only moves in one direction (continued).	Defective DSP Multi Axis PCBA.	• Check LED DS8 (heartbeat) on the DSP Multi Axis PCBA—LED should be on (solid or blinking). • Check LED DS7 on the DSP Multi Axis PCBA for error codes; see ***Diagnostic LED DS7 E-Stop Codes*** on page 66. • Check power supply voltages. • Replace the DSP Multi Axis PCBA if necessary; see ***Replacing the DSP Multi Axis PCBA*** on page 183.
Axis runs to a hard stop.	Loose or faulty cabling to/ from the DSP Multi Axis PCBA.	• Check and secure all cable connections to/ from the DSP Multi Axis PCBA. • Reconnect or replace any disconnected or damaged cables.
	Defective DSP Multi Axis PCBA.	• Check LED DS8 (heartbeat) on the DSP Multi Axis PCBA—LED should be on (solid or blinking). • Check LED DS7 on the DSP Multi Axis PCBA for error codes; see ***Diagnostic LED DS7 E-Stop Codes*** on page 66. • Check power supply voltages. • Replace the DSP Multi Axis PCBA if necessary; see ***Replacing the DSP Multi Axis PCBA*** on page 183.
	Incorrect tuning parameters.	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
Axis “runs away” at power up. **Note:** This is very rare, so contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4) and provide as much information as possible.	DSP Multi Axis PCBA not loaded correctly.	Reboot the metrology software.
	Loose or faulty cabling to/ from the DSP Multi Axis PCBA.	• Check and secure all cable connections to/ from the DSP Multi Axis PCBA. • Reconnect or replace disconnected or damaged cables.
	Loose or faulty scale cables.	• Check and secure all scale cable connections. • Reconnect or replace disconnected or damaged cables.

Symptom	Possible Causes	Possible Solutions
Axis "runs away" at power up (continued). **Note:** This is very rare, so contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4) and provide as much information as possible	Misaligned scale reader head.	• Isolate problem axis and check the scale reader head alignment along the full length of travel. • Re-align the scale reader head if necessary.
	Defective scale reader head on the affected axis.	• Check for lost scale counts by zeroing the affected axis, moving a known distance along the axis, and comparing the reading displayed in the DRO to the nominal distance. • Check for proper scale operation by observing the corresponding diagnostic LEDs on the DSP Multi Axis PCBA as you *slowly* move along the affected axis—the LEDs should indicate quadrature (see ***Quadrature*** on page 65). • Replace the scale reader head if necessary; see ***Replacing the Scale Reader Heads*** on page 161.
	Defective DSP Multi Axis PCBA.	• Check LED DS8 (heartbeat) on the DSP Multi Axis PCBA—LED should be on (solid or blinking). • Check LED DS7 on the DSP Multi Axis PCBA for error codes; see ***Diagnostic LED DS7 E-Stop Codes*** on page 66. • Check power supply voltages. • Replace the DSP Multi Axis PCBA if necessary; see ***Replacing the DSP Multi Axis PCBA*** on page 183
Axis exhibits squealing, knocking, or hard clicks.	Loose Z-axis hardware or damaged Z-axis ball screw.	• Power down the system. Then remove the front cover and check for loose hardware or defective ball screw. • Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4) for more information.
	Incorrect tuning parameters or the acceleration is set too high.	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
Z brake makes a "rubbing" noise when Z-axis is in motion.	Incorrect gap between brake hub and friction disc in the Z brake	Perform the Z Brake Adjustment procedure on page 149.

Symptom	Possible Causes	Possible Solutions
Axis does not finish a move or hesitates when finishing a move.	Defective scale reader head on the affected axis.	• Check for lost scale counts by zeroing the affected axis, moving a known distance along the axis, and comparing the reading displayed in the DRO to the nominal distance. • Check for proper scale operation by observing the corresponding diagnostic LEDs on the DSP Multi Axis PCBA as you *slowly* move along the affected axis—the LEDs should indicate quadrature (see ***Quadrature*** on page 65). • Replace the scale reader head if necessary; see ***Replacing the Scale Reader Heads*** on page 161.
	Incorrect tuning parameters.	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
Axis oscillates.	Loose or faulty cabling to/ from the DSP Multi Axis PCBA.	• Check and secure all cable connections to/ from the DSP Multi Axis PCBA. • Reconnect or replace disconnected or damaged cables.
	Loose or defective motor on the affected axis.	Verify motor mounting hardware is secure; replace defective motor if necessary. • If the X-axis or Y-axis motor is defective, Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4). • If the Z-axis motor is defective, see ***Replacing the Z-Axis Motor*** on page 178.
	Incorrect servo parameters.	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).

Symptom	Possible Causes	Possible Solutions
Axis oscillates (continued).	Defective scale reader head on the affected axis.	• Check for lost scale counts by zeroing the affected axis, moving a known distance along the axis, and comparing the reading displayed in the DRO to the nominal distance. • Check for proper scale operation by observing the corresponding diagnostic LEDs on the DSP Multi Axis PCBA as you *slowly* move along the affected axis—the LEDs should indicate quadrature (see ***Quadrature*** on page 65). • Replace the scale reader head if necessary; see ***Replacing the Scale Reader Heads*** on page 161.
	Defective DSP Multi Axis PCBA.	• Check LED DS8 (heartbeat) on the DSP Multi Axis PCBA—LED should be on (solid or blinking). • Check LED DS7 on the DSP Multi Axis PCBA for error codes; see ***Diagnostic LED DS7 E-Stop Codes*** on page 66. • Check power supply voltages. • Replace the DSP Multi Axis PCBA if necessary; see ***Replacing the DSP Multi Axis PCBA*** on page 183
	Incorrect tuning parameters.	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
Unexpected contact between the optics and a part on the stage.	Part programming error. Fixturing problem. Stage initialization error. Unexpected Z-axis movement.	Perform the Recovering from Unexpected Z-Axis Contact procedure on page 113.

7.9.4 Video

Symptom	Possible Causes	Possible Solutions
No live video, but menus OK.	Incorrect color settings.	1. Right-click on the Windows Desktop and select **Properties** from the context menu. 2. Click the **Settings** tab and make sure **Colors** is set to 24- or 32-bit.
	Loose or faulty video and/or camera cables.	• Check and secure all cable connections. • Reconnect or replace any disconnected or damaged cables.
	Corrupted registry of `.INI` files.	Copy known good files from backup disk.
	Corrupt inspection program.	Reload the program.
	Defective camera.	Replace the defective camera; see ***Replacing the High & Low Mag Cameras*** on page 155.
	Defective QVI video capture card.	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
No live video or menus.	Loose or faulty monitor cabling.	• Check and secure all cable connections. • Reconnect or replace any disconnected or damaged cables.
	Defective QVI video capture card.	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
	If the system boots up on power and cabling is not the problem, check for defective monitor.	Replace the monitor.
Live video but no stored video.	Defective QVI video capture card.	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
During focus, video image moves erratically	Environmental vibration.	Relocate system.
	Misconfigured camera.	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
	Loose Z-axis motor mounting hardware.	Power down the system. Then remove the front cover and verify the motor mounting hardware is secure.
	Defective Z-axis motor.	Replace the Z-axis motor if necessary; see ***Replacing the Z-Axis Motor*** on page 178.

7.10 Identifying Problems with the PC & User-Interface Components

Before you suspect a serious problem with the PC, remember that adding hardware and/or software can affect the existing system. Recheck any installations you may have recently performed.

7.10.1 Start-Up & General Performance

Symptom	Possible Causes
Computer does not power up when you press the power switch	• Check for loose or disconnected power cord; reconnect the power cord if necessary. • Computer BIOS not configured to power on after a power failure; contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
Computer is unable to download to the DSP Multi Axis PCBA during start-up.	• Check for loose or disconnected parallel cable
Computer does not boot from floppy disk.	• Check associated cables and verify power to the floppy disk drive; replace drive if necessary. • Computer BIOS is not configured to boot from floppy disk drive first; contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
Computer does not boot from hard drive.	• Verify that there is no disk in the floppy disk drive. • Check for data corruption on the hard drive. • Check the power and data connections to the hard drive.
Erratic computer operation after booting.	• Check for sags in power supply voltage—measure voltages with all cards plugged in.
Computer does not read floppy disk.	• Floppy disk is damaged; reformat floppy disk or try new disk. • Check cabling to floppy disk drive; replace drive if needed.

7.10.2 Communications

The serial ports rarely have hardware problems. Almost all problems are external wiring or software issues.

Symptom	Possible Causes
Serial port does not seem to operate.	• Test communications to a second CPU or terminal.
Cannot communicate on network.	• Check for appropriate software drivers. • Check cable termination and length. • Check network card/software configuration. • Check memory allocation. • Check firewall settings.

7.10.3 Joystick

Symptom	Possible Causes
No movement.	• Remote E-Stop switch has been pressed. • System is in Stop Mode; press the **Start/Stop** button on the joystick to resume normal operation. • Loose or disconnected joystick; verify joystick is properly connected to the machine. • Defective joystick; perform the joystick troubleshooting procedure on page 104. • Check stage for holding torque; stage may have faulted.
Stage moves without input.	• Centering switches on joystick are not locked. • Check the DAC test points on the DSP Multi Axis PCBA and adjust the offset potentiometers if necessary; refer to the *DSP Multi Axis Board Service Guide* (P/N 790168). • Defective joystick; perform the joystick troubleshooting procedure on page 104.

7.10.4 Troubleshooting the Joystick

Note: The following procedure only applies to systems equipped with the DSP Multi Axis PCBA (P/N 03640x, revision E or higher).

Figure 7-11 shows the test points on the DSP Multi Axis PCBA that are used to troubleshoot the joystick.

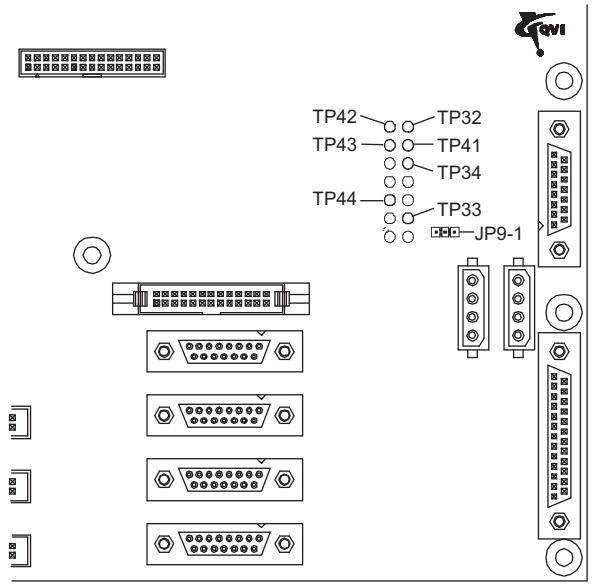


Figure 7-11 Location of the Joystick Troubleshooting Test Points on the DSP Multi Axis PCBA

7.10.4.1 Verifying VREF+ from the DSP PCBA to the Joystick

1. Connect the positive (+) lead of a Digital Volt Meter (DVM) to pin 1 on JP9 and connect the negative (-) lead to TP41. The reading (VREF+) should be **3.0VDC ±10%**.

   - If the reading is within specification, the joystick, interconnecting cables, and DSP Multi Axis PCBA are all working properly; you do not have to perform the rest of this procedure.
   - If the reading is not within specification, continue with the next step in this procedure.

2. Unplug the joystick and re-check VREF+. Again, the reading should be **3.0VDC ±10%**.

   - If the reading is within specification, connect the joystick **directly** to the DSP Multi Axis PCBA (no interconnecting cables) and re-check VREF+.
     – If the reading is within specification, replace the interconnecting cables between the joystick and the DSP Multi Axis PCBA.
     – If the reading is not within specification, replace the joystick.
   - If the reading is not within specification, check the power supply voltages to the DSP Multi Axis PCBA (+5VDC and +12VDC). If the voltages are OK, perform the next procedure. Otherwise, replace the DSP Multi Axis PCBA; see ***Replacing the DSP Multi Axis PCBA*** on page 183.

7.10.4.2 Verifying Joystick Potentiometer at Input to the DSP PCBA

1. Make sure the joystick is not deflected and use a DVM to measure the voltage between the following on the DSP Multi Axis PCBA:

- TP41 and TP32
- TP41 and TP33
- TP41 and TP34

Each reading should be (VREF+/2) ±5%.

- If the voltages are within specification, continue with the next step in this procedure.
- If the voltages are not within specification and cabling is not the problem, replace the joystick.

2. Connect the negative (-) lead to TP41 and connect the positive (+) lead to:

- TP32 to measure the X_POT—voltage should vary from ~0VDC to VREF+ when you move the joystick lever in the X direction
- TP34 to measure the Y_POT—voltage should vary from ~0VDC to VREF+ when you move the joystick lever in the Y direction
- TP33 to measure the Z_POT—voltage should vary from ~1VDC to 2VDC when you twist the joystick knob

Move the joystick lever (XY) or twist the joystick knob (Z) to check the different input voltages. The voltages should be within the specifications listed above.

- If the voltages are within specification, perform the next procedure.
- If the voltages are not within specification and cabling is not the problem, replace the joystick.

7.10.4.3 Verifying Joystick Potentiometers at Input to A/D Converter

1. Connect the negative (-) lead to TP41 and connect the positive (+) lead to:

- TP42 to measure the X_POT—voltage should vary from ~0VDC to VREF+ when you move the joystick lever in the X direction
- TP44 to measure the Y_POT—voltage should vary from ~0VDC to VREF+ when you move the joystick lever in the Y direction
- TP43 to measure the Z_POT—voltage should vary from ~0VDC to VREF+ when you twist the joystick knob

Move the joystick lever (XY) or twist the joystick knob (Z) to check the different input voltages. The voltages should be within the specifications listed above.

- If the potentiometer voltages are within specification, the joystick, interconnecting cables and DSP Multi Axis PCBA are all working properly.
- If the voltages are not within specification, replace the DSP Multi Axis PCBA; see ***Replacing the DSP Multi Axis PCBA*** on page 183.

7.10.5 Keyboard

Symptom	Possible Causes
No response.	• Check keyboard cabling. Replace keyboard if necessary. • Make sure CPU is operating.
Some keys do not work or stick.	• Clean all internal surfaces of keyboard.

Caution: Never connect or unplug the keyboard (or mouse) from the PS2 port while the system is energized. Doing so could damage the motherboard in the system computer.

7.10.6 Flat Panel Display

Symptom	Possible Causes
No video.	• Make sure the flat panel display is plugged in and on. • Check the video acquisition and memory cards for failure. • Make sure the CPU is booting and cables are connected properly.
No video, or high pitched squeal and no video.	• Internal circuit or high-voltage breakdown.
Color shift or image not straight.	• Degauss the monitor. • Reduce proximity to nearby magnetic field.
Noise in image or noisy (floating) image.	• Reduce proximity to nearby electric field, including a second monitor. • Screen adjustment pots could be dirty. Turn all pots several times from end to end to clean wipers.
Fixed bars or striped pattern on screen (live video window).	• Re-install `.INI` files from backup disk. • Confirm that all display settings and drivers are correct.

Symptom	Possible Causes
No live video (software running and lights on).	• See if lights are turned off or if lighting is too low for the part. • Check for damaged camera cable.
Image appears “choppy” during stage motion.	• This is normal and can be minimized by increasing the monitor refresh frequency. 1. Right-click on the Windows desktop. 2. Select **Properties** from the context menu. 3. Click the **Settings** tab and click the **Advanced** button. 4. Click the **Monitor** tab and select a refresh frequency of 75 Hertz or higher from the **Refresh Frequency** list. (We recommend selecting the maximum refresh frequency.)
Circles appear elliptical.	• Incorrect monitor aspect ratio. Replace with a monitor that has a native aspect ratio of 4:3.

7.11 Troubleshooting the Power Supply

Warning: This procedure requires that power be applied to the system with the rear door open and should only be performed by qualified personnel. Exercise caution whenever operating the system with the rear door open.

1. Power down the system.

Caution: Support the rear door while gently lowering it into position, to prevent the door from dropping.

2. Use a flat-head screwdriver to loosen the six rear door fasteners and slowly lower the door until it is perpendicular to the electronics tower and is supported by the rear door retainer.

3. Remove all DC loads by disconnecting the cables connected to **J300**, **J301**, and **J302** (if applicable) on the top of the power supply (see Figure 7-12).

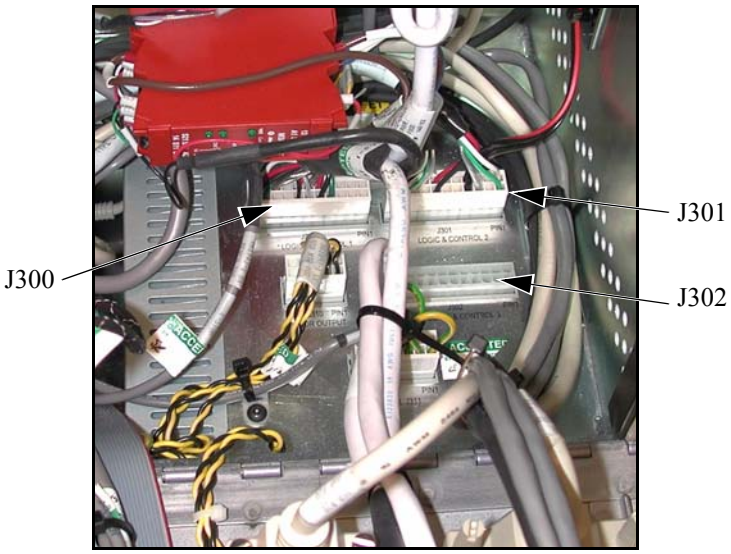


Figure 7-12 Power Supply (Top View)

4. Verify that the machine power switch on the back of the power supply is in the ON position, and then power up the system PC.

5. Observe the status of the **+5V**, **+12V**, **+15V**, and **+24V** LEDs on the back of the power supply.

   - If the **LEDs are on**, a problem exists with the cabling or connected circuit boards. Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4) for more information.
   - If the **LEDs are off**, continue with the next step in this procedure.

6. Shut down the computer (do not turn off the power switch on the back of the power supply).

7. Disconnect the cable connected to **J311** on the top of the power supply.

Caution: When installing a jumper on the pins indicated in the next step, be sure to install the jumper on the correct pins to avoid damaging the power supply.

8. Apply +5V to pin **13** on connector **J311** by installing a jumper between pins **11** and **13** *or* pins **12** and **13**.

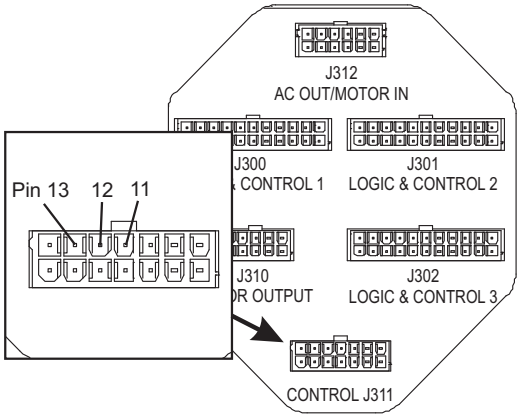


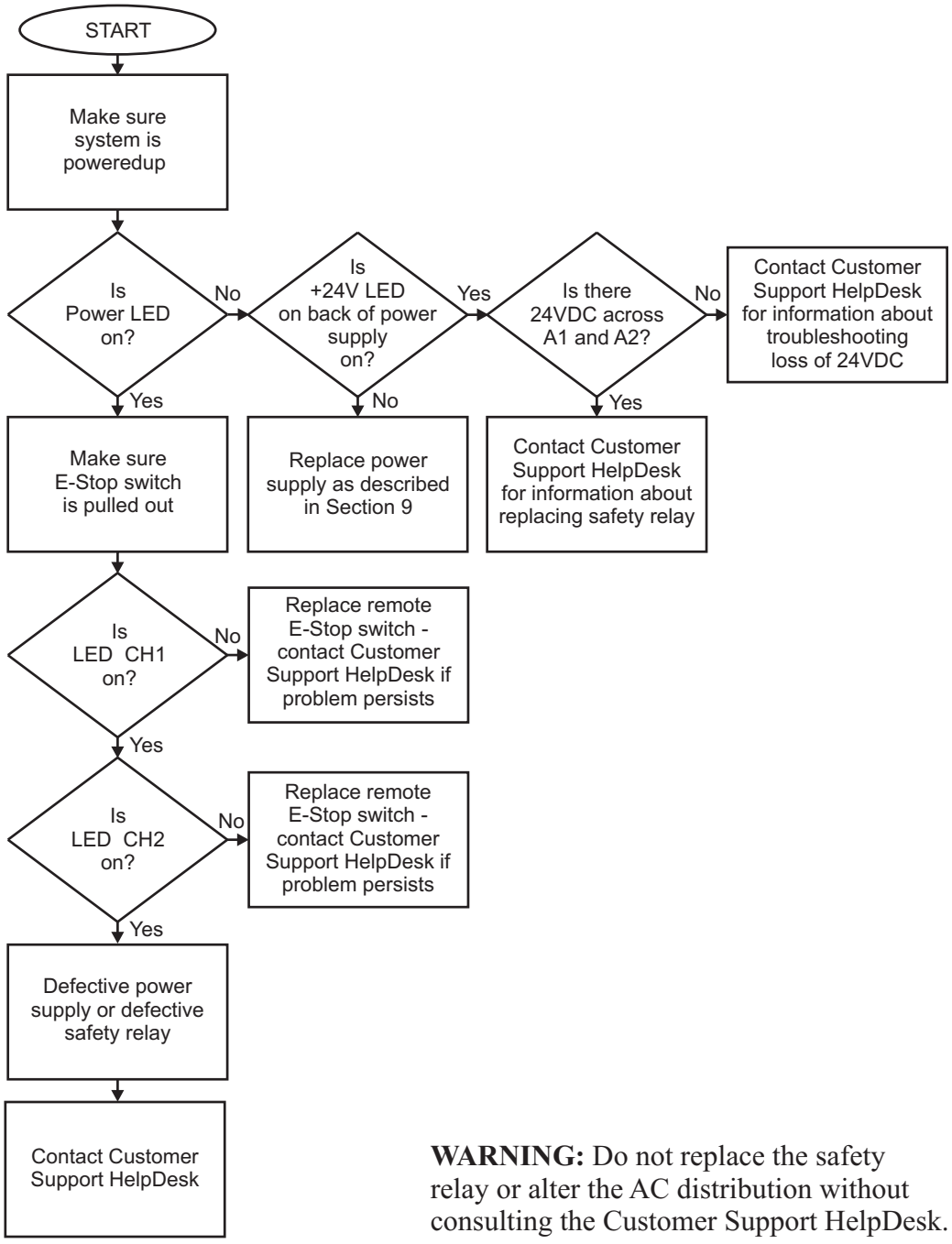
Figure 7-13 Location of Pins 11, 12, and 13 on Connector J311

9. Observe the status of the **+5V**, **+12V**, **+15V**, and **+24V** LEDs on the back of the power supply.

   - If the **LEDs are on**, a problem exists with the cabling or QVI Video Capture Card. Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4) for more information.
   - If the **LEDs are off**, replace the power supply; see ***Replacing the Power Supply*** on page 195.

10. When finished, re-connect all cables and close the rear door.

7.12 Troubleshooting the Safety Relay



WARNING: Do not replace the safety relay or alter the AC distribution without consulting the Customer Support HelpDesk.

Figure 7-14 Troubleshooting the Safety Relay

7.13 Recovering from Unexpected Z-Axis Contact

Warning: NEVER ATTEMPT TO MANUALLY MOVE THE Z-AXIS BY TURNING THE BALL SCREW WITH POWER APPLIED TO THE MACHINE. Doing so could result in personal injury.

Caution: Never attempt to lift the Z-axis transport by the optics. Possible damage to the equipment could occur.

Note: It is not necessary to remove the optics cover in order to recover from unexpected Z-axis contact.

1. Press the **Stop/Start** button on the joystick.
2. Twist the joystick knob clockwise to raise the Z-axis transport.

Note: The system may re-enter E-Stop immediately after you twist the joystick knob, which indicates that the Z-axis transport has separated mechanically from the Z-axis ball screw.

3. Repeat Steps 1 and 2 until the Z-axis clears the obstruction.
4. Once the Z-axis is clear, remove the obstruction from the stage area.
5. Twist the joystick knob clockwise to raise the Z-axis transport to the upper limit of travel to clear the error message displayed on the screen.

If you are unable to return the system to normal operation by performing the procedure outlined above, perform the following procedure to manually turn the Z-axis ball screw and reseat the Z-axis drive bracket onto the Z-axis drive nut.

1. Press the remote E-Stop switch.

Warning: Make sure the system is in E-Stop before performing the next step; the Stop LED on the right-hand side of the machine should be blinking rapidly.

2. Insert a large, flat-head screwdriver into the access hole in the bottom of the Z-axis brake assembly and into the slot in the bottom of the Z-axis ball screw (see Figure 7-15 on the next page).

Note: The bottom of the Z-axis ball screw is slotted so a flat-head screwdriver can be used to turn it. However, the Z-axis electric brake will be engaged, which may make it difficult to turn the Z-axis ball screw.

3. Once the Z-axis is clear, remove the obstruction from the stage area.

4. Reset the remote E-Stop switch by twisting the knob in the direction of the arrows.

5. Press the **Stop/Start** button on the joystick.

6. Twist the joystick knob clockwise to raise the Z-axis transport to the upper limit of travel to clear the software message displayed on the screen.

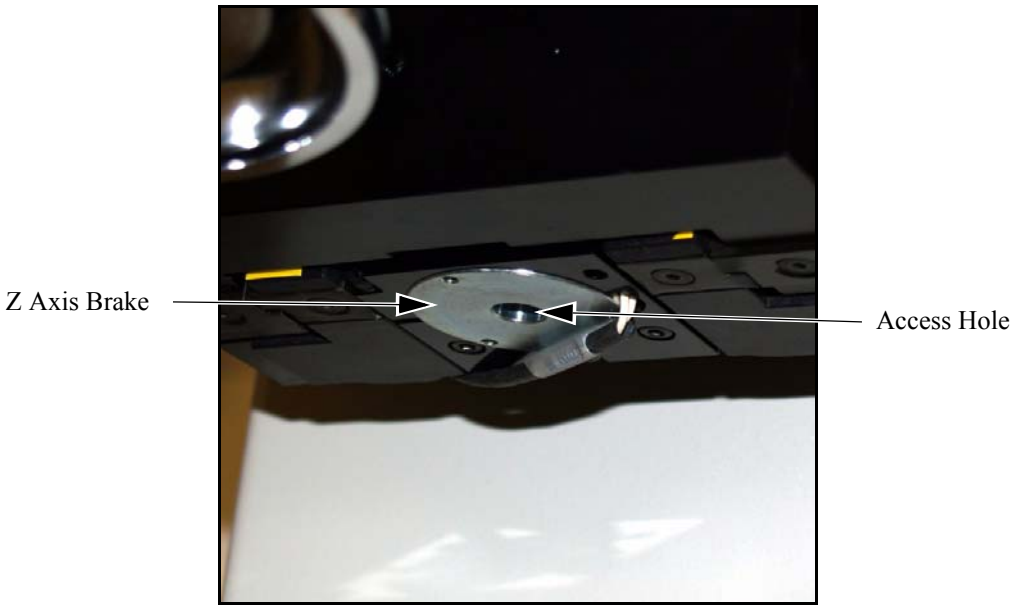


Figure 7-15 Access Hole in the Bottom of the Z-Axis Electric Brake

Service Adjustments

Chapter 8

8.1 What This Chapter Contains

This chapter describes how to make service adjustments to the Benchmark 250 system.

Warning: The risk of electrical shock is present any time the covers are removed from the machine. Never remove the covers from the monitor or system power supplies, or you expose yourself to high voltage.

Caution: Protect the Benchmark 250 system from electrostatic damage. Perform these procedures at a static-safe workstation and wear a ground strap. If a ground strap is not available, follow these guidelines:

- Work in an uncarpeted area.
- Before touching electronic components, discharge static electricity by touching a known-grounded object.
- Do not touch components on printed circuit boards, except as directed.

8.2 Benchmark 250 Service Adjustments

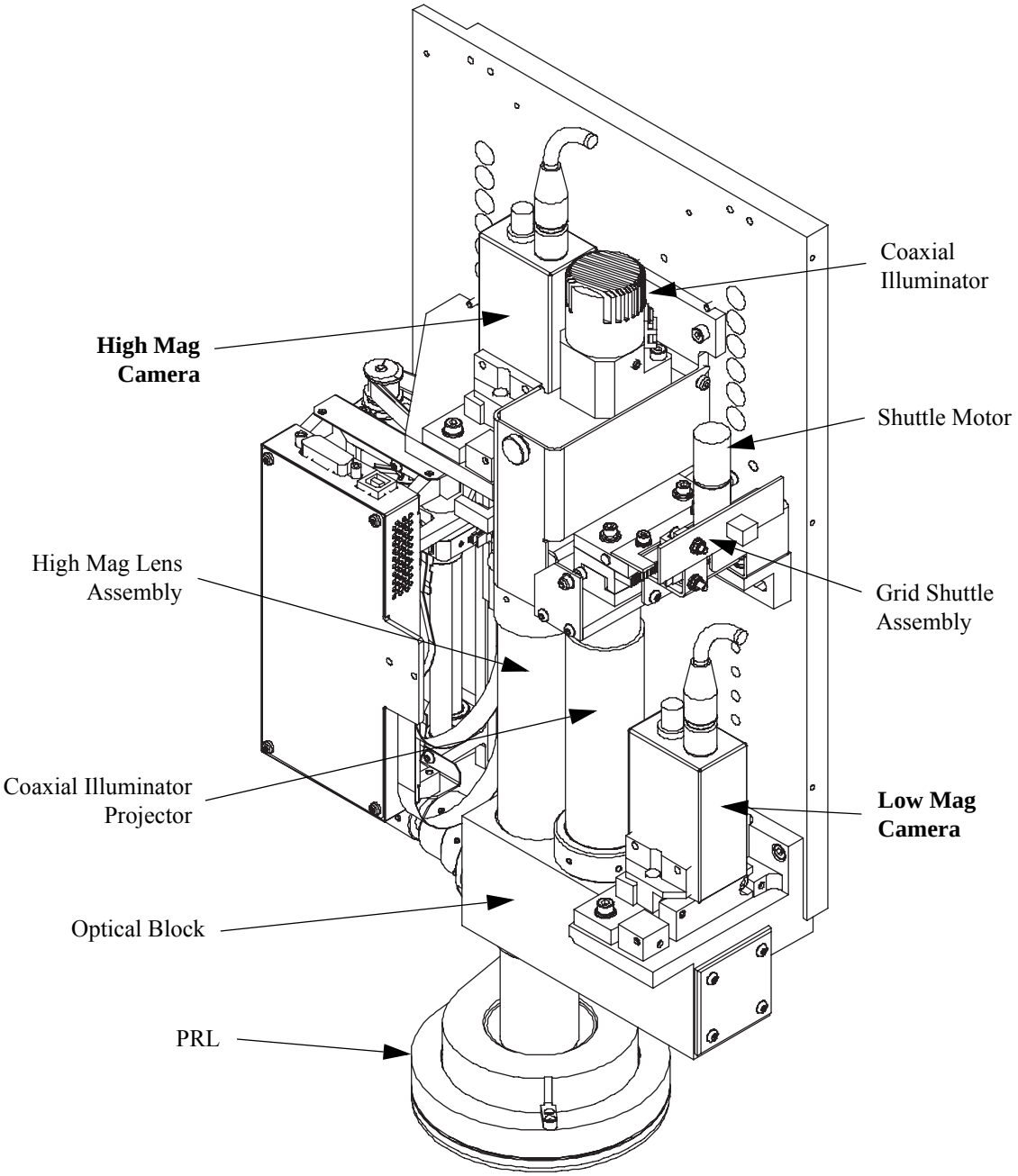
The following is a list of service adjustments that should be performed on the Benchmark 250 system if components are repaired or replaced.

Service Adjustment	Purpose	Where to Find Procedure
Dual Magnification Optical System Adjustments	Perform whenever a critical component within the optical path has been removed and/or replaced	See ***Dual Magnification Optical System Adjustments*** on page 117.
Lens Calibration	Perform to calibrate the field of view for the magnification lens that is currently installed on the system	See ***Lens Calibration*** on page 132.
AccuCentric Assembly Alignment (If Equipped)	Perform whenever the AccuCentric assembly or optical system is replaced	See ***AccuCentric Assembly Alignment (If Equipped)*** on page 134.
LED Programmable Ring Light (PRL) Adjustments (If Equipped)	Perform after Z certification or installation of a new PRL to ensure proper light output and concentricity within the system optics	See ***LED Programmable Ring Light (PRL) Adjustments (If Equipped)*** on page 137.
Z Brake Adjustment	Perform to adjust the gap between the brake hub and the friction disk.	See ***Z Brake Adjustment*** on page 149.

8.3 Dual Magnification Optical System Adjustments

The dual magnification optical system uses two monochrome cameras on two separate optical paths to provide instant magnification switching under software control. A third optical path is included to provide coaxial (through the lens) illumination and a (Ronchi) grid pattern for autofocus. This section outlines the procedures for on-system alignment of the dual magnification optical system.

8.3.1 Component Location



8.3.2 Sequence of Optical Adjustments

The following list summarizes the optical system adjustments and the order in which they should be performed.

Optical Adjustment	Purpose	Where to Find Procedure
Coaxial Illuminator and Shuttle Window Position (procedure only applies to systems equipped with the optional Ronchi grid)	Aligns the coaxial illuminator and Ronchi shuttle so there are no shadows in the field of view	See ***Coaxial Illuminator & Ronchi Shuttle Window Position Adjustment*** on page 119.
Shuttle Opto Switch Flag and End Limits	Ensures that each grid covers the entire field of view when selected	See ***Ronchi Shuttle Opto Switch Flag & End Limits Adjustment*** on page 120.
Ronchi Grid Rotation	Ensures that each grid is square to the field of view	See ***Ronchi Grid Rotation Adjustment*** on page 122.
Camera Parfocal	Adjusts the focus of both cameras so the part image stays in focus when switching from High to Low Mag, and vice versa	See ***Camera Parfocal Adjustment*** on page 123.
Camera Par-Center (Coaxial)	Aligns the optical axis of each camera with the optical axis of the lens	See ***Camera Par-Center (Coaxial) Adjustment*** on page 127.
Camera Rotation	Ensures that each camera is square to the stage axis	See ***Camera Rotation Adjustment*** on page 130.

Note: The various optical system adjustments are interrelated. Adjustments, no matter how minor, to one component may affect the alignment of other components. Repeat all adjustment procedures until there are no visible offsets.

8.3.3 Coaxial Illuminator & Ronchi Shuttle Window Position Adjustment

Warning: Adjusting the Ronchi shuttle requires you to perform adjustments on powered parts. When the shuttle is powered up, be careful where you place your fingers, and do not allow anyone to move the shuttle (or even use an Autofocus Finder) or access the shuttle electronics or cabling while a person's fingers are near the shuttle.

Tools Required	Part No.
1X magnification lens	638939
Set of Metric Allen wrenches	N/A
Set of English Allen wrenches	N/A
Small Phillips-head screwdriver	N/A
Mirror	N/A

1. Using a 1X magnification lens, the Low Mag camera, and coaxial illumination, manually focus on a mirror (dust or scratches help!). If necessary, manually position the Ronchi shuttle so the grids are not visible in the image.

2. Inspect the image to see if the Ronchi shuttle is blocking the light on the left or right sides. If it is, loosen the two shuttle mounting screws, and slide it horizontally to a position where it does not block the coaxial illumination. Make sure the shuttle assembly vertically touches the two locating pins that keep it at a calibrated Z position. Lock down the shuttle mounting screws when finished.

3. Inspect the Low Mag camera image for dark corners (vignetting). (This will be more evident when using a 2/3" camera in the Low Mag optical path.)

   - If the corners are dark, they should at least be equally dark in all four corners.

   - If they are not, try adjusting the XY position of the coaxial illuminator by unscrewing the upper and lower halves and repositioning the assembly. If this does not work, either the cameras are not on the optical centerline (see ***Camera Par-Center (Coaxial) Adjustment*** on page 127) or there is an internal problem in the optical block assembly, in which case you should contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).

8.3.4 Ronchi Shuttle Opto Switch Flag & End Limits Adjustment

Tools Required	Part No.
1X magnification lens	638939
Set of Metric Allen wrenches	N/A
Set of English Allen wrenches	N/A
Small Phillips-head screwdriver	N/A
Mirror	N/A

1. Using a 1X magnification lens, the Low Mag camera, and coaxial illumination, manually focus on a mirror again. Then manually position the Ronchi shuttle so the Low Mag grid is visible in the image.

2. Adjust the Low Mag end limit set screw on the Ronchi shuttle so the diagonal Ronchi grid pattern covers the entire video image without any obstruction when the shuttle contacts the Z back plate.

3. Check to make sure that the Ronchi shuttle opto switch is connected to the Ronchi shuttle controller cable. If not, press the remote E-Stop switch, connect it, and then reset the E-Stop condition. **Do not connect the Ronchi shuttle motor yet.**

4. Move the shuttle in and out of the Low Mag grid position. The red light on the opto switch should turn off when the shuttle is within 3 to 4 mm of touching the end limit. If it does not, adjust the opto switch flag.

5. Press the remote E-Stop switch and connect the motor. Reset the E-Stop switch by twisting the knob in the direction of the arrows. Then press the **Stop/Start** button on the joystick and watch the shuttle. The shuttle should move quickly to the Low Mag grid position, sense the opto switch, and then move to the center position.

6. Look at the Low Mag camera image in the Video window, and check to see if either grid is partially visible at the top or bottom of the screen. Gently push the shuttle back and forth within its center position *dead band*. If you can see either grid starting to enter the Video window, adjust the shuttle flag position; see Figure 8-1.

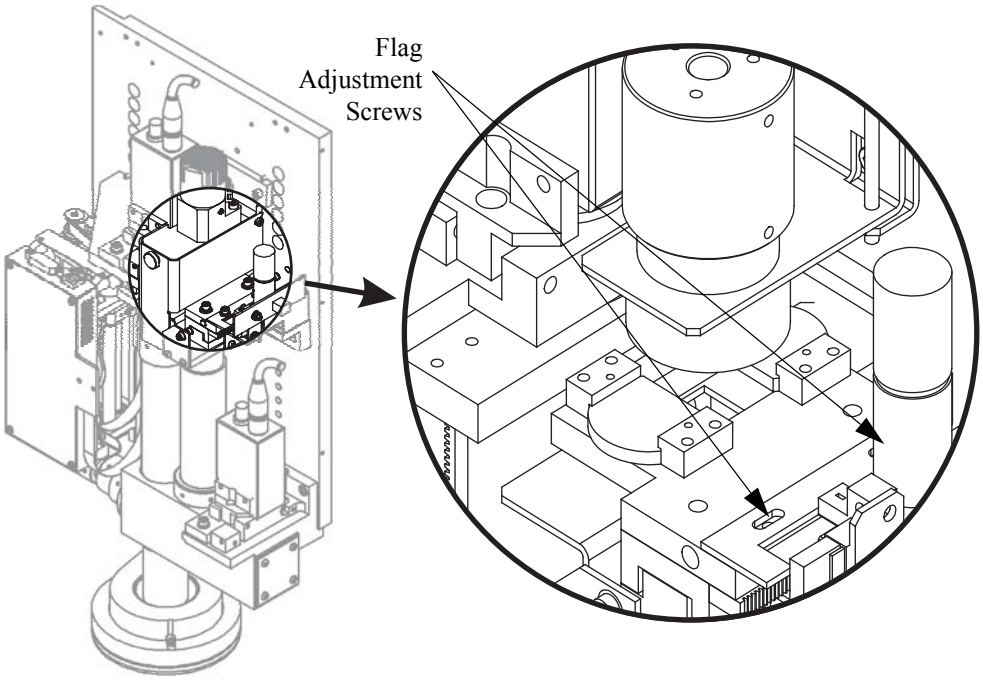


Figure 8-1 Flag Adjustment

7. To adjust the flag position, press the remote E-Stop switch and move the flag.

8. When finished, reset the E-Stop switch by twisting the knob in the direction of the arrows, and then press the **Stop/Start** button on the joystick. The shuttle will re-zero itself. (The shuttle only reacts to the new flag position after moving to the Low Mag grid position, which it does automatically when it powers up.)

9. Click  in the VMS Video window and click  in the Autofocus Settings window. Verify that the grid is displayed properly.

10. Click  and verify that there are no obstructions in the image from the Ronchi shuttle.

11. Switch to the High Mag camera, and click  . The shuttle should move to the High Mag position. (You may need to move in Z to manually focus the grid image.) Adjust the High Mag grid end travel limit so it lightly touches the shuttle as it comes to a stop. When done, there should be a 3 to 4 mm dead band.

8.3.5 Ronchi Grid Rotation Adjustment

Tools Required	Part No.
Set of Metric Allen wrenches	N/A
Set of English Allen wrenches	N/A

1. Remove the grid dust cover so you can visually check the rotation of the High and Low Mag grids (see Figure 8-2). Both grids should be square to the X-axis.

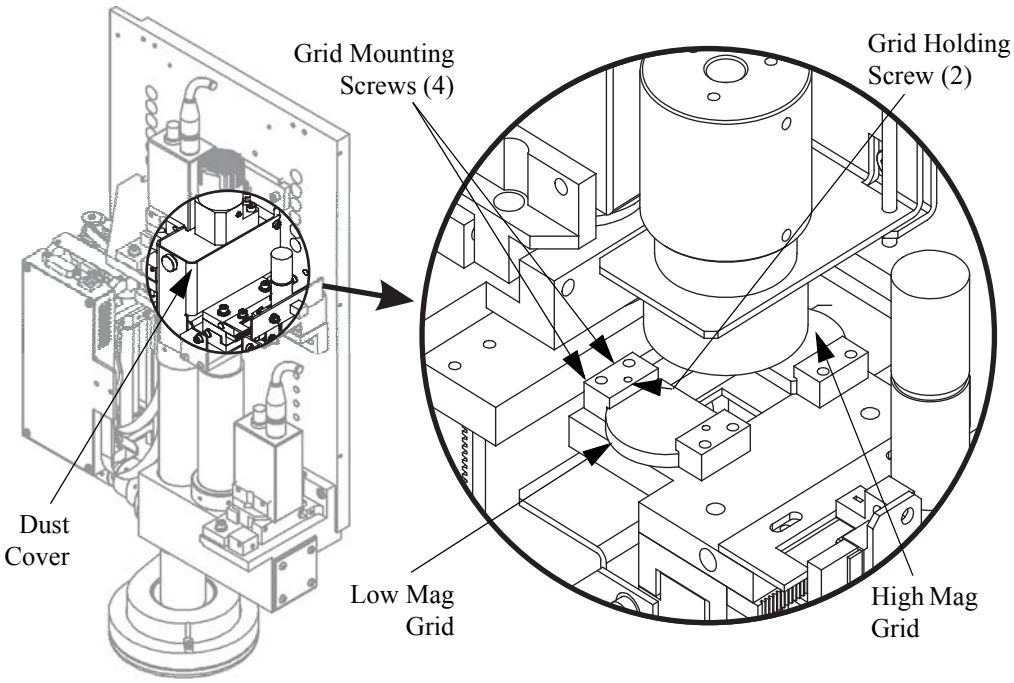


Figure 8-2 Ronchi Grid Rotation Adjustment

2. If either grid is not square, loosen the mounting screws for that grid and adjust the rotation of the grid. When the grid is square, carefully lock down the grid mounting screws.

3. Re-install the dust cover.

8.3.6 Camera Parfocal Adjustment

Note: Camera parfocal affects camera centering and camera rotation; repeat all adjustment procedures until there are no visible offsets.

Tools Required	Part No.
1X magnification lens	638939
Parfocal Reticle	638840
Set of Metric Allen wrenches	N/A
Set of English Allen wrenches	N/A
Small Phillips-head screwdriver	N/A

1. Install a 1X magnification lens.
2. Place the Parfocal Reticle on the Benchmark 250 stage, below the optics.
3. Use the Coax Light slider in the VMS Stage and Lights window to turn on the coaxial illuminator.
4. Select the Low Mag camera.
5. Select **Setup / Calibration** to display the Lens Calibrations window (see Figure 8-3).

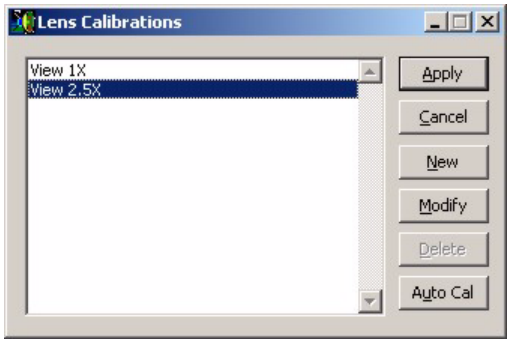


Figure 8-3 Lens Calibrations Window

6. From the list, select the lens that is currently installed (e.g., “View 1X”) and click the **Modify** button to display the Define Lens Calibration window (see Figure 8-4).

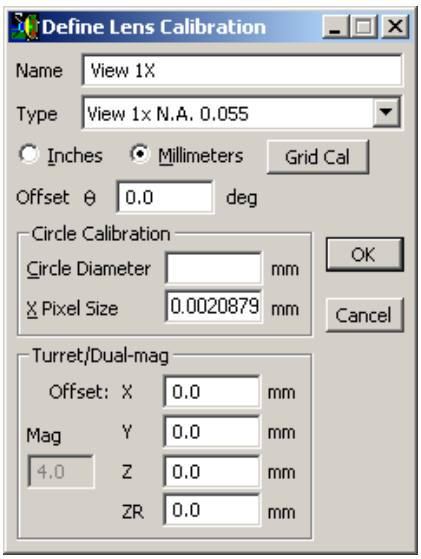


Figure 8-4 Define Lens Calibration Window

7. Zero the *Z* offset and click **OK**. Then click **Apply** in the Lens Calibrations window and close the window.

Ronchi-to-Surface Parfocal

8. Select the High Mag camera.

9. Click  in the Video window toolbar and click  in the Autofocus Settings window so the Ronchi grid is in the optical path (directly below the coaxial illuminator). You should now see the diagonal Ronchi grid in the Video window; adjust the illumination if necessary.

10. Perform an autofocus on the reticle and then zero the DRO by right-clicking in the DRO window and selecting **Zero DRO** in the context menu.

11. Click  in the Autofocus Settings window to select the Textured Surface Focus tool (no grid) and perform another autofocus on the reticle. The Z change in the DRO should be zero or very close to zero.

    If the change is more than **0.05 mm (0.002")**, continue with the next step. Otherwise, advance to Step 14.

12. Click  to select the Ronchi Focus tool and adjust the focus of the High Mag camera until the best focus is achieved—loosen the camera clamp and adjust the focus set screw shown in Figure 8-5. Re-tighten the camera clamp when finished. If necessary, find the two focus settings where the image goes out of focus and set the focus adjustment midway between them.

Note: The camera clamp screw for the High Mag camera is on the left side and it is a left-hand thread screw; i.e., turn clockwise to loosen, counterclockwise to tighten.

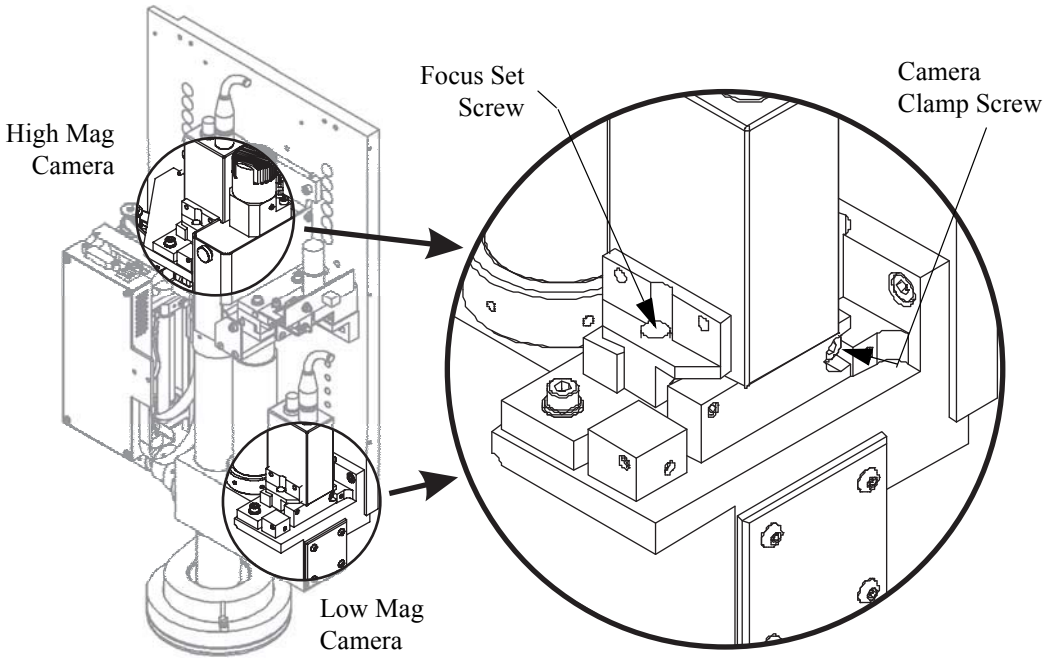


Figure 8-5 Camera Focus Adjustment

13. Repeat Steps 9 through 12 until the Ronchi-to-surface focus comparison is within specification.

High-to-Low Mag Parfocal

14. Zero the DRO and select the Low Mag camera. Then use the Textured Surface Focus tool to perform an autofocus on the reticle. The Z change in the DRO should be zero or very close to zero.

If the change is more than **0.05 mm (0.002")**, continue with the next step. Otherwise, no adjustment is required and you can advance to Step 18.

15. Adjust the focus of the Low Mag camera until the best focus is achieved—loosen the camera clamp, and adjust the focus set screw shown in Figure 8-5. Re-tighten the camera clamp screw when finished.

16. Select the High Mag camera and perform an autofocus on the reticle.

17. Repeat Steps 14 through 16 until the High Mag-to-Low Mag focus comparison is within specification.

Ronchi-to-Surface Parfocal (Fine Tuning)

18. Select the High Mag camera.

19. Click  in the Video window toolbar and click  in the Autofocus Settings window so the Ronchi grid is in the optical path (directly below the coaxial illuminator). You should now see the diagonal Ronchi grid in the Video window; adjust the illumination if necessary.

20. Perform an autofocus on the reticle and then zero the DRO by right-clicking in the DRO window and selecting **Zero DRO** in the context menu.

21. Click  in the Autofocus Settings window to select the Textured Surface Focus tool (no grid) and perform another autofocus on the reticle.

22. Write down the Z change in the DRO, which should be zero or very close to zero.

23. Select **Setup / Calibration** to display the Lens Calibrations window (seeFigure Figure 8-3 on page 123).

24. From the list, select the lens that is currently installed (e.g., “View 1X”) and click the **Modify** button to display the Define Lens Calibration window (see Figure Figure 8-4 on page 124).

25. Type the value from Step 22 into the *ZR* offset box and click **OK**. Then click **Apply** in the Lens Calibrations window and close the window.

8.3.7 Camera Par-Center (Coaxial) Adjustment

Note: Camera centering affects camera rotation and camera parfocal; repeat all adjustment procedures until there are no visible offsets.

Tools Required	Part No.
1X magnification lens	638939
50X magnification lens (see note)	N/A
View Lens Calibration Standard	2110546-1
Set of Metric Allen wrenches	N/A
Set of English Allen wrenches	N/A
Small Phillips-head screwdriver	N/A

Note: For the best results, we recommend using a 50X magnification lens. If a 50X magnification lens is unavailable, you can:

- Use the highest available magnification lens.
- Contact the Customer Support HelpDesk to arrange for an on-site service call.
- Contact the Customer Support HelpDesk to obtain a 50X magnification lens.

Par-Center Between Lenses

1. Place the View Lens Calibration Standard on the stage glass, within the field of view.
2. Install a 50X magnification lens and select the High Mag camera.
3. Focus on the chrome-on-glass calibration target using coaxial illumination. (Do not use backlight.)
4. Click  to display the Circle Finder. Then use XY stage motion to center the concentric circles within the Circle Finder. You can change the diameter of the Circle Finder, but make sure the center is at the "X = 0, Y = 0" location.
5. Without moving the calibration reticle or stage, very carefully switch to the 1X magnification lens and observe whether or not the reticle is centered within the Circle Finder; within **±0.005 mm (±0.0002")**.

   If the concentric circles are no longer centered within the Circle Finder, continue with the next step. If the concentric circles are centered, advance to Step 8.

6. Loosen the camera position lock-down screws and adjust the X and Y direction set screws (see Figure 8-6) until the concentric circles are centered again within the Circle Finder; within **±0.005 mm (±0.0002")**.

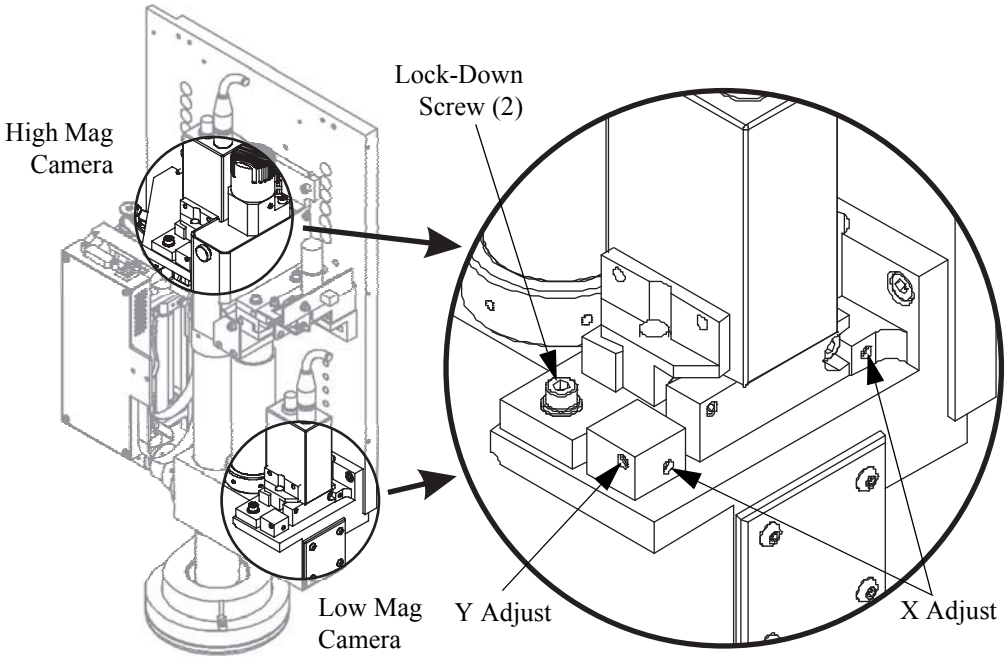


Figure 8-6 Camera Par-Center Adjustment

7. Repeat Steps 2 through 6 until the concentric circles remain centered (without moving the reticle or stage) when you switch from the 50X magnification lens to the 1X magnification lens, and vice versa. Make sure the High Mag camera lock-down screws are fully tightened when finished.

Par-Center Between Cameras

8. With the 1X magnification lens installed and the calibration reticle in the same position as in the previous steps, switch to the High Mag camera and use XY stage motion and the Circle Finder to center the concentric circles in the Video window. You can change the diameter of the Circle Finder, but make sure that the center is at the "X = 0, Y = 0" location.

9. Without moving the calibration reticle or stage, very carefully switch to the Low Mag camera and observe whether or not the reticle is centered within the Circle Finder; within **±0.005 mm (±0.0002")**.

- If the concentric circles are no longer centered within the Circle Finder graphics, continue with the next step.
- If the concentric circles remain centered, no adjustment is required and you do no have to perform the rest of this procedure (check the rotational alignment of each camera; see ***Camera Rotation Adjustment*** on page 130).

10. Loosen the Low Mag camera position lock-down screws, and adjust the X and Y direction set screws (see Figure 8-6) until the concentric circles are centered again within the Circle Finder; within **±0.005 mm (±0.0002")**. You can change the diameter of the circle finder, but make sure that the center is at the "X = 0, Y = 0" location.

11. Repeat Steps 8 through 10 until the concentric circles are centered at High and Low Mag without moving the calibration reticle or stage. Make sure the Low Mag camera lock-down screws are fully tightened when finished.

12. Check the rotational alignment of each camera; see ***Camera Rotation Adjustment*** on page 130.

8.3.8 Camera Rotation Adjustment

Note: Camera rotation affects camera centering and camera parfocal; repeat all adjustment procedures until there are no visible offsets.

Tools Required	Part No.
1X magnification lens	638939
Chrome-on-glass linear scale (longer than the X length of travel)	N/A
Set of Metric Allen wrenches	N/A
Set of English Allen wrenches	N/A
Small Phillips-head screwdriver	N/A

1. Place a chrome-on-glass scale that is longer than the X length of travel on the stage. Make sure the scale is parallel to the X-axis.
2. Install a 1X magnification lens and select the High Mag camera.
3. Focus on the scale using coaxial illumination. (Do not use backlight.)
4. Click  to display the Crosshair Finder and adjust (tram in) the rotation of scale until the observed vertical movement in the video is less than **0.005 mm (0.0002")** when the stage is moved over the entire X length of travel.
5. Once the glass scale has been trammed in and the Crosshair Finder is displayed in the Video window, use the joystick to move the stage over the X length of travel while observing the image of the scale.

   If the image of the glass scale appears to move vertically more than **0.005 mm (0.0002")**, continue with the next step. Otherwise, advance to Step 7.

6. Loosen the High Mag camera clamp screw and adjust the rotation set screws (see Figure 8-7) until the observed vertical movement between the Crosshair Finder and the scale is less than 0.005 mm (0.0002") when the stage is moved over the entire X length of travel. Tighten the camera clamp when finished.

Note: The camera clamp screw for the High Mag camera is a left-hand thread screw; i.e., turn clockwise to loosen, counterclockwise to tighten.

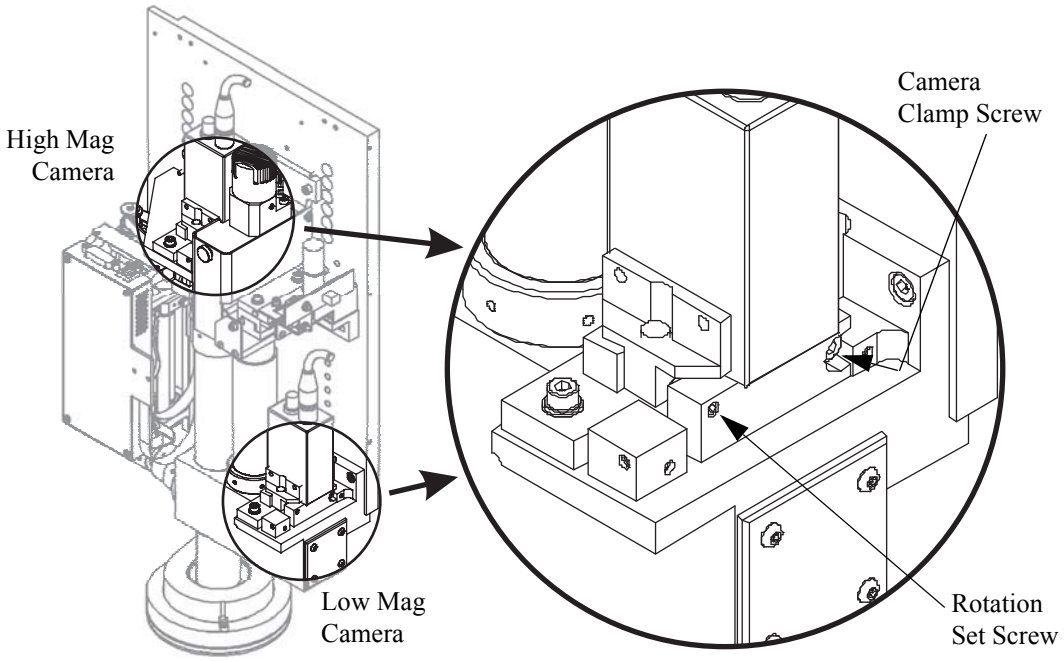


Figure 8-7 Camera Rotation Adjustment

7. Without moving the glass scale, select the Low Mag camera. Then use the joystick to move the stage over the X length of travel while observing the image of the scale.

   If the image of the scale appears to move vertically more than 0.005 mm (0.0002"), continue with the next step. If the observed vertical movement is less than 0.005 mm (0.0002"), you do not have to perform the rest of this procedure (check the par-center (coaxial) alignment of each camera; see ***Camera Par-Center (Coaxial) Adjustment*** on page 127).

8. Loosen the Low Mag camera clamp screw and adjust the rotation set screws until the observed vertical movement between the Crosshair Finder and the scale is less than 0.005 mm (0.0002") when the stage is moved over the entire X length of travel. Tighten the camera clamp when finished.

9. Check the par-center (coaxial) alignment of each camera; see ***Camera Par-Center (Coaxial) Adjustment*** on page 127.

8.4 Lens Calibration

Tools Required	Part No.
QVI Alignment Reticle	623970

Note: All optics should be aligned before performing this procedure.

1. Install the lens that you want to calibrate; see ***Replacing the Magnification Lens*** on page 154.
2. Mount and secure the QVI Alignment Reticle on the stage glass, so the lower-left corner of the reticle square in the field of view.
3. Click  to display the Crosshair Finder and adjust (tram in) the rotation of the reticle so it is square to the field of view.
4. Select the High Mag camera and manually focus on the lower-left corner of the reticle square.
5. Select **Setup / Calibration** to display the Lens Calibrations window (see Figure 8-8).

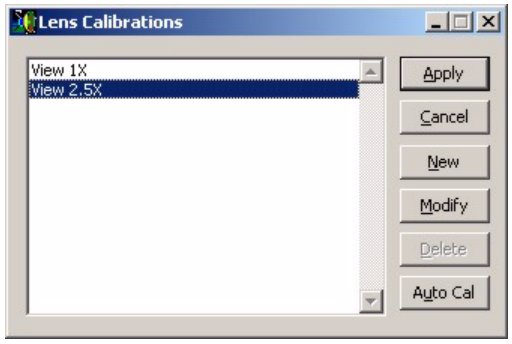


Figure 8-8 Lens Calibrations Window

6. From the list, select the lens that is currently installed on the system.

Note: If the lens you want to calibrate is not listed in the Lens Calibrations window, click the New button and define the new lens by selecting the type of lens and entering a descriptive name for the lens (for example, View 1X).

7. Click the **Auto Cal** button to display the FOV Calibration window (see Figure 8-9).

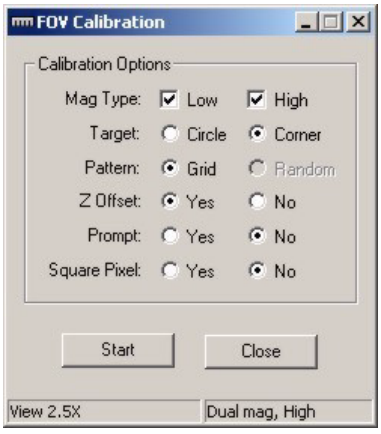


Figure 8-9 FOV Calibration Window

8. Select the **No Square Pixel** radio button.

9. Click the **Start** button and then click **OK** in response to the displayed prompt.

   The system automatically performs the lens calibration and displays the FOV Calibration window (see Figure 8-9) when finished.

10. Close the FOV Calibration window by clicking the **Close** button.

11. In the Lens Calibrations window (see Figure 8-8), click the **Apply** button to apply the changes.

12. Close the Lens Calibrations window by clicking the **Close** button.

8.5 AccuCentric Assembly Alignment (If Equipped)

Note: This section only applies to systems equipped with the optional AccuCentric assembly.

Tools Required	Part No.
Set of Metric Allen wrenches	N/A

Note: The AccuCentric assembly inserts a reticle image into the optical path that can be used to recalibrate the optical system whenever you switch from High Mag to Low Mag, and vice versa.

1. Launch the VMS software and zero the stages by clicking the **Zero Stage** button in the Stage and Lights window.
2. Switch to the High Mag camera and turn off all light sources.
3. Increase the intensity of the AccuCentric LED as much as possible without saturating the camera. You will see a bright spot, occupying most of the field of view, in the Video window. This is the image of the LED reticle.
   - If the reticle image is *not* in focus, continue with Step 4.
   - If the reticle image is in focus, advance to Step 8.
4. Remove the front cover by lifting it straight up.

5. Use a 1.5 mm Allen wrench to loosen the set screws that secure the reticle housing in place (see Figure 8-10).

6. Slide the reticle housing in and out until the reticle image is in focus in the Video window.

7. Hold the reticle housing as you re-tighten the set screws.

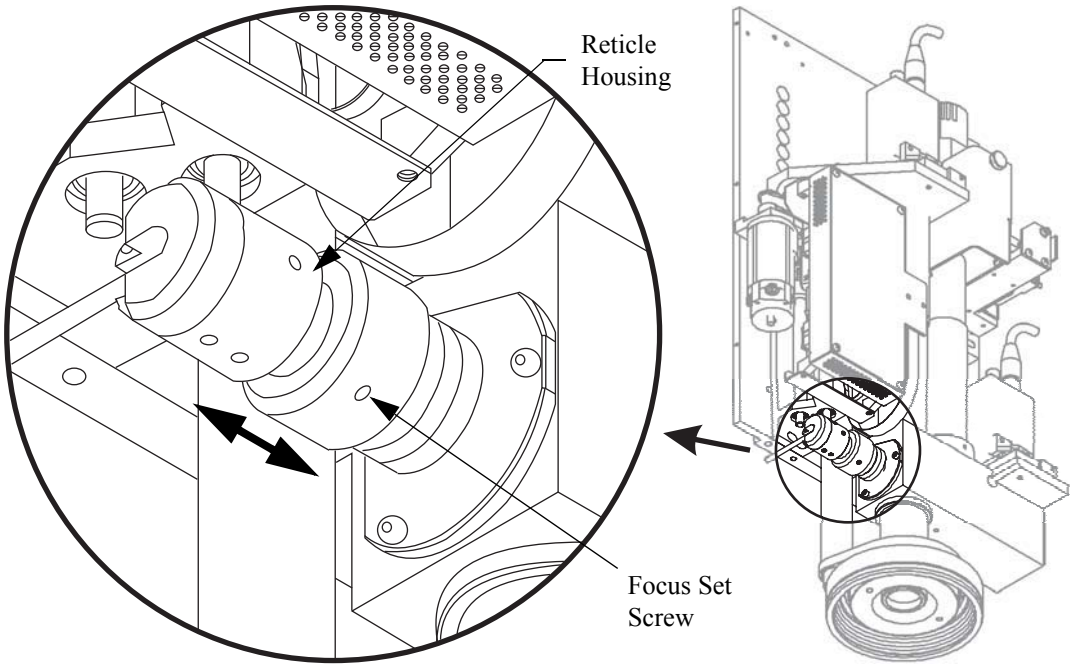


Figure 8-10 Focusing the LED Reticle

8. In VMS, click  to select the Circle Finder. If aligned correctly, the reticle image should be centered within the Circle Finder.

   - If the reticle image is *not* centered, continue with Step 9.
   - If the reticle image is centered, advance to Step 11.

9. If you have not already done so, remove the front cover by lifting it straight up.

10. Use a 1.5 mm Allen wrench to adjust the two centering set screws in the reticle housing (see Figure 8-11) until the reticle image is centered within the Circle Finder.

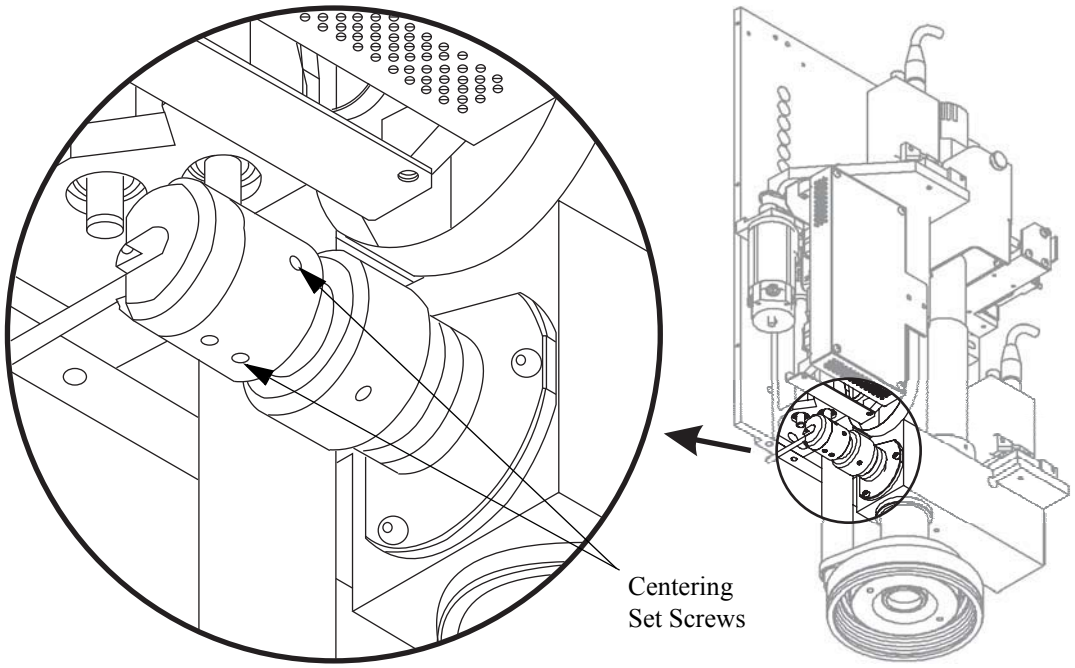


Figure 8-11 Centering the LED Reticle

11. Switch to the Low Mag camera and verify that the LED reticle image is centered within the Circle Finder at Low Mag.

- If the reticle image is *not* centered, perform the mechanical adjustment outlined in Step 10.
- If the reticle image is centered, continue with Step 12.

12. Re-install the front cover (if it was removed).

8.6 LED Programmable Ring Light (PRL) Adjustments (If Equipped)

Note: This section only applies to systems is equipped with the PRL.

Tools Required	Part No.
Set of Metric Allen wrenches	N/A
Set of English Allen wrenches	N/A
1X magnification lens	638939
Small, flat-head screwdriver	N/A
ViewDiag software (rev 2.01 or higher)	N/A
`LIGHTTEST70.VOY` part program	N/A
3 1/2-inch floppy disk	N/A
Gage blocks (at least 2 inches long)	N/A
Light Calibration Diffuser Block	3461257-1
1/8-inch thick plate (optional)	N/A

Note: Be sure to perform the PRL adjustment procedures outlined in this section in the order in which they are presented.

8.6.1 Centering the PRL

1. Power down the system.
2. Manually, drive the PRL down so the mirrors stop at their lower limit.

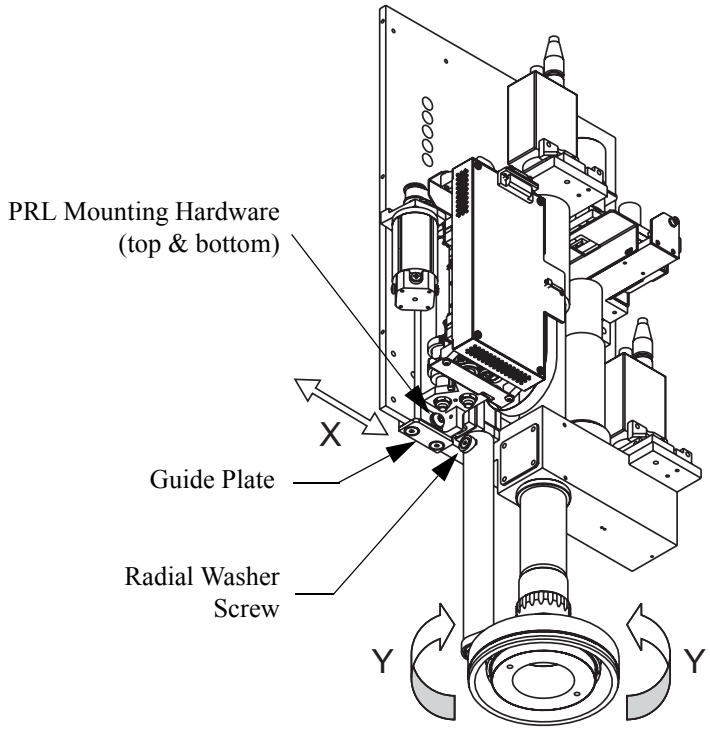


Figure 8-12 Centering the PRL

3. Loosen (do not remove) the PRL mounting screws.
4. Loosen the radial washer screw and then slightly re-tighten it so it is snug.
5. Manually drive the PRL up, so the mirrors are above the end of the lens tube (up travel). Pivot the mirror assembly as required.
6. Install a calibrated 1X magnification lens.
7. Manually drive the PRL up/down so the inner ring is approximately centered on the larger diameter (grip ridges) of the lens cover (down travel).

8. Adjust the PRL in the X and Y directions until the inner ring is approximately centered around the lens.

- **To set the X direction:** move the PRL base left or right, keeping the bottom edge of the base against the guide plate. Check for squareness by placing gage blocks on the stage glass, under the mirrors (see Figure 8-13). Adjust as necessary.

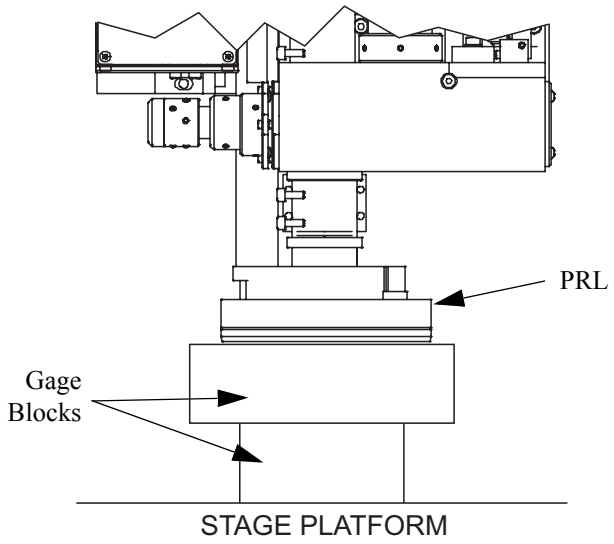


Figure 8-13 Checking for Squareness

- **To set the Y direction:** rotate the inner ring (the outer ring will follow). Make sure that the drive clamp does not come off of the upper drive block. If it does, loosen the clamp screw and rotate the tab until it engages the drive block. Then re-tighten the clamp screw (see Figure 8-14).

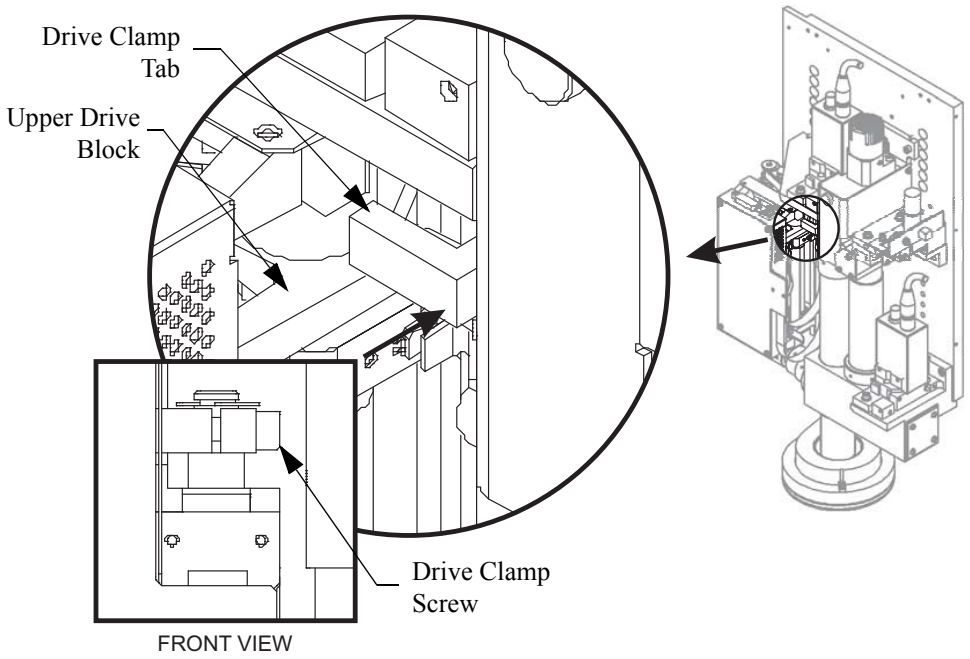


Figure 8-14 Upper Drive Block, Drive Clamp Tab, and Clamp Screw

9. After centering the inner ring, tighten all adjusting hardware. (You will need to manually drive the PRL down to access the radial washer screw.)

8.6.2 Adjusting the PRL Height

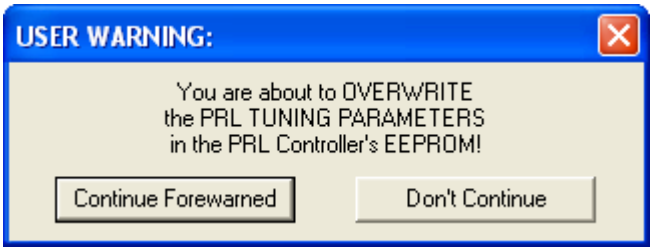
Note: This procedure sets the absolute height of the PRL rings in relation to the inspection surface.

1. Power up the system and launch the VMS software.
2. In the Stage and Lights window, select the **Stage** tab and click the **Zero Stage** button.
3. Wait for the stages to stop moving and then use the joystick to drive the Z-axis to its upper limit of travel.
4. Exit the VMS software and launch the ViewDiag software.

Caution: In the next step, the PRL will travel to its upper limit of travel and could make contact with the Z-axis assembly if the Z-axis is positioned too low. Performing Step 3 is critical to avoiding contact.

5. Click  in the toolbar and turn on Motion Enable by clicking the **On** button.
6. Click the **Calibrate Limit Switches** button.

   The PRL automatically calculates its upper and lower software limits.
7. After the PRL finishes calculating its upper and lower limits, click the **Save to EPROM** button and then click the **Continued Forewarned** button in response to the following warning:



8. If necessary, select the **Pos 1** or **Pos 2** radio button to re-display the Position slider. Then use the slider to drive the PRL to its upper limit of travel.

9. Exit the ViewDiag software and launch the VMS software.

10. In the Stage and Lights window, select the **Stage** tab and click the **Zero Stage** button.

11. Wait for the stages to stop moving and then turn on the coaxial light.

12. Use the following reference target to align the PRL to the optics. Photocopy the target and place the copy on the stage glass, below the optics. Tape it to the stage glass to prevent the target from moving during the alignment.

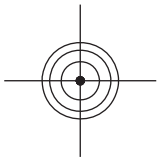


Figure 8-15 PRL to Optics Reference Target

13. Use the joystick to manually focus on and center the reference target within the field of view.

14. Right-click in the Video window and perform an Autofocus (no Ronchi). Click **OK**.

15. Click  to select the Circle Finder. Then verify that the optics are focused and the reference target is centered in the field of view. If necessary, focus the optics and center the target.

Note: After focusing the optics and centering the reference target, do not move the reference target or stage for any reason.

16. Exit the VMS software and launch the ViewDiag software.

17. Click  in the toolbar and turn on Motion Enable by clicking the **On** button.

18. Use the **Position** slider to drive the PRL to its lower limit.

19. Place a 1/8-inch thick plate (or 3 1/2-inch floppy disk) on the stage glass, below the optics.

20. Adjust the margin of the bottom switch to lower the PRL assembly so the mirrors are resting LIGHTLY on the 1/8-inch thick plate (or floppy disk); see Figure 8-16. This ensures that the mirrors are approximately 1/8-inch above the focal plane.

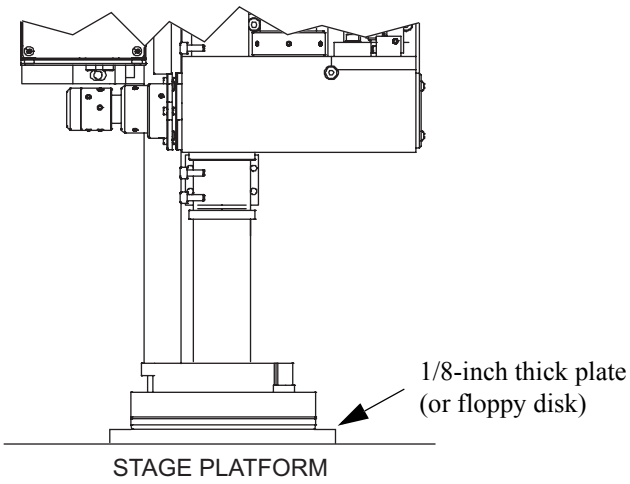
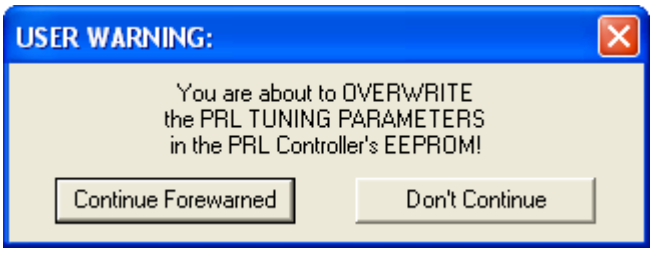


Figure 8-16 Height Adjustment

21. Click the **Save to EPROM** button and then click the **Continued Forewarned** button in response to the following warning:



22. Using the **Position** slider, drive the PRL to its upper limit and then turn off Enable Motion by clicking the **Off** button.

8.6.3 Setting Up the PRL Lights

Note: If you are performing this procedure immediately after the previous procedure and the stages and reference target have not been moved, advance to Step 9.

1. Launch the VMS software.
2. Click the **Zero Stage** button in the VMS Stage and Lights window.
3. Wait for the XY stage and Z-axis transport to stop moving, and then use the Coax Light slider in the VMS Stage and Lights window to turn on the coaxial illuminator.
4. Photocopy the PRL reference target (seeFigure Figure 8-15 on page 142) and place the copy on the stage glass, below the optics. Tape the target to the glass so it will not move during the alignment.
5. Use the joystick to manually focus on and center the reference target within the field of view.
6. Right-click in the Video window and perform an Autofocus (no Ronchi). Click **OK**.
7. Click  to select the Circle Finder. Then verify that the optics are focused and the reference target is centered in the field of view. If necessary, focus the optics and center the target.

Note: After focusing the optics and centering the reference target, do not move the reference target or stage for any reason.

8. Exit the VMS software and launch the ViewDiag software.
9. Click  in the toolbar and turn off Motion Enable by clicking the **Off** button.
10. Disconnect the PRL motor cable from the PRL Controller PCBA.

11. Manually drive the PRL down, so a 3 1/2-inch floppy disk fits between the optical block and the top of the inner PRL ring housing (see Figure 8-17). Turn the motor shaft so the disk is firmly held in place.

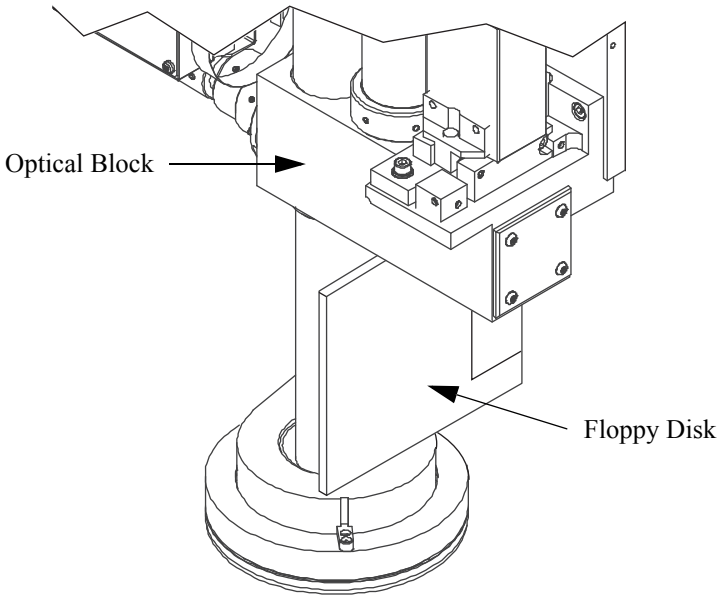


Figure 8-17 Inserting a Disk Between Optical Block and PRL

12. In the ViewDiag software, click  in the toolbar to display the Light Control window.

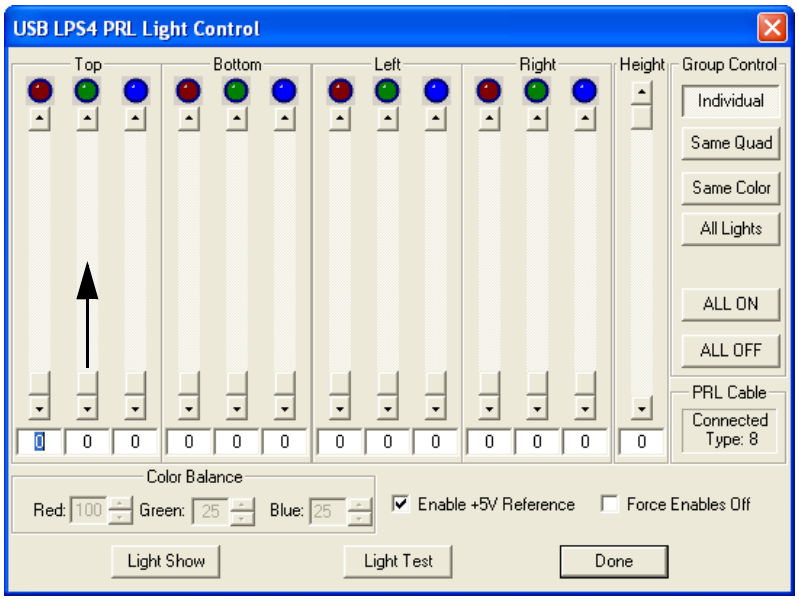


Figure 8-18 Light Control Window

13. Click the **Individual** button and turn on (about half way) one of the LED arrays (any color) in the **Top** quadrant (see Figure 8-18).

14. Loosen the PRL motor mount and belt tension screws.

Caution: Do not release tension on the rear shaft; this shaft is responsible for securing the floppy disk in place.

15. Without releasing the tension on the rear shaft, rotate the PRL motor to loosen the drive belt. Then manually rotate the front shaft (which controls the outer ring) up and down, observing where the light concentration "sweeps" across the reference target. The "sweet spot" should cover an 8 mm diameter, with the margins covering a diameter of 10 mm.

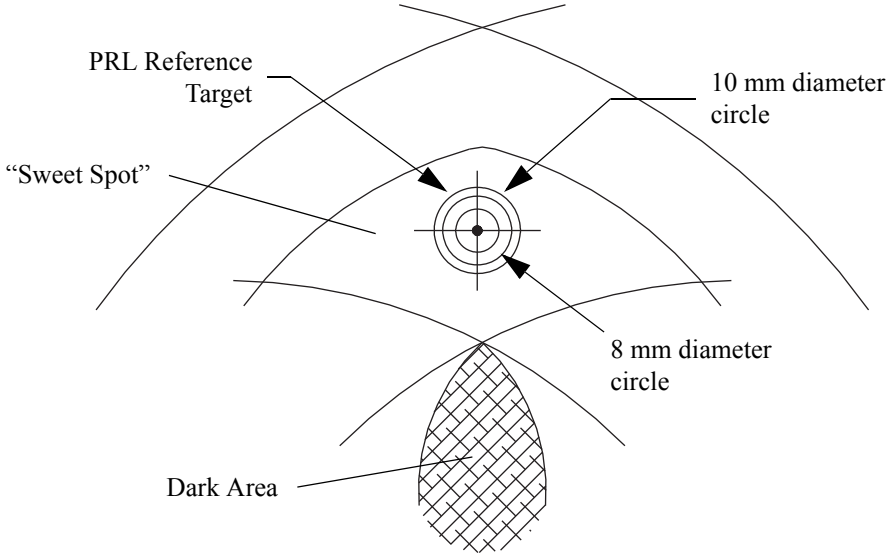


Figure 8-19 Finding the PRL's "Sweet Spot"

16. After finding the PRL's "sweet spot," rotate the PRL motor assembly to re-tighten the drive belt. Tighten the motor mount and tension screws. (It is acceptable for the outer ring's pulley to slip into an adjacent notch on the drive belt.)

17. Manually drive the PRL assembly down so you can remove the floppy disk.

18. Separately, check all of the LED arrays (colors) in all four quadrants. If the relationship between the target diameters and the "sweet spot" of the current LED array appears out of sync, you may have to re-center the mirrors around the lens tube; see ***Centering the PRL*** on page 138.

19. Exit the ViewDiag software.

20. Reconnect the PRL motor cable to the PRL Controller PCBA. (The PRL should not move when you reconnect the motor cable because you disabled motion in Step 9 above.)

21. Run the light test part program, as described next.

8.6.4 Checking the PRL Light Setup with the Light Test Part Program

1. Launch the VMS software.
2. Click the **Zero Stage** button in the VMS Stage and Lights window.
3. If necessary, place the copy of the PRL reference target (seeFigure Figure 8-15 on page 142) on the stage glass, below the optics. Tape the target to the stage glass so it will not move during the alignment.
4. Use the joystick to manually focus on and center the reference target within the field of view.
5. Right-click in the Video window and perform an Autofocus (no Ronchi). Click **OK**.
6. Click  to select the Circle Finder. Then verify that the optics are focused and the reference target is centered in the field of view. If necessary, focus the optics and center the target
7. Lower the PRL to its lower limit. The mirrors should be 1/8-inch above the stage glass (the thickness of a 3 1/2-inch floppy disk).
   - If the height is correct, continue with the next step in this procedure.
   - If the height is incorrect, perform Steps 16 through 22 in the procedure, ***Adjusting the PRL Height*** on page 141. Then go back to the beginning of this procedure.
8. Remove the PRL reference target from the stage glass and replace with the Light Calibration Diffuser Block (P/N 3461257-1).
9. Click  in the VMS toolbar and open the `LIGHTTEST70.VOY` part program.
10. Click  in the VMS toolbar and type the appropriate header information in the displayed User Input window.
11. In the next User Input window, type **B**.
12. In the final User Input window, type **P**.

    The part program automatically runs and checks the PRL light setup.

8.7 Z Brake Adjustment

Tools Required	Part No.
Set of Metric Allen wrenches	N/A
200 mm (8") wood block	N/A

Warning: This procedure is intended for qualified personnel only.

1. With the system powered up, use the joystick to lower the Z-axis transport to the lower limit of travel.
2. Power down the system and disconnect the power cord from the main power source.

Note: The following steps assume that power has been removed from the system.

3. Remove the front cover by lifting it straight up.

Caution: Never lift the Z-axis transport by the optics. Possible damage to the equipment could occur.

4. Grasp the sides of the Z-axis slide and slowly lift the slide.
5. Place a 200 mm (8") block on the stage, beneath the Z-axis slide.
6. Slowly lower the slide so it is resting on the wood block.

7. Use a 3 mm Allen wrench to loosen the brake clamp screw shown in Figure 8-10. The Z-axis brake is now free to move.

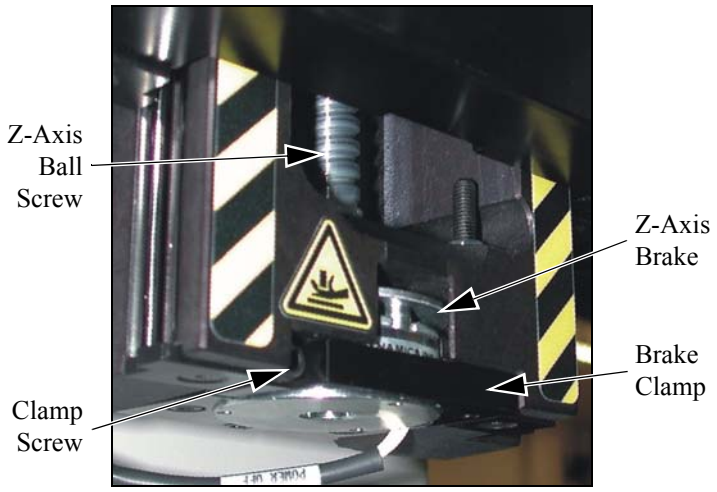


Figure 8-20 Loosening the Brake Clamp

8. Push the brake up against the brake hub, which is attached to the bottom of the Z-axis ball screw. Then back the brake off approximately 0.4 mm (0.015") and tighten the brake clamp screw. The gap between the hub and the friction disk in the brake must be 0.25 - 0.50 mm (0.010 - 0.020").

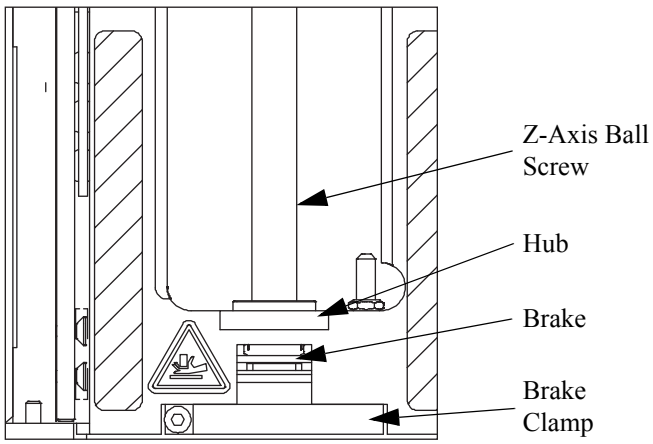


Figure 8-21 Adjusting the Z-Axis Brake

9. Remove the wood block and gently lower the Z-axis slide.

10. Re-install the front cover.

11. Re-connect the power cord, power up the system, and verify proper system operation.

Parts Repair & Replacement

Chapter 9

9.1 What This Chapter Contains

This chapter describes how to replace the Benchmark 250 imaging, transport, and electrical components. Contact your local Sales or Service Representative for part ordering information.

Warning: Unless instructed otherwise, always turn off the equipment and disconnect it from the main power supply while servicing; see ***System AC Power Connector*** on page 12.

Note: The risk of electrical shock is present any time the covers are removed from the machine. To avoid exposure to high voltage, never remove the covers from the monitor or system power supply.

Caution: Protect the Benchmark 250 system from electrostatic damage. Perform these procedures at a static-safe workstation and wear a ground strap. If a ground strap is not available, follow these guidelines:

- Work in an uncarpeted area.
- Before touching electronic components, discharge static electricity by touching a known-grounded object.
- Do not touch components on printed circuit boards, except as directed.

9.2 Repairing & Replacing Parts on Your System

The following is a list of user-serviceable parts. Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4) for the latest part revisions.

Parts to Replace	Part No.	Where to Find Procedure
Joystick, 3-axis, 2-button	039037	—
Mouse	3481204-1	—
Keyboard	3481284-1	—
Remote E-Stop	039836	—
20-inch Flat Panel LCD Monitor	037982	—
Magnification Lens, 0.8X	638685	See ***Replacing the Magnification Lens*** on page 154.
Magnification Lens, 1.0X	638939	
Magnification Lens, 2.5X	638940	
Magnification Lens, 5.0X	638941	
Magnification Lens, 10X	638942	
Magnification Lens, 25X	532186	
Camera, Low Mag, 1/2" (standard)	036473	See ***Replacing the High & Low Mag Cameras*** on page 155.
Camera, Low Mag, 2/3" (optional)	036474	
Camera, High Mag, 1/2"	036473	
PRL Assembly (if equipped)	2111420	See ***Replacing the Programmable Ring Light (PRL) (If Equipped)*** on page 157.
AccuCentric Assembly (if equipped)	529650	See ***Replacing the AccuCentric Assembly (If Equipped)*** on page 159.
Scale Reader Head, X-Axis	036791	See ***Replacing the X-Axis Scale Reader Head*** on page 162.
Scale Reader Head, Y-Axis	036791	See ***Replacing the Y-Axis Scale Reader Head*** on page 168.
Scale Reader Head, Z-Axis	036791	See ***Replacing the Z-Axis Scale Reader Head*** on page 174.
Motor, X-axis	036093	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).
Motor, Y-Axis	036093	Contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).

Parts to Replace	Part No.	Where to Find Procedure
Motor, Z-Axis	030279	See ***Replacing the Z-Axis Motor*** on page 178.
PCBA, DSP Multi Axis	036405.02	See ***Replacing the DSP Multi Axis PCBA*** on page 183.
PCBA, Z Brake Control	028181.02	See ***Replacing the Z Brake Control PCBA*** on page 185.
PCBA, LED Driver	039322.02	See ***Replacing the LED Driver PCBA*** on page 187.
PCBA, Dual Mag Optics	034702.01	See ***Replacing the Dual Mag Optics PCBA*** on page 189.
PCBA, Universal Multi-Sensor	032881	See ***Replacing the Universal Multi-Sensor PCBA (If Equipped)*** on page 191.
PCBA, Micro Theta Control	039192	See ***Replacing the Micro Theta Control PCBA (If Equipped)*** on page 193.
Power Supply	026775	See ***Replacing the Power Supply*** on page 195.
Fan, Electronics Exhaust	020372	See ***Replacing the Exhaust Fan*** on page 198.

9.3 Replacing the Magnification Lens

Caution: Make sure no parts are located on the stage, below the optics, before replacing the magnification lens.

1. Use the joystick to lower the optical assembly so the magnification lens is accessible.

2. If the system is equipped with the Programmable Ring Light (PRL), move the assembly to the **0** setting (from within the metrology software). This provides access to the magnification lens.

3. Unscrew the magnification lens (CCW) from the lens tube and carefully set the lens aside.

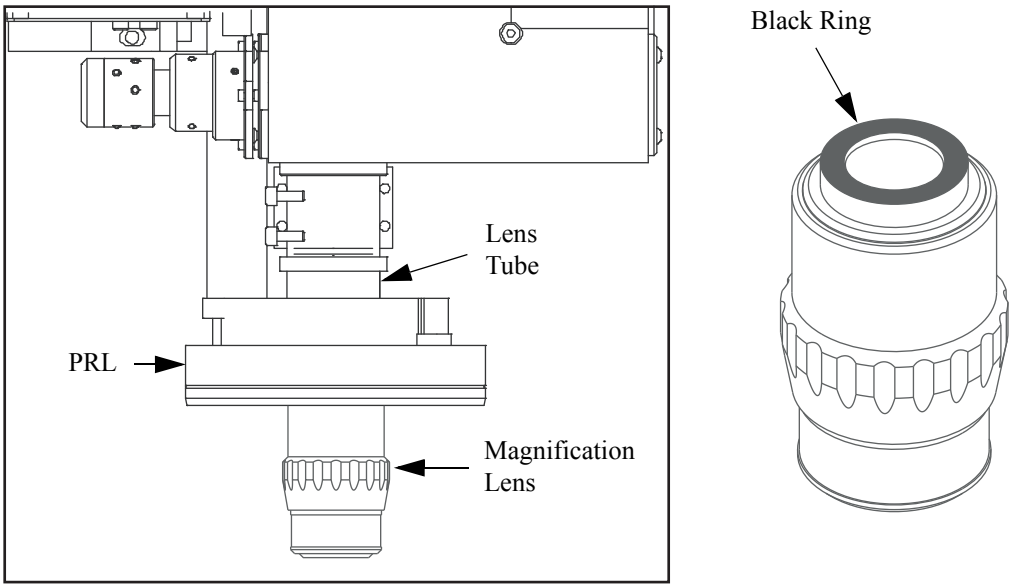


Figure 9-1 Removing the Magnification Lens

4. Install the replacement magnification lens by screwing it (CW) into the threaded opening in the bottom of the lens tube.

5. Select **Setup / Lens Calibration** and apply the lens calibration values. If the lens has never been calibrated on the system, perform the Lens Calibration procedure on page 132.

9.4 Replacing the High & Low Mag Cameras

Tools Required	Part No.
Small Phillips-head screwdriver	N/A
Set of Metric Allen wrenches	N/A

1. Power down the system and disconnect the power cord from the main power source.
2. Remove the front cover by lifting it straight up.
3. Disconnect the coaxial cable from the top of the camera to be replaced by pulling up on the connector (see Figure 9-2).

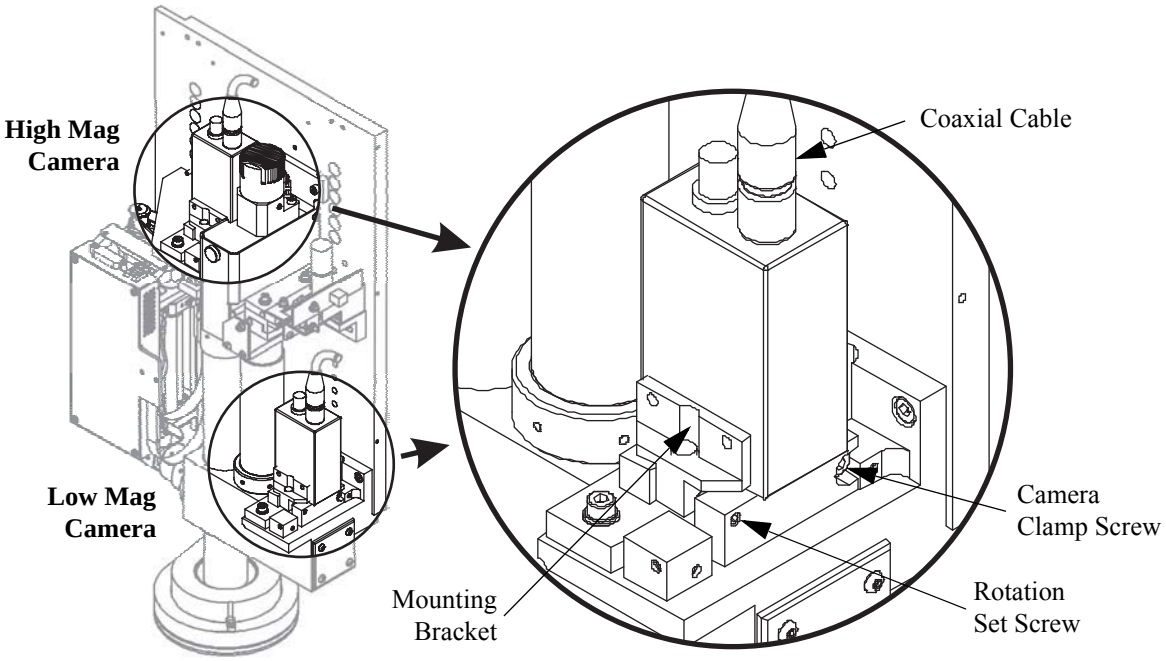


Figure 9-2 Replacing the Camera(s)

4. Loosen the camera clamp set screw.

Note: The high mag camera clamp is accessed from the left, with a *left-hand thread set screw*; i.e., turn CW to loosen, CCW to tighten.

5. There are two rotation set screws, one on each side of the mounting plate. Loosen either one, but not both; this will ensure that camera alignment is maintained.

6. Lift the camera (with threaded adapter tube and mounting bracket) out of the camera assembly.

7. Remove the camera mounting screws and washers from the camera mounting bracket. Retain all hardware.

8. Slide the camera and threaded adapter tube out of the mounting bracket.

Caution: Carefully remove and install threaded adapter tubes on the cameras *in a dust-free environment*.

9. Unscrew the camera from the threaded adapter tube.

10. Screw the threaded adapter tube (removed in Step 9) into the replacement camera. Note that these tubes are *not* interchangeable.

11. Put the replacement camera and threaded adapter tube into the camera mounting bracket, and re-install all hardware.

12. Set the camera (with threaded adapter tube and mounting bracket) in place. Make sure the proper camera is installed in the proper path.

13. Tighten the rotation set screw and the camera clamp set screw.

14. Connect the coaxial cable to the top of the camera.

15. Perform the optical adjustment procedures; see ***Dual Magnification Optical System Adjustments*** on page 117.

16. Re-install the front cover.

Note: The Benchmark 250 system comes standard with 1/2" format Low Mag and High Mag cameras. A 2/3" format Low Mag camera is available as an option.

9.5 Replacing the Programmable Ring Light (PRL) (If Equipped)

Tools Required	Part No.
Set of Metric Allen wrenches	N/A

1. With the system powered up, use the joystick to raise the optical assembly to the upper limit of travel.
2. Power down the system and disconnect the power cord from the main power source.
3. Remove the front cover by lifting it straight up. The PRL assembly is mounted on the left side of the optics plate (see Figure 9-3).

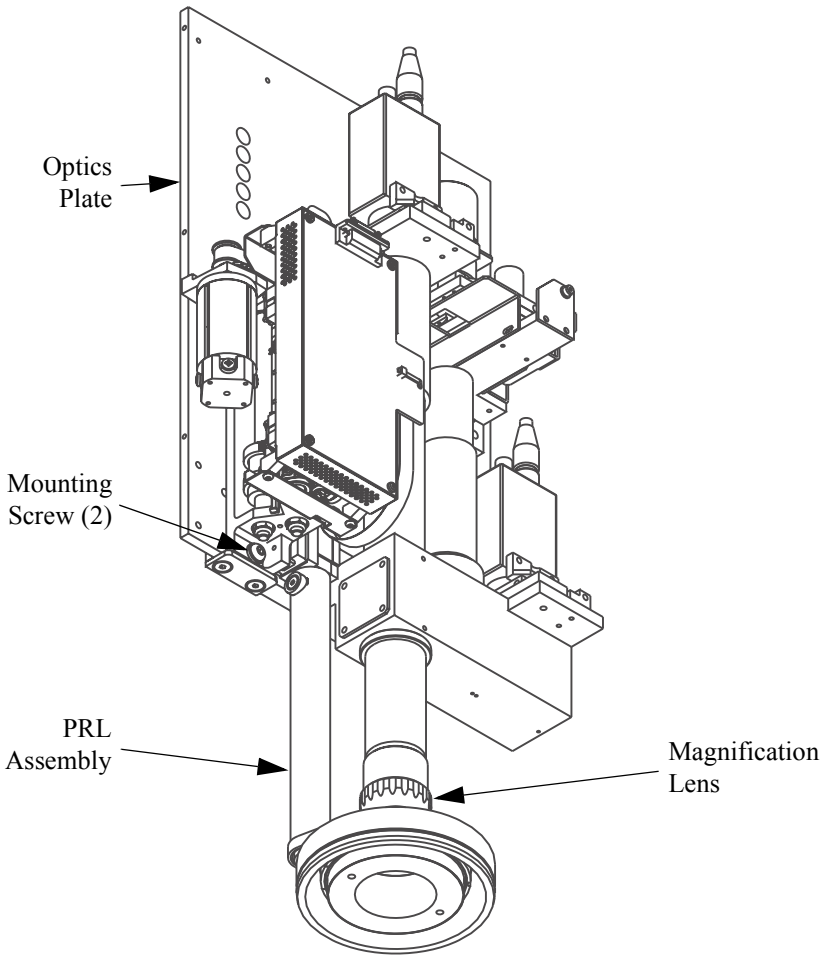


Figure 9-3 Location of PRL Mounting Screws

4. Disconnect all cables from the PRL assembly. If necessary, label the connectors to aid in re-installation.

5. Remove the mounting screws that secure the PRL assembly to the optical plate. Retain all mounting hardware.

6. Remove the PRL assembly by lowering it until it clears the magnification lens.

7. Replace the old PRL assembly with the new PRL assembly.

8. Re-install the mounting screws (and washers) that secure the PRL assembly to the optics plate. Then reconnect all cables that were previously removed.

9. Perform the PRL adjustment procedures; see ***LED Programmable Ring Light (PRL) Adjustments (If Equipped)*** on page 137.

10. Re-install the front cover.

9.6 Replacing the AccuCentric Assembly (If Equipped)

Tools Required	Part No.
Set of Metric Allen wrenches	N/A
Wire cutters	N/A
Cable ties	N/A

1. Power down the system and disconnect the power cord from the main power source.

2. Remove the front cover by lifting it straight up. The AccuCentric assembly is located on the left side of the optics (see Figure 9-4).

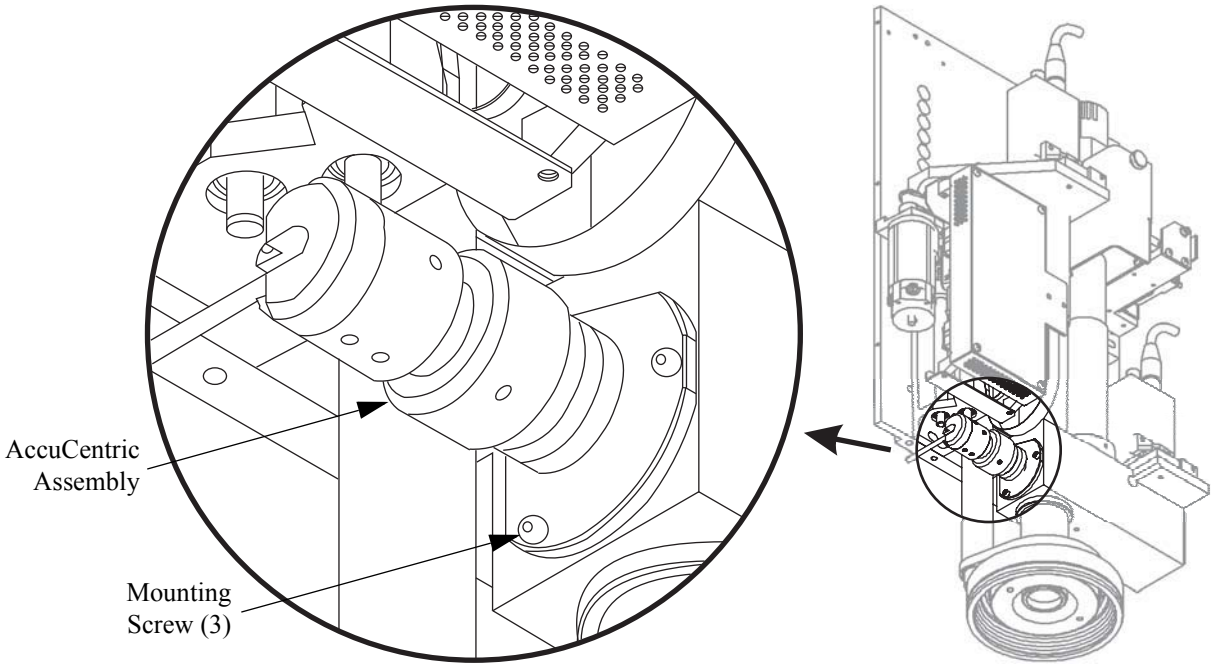


Figure 9-4 Location of the AccuCentric Assembly

3. Follow the AccuCentric cable to the Dual Mag Optics PCBA and disconnect the cable from connector **J615**, cutting the cable ties to free the cable.

4. Remove the mounting screws and washers that secure the AccuCentric assembly to the optical block. Retain all mounting hardware.

5. Replace the old AccuCentric assembly with the new assembly.

6. Re-install the three screws that secure the AccuCentric assembly to the optical block.

7. Connect the AccuCentric cable to connector **J615** on the Dual Mag Optics PCBA and use cable ties to secure the cable.

8. Return the system to normal operation and align the AccuCentric assembly; see ***AccuCentric Assembly Alignment (If Equipped)*** on page 134.

9. Re-install the front cover.

9.7 Replacing the Scale Reader Heads

Tools Required	Part No.
Set of Metric Allen wrenches	N/A
Small, flat-head screwdriver	N/A
Shock absorbing material	N/A
Wire cutters	N/A
Cable ties	N/A

This section outlines how to replace the following:

- X-axis scale reader head; see ***Replacing the X-Axis Scale Reader Head*** on page 162
- Y-axis scale reader head; see ***Replacing the Y-Axis Scale Reader Head*** on page 168
- Z-axis scale reader head; see ***Replacing the Z-Axis Scale Reader Head*** on page 174

Caution: Avoid scratching the tape scale when replacing a scale reader head.

Note: When removing an old scale reader head, be sure to retain all mounting hardware.

9.7.1 Replacing the X-Axis Scale Reader Head

Tools Required	Part No.
Set of Metric Allen wrenches	N/A
Small, flat-head screwdriver	N/A
Wire cutters	N/A
Cable ties	N/A

1. Power down the system and disconnect the power cord from the main power source.

2. Use a 2.5 mm Allen wrench to remove the two button-head screws that secure the post Y-axis cover to the electronics tower (see Figure 9-5). Remove the cover and set it aside.

3. Use a small flat-head screwdriver to remove the four flat-head screws that secure the Y-axis cover to the machine. Remove the cover and set it aside. Retain all hardware.

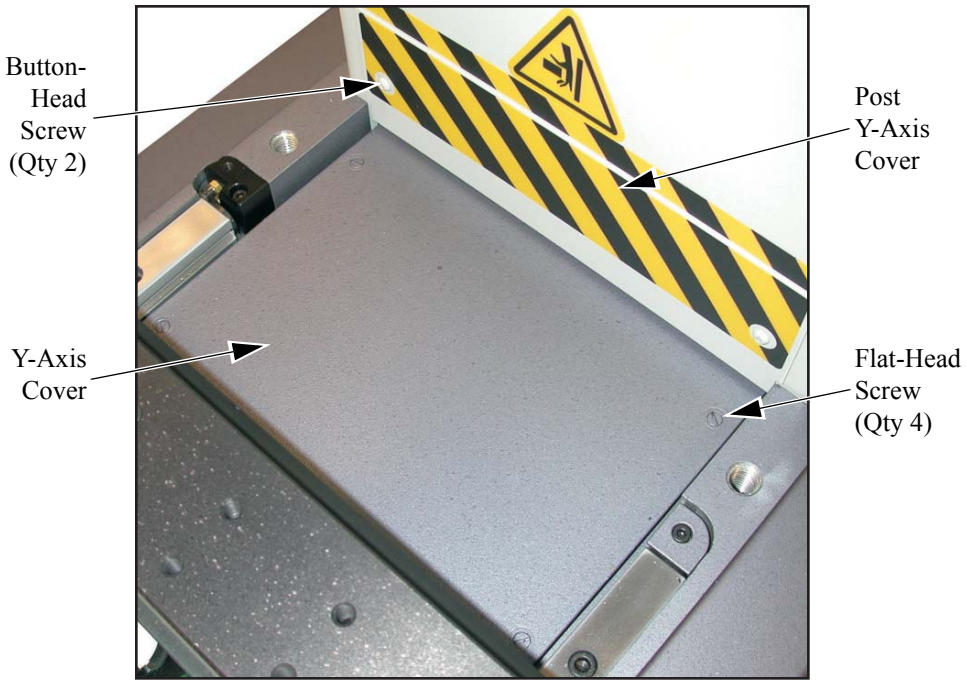


Figure 9-5 Removing the Y-Axis Covers

4. Locate the X-axis scale reader head, which is mounted below the back of the stage (see Figure 9-6).

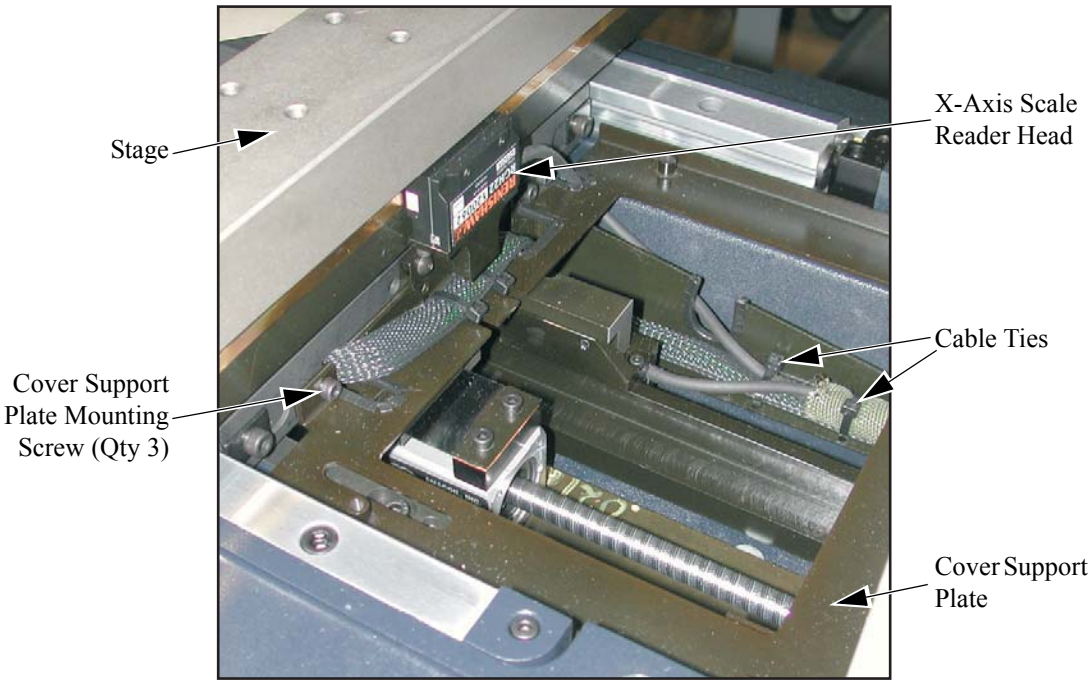


Figure 9-6 Removing the Cover Support Plate

5. Use a 3 mm Allen wrench to remove the three socket-head cap screws that secure the cover support plate to the machine.

6. Remove the cover support plate and set it aside. Then cut and remove any cable ties that secure the reader head cable to the machine.

Caution: Do not let the rear door drop. Support it while lowering it into position.

7. Use a flat-head screwdriver to loosen the rear door fasteners, and slowly lower the door until it is perpendicular to the electronics tower and is supported by the rear door retainer.

8. Disconnect the X and Y scale connectors from **J304** and **J303** on the DSP Multi Axis PCBA (see Figure 9-7).

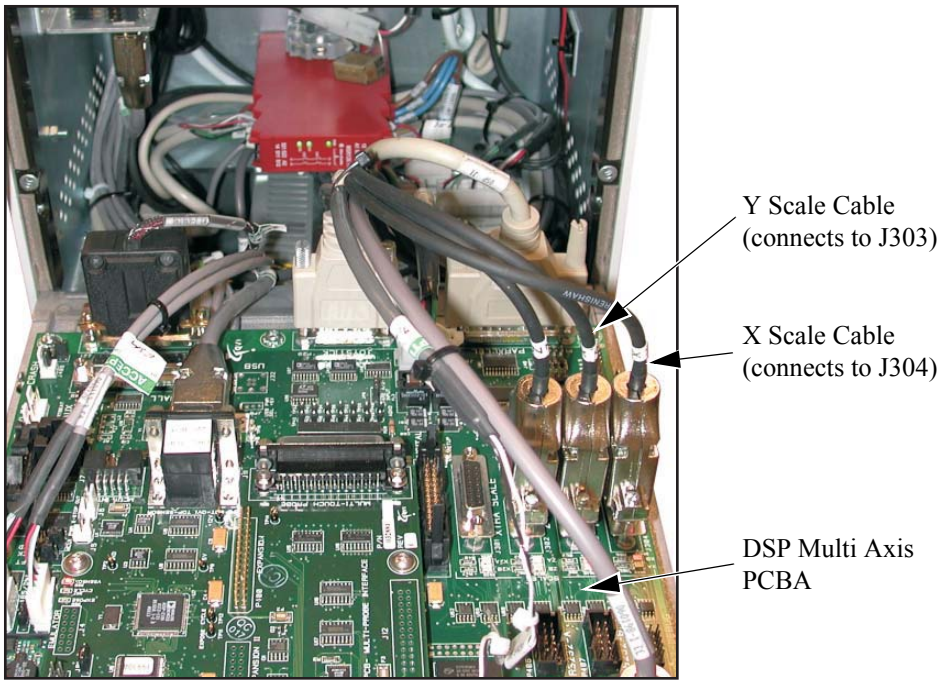


Figure 9-7 Disconnecting the X and Y Scale Connectors from the DSP Multi Axis PCBA

9. Cut any necessary cable ties to free the X and Y scale cables. Then drop the cables into the lower portion of the electronics tower.

10. Use a flat-head screwdriver to loosen the five lower rear panel fasteners. Move the rear panel out of the way without damaging the ground wire attached to the panel. This provides access to the lower electronics compartment.

11. Unlatch the upper and lower cable clamps (see Figure 9-8) and pull the flex cable tubing—contains the X and Y scale cables—out of the lower clamp and straight back, toward you.

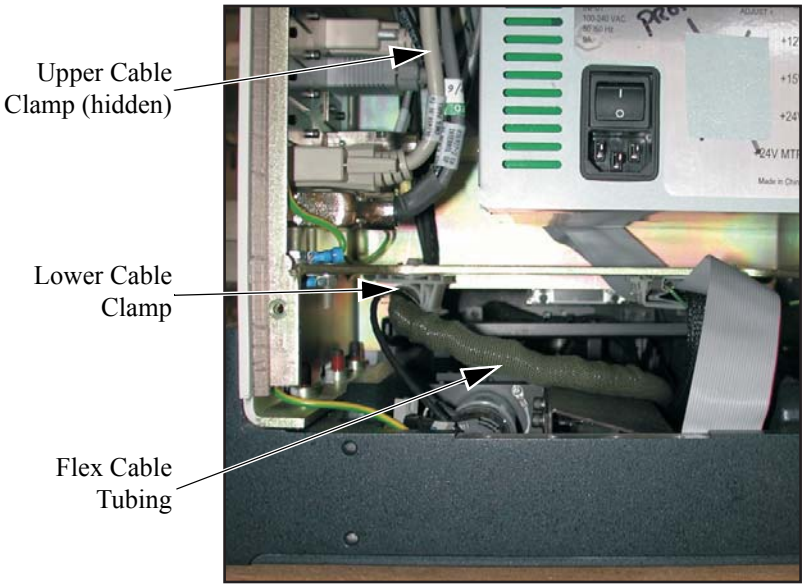


Figure 9-8 Lower Electronics Compartment (Lower Rear Panel Removed)

Caution: Avoid scratching the tape scale when removing the X-axis scale reader head.

12. Use a 2.5 mm Allen wrench to remove the two socket-head cap screws that secure the X-axis scale reader head to its mounting bracket (see Figure 9-9).

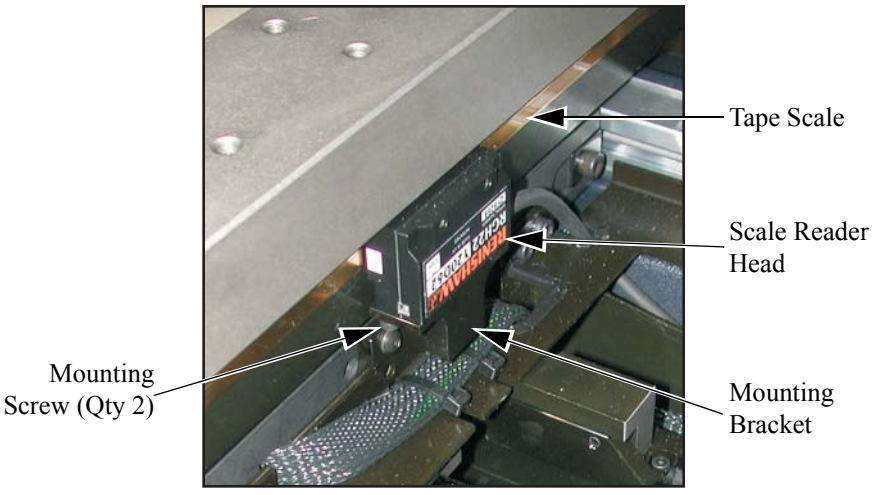


Figure 9-9 Removing the X-Axis Scale Reader Head

13. Remove the X-axis scale reader head. The flex cable tubing should be free to follow the reader head.

14. Remove the X scale cable from the flex cable tubing, while leaving the Y scale cable inside the tubing. Discard the defective X-axis scale reader head.

Caution: Avoid scratching the tape scale when inserting and removing the orange and blue spacers.

15. Loosely install the replacement X-axis scale reader head, using the supplied orange spacer to align the reader head to the tape scale.

16. Remove the orange spacer and insert the supplied blue 0.8 mm spacer between the reader head and the tape scale. Slightly push the reader head toward the tape scale and tighten the mounting screws. Then remove the spacer.

Note: Refer to the Installation Guide provided with the new scale reader head for more information about adjusting the reader head.

17. Feed the X scale cable into the flex cable tubing, next to the Y scale cable, and route the flex cable tubing back through the lower and upper electronics compartments.

18. Reconnect the X and Y scale connectors to **J304** and **J303** on the DSP Multi Axis PCBA.

19. Refer to the previous steps and complete the re-assembly process by:

    - Installing any previously removed cable ties
    - Re-installing the lower rear panel (see Step 10)
    - Closing the rear door (see Step 7)
    - Re-installing the cover support plate (see Step 5 and Step 6)

Warning: The next step involves powering up the system with covers removed. Exercise caution whenever operating the system in this state.

20. Power up the system and launch the metrology software.

21. Use the joystick to move the stage along the full length of X travel while observing the lamp on the X-axis scale reader head.

The lamp should remain green through the entire X travel.

- If the lamp remains green through the entire travel, no adjustment is necessary. Power down the system and re-install the Y-axis cover (see Step 3) and post Y-axis cover (see Step 2).
- If the lamp illuminates yellow or red, even for a short period of time, power down the system and re-adjust the reader head spacing. Repeat Step 20 and Step 21 until the lamp remains green through the entire travel.

Note: The lamp may illuminate yellow or red if the reader head is too close to the scale, too far away from the scale, or not parallel to the scale.

9.7.2 Replacing the Y-Axis Scale Reader Head

Tools Required	Part No.
Set of Metric Allen wrenches	N/A
Small, flat-head screwdriver	N/A
Wire cutters	N/A
Cable ties	N/A

1. Power down the system and disconnect the power cord from the power source.

2. Use a 2.5 mm Allen wrench to remove the two button-head screws that secure the post Y-axis cover to the electronics tower (see Figure 9-5). Remove the cover and set it aside.

3. Use a small flat-head screwdriver to remove the four flat-head screws that secure the Y-axis cover to the machine. Remove the cover and set it aside. Retain all hardware.

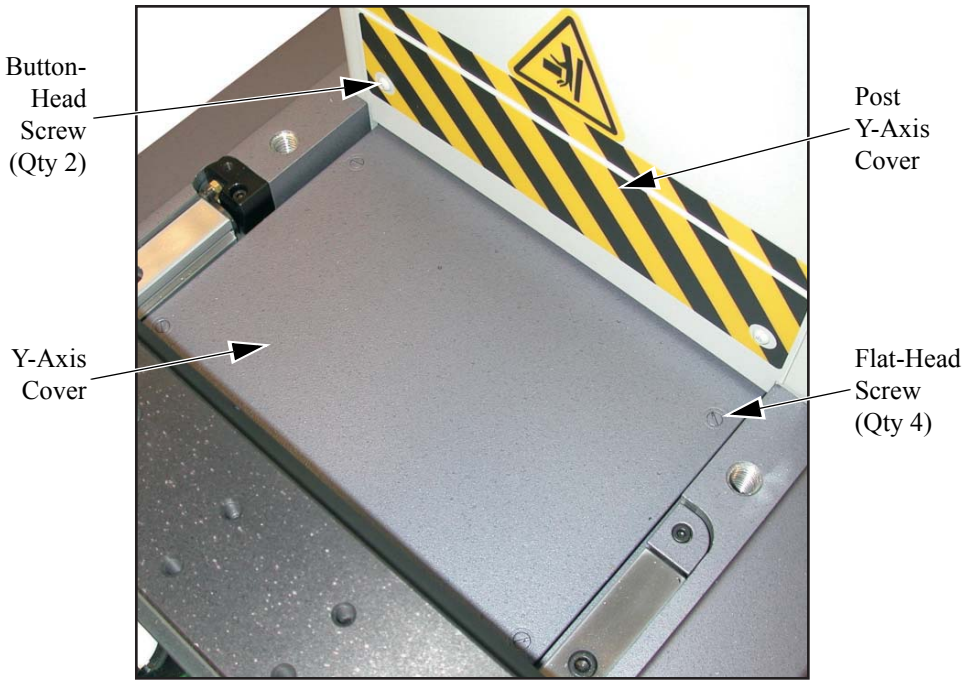


Figure 9-10 Removing the Y-Axis Covers

4. Locate the Y-axis scale reader head (see Figure 9-11).

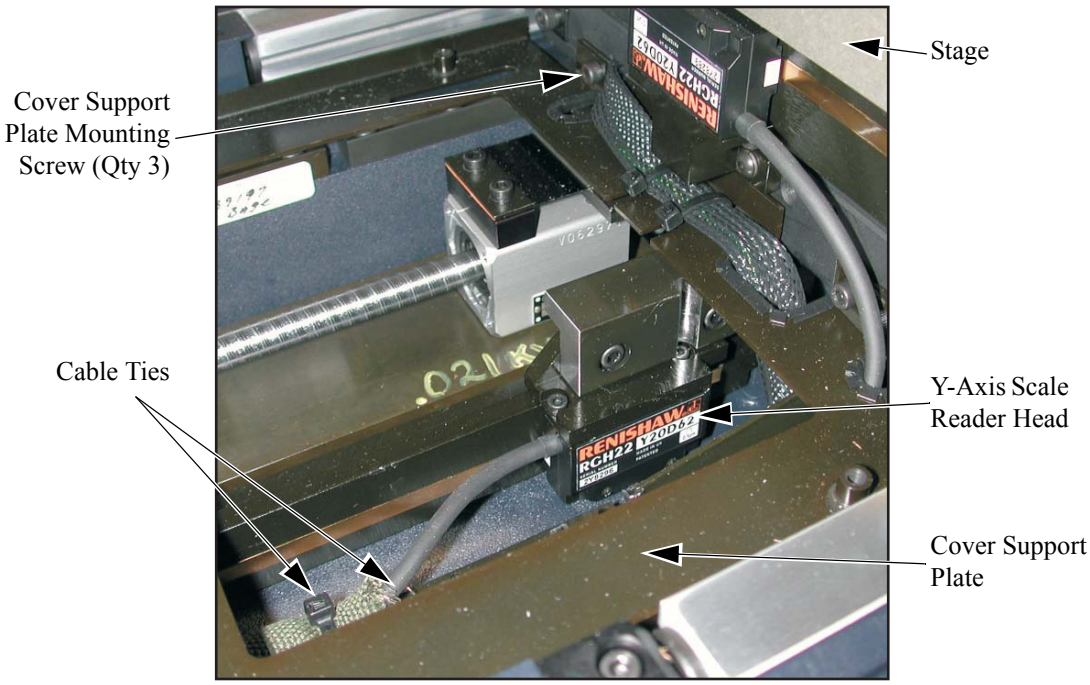


Figure 9-11 Removing the Cover Support Plate

5. Use a 3 mm Allen wrench to remove the three socket-head cap screws that secure the cover support plate to the machine.

6. Remove the cover support plate and set it aside. Then cut and remove any cable ties that secure the reader head cable to the machine.

Caution: Do not let the rear door drop. Support it while lowering it into position.

7. Use a flat-head screwdriver to loosen the rear door fasteners, and slowly lower the door until it is perpendicular to the electronics tower and is supported by the rear door retainer.

8. Disconnect the X and Y scale connectors from **J304** and **J303** on the DSP Multi Axis PCBA.

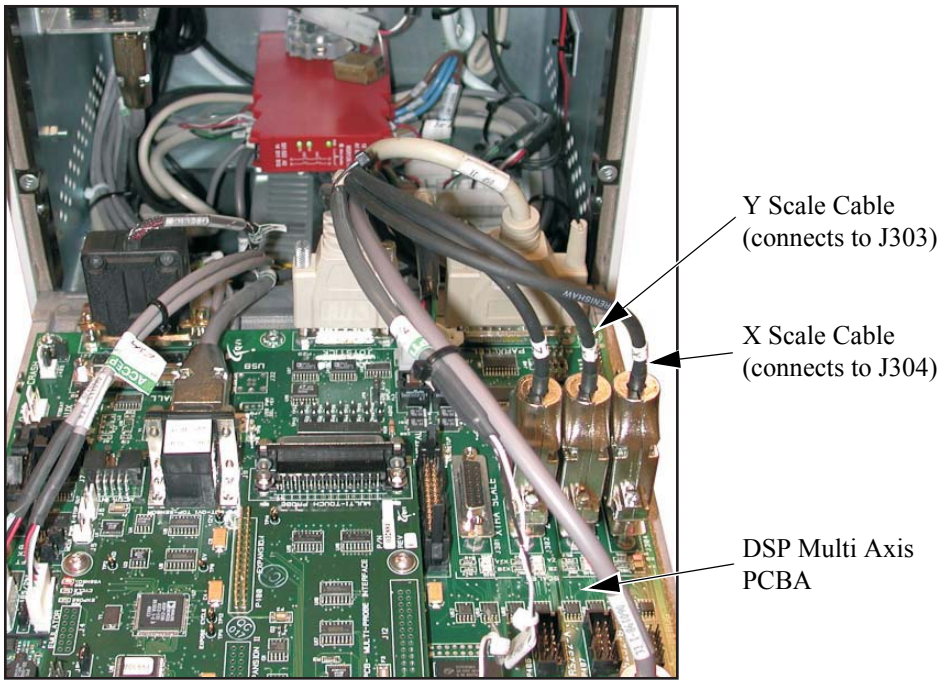


Figure 9-12 Disconnecting the X and Y Scale Connectors from the DSP Multi Axis PCBA

9. Cut any necessary cable ties to free the cables. Then drop the cables into the lower portion of the tower.

10. Use a flat-head screwdriver to loosen the five lower rear panel fasteners. Move the rear panel out of the way without damaging the ground wire attached to panel. This provides access to the lower electronics compartment.

11. Unlatch the upper and lower cable clamps (see Figure 9-13) and pull the flex cable tubing—contains the X and Y scale cables—out of the lower clamp and straight back, toward you.

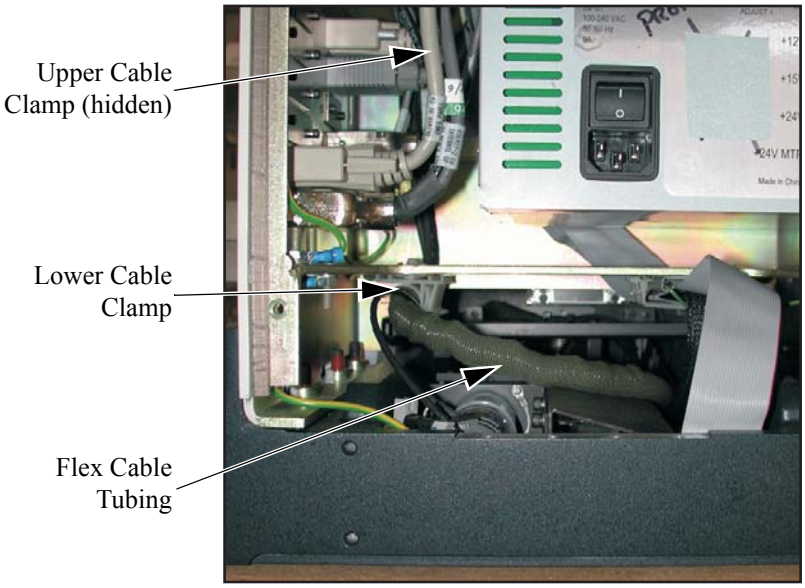


Figure 9-13 Lower Electronics Compartment

Caution: Avoid scratching the tape scale when removing the Y-axis scale reader head.

12. Use a 2.5 mm Allen wrench to remove the two socket-head cap screws that secure the reader head to the mounting bracket.

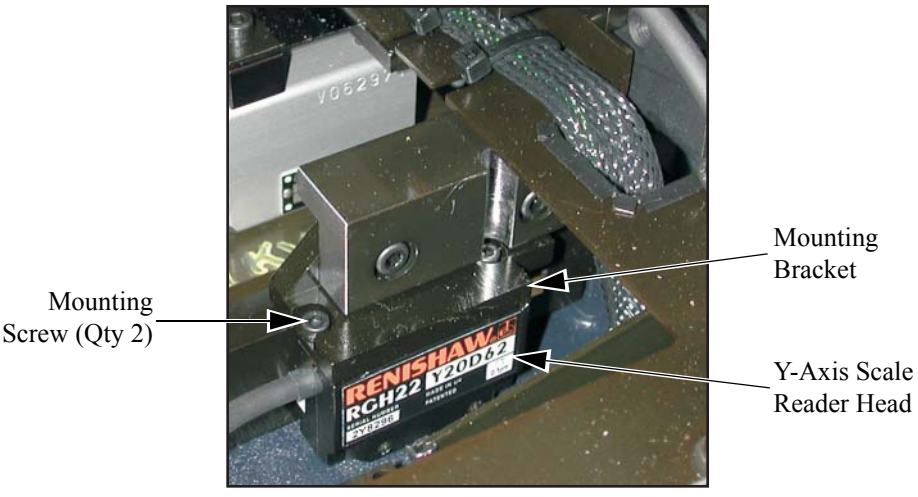


Figure 9-14 Removing the Y-Axis Scale Reader Head

13. Remove the Y axis reader head. The flex cable tubing should be free to follow the reader head.

14. Remove the Y scale cable from the flex cable tubing, while leaving the X scale cable inside the tubing. Discard the defective Y axis reader head.

Caution: Avoid scratching the tape scale when inserting and removing the orange and blue spacers.

15. Loosely install the replacement Y axis reader head, using the orange spacer to align the reader head to the tape scale.

16. Remove the orange spacer and insert the blue 0.8 mm spacer between the reader head and the tape scale. Slightly push the reader head toward the tape scale and tighten the mounting plate screws. Then remove the spacer.

17. Feed the Y Scale Cable into the flex cable tubing, next to the X scale cable, and route the flex cable tubing back through the lower and upper electronics compartments.

18. Reconnect the X and Y scale connectors to **J304** and **J303** on the DSP Multi Axis PCBA.

Note: Refer to the Installation Guide provided with the new scale reader head for more information about adjusting the reader head.

19. Refer to the previous steps and complete the re-assembly process by:

    - Installing any previously removed cable ties
    - Re-installing the lower rear panel (see Step 10)
    - Closing the rear door (see Step 7)
    - Re-installing the cover support plate (see Step 5 and Step 6)

Warning: The next step involves powering up the system with covers removed. Exercise caution whenever operating the system in this state.

20. Power up the system and launch the metrology software.

21. Use the joystick to move the stage along the full length of Y travel while observing the lamp on the Y axis reader head.

The lamp should remain green through the entire Y travel.

- If the lamp remains green through the entire travel, no adjustment is necessary. Power down the system and re-install the Y axis cover (see Step 3) and post Y axis cover (see Step 2).
- If the lamp illuminates yellow or red, even for a short period of time, power down the system and re-adjust the reader head spacing. Repeat Step 20 and Step 21 until the lamp remains green through the entire travel.

Note: The lamp may illuminate yellow or red if the reader head is too close to the scale, too far away from the scale, or not parallel to the scale.

9.7.3 Replacing the Z-Axis Scale Reader Head

Tools Required	Part No.
Set of Metric Allen wrenches	N/A
Small, flat-head screwdriver	N/A
Shock absorbing material	N/A
Wire cutters	N/A
Cable ties	N/A

1. Power down the system and disconnect the power cord from the main power source.
2. Place a piece of shock absorbing material on the stage glass for protection.
3. Remove the front cover by lifting it straight up, which reveals the Z-axis slide assembly. Note the location of the scale reader head on the left side of the Z-axis slide (see Figure 9-15).

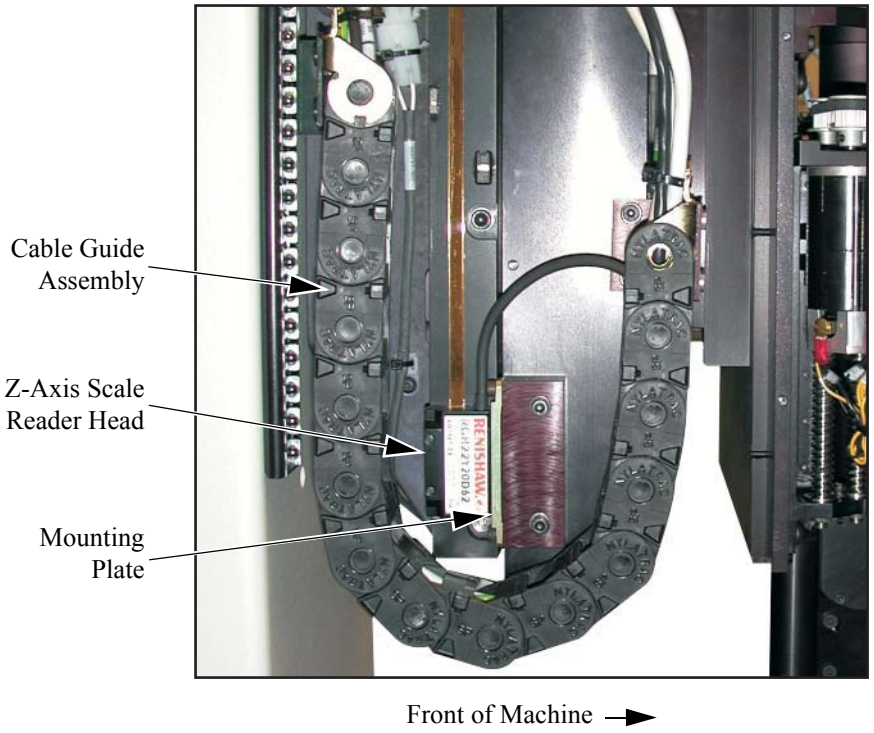


Figure 9-15 Location of the Z-Axis Scale Reader Head

Caution: Do not let the rear door drop. Support it while gently lowering it into position.

4. Use a flat-head screwdriver to loosen the six rear door fasteners, and slowly lower the door until it is perpendicular to the electronics tower and is supported by the rear door retainer.

5. Disconnect the Z scale cable from connector **J302** on the DSP Multi Axis PCBA.

6. Cut any necessary cable ties to free the Z-axis scale cable. Then feed the cable through the cable access hole in the front wall of the tower and remove it from the cable guide assembly (shown in Figure 9-15 on the previous page).

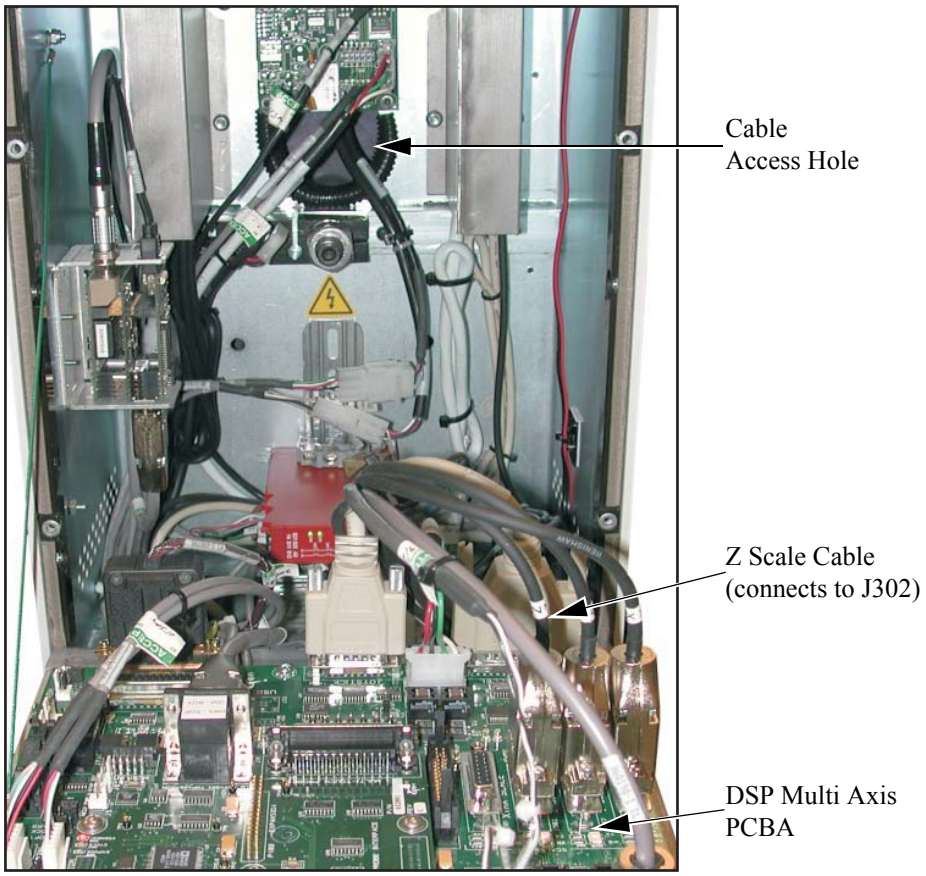


Figure 9-16 Disconnecting the Z Scale Cable from the DSP Multi Axis PCBA

Caution: Avoid scratching the tape scale when removing the Z-axis scale reader head.

7. Use a 2.5 mm Allen wrench to remove the mounting plate and attached scale reader head.

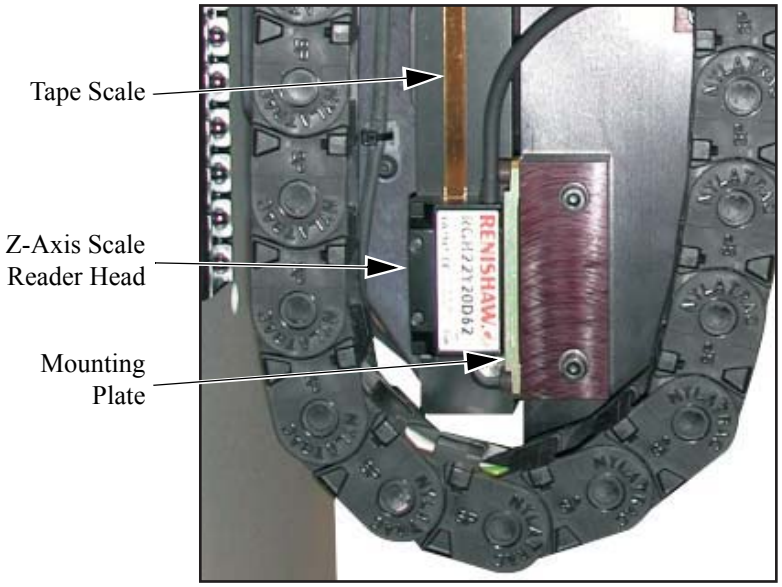


Figure 9-17 Removing the Z-Axis Scale Reader Head

8. Use a 2.5 mm Allen wrench to remove the two screws that secure the scale reader head to the mounting plate.

9. Attach the mounting plate to the replacement scale reader head.

Caution: Avoid scratching the tape scale when removing the Z-axis scale reader head.

10. Loosely install the replacement Z-axis scale reader head, using the orange spacer to align the scale reader head to the tape scale.

11. Remove the orange spacer and insert the blue 0.8 mm spacer between the reader head and the tape scale. Slightly push the reader head toward the tape scale and tighten the mounting plate screws. Then remove the spacer.

Note: Refer to the Installation Guide provided with the new scale reader head for more information about adjusting the reader head.

12. Feed the Z-axis scale cable into the electronics tower and connect it to connector **J302** on the DSP Multi Axis PCBA (see Figure 9-16 on page 175 for reference).

13. Re-install any previously removed cable ties to secure the Z-axis scale cable.

Warning: In the next step you will power up the system with covers removed. Exercise caution whenever operating the system in this state.

14. Power up the system and launch the metrology software.

15. Use the joystick to raise and lower the Z-axis assembly the full length of Z travel while observing the lamp on the Z-axis scale reader head.

    - The lamp should remain green through the entire Z travel.
    - If the lamp remains green through the entire travel, no adjustment is necessary. Power down the system and re-install the front cover.
    - If the lamp illuminates yellow or red, even for a short period of time, power down the system and re-adjust the reader head spacing. Repeat Steps 14 and 15 until the lamp remains green through the entire travel.

Note: The lamp may illuminate yellow or red if the reader head is too close to the scale, too far away from the scale, or not parallel to the scale.

9.8 Replacing the Z-Axis Motor

Tools Required	Part No.
Set of Metric Allen wrenches	N/A
Set of English Allen wrenches	N/A
Small, flat-head screwdriver	N/A
Shock absorbing material	N/A
Cable ties	N/A

1. With the system powered up, lower the Z-axis transport to the lower limit of travel.
2. Power down the system and disconnect the power cord from the main power source.
3. Place a piece of shock absorbing material on the stage glass for protection.

Caution: Do not let the rear door drop. Support it while gently lowering it into position.

4. Use a flat-head screwdriver to loosen the six rear door fasteners and slowly lower the door until it is perpendicular to the electronics tower and is supported by the rear door retainer.

5. Unplug the Z-axis motor power and Z-axis motor tachometer connectors (see Figure 9-18) and push both connectors through the cable access hole in the front wall of the electronics tower.

Figure 9-18 Disconnecting the Z-Axis Motor Cables

6. Remove the front cover by lifting it straight up.

Refer to Figure 9-19 as you perform the remaining steps in this procedure.

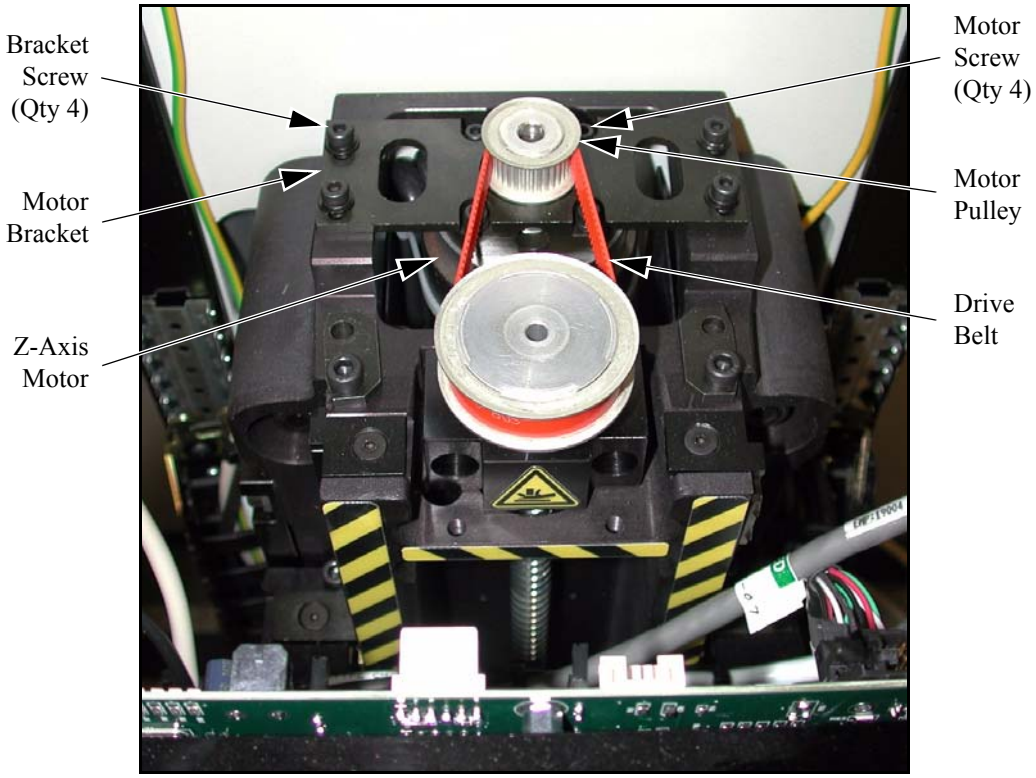


Figure 9-19 Removing the Z-Axis Motor

7. Use a 3 mm Allen wrench to loosen (but do not remove) the four Z-axis motor bracket mounting screws slightly.

8. Grasp the bracket and pull it forward to release the tension on the Z-axis drive belt. Remove the drive belt and set it aside.

9. Grasp the bracket and use a 3 mm Allen wrench to remove the four bracket mounting screws (and washers). Retain all mounting hardware.

10. Lift the Z-axis motor bracket (and attached motor) straight up and out of the Z-axis motor housing.

11. Loosen (but do not remove) the two pulley set screws. Then slide the pulley off of the Z-axis motor shaft. Set the pulley aside.

12. Use a 7/64-inch Allen wrench to remove the Z-axis motor from the mounting bracket. Retain all mounting hardware.

13. Replace the old Z-axis motor with the replacement motor.

14. Use the mounting hardware removed in Step 12 to attach the Z-axis motor loosely to the Z-axis motor mounting bracket.

15. Slide the motor pulley onto the motor shaft and tighten the two pulley set screws.

16. Set the Z-axis motor mounting bracket (and attached motor) on the Z-axis motor housing and install the mounting hardware removed in Step 9.

17. Slip the Z-axis drive belt onto the motor pulley.

18. Move the Z-axis motor to tension the drive belt so it is snug. Make sure the belt is centered within the two pulleys, and then tighten the Z-axis motor mounting screws.

19. Verify that the Z-axis drive belt is parallel to the stage; adjust the height of the Z-axis motor pulley if necessary.

20. Re-install the front cover.

21. Re-connect the power cord, power up the system, and verify proper system operation.

9.9 Replacing the PCBAs

Tools Required	Part No.
Phillips-head screwdriver	N/A
Flat-head screwdriver	N/A
Set of Metric Allen wrenches	N/A
Set of English Allen wrenches	N/A

Caution: Protect the Benchmark 250 system from electrostatic damage. Perform these procedures at a static-safe workstation and wear a ground strap. If a ground strap is not available, follow these guidelines:

- Work in an uncarpeted area.
- Before touching electronic components, discharge static electricity by touching a known-rounded object.
- Do not touch components on printed circuit boards assemblies (PCBAs), except as directed.

Note: For each new PCBA that you install, record the jumpers installed, switch positions, PCBA revision, and firmware revision. You might want to put a sticker on the new PCBAs so you do not get them mixed up with old ones.

Note: Before removing any cables or PCBAs, note all cable connections and cable routing.

9.9.1 Replacing the DSP Multi Axis PCBA

1. Power down the system and disconnect the power cord from the main power source.

Caution: Do not let the rear door drop. Support it while gently lowering it into position.

2. Use a flat-head screwdriver to loosen the six rear door fasteners and slowly lower the door until it is perpendicular to the electronics tower and is supported by the rear door retainer.

3. Locate the DSP Multi Axis PCBA, which is mounted on the rear door (see Figure 9-20).

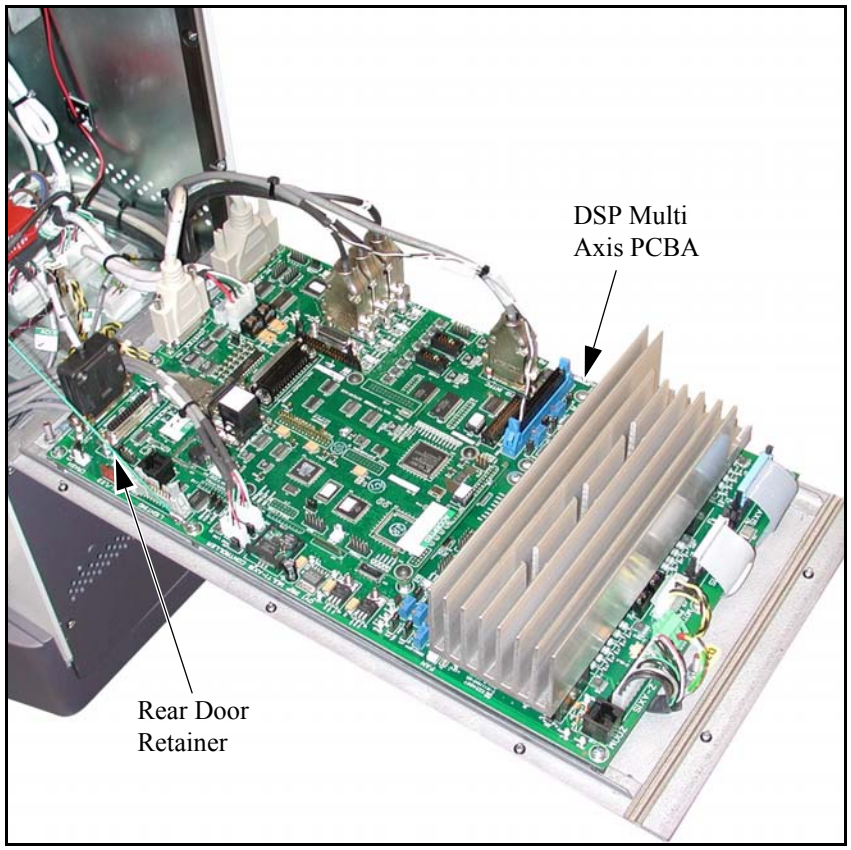


Figure 9-20 Location of the DSP Multi Axis PCBA

4. If there are any daughter boards mounted on the DSP Multi Axis PCBA, remove them before continuing.

   - If the system is equipped with a laser sensor, see ***Replacing the Universal Multi-Sensor PCBA (If Equipped)*** on page 191.
   - If the system is equipped with a rotary indexer, see ***Replacing the Micro Theta Control PCBA (If Equipped)*** on page 193.

5. Disconnect all cables from the DSP Multi Axis PCBA. If necessary, label the connectors to aid in re-assembly.

Note: Be sure to disconnect the Chassis Ground (J31) from the DSP Multi Axis PCBA because a new one is not supplied with the replacement board.

Caution: Do not let the rear door drop. Have one person support it while you remove the DSP Multi Axis PCBA mounting screw that secures the rear door retainer to the machine.

6. Use a Phillips-head screwdriver to remove the mounting screws that secure the DSP Multi Axis PCBA to the rear door. Retain all mounting hardware.
7. Remove the DSP Multi Axis PCBA and place it in a plastic, anti-static bag.
8. Use the mounting hardware removed in Step 6 to mount the replacement DSP Multi Axis PCBA to the rear door, in the same orientation as the old board. Be sure to re-attach the rear door retainer to the rear door.
9. Re-connect all previously disconnected cables.
10. Re-install any removed daughter boards.
11. Close the rear door and tighten the rear door fasteners.
12. Re-connect the power cord, power up the system, and verify proper system operation.

9.9.2 Replacing the Z Brake Control PCBA

1. Power down the system and disconnect the power cord from the main power source.

Caution: Do not let the rear door drop. Support it while gently lowering it into position.

2. Use a flat-head screwdriver to loosen the six rear door fasteners and slowly lower the door until it is perpendicular to the electronics tower and is supported by the rear door retainer.

3. Locate the Z Brake Control PCBA, which is mounted to the front-inside wall of the electronics tower.

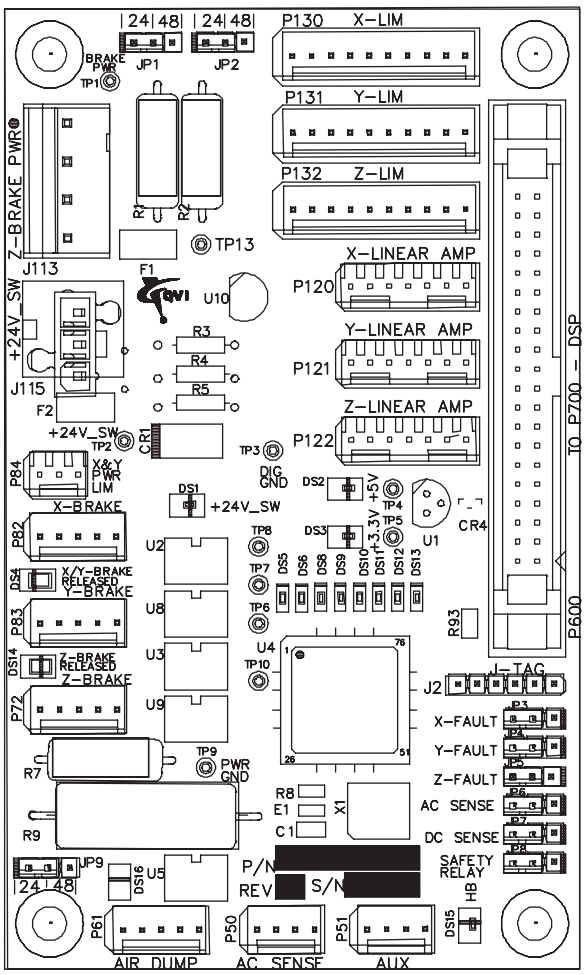


Figure 9-21 Z Brake Control PCBA

4. Disconnect all external cables from the Z Brake Control PCBA. If necessary, label the connectors to aid in re-assembly.

5. Use a 3 mm Allen wrench to remove the four mounting screws that secure the Z Brake Control PCBA to the electronics tower. Retain all mounting hardware.

6. Remove the old Z Brake Control PCBA and put it in a plastic, anti-static bag.

7. Use the mounting hardware removed in Step 5 to install the replacement Z Brake Control PCBA, in the same orientation as the old board.

8. Re-connect all previously disconnected cables.

9. Close the rear door and tighten the rear door fasteners.

10. Re-connect the power cord, power up the system, and verify proper system operation.

9.9.3 Replacing the LED Driver PCBA

1. Power down the system and disconnect the power cord from the main power source.

Caution: Do not let the rear door drop. Support it while gently lowering it into position.

2. Use a flat-head screwdriver to loosen the six rear door fasteners and slowly lower the door until it is perpendicular to the electronics tower and is supported by the rear door retainer.

3. Remove the Z Brake Control PCBA (see ***Replacing the Z Brake Control PCBA*** on page 185).

4. Locate the LED Driver PCBA, which is mounted on the front-inside wall of the electronics tower.

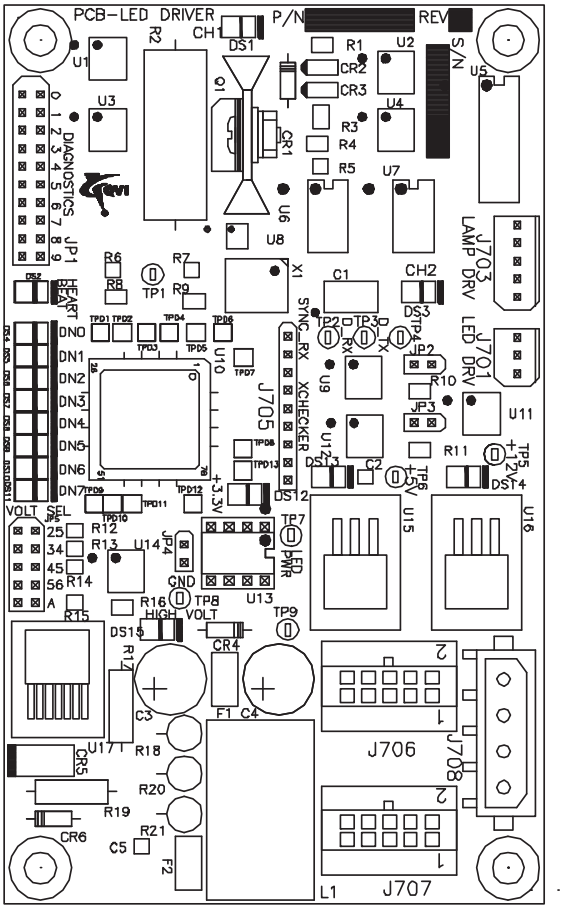


Figure 9-22 LED Driver PCBA

5. Disconnect all cables from the LED Driver PCBA. If necessary, label the connectors to aid in re-assembly.

6. Use a 3 mm Allen wrench to remove the four mounting screws that secure the LED Driver PCBA to the electronics tower. Retain all mounting hardware.

7. Remove the old LED Driver PCBA and put it in a plastic, anti-static bag.

8. Use the mounting hardware removed in Step 6 to install the replacement LED Driver PCBA, in the same orientation as the old board.

9. Re-connect all previously disconnected cables.

10. Re-install the Z Brake Control PCBA.

11. Close the rear door and tighten the rear door fasteners.

12. Re-connect the power cord, power up the system, and verify proper system operation.

9.9.4 Replacing the Dual Mag Optics PCBA

1. Power down the system and disconnect the power cord from the main power source.

2. Remove the front cover by lifting it straight up.

3. Locate the Dual Mag Optics PCBA, which is mounted behind the optical assembly.

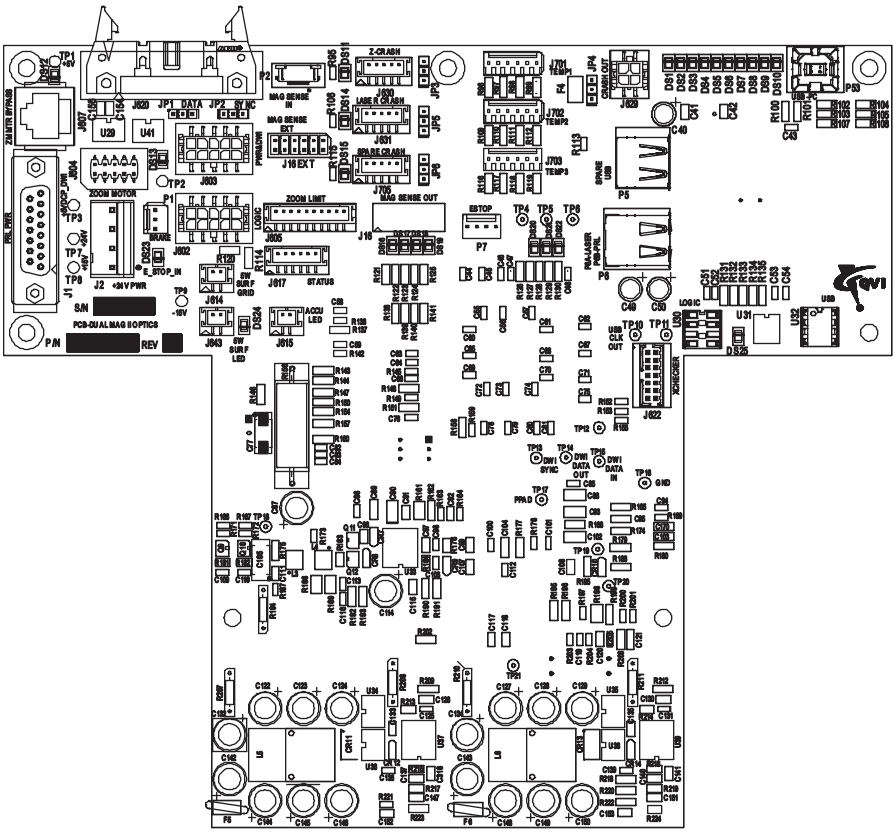


Figure 9-23 Dual Mag Optics PCBA

4. Disconnect all cables from the Dual Mag Optics PCBA. If necessary, label the connectors to aid in re-assembly.

5. Use a 3 mm Allen wrench to remove the four mounting screws that secure the Dual Mag Optics PCBA to the electronics tower. Retain all mounting hardware.

6. Remove the old Dual Mag Optics PCBA and put it in a plastic, anti-static bag.

7. Use the mounting hardware removed in Step 5 to install the replacement Dual Mag Optics PCBA, in the same orientation as the old board.

8. Re-connect all previously disconnected cables.

9. Re-install the front cover.

10. Re-connect the power cord, power up the system, and verify proper system operation.

9.9.5 Replacing the Universal Multi-Sensor PCBA (If Equipped)

1. Power down the system and disconnect the power cord from the main power source.

Caution: Do not let the rear door drop. Support it while gently lowering it into position.

2. Use a flat-head screwdriver to loosen the six rear door fasteners and slowly lower the door until it is perpendicular to the electronics tower and is supported by the rear door retainer.

3. Locate the Universal Multi-Sensor PCBA, which is mounted to the DSP Multi Axis PCBA (connected to P400) or Micro Theta Control PCBA (if equipped).

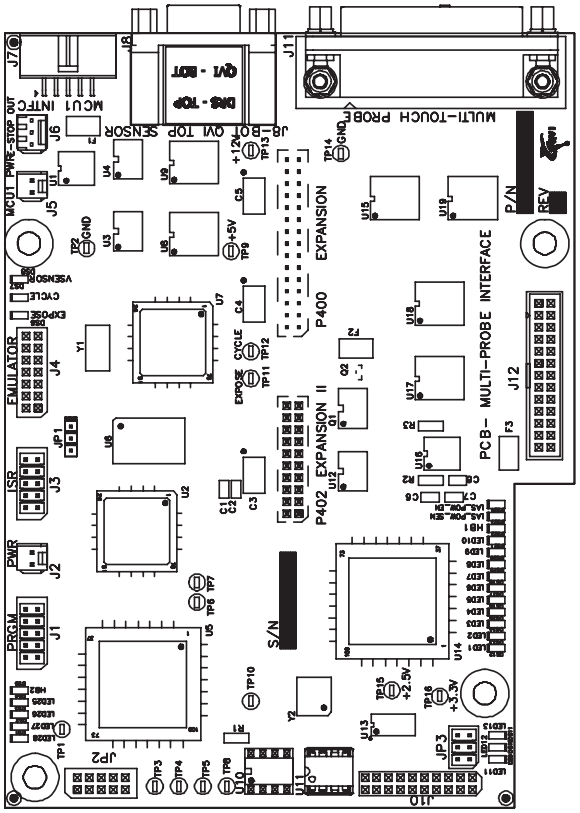


Figure 9-24 Universal Multi-Sensor PCBA

4. Disconnect all cables from the Universal Multi-Sensor PCBA. If necessary, label the connectors to aid in re-assembly.

5. Use a 2.5 mm Allen wrench to remove the four mounting screws that secure the Universal Multi-Sensor PCBA to the DSP Multi Axis PCBA or Micro Theta Control PCBA (if equipped).

6. Remove the old Universal Multi-Sensor PCBA and put it in a plastic, anti-static bag.

7. Use the mounting hardware removed in Step 5 to install the replacement Universal Multi-Sensor PCBA.

8. Re-connect all previously disconnected cables.

9. Close the rear door and tighten the rear door fasteners.

10. Re-connect the power cord, power up the system, and verify proper system operation.

9.9.6 Replacing the Micro Theta Control PCBA (If Equipped)

1. Power down the system and disconnect the power cord from the main power source.

Caution: Do not let the rear door drop. Support it while gently lowering it into position.

2. Use a flat-head screwdriver to loosen the six rear door fasteners and slowly lower the door until it is perpendicular to the electronics tower and is supported by the rear door retainer.

3. Locate the Micro Theta Control PCBA, which is mounted to the DSP Multi Axis PCBA (connected to P400).

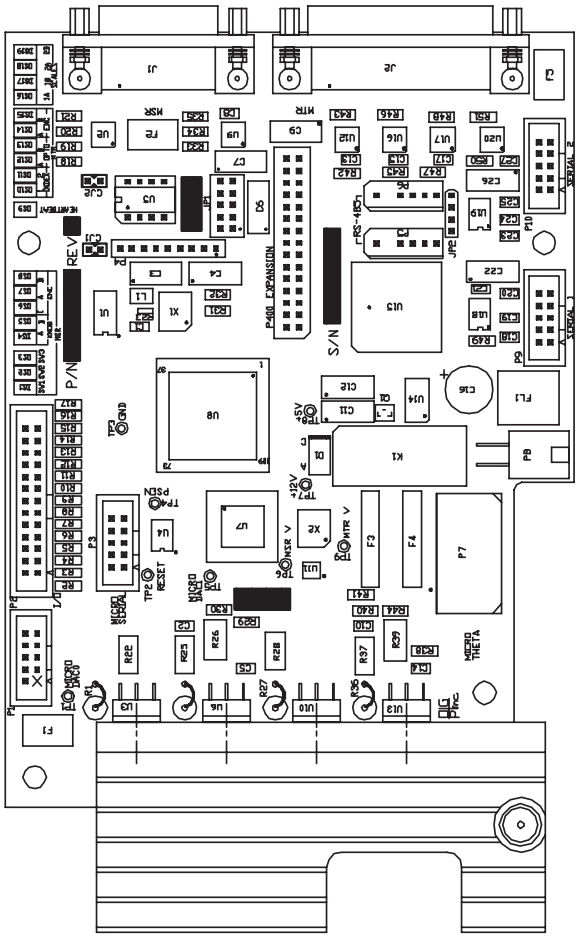


Figure 9-25 Micro Theta Control PCBA

4. If the system is equipped with the Universal Multi-Sensor PCBA, remove it before continuing; see ***Replacing the Universal Multi-Sensor PCBA (If Equipped)*** on page 191.

5. Disconnect all cables from the Micro Theta Control PCBA. If necessary, label the connectors to aid in re-assembly.

6. Use a 2.5 mm Allen wrench to remove the four mounting screws (or remove the four standoffs) that secure the Universal Multi-Sensor PCBA to the DSP Multi Axis PCBA.

Note: If the system is equipped with the Universal Multi-Sensor PCBA, the Micro Theta Control PCBA is mounted to the DSP Multi Axis PCBA with standoffs, not screws.

---

7. Remove the old Micro Theta Control PCBA and put it in a plastic, anti-static bag.

8. Use the mounting hardware removed in Step 5 to install the replacement Micro Theta Control PCBA.

9. If the system is equipped with the Universal Multi-Sensor PCBA, re-install it using the mounting hardware retained during disassembly. Then re-connect all previously disconnected cables.

10. Close the rear door and tighten the rear door fasteners.

11. Re-connect the power cord, power up the system, and verify proper system operation.

9.10 Replacing the Power Supply

Tools Required	Part No.
Phillips-head screwdriver	N/A
Flat-head screwdriver	N/A

1. Power down the system and disconnect the power cord from the main power source.

2. Use a flat-head screwdriver to loosen the five lower rear panel fasteners. Being careful not to damage the ground wire attached to the lower rear panel, move the panel out of the way.

Caution: Do not let the rear door drop. Support it while gently lowering it into position.

3. Use a flat-head screwdriver to loosen the six rear door fasteners, and slowly lower the door until it is perpendicular to the electronics tower and is supported by the rear door retainer.

4. Disconnect all external cables from the top of the power supply. If necessary, label the connectors to aid in re-assembly.

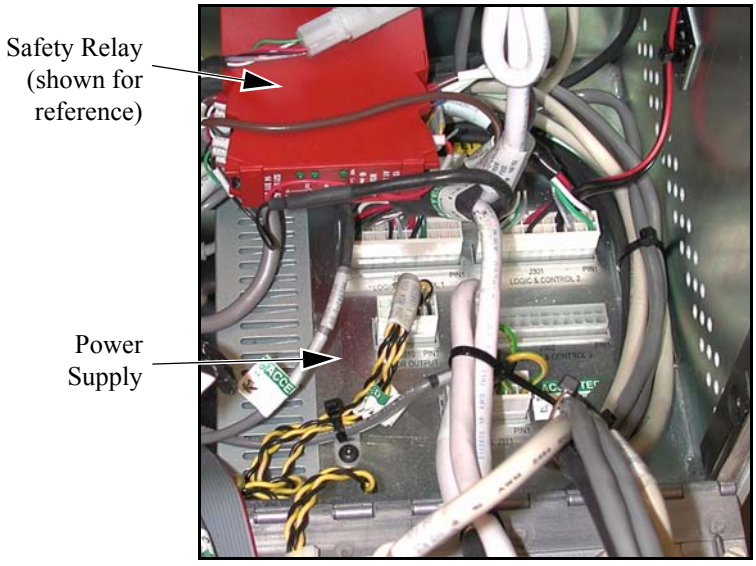


Figure 9-26 Top of the Power Supply

5. Remove the hex nut that secures the ground wire to the grounding stud on top of the power supply.

Caution: During re-assembly, do not overtighten the hex nut that secures the ground wire to the grounding stud on top of the power supply. Doing so could damage the power supply.

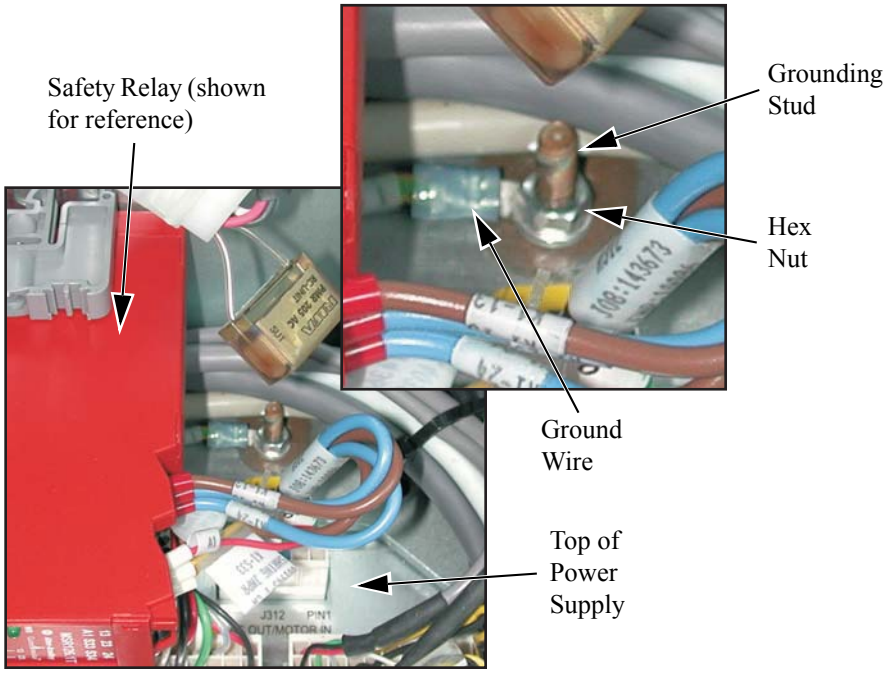


Figure 9-27 Removing the Power Supply Ground Wire

Caution: Do not let the power supply drop. Support the power supply while removing its mounting screws.

6. While grasping the power supply, use a Phillips-head screwdriver to remove the four mounting screws (accessed from outside the tower) that secure the power supply to the electronics tower.

Figure 9-28 Removing the Power Supply

7. Remove the power supply from the electronics tower.

8. Use the mounting hardware removed in Step 6 to install the replacement power supply.

Caution: When installing the ground wire on the replacement power supply, do not overtighten the hex nut that secures the ground wire to the grounding stud on top of the power supply. Doing so could damage the power supply.

9. Re-install the power supply ground wire and re-connect any cables that were previously disconnected.

10. Close the rear door and re-install the lower rear panel.

11. Re-connect the power cord, power up the system, and verify proper system operation.

9.11 Replacing the Exhaust Fan

Tools Required	Part No.
Phillips-head screwdriver	N/A
Flat-head screwdriver	N/A
Set of Metric Allen wrenches	N/A

1. Power down the system and disconnect the power cord from the main power source.

Caution: Do not let the rear door drop. Support it while gently lowering it into position.

2. Use a flat-head screwdriver to loosen the six rear door fasteners, and slowly lower the door until it is perpendicular to the electronics tower and is supported by the rear door retainer.

Caution: Do not let the heatsink baffle drop. Support it while removing the mounting screws.

3. While grasping the heatsink baffle, remove the three button-head screws and two Phillips-head screws.

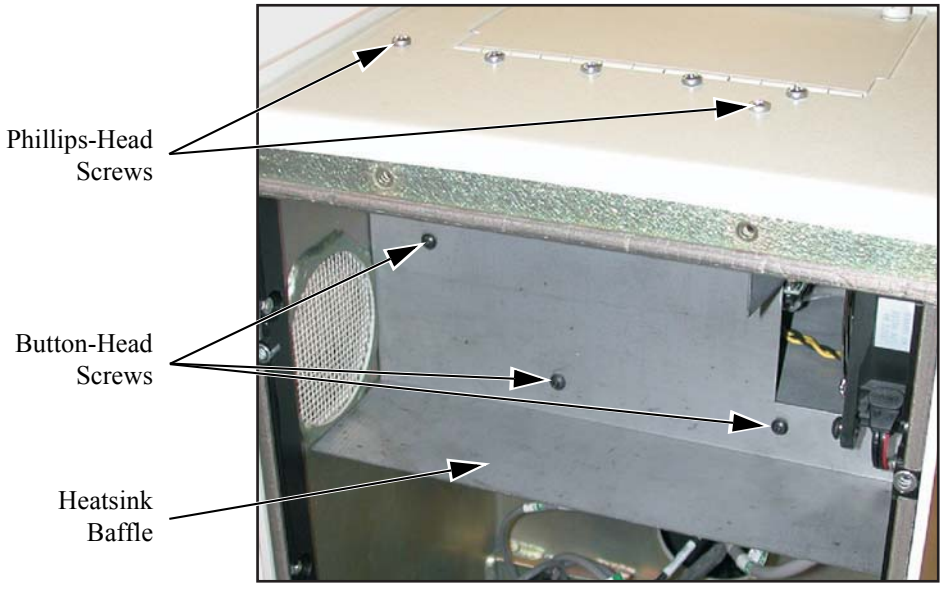


Figure 9-29 Removing the Heatsink Baffle

4. Carefully lower the heatsink baffle and move it out of the way.

5. Unplug the fan power connector from the bottom of the fan.

Caution: Do not let the fan drop. Support it while removing the mounting screws.

Caution: Do not let the rear door drop. Have one person support it while you remove the screw that secures the rear door retainer to the machine.

6. While grasping the fan, remove the four mounting screws (accessed from outside of the tower) and hex nuts securing the fan mounting plate (and attached fan) to the tower. Use a Phillips-head screwdriver and retain all mounting hardware.

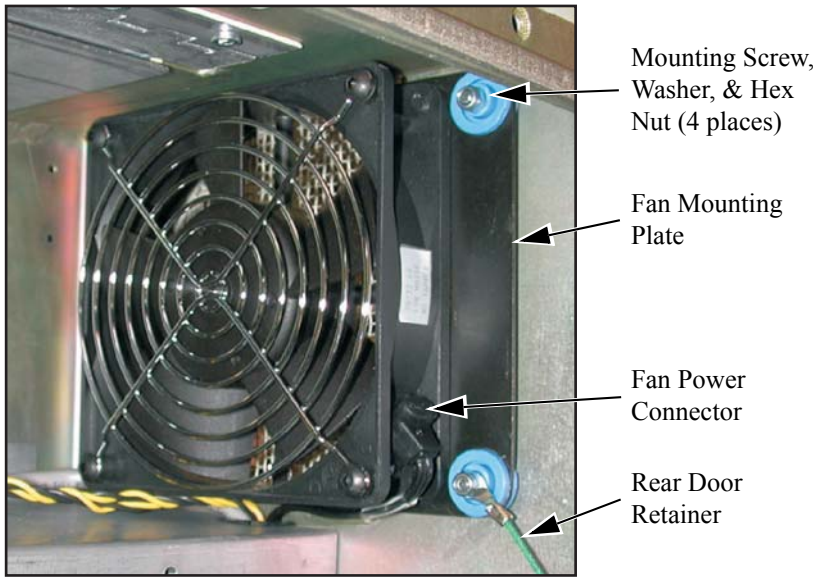


Figure 9-30 Removing the Fan Mounting Screws

7. Remove the fan from the electronics tower.

8. Remove the fan from its mounting plate (see Figure 9-31). Retain all mounting hardware.

9. Remove the finger guard from the old fan and install it onto the new fan.

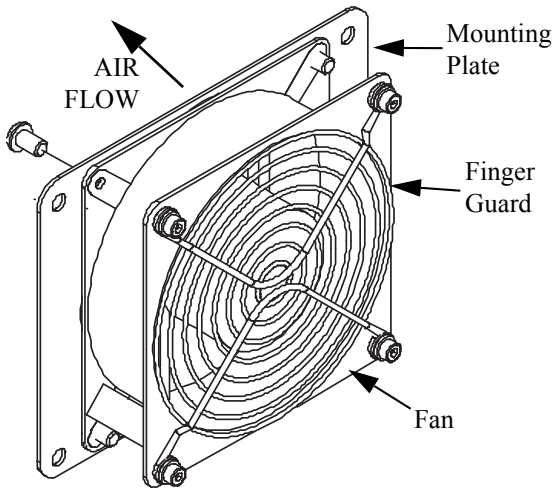


Figure 9-31 Removing the Fan from the Mounting Plate

10. Use the mounting hardware removed in Step 8 to secure the replacement fan to the mounting plate. Make sure the air flow is in the direction indicated by the arrow in Figure 9-32.

11. Use the mounting hardware removed in Step 6 to install the replacement fan.

12. Reconnect the fan power connector to the bottom of the fan. Be sure to connect the power connector so the red wire (positive side) lines up with the positive plug on the fan. **Do not reverse polarity.**

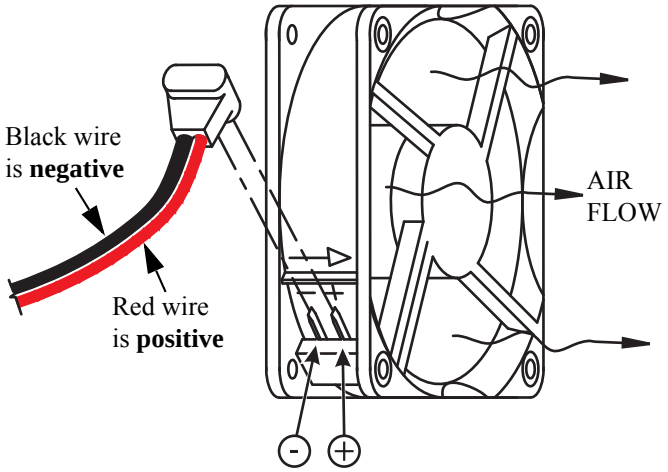


Figure 9-32 Connecting the Fan Power Connector

VMS System Certification & Verification 7.02

Appendix A

A.1 What This Appendix Contains

This appendix covers:

- General Guidelines
- Handling & Cleaning Grid Plates, Scales, & Lenses
- Wringing Gage Blocks
- System Certification
- System Verification

This appendix is intended to assist you in completing an accurate X-, Y-, and Z-axis certification and/or verification of the Benchmark 250 system. It outlines the equipment and the steps necessary to properly complete an accurate system certification and/or system verification using the VMS certification software.

A.2 General Guidelines

- The system must have the patented Ronchi Grid Autofocus capability; if not, run Certification & Verification 5.3.
- The Benchmark 250 system requires an application-specific program and an NIST-traceable artifact to properly certify and/or verify the system.
- By performing these procedures, you will create an essential error map and test that error map after it has been created. This error map, created and used by the VMS software, is named `LOOKUP.TBL`.
- We recommend that you calibrate the system annually to assure accurate and repeatable results.

A.3 Handling & Cleaning Grid Plates, Scales, & Lenses

Caution: The chrome surface on the grid plates and scales should never be touched by hand near the area of the grid lines.

Grid plates should only be handled with minimal contact (perimeter only) of the chrome surface. Oil from your hands is corrosive and the scales and plates can be damaged when you attempt to clean them. Grid lines are typically fifty microns wide and scale tick marks are typically thirty microns wide—even a small scratch can cause an error of a couple of microns. Use only a soft hair brush, lens tissue and lens cleaner to gently clean a lens, scale or grid plate. Any other materials or improper handling can damage these artifacts. Use the brush first to remove loose contamination. If you have any questions about how to handle or clean these artifacts, please contact the Customer Support HelpDesk (see ***Where to Get Help*** on page 4).

A.4 Wringing Gage Blocks

Caution: Gage Blocks and accessories manufactured from croblox (Chromium-carbide) are harder but more brittle than gage blocks made from regular hardened tool steel. These gage blocks may be expected to give more than 10 times the wear-life over steel gage blocks, but *extreme care should be taken in their use and handling*.

- NEVER ALLOW THESE GAGE BLOCKS TO HIT EACH OTHER. If nicked, the surfaces may chip or become raised and the gage blocks may not be suitable for use. Do not try to assemble combinations of gage blocks above an open set. If they fall into the set, many pieces may be damaged.
- DO NOT OVER-STRESS THE GAGE BLOCKS when taking I.D., O.D., or slot measurements; they may easily break because they are extremely brittle.
- These gage blocks have undergone exhaustive inspection to assure maximum quality and are guaranteed to meet the requirements of Federal Specification GGG-G-15C. However, due to the fragile nature of these materials, we regret to advise that we will not be held responsible for breakage, cracking, or other damage caused by rough handling or misuse.

1. Clean the blocks by applying a small amount of mineral spirits to a clean, soft, lint-free cloth.
2. If the optical surface (i.e., top surface) needs visible spots removed, it can be cleaned with lens cleaner and tissue.
3. Lay another piece of clean, soft, lint-free cloth on a flat, non-absorbent surface.
4. Place two drops of clean, filtered, light oil on one area of the cloth.
5. Take one of the clean blocks; and place it with the measuring face down on the cloth, rubbing it gently in the oiled area.
6. Move the block to an un-oiled section of the cloth, and move it in a figure-eight motion to clean off the excess oil. (When cleaned correctly, the oil should only be visible as a slight discoloration to the block surface.)
7. Slide the gage block with light pressure onto another clean gage block.
8. Wring the block half out of engagement and then back into the matched position in a circular motion.
9. Continue this wringing procedure until the desired setup is complete.

Note: With practice, wringing gage blocks becomes second nature. To check your skill level while learning, wring a 1-inch block and a 2-inch block together. After letting them “soak” back (or return) to ambient temperature, compare the setup to a 3-inch block with a system using a field of view (FOV) of ~1.5mm and a Ronchi Grid.

A.5 System Certification

The XY Certify procedure detects measurement error and stores it in a table to be used for correction. Depending on the default machine type selected during the certification process, the system will measure the grid plate in one of two ways:

- By measuring an entire row (from -X to +X) five times, and then indexing in the -Y direction and measuring the remaining rows on the grid plate—in this case, the primary moving axis is the X-axis
- By measuring an entire column (from +Y to -Y) five times, and then indexing in the +X direction and measuring the remaining columns on the grid plate—in this case, the primary moving axis is the Y-axis

Note: We recommend using the shorter axis as the primary moving axis (for example, the Y-axis is the shorter axis on the Benchmark 250 system). Be sure to take this into account when choosing the appropriate method to measure the grid plate (either by rows or by columns).

The results are averaged and the raw, uncorrected, measured distances (in X and Y) of each intersection from the center intersection are rotated to match the measured data more closely. That data is then compared to the "known" certified distances, and the difference is the detected error at that location on the stage. That error is saved in the lookup (correction) table with a resolution of 1/10 micron.

The Z Certify measurements and derived performance statistics are similar with some exceptions; see ***Z Certification*** on page 212.

Tools Required

XY-axis grid plate and data file
Z-axis step gage and data file or Z-axis gage-block fixture and data file
1X magnification lens
High magnification lens
Lens calibration standard
Standard set of Allen wrenches
VMS Cert & Verify Program

A.5.1 Certification Setup

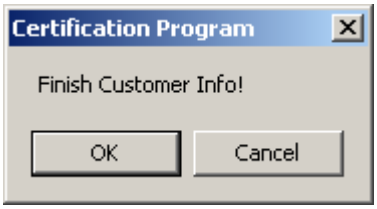
1. If necessary, install the VMS Cert & Verify program. This program should be installed into the current VMS directory (e.g., C:\Program Files\VMS).

2. Install a calibrated 1X magnification lens.

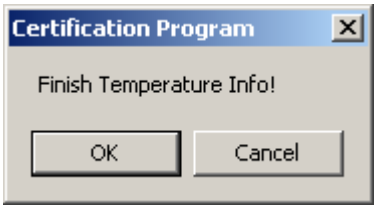
3. [XY Certification ONLY] Carefully place the XY-axis grid plate on the Benchmark 250 stage. Then secure the XY-axis grid plate by tightening the set screws or retaining clamps at each end of the Y-axis stage. Make sure that the grid plate is level to within **±0.01 mm (0.0004")** and is aligned to the XY travel.

4. If the VMS software is running, exit it before continuing.

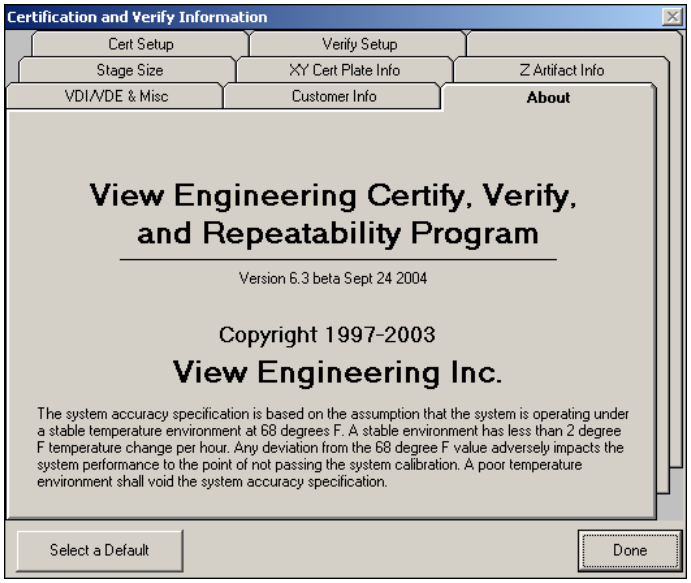
5. Launch the Cert & Verify program by double-clicking on the desktop icon (`VOYCERT.EXE`). The system displays the following prompt:



6. Click **OK** in response to the prompt. The system displays the following prompt:



7. Click **OK** in response to the prompt. The system displays the Certification and Verify Information window:



8. Click the **Select a Default** button and double-click on the system that you are certifying—the system specific information is automatically entered into the required fields in the various tabs.

Caution: Be sure to choose the correct system in the default machine type list. If the incorrect default machine type is chosen, the correction factors will be incorrect, and the verification process may not pass after you perform an XY and/or Z certification.

9. Click the **Customer Info** tab and enter the following information:

   - customer
   - operator name
   - machine & model
   - machine serial number

10. Click the **VDI/VDE & Misc** tab. Then click the **Manual (deg F)** radio button and enter the current room temperature in the Temperature box.

Note: Some systems are set up to automatically read and record ambient temperature. If this is the case for your system, we recommend that you click the Auto radio button to record the temperature automatically.

11. [XY Certification ONLY] Click the **Scan rows before columns** radio button.

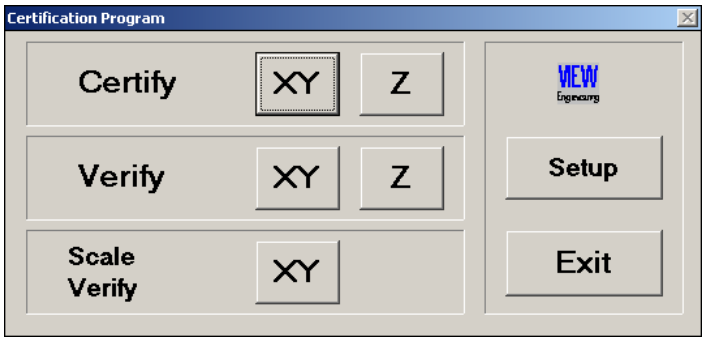
Note: If you want to measure the entire plate before repeating a row, select the *Inspect entire plate before repeating row or column* checkbox.

12. [XY Certification ONLY] Click the **XY Cert Plate Info** tab and enter the following information:

- P.O. number of the plate—all digits must match the `XYNOM.CRT` file
- serial number of the plate—leading zeros are ignored
- number of unreachable lines (if any) on each side of the plate

13. [Z Certification ONLY] Click the **Z Artifact Info** tab and enter the Artifact set # (must match the `ZNOM.CRT` file) and select the **Gauge Blocks** radio button or the **Step Gauge** radio, depending on which method you will be using to certify the Z-axis. Then enter the correct offset information.

14. Once all the parameters have been set and the customer information has been updated, click **Done**. The system displays the Certification Program window:



You are now ready to perform an XY Certification (see ***XY Certification*** on page 208) or a Z Certification (see ***Z Certification*** on page 212).

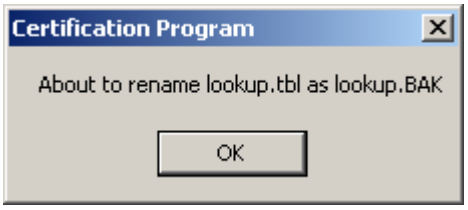
Caution: Do not close the Certification Program window. Doing so will require you to re-enter customer and temperature information.

A.5.2 XY Certification

1. Using Windows Explorer, copy the associated grid plate data file into the current VMS directory. Rename the data file to `XYNOM.CRT`.

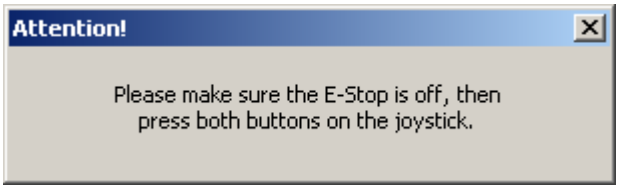
2. Perform the Certification Setup procedure; see ***Certification Setup*** on page 205.

3. Click the Certify **XY** button. The system displays the following prompt:



Note: A window may appear excluding a number of lines from the top and right sides of the plate. This is normal, click OK.

4. Click **OK** in response to the prompt. The Cert & Verify program automatically launches the VMS software and the system displays the following prompt:



5. Make sure the remote E-Stop switch is pulled out, and then press the **Stop/ Start** button on the joystick.

6. Wait for the VMS software to launch and then click **Continue** in the Certification Program instruction window.

7. Re-position the Certification Program instruction window to the lower-right portion of the screen, so you can see any prompts or messages that are displayed in the center of the screen.

8. Verify that the stage is clear to move and then click **Continue** in the Certification Program instruction window to zero the stages.

9. Wait for the stages to stop moving and observe the Ready/Not-Zeroed status display switch to *Ready*. Then click **Continue** in the Certification Program instruction window.

Note: If you are directed to *select OK*, do not press the Enter key on the keyboard—doing so will be interpreted as a "cancel" instruction in the program. Instead, click OK with the mouse.

Caution: You may receive a message stating *"The lens used by this program is not mounted. The wrong lens may be in use."* This error message is normal and is a precaution. Check and make sure you are using the correct lens. If the lens is correct, click OK and continue with this procedure. If the wrong lens is installed, abort the process and install and calibrate the correct lens before restarting.

Note: If a warning is displayed for lighting configuration, click OK.

Caution: As the program loads, a number of screens may appear and then disappear. This is normal; do not press any keys or mouse buttons while the program loads, unless prompted to do so.

10. Click  in the VMS toolbar.

11. Set the coaxial light to a value that will allow you to find and focus on the 0/0 intersection at the center of the XY-axis grid plate.

a. Use the joystick to move the stage so the 0/0 intersection (see Figure A-1) is visible in the Video window.

b. Click  and center the Crosshair Finder over the 0/0 intersection. Then focus on the intersection.

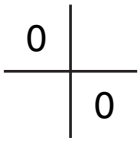


Figure A-1 0/0 intersection

c. Align the plate so it is parallel to the X-axis travel assuring full travel and good focus in both X and Y directions; adjust the plate height if needed. Full travel assumes that, during the entire Cert and Verify process, all outer intersections (except those excluded in the setup) used in `XYNOM.CRT` can be reached.

d. After the plate has been aligned, re-position the Crosshair Finder over the 0/0 intersection.

e. Focus again.

Caution: Before clicking Set Home in the next step, be aware that the stage will return to this location when you click Go Home.

f. Click **Set Home** to establish the current XYZ position as the home position.

12. After all alignments are complete and the XY-axis grid plate is secure, click **OK** in the Autofocus Finder window.

Caution: Before selecting Go Home in the next step, make sure it is safe for the stage to move.

13. The stages may have moved to a preset position in the program. Click **Go Home** to move the stages to the home position you defined earlier.

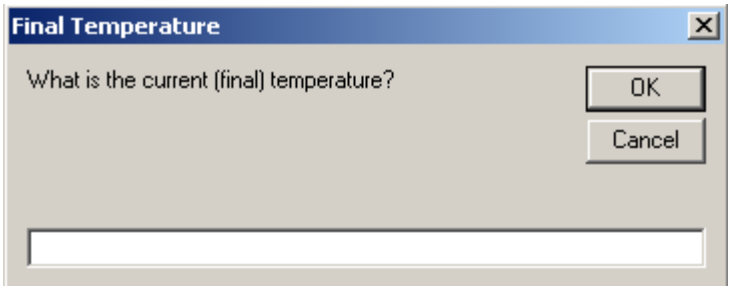
14. Double-click in the Video window.

15. Click  to store the position and begin the certification process.

Note: Light levels are adjusted automatically. If the system cannot converge on a light level, a prompt will appear for the operator to select a coaxial light level manually. Record the number, and then enter the value at the prompt.

Note: A status bar, displayed in the instruction window, shows the progress of the Certification program.

When the certification process is complete, the system displays the following dialog box:



16. Enter the current room temperature and click **OK**. The file `LOOKUP.TBL` is created in the current VMS directory. This is the actual error map file used during measurement.

17. Exit the Cert & Verify program and the VMS software.

18. Perform the XY Verification procedure; see ***XY Verification*** on page 226.

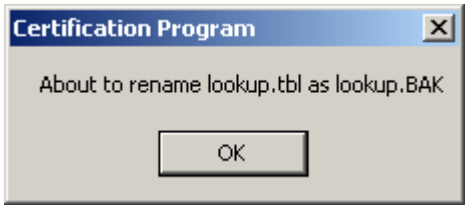
A.5.3 Z Certification

Note: Although you can use a Z-axis step gage or a Z-axis gage block fixture and gage blocks to perform the Z-axis certification, we recommend using a step gage.

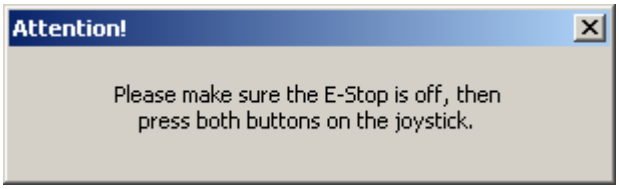
Note: Use the highest available magnification lens to perform the Z certification.

A.5.3.1 Z Certification with a Step Gage

1. Using Windows Explorer, copy the associated Z-axis step gage file into the current VMS directory. Rename the data file to `ZNOM.CRT`.
2. Perform the Certification Setup procedure; see ***Certification Setup*** on page 205.
3. Install the highest available magnification lens.
4. Click the Certify **Z** button. The system displays the following prompt:



5. Click **OK** in response to the prompt. The Cert & Verify program automatically launches the VMS software and the system displays the following prompt:



6. Make sure the remote E-Stop switch is pulled out, and then press the **Stop/ Start** button on the joystick.
7. Wait for the VMS software to launch and then click **Continue** in the Certification Program instruction window.

8. Re-position the Certification Program window to the lower-right portion of the screen, so you can see any prompts or messages that are displayed in the center of the screen.

9. Verify that the stage is clear to move and then click **Continue** in the Certification Program instruction window to zero the stages.

10. Wait for the stages to stop moving and observe the Ready/Not-Zeroed status display switch to *Ready*. Then click **Continue** in the Certification Program instruction window.

11. Temporarily mount the Z-axis step gage on the stage as shown in Figure A-2. Make sure that:

- the step gage steps ascend toward you when you are standing in front of the machine
- the step gage is placed toward the front of the stage
- the step gage is visually square in the X and Y directions
- the step gage is secure on the stage and will not move during the certification process

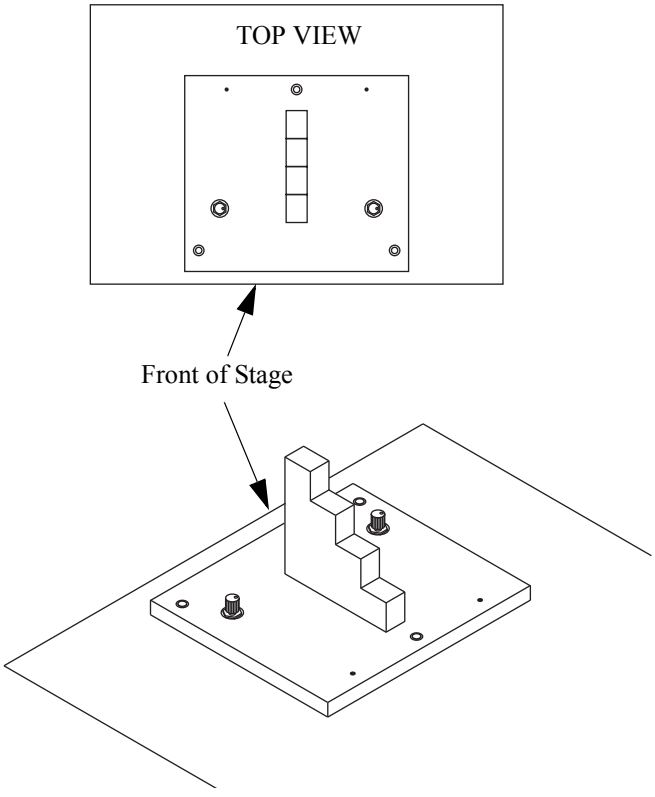


Figure A-2 Mounting the Step Gage

12. Level the step gage to within **±0.002 mm (0.00008")**.

a. Use the joystick to move the stage so focus point ❶ (see Figure A-3) is visible in the Video window.

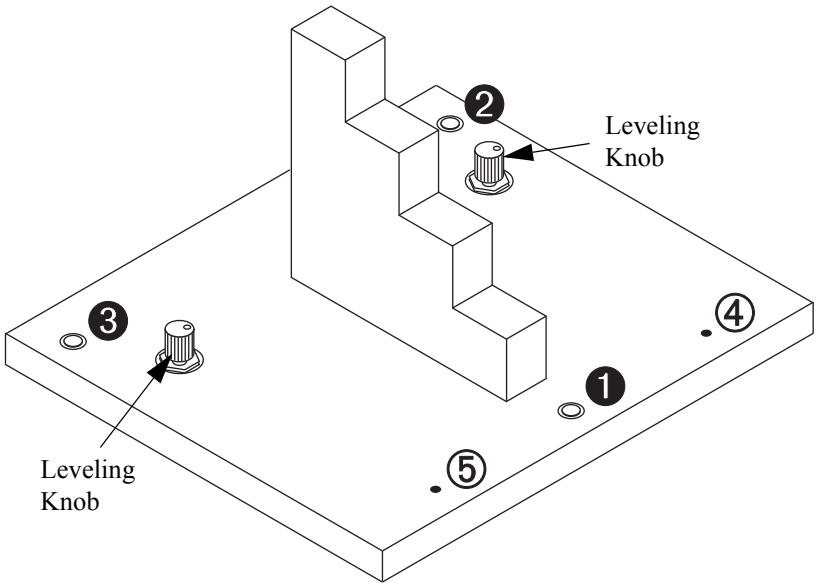


Figure A-3 Leveling the Step Gage

b. Click  in the Video window toolbar and click  in the Autofocus Settings window to select the Textured Surface Focus tool.

c. Select the High Mag camera and perform an autofocus on focus point ❶.

d. Zero the Z-axis readout by right-clicking in the DRO window and selecting **Zero DRO** in the context menu.

e. Move the stage so focus point ❷ (see Figure A-3) is visible in the Video window and perform an autofocus on focus point ❷. The Z value in the DRO window should be zero or very close to zero.

If the Z value for focus point ❷ is within ±0.002 mm (0.00008") of the Z value for focus point ❶, no adjustment is required; advance to Step 12g. If the Z value is not within ±0.002 mm (0.00008"), use the leveling knob adjacent to focus point ❷ to level the step gage; continue with the next step.

f. Repeat Steps 12a to 12.

g. Move the stage so focus point ❸ (see Figure A-3) is visible in the Video window and perform an autofocus on focus point ❸. Again, the Z value in the DRO window should be zero or very close to zero.

h. If the Z value for focus point ❸ is within ±0.002 mm (0.00008") of the Z value for focus point ❷, no adjustment is required; continue with Step 13. If the Z value is not within ±0.002 mm (0.00008"), use the leveling knob adjacent to focus point ❸ to level the step gage; continue with the next step.

i. Repeat Steps 12a to 12h as many times as necessary to level the step gage to within ±0.002 mm (0.00008").

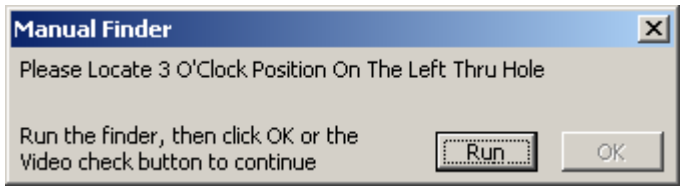
13. Set the Joystick Mode to **Slow**.

Note: If you are directed to *select OK*, do not press the Enter key on the keyboard—doing so will be interpreted as a "cancel" instruction by the program. Instead, click OK with the mouse.

Caution: You may receive a message stating *"The lens used by this program is not mounted. The wrong lens may be in use."* This error message is normal and is a precaution. Check and make sure you are using the correct lens. If the lens is correct, click OK and continue with this procedure. If the wrong lens is installed, abort the process and install and calibrate the correct lens before restarting.

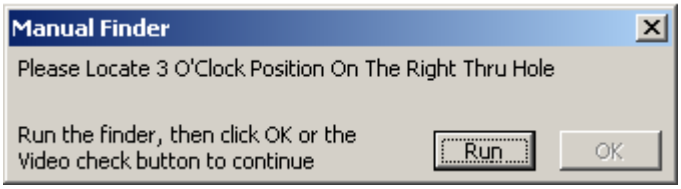
Caution: As the program loads, a number of screens may appear and then disappear. This is normal. Do not press any keys or mouse buttons while the program loads, unless prompted to do so.

14. Click  in the VMS toolbar. The system displays the following prompt:



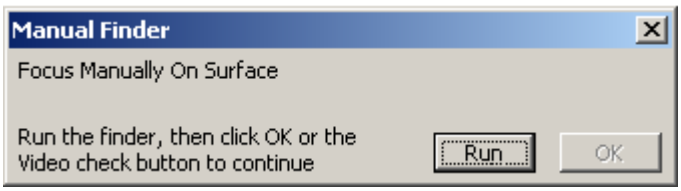
15. Move the stage so the left through hole (④ in Figure A-3) is visible in the Video window and place the Crosshair Finder on the right edge of the hole (3 o'clock position).

16. Click the **Run** button in the displayed prompt to run the finder, and then click the **OK** button. The system displays the following prompt:

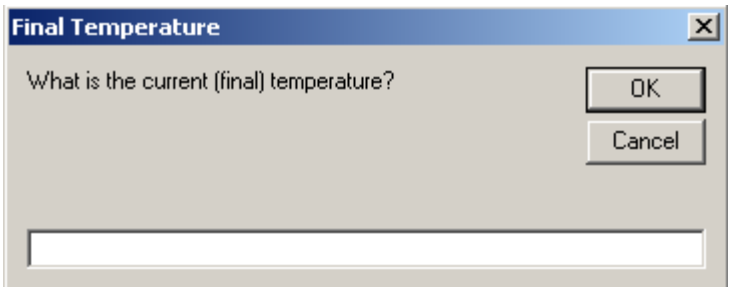


17. Move the stage so the right through hole (⑤ in Figure A-3) is visible in the Video window and place the Crosshair Finder on the right edge of the hole (3 o'clock position).

18. Click the **Run** button in the displayed prompt to run the finder and then click the **OK** button. The system moves the stage to the first step on the step gage and displays the following prompt:



19. Manually focus on the surface of the first step and click the **Run** button in the displayed prompt to run the finder. Then click the **OK** button to run the Z-axis certification program. When the certification process is complete, the system displays the following dialog box:



20. Enter the current room temperature and click **OK**. The Certification Program window displays, *"Calculating lookup table values .... New Lookup Table created. Press Continue to exit VMS. Changes will take effect when VMS is restarted."*

21. Click **Continue**. Additional information will be added to the error map file (`LOOKUP.TBL`).

22. Exit the Cert & Verify program and the VMS software.

23. Perform the Z Verification procedure; see ***Z Verification*** on page 230.

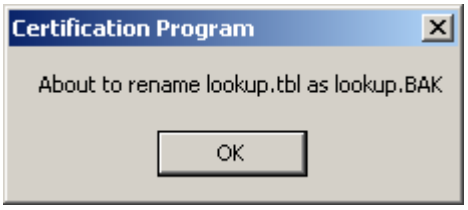
A.5.3.2 Z Certification with Gage Blocks

Note: The use of gage blocks requires you to place and remove blocks from a base block that is permanently mounted in a fixture.

- If the Z verification is at 1-inch intervals, four blocks are used, one at a time, in the 1 through 4-inch range.
- If the Z verification is at 1/2-inch intervals, a 1/2-inch bock is used in combination with the four blocks for a 1/2-inch interval Z certification.
- For systems with 6 inches of travel in Z, the 1 and 2-inch blocks are wrung onto the 4-inch block.

The program automatically moves the Z axis at the appropriate interval as the process proceeds.

1. Using Windows Explorer, copy the associated Z-axis fixture data file into the current VMS directory. Rename the data file to `ZNOM.CRT`.
2. Perform the Certification Setup procedure; see ***Certification Setup*** on page 205.
3. Install the highest available magnification lens.
4. Click the Certify **Z** button. The system displays the following prompt:



5. Click **OK** in response to the prompt. The Cert & Verify program automatically launches the VMS software and the system displays the following prompt:

6. Make sure the remote E-Stop switch is pulled out, and then press the **Stop/Start** button on the joystick.

7. Wait for the VMS software to launch and then click **Continue** in the Certification Program instruction window.

8. Re-position the Certification Program window to the lower-right portion of the screen, so you can see any prompts or messages that are displayed in the center of the screen.

9. Verify that the stage is clear to move and then click **Continue** in the Certification Program instruction window to zero the stages.

10. Wait for the stages to stop moving and observe the Ready/Not-Zeroed status display switch to *Ready*. Then click **Continue** in the Certification Program instruction window.

11. Temporarily secure the Z-axis fixture to the stage. The Z-axis fixture is mounted on center, in the X-axis direction.

Note: If you are directed to *select OK*, do not press the Enter key on the keyboard—doing so will be interpreted as a "cancel" instruction by the program. Instead, click OK with the mouse.

Caution: You may receive a message stating *"The lens used by this program is not mounted. The wrong lens may be in use."* This error message is normal and is a precaution. Check and make sure you are using the correct lens. If the lens is correct, click OK and continue with this procedure. If the wrong lens is installed, abort the process and install and calibrate the correct lens before restarting.

Caution: As the program loads, a number of screens may appear and then disappear. This is normal. Do not press any keys or mouse buttons while the program loads, unless prompted to do so.

12. Click  in the VMS toolbar.

13. Set the Joystick Mode to **Slow**.

14. Find and focus on the upper-right corner of the gage block that is permanently mounted on the fixture (see Figure A-4). You may have to adjust the coaxial light level.

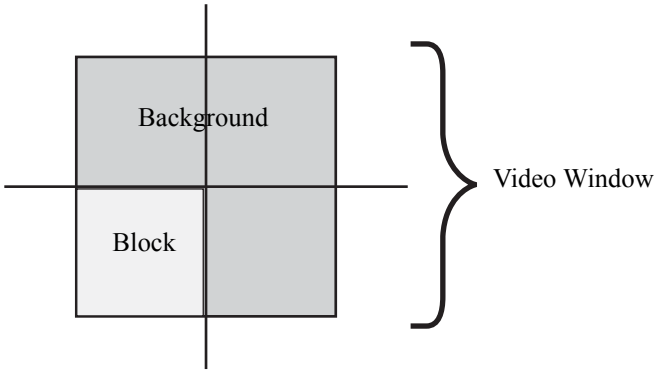


Figure A-4 Crosshair Location, Z-Axis Gage Block

15. Run the Crosshair Finder by double-clicking in the Video (Live) window. **Do not click on the finder.**

16. Click  to store the position and begin the certification process.

Note: Light levels are adjusted automatically. If the system cannot converge on a light level, a prompt will appear for you to select a coaxial light level manually. Record the number, and then enter the value at the prompt.

- The system performs an autofocus on the base gage block that is permanently mounted on the fixture.
- The Z-axis transport moves up to the next step size in the certification series.

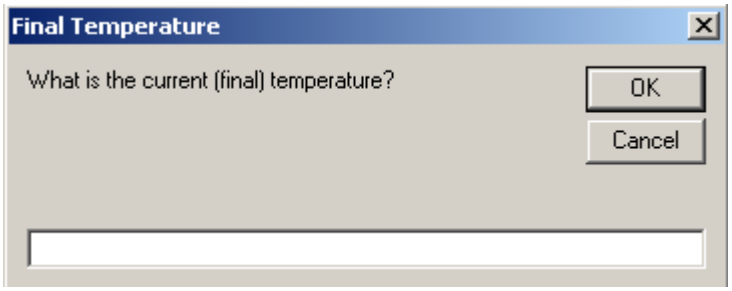
17. Observe the User Input window, and carefully follow the instructions; e.g., place a 25.4 mm (1-inch) tall block on the base.

18. Wring in the next gage block; see ***Wringing Gage Blocks*** on page 202.

19. Click **OK**.

20. Observe the Z measurements with Ronchi grid in the User Input window.

21. Repeat Step 17 through Step 20 until the certification process is complete. When the certification process is complete, the system displays the following dialog box:



22. Enter the current room temperature and click **OK**. The Certification Program window displays, *"Calculating lookup table values .... New Lookup Table created. Press Continue to exit VMS. Changes will take effect when VMS is restarted."*

23. Click **Continue**. Additional information will be added to the error map file (`LOOKUP.TBL`).

24. Remove all stacked gage blocks from the fixture.

25. Exit the Cert & Verify program and the VMS software.

26. Perform the Z Verification procedure; see ***Z Verification*** on page 230.

A.6 System Verification

For the specifications tested in the XY Verify procedure, the same measurement sequence described in the certification process (see ***System Certification*** on page 204) is used to measure the intersection coordinates again, but this time the lookup table is used to correct the known errors, as it would be in measuring anything. In the XY Verify procedure, the grid plate is measured the number of times specified in the setup. For each intersection, its X and Y distances from the center intersection are measured by VMS. These measured distances, or coordinates with respect to the center, will be referred to as *locations*. The locations are passed to the Cert & Verify program for statistical processing, and the results are provided for the desired specifications.

The Z Verify measurements and derived performance statistics are similar with some exceptions; see ***Z Verification*** on page 230.

Tools Required

XY-axis grid plate and data file
Z-axis step gage and data file or Z-axis gage-block fixture and data file
1X magnification lens
High magnification lens
Lens calibration standard
Standard set of Allen wrenches
VMS Cert & Verify Program

A.6.1 Verification Setup

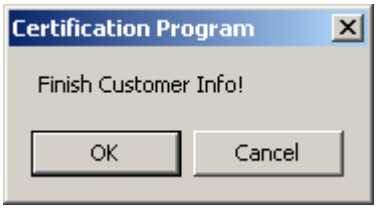
1. If necessary, install the VMS Cert & Verify program. This program should be installed into the current VMS directory (e.g., C:\Program Files\VMS).

2. Install a calibrated 1X magnification lens.

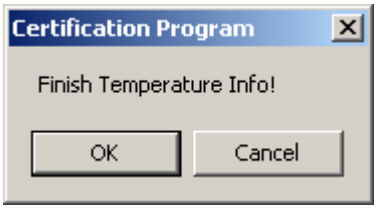
3. [XY Verification ONLY] Carefully place the XY-axis grid plate on the Benchmark 250 stage. Then secure the XY-axis grid plate by tightening the set screws or retaining clamps at each end of the Y-axis stage. Make sure that the grid plate is level to within **±0.01 mm (0.0004")** and is aligned to the XY travel.

4. If the VMS software is running, exit it before continuing.

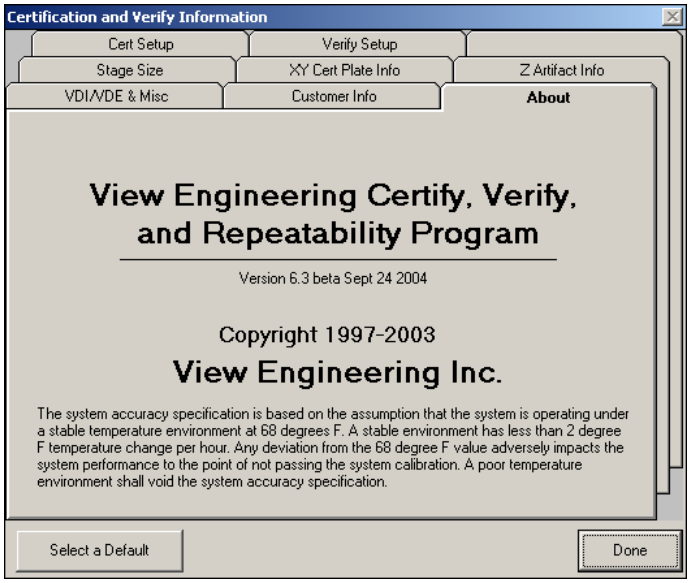
5. Launch the Cert & Verify program by double-clicking on the desktop icon (`VOYCERT.EXE`). The system displays the following prompt:



6. Click **OK** in response to the above prompt. The system displays the following prompt:



7. Click **OK** in response to the prompt. The system displays the Certification and Verify Information window:



8. Click the **Select a Default** button and double-click on the system that you are verifying—the system specific information is automatically entered into the required fields in the various tabs.

Caution: Be sure to choose the correct system in the default machine type list. If the incorrect default machine type is chosen, the correction factors will be incorrect, and the verification process may not pass after you perform an XY and/or Z certification.

9. Click the **Customer Info** tab and enter the following information:

   - customer
   - operator name
   - machine & model
   - machine serial number

10. Click the **VDI/VDE & Misc** tab. Then click the **Manual (deg F)** radio button and enter the current room temperature in the Temperature box.

Note: Some systems are set up to automatically read and record ambient temperature. If this is the case for your system, we recommend that you click the Auto radio button to record the temperature automatically.

11. [XY Verification ONLY] Click the **Scan rows before columns** radio button.

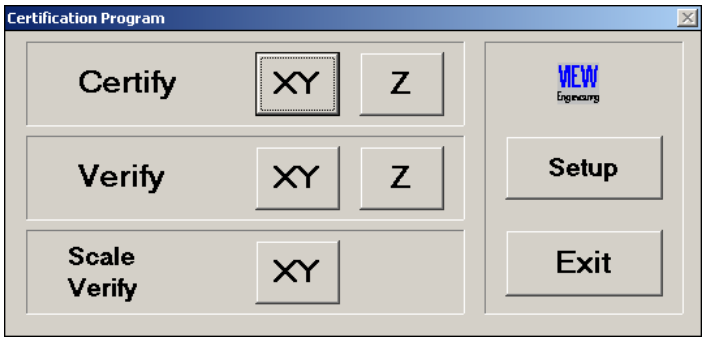
Note: If you want to measure the entire plate before repeating a row, select the *Inspect entire plate before repeating row or column* checkbox.

12. [XY Verification ONLY] Click the **XY Cert Plate Info** tab and enter the following information:

    - P.O. number of the plate—all digits must match the `XYNOM.CRT` file
    - serial number of the plate—leading zeros are ignored
    - number of unreachable lines (if any) on each side of the plate

13. [Z Verification ONLY] Click the **Z Artifact Info** tab and enter the Artifact set # (must match the `ZNOM.CRT` file) and select the **Gauge Blocks** radio button or the **Step Gauge** radio, depending on which method you will be using to verify the Z-axis. Then enter the correct offset information.

14. Once all the parameters have been set and the customer information has been updated, click **Done**. The system displays the Certification Program window:



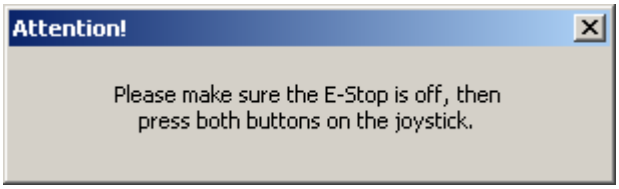
You are now ready to perform an XY Verification (see ***XY Verification*** on page 226) or a Z Verification (see ***Z Verification*** on page 230).

Caution: Do not close the Certification Program window. Doing so will require you to re-enter customer and temperature information.

A.6.2 XY Verification

Caution: Data file XYVER.DAT is created automatically at the end of the XY Verification process. If you want to save the old file, rename it before running this process.

1. Using Windows Explorer, copy the associated grid plate data file into the current VMS directory. Rename the data file to XYNOM.CRT.
2. Perform the Verification Setup procedure; see ***Verification Setup*** on page 223.
3. Click the Verify **XY** button. The Cert & Verify program automatically launches the VMS software and the system displays the following prompt:



Note: A window may appear excluding a number of lines from the top and right sides of the plate. This is normal, click OK.

4. Make sure the remote E-Stop switch is pulled out, and then press the **Stop/ Start** button on the joystick.
5. Wait for the VMS software to launch and then click **Continue** in the Certification Program instruction window.
6. Re-position the Certification Program instruction window to the lower-right portion of the screen, so you can see any prompts or messages that are displayed in the center of the screen.
7. Verify that the stage is clear to move, and then click **Continue** in the Certification Program instruction window to zero the stages.
8. Wait for the stages to stop moving and observe the Ready/Not-Zeroed status display switch to *Ready*. Then click **Continue** in the Certification Program instruction window.

Note: If you are directed to *select OK*, do not press the Enter key on the keyboard—doing so will be interpreted as a "cancel" instruction in the program. Instead, click OK with the mouse.

Caution: You may receive a message stating *"The lens used by this program is not mounted. The wrong lens may be in use."* This error message is normal and is a precaution. Check and make sure you are using the correct lens. If the lens is correct, click OK and continue with this procedure. If the wrong lens is installed, abort the process and install and calibrate the correct lens before restarting.

Note: If a warning is displayed for lighting configuration, click OK.

Caution: As the program loads, a number of screens may appear and then disappear. This is normal; do not press any keys or mouse buttons while the program loads, unless prompted to do so.

9. Click  in the VMS toolbar.

10. Set the coaxial light to a value that will allow you to find and focus on the 0/0 intersection at the center of the XY-axis grid plate.

a. Use the joystick to move the stage so the 0/0 intersection (see Figure A-5) is visible in the Video window.

b. Click  and center the Crosshair Finder over the 0/0 intersection. Then focus on the intersection.

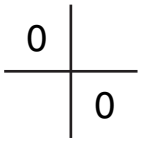


Figure A-5 0/0 intersection

c. Align the plate so it is parallel to the X-axis travel assuring full travel and good focus in both X and Y directions; adjust the plate height if needed. Full travel assumes that, during the entire Cert and Verify process, all outer intersections (except those excluded in the setup) used in `XYNOM.CRT` can be reached.

d. After the plate has been aligned, re-position the Crosshair Finder over the 0/0 intersection.

e. Focus again.

Caution: Before clicking Set Home in the next step, be aware that the stage will return to this location when you click Go Home.

f. Click **Set Home** to establish the current XYZ position as the home position.

11. After all alignments are complete and the XY-axis grid plate is secure, click **OK** in the Autofocus Finder window.

Caution: Before selecting Go Home in the next step, make sure it is safe for the stage to move.

12. The stages may have moved to a preset position in the program. Click **Go Home** to move the stages to the home position you defined earlier.

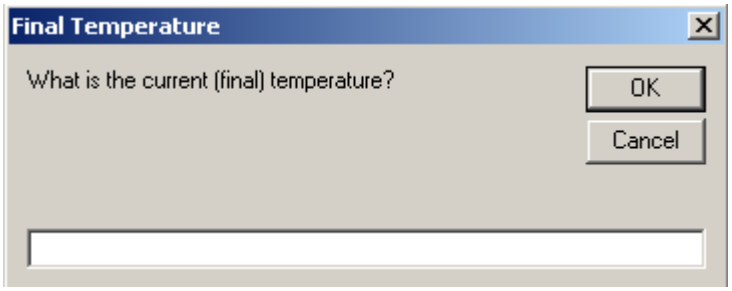
13. Double-click the left mouse button in the Video window.

14. Click  to store the position and begin the verification process.

Note: Light levels are adjusted automatically. If the system cannot converge on a light level, a prompt will appear for the operator to select a coaxial light level manually. Record the number, and then enter the value at the prompt.

Note: A status bar, displayed in the instruction window, shows the progress of the Verification program.

When the verification process is complete, the system displays the following dialog box:



15. Enter the current room temperature and click **OK**. The system displays a *PASS* or *FAIL* message in the Certification Program window.

16. Click the **Make LUT** button to improve the current lookup table.

17. Save (i.e., manually copy) the `XYVER.DAT` file from the current VMS directory onto removable media. This is a text file that can be viewed or printed at a later date from any standard PC.

18. Close the Verification window, and exit the Cert & Verify program.

19. Remove the XY-axis grid plate.

A.6.3 Z Verification

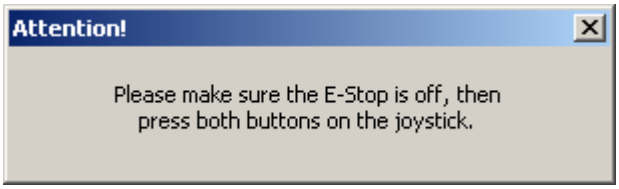
Caution: Data file ZVER.DAT is created automatically at the end of the Z Verification process. If you want to save the old file, rename it before running this process.

Note: Although, you can use a Z-axis step gage or a Z-axis gage block fixture and gage blocks to perform the Z-axis verification, we recommend using a step gage.

Note: Use the highest available magnification lens to perform the Z verification.

A.6.3.1 Z Verification with a Step Gage

1. Using Windows Explorer, copy the associated Z-axis step gage file into the current VMS directory. Rename the data file to ZNOM.CRT.
2. Perform the Verification Setup procedure; see ***Verification Setup*** on page 223.
3. Click the Verify **Z** button. The Cert & Verify program automatically launches the VMS software and the system displays the following prompt:



4. Make sure the remote E-Stop switch is pulled out, and then press the **Stop/ Start** button on the joystick.
5. Wait for the VMS software to launch and then click **Continue** in the Certification Program instruction window.
6. Re-position the Certification Program window to the lower-right portion of the screen, so you can see any prompts or messages that are displayed in the center of the screen.
7. Verify that the stage is clear to move and then click **Continue** in the Certification Program instruction window to zero the stages.
8. Wait for the stages to stop moving and observe the Ready/Not-Zeroed status display switch to *Ready*. Then click **Continue** in the Certification Program instruction window.

9. Temporarily mount the Z-axis step gage to the stage as shown in Figure A-6. Make sure that:

- the step gage steps ascend toward you when you are standing in front of the machine
- the step gage is placed toward the front of the stage
- the step gage is visually square in the X and Y directions
- the step gage is secure on the stage and will not move during the verification process

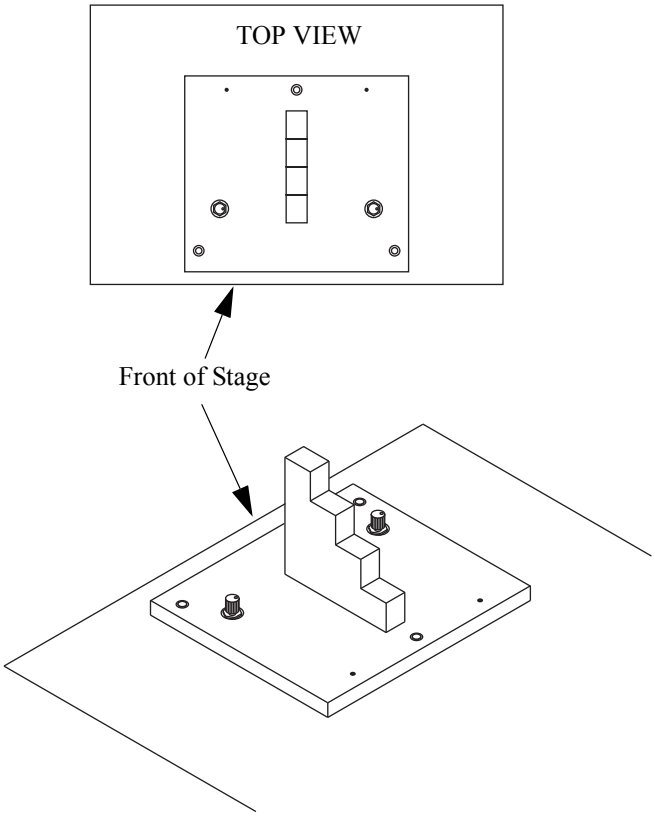


Figure A-6 Mounting the Step Gage

Note: If you are performing this procedure immediately after the Z Certification procedure and the step gage has not been moved, you can skip the next step because the step gage should still be level.

10. Level the step gage to within **±0.002 mm (0.00008")**.

a. Use the joystick to move the stage so focus point ❶ (see Figure A-7) is visible in the Video window.

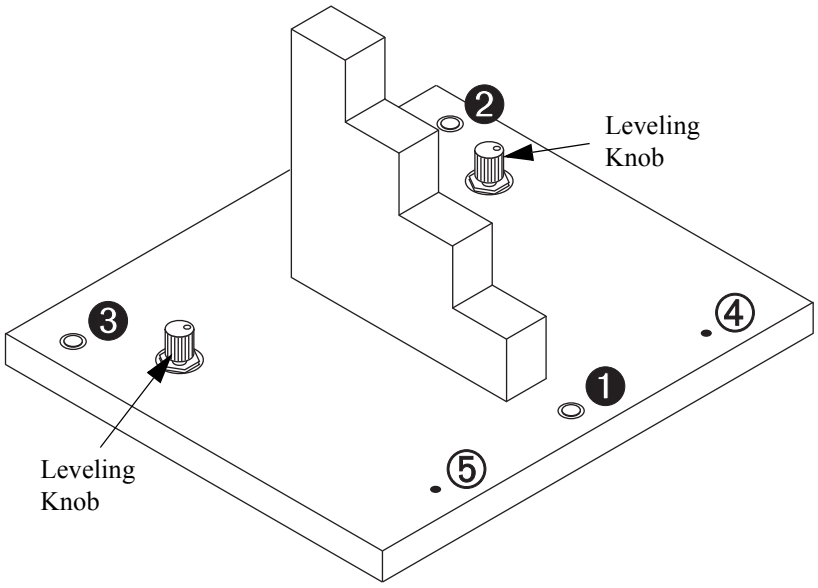


Figure A-7 Leveling the Step Gage

b. Click  in the Video window toolbar and click  in the Autofocus Settings window to select the Textured Surface Focus tool.

c. Select the High Mag camera and perform an autofocus on focus point ❶.

d. Zero the Z-axis readout by right-clicking in the DRO window and selecting **Zero DRO** in the context menu.

e. Move the stage so focus point ❷ (see Figure A-7) is visible in the Video window and perform an autofocus on focus point ❷. The Z value in the DRO window should be zero or very close to zero.

If the Z value for focus point ❷ is within ±0.002 mm (0.00008") of the Z value for focus point ❶, no adjustment is required; advance to Step 10g. If the Z value is not within ±0.002 mm (0.00008"), use the leveling knob adjacent to focus point ❷ to level the step gage; continue with the next step.

f. Repeat Steps 10a to 10.

g. Move the stage so focus point ❸ (see Figure A-7) is visible in the Video window and perform an autofocus on focus point ❸. The Z value in the DRO window should be zero or very close to zero.

If the Z value for focus point ❸ is within ±0.002 mm (0.00008") of the Z value for focus point ❷, no adjustment is required; continue with Step 11. If the Z value is not within ±0.002 mm (0.00008"), use the leveling knob adjacent to focus point ❸ to level the step gage; continue with the next step.

h. Repeat Step 10a to 10 as many times as necessary to level the step gage to within ±0.002 mm (0.00008").

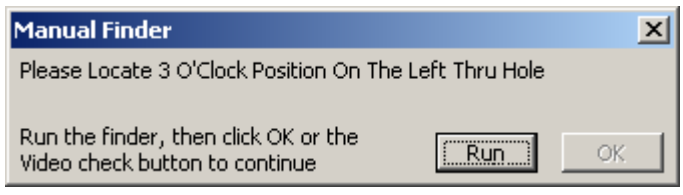
11. Set the Joystick Mode to **Slow**.

Note: If you are directed to *select OK*, do not press the Enter key on the keyboard—doing so will be interpreted as a "cancel" instruction by the program. Instead, click OK with the mouse.

Caution: You may receive a message stating *"The lens used by this program is not mounted. The wrong lens may be in use."* This error message is normal and is a precaution. Check and make sure you are using the correct lens. If the lens is correct, click OK and continue with this procedure. If the wrong lens is installed, abort the process and install and calibrate the correct lens before restarting.

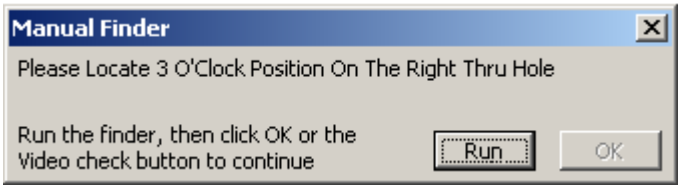
Caution: As the program loads, a number of screens may appear and then disappear. This is normal. Do not press any keys or mouse buttons while the program loads, unless prompted to do so.

12. Click  in the VMS toolbar. The system displays the following prompt:



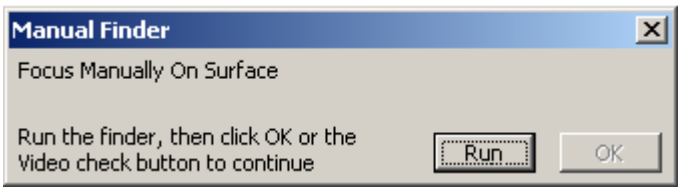
13. Move the stage so the left through hole (④ in Figure A-7) is visible in the Video window and place the Crosshair Finder on the right edge of the hole (3 o'clock position).

14. Click the **Run** button in the displayed prompt to run the finder and then click the **OK** button. The system displays the following prompt:



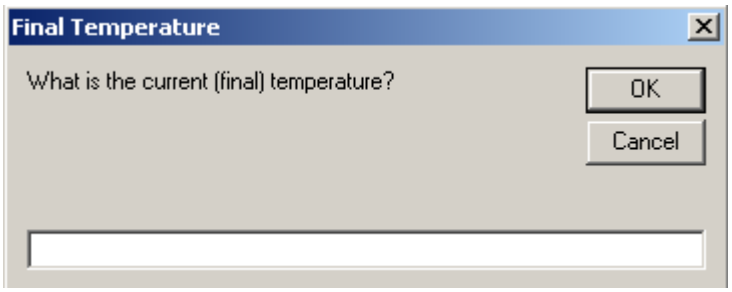
15. Move the stage so the right through hole (⑤ in Figure A-7) is visible in the Video window and place the Crosshair Finder on the right edge of the hole (3 o'clock position).

16. Click the **Run** button in the displayed prompt to run the finder and then click the **OK** button. The system moves the stage to the first step on the step gage and displays the following prompt:



17. Manually focus on the top surface of the first step and click the **Run** button in the displayed prompt to run the finder. Then click the **OK** button to run the Z-axis verification program.

When the verification process is complete, the system displays the following dialog box:



18. Enter the current room temperature and click **OK**. The system displays a *PASS* or *FAIL* message in the Certification Program window.

19. Save (i.e., manually copy) the `ZVER.DAT` file from the current VMS directory onto removable media. This is a text file that can be viewed or printed at a later date from any standard PC.

20. Close the Verification window, and exit the Cert & Verify program.

21. Remove the Z-axis step gage from the stage.

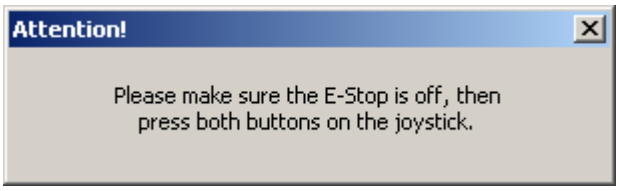
A.6.3.2 Z Verification with Gage Blocks

Note: The use of gage blocks requires you to place and remove blocks from the base block that is permanently mounted in a fixture.

- If the Z verification is at 1-inch intervals, four blocks are used, one at a time, in the 1 through 4-inch range.
- If the Z verification is at 1/2-inch intervals, a 1/2-inch bock is used in combination with the four blocks for a 1/2-inch interval Z certification.
- For systems with 6 inches of travel in Z, the 1 and 2-inch blocks are wrung onto the 4-inch block.

The program automatically moves the Z-axis at the appropriate interval as the process proceeds.

1. Using Windows Explorer, copy the associated Z-axis fixture data file into the current VMS directory. Rename the data file to `ZNOM.CRT`.
2. Perform the Verification Setup procedure; see ***Verification Setup*** on page 223.
3. Click the Verify **Z** button. The Cert & Verify program automatically launches the VMS software and the system displays the following prompt:



4. Make sure the remote E-Stop switch is pulled out, and then press the **Stop/ Start** button on the joystick.
5. Wait for the VMS software to launch and then click **Continue** in the Certification Program instruction window.
6. Re-position the Verification Program window to the lower-right portion of the screen, so you can see any prompts or messages that are displayed in the center of the screen.
7. Verify that the stage is clear to move, and then click **Continue** in the Certification Program instruction window to zero the stages.
8. Wait for the stages to stop moving and observe the Ready/Not-Zeroed status display switch to *Ready*. Then click **Continue** in the Certification Program instruction window.

9. Temporarily secure the Z-axis fixture to the stage. The Z-axis fixture is mounted on center, in the X-axis direction.

Note: If you are directed to *select OK*, do not press the Enter key on the keyboard—doing so will be interpreted as a "cancel" instruction by the program. Instead, click OK with the mouse.

Caution: You may receive a message stating *"The lens used by this program is not mounted. The wrong lens may be in use."* This error message is normal and is a precaution. Check and make sure you are using the correct lens. If the lens is correct, click OK and continue with this procedure. If the wrong lens is installed, abort the process and install and calibrate the correct lens before restarting.

Caution: As the program loads, a number of screens may appear and then disappear. This is normal. Do not press any keys or mouse buttons while the program loads, unless prompted to do so.

10. Click  in the VMS toolbar.

11. Set the Joystick Mode to **Slow**.

12. Find and focus on the upper-right corner of the gage block that is permanently mounted on the fixture (see Figure A-8). You may have to adjust the coaxial light level.

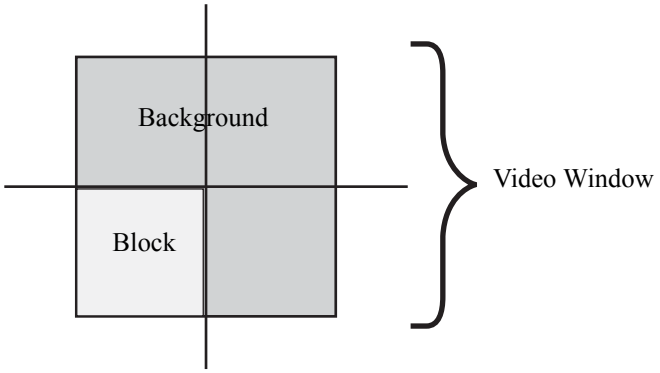


Figure A-8 Crosshair Location, Z-Axis Gage Block

13. Run the Crosshair Finder by double-clicking in the Video (Live) window. **Do not click on the finder.**

14. Click  to store the position and begin the verification process.

Note: Light levels are adjusted automatically. If the system cannot converge on a light level, a prompt will appear for you to select a coaxial light level manually. Record the number, and then enter the value at the prompt.

- The system performs an autofocus on the base gage block that is permanently mounted on the fixture.
- The Z-axis stage moves up to the next step size in the verification series.

15. Observe the User Input window, and carefully follow the instructions; e.g., place a 25.4 mm (1-inch) tall block on the base.

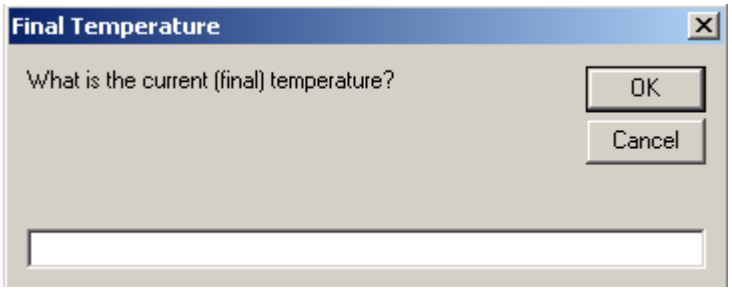
16. Wring in the next gage block; see ***Wringing Gage Blocks*** on page 202.

17. Click **OK**.

18. Observe the Z measurements with Ronchi grid in the User Input window.

19. Repeat Step 15 through Step 18 until the verification process is complete.

When the verification process is complete, the system displays the following dialog box:



20. Enter the current room temperature and click **OK**. The system displays a *PASS* or *FAIL* message in the Certification Program window.

21. Save (i.e., manually copy) the `ZVER.DAT` file from the current VMS directory onto removable media. This is a text file that can be viewed or printed at a later date from any standard PC.

22. Close the Verification window, and exit the Cert & Verify program.

23. Remove all stacked gage blocks from the Z-axis fixture and remove the fixture.

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Accessing Parameters

Appendix B

B.1 What This Appendix Contains

This appendix covers VMS parameters.

Caution: Do not change any parameters without consulting the Customer Support HelpDesk; see ***Where to Get Help*** on page 4.

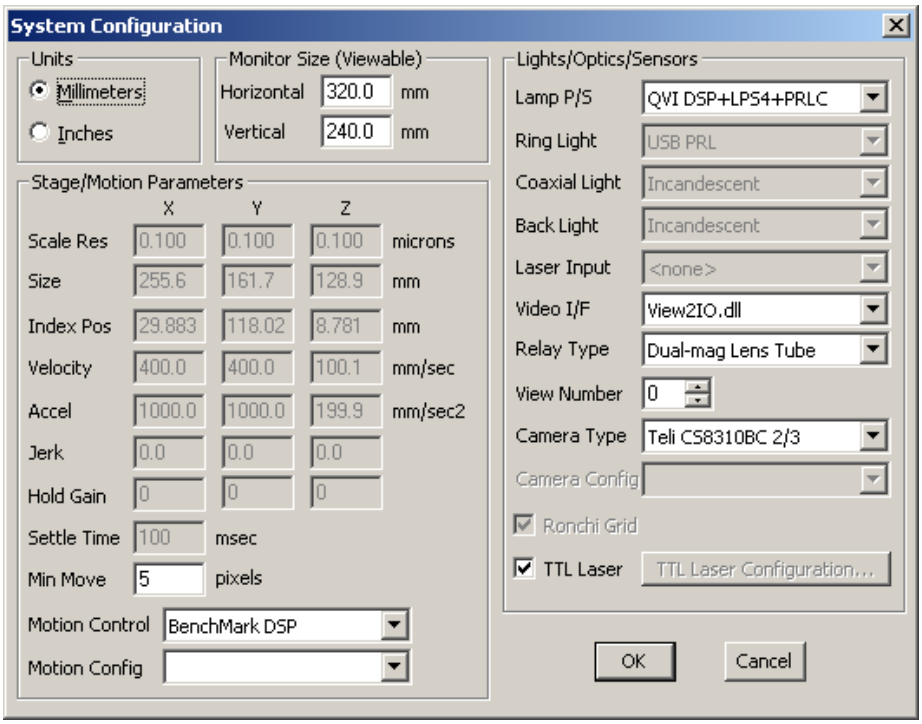
Note: This appendix describes how to view the VMS parameters; it does not describe how to change parameters. Contact the Customer Support HelpDesk for information about changing parameters.

B.2 Accessing Basic Parameters

1. Launch the VMS software.

2. Select **Setup** / **Options** => **System**.

   The system displays a window that shows the system configuration parameters. Typically, these parameters are locked for editing; contact the View Engineering, Inc., Customer Support HelpDesk (see ***Where to Get Help*** on page 4) for information about changing parameters.



3. Click **OK** to close the window.

B.3 Accessing Advanced Parameters

1. Using Windows Explorer, navigate to the following directory: `C:\PROGRAM FILES\VMS\EEPARAMS`

2. Create a backup of the `DSPPARAMS.TXT` file so you can refer back to it if necessary.

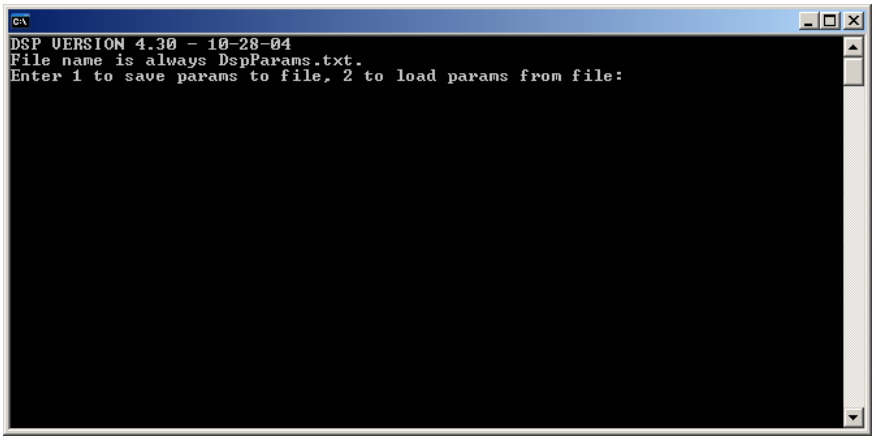
   a. Open the file `DSPPARAMS.TXT`.

   b. Select **File** / **Save As**.

   c. Type a unique name (for example, `DSPPARAMS_BACKUP.TXT`) in the **File name** box and click the **Save** button.

3. Double-click the `EEPARAMS.EXE` program.

   The system displays the following DOS window:



4. Type **1** and press **Enter** on the keyboard.

   The system saves the currently loaded parameters to the text file, `DSPPARAMS.TXT`. This file is located in the `C:\PROGRAM FILES\VMS\EEPARAMS` directory.

5. Open `DSPPARAMS.TXT` to view all of the current system parameters.

Caution: Do not make any changes to the `DSPPARAMS.TXT` file without consulting the View Engineering, Inc., Customer Support HelpDesk; see ***Where to Get Help*** on page 4.

Note: If you make any changes to the `DSPPARAMS.TXT` file, you must reload the parameters onto the DSP Multi Axis PCBA (as described on the next page) in order for the changes to take effect.

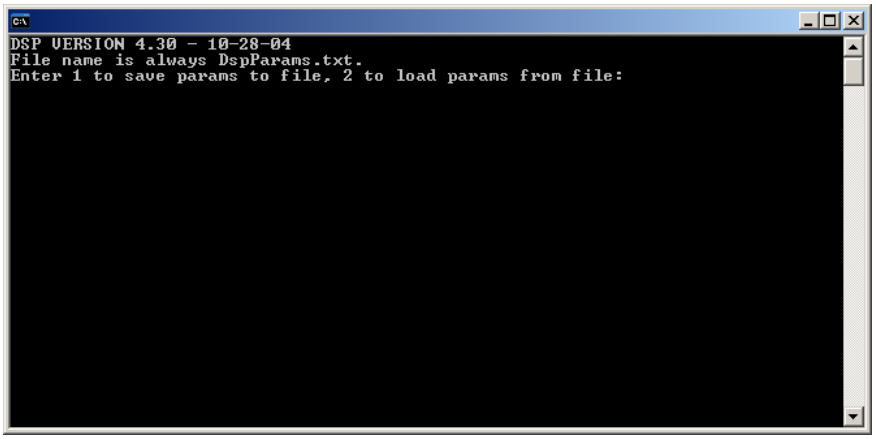
B.4 Loading Parameters

1. Using Windows Explorer, navigate to the following directory:
   `C:\PROGRAM FILES\VMS\EEPARAMS`

2. If necessary, overwrite the `DSPPARAMS.TXT` file already in the EEPARAMS directory with a new `DSPPARAMS.TXT` file.

3. Double-click the `EEPARAMS.EXE` program.

   The system displays the following DOS window:



4. Type **2** and press **Enter** on the keyboard.

   The system loads the parameters from the `DSPPARAMS.TXT` file onto the DSP Multi Axis PCBA.

Software Installation

Appendix C

C.1 What This Appendix Contains

This appendix covers:

- VMS Software Installation
- Elements Software Installation

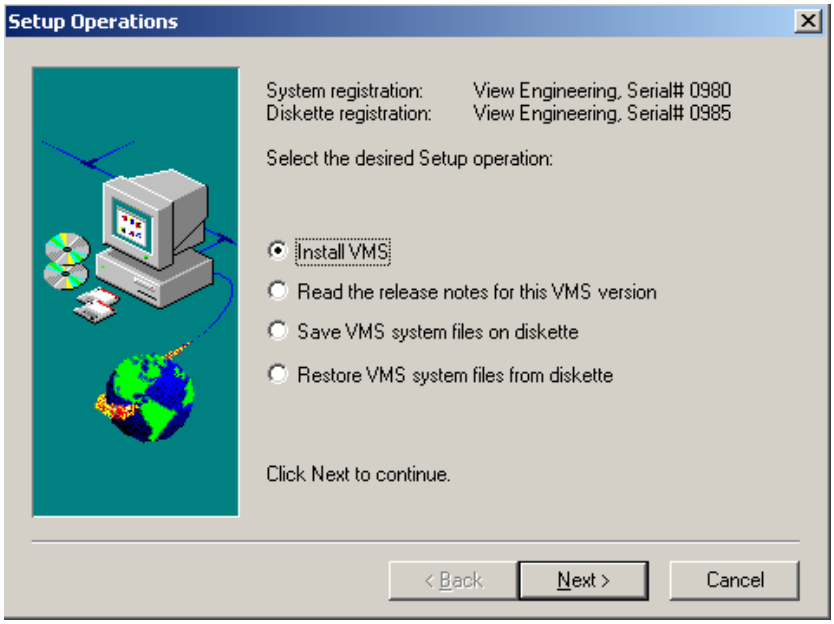
C.2 VMS Software Installation

Note: In addition to a VMS software CD, you will need an options disk for the system in order to install the VMS software.

Caution: We strongly recommend that you close all Windows programs before installing the VMS software.

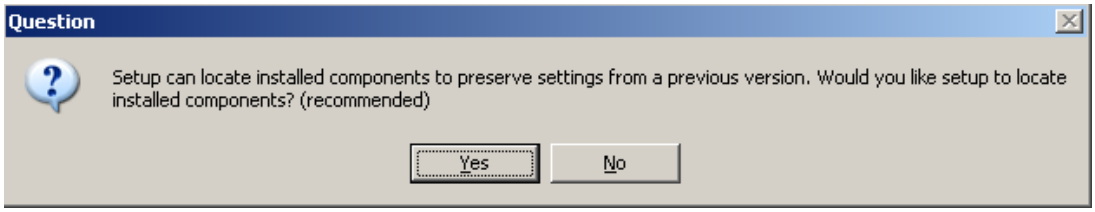
1. Insert the software CD into the CD-ROM drive and the options disk into the floppy disk drive.

   The system reads the software CD and automatically displays the Setup Operations dialog box.



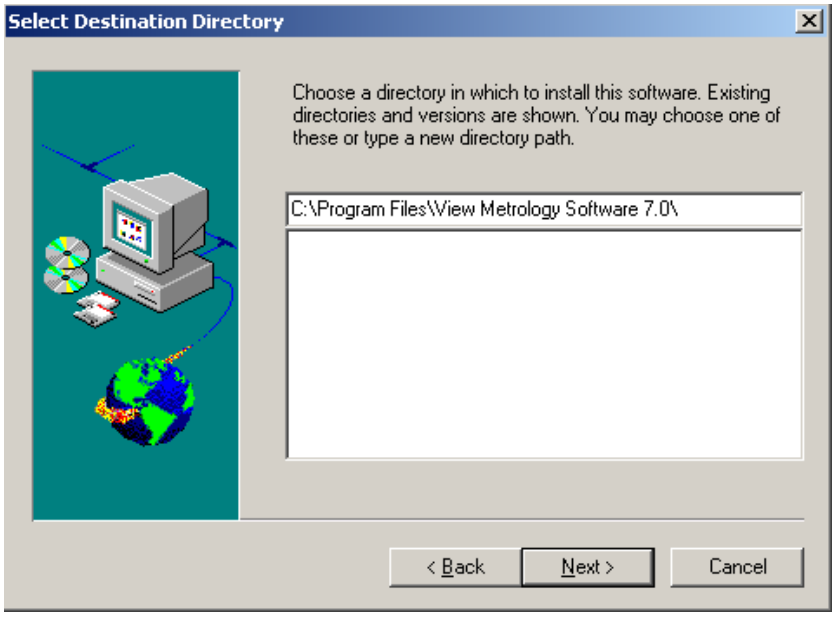
2. Select the **Install VMS** radio button and click the **Next** button.

   The following prompt is displayed:



3. Click the **Yes** button.

   The system searches for installed VMS software components and existing VMS software directories. It displays the Select Destination Directory dialog box when finished.

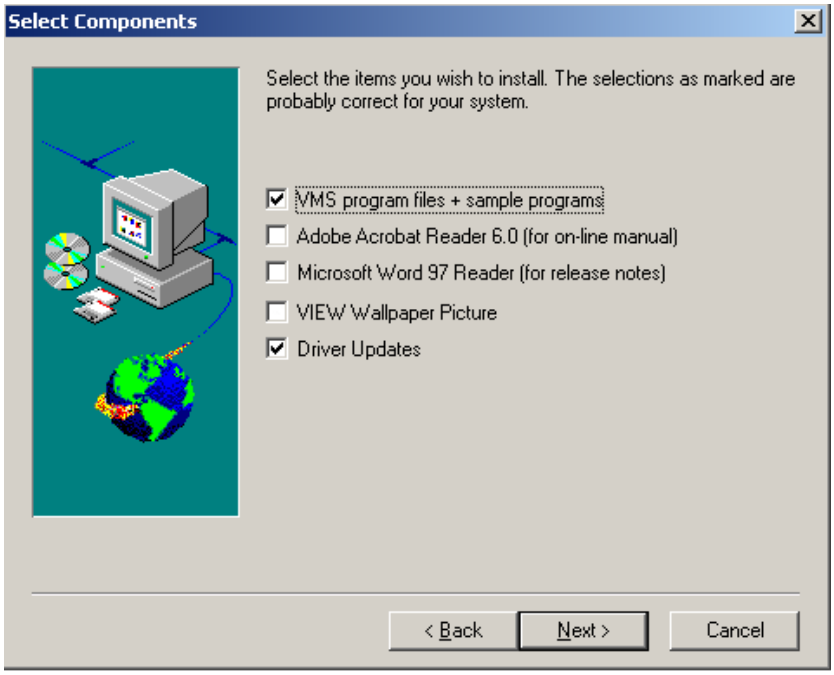


4. If you agree with the recommended directory shown in the Select Destination Directory dialog box, click the **Next** button. Otherwise, type a new directory path or select an existing directory before clicking the Next button.

Note: If an existing version of VMS was detected, it will appear in the Select Destination Directory dialog box.

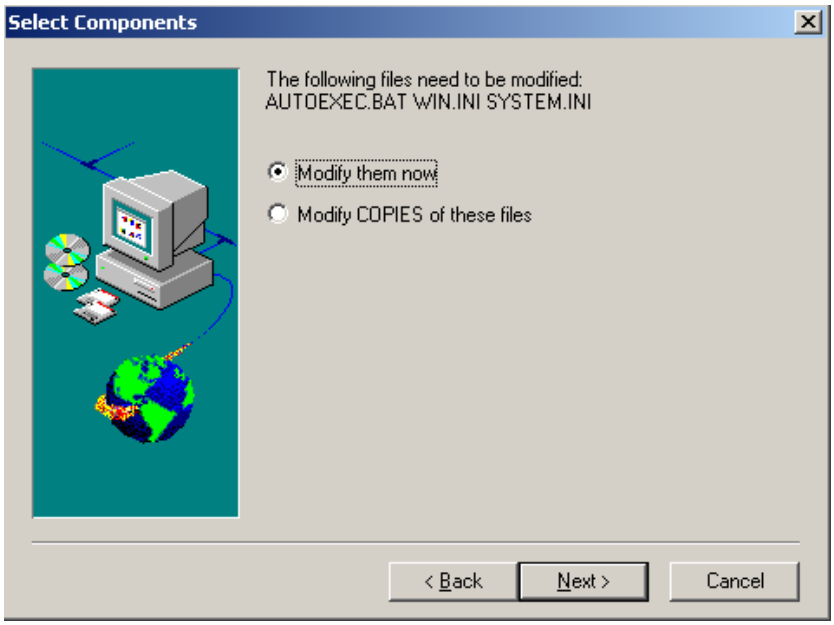
Note: If you choose to install the VMS software in an existing directory, the system displays a confirmation prompt. Click the **Yes** button to overwrite the existing files.

The system displays the Select Components dialog box.

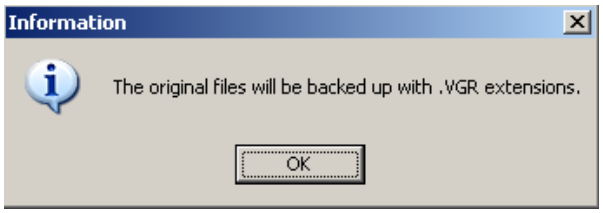


5. Select the **VMS program files + sample programs** and the **Driver Updates** checkboxes. If you want, select any of the other checkboxes to install the optional components. Then click the **Next** button.

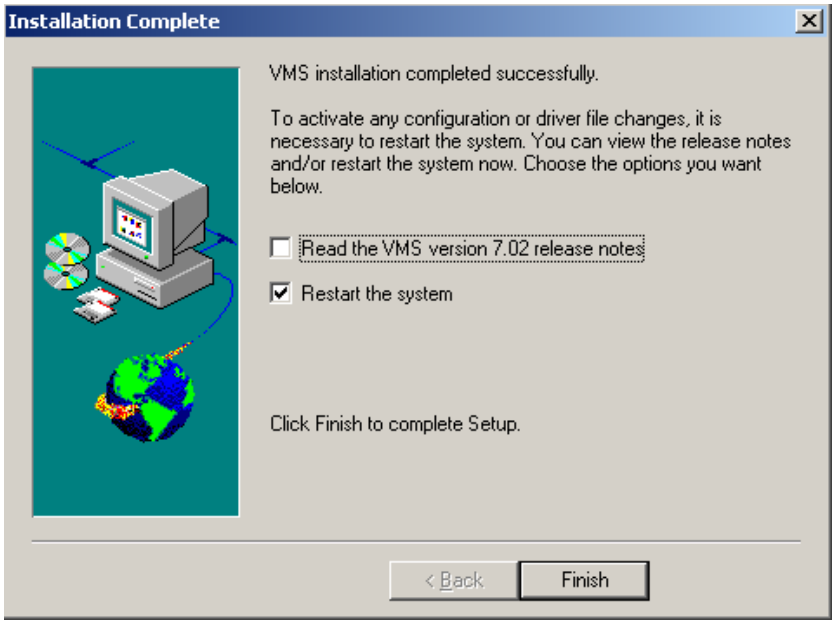
   The system starts copying files from the software CD and displays the following dialog box when finished:



6. Select the **Modify them now** checkbox and click the **Next** button. Then click **OK** in response to the following prompt:



The system displays the Installation Complete dialog box.



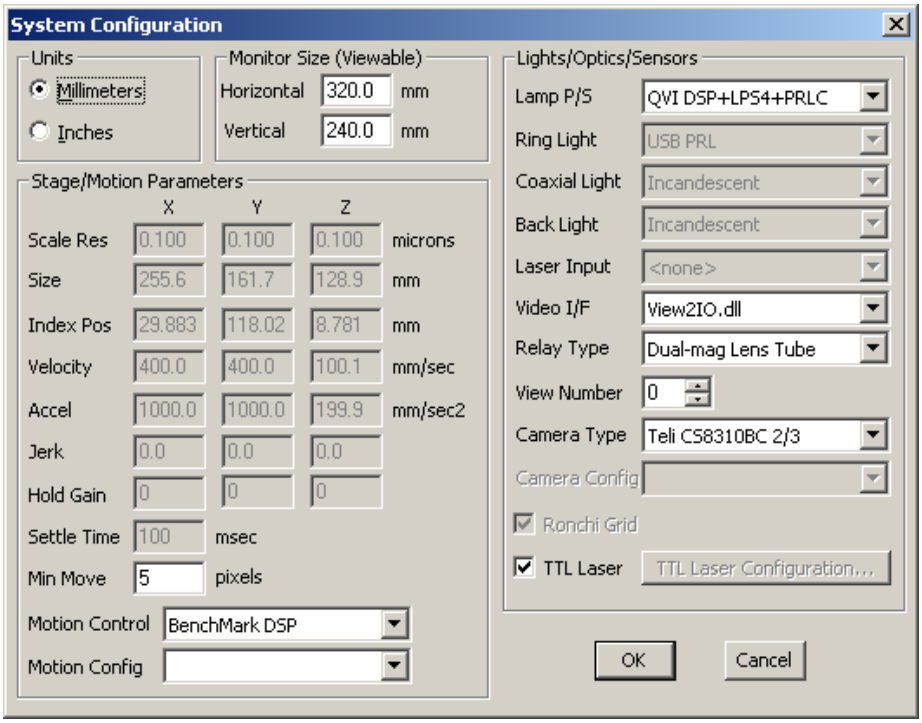
7. Select the **Restart the system** checkbox and click the **Finish** button to complete the setup program.

Note: If you want to view the VMS software release notes, select the *Read the VMS version 7.XX release notes* checkbox before clicking the Finish button.

---

8. Remove the software CD and options disk from their respective drives and store them in a secure place.

When you initially launch the VMS software, the following System Configuration window is displayed. Click the **OK** button to close the window and access the VMS software.

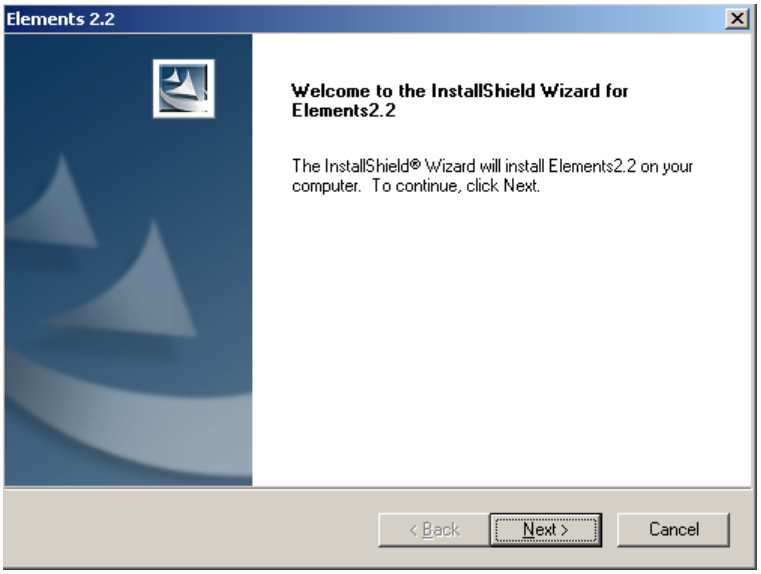


C.3 Elements Software Installation

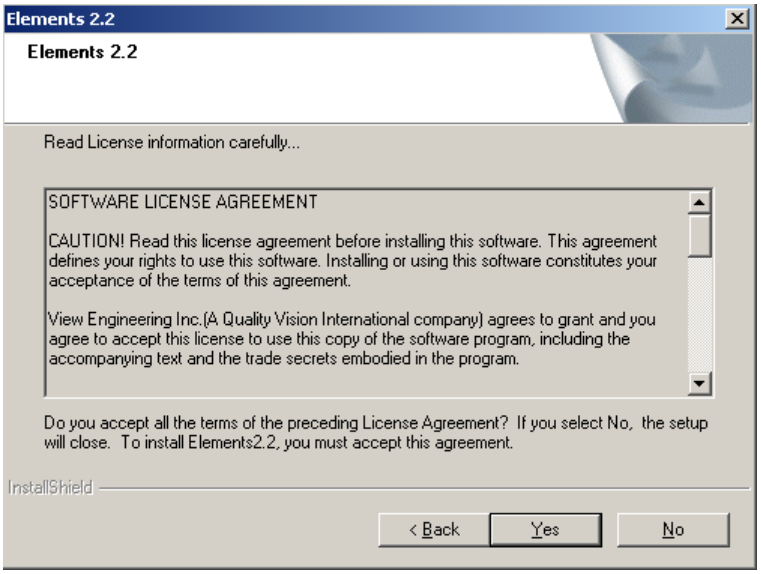
Caution: We strongly recommend that you close all Windows programs before installing the Elements software.

1. Insert the Elements software CD into the CD-ROM drive.

   The system reads the software CD and automatically loads the InstallShield® Wizard.

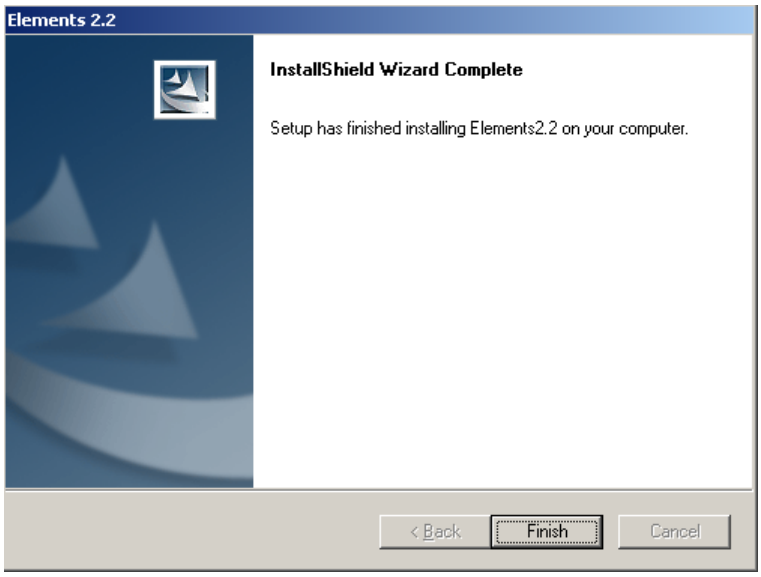


2. Click the **Next** button to display the following dialog box:



3. Read the license agreement and click the **Yes** button to install the software.

   The system starts copying the necessary files and displays the following dialog box when finished:



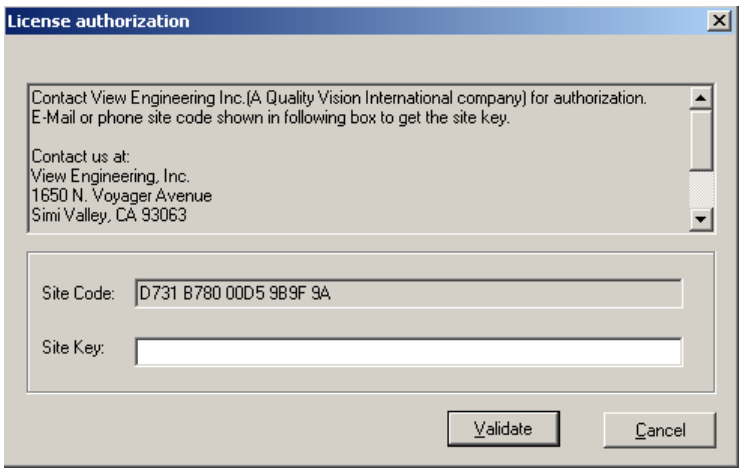
4. Click the **Finish** button to complete the installation.

Note: Although it is not required, we recommend that you restart the system before launching the Elements software.

When you initially launch the Elements software, the system displays a prompt to enter a valid site key in order to use the software.

1. Click **OK** in response to the prompt.

2. Select **Help / License** to display the License authorization dialog box.



3. Enter a valid site key in the Site Key box and click the **Validate** button.

Note: To obtain a site key, contact the View Engineering Inc., Customer Support HelpDesk (see ***Where to Get Help*** on page 4).

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