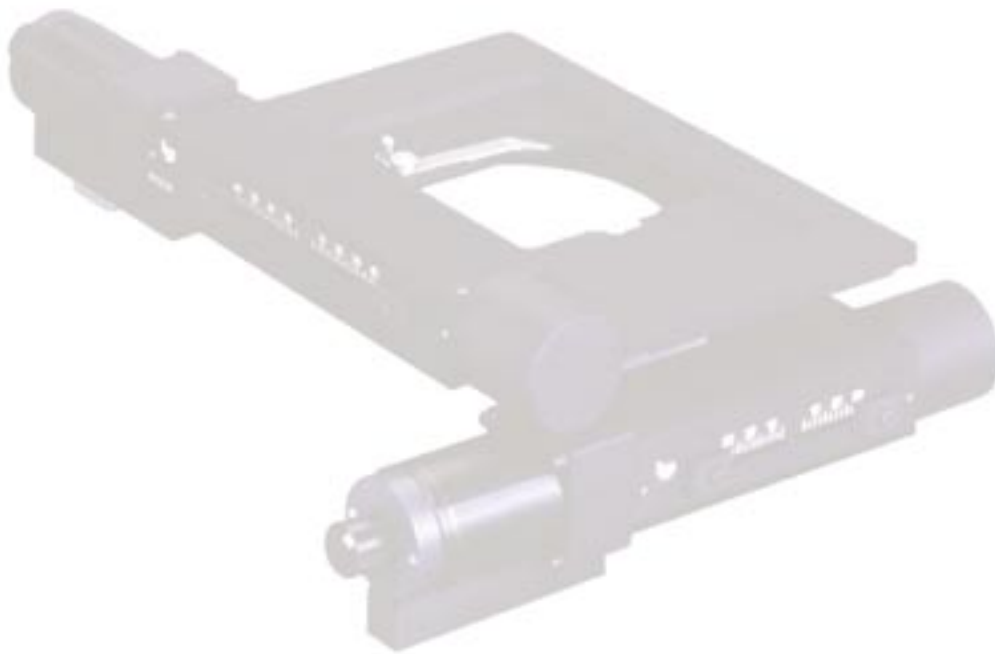


BioPrecision Stages

LEP BioPrecision stages are very well known for reliability, accuracy and precision. Coupled with the MAC 5000 controller system, it is a versatile solution for demanding microscope automation requirements. The BioPrecision stages cover a wide range of applications with stage sizes from 3"x2" (77mm x 51mm) travel up to 10"x4" (406mm x 102mm) travel stages. Specialized stages for specific microscopes including inverted microscopes eliminate compromise.

BioPrecision stages are designed to meet the requirements of the most challenging applications. High precision, high repeatability, high accuracy and high speed specifications enable applications such as image mosaic building, time-lapse studies, tracing and rapid screening.



DC Servo Motors vs. Stepper Motors

“Which is better: DC servo motors or stepper motors?”. The answer is: “it depends”. Stepper motors and DC servo motors have specific technological advantages, and of course, some respective disadvantages.

DC servo motors characteristically provide higher speeds. When used with LEP stages and the MAC 5000 control system, speeds are about double that of the same system using stepper motors. Positional repeatability and control is entirely dependent on the encoder feedback system. Resolution is never greater than the encoder.

Stepper motors don't have the high speed performance of the DC servo motors, but they do have several advantages. The motor is very simple and stepper motors almost never wear out or fail. The stepper motor has excellent slow speed control. This can be useful for scanning areas or strobed image acquisition. Since the motor step resolution can be higher than the stage encoder resolution, quasi closed loop positioning with resolutions higher than the stage encoder resolution is possible.

All BioPrecision stages are available with either stepper motor or DC servo motor drive. While sometimes the decision which to choose is purely based on personal preference, each technology offers an advantage over the other. LEP recognizes the benefits of each drive technology and supports both.

Stepper Motor Encoder Options

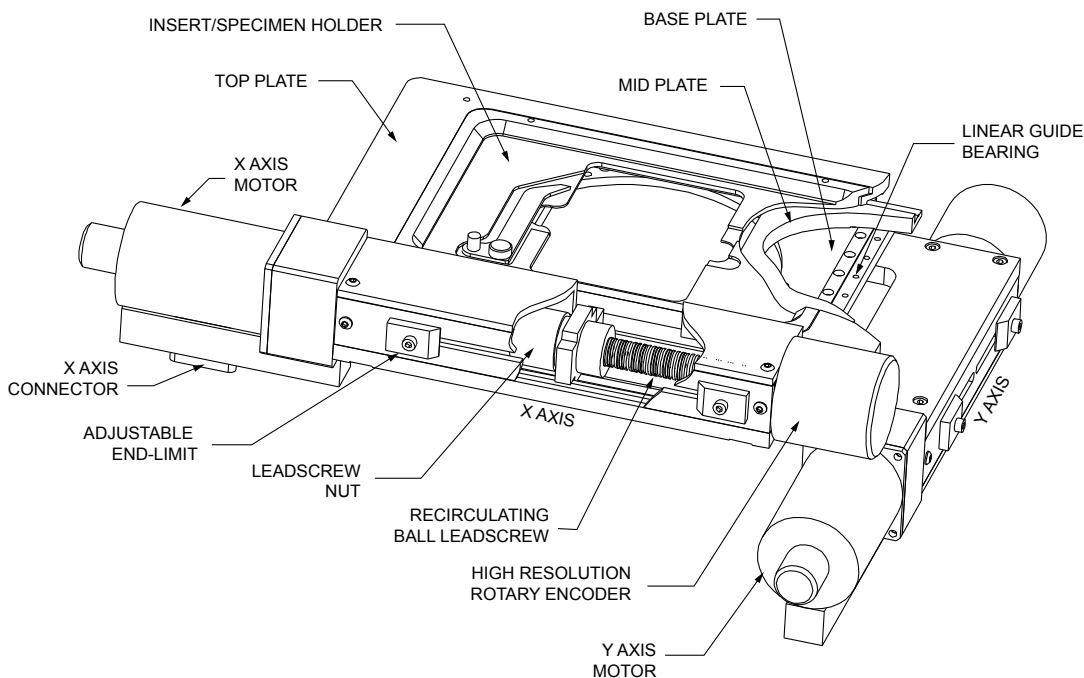
Certain BioPrecision stages are available with or without encoders. With the addition of encoders the stage gives feedback to the controller to enable corrections for errors. The rotary encoder is directly mounted to the leadscrew shaft and compensates for motor step errors. Typically a 10% improvement in positional repeatability is gained using a rotary encoder.

The rotary encoder also adds a degree of robustness to the stage system as well as improved repeatability. In an open loop system, without an encoder, the stage position is determined from counting motor steps. Since a stepper motor is vulnerable to stalling or other external disruptions, the stage may not move the exact distance expected. An encoder simply provides feedback to the controller so that it can compensate for any spurious motor error.

The BioPrecision Difference

BioPrecision stages are designed for the highest performance possible. Design features include precision recirculating ball leadscrews, high resolution rotary encoders, precision ground crossed roller guide bearings and adjustable limits. Each stage is carefully assembled by experienced technicians with careful measurements taken at each step to ensure that the stage performs to expectations.

The quality extends itself to the appearance of the stage also. All aluminum components are anodized to military specifications. In addition, the stages are assembled using stainless steel hardware. This means that over years of use and exposure to solvents and reagents the stage will continue to maintain its performance and appearance.



Adaptability is also a hallmark of the BioPrecision stages. The adjustable end limits allow the working envelope to be enlarged or reduced to provide clearance for different lens configurations or specimen clearance. The removable insert adds the ability to use different interchangeable specimen holders for different applications. Whenever your requirements change, the BioPrecision stage will fill the need.

- **3"x2" (77x51mm) travel range**
- **1mm recirculating ball leadscrew**
- **0.1µm encoder resolution**
- **0.75µm repeatability**
- **3µm accuracy over full range of travel**
- **Stepper motor and DC servo motor versions available**
- **Modular mount for easy adaptability**



99S000 stage with optional 99A153 slide holder

The most popular BioPrecision stage, this stage covers the broadest application range while supplying high performance. The slide holder design increases objective clearance for high magnification and large diameter optics. Improved condenser access accommodates newer motorized condensers.

Many features normally found in large format measuring stages are used to achieve the highest performance possible. Precision zero backlash recirculating ball leadscrews make the stage smooth, accurate and reliable.

A universal mounting ring ensures that this stage will fit perfectly on nearly every popular microscope available. In fact, this stage will fit most microscopes produced in the last 20 years.

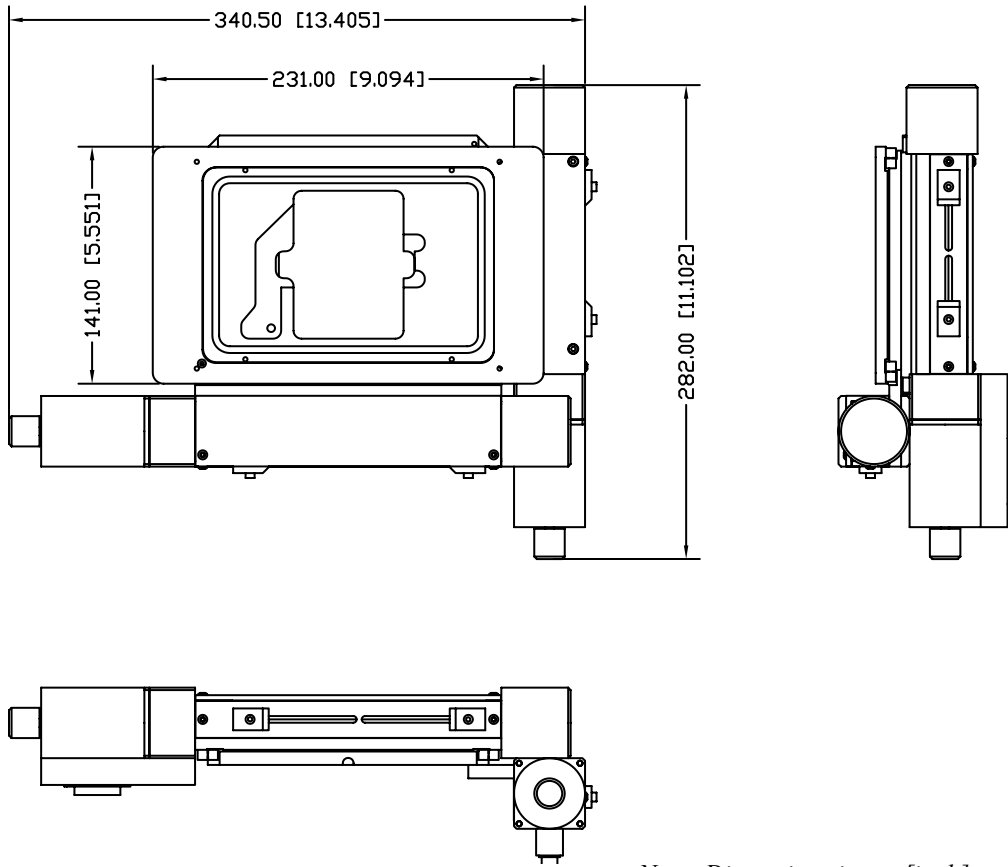
The very low profile of the stage allows it to mount to most microscopes while maintaining proper focus for high aperture condensers and objectives.

Ordering Information

| | |
|-----------------|--|
| 99S000 | 3"x2" (77mm x 51mm) stepper motor stage |
| 99S000-NE | 3"x2" (77mm x 51mm) stepper motor stage without encoders |
| 99D000 | 3"x2" (77mm x 51mm) DC servo motor stage |

3"x2" BioPrecision Stage Accessories

| | |
|--------------|---|
| 99A153 | Slide holder for single 1"x3" (25mm x 75mm) slide |
| 99A154 | Slide holder for double 2"x3" slide (50mm x 75mm) |
| 99A155 | Solid aluminum insert for 3"x2" stage |
| 99A156 | Glass insert for 3"x2" stage |



Note: Dimensions in mm[inch]

Specifications

| | | | |
|--------------------------|-----------|----------------------------|-------------|
| Height | 17mm** | Travel Range | 77mm x 51mm |
| Weight | 3.1kg | Encoder Resolution | 0.1µm |
| Speed with stepper motor | 30mm/sec. | Speed with DC servo motor | 60mm/sec. |
| Straightness | 0.04ppt | Accuracy | 3 µm |
| Flatness | 0.04ppt | Repeatability | 0.75 µm |
| Clear Opening | 82mm | Min. Motor Step Resolution | 0.025µm |

* Applies to stages with rotary encoders installed

** Measured height when using LEP recessed specimen holder

Specifications valid when used with properly configured MAC 5000 controller

- **4"x4" (102x102mm) travel range**
- **1mm recirculating ball leadscrew**
- **0.1µm encoder resolution**
- **0.75µm repeatability**
- **3µm accuracy over full range of travel**
- **Stepper motor and DC servo motor versions available**



99S001 stage with optional 99A153 slide holder

For applications requiring more scanning area than the 3"x2" stage, the 4"x4" adds versatility while still being compatible with most laboratory microscopes. The new slide holder design increases objective clearance for high magnification and large diameter optics. Improved condenser access accomodates newer motorized condensers.

This stage has many features that set it apart from others. Precision recirculating ball leadscrews ensure accurate, repeatable position translation. Adjustable end-limits allow for tailoring stage travel to each application. Flexible encoder options provide high accuracy and reliability.

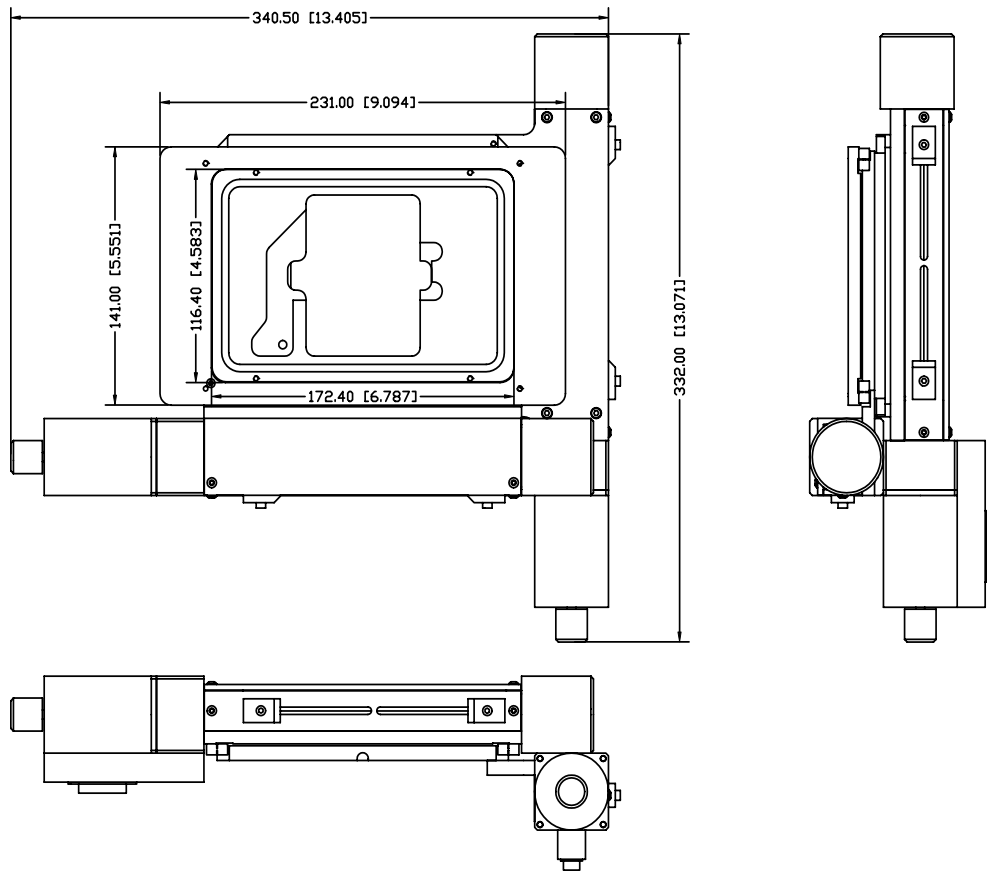
The low profile and high precision of this stage make it the best choice for high precision applications that require scanning a large area. Applications include scanning large thin sections, material analysis, forensic studies and specimen inspection.

Ordering Information

| | |
|-----------------|--|
| 99S001 | 4"x4" (102mm x 102mm) travel stepper motor stage |
| 99S001-NE | 4"x4" (102mm x 102mm) travel stepper motor stage without encoder |
| 99D001 | 4"x4" (102mm x 102mm) travel DC servo motor stage |

4"x4" BioPrecision Stage Accessories

| | |
|--------------|--|
| 99A153 | Slide holder for single 1"x3" (25mm x 75mm) slide |
| 99A154 | Slide holder for double 2"x3" slide (50mm x 75mm) |
| 99A155 | Solid aluminum insert for 4"x4" stage for custom specimen applications |
| 99A156 | Glass insert for 4"x4" stage |



Note: Dimensions in mm[inch]

Specifications

| | | | |
|--------------------------|-----------|----------------------------|---------------|
| Height | 17mm** | Travel Range | 102mm x 102mm |
| Weight | 3.1kg | Encoder Resolution | 0.1µm |
| Speed with stepper motor | 30mm/sec. | Speed with DC servo motor | 60mm/sec. |
| Straightness | 0.04ppt | Accuracy | 3 µm |
| Flatness | 0.04ppt | Repeatability | 0.75 µm |
| Clear Opening | 82mm | Min. Motor Step Resolution | 0.025µm |

* Applies to stages with rotary encoders installed

** Measured height when using LEP recessed specimen holder

Specifications valid when used with properly configured MAC 5000 controller

- 4"x4" (102x102mm) travel range
- 1mm recirculating ball leadscrew
- High accuracy grid encoder
- 0.2 µm repeatability
- < 2.0 µm absolute accuracy over full range of travel
- Most accurate and precise microscope stage available



99S026 stage with optional 99A153 slide holder

The 4x4 Grid Encoded Stage features the highest accuracy and precision of any motorized microscope stage. Built upon the standard LEP 4x4 stage platform, this stage features a two dimensional grid encoder rather than separate conventional linear encoders for the X and Y axes. The grid encoder is mounted to the top-plate of the stage and moves in both axes with the sample. As a result, the position of the sample is tracked directly; effectively removing mechanical position uncertainty due to orthogonality, linearity and hysteresis errors. The positional repeatability and accuracy is improved by at least an order of magnitude over the standard LEP stage systems.

The high performance of this stage makes it ideal for applications that require either or both high accuracy and repeatability. Applications such as image tiling, time-lapse studies and measurement are particularly suited for this stage.

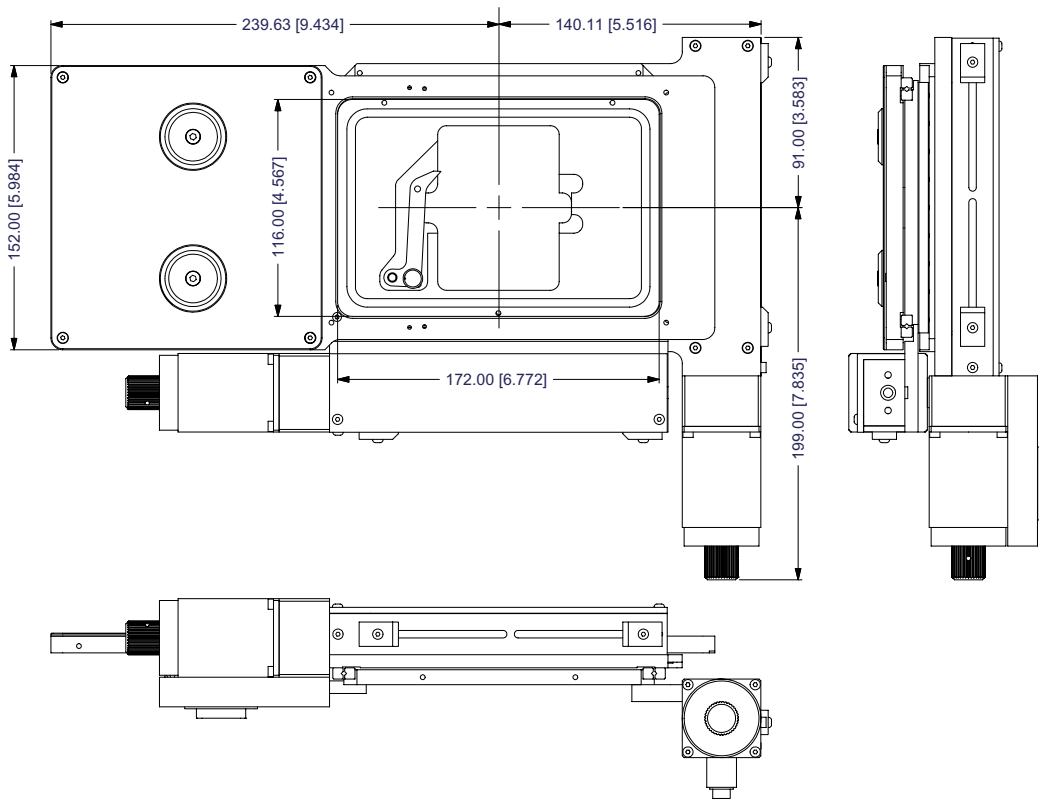
The grid encoded stage is completely compatible with the MAC 5000 controller system and all peripherals. There are no added software commands required. Both the user and software interface is fully compatible with standard LEP stages. The full range of LEP upright stage accessories are available for this stage.

Ordering Information

99S026 4"x4" (102mm x 102mm) grid encoded stage

BioPrecision Stage Accessories

99A153 Slide holder for single 1"x3" (25mm x 75mm) slide
 99A154 Slide holder for double 2"x3" slide (50mm x 75mm)
 99A155 Solid aluminum insert for 4"x4" stage for custom specimen applications
 99A156 Glass insert for 4"x4" stage



Note: Dimensions in mm [inch]

Specifications

| | | | |
|---------------|-----------|----------------------------|---------------|
| Height | 17mm** | Travel Range | 102mm x 102mm |
| Weight | 3.95 kg | Encoder Resolution | 0.1 μm |
| Speed | 30mm/sec. | Encoder type | 2-D grid |
| Straightness | 0.04ppt | Absolute accuracy* | < 2.0 μm |
| Flatness | 0.04ppt | Repeatability | 0.2 μm |
| Clear Opening | 82mm | Min. Motor Step Resolution | 0.025 μm |

* Absolute accuracy is defined as maximum error when the stage is moved from any position to any position

** Measured height when using LEP recessed specimen holder

Specifications valid when used with properly configured MAC 5000 controller

- 4.75"x4" (121x102mm) travel range
- 0.05µm minimum resolution
- <1µm repeatability
- 6µm absolute accuracy
- Maximum speed 60mm/sec. (stepper motor)
- Thermal compliant design is suitable for environmental chambers
- All parts anodized for long lasting finish



The LEP inverted microscope stages are designed to compliment and enhance the capabilities of most research inverted microscopes. The 121mm x 102mm travel stages are very well suited to the wide array of applications that make the inverted microscope so versatile. A full range of specimen holders such as multi-well plates, flasks, petri dishes and standard 1"x3" and 2"x3" glass slide holders further enhance the flexibility of the microscope.

Each inverted microscope has unique features and configurations. To accommodate this LEP inverted stages are designed individually to fit each microscope. By configuring the leadscrew housings and mounting locations each stage minimizes interference with normal microscope functions.

The BioPrecision stages also offer flexibility with drive and encoder options. The standard version includes stepper motors and high resolution rotary encoders. This version is very well suited to most applications and delivers high accuracy. Another version with stepper motor drive is available without encoders. Sacrificing encoders forfeits some accuracy and robustness in exchange for price. Higher throughput applications will benefit from the DC servo motor configuration. The DC servo motor can drive the stage with a maximum velocity about twice that of the stepper motor version. For applications that require very high repeatability and accuracy the 99S007 stage adds high resolution linear encoders for the X and Y axes.

Since the inverted stages are part of the BioPrecision family they all feature anodized components, precision recirculating ball leadscrews, ground linear guide ways and adjustable limits. In addition, the inverted stages feature a unique floating guide design that makes the stage thermally compliant to eliminate inaccuracies associated with temperature variation.

Ordering Information

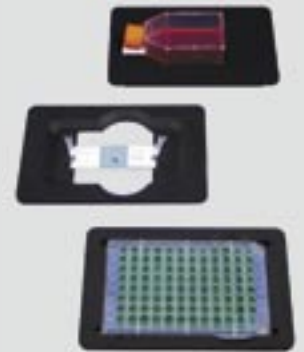
- 99S008 Inverted BioPrecision stepper motor stage
- 99S008-NE Inverted BioPrecision stepper motor stage without rotary encoders
- 99D008 Inverted BioPrecision DC servo motor stage
- 99S007 Inverted BioPrecision stage with high accuracy linear encoders

*Please specify exact microscope brand and model when making inquiries about this stage.
The exact stage configuration will vary according to microscope brand and model.*

Inverted BioPrecision Accessories

- 99A061 Single (1"x3") slide holder for inverted stage
- 99A062 Double (2"x3") slide holder for inverted stage
- 99A123 Glass insert plate for inverted stage
- 99A049 Solid aluminum insert plate for inverted stage
- 99A064-36 Petri dish holder for 36mm diameter petri dish
- 99A064-54 Petri dish holder for 54mm diameter petri dish
- 99A064-65 Petri dish holder for 65mm diameter petri dish
- 99A064-88 Petri dish holder for 88mm diameter petri dish
- 99A063 Well plate holder for inverted stage
- 99A074 Adjustable slide/petri dish holder (65mm diam. max)
- 99A088 Double Terasaki plate holder inverted stage

Please call for special requirements



Specifications

| | | | |
|---------------------------|-----------------|---------------------------------------|---------------|
| Height | 23mm** | Travel Range | 121mm x 102mm |
| Weight | 4.2kg (approx.) | Encoder Resolution | 0.2µm* |
| Speed with stepper motor | 60mm/sec. | Speed with DC servo motor | 120mm/sec. |
| Straightness | 0.04ppt | Accuracy | 6 µm |
| Flatness | 0.04ppt | Repeatability | 1 µm |
| Insert opening | 160mm x 110mm | Min. Motor Step Resolution | 0.05µm |
| Linear encoder resolution | 0.1 µm | Linear encoder position repeatability | 0.2 µm |

* Applies to stages with rotary encoders installed

** Measured height when using LEP recessed specimen holder

Specifications valid when used with properly configured MAC 5000 controller

- Adaptable to most standard microscopes
- 0.4µm resolution
- 2µm repeatability
- 20µm accuracy
- Open frame design
- All parts anodized for long lasting finish



The extended travel LEP stages are suitable for applications where either the specimen is too large for a standard stage or there is a requirement for multiple specimens to be placed on the stage at one time.

For automated scanning applications it is frequently more efficient to place multiple specimens on the stage per ‘run’ so that the impact of specimen exchange time is reduced. For example, multiple position 1”x3” slide holders are available for the 6”x4” and 10”x4” (99S009 and 99S021) stages. The ability to load multiple slides means that an imaging system can be set to process for longer intervals without pausing for reloading. Additionally, some applications may involve time studies where specific points may need to be revisited frequently. The multiple slide holders make this possible without pausing for specimen changes.

The extended travel stages are designed for use in applications requiring maximum throughput. Higher speeds with less wear is achieved with precision 4mm pitch recirculating ball leadscrews. High resolution rotary encoders offer more accuracy and reliability over non-encoded versions.

Ordering Information

| | |
|-----------------|---|
| 99S009 | 6”x4” (152mm x 102mm) travel stepper motor stage |
| 99D009 | 6”x4” (152mm x 102mm) travel DC servo motor stage |
| 99S009-NE | 6”x4” (152mm x 102mm) travel stepper motor stage w/o encoder |
| 99S021 | 10”x4” (254mm x 102mm) travel stepper motor stage |
| 99D021 | 10”x4” (254mm x 102mm) travel DC servo motor stage |
| 99S021-NE | 10”x4” (254mm x 102mm) travel stepper motor stage w/o encoder |

Extended Travel Stage Accessories

| | |
|--------------|---|
| 99A108 | Four position slide holder for single (1”x3”) slides, 6”x4” stage(99S009, 99D009) |
| 99A073 | Glass insert plate for 6”x4” stage |
| 99A196 | Eight position slide holder for single (1”x3”) slides, 10”x4” stage(99S021, 99D021) |
| 99A194 | Glass insert plate for 10”x4” stage |
| 99A195 | Solid aluminum insert plate for 10”x4” stage |

Specimen Holders

| | |
|-----------------|---|
| 99A049 | Solid aluminum insert plate for 99S008 inverted stage |
| 99A153 | Single (1" x 3") slide holder for 99S000,99S001 (3"x2",4"x4") stage |
| 99A154 | Double (2" x 3") slide holder for 99S000,99S001 (3"x2",4"x4") stage |
| 99A061 | Single (1" x 3") slide holder for 99S008 inverted stage |
| 99A062 | Double (2" x 3") slide holder for 99S008 inverted stage |
| 99A063 | Terasaki plate holder (96 well) for 99S008 inverted stage |
| 99A064-36 | Petri dish holder, 36mm diameter for 99S008 inverted stage |
| 99A064-51 | Petri dish holder, 51mm diameter for 99S008 inverted stage |
| 99A064-54 | Petri dish holder, 54mm diameter for 99S008 inverted stage |
| 99A064-60 | Petri dish holder, 60mm diameter for 99S008 inverted stage |
| 99A064-65 | Petri dish holder, 65mm diameter for 99S008 inverted stage |
| 99A064-88 | Petri dish holder, 88mm diameter for 99S008 inverted stage |
| 99A074 | Adjustable petri dish/slide holder for inverted stage |
| 99A088 | Dual Terasaki plate holder for 99S008 inverted stage |
| 99A108 | Four pos. single (1"x3") slide holder for 99S009 (6"x4") stage |

Mounting Adapters

Leica Microscopes

| | |
|--------------|---------------|
| 99A200 | DML series |
| 99A204 | DMRXA2/DMR |
| 99A206 | DM4000/DM5000 |

Nikon Microscopes

| | |
|--------------|------------------------------|
| 99A202 | Optiphot2 Labophot2 |
| 99A205 | E800/E1000 |
| 99A207 | E400/E600 (excluding E600FN) |
| 99A209 | E800M/E1000M |
| 99A211 | E50i/E80i |

Olympus Microscopes

| | |
|--------------|-------------------------------|
| 99A202 | BH2 (dovetail mount) |
| 99A203 | BX, BX2 series (excluding WI) |
| 99A210 | AX80 |

Zeiss Microscopes

| | |
|--------------|---|
| 99A201 | Axioplan 1 Axioplan 2 Axioskop 1 Axioskop 2 Axioskop 40 |
|--------------|---|

- **Configured systems simplify ordering**
- **Includes cables and documentation**
- **Modular design for practical, convenient expansion**

The MAC 5000 controller system provides high performance motion control for all LEP XY stages. The unique, patented stacked modular design allows for the system to be configured for almost any application. The LEP design philosophy makes the MAC 5000 system easy to integrate, simple enough for basic applications, yet sophisticated and powerful enough for very advanced applications.

The ability to unify all the automation into a single controller dramatically simplifies system design, programming, implementation and troubleshooting. There are no boards to install into your computer; only a standard RS-232 or USB port is required. Each module is configurable either via hardware switches or by software override. Application software is also simplified through the use of common command structures across all the MAC 5000 modules.

The LEP philosophy makes basic operation and programming of the MAC 5000 system easy. The high level command set provides an intuitive, easy to use interface suitable for even novice programmers. While at the same time sophisticated low level commands are available that enable an application to fine tune the system for the vital performance edge.



XY Stage Controller

The MAC 5000 XY stage controller systems are ideal for LEP BioPrecision stages. Available for both stepper motor and DC servo stages this system includes the system power supply, communication interface, motor drive modules, XY digipot(Z) joystick, line-cord, interface cable and user documentation. This high performance controller is designed for maximum speed, resolution and flexibility.

Ordering Information

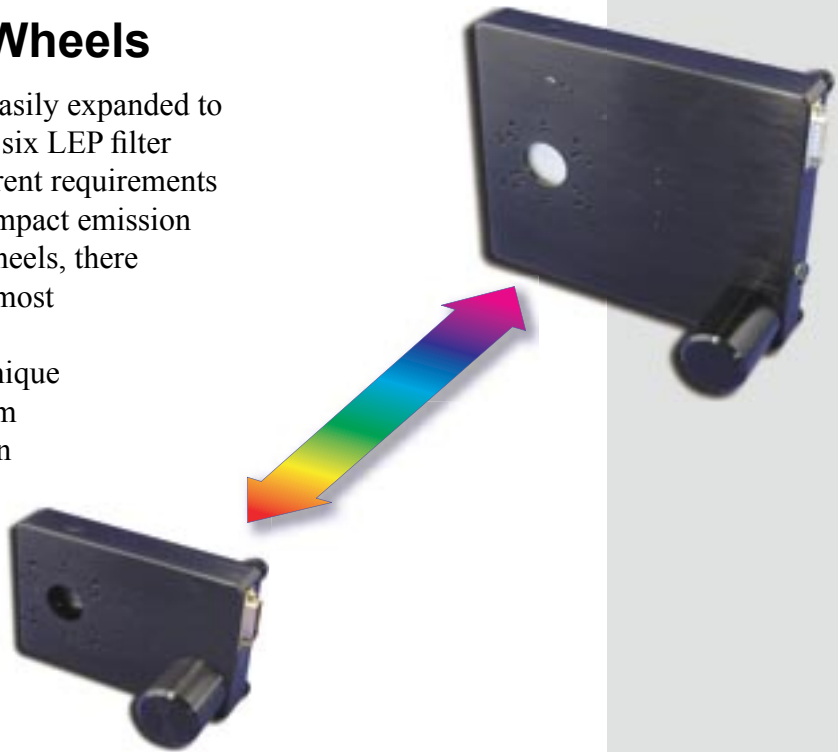
- 995052MAC 5000 XY Stepper Stage Controller
- 995053MAC 5000 XY DC Servo Stage Controller

Programmable Filter Wheels

A basic XY stage system can be easily expanded to include filter wheel control. There are six LEP filter wheels, each designed to address different requirements for different applications. From the compact emission filter wheels to the dual ten position wheels, there is a filter wheel that can directly meet most requirements.

The LEP filter wheels feature a unique easily exchangeable filter carrier system that can accommodate any combination of 25 and 32mm filters.

LEP filter wheels integrate seamlessly with existing microscope systems and are widely supported by most imaging software applications.



Microscope Focus Control

High resolution focus control is an important accessory for an automated system. With the addition of a high resolution stepper motor to the microscope focus, the system gains the ability to tightly integrate positioning in XY and Z axes. Applications include autofocus, image deconvolution, stereology and tele-imaging.

The standard focus drive motor couples to the coarse focus knob of most microscopes using microscope specific adapters. This convenient mounting arrangement enables automated control of the microscope fine focus while retaining the ability to manipulate the coarse focus for specimen loading. Once engaged, manual focus control is accomplished with the joystick mounted digipot control.

For more demanding applications the linear encoder option provides direct z-axis position feedback. Utilizing a high accuracy linear encoder directly mounted to the microscope, high accuracy is achieved by measuring the actual stage height.





Ludl Electronic Products designs and manufactures the finest automation products for microscopy. For more than 25 years LEP has been in the forefront of integrating routine microscopy with computer analysis equipment. The result is a thorough understanding and very wide application experience with bio-science and industrial systems.

Ludl Electronic Products has a solution for automation of nearly every aspect of microscopy. This includes XY positioning, focus control, filter changing, objective turret automation, and lamp control. Custom automation applications demand custom solutions and LEP is your solutions provider.



Focus control provides motorized control for the microscope focus motor. Adapters for most microscopes ensure a perfect fit.

Options are available for precision encoders and adjustable end-limits.



Essential for fluorescence imaging, programmable filter wheels provide rapid changing of the excitation and emission wavelengths. Available to accept either 25 or 32mm diameter filters, the 10 position wheel is programmable to respond to computer or ttl commands for intelligent filter positioning.



The MAC 5000 controller system is the heart of any LEP automation system. The stacking modular concept makes expansion and configuration intuitive. By expanding vertically, the system footprint remains the same regardless of how many modules are added. The MAC 5000 controller system has the wide support of commercial and institutional software packages.

