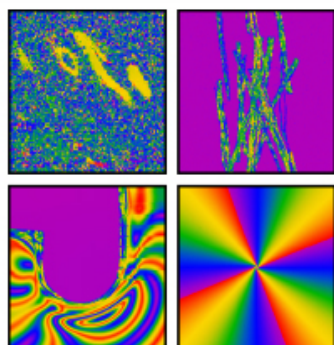


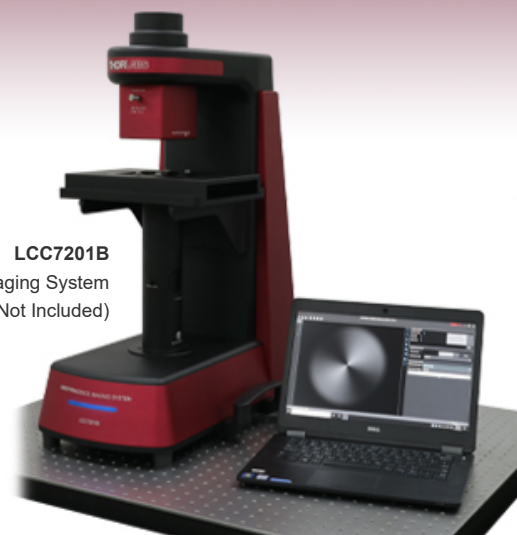
BIREFRINGENCE IMAGING SYSTEM

- ▶ Measurements of Retardance and Azimuth (Fast Axis Orientation) in Flat Samples
- ▶ Stress- and Strain-Induced Birefringence Imaging
- ▶ Measure Ø20 mm Field of View in <20 s
- ▶ Additional Sample Mounting Accessories Available



Sample Measurement Results Using the LCC7201B Software

LCC7201B
Birefringence Imaging System
(Laptop Not Included)



Алматы (7273)495-231
Ангарск (3955)60-70-56
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
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Брянск (4832)59-03-52
Владивосток (423)249-28-31
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Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Ноябрьск (3496)41-32-12
Новосибирск (383)227-86-73
Омск (3812)21-46-40
Орел (4862)44-53-42
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Рязань (4912)46-61-64
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Саранск (8342)22-96-24
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Смоленск (4812)29-41-54
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Ставрополь (8652)20-65-13
Сургут (3462)77-98-35
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Тамбов (4752)50-40-97
Тверь (4822)63-31-35

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Тула (4872)33-79-87
Тюмень (3452)66-21-18
Ульяновск (8422)24-23-59
Улан-Удэ (3012)59-97-51
Уфа (347)229-48-12
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Чита (3022)38-34-83
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Казахстан +7(7172)727-132

Киргизия +996(312)96-26-47

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Features

- Built-In 633 nm LED Light Source
- Measures Sample Retardance up to a Half-Wave (316 nm) and Azimuths up to $\pm 90^\circ$
- $\varnothing 20$ mm Field of View
- Included with the LCC7201B Birefringence Imaging System
 - MLS203P2 Sample Holder
 - Sample Holder Adapters for $\varnothing 1/2"$, $\varnothing 1"$, and $2" \times 2"$ Optics
 - Software (See *Software* Tab for Details)
- Optional Sample Mounting Accessories Offered Below
 - MSB2328(M) Breadboard
 - MPSHA1 Slide Holder Insert or Recording Chamber Adapter
 - MPSH2 and MPSH2SS Slide Holder Inserts
 - MLS203-1 Fast XY Scanning Stage
- Custom Operating Wavelengths by Contacting Tech Support

The LCC7201B Birefringence Imaging System measures stress- and strain-induced birefringence in flat samples for a variety of applications ranging from materials and biological research to product assurance (see the *Applications* tab for examples). This system is designed for use in academic research, medical diagnostics, industrial manufacturing, and product quality assurance. Since it is based on a liquid crystal device, there is no internal mechanical movement, leading to very stable, vibration-free operation.

The illumination wavelength of the standard imaging system is 633 nm. This wavelength can be customized from 488 nm to 780 nm by contacting Tech Support. The system provides a $\varnothing 20$ mm field of view and measures retardance up to a half-wave (316 nm) and azimuths up to $\pm 90^\circ$. The specifications of the LCC7201B system are outlined in the *Specs* tab.

A Windows[®]-based software package is included with the LCC7201B system that contains every feature needed for system control and data acquisition. To view additional information about this system's software features and sample measurement results, please refer to the *Software* tab above.

For applications requiring imaging with higher spatial resolution, our CM50x Cerna[®] Birefringence Imaging Microscopes offer the same retardance and azimuth range and accuracy, with a $1.055 \mu\text{m}$ spatial resolution using the included 10X objective.

Sample Mounting Options

For sample viewing, the LCC7201B system includes Thorlabs' MLS203P2 Sample Holder. It also includes three sample holder adapters that are sized to hold $\varnothing 1/2"$, $\varnothing 1"$, and $2" \times 2"$ optics. The MLS203P2 sample holder provides manual adjustment in the X direction, which is useful for samples larger than the $\varnothing 20$ mm field of view. For sample rotation, the standard sample stage can be replaced with the MSB2328(M) breadboard and MPSHA1 adapter. Additionally, larger samples can be scanned by upgrading the system with Thorlabs' MLS203-1 Fast XY Scanning Stage, which provides manual and motorized adjustment in both the X and Y directions. Examples of sample mounting options are shown below.



Click to Enlarge
LCC7201B Birefringence Imaging System with Rigid Sample Stage and MLS203P2 Sample Holder. The stage and sample holder are included with the imaging system.



Click to Enlarge
LCC7201B Birefringence Imaging System with MSB2328/M Aluminum Breadboard, MPSHA1 Slide Holder Insert Adapter, and MPSH2 Slide Holder Insert. Breadboard, adapter, and insert are not included with the imaging system.



Click to Enlarge
LCC7201B Birefringence Imaging System with MLS203-1 Motorized Scanning Stage (not included) and included MLS203P2 Sample Holder.

LCC7201B Specifications		
Light Source Wavelength^a		633 nm
Measurement Range	Retardance	Standard Retardance Range: 0 nm to 316 nm Low Retardance Range: 0 nm to 100 nm
	Azimuth	±90°
Measurement Accuracy	Retardance	Standard Retardance Range: ±10 nm Low Retardance Range: ±1 nm
	Azimuth	Standard Retardance Range: ±3° Low Retardance Range: ±1°
Measurement Rate		<20 s (Based on Default Camera Settings)
Field of View		Ø20 mm
Spatial Resolution		9.77 µm
Interfaces		USB 2.0 and USB 3.0
Imager Resolution		2448 x 2048 Pixels
Dimensions (D x W x H)		500.0 mm x 360.0 mm x 672.0 mm
Weight		25 kg (55.1 lbs)
Operating Temperature		0 °C to 40 °C
Storage Temperature		-15 °C to 65 °C
Included Accessories		Sample Holder Adapters, Birefringent Resolution Target (Item # R2L2S1B)

- Customizable upon request. Contact Tech Support for details.

The LCC7201B system includes a Windows[®]-based software package that contains every feature needed for system control and data acquisition. Please click the Software button to the right to download the latest software for this system.

Software

Version 1.0.0

Click the button below to visit the LCC7201B Birefringence Imaging System software page.

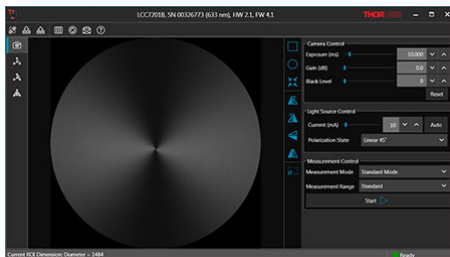
Features

- Standard and Low Noise Modes for Retardance Measurements
- Selectable Rectangular or Circular Region of Interest (ROI)
- Adjustable Dynamic Camera Settings (Gain, Exposure Time, Black Levels)
- Overexposure Detection
- Auto Adjustment of Light Source Level
- 1D, 2D, and 3D Measurement Result Displays
- Data Output in Binary, CSV, and Image (PNG and TIFF) Formats

The LCC7201B software includes two modes, Standard Mode and Low-Noise Mode, to measure a sample's retardance. Standard Mode provides a higher measurement rate with a lower signal-to-noise ratio, while Low Noise Mode provides a lower measurement rate with a higher signal-to-noise ratio. An exposure time of 10 ms is set as the default, which allows a measurement to be finished within 20 seconds in Standard Mode and 4 minutes in Low Noise Mode.

These two modes provide two ranges of measurement accuracy: Standard Retardance Range and Low Retardance Range. Standard Retardance provides a measurement accuracy of ± 10 nm for retardances in the 0 nm to 316 nm range and $\pm 3^\circ$ for azimuths over the entire measurement range. Low Retardance Range will improve the measurement accuracy to ± 1 nm for retardances in the 0 nm to 100 nm range and $\pm 1^\circ$ for azimuths over the entire measurement range. The minimum exposure time is 0.021 ms, and the maximum exposure time is 7330 ms.

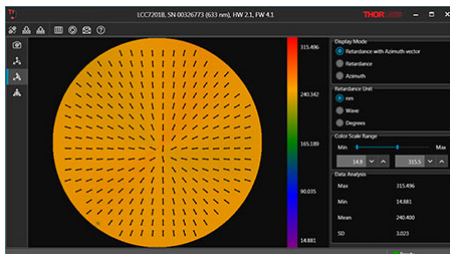
Below are screenshots from the included user interface, showing the different measurement display modes available. The Preview, 1D, 2D, and 3D views are all of an $m = 2$, zero-order vortex half-wave plate.



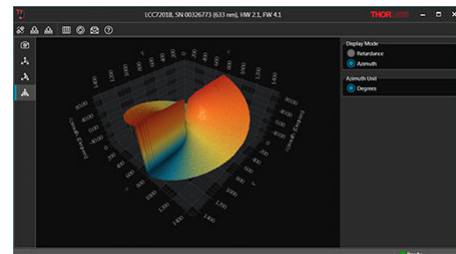
Click to Enlarge
Camera Preview Showing Included Test Target



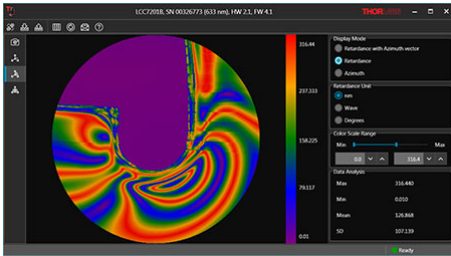
Click to Enlarge
1D View



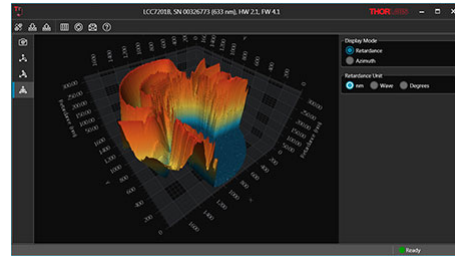
Click to Enlarge
Retardance with Azimuth Vector 2D View



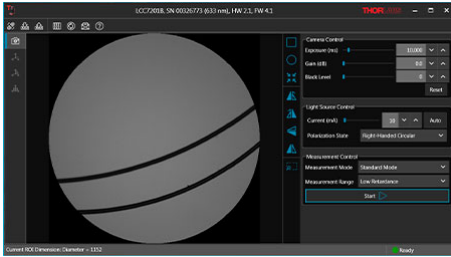
Click to Enlarge
Azimuth 3D View



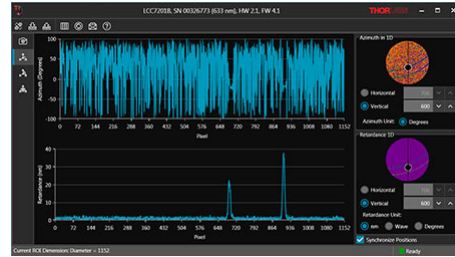
Click to Enlarge
Retardance 2D View



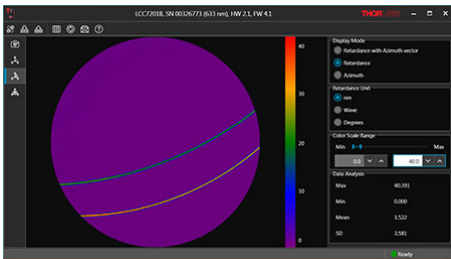
Click to Enlarge
Retardance 3D View



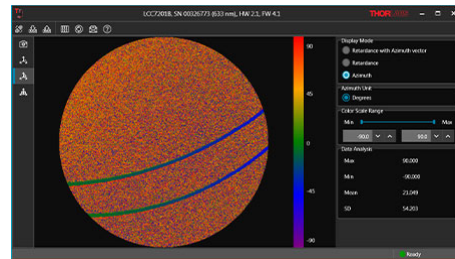
Click to Enlarge
Preview View



Click to Enlarge
1D View



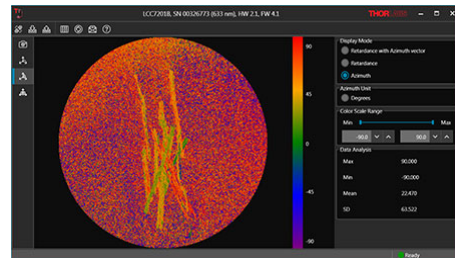
Click to Enlarge
Retardance 2D View



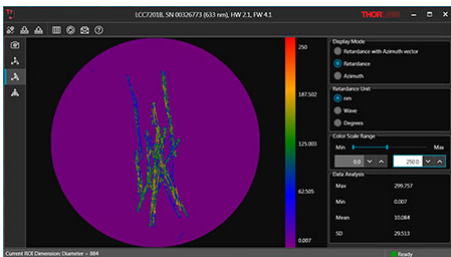
Click to Enlarge
Azimuth 2D View



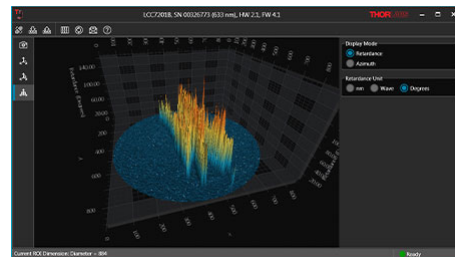
Click to Enlarge
Preview View



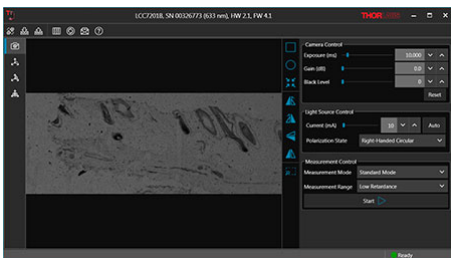
Click to Enlarge
Azimuth 2D View



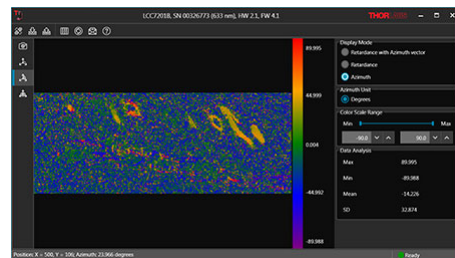
Click to Enlarge
Retardance 2D View



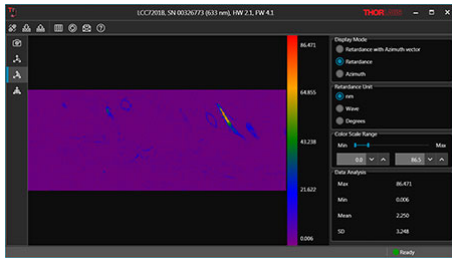
Click to Enlarge
Retardance 3D View



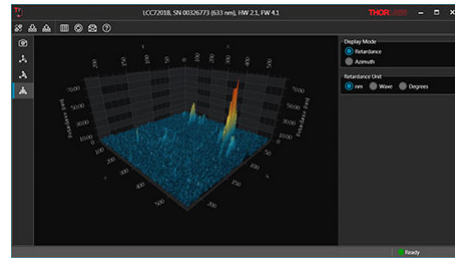
Click to Enlarge
Preview View



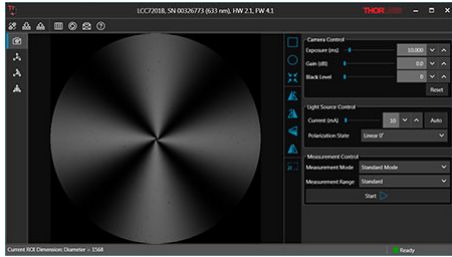
Click to Enlarge
Azimuth 2D View



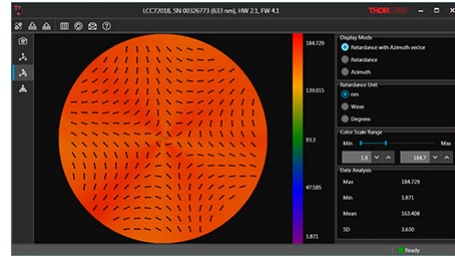
Click to Enlarge
Retardance 2D View



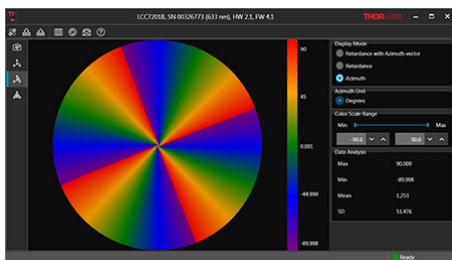
Click to Enlarge
Retardance 3D View



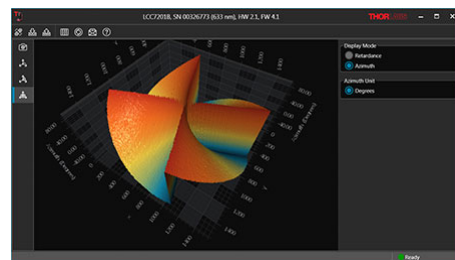
Click to Enlarge
Preview View



Click to Enlarge
Retardance with Azimuth Vector 2D View



Click to Enlarge
Azimuth 2D View



Click to Enlarge
Azimuth 3D View

W

PUBLICATIONS

Birefringence Imaging System Publications

Sergey I. Kudryashov, Pavel A. Danilov, Alexey E. Rupasov, Mikhail P. Smayev, Nikita A. Smirnov, Vladimir V. Kesaev, Andrey N. Putilin, Michael S. Kovalev, Roman A. Zakoldaev, and Sergey A. Gonchukov, "Direct laser writing regimes for bulk inscription of polarization-based spectral microfilters and fabrication of microfluidic bio/chemosensor in bulk fused silica," *Laser Physics Letters* 19, no. 6 (): 065602.

Megan Lynn Morgan, Craig Brideau, Wulin Teo, Andrew Vincent Capriarello, Peter K. Stys, "Label-free assessment of myelin status using birefringence microscopy," *Journal of Neuroscience Methods*, Volume 360, p. 109226 ().

Birefringence Imaging System

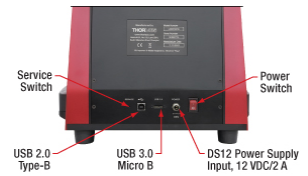


- ▶ Built-In 633 nm LED Light Source
- ▶ Measures Sample Retardance up to a Half-Wave (316 nm) and Azimuths up to $\pm 90^\circ$
- ▶ $\varnothing 20$ mm Field of View
- ▶ Windows[®]-Based Software Package Included (See *Software* Tab for Details)
- ▶ Included Sample Holders
 - ▶ MLS203P2 Sample Holder
 - ▶ Sample Holder Adapters for $\varnothing 1/2$ ", $\varnothing 1$ ", and 2" x 2" Optics

The LCC7201B Birefringence Imaging System measures stress- and strain-induced birefringence in flat samples for a variety of applications ranging from materials and biological research to product assurance (see the *Applications* tab for examples).

The system includes a rigid stage and adapters to hold $\varnothing 1/2$ ", $\varnothing 1$ ", and 2" x 2" samples. For a wider variety of sample shapes and applications requiring motorized scanning or rotation, additional accessories are available below.

In addition to the sample holder adapters, the LCC7201B system comes with a DS12 12 VDC power supply, region-specific power cord, USB Drive with Software and Manual, USB 2.0 Type-A to Type-B Cable, USB 3.0 A to Micro B Cable and a R2L2S1B Birefringent NBS 1963A Resolution Target. A Windows[®]-based computer (not included) is required for operation.

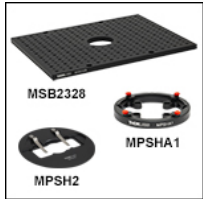


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The back panel of the LCC7201B provides USB 2.0 Type-B and USB 3.0 Micro B ports for connecting the system to a PC, a service switch, a power supply input, and a power switch.

Part Number	Description
LCC7201B	Customer Inspired! Birefringence Imaging System

Sample Mounting Accessories - Optional



- ▶ Breadboards Provide Flexible Mounting Platform
- ▶ Adapter for Holding Recording Chambers and Slide Holder Inserts
- ▶ Slide Holder Insert for Holding Microscope Slides

For samples requiring rotation or greater flexibility in mounting, the MSB2328(/M) Aluminum Breadboards, MPSHA1 Slide Holder Insert and Recording Chamber Adapter, and aluminum (Item # MPSH2) or stainless steel (Item # MPSH2SS) Slide Holder Inserts are available for use with the LCC7201B birefringence imaging system.

The MSB2328(/M) breadboards have four M5 counterbored mounting holes positioned to allow the breadboards to be mounted in the LCC7201B system. The 1.97" (50.0 mm) central aperture of the breadboards is aligned with the optical axis of the imaging system.

The MPSHA1 adapter is designed for convenient mounting of a recording chamber in the optical path of an LCC7201B system with an integrated MSB2328(/M) breadboard. The adapter can be attached to the breadboard with four 1/4"-20 (M6) screws. The top platform has a Ø110 mm opening with a 5 mm wide lip and four clamps to securely mount a recording chamber in the optical path. Alternatively, the MPSH2 and MPSH2SS slide holder inserts are available for mounting a microscope slide (up to 26.0 mm x 76.2 mm). The MPSH2 insert has a nonmagnetic aluminum base plate while the MPSH2SS insert is stainless steel, which is ideal in setups where a magnetic surface is needed.

For custom plate inserts, please contact Tech Support.

Breadboard Specifications									
Item #	Top Surface Dimensions	Breadboard Thickness	Central Aperture Diameter	Hole Threading and Spacing	Distance from Edge to First Hole	Number of Counterbored Holes	Material	Finish	Flatness
MSB2328	9.06" x 11.02"	0.37"	1.97"	8-32 Taps with 1/2" Spacing and 1/4"-20 Taps with 1" Spacing ^a	0.51" from the Short Edges and 0.53" from the Long Edges	Four M5 ^b	Aluminum Plate	Matte Black Anodized	±0.010" (0.25 mm) over Entire Surface
MSB2328/M	230 mm x 280 mm	9.5 mm	50.0 mm	M4 Taps with 12.5 mm Spacing and M6 Taps with 25 mm Spacing ^a	15 mm on All Sides	Four M5 ^b	Aluminum Plate	Matte Black Anodized	±0.010" (0.25 mm) over Entire Surface

- Note that the 8-32 (M4) and 1/4"-20 (M6) grids overlap.
- Aligned with Taps in LCC7201B Birefringence Imaging System

Part Number	Description
MSB2328/M	Customer Inspired! Aluminum Breadboard for LCC7201B, 230 mm x 280 mm x 9.5 mm, Ø50 mm Access Hole, M4 and M6 Taps
MPSHA1	Customer Inspired! Slide Holder Adapter Insert
MPSH2	Low-Profile Slide Holder Insert for Recording Chamber Holder, Aluminum
MPSH2SS	Low-Profile Slide Holder Insert for Recording Chamber Holder, Stainless Steel
MSB2328	Customer Inspired! Aluminum Breadboard for LCC7201B, 230 mm x 280 mm x 9.5 mm, Ø50 mm Access Hole, 8-32 and 1/4"-20 Taps

High-Speed Motorized XY Scanning Stages



The MLS203-1 XY scanning stage can be used as a drop-in replacement for the manual stage found on the LCC7201B system and provides motorized XY positioning of microscopy samples. We also offer a range of slide holders to allow the positioning of standard microscope slides, multiwell plates, petri dishes, and mounted metallurgical specimens.

The recommended controller for the MLS203 stage is the BBD302 dual-axis Brushless DC Motor Controller. An APT GUI interface ships with each controller. The stage is also compatible with μ Manager, which is open-source software for controlling microscopes and peripherals, and Molecular Devices' MetaMorph, which is software that provides automated acquisition, control, and image analysis.

For more details on the MLS203-1 stage, accessories, and use with the BBD302 controller, please see the full presentation for our high-speed motorized XY scanning stages.

Key Specifications ^a	
Travel Range	110 mm x 75 mm (4.3" x 2.95")
Velocity (Max)	250 mm/s
Acceleration (Max)	2000 mm/s ²
Bidirectional Repeatability	0.25 μ m
Unidirectional Repeatability	0.25 μ m
Horizontal Load Capacity (Max)	1.0 kg (2.2 lb)
Min Achievable Incremental Movement	0.1 μ m
Home Location Accuracy	0.25 μ m
Absolute On-Axis Accuracy	<3 μ m

- For complete specifications, see the *Specs* tab on the main web presentation.

Part Number	Description
MLS203-1	Fast XY Scanning Stage

Алматы (7273)495-231
Ангарск (3955)60-70-56
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
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Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Коломна (4966)23-41-49
Кострома (4942)77-07-48
Краснодар (861)203-40-90
Красноярск (391)204-63-61
Курск (4712)77-13-04
Курган (3522)50-90-47
Липецк (4742)52-20-81

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Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
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