MicroLUPI™
Operating Manual
OMP-0448

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ZYGO CUSTOMER SUPPORT

For help within North America, please use the contacts listed below. For help in other countries, please contact your local Zygo representative. Be sure to supply the instrument model and serial number, and the software version.

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Attn: Customer Support

MANUAL REVISION INFORMATION

The document (OMP) number and the applicable revision letter for this manual appear on the title page. The publication date appears below.

Revision	*Publication Date*	*Revision*	*Publication Date*
1st Release	August 2001		

MANUAL NOTATIONS

▲ **Warning!** Denotes a hazard that could cause injury to personnel, and can also cause damage to the equipment.

Note: Provides helpful information.

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ZYGO STATEMENT OF WARRANTY AND PRODUCT SUPPORT

Zygo Corporation provides this warranty to protect its customers from defects in product workmanship or product materials. This warranty covers all products manufactured by Zygo Corporation. Zygo warrants that the equipment purchased will be free from any defects in material and/or workmanship under normal operating conditions for a period of one year from the date of shipment.

In addition, being committed to providing our customers with superior service, Zygo will support all standard products for a period of five years after the sale of the last newly-manufactured unit. Beyond this five-year period, we will continue to support these products on a "best-effort" basis.

WARRANTY SERVICE

Zygo's responsibility under this warranty shall be limited to the repair or replacement (at Zygo's option) of defective equipment at no cost to the buyer, except for transportation, cleaning, and recalibration charges.

Zygo will perform warranty service by: (1) sending replacement parts with appropriate installation instructions to the buyer, the buyer returning his defective part to Zygo or; (2) repairing the product at a Zygo repair facility after it has been returned freight prepaid, or; (3) at the buyer's request, dispatching a service representative to the buyer's facility. The buyer shall pay Zygo's travel and living expenses as well as travel time.

Defective products or parts will be repaired or replaced with new or like-new parts. These replacement parts will be warranted for a period of 90 days after they are shipped, or for the remainder of the original warranty period, whichever is longer. Warranty service will be performed only if the buyer notifies Zygo within 14 days of discovering any defects. Equipment or parts that are to be returned to Zygo must be issued a Return Authorization number. This number can be obtained by contacting the Zygo Service Department. Should Zygo's subsequent inspection reveal that the parts were not defective, all expenses incurred by Zygo shall be charged back to the buyer. Defective equipment that is replaced shall become the property of Zygo.

Warranty period begins when the product is shipped from Zygo. Replacement parts, service workmanship, used equipment, and refurbished equipment are warranted for a period of 90 days.

RETURNS

Unused and undamaged products, in their original shipping containers, may be returned for credit within 30 days of receipt. All such products will be subject to a restocking fee equal to 20 percent of the purchase price. Custom products are not returnable.

EXCLUSIONS

The above warranty and product support statement applies only to equipment that is an integral part of a Zygo manufactured product. It does not apply to peripheral equipment manufactured by others, such as: computers, printers, vibration isolation tables, etc. In such cases, the warranty and the support that the original manufacturer supplies will apply.

In addition, warranty service does not include or apply to any product or part which, in Zygo's judgment:

a. Has been repaired by others, improperly installed, altered, modified, or damaged in any way.
b. Malfunctions because the customer has failed to perform maintenance, calibration checks or good operating procedures.
c. Is expendable or consumable (such as panel lights, fuses, batteries, windows, and filters) if such items were operable at the time of initial use.
d. Requires replacement because of decomposition due to chemical action.
e. Fails because of poor facility, operating conditions, or utilities.

Other than expressly described above, Zygo makes no express or implied warranties, including any regarding merchantability or fitness for a particular purpose relating to the use or performance of the equipment. Zygo will not be liable for personal injury or property damage (unless caused solely by its own negligence), loss of profit or other incidental or consequential damages arising out of the use or inability to use the equipment. Nor does this warranty apply to any equipment, which has been subject to misuse, neglect or accident; or repaired or altered by other than service representatives qualified by Zygo.

01/96

CE Notice

Marking by the CE symbol indicates compliance of this Zygo Corp. instrument to EMC (electromagnetic compatibility) Directive and the Low Voltage Directive of the European Union. Such marking indicates that this system meets the following technical standards:

- EN 55011 – "Limits and methods of measurements or radio disturbance characteristics of ISM (Industrial Scientific & Medical) radio frequency equipment." Class A, for use in typical commercial environments.
- EN 55022 – "Limits and methods of measurements of radio disturbance characteristics of ITE (Information Technology Equipment)." Class A, for use in typical commercial environments.
- EN 50082-1 1992 – "Electromagnetic compatibility generic immunity standard for the residential, commercial, and light industrial environments."
- EN 61010-1 1993/A2: 1995 – "Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1:General requirements."
- EN 60825-1:1994/IEC825-1 :1993 – "Safety of laser products—Part 1. Equipment classification, requirements and user's guide. Part 2. Safety of optical fibre communication systems."

A Declaration of Conformity in accordance with the preceding directives and standards has been made and is on file at Zygo Corporation, Middlefield, Connecticut, USA.

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Overview and Safety

Chapter 1

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- The MicroLUPI System
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  - How the MicroLUPI Works
- MicroLUPI Components
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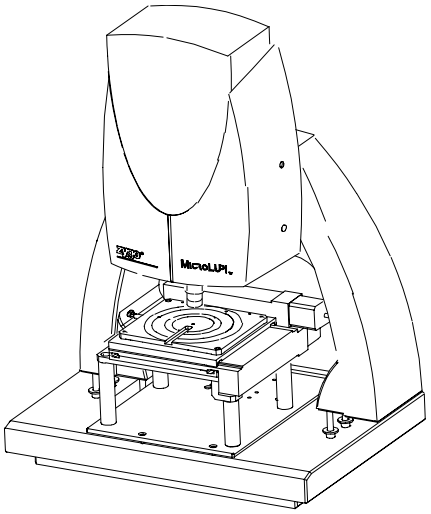
  – Setting Objective Crash Protection

The MicroLUPI System

The ZYGO MicroLUPI[(1)] is a micro-aperture laser unequal path interferometer (LUPI). It is a phase shifting interferometer designed for non-contact, high speed automated measurement of micro-optics. The MicroLUPI is a versatile and precise instrument used for testing spherical and flat optics. It can be configured to measure surface figure and radius of curvature of individual optical parts or optical arrays.

The MicroLUPI has a 3 millimeter diameter, collimated measurement beam. All MicroLUPI's come with a granite base, a stable gantry column, motorized focus control, and X/Y motorized stage.



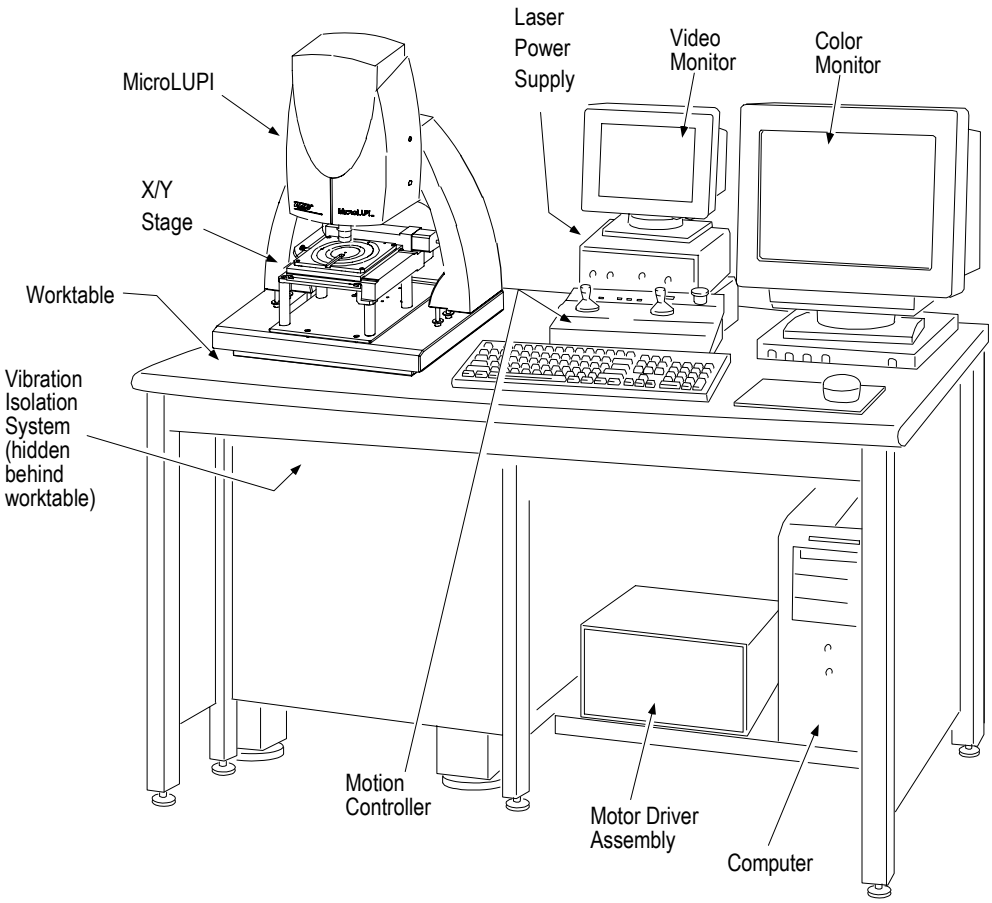
Options

Option	Description
Objectives	50X SLWD, 0.45 NA (0.38 NA useable), Objective 100X SLWD, 0.73 NA, Objective (SWLD = Super-Long Working Distance)
Wavelength	Custom from blue to near-IR. (632.8 nm standard)
Z-axis Digital Indicator	Incremental z-axis length gauge for high-accuracy radius of curvature measurements. (standard on some models)
Vacuum Chuck	Stage vacuum chuck to hold 3, 4, or 6 inch wafers.

(1) US patents pending.

The MicroLUPI system can be broken down into two basic subsystems - the interferometer and the computer. The interferometer provides the raw data needed for analysis; it includes the interferometer itself, laser, laser power supply, objective, motorized X/Y stage, motor driver assembly, motion controller, and a vibration isolation system. The computer controls the measurement process, performs calculations, displays measurement results on a color monitor, and displays part images on a monochrome video monitor.

Typical MicroLUPI System

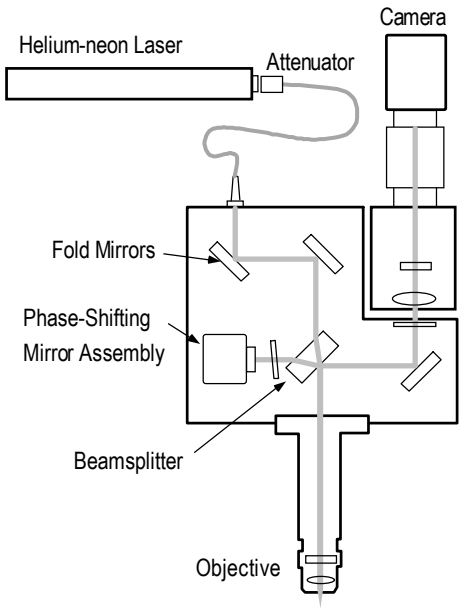


The MicroLUPI is designed to be used in a production environment with simple point and click control of the interferometer. Focusing is guided by a real-time display of the test part. A motorized stage simplifies aligning the part under the objective. Initiating a measurement is a single button operation.

The real power to analyze the measurement data lies in its MetroPro™ analysis and control software. MetroPro runs in a windows environment and has a graphical user interface. MetroPro performs image reconstruction and analyzes entire areas as well as profiles, and provides numerous numerical results. The MicroLUPI also provides flexible scripting capabilities for specific application needs.

How the MicroLUPI Works

The MicroLUPI is a Twyman-Green, unequal-path interferometer. Light from the laser is ported to the MicroLUPI head through a fiber optic cable. The laser beam is split into two beams by an internal beamsplitter. One portion exits the interferometer through the objective and reflects from the test surface back into the interferometer. The other portion reflects from an internal, high quality phase-shifting reference mirror assembly. Both portions are then recombined and directed onto a solid-state camera.



Due to surface irregularities, the test or measurement wavefront travels different distances. When the reference and measurement wavefronts are recombined, the waves are out of phase and form an interference pattern. This interference pattern between the two light wavefronts results in an image of light and dark bands, called fringes, that indicate the surface quality of the part being tested. Beam differences indicate surface topography and the variation from an "ideal" surface of the part being measured.

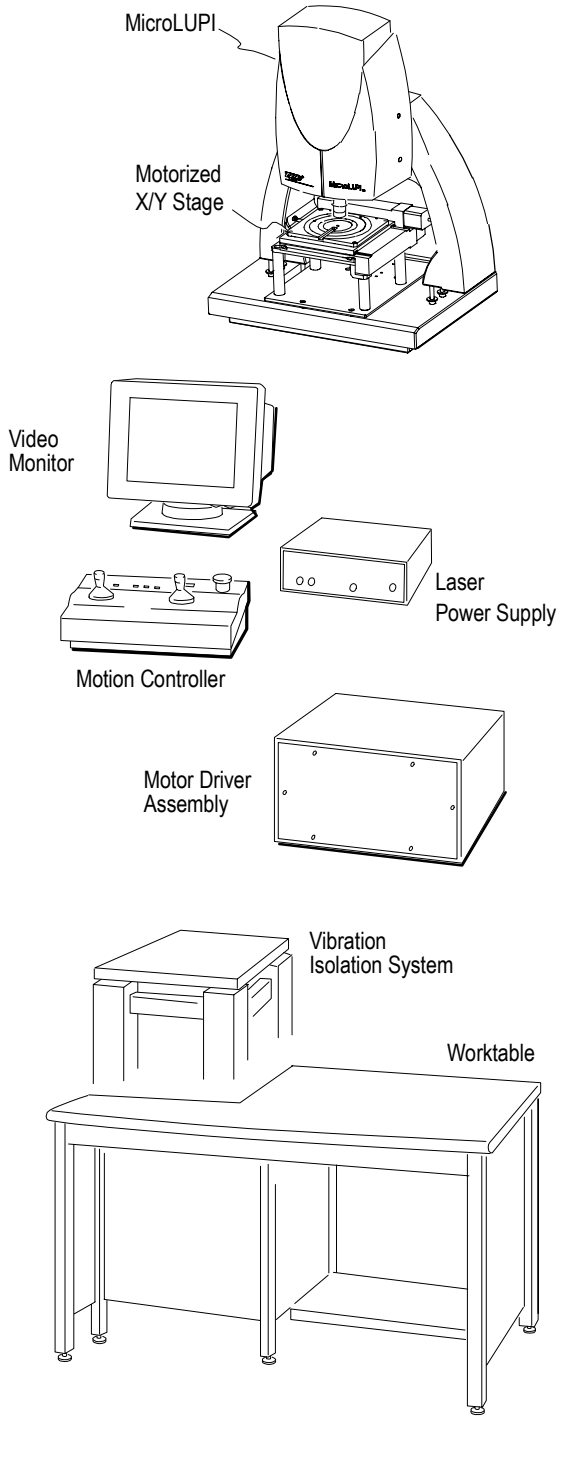
The phase-shifting reference mirror assembly uses a piezoelectric transducer (or PZT) to move the reference element forward and backward, causing constant phase variations between the reference wavefront and the measurement wavefront. The motion of the reference element is precisely controlled and is synchronized with the frame rate of the solid-state video camera. During a data acquisition sequence, the computer takes several "snapshots" of the interference pattern, each at a point when the interfering wavefronts have undergone a 90-degree phase shift in relation to one another.

These snapshots are processed in MetroPro by the computer to determine the phase of the wavefront at each point when the interfering wavefronts have undergone a 90-degree phase shift in relation to one another. The result is a very accurate map of the wavefront and therefore, the quality of the component being tested.

Measurements are three-dimensional. Vertical measurements, normal to the surface, are performed interferometrically. Lateral measurements, in the plane of the surface, are performed by calculating the pixel size from the field of view of the objective in use. Results are displayed on a color display as solid images, plots, and numeric representations of the surface or wavefront.

MicroLUPI Components

Actual equipment may vary; see specification page for more detail. Items not to scale.



MicroLUPI
The MicroLUPI is a phase-shifting interferometer. It provides non-contact measurement and analysis of highly curved, nominally spherical surfaces, radius of curvature, and transmitted wavefront measurements of micro-optics. The MicroLUPI objective forms a converging spherical wavefront for testing spherical parts.

X/Y Motorized Stage
Holds the part under test and provides for positioning under the objective.

Video Monitor
Displays a monochrome live image of the part under test.

Laser Power Supply
Provides power for the laser. For additional information, refer to the manual provided by Melles Griot.

Motion Controller
and Motor Driver Assembly
Drives the stages. Moves the X/Y stage for part positioning and the MicroLUPI Z-Axis for part focusing.

Vibration Isolation System
Isolates the interferometer from environmental vibrations that degrade measurements.

Worktable
Nests against the vibration isolation system and holds the various system components.

MicroLUPI

General:
Dimensions: see *Chapter 2*, "Positioning Components"
Weight: 170 lb (77 kg)
Measurement Technique:
Phase-shifting interferometry

Laser:
Type: frequency stabilized Helium-Neon laser with fiber optic output
Wavelength: 632.8 nanometers
Maximum Output Power: <1 milliwatt
Output Power at Instrument Aperture: ≤1 milliwatt
Test Beam Diameter: 3 mm
Coherence Length: ≥10 meters

Objectives:
Mounting: Dovetail
Type: Infinity Corrected SLWD

Mag.	N.A.	Working Dist.
50X	0.45(1)	13.80 mm
100X	0.73	4.70 mm

(1) 0.38 NA useable

Z-Drive (Focus) Stage:
Motor: DC brushless, microstepper
Drive: leadscrew
Range: 6 in. (152 mm)
Resolution: 4 µin. (0.1 µm)

X/Y Stage:
Motor: DC brushless, microstepper
Drive: leadscrew
Range: 6 in. (152 mm)
Resolution: 4 µin. (0.1 µm)
Maximum Velocity: 0.50 in/sec (12.7 mm/sec)

Sample Viewing:
Camera Size: 640 x 480 pixels maximum
Viewing: 9 in. monochrome video monitor and MetroPro on-screen display
Focus: manual or automatic

Test Part Characteristics:
Type: nominally spherical surfaces (using objective) and flat surfaces (without objective)
Radius of Curvature: from 100 µm to 3 mm
Reflectivity: 4 to 100 %

Utility Requirements:
Electrical: 90 – 250 VAC, 50/60 Hz
(for laser power supply, motor driver assembly, video monitor, and computer) The MicroLUPI receives +12 VDC from Zygo Controller Board installed in the computer
Compressed Air (for Vibration Isolation Table):
60 psi minimum, with 1/4 in. input

Operating Environment:
Temperature: 15° to 30°C (59° to 86° F)
Rate of Temperature Change: <1.0°C/15 min.
Humidity: 5 to 95% relative, noncondensing
Vibration: Frequency Isolation 1Hz < freq < 120Hz

Compliance:
DHHS Laser Safety Classification: Class II laser product conforming to NCDRH regulations.

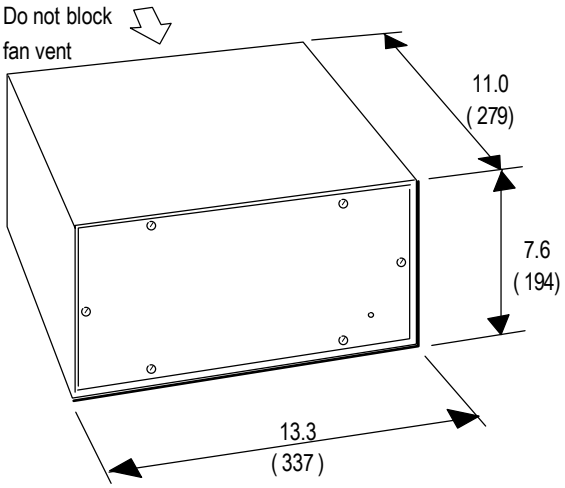
Motor Driver Assembly

Physical Characteristics:

Dimensions as shown.
Weight: 16.3 lb. (7.4 kg)

Electrical:

Incoming Power:
100/240 VAC, 50/60 Hz
Power Dissipation: 200 watts max.
Fuse Rating (supply module): 2A 250V



Dimensions shown in inches and (millimeters).

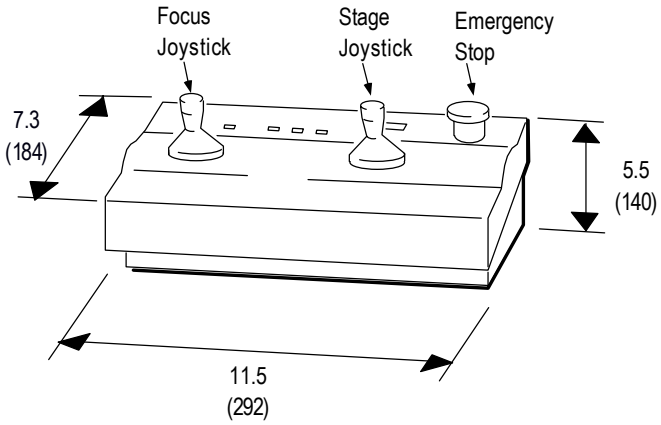
Motion Controller

Physical Characteristics:

Dimensions as shown.
Weight: 6.0 lb (2.7 kg)

Electrical:

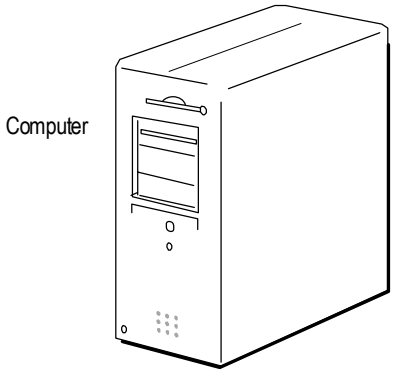
Incoming power and signal
from Motor Driver Assembly



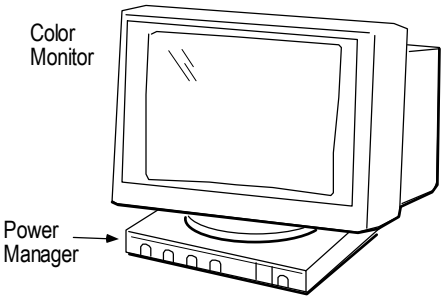
Dimensions shown in inches and (millimeters).

Computer Components

Actual equipment may vary. Refer to the documentation supplied by the original equipment manufacturer for details.

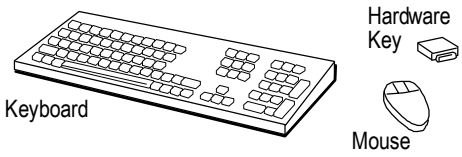


Computer
For system control and data storage.



Color Monitor
Displays graphics and data.

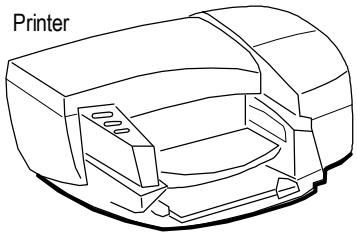
Power Manager
Provides electrical surge and noise protection and on/off switches for the system.



Keyboard
For data entry.

Mouse
For software control and selecting menus.

Hardware Key
Enables MetroPro software and options.



Printer (Optional)
Outputs color copies of MetroPro displays. Connects directly to the computer.

Laser Safety

The MicroLUPI emits visible red light only; no invisible radiation is emitted. The radiation emitted cannot burn or drill holes, even if a lens is used to focus the light. However, the laser light emitted by the MicroLUPI should be treated with caution and common sense. It will not damage skin, but to protect your eyes, do not look directly into the laser beam or stare at its bright reflections.

Laser Safety Standards

The American National Standard for the Safe Use of Lasers (ANSI Z136.1-1986) classifies this laser product as low power-Class II (per Table A1), and provides reasonable and adequate guidelines for its safe use. The user and personnel responsible for the safe use of the MicroLUPI in the user's organization should consult the ANSI standard. It is available from:

The American National Standards Institute
1430 Broadway
New York, New York 10018

The MicroLUPI conforms to the National Center for Devices and Radiological Health (NCDRH) of the Food and Drug Administration and to international laser safety regulations.

To encourage proper laser safety and to abide by the above laser safety regulations, Zygo supplies the information listed on the next page. Refer to the following tables and figure to locate the controls and the labels listed.

Product Use Warning

▲**Warning**
Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

▲**Warning**
For complete laser safety information refer to the Melles Griot manual included with the system. To stop laser emission, turn off the keyed power switch on the laser power supply.

Output Beam Data

Laser Medium:	Frequency stabilized Helium-Neon with fiber optic output
Radiant Power:	<1 milliwatt
Output Power at Instrument Aperture:	≤1 milliwatt
Wavelength:	632.8 nanometers

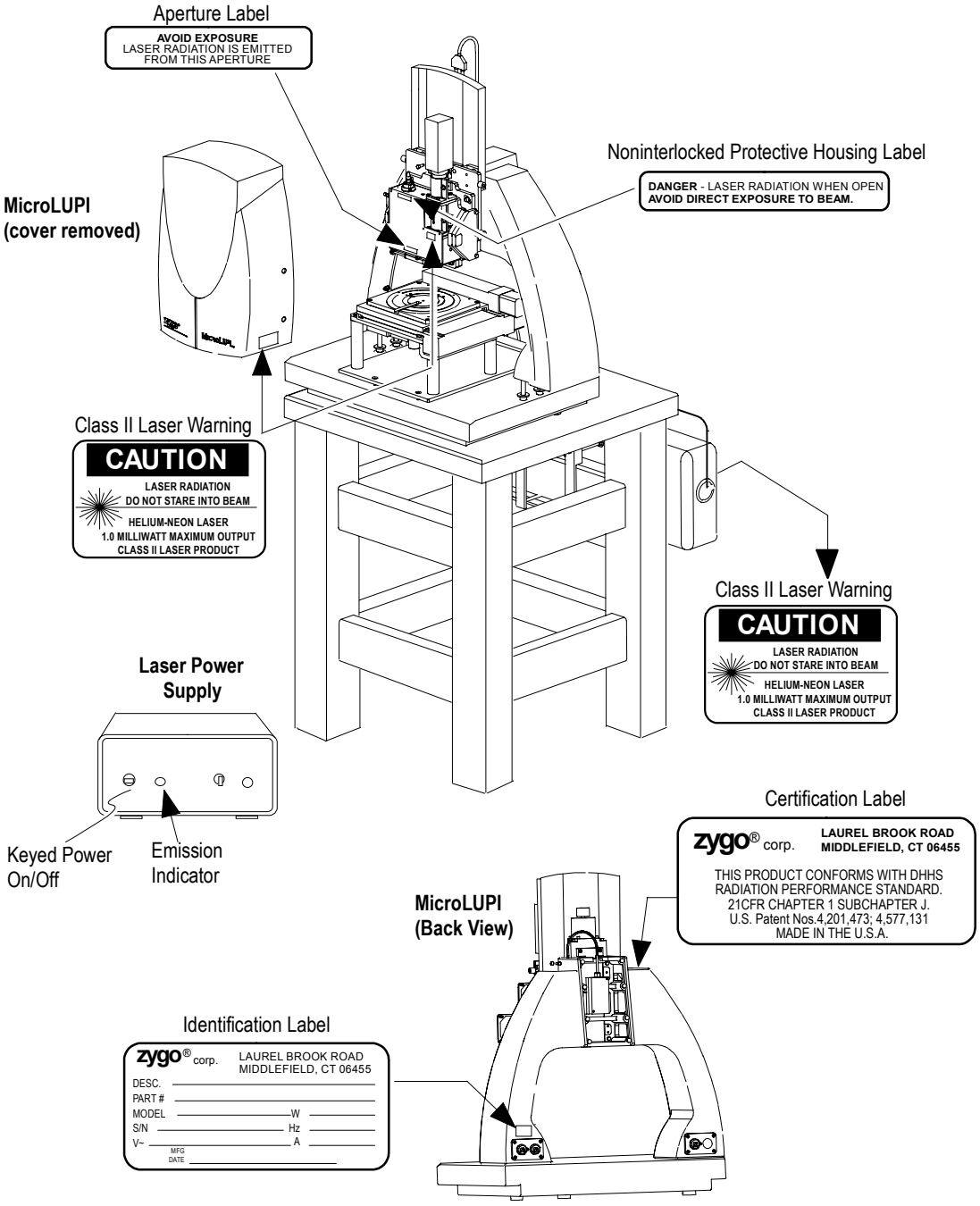
Laser Emission Control Devices

Device	Function
Emission Indicator (on laser power supply)	When lit, indicates that power is being supplied to the laser, and that Class II laser radiation may be emitted from the instrument's aperture.
Power Switch (Keyed power switch on laser power supply)	In the off position, the laser is not energized and laser radiation is not emitted from the instrument.

Laser Safety Labels

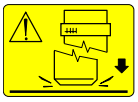
Label	Purpose
Class II Laser Warning	Federal Requirement for Class II lasers.
Aperture	Labels the instrument's aperture through which laser radiation is emitted.
Noninterlocked Protective Housing	Reminds you that when the covers are removed, and the system is turned on, Class II laser radiation is being emitted.
Certification	Shows that Zygo Corp. has conformed to the DHHS standard.
Identification	Provides information about the instrument, including serial number, manufacture date, model number, etc.

Label Locations

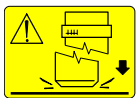


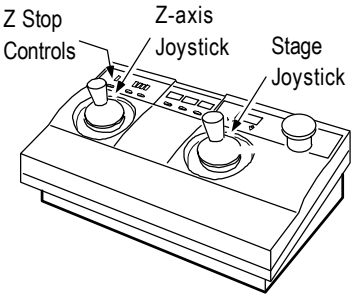
Safety Labels

The following table describes the general meaning of safety labels found on the instrument. Specific warnings are covered in the applicable section within this manual. Failure to follow the safety labels and the recommendations in this manual could result in damage to personnel and the instrument, and may void the warranty.

Label	Meaning
	General hazard. Proceed with caution. Refer to the manual for instructions.
	Electrical shock hazard. Proceed with caution, there is a risk of electrical shock.
	Hot surface; possibility of burns. Keep hands and objects away.
	Objective crash warning. Do not drive the objective into the part or stage.
	Disconnect power.
	Refer to the manual for instructions.
	Earth ground.
	Protective conductor terminal.

Setting Objective Crash Protection





1. Move the Motion Controller's Z-axis joystick to drive the objective slightly closer to the part than its working distance.

   50X 13.8 mm 100X 4.7 mm

Note: When measuring the radius of curvature of convex parts in the confocal position the objective is closer to the optic than its working distance. Use extreme caution to prevent damage to the objective or part.

2. Press the Z Stop button, it should turn green and stop blinking.

Installation

Chapter 2

In This Chapter

- Note Regarding Installation
- Preinstallation Considerations
  - Operating Environment
  – Required Utilities
- Installation Checklist
- Positioning Components – Space Requirements
- Cable Connections
- Installing and Removing an Objective Assembly
- Leveling the Head to the X/Y Stage

Note Regarding Installation

This equipment is intended for Category 2 Installation per EN 61010-1, Clause 5.4.1, of the Low Voltage Directive of the European Union.

This chapter describes the appropriate operating environment, which should be considered before the system is set up. It also provides installation instructions.

Installation instructions for the computer are covered separately in documentation provided by the original manufacturers.

> ▲ **Warning**
> Installation must be performed by Zygo Corporation trained personnel.

Preinstallation Considerations

Because your instrument is capable of measuring to the sub-Angstrom level, the environment in which it is installed is significant and will have an effect on its overall performance. Before installing your instrument, you should carefully consider the operating location to ensure that the system can be easily installed and operate as designed.

Operating Environment

Vibration Isolation - Vibration is the most significant environmental concern for the system, and the most difficult to control. Vibration can be introduced by any of several sources: floors with insufficient support or rigidity, acoustic noise, other equipment (fans, etc.), human activity, and so on. The vibration isolation table included with the MicroLUPI should minimize vibration effects.

Ideally, the floor of the installation site should be a poured concrete slab at ground level. This greatly reduces large-amplitude vibrations. Small amplitude vibrations transmitted through the ground, such as those caused by human activity, can be eliminated by using a vibration isolation system.

Acoustic vibration (sound) of sufficient amplitude can cause vibration of the instrument, items under test, and even of the vibration isolation table. This is especially true of low-frequency vibrations, which may not be audible even at relatively high amplitude. Uninsulated walls made are prone to retransmitting acoustic vibration from adjoining areas and suspended ceilings can couple roof mounted air conditioning noise.

Vibration can also be transmitted to the instrument through connecting cables. Be careful not to run cables where they would be touching sources of vibration or are likely to be jarred or kicked. Don't place the keyboard, mouse, or anything that has moving parts, on the vibration isolation table.

Temperature Change- Rapid temperature changes degrade system performance because different materials absorb and release heat at different rates, resulting in uneven expansion and contraction of the instrument and components under test. Temperature differences can be caused by air conditioning, heating devices, or vents. Wide concurrent temperature differences in the operating environment also degrade performance because they create air turbulence.

Air Turbulence - Air turbulence, or the movement of air, causes uneven air density within small areas, which can refract parts of the measurement beam and alter the measurement. Fans or blowers may help to even out temperature differences in the operating area, but they can introduce air turbulence if positioned improperly.

Airborne Impurities - Smoke, dust, and oil impurities can accumulate on optical components; degrading system performance and even ruining optical coatings.

Required Utilities

Electrical - Supply voltage must be 100/240 V at 50/60 Hz. The system should be connected to an isolated circuit with an earth ground.

> ▲ **Warning**
> The power manager plug is used as the disconnecting device. Ensure that the outlet is accessible.

Air Supply - The Vibration Isolation Table requires a compressed air supply. Operation at maximum load requires a supply line pressure of approximately 80 psi (5.5 bar), although typical operation pressure is less. The flow rate is negligible once the isolator has been pressurized. The air supply should be filtered and oil and water free.

Vacuum – The optional Vacuum Chuck requires a 1/8-inch NPT Male fitting for a 1/8 in. (3 mm) plastic tube. A shop vacuum source must be supplied.

Installation Checklist

Preinstallation

- ☐ Inspect all packages for signs of shipping damage. Report any damage to the carrier.
- ☐ Check that the shipment is complete.
- ☐ Ensure that the worksite has the necessary utilities and environmental control.
- ☐ If installation and training are included in your purchase, contact your Zygo representative to make arrangements.
- ☐ Move all shipping containers to the worksite. Allow the equipment to acclimate for at least 24 hours. Save the shipping containers for future transport of the equipment.

> ▲**Warning**
> When lifting or moving equipment or pallets, contact the appropriate local and national agencies in your country for proper lifting recommendations.

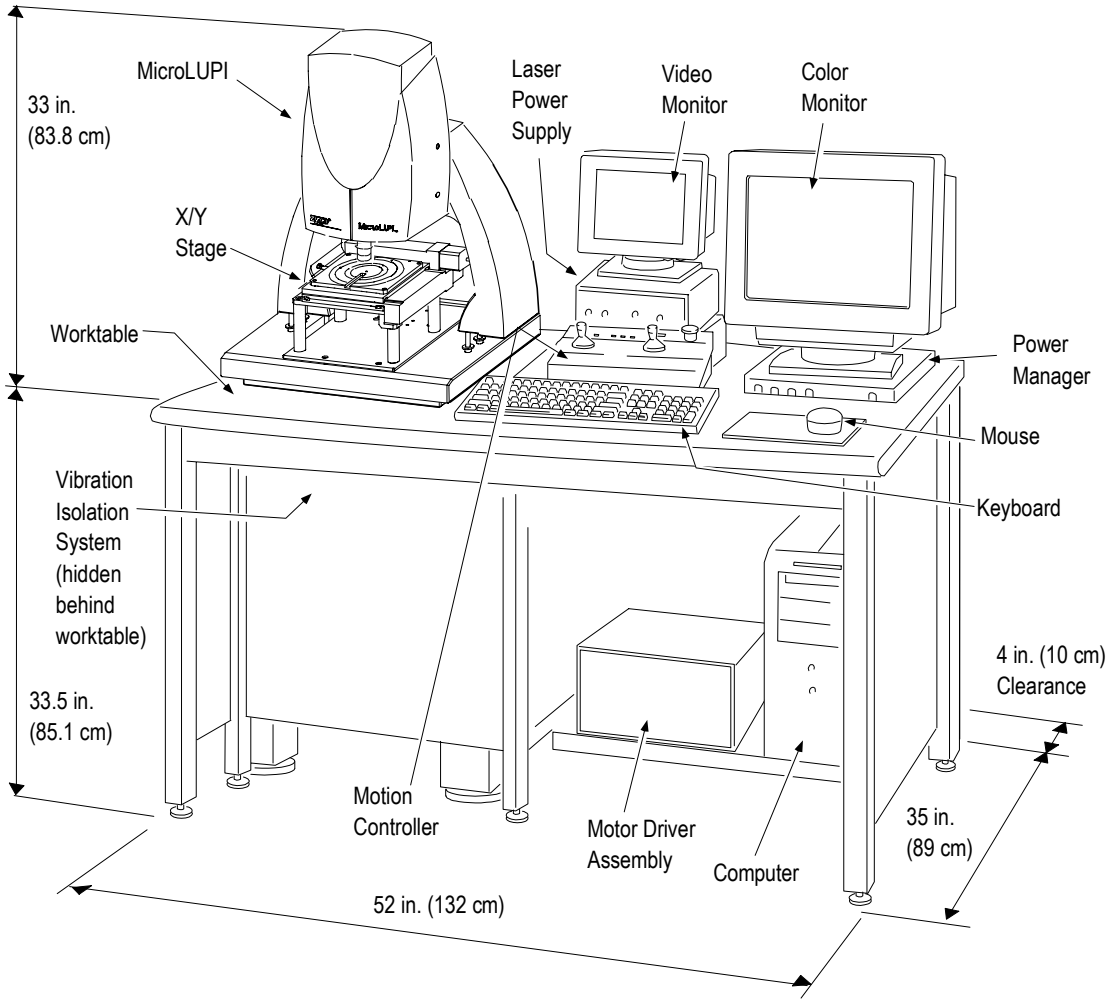
System Installation

- ☐ Unpack the Vibration Isolation System, position the isolator legs near their final working location, place the table on the isolators.
- ☐ Unpack the worktable and move it into position around the Vibration Isolation System.
- ☐ Position the computer and Motor Driver Assembly on the shelf under the worktable.
- ☐ Position the power manager, color monitor, video monitor, keyboard, mouse, Motion Controller, and laser power supply on top of the worktable.
- ☐ Connect the power cords through the power manager.
- ☐ Unpack the granite base and column and place it on the Vibration Isolation System.
- ☐ Unpack and install the Z-Stage to the column.
- ☐ Unpack the MicroLUPI head and mount it to the column.
- ☐ Mount the laser on the vibration isolation table behind the MicroLUPI.
- ☐ Connect the cables to the MicroLUPI head.
- ☐ Install the X/Y platform and stage.
- ☐ Connect signal and power cables to all components routing cables through the holes in the worktable and securing them with the supplied clamps.
- ☐ Connect the Vibration Isolation System to a compressed air supply.
- ☐ Mount an objective.
- ☐ If necessary, install MetroPro software following the instructions in the *Getting Started With MetroPro* manual.

Positioning Components – Space Requirements

The recommended locations for components and overall system space requirements are shown in the following figure. The MicroLUPI is isolated from vibrations from the working surface by the vibration isolation system. The laser is mounted on the vibration isolation table behind the instrument. The computer and Motor Driver Assembly are placed on the worktable shelf.

Suggested System Layout



Cable Connections

The computer connections shown in the following figure are for reference only; always consult the original equipment documentation.

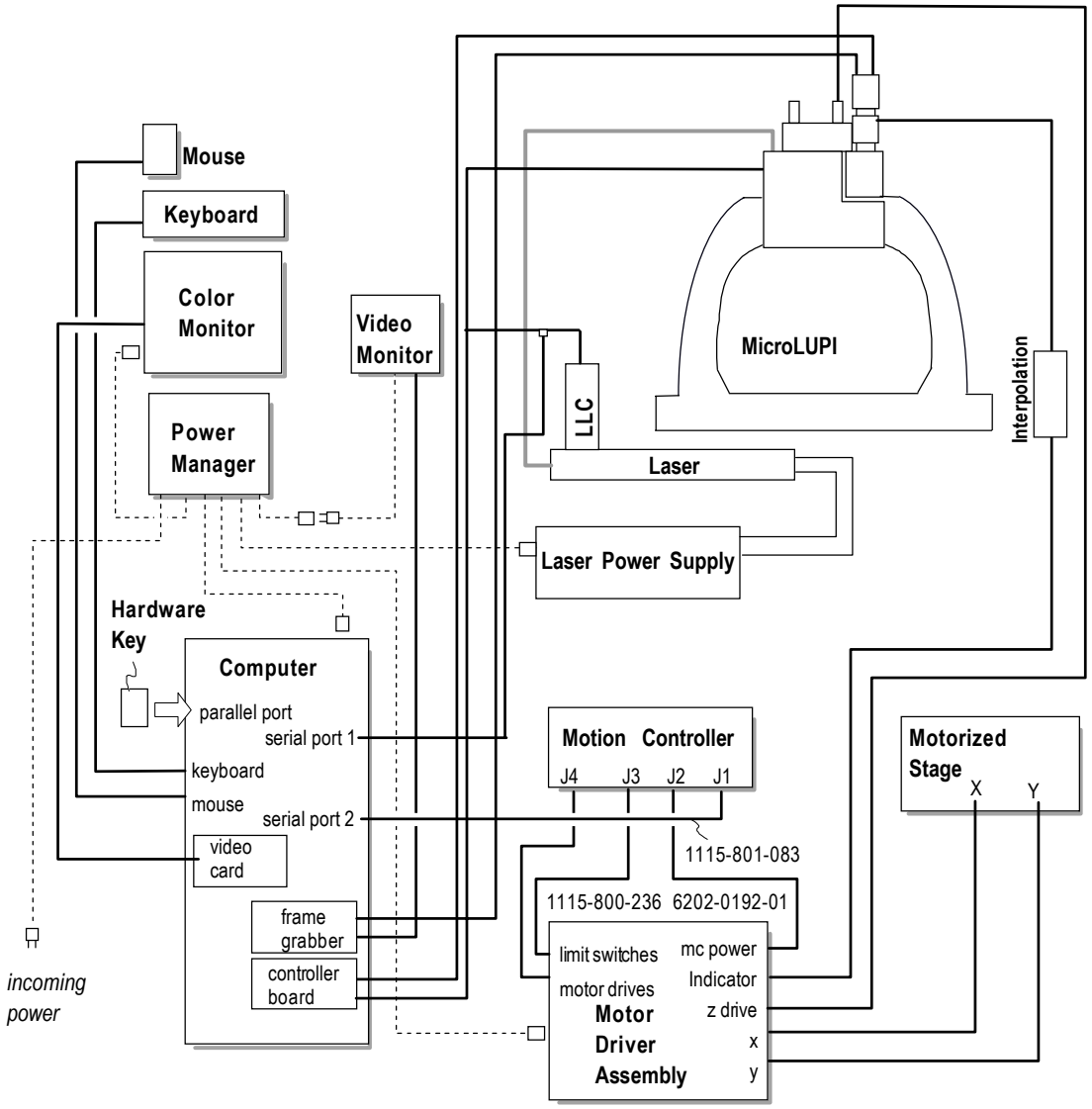
▲Warning

The equipment must be electrically grounded through the supply outlet. The power manager is for power distribution for the system. Other equipment should not be connected to the power manager.

The Hardware Key and the Controller Board cable have identical connectors. Make sure they are properly connected or the equipment may be damaged. The Hardware Key is connected to the computer's parallel port. The MicroLUPI cable is connected to the Controller Board.

Disconnect equipment from power when connecting cables.

Proceed with caution; there is risk of electrical shock.



Installing and Removing an Objective Assembly

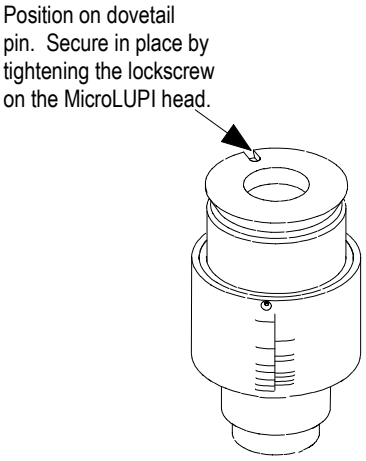
⚠ Warning

Do not touch the objective lenses. Dust, dirt, and fingerprints can impair the system's optical imaging and harm optical coatings.

Whenever an objective is installed, changed, or removed and reinstalled, a system error file should be made. The system error file removes optical errors associated with the instrument. For information on making a system error file, refer to Chapter 3.

Installing an Objective

1. Align the slot on the objective's dovetail mount with the pin on the MicroLUPI head.
2. Tighten the dovetail lockscrew.



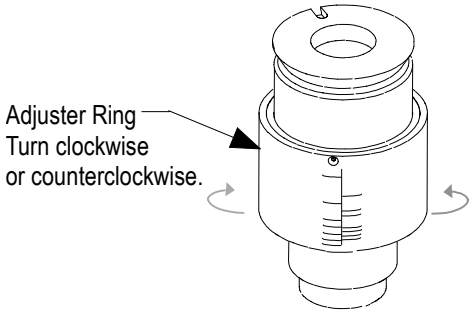
Removing an Objective

1. Support the objective assembly with one hand. Do not touch the lens.
2. Loosen the dovetail lockscrew and remove the objective from the MicroLUPI head.

Setting the Objective's Working Distance

The objective assembly has an adjustable imaging plane so spheres of different diameters can be easily imaged and measured.

1. Install the objective assembly as described above.
2. Turn the large adjuster ring clockwise or counterclockwise to retract or extend the assembly. Match the scribe line on the assembly with the value that matches the nominal radius of curvature of the part
3. Drive the Z-Axis so the part is in focus.



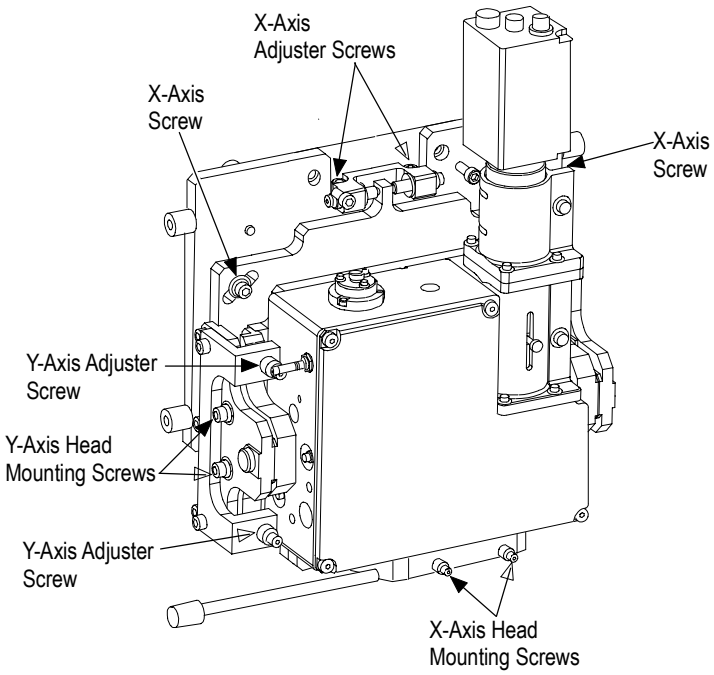
Leveling the Head to the X/Y Stage

This procedure properly aligns the axes of the MicroLUPI head with the X/Y stage. It should be performed when the system is first installed. It can also be checked and verified as part of preventive maintenance, if desired.

Note: The hardware and software must be operational to perform this procedure. Refer to Chapter 3 for system power up instructions.

1. If an objective is installed, remove the objective.
2. Place a mirrored optical flat on the X/Y stage under the objective area. If necessary drive the stage to position the optical flat under the collimated beam.

Note: A quality silicon carbide optical flat is available from Zygo Corp.



3. To adjust the X-axis:
   a. Loosen the X-axis head mounting screws 1/4 turn.
   b. Using a 5/32-inch Allen wrench, turn the two-adjuster screws to minimize the number of fringes in the screen image.
   c. Tighten the X-axis head-mounting screws.
4. To adjust the Y-axis:
   a. Loosen the two Y-axis head mounting screws 1/4 turn.
   b. Using an Allen wrench, turn the two-adjuster screws to minimize the number of fringes in the screen image.
   c. Tighten the two X-axis head-mounting screws.
5. Install the objective.

Making Measurements

Chapter 3

In This Chapter

- Note on MetroPro Documentation
- Start-Up
- Measurement Overview
- Motion Controller Controls
  - Using the Motion Controller
- Light Level Controls
  - The Light Level Window
- Making and Using System Error Files
- A Look at the MicroLUPI™ Application
  – Home the Stage
  – Home the Z Axis
  – Using AutoNULL
  – Using AutoCalibrate
  – Setting Measurement Parameters
  – Making a Radius of Curvature Measurement
  – Defining a Measurement Pattern
- Shutdown

Note on MetroPro Documentation

MetroPro software is documented in separate manuals. For information on MetroPro software, and for software details not covered in this manual, refer to the manuals listed below.

Manual	Description	Source
Getting Started With MetroPro, OMP-0398	How to install and use the basic features of MetroPro.	Paper copy included.
MetroPro Reference Guide, OMP-0347	Listing and explanation, in a dictionary format, of most MetroPro's features.	Zygo Manual CD
MetroScript Programming Language, OMP-0399	A user's guide for MetroPro's scripting language.	Zygo Manual CD

A Note About Operation

Warning

The operator must be trained before operating the system. Read all operation instructions before starting the equipment. The equipment should only be used in the manner in which it is intended.

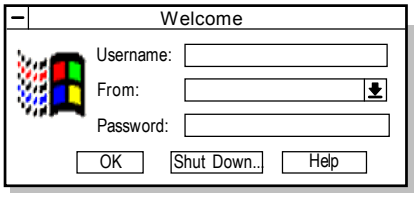
Start-Up

Warning

The operator is responsible for ensuring that the joysticks are not activated when the system is first started. People and objects must be clear of the stage area. For emergencies, press the Motion Stop button to halt all stage motion.

1. Turn on the laser power supply using the key. Wait for the "Locked" indicator lamp to light.
2. Turn on all components with the master switch on the Power Manager.

Windows NT Log on

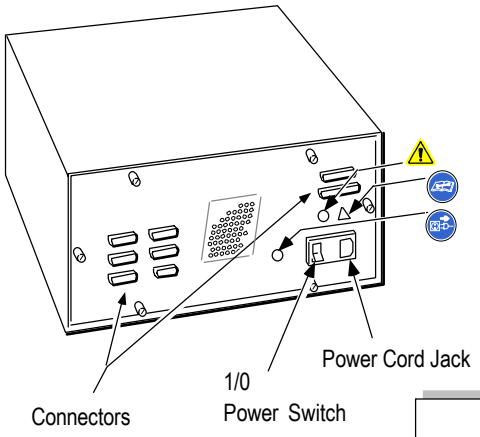


3. After the Welcome message appears, press Ctrl-Alt-Del to log on. In the Welcome dialog box, type a username and a password. If you do not have a username, enter "zygo" and press the Enter key.
4. To open the application, click on the MicroLUPI.app icon. If the icon is not on the MetroPro Main window, use the Load Application command to load the application icon.

Location of Controls

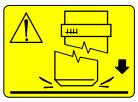
Motor Driver Assembly Controls

▲ **Warning**
Do not remove the cover from the Motor Driver Assembly. Doing so will void the warranty. Only Zygo Service Personnel should perform service on this unit.

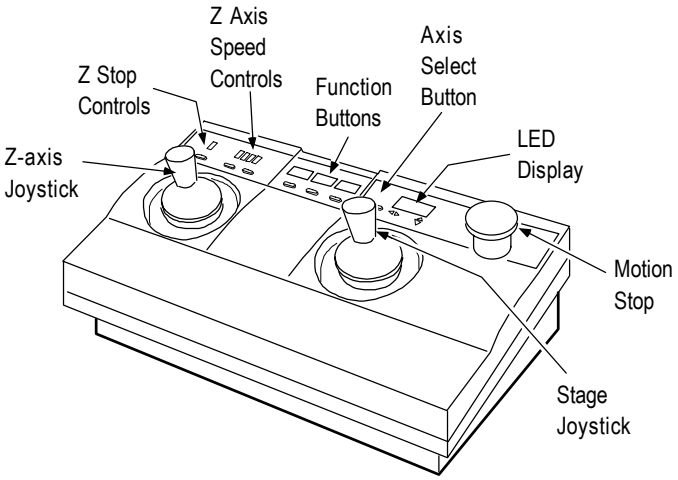


Warning!
There are no user-serviceable parts in this unit. Do not remove the cover.

Motion Controller Controls



Do not crash the objective into the test part or stage. Use caution when focusing and driving the Z-Axis. Set the Z Stop to prevent crashes.



Z-Axis Joystick
Drives the Z-axis up or down when pushed forward and backward.

Z Stop Controls
Set button makes present position the Z stop location. Indicator displays status of Z stop: red flashing - not set; red on - head at stop, stop set; green on - head above stop, stop set.

Z-Axis Speed Controls
Number of lights indicates relative speed. Slow/Fast buttons decrease or increase Z-Axis (focus) speed.

Function Buttons
Perform various software functions, such as: 1 - measure, 2 - run stage pattern.

Axis Select Button
Selects which stage axes are controlled by the stage joystick. Serves no function unless the Z-Axis wedge stage for transmission testing is installed.

LED Display
Shows the setting of the Axis Select button or the status of the motion system.

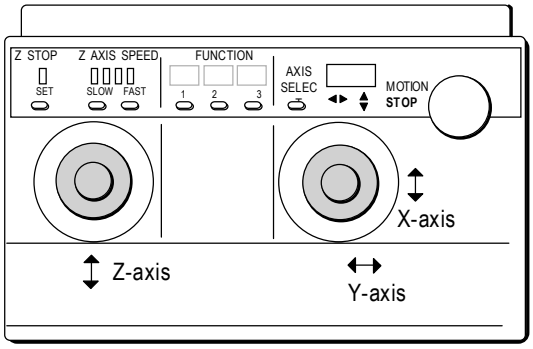
Motion Stop (Emergency) Button
Stops all motion and disables joysticks.

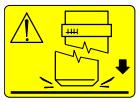
Stage Joystick
Drives the stage in X/Y, based on the setting of the Axis Select button.

Connector Panel (hidden from view)
Provides connection to the Motor Drive Assembly and computer.

Using The Motion Controller

The Motion Controller is used for manually focusing the instrument and driving the stage motors. The table below summarizes how to use the Motion Controller.



Operation	How To
	Push Z-axis (left) joystick to raise, pull to lower. The greater the deflection the faster the motion.
Drive Z-Axis	**Do not crash the objective into the test part or stage. Use caution when focusing and driving the Z-Axis. Set the Z Stop to prevent crashes.**
Z-Axis speed	Press SLOW (decrease) or FAST (increase).
Set Z Stop	Lower head with Z-Axis joystick to slightly less than objective working distance; press SET.
Unset Z Stop	Raise head with Z-Axis (left) joystick until the Z STOP indicator is green, then press SET.
Select stage axes	Press AXIS SELECT repeatedly until the axes are shown in the display. [X Y] should be displayed.
Drive stage (controlling speed)	Move the stage (right) joystick. Up/Down for y-axis. Left/Right for x-axis. The greater the deflection the faster the motion.
Emergency Stop	Press MOTION STOP to stop stage motion. For emergency stop only.
Reset after MOTION STOP pressed	Press and hold AXIS SELECT, turn MOTION STOP knob clockwise until it pops back up, and then release the AXIS SELECT button. Also click the Reset MC button in MetroPro.
MetroPro shortcuts	Press 1 to Measure, Press 2 to Run Pattern, Press 3 to Focus.

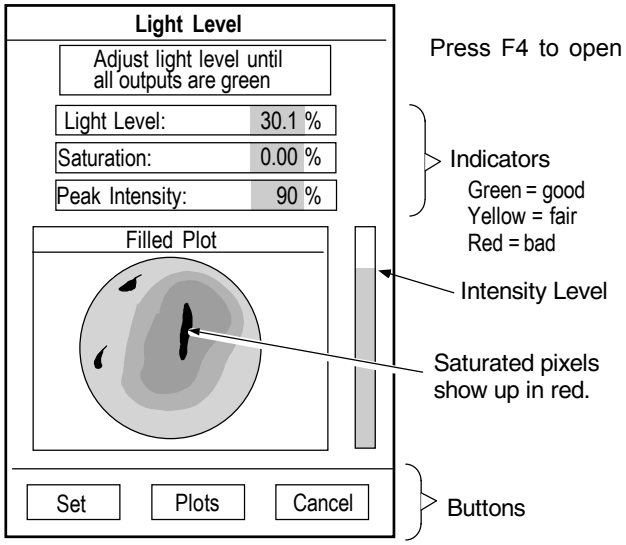
Light Level Controls

The MetroPro Light Level Window is used as a readout. The light level must be adjusted every time the part changes.

Key	Function
F4	Open Light Level Window to manually set light level.
F5	Automatically set light level.

The Light Level Window

1. Adjust the instrument for proper focus.
2. Press the F4 key to open the Light Level window.
3. Use the numeric keypad to adjust levels until all indicators are green. Saturation causes data dropout.
4. Click the Set button or press the Enter key to change the light level for measure. To cancel light level adjustment, click the Cancel button or press the Esc key.



Light Level Keys

Key	Function
* /	Coarse up and down.
+ -	Fine up and down.
1 2 3	Adjust level in 10% steps, 1=10%, 3=30%, 9=90%
Tab	Toggles between last two light settings.
Esc	Cancel current action and abort measurement.

Making and Using System Error Files

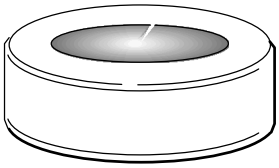
System error files are used to subtract the systematic errors associated with the instrument's optics to improve measurement accuracy. Zygo recommends that you use system error files for optimum measurement performance. Create a system error file by measuring a component of known high quality. Use a Zygo Reference Sphere when using an objective to measure radius of curvature. Use the Zygo silicon carbide optical flat when measuring flat surfaces without an objective.

Make new system error files when:

- Software changes in the Camera Mode control, or Phase Res control
- Changes in the operating environment, especially temperature fluctuations
- Removing and installing an objective.

Reference Sphere

The Reference Sphere is a high precision glass optic.



▲Warning
Handle the Reference Sphere with care and do not touch the exposed glass surface. Store the Reference Sphere in a clean and dry location when not in use.

Making System Error Files

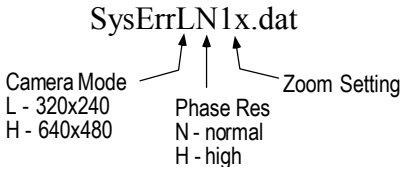
1. Make sure the software Camera Mode control and Phase Res control are set to the desired settings.

   Note: The systematic errors mapped out by the system error file is specific to the above mentioned settings. Make a new system error file whenever settings are changed.

2. Place the Reference Sphere on the stage under the objective.
3. Adjust X, Y, and Z to center the sphere and null the fringes.
4. Enter the number of averages desired in the Phase Avgs control located in the Measure Control window. A good rule of thumb is to use 3X the same number of averages as used during typical measurements, or a minimum of 8.
5. Set the Subtract Sys Error control to Off.
6. Press **F1** or click the Measure button to measure.

7. Click the Save Data button. In the File Handler, click the "Current Selection" box, enter a name for the reference error file, ending with ".dat" and press Enter, then click the Done button to close the File Handler.

   Note: Try to use a naming convention that you will recognize, such as that shown below. The default directory for storing system error files is "C:\Users\Zygo\MetroPro\Apps".



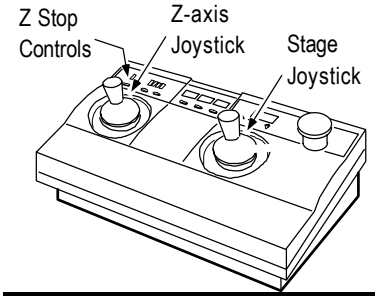
Using System Error Files

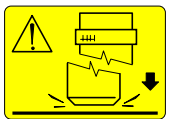
1. Click the Measure Cntrl button.
2. Click the Subtract Sys Err control to set it to On.
4. Click the Sys Err File control and enter the name of the system error file that matches your software and instrument settings, then press Enter.

Measurement Overview (Spherical Part)

(Additional information is provided in the MicroLUPI Application section of this chapter. Be sure to review the following Objective Crash Protection procedure before beginning a measurement sequence.)

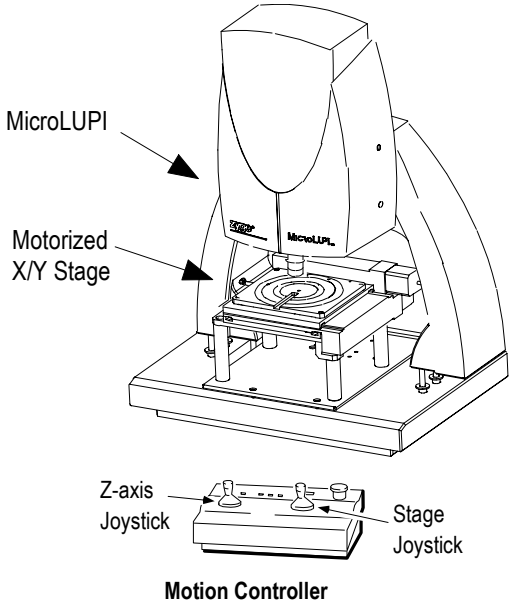
Setting Objective Crash Protection





1. Move the Motion Controller's Z-axis joystick to drive the objective slightly closer to the part than its working distance.
2. Press the Z Stop button; it should turn green and stop blinking.

1. Turn on the laser power supply. Wait for the "Locked" indicator to go on.
2. Power up the instrument, start MetroPro, and click the MicroLUPI icon to open the application.
3. Select the correct objective value, either 50X or 100X. The working distances for these objectives are: 50X=13.8 mm 100X=4.7 mm
4. Home the X/Y Stage.
5. Home the Z-Axis.
6. Place the test part on the stage under the objective. Using the Z-Axis joystick, position the objective at its working distance from the part. Reminder: *If you have not set objective crash protection, be careful not to crash the objective into the part or the stage.*
7. Using the stage joystick, move the stage in the x and y axes to center the part under the objective. Using the Z-axis joystick, adjust until 3-10 fringes are visible.
8. Set an Acquisition Mask. It should include approximately 95% of the part. Refer to the *MetroPro Reference Guide* for information on using masks.

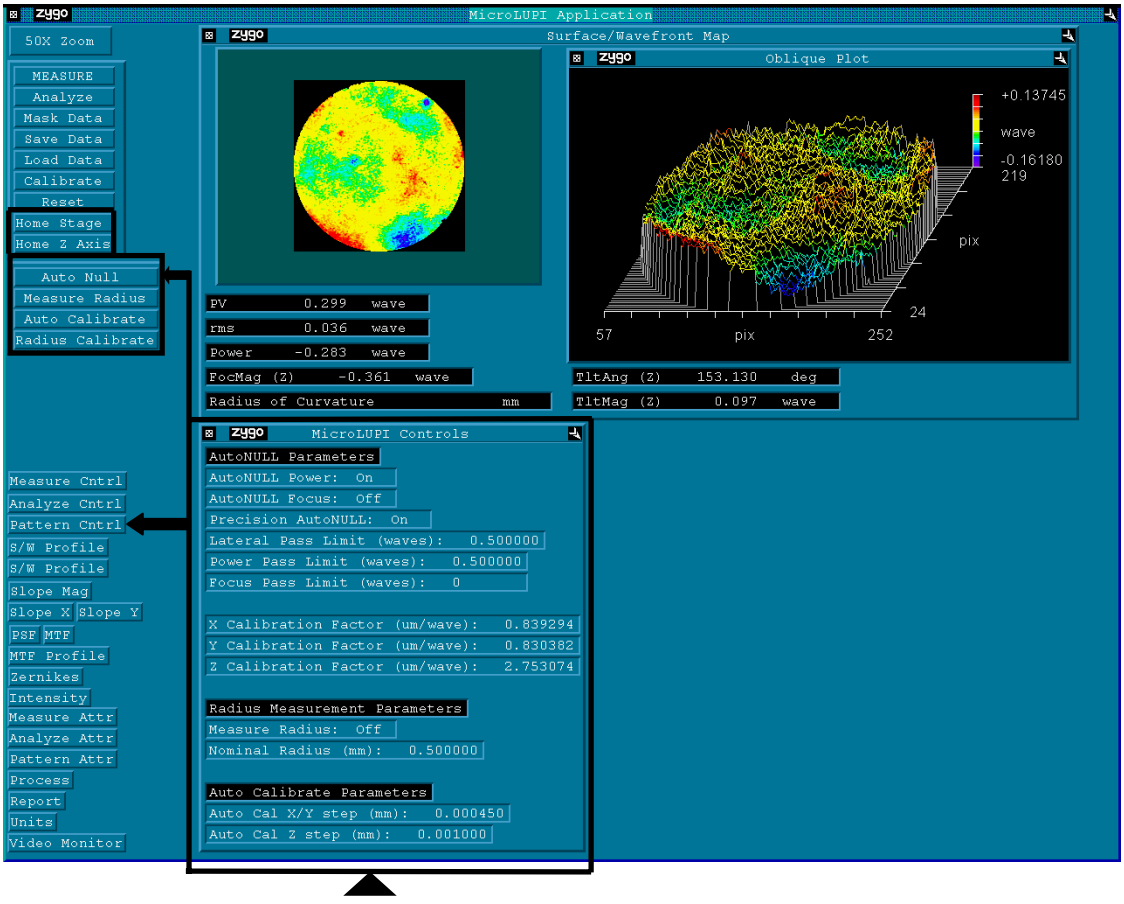


Motion Controller

9. Toggle either AutoNULL Power or AutoNULL Focus on.
10. Click the Auto Calibrate button. Verify that the fit quality numbers are good. This number should be as close to 1 as possible.
11. Enter a value for Lateral Pass Limit and a value for either Power Pass Limit or Focus Pass Limit.
12. Click the AutoNULL button.
13. Press the **F1** key or click the MEASURE button to make the measurement.

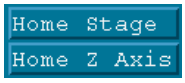
The MicroLUPI Application

This is a typical display for the MicroLUPI Application including a sample data set. Buttons, controls, and results specific to this application are described below. For information on all other items shown on this screen which are not described in this chapter, refer to the *MetroPro Reference Guide*, OMP-0347.



These buttons and controls are described in this chapter. All other items on the MicroLUPI screen are covered in the *MetroPro Reference Guide*.

Click to activate the function.



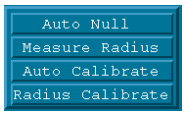
Home Stage

Establishes a reference start position for the X/Y Stage. Home Stage should be done each time the system is powered on.

Home Z Axis

Establishes a beginning travel position for the Z-Axis head. Before using this function, the Motion Controller Z Stop control must be in the set position (red).

Click to activate the function.



Auto Null Button

Initiates the Auto Null routine. Set values for the corresponding parameters. See MicroLUPI Controls for usage information on Auto Null.

Measure Radius Button

Measures the Radius of Curvature of a part. Set values for the corresponding parameters. See MicroLUPI Controls for usage information on Measure Radius.

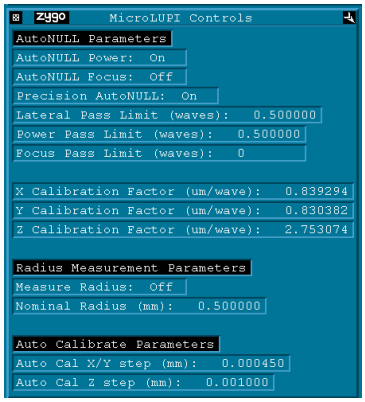
Auto Calibrate Button

Begins the Auto Calibrate Routine. Set values for the corresponding parameters. See MicroLUPI Controls for usage information on Auto Calibrate.

Radius Calibrate Button

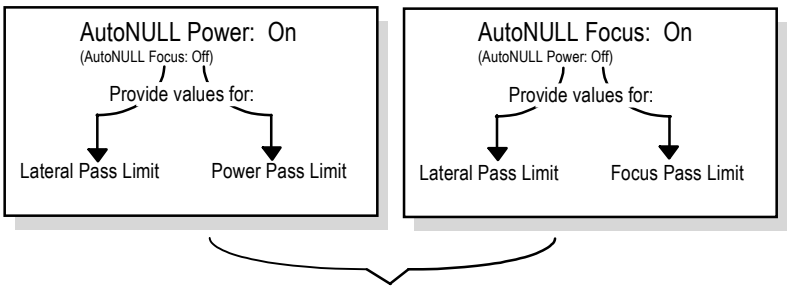
Begins the Radius Calibrate routine. This function establishes the radius of curvature calibration factor. The system automatically updates the corresponding .cfg file in the working directory. The Radius Calibration standard is used for this procedure. Refer to the "Measuring the Radius Calibration Standard" section of this chapter.

MicroLUPI Controls Window



AutoNull Process

Designed to minimize tilt magnitude and establish limits for the removal of *either* power or defocus. Several parameters must be set for this feature to function correctly.



Precision AutoNULL can be ON at the same time as either AutoNULL Power or AutoNULL Focus. The Precision feature adds 5 extra attempts to the software routine.

Important! Run Auto Calibrate *before* using AutoNULL as Auto Calibrate establishes the X, Y, and Z Calibration factors.

AutoNULL Power

The Z calibration factors and the Lateral Pass Limit values are used to adjust part positioning. The Z-Axis head is moved to find the optimum location for fringes and power. The X/Y Stage is moved to minimize the number of tilt fringes.

When using AutoNULL Power, set these parameters:

- Click on Power Pass Limit. (This value identifies the maximum number of waves of power.)
- Type a value and press Enter.
- Click on Lateral Pass Limit. Type a value and press Enter. This value identifies the maximum number of waves of tilt that can be allowed in the measurement.

AutoNULL Focus

The Z calibration factors and the Lateral Pass Limit values are used to adjust part positioning. The Z-Axis head is moved to find the optimum location for fringes and focus. The X/Y Stage is moved to minimize the number of tilt fringes.

Click on Lateral Pass Limit. Enter a value and press Enter.

This control specifies the maximum number of waves of tilt that can be allowed in the measurement.

Click on Focus Pass Limit. Enter a value and press Enter. This control specifies the maximum number of waves of defocus that can be allowed in the measurement.

Radius Measurement Parameters

Measure Radius

This is a toggle that is either on or off. When it is on and a pattern is used, Measure Radius is activated automatically, and the radius of curvature of the part is measured. Radius of Curvature is defined as the distance from the surface (or its best-fit spherical equivalent) to the center of curvature. The system automatically measures both the confocal and cat's eye positions. These measurements are used to calculate slight part positioning (null or focus) errors and eliminate them from the radius measurement.

Nominal Radius

Click on this control and enter the nominal radius value. Press Enter.

Auto Calibrate Parameters

The calibrate routine establishes the lateral measurement resolution of each camera pixel. This process provides a reference dimension with which to compute lateral dimension seen by each pixel of the instrument's camera. Calibration is covered in more detail in "Chapter 7" of the *MetroPro Reference Guide*.

Auto Cal X/Y step

Specifies the distance to step in the X and Y axes during auto calibration. Use the default values.

Auto Cal Z step

Specifies the distance to step in the Z-Axis during auto calibration. Use the default values.

Measuring the Radius Calibration Standard

1. Select the correct objective value, either 50X or 100X.
2. Home the X/Y Stage.
3. Home the Z Axis.
4. Place the Radius Calibration Standard on the stage. The small pin on the bottom of the standard fits into the slot in the center of the stage.

Radius Calibration Standard

5. Using the stage joystick, center the standard under the objective. There should be fringes on the monitor. Adjust in the Z Axis until there are between 3 and 10 fringes.
6. Create a circular acquisition mask over 95% of the surface.
7. Click either AutoNULL Focus or AutoNULL Power.
8. Click the Auto Calibrate button.
9. Click on Lateral Pass Limit and enter a value. Press Enter.
10. Click on either Focus or Power Pass Limit, enter a value, and press Enter
11. Click the AutoNULL button.
12. Click on Nominal Radius and enter the standard's actual radius value. Press Enter.
13. Click on the Radius Calibrate button.

The Light Level Window will open automatically. Adjust for proper light level.

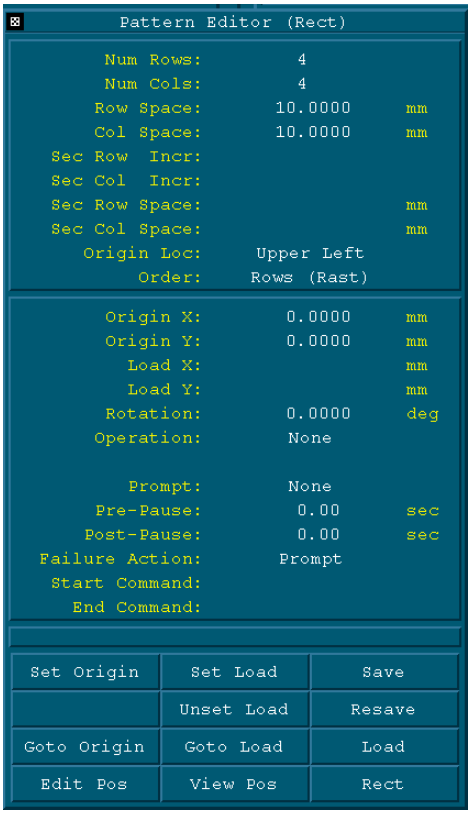
14. Use the numeric keypad to adjust levels until all indicators are green. Saturation causes data dropout. Click the Set button or press the Enter key to change the light level for measure. To cancel light level adjustment, click the Cancel button or press the Esc key.
15. Click yes to set the radius calibration factor.

Using the Pattern Editor

The Pattern Editor function is used for creating, editing, saving and loading stage control pattern files. Pattern files direct the movement of programmable stages. The information in this section is an overview of Pattern Editor operation. Refer to "Chapter 8" in the *MetroPro Reference Guide* for a complete explanation.

Sample Steps for Creating a Pattern

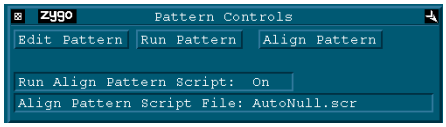
1. Click the Pattern Cntrl button (on the left side of the MicroLUPI Main Window) to open the Pattern Editor.
2. Select the pattern type using the Mode button. (Lower right corner. This button will display one of the following: Rect, Circ, or FreeRect.)
3. Enter values for the applicable Pattern Editor's controls as described in "Chapter 8" of the *MetroPro Reference Guide*.
4. Using the Motion Controller, drive the stage to the first pattern position and set the origin by clicking the Set Origin button. Then drive the stage to the location for loading parts and click the Set Load button.
5. To make a trial pattern test run, set the Pattern Editor's Operation control to None.
6. Set the Pattern Editor's Operation control to Run Script. A Filename: field will appear beneath Operation. In this field, type MicroLUPIPat.scr and press Enter.



7. To save the defined pattern, click the Pattern Editor's Save button. In the File Handler, click on the Current Selection field, type in a file name ending with ".pat," and press Enter. Click Done to close the File Handler.

8. Click the Auto Load Pattern control to On. Enter the name of the pattern in the Pattern File Control.
9. Save changes to the application. If it is an application from Zygo, select the Save Application command from the Application Window menu. In the File Handler, enter a name for the file, ending with ".app," and press Enter. Click the Done button.

Pattern Controls Window



Edit Pattern
Opens the control window used for creating, editing, and saving patterns. Refer to the *MetroPro Reference Guide*, "Chapter 8," for a complete description of the Pattern Editor function.

Run Pattern
Activates the automated measurement routine using the specified pattern.

Align Pattern
This button provides for semi-automatic calculation of the stage rotation value in the X and Y axes and/or where the origin is located. The routine varies slightly depending upon the number of designated alignment positions. In patterns in which there is only one alignment position, the system adjusts ONLY for origin. In patterns with two or more alignment positions, the system adjusts for ORIGIN and ROTATION value. Once the rotation value is determined, it is factored into the pattern during the Run Pattern operation.

Refer to "Chapter 8" of the *MetroPro Reference Guide* for information on aligning a rectangular or circular pattern. The following steps cover alignment of a FreeRect pattern. This procedure may also be used for a normal rectangular pattern as long as alignment positions are selected.

1. Before using Align Pattern, be sure the stage has been homed, and AutoCalibrate has been run.
2. Open the Pattern Editor and use the Load button to open a valid pattern.
3. Click on the Edit Pos button and open the Position Editor. Use the middle mouse button to click on the position(s) that will be used as alignment positions. They will be highlighted yellow. Alignment positions do not have to be included in the pattern.

For a pattern with one alignment position, follow steps 4 through 7. For a pattern with 2 or more alignment positions, follow steps 8 through 13.

4. For one alignment position, click the Align Pattern button. The following dialog box is displayed. Follow the screen prompts.

Message
The following dialog will guide you through the process of adjusting ONLY THE ORIGIN of the current pattern. Click 'Ok' to continue. Click Cancel to abort.
OK **Cancel**

5. To continue, click OK.
6. The system moves the stage to the location where it thinks the position is. You may need to use the X/Y joystick to adjust the position so that fringes are visible. Click Ok. The pattern's origin is automatically updated and "Pattern Alignment Complete" is displayed.
7. Click the Save button to save the aligned pattern.
8. For two or more alignment positions, click the Align Pattern button. The following dialog box is displayed. Follow the screen prompts.

Message
The following dialog will guide you through the process of adjusting the ORIGIN and ROTATION of the current pattern. Click 'Ok' to continue. Click Cancel to abort.
OK **Cancel**

9. To continue, click OK.
10. The system moves the stage to the location where it thinks the first position is. You may need to use the X/Y joystick to adjust the position so that fringes are visible. The position will be autonulled and the stage will move to the next alignment position. At each position, the system temporarily calculates and updates the rotation value. The same process is repeated for all of the alignment positions.
11. After the stage has moved to the last alignment position, the pattern's origin and rotation will be automatically updated and a message indicating "Pattern Alignment Complete" will be displayed.
12. Click the Goto Origin button to check the first position.
13. Click on the Save button to save the aligned pattern.

Run Align Pattern Script
When on, the script file specified below is activated during the align pattern routine. This control should be on.

Align Pattern Script File
Specifies the filename of the script that should run during the pattern alignment procedure. *Do not* delete or change the AutoNULL.scr file name.

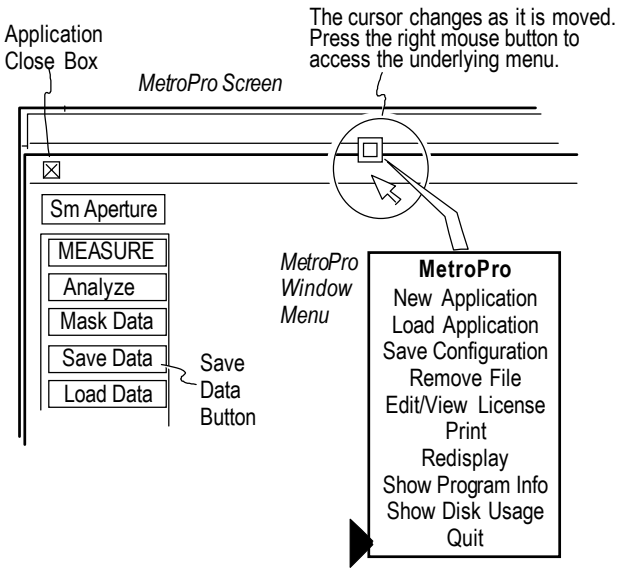
Frequently Used MicroLUPI Software Operations

Operation	How To …
Save data	Click the Save Data button. In the File Handler, click the Current Selection box, enter a name for the file, ending with ".dat," and press Enter. Then click Done.
Print results	Click the word "zygo" in the window you want to print, or select the Print command from the window's menu. In the Print Panel, click the Print button.
Save changes made to controls, plots, results, and windows	You must save the application under a new name. Select the Save Application command from the Application Window menu. In the File Handler, click the Current Selection box, enter a name for the file, ending with ".app" and press Enter. Then click Done.
Define a mask	Click the Mask Data button. Use the Mask Editor to define areas to include or exclude from the test part measurement. See "Chapter 7" of the *MetroPro Reference Guide*.
Turn off the System	**Warning!** Improper shutdown can damage the instrument. Select the Quit command from the MetroPro menu; turn off power after you have shut down from within Windows. See the "Shut Down" section of this chapter.

Shutdown

1. Save data and other files.
2. Close open applications by clicking the close box in the upper left corner. Press and hold the right mouse button; choose Quit from the MetroPro Window menu.
3. From Windows, use the Start menu and select the Shutdown command.
4. Turn off all components with the master switch on the Power Manager. Turn off the laser power supply.

Sample MetroPro Screen



Measurement Types

Chapter 4

In This Chapter

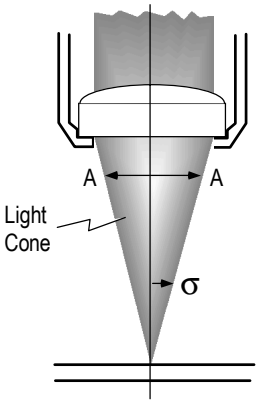
- Choosing the Right Objective
- Surface Reflection Measurement
- Radius of Curvature Measurement

Choosing the Right Objective

To successfully use the MicroLUPI to measure parts, it is necessary to understand some background information about objectives and spherical elements. The objective is used to transform the collimated output beam of the instrument into a spherical wavefront. Zygo Corp. offers various objectives to accommodate a range of concave and convex test parts. Objectives are specified by numerical aperture (NA).

Background Information - What is NA?

The objective's Numerical Aperture (N.A.) is a term representative of the angle included by a cone of light accepted by the objective. The higher the N.A., the greater the resolving power and the larger the part diameter that can be measured.



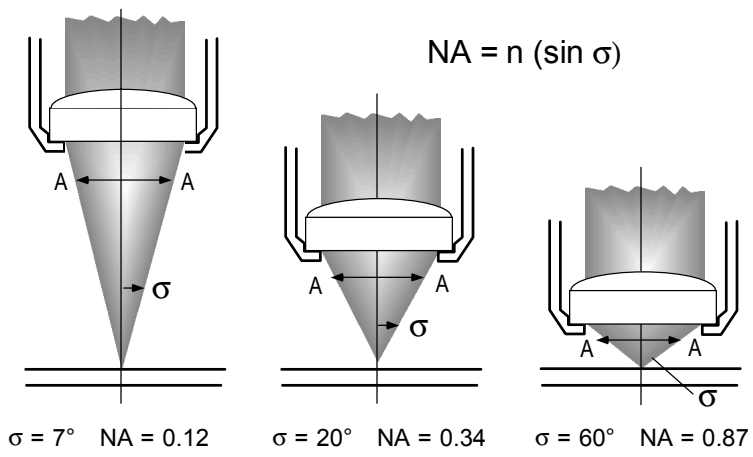
The numerical aperture of an objective is a measure of its ability to gather light and resolve fine part detail at a fixed object distance. Image-forming light waves from the test part enter the objective in an inverted cone. A longitudinal slice of this cone of light shows the angular aperture (A), a value that is determined by the focal length of the objective.

The angle σ is one-half the angular aperture (A) and is related to the numerical aperture through the following equation:

Numerical Aperture (NA) = n (sin σ)

Where n is the refractive index of the imaging medium between the front lens of the objective and the test part, which is a value of 1.00 for air. Since the refractive index of air is 1.0, the numerical aperture is dependent only upon the angle σ whose maximum value is 90°. The theoretical maximum numerical aperture of a lens operating with air as the imaging medium is 1.0 [NA = 1 (sin 90°)].

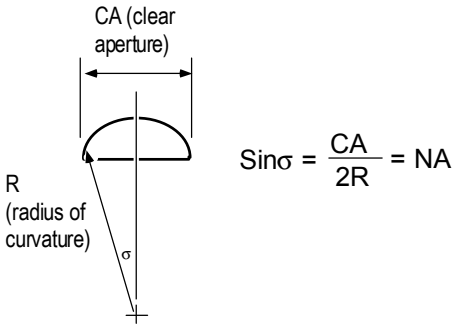
In practice, however, it is difficult to achieve numerical aperture values above 0.95 with objectives used in air. The examples shown here illustrate a series of light cones derived from objectives of varying focal length and numerical aperture.



Determining the NA of the Test Optic

The NA of the test optic must be matched to the NA of the objective. To calculate the NA of the test optic you have to know the clear aperture and nominal radius of curvature.

The NA of the objective must be greater than or equal to the NA of the optic under test.

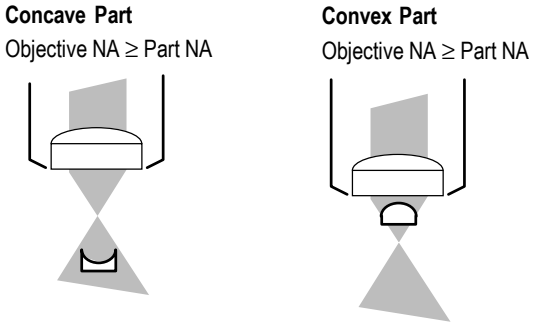


MicroLUPI Objective Specifications

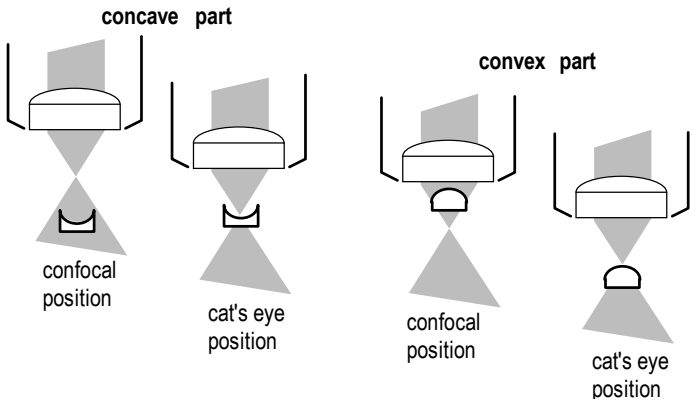
Objective	NA	Working Distance
50X	0.45	13.80 mm
100X	0.73	4.70 mm

Measurement Constraints

To measure the entire surface of a spherical test part, the cone of light from the objective must be large enough to completely fill the test part. The objective NA must be equal to or larger than the NA of the test part.



When measuring the radius of curvature the objective's working distance must be considered. For a concave part, the working distance must be able to measure at cat's eye. For a convex part, the working distance must accommodate the confocal position.



Surface Reflection Measurement

This test setup is designed to measure the shape of a near spherical surface. A spherical wavefront is retro-reflected from the first surface of the part to measure the deviation of the surface from a sphere.

Difficulties may arise when measuring a transparent sphere where the front and back surface reflections coincide. With a plano-convex lens it is also possible for the reflection from the plano back surface to be coincident with the cat's eye. To overcome these difficult conditions, you can use index matching fluid to attenuate or eliminate the back surface reflection, measure the optic in transmission, or coat the first surface with a metalized film.

Radius of Curvature Measurement

The radius of curvature of a spherical surface is defined as the distance from the surface (or its best-fit spherical equivalent) to the center of curvature. Two measurements are required to determine this result, one at cat's eye, the second at confocal position.

One measurement is made at cat's eye position with the measurement beam converging at a point on the spherical surface. The objective is moved to the confocal position, where the center of curvature is coincident with the convergence point of the interferometer's measurement beam, and the second measurement is made. The part radius is determined using the cat's eye and confocal measurements and the distance traveled between these two measurements.

Maintenance

Chapter 5

In This Chapter

- A Note About Maintenance
- General Care
- Maintenance and Care for Computer Components
- Maintenance and Care for the MicroLUPI
  - Cleaning of External Surfaces
  - Cleaning Optics
  - Recommended Optical Cleaning Procedures
- Servicing the MicroLUPI

General Care

The components used in the MicroLUPI system will provide many years of service with little maintenance if a few guidelines are observed:

- *Keep the Environment Clean*
  The working environment should be as clean, dry, and as dust-free as possible. Occasionally clean painted surfaces and covers by wiping with a cloth dampened with a mild cleaning solution.
- *Handle Objectives Carefully*
  Objectives are precision optics. Handle objectives only when necessary. Keep unused objectives stored in their protective containers. Do not clean objectives unless you have experience cleaning optics.
- *Do Not Disassemble Components*
  Do not attempt to remove component covers, dismantle optical parts or repair circuit boards since system performance may be impaired. There are no user-serviceable internal parts.
- *Contact Zygo Customer Support Center or Your Zygo Representative*
  Call Zygo or your Zygo representative if you have questions or problems.

Maintenance and Care for Computer Components

Refer to the original manufacturer's documentation for maintenance information for the computer components, which includes the computer, color display, mouse, keyboard, and any accessories, such as a printer.

If you are experiencing problems, but are not sure of the cause, contact Zygo.

Maintenance and Care for the MicroLUPI

MicroLUPI components require minimal upkeep. For details, refer to the following sections. Recommended maintenance items are listed below.

Maintenance Schedule

Maintenance	Frequency
Clean exterior surfaces of equipment.	As needed, based on the operating environment.
Clean optics (objectives).	As needed; only when dirty.

Cleaning of External Surfaces

Occasionally clean the painted surfaces of the equipment and covers by wiping with a cloth dampened, but not wet, with a mild cleaning solution.

Cleaning Optics

Cleaning of any precision optic risks degrading the surface. All the cleanable objective lens surfaces are coated. Coated optics are easily damaged by improper or unnecessary cleaning. The need for cleaning can be minimized by proper handling techniques, returning the objectives to their plastic case when not in use, and by keeping the environment clean.

Do not attempt to clean optics within the instrument head since system performance may be impaired.

Recommended Cleaning Materials:

- *Polyethylene lab gloves*
  Wear to prevent contamination of surfaces and protect the skin against harsh chemicals.
- *Compressed gas with blower nozzle*
  Use to blow off dust and lint from the optic.
- *Lens tissue*
  Use when it is necessary to clean an optical surface. The lens tissue should be optics grade.

- *Cotton swabs*
  Use to clean difficult to reach surfaces. The swabs should have wood or paper stems; plastic stems can dissolve in acetone.
- *Solvents*
  Use spectroscopic grade isopropyl alcohol and methanol to remove contaminates fixed to the optical surface. Use a mild, neutral 1% soap solution or lens cleaner to remove oily contaminates.

Recommended Optic Cleaning Procedures

▲Warning

- Be careful when using isopropyl alcohol and methanol; both are flammable and toxic.
- Do not reuse any cleaning tissue or pads, reusing tissues can cause contamination and damage to the optic.
- Before cleaning optics, remove all rings and jewelry from your hands and wrists; wash your hands thoroughly to remove excess skin oils; and put on lab gloves.

Optics Cleaning Procedures

Contaminant	Procedure
Dust or light dirt	1. Blow off loose particles. 2. If any dust remains, twist two sheets of lens tissue around a swab or fold a lens tissue so it is just wider than the area you are cleaning. 3. Dampen the tissue with alcohol or methanol. 4. Wipe the lens straight across once. If it needs wiped again use a new swab or tissue.
Fingerprints, oil and water spots *Note: Clean surface immediately; skin acids attack lens coatings.*	1. Blow off loose particles. 2. Twist two sheets of lens tissue around a swab or fold a lens tissue so it is just wider than the area you are cleaning. 3. Dampen it with 1% soap solution. 4. Wipe the lens straight across once. If it needs to be wiped again, use a new swab or tissue. 5. Repeat steps 2 and 4 with tissue dampened with distilled water to remove soap residue. 6. Repeat steps 2 and 4 with tissue dampened with alcohol or methanol.

Servicing the MicroLUPI

▲ **Warning**
The equipment does not have any user-serviceable components. Service must be performed by Zygo Corporation trained service personnel. Any attempt to service or repair equipment may void the warranty.

Components have been selected for conformance to applicable industry standards, all replacement parts must be approved by Zygo Corporation. Contact your Zygo Corporation representative for service.

For service on the computer equipment, refer to the original manufacturer's documentation.

Returning Equipment to Zygo

To return equipment to Zygo Corporation, it is necessary to have an RA (return authorization) number. Contact Zygo Corporation for an RA number and instructions on packing and shipping the equipment.

Note: Do not return equipment to Zygo without an RA number. Equipment returned without an RA number is not accepted.

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