

# New Scale Technologies

## M3-LS-3.4-15 Linear Smart Stage

High load, long travel micro positioning stage features built-in controller

- **All-in-one microstage - no separate controller**
  - Direct high-level command interface (I<sup>2</sup>C or SPI)
  - USB adapter enables direct connection to PC
- **Small:** < 32x32x11 mm *including controller*
- **Absolute encoding:** high repeatability, no homing
- **Low power:** 6 VDC, ~5 W (only when moving)
  - For integration into battery powered devices
- **Long stroke:** 15 mm
- **High force:** 1 N (~100g load vertical, ~200g horizontal)
- **High stiffness** with crossed roller bearing design

### Absolute positioning, quiet operation

The **M3-LS-3.4-15** is a direct-drive precision piezoelectric micro stage with embedded controller, designed for integration into compact instruments. With long travel and 100 gram vertical load capacity, it has 0.5 μm resolution for precise, repeatable positioning of optics, probes, sensors and more.

Absolute encoding means there is no need to home the stage on power-up, eliminating errors and disruptions in processes and experiments. It has high stiffness with no gears or backlash.

With quiet operation and no high voltage, M3-LS Smart Stages are superior to piezo inertia (stick-slip) stages especially for near-patient instruments and wearable devices.

### Embedded controller means "all-in-one" simplicity for smallest size, fastest integration

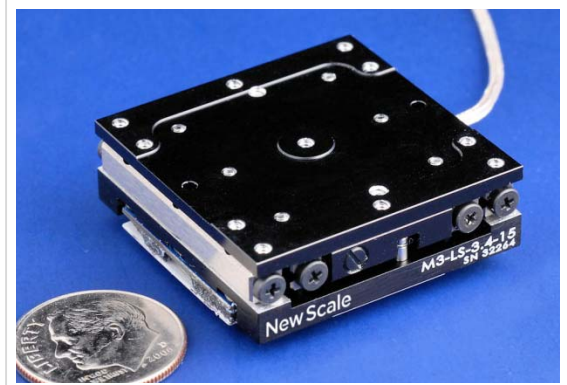
All drive electronics are integrated right into the stage housing to give product designers the smallest system size and fastest, easiest integration into miniature OEM systems.

The M3-LS-3.4-15 Smart Stage accepts simple high-level motion commands directly via standard serial interface (I<sup>2</sup>C or SPI) or via USB with adapter. Control multiple stages from one New Scale Pathway™ software screen. Or use the intuitive script generator to create command sequences for automated operation.

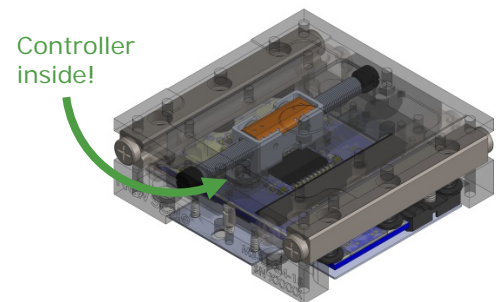
### Precision motion in battery-powered systems

The M3-LS-3.4-15 Linear Smart Stage can be powered by standard batteries or any low-cost DC supply. The internal SQUIGGLE® motor holds position with no power. The embedded controller's sleep mode further reduces power consumption.

SMALL, PRECISE, SMART ... IN MOTION



The M3-LS-3.4 Linear Smart Stage has a built-in controller for small system size and fast integration into miniature instruments.



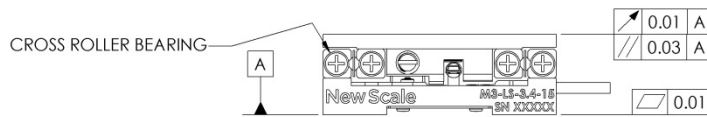
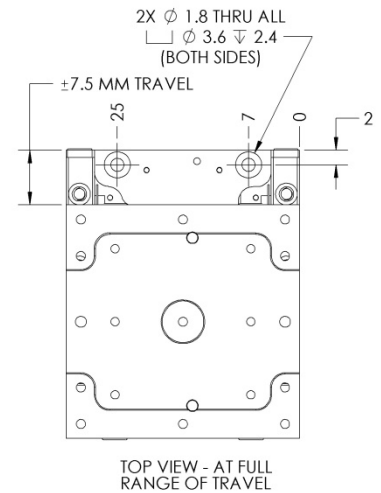
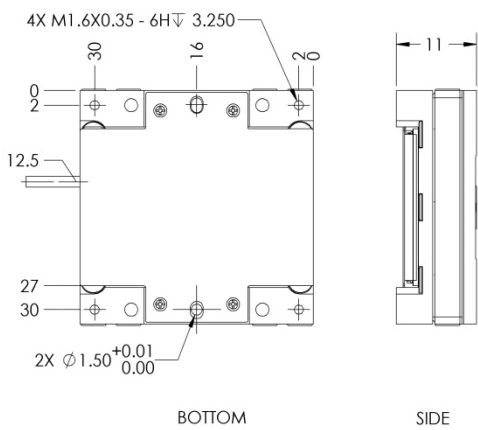
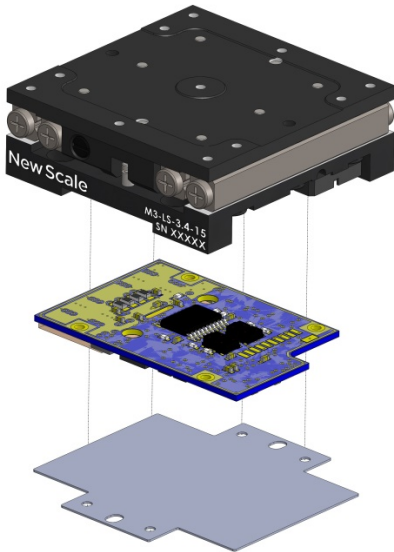
### APPLICATIONS

- Hand-held and battery-powered instruments
- Biomedical devices
- Miniature/embedded microscopes
- Spectroscopy
- Precision opto-mechanical alignment
- Micro manipulation

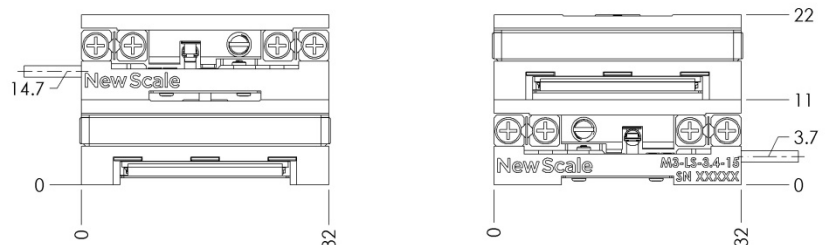
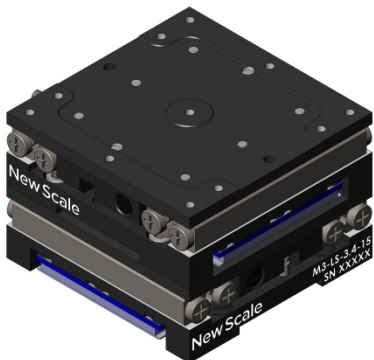


Stages are easily assembled into XY and XYZ configuration for microscopy applications requiring small size and battery-powered operation.

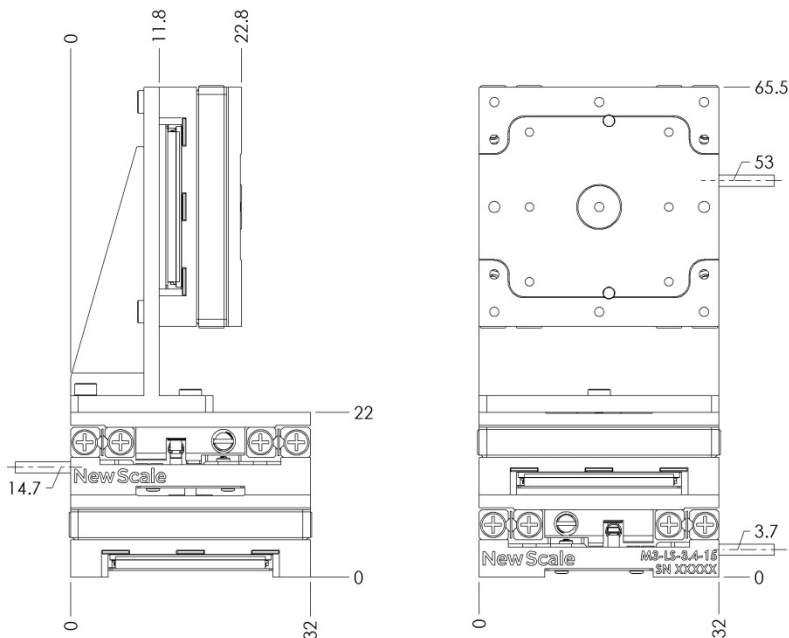
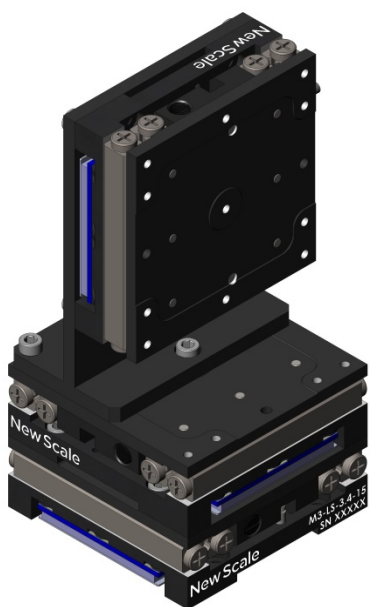
M3-LS-3.4-15 Linear Smart Stage



M3-LS-3.4-15 Linear Smart Stage 2-axis configuration (XY)



M3-LS-3.4-15 Linear Smart Stage 3-axis configuration (XYZ)



Specifications

MODEL	M3-LS-3.4-15
<b>Travel Range (Stroke)</b>	15 mm
<b>Dimensions</b>	32 x 32 x 11 mm
<b>Mass (includes controller)</b>	30 grams (Smart Stage) 36 grams (Smart Stage + cable + connector)
<b>Moving mass (vertical) (note 1)</b>	100 grams
<b>Moving mass (horizontal) (note 1)</b>	200 grams
<b>Force (operating)</b>	1 N
<b>Speed (at operating force)</b>	> 4 mm/s
<b>Duty cycle</b>	50% max recommended
<b>Closed-loop performance</b>	
<b>Resolution</b>	0.5 μm with absolute encoding
<b>Bi-directional repeatability</b>	< 5 μm
<b>Accuracy</b>	< 20 μm
<b>Input Power (note 2)</b>	6 V DC   5 W typical at 4mm/s, 1 N load, closed-loop   < 0.2 W quiescent
<b>Mechanical stage</b>	
<b>Static parallelism</b>	< 30 μm
<b>Runout</b>	< 10 μm
<b>Pitch and yaw</b>	< 1 mrad
<b>Absolute maximum load</b>	10 N
<b>Environment</b>	
<b>Relative humidity</b>	< 70%
<b>Operating temperature</b>	+5 °C to +40 °C
<b>Storage temperature</b>	-40 °C to +85 °C
<b>Compliance</b>	CE / RoHS
<b>Controller</b>	Integrated into the smart stage
<b>Control interface</b>	Via USB adapter from PC or directly to I <sup>2</sup> C or SPI serial interface

Note 1: Higher mass is possible but will affect performance and lifetime.  
Note 2: Power depends on input voltage, speed and load.

**New Scale Pathway™** software included in the developer's kit provides control of multiple stages from one screen, and an intuitive scripting tool for code development.

Ordering Information

Order Developer's Kits from distributors. Contact New Scale for information about configuring multi-axis systems and to discuss volume pricing.

MODEL	Description
<b>DK-M3-LS-3.4-15</b>	<b>Developer's kit, 15 mm travel</b> <ul style="list-style-type: none"> <li>One M3-LS-3.4-15 linear smart stage with integrated controller</li> <li>USB adapter and breakout board</li> <li>Power supply</li> <li>New Scale Pathway software</li> <li>Accessories</li> </ul>
<b>M3-LS-3.4-15</b>	<b>Linear smart stage (15 mm travel)</b> with integrated controller and cable

## M3-LS-U2-8 Linear Smart Stage All-In-One Motion Module

- **Smart Stage:** Embedded controller, no separate electronics
  - Operate directly using I<sup>2</sup>C or SPI ASCII commands **-or-**
  - Evaluate with Pathway™ PC Software and USB adapter
- **Cost-effective, long-life:** For high-volume production
- **Small size:** 32 x 32 x 10 mm
- **High resolution:** 0.5 μm with absolute encoding
- **High speed:** 35 mm/s
- **Long stroke:** 8 mm
- **Power:** 5 V DC input, ~ 3.2 W peak when moving
- **High repeatability** (± 2 μm typical)

### Precision, stability and ease of use for high volume product applications

The M3-LS-U2 Linear Smart Stage is a direct-drive, high-precision micro stage built for fast, simple integration into miniature OEM systems. All drive and control functions are embedded into the compact stage assembly – **no external electronics** are needed!

The stage drive is a UTAF2 piezo motor combined with a 0.5 μm resolution sensor for precise, repeatable positioning of optics, probes, sensors and more. The piezo motor operates at 5 VDC. No high voltage boost is needed. **Absolute encoding** removes the need to home the stage on power-up, eliminating errors and disruptions in processes and experiments.

At 35 mm/sec it is **7x faster** than other M3 Smart Stages.

The anodized aluminum stage uses linear ball bearing races **with very low uniform friction**. The bearings directly support the motor preload which creates a stable, precise and zero clearance guide system. The base is the maximum footprint required for installation in your product because the carriage moves within the total length of the base.

**This smart stage is designed for long life and is ideal for embedding precision motion into high-volume products.**

### Digital Control and Pathway™ Software

The M3-LS-U2-8 Smart Stage can be driven directly via standard I<sup>2</sup>C or SPI serial protocols. The smart stage microprocessor accepts ASCII high-level motion instructions.

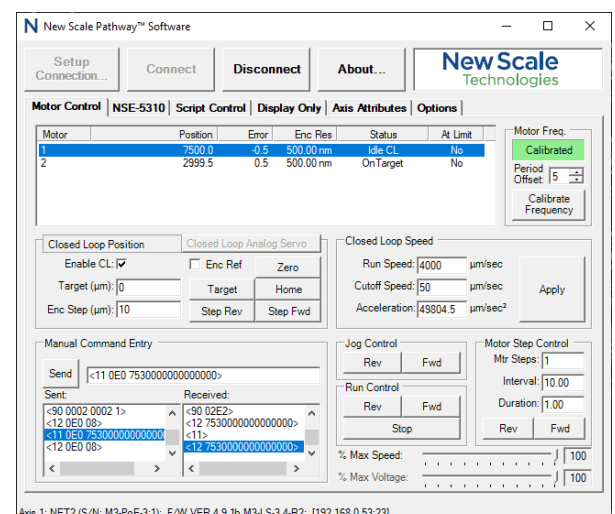
New Scale Pathway™ software and USB adapter enable PC control. Access all stage capabilities including settings, motion commands, performance diagnostics, and parameters stored in non-volatile memory. Use the intuitive script generator to create command sequences for automated operation.



**The M3-LS-U2-8 Linear Smart Stage** is an ultra-compact positioning stage with sub-micrometer resolution and absolute encoding. *All electronics are built into the stage* for simple system integration. This model features power-off hold, high speed, and is cost-effective for high volume manufacturing.

### APPLICATIONS

- DNA sequencing instruments
- Point-of-care diagnostic systems
- Portable spectroscopy instruments
- Biomedical probing & sampling
- Laser beam steering
- Miniature camera systems
- And much more



**New Scale Pathway™ Software** with easy-to-use graphical interface enables PC control for evaluation and system development. Control multiple smart stages from one PC screen, or develop your own code using the intuitive scripting tool.

## Specifications

M3-LS-U2-8 Linear Smart Stage Specifications	
<b>MODEL</b>	<b>M3-LS-U2-8</b>
<b>Stroke</b>	8 mm
<b>Dimensions</b>	32 x 32 x 10 mm <i>including controller</i>
<b>Mass of Smart Stage</b> (Note 1)	15 grams <i>including controller</i>
<b>Payload mass (vertical)</b> (Notes 2, 3)	≤ 5 grams recommended
<b>Payload mass (Sideways and horizontal)</b> (Notes 2, 3)	≤ 40 grams recommended
<b>Holding Force</b>	≥ 0.3 N
<b>Force (bidirectional)</b>	≥ 0.1 N
<b>Speed</b>	35 mm/sec
<b>Closed-loop performance</b>	
<b>Resolution</b>	0.5 μm with absolute encoding
<b>Bi-directional repeatability</b>	± 5 μm
<b>Accuracy</b>	± 10 μm
<b>Input Quiescent Power</b>	~ 0.35 W
<b>Input Power (peak)</b>	~ 3.2 W
<b>Input Voltage</b>	5 V DC (4.75 V to 5.5 V)
<b>Mechanical stage</b>	
<b>Static parallelism</b>	< 30 μm
<b>Runout</b>	< 10 μm
<b>Pitch, yaw, and roll</b>	< 1 mrad
<b>Absolute maximum loads</b>	See chart on page 3
<b>Environment</b>	
<b>Relative humidity</b>	< 70%
<b>Operating temperature</b> (Note 4)	-30 °C to +70 °C
<b>Storage temperature</b>	-40 °C to +80 °C
<b>Lifetime</b> (Note 5)	50 km
<b>Compliance</b>	RoHS; CE pending
<b>Drive electronics</b>	Integrated into the smart stage
<b>Control interface</b>	Directly via I <sup>2</sup> C or SPI interface. Indirectly via USB adapter to PC.
<b>Standard Cable Length</b>	100 mm (90 mm to edge of stage)
<b>Maximum Cable Length</b>	600 mm, > 250 mm requires reduced clock rate

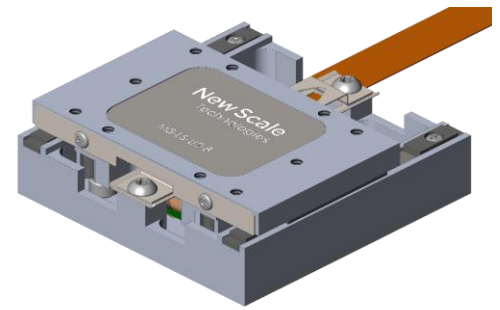
Note 1: Moving mass of the stage carriage without payload is ~ 6 grams.

Note 2: Higher mass is possible but will affect performance and lifetime.

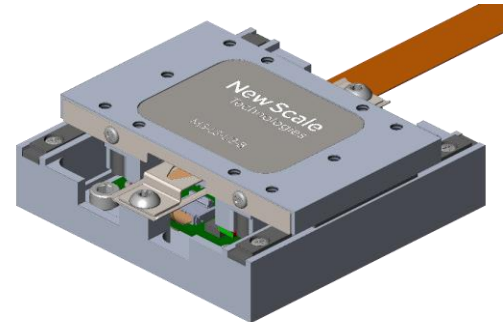
Note 3: Torque due to gravity of the payload calculated from center point (see the coordinates in the next page) on the carriage is recommended to be within 1.5 Nm. Also recommend center of gravity of the payload above the carriage surface to be ≤ 15 mm.

Note 4: Speed and force reduced at lower temperatures within the range.

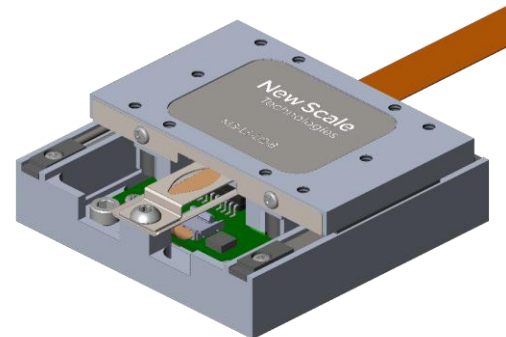
Note 5: Tested horizontally, with 20 grams load offset 8.75 mm at reverse position.



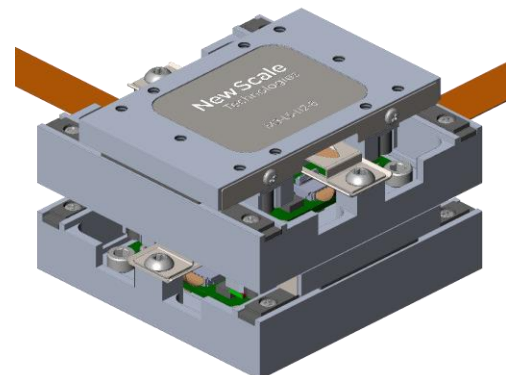
**Forward Position**



**Center Position**

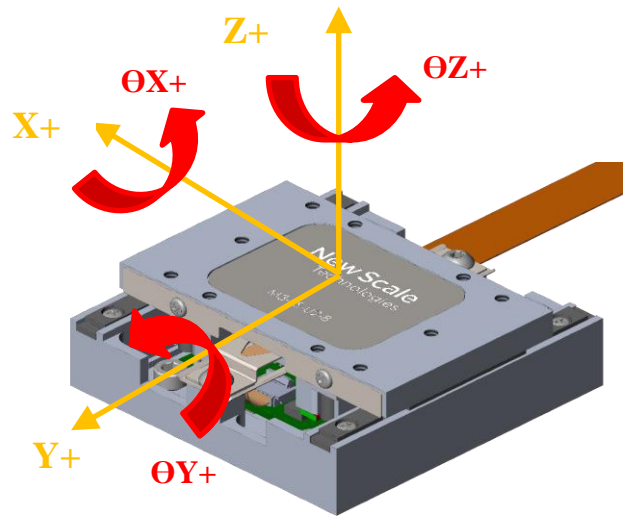


**Reverse Position**



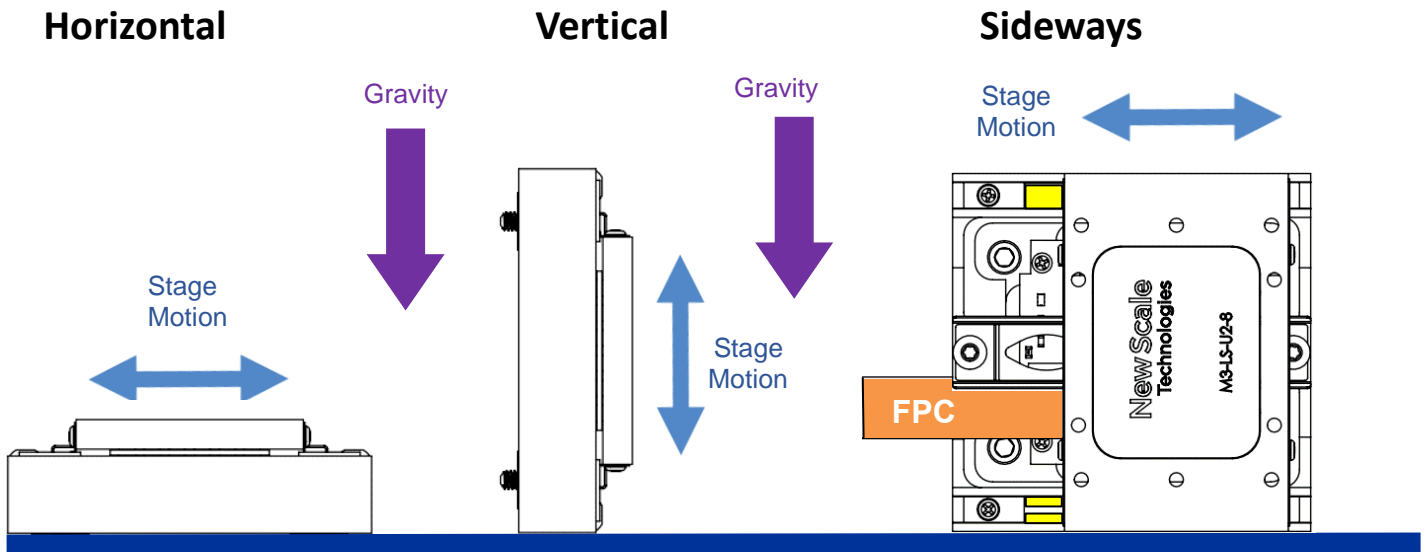
**X-Y Assembly (Centered)**

Single Stage Load Capacity M3-LS-U2-8	
Direction	Absolute Maximum Load <sup>(1)</sup>
X+	2 N
X-	2 N
Y+	2 N
Y-	2 N
Z+	2 N
Z-	10 N
$\theta_x$ (+/-)	10 N-mm
$\theta_y$ (+/-)	10 N-mm
$\theta_z$ (+/-)	10 N-mm



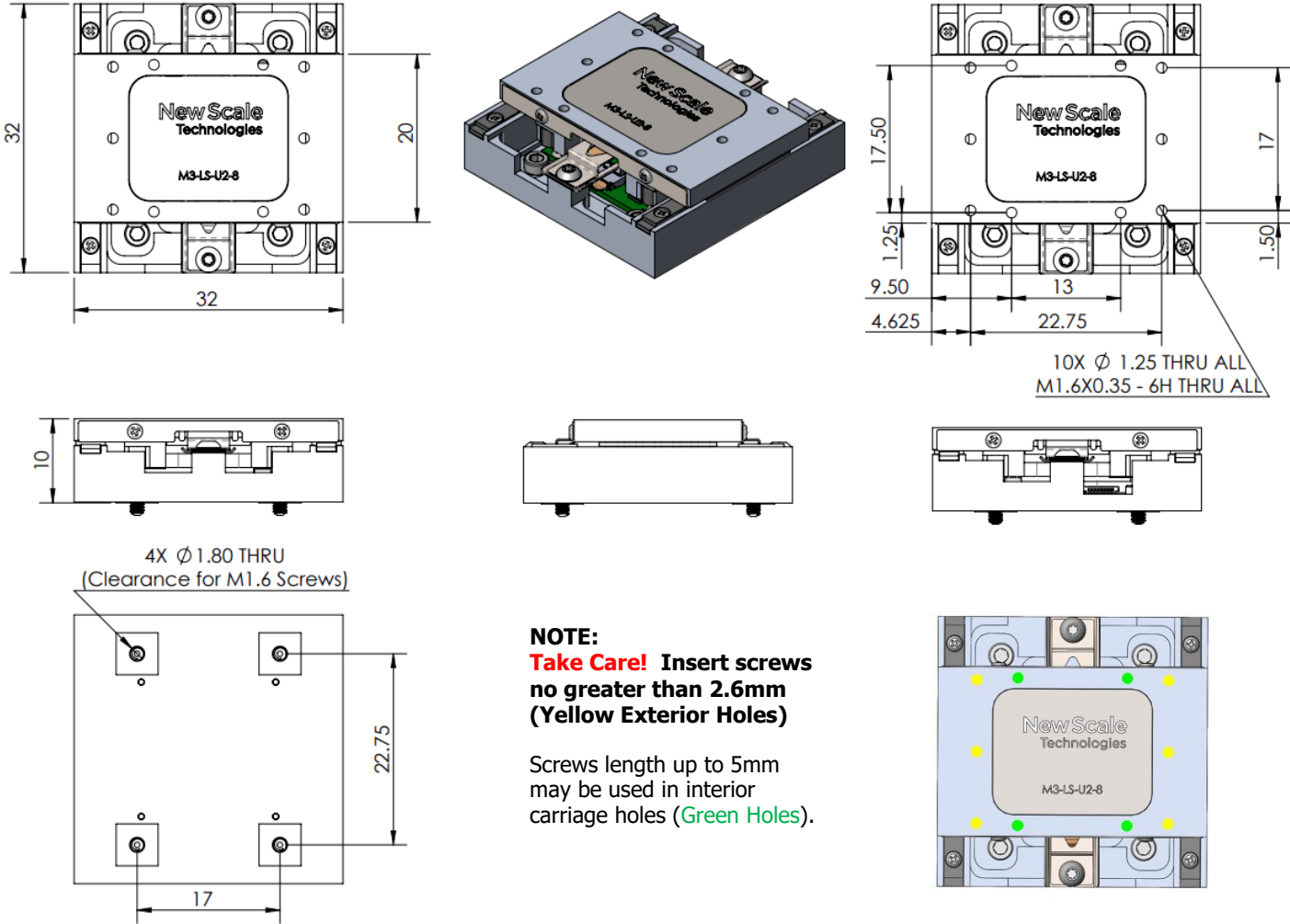
1. Non-operation (without damage)

### Single Stage Orientation Definitions



Note: Sideways Orientation Requires Flat Bearing Race Located at Top of Stage (As Pictured Above)

# Single Stage Dimensions



## Developer's Kits

M3-LS developer's kits provide easy evaluation and prototyping of one-axis M3-LS Linear Smart Stage systems. Developer's kits are available from New Scale and select reps and distributors.

Contact New Scale regarding additional stages and flex cables for use with the developer's kit to create more complicated systems, or to inquire about volume pricing.

Developer's Kit	Description
DK-M3-LS-U2-8	<p><b>M3-LS-U2 Developer's Kit</b></p> <ul style="list-style-type: none"> <li>• One M3-LS-U2-8 Linear Smart Stage</li> <li>• USB-I2C/SPI adaptor PCB</li> <li>• Two Straight Flex Cables (100mm &amp; 250 mm)</li> <li>• USB Extension Cable (Micro B)</li> <li>• Mounting Screws and wrench</li> <li>• New Scale Pathway Software</li> <li>• Quick Start Guide</li> </ul>



## M3-LS Linear Smart Stage *All-in-one USB micro stage*

- **All-in-one smart module:** no separate electronics
  - Runs directly from USB adapter
  - USB, I<sup>2</sup>C or SPI interface
- **Small size:** less than 29 x 20 x 10 mm
- **High resolution:** 0.5  $\mu$ m
- **Absolute encoding:** no homing
- **Long stroke:** 6 mm
- **Low power use:** 3.3 V DC input, < 0.75 W when moving
- **High repeatability** and low runout

### Unmatched precision, stability and ease of use

The M3-LS Linear Smart Stage is a direct-drive, high-precision micro stage built for fast, simple integration into miniature OEM systems. All drive electronics are integrated right into the compact stage housing – no external board needed!

The piezo-driven stage has 0.5  $\mu$ m resolution for precise, repeatable positioning of optics, probes, sensors and more. **Absolute encoding** removes the need to home the stage on power-up, eliminating errors and disruptions in processes and experiments.

The unique linear slide **has uniform and very low friction**, even under high direct loads and side loads. Six ball bearings in a kinematic “V” guide-way eliminate cage creep and friction spike problems common in other micro stages.

The M3-LS has high stiffness and lateral stability, no backlash, and less than 10  $\mu$ m runout over its full travel range.

### Direct input via USB, I<sup>2</sup>C or SPI

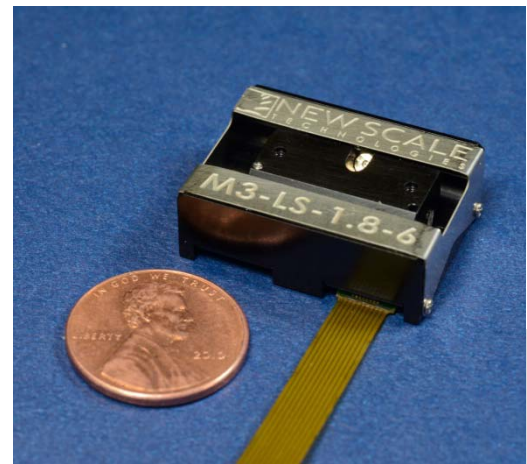
The stage accepts simple high-level motion commands via standard serial interface. Use the USB adapter to power and control multiple stages from a single New Scale Pathway™ software screen. Use the intuitive script generator to easily create command sequences for automated operations.

The M3-LS stage can also be driven directly from your system processor via standard I<sup>2</sup>C or SPI interface.

### Low power for hand-held systems

The M3-LS Linear Smart Stage needs only 3.3 V DC and uses less than 0.75 W typical when moving. It can be powered by USB or standard batteries. The integrated piezo motor holds position without using power. The internal electronics can be switched to sleep mode for extreme low-power applications.

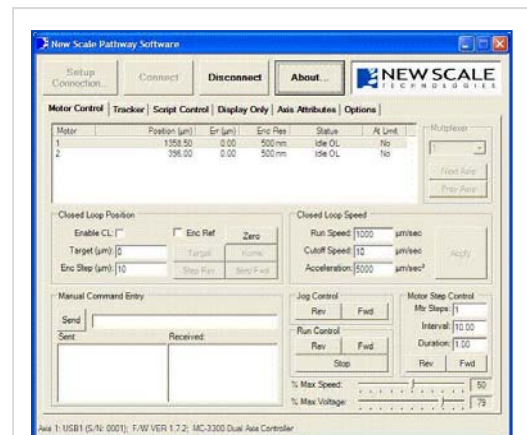
SMALL, PRECISE, SMART ... IN MOTION



The M3-LS Linear Smart Stage is an ultra-compact positioning stage with high resolution, low power use and absolute encoding. All electronics are built into the stage for simple system integration. Control the stage using high-level motion commands via USB, I<sup>2</sup>C or SPI interface.

### APPLICATIONS

- Hand-held and mobile instruments
- Battery-powered instruments
- Portable medical devices
- Miniature microscopes
- Spectroscopy
- Micro assembly
- Biomedical probing & sampling
- High-resolution tuning systems
- Targeting systems
- UAV/UGV controls and optics
- Miniature camera systems



New Scale Pathway™ software with easy-to-use graphical interface. Control multiple smart stages from one PC screen, or develop your own code using the intuitive scripting tool.



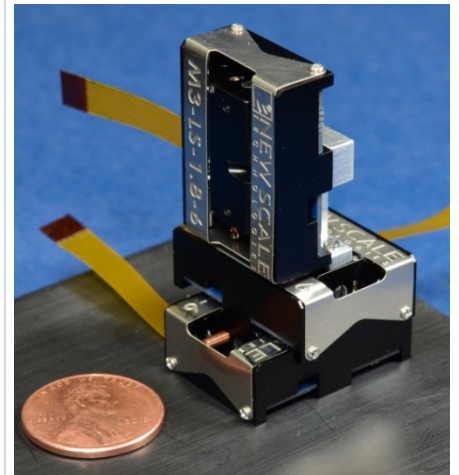
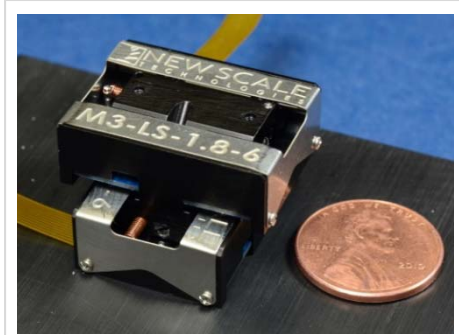
## Specifications

M3-LS Linear Smart Stage specifications	
<b>MODEL</b>	<b>M3-LS-1.8-6</b>
<b>Stroke</b>	6 mm
<b>Dimensions</b>	29 x 20 x 9.5 mm
<b>Mass of Smart Stage</b>	8.4 grams
<b>Moving mass (vertical) (note 1)</b>	≤ 10 grams recommended
<b>Moving mass (horizontal) (note 1)</b>	≤ 20 grams (offset < 10 mm) recommended
<b>Force (operating)</b>	0.2 N
<b>Speed (at operating force)</b>	5 mm/s
<b>Closed-loop performance</b>	
<b>Resolution</b>	0.5 μm with absolute encoding
<b>Bi-directional repeatability</b>	< 5 μm
<b>Accuracy</b>	< 20 μm
<b>Input Power</b>	3.3 V DC < 0.75 W typical at 5 mm/s, closed-loop (2 W max.)
<b>Mechanical stage</b>	
<b>Static parallelism</b>	< 30 μm
<b>Runout</b>	< 10 μm
<b>Pitch and yaw</b>	< 1 mrad
<b>Absolute maximum load</b>	10 N
<b>Environment</b>	
<b>Relative humidity</b>	< 70%
<b>Operating temperature (note 2)</b>	-30 °C to +70 °C
<b>Storage temperature</b>	-40 °C to +80 °C
<b>Lifetime (note 3)</b>	>10 million random moves while not exceeding 1.2 km total travel. See note 3.
<b>Compliance</b>	CE / RoHS
<b>Drive electronics</b>	Integrated into the smart stage
<b>Control interface</b>	Via USB adapter from PC or directly to I <sup>2</sup> C or SPI serial interface

Note 1: Higher mass is possible but will affect performance and lifetime.

Note 2: Speed and force reduced at lower temperatures within the range.

Note 3: Corresponds to 10 million moves with an average random move of 120 μm. Lifetime depends on the application and use case. Please consult the factory to discuss your specific system design.

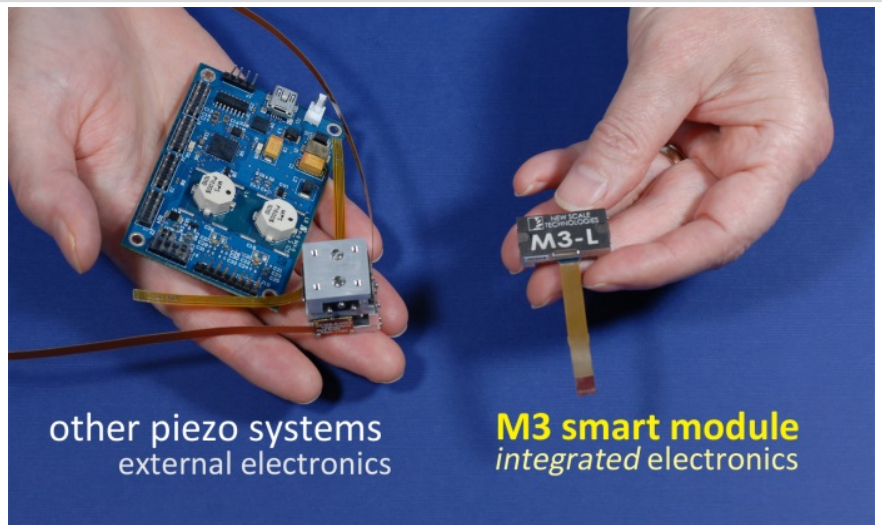


**Multi-axis systems:** Create miniature X-Y or X-Y-Z smart stages using two or three M3-LS Linear Smart Stages.

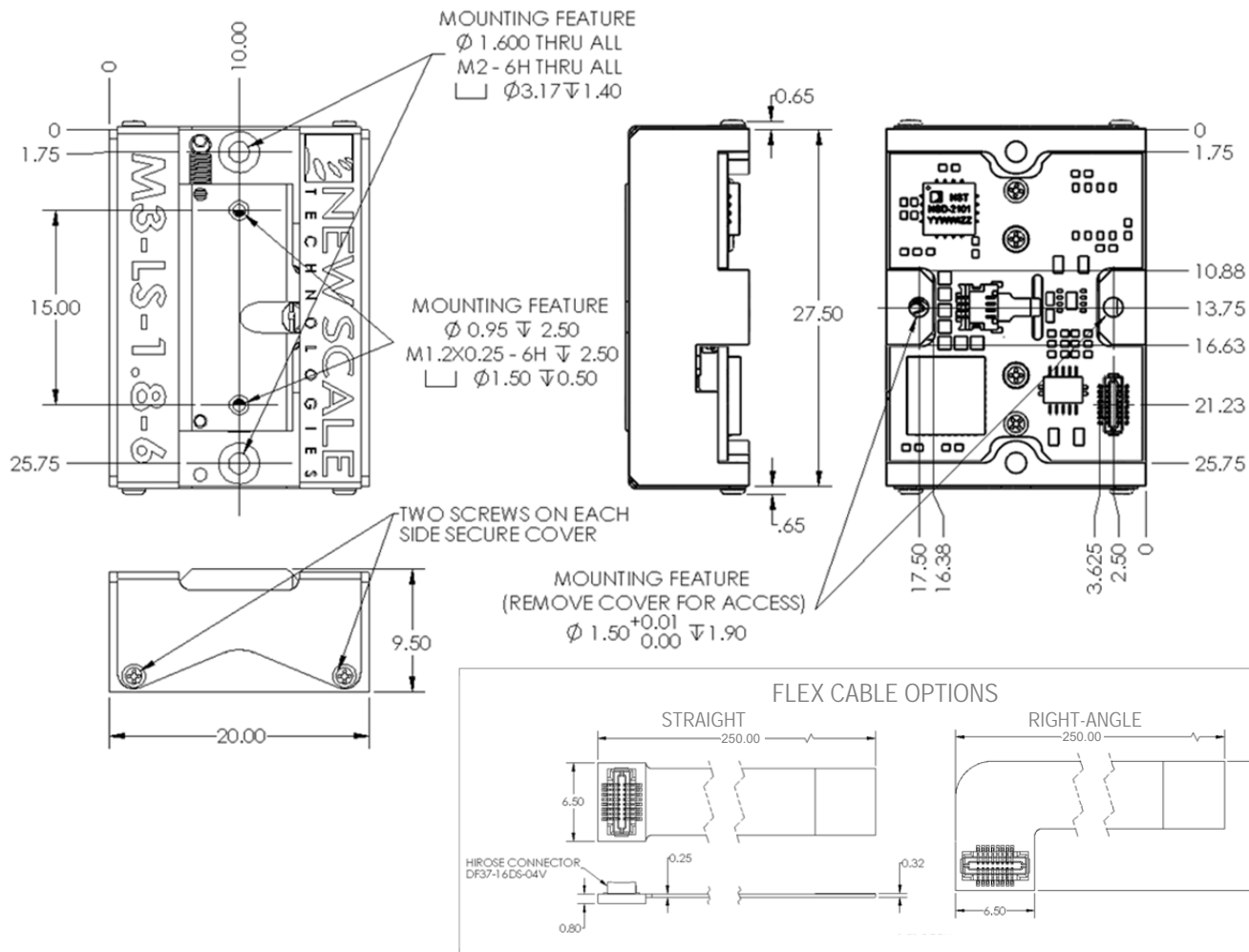
### M3 smart module platform

The M3-LS Linear Smart Stage is built on New Scale's M3 micro-mechatronic "smart module" platform, integrating a patented piezoelectric SQUIGGLE® micro motor, precision mechanical guide system, position sensor, microprocessor, and drive electronics into one tiny package.

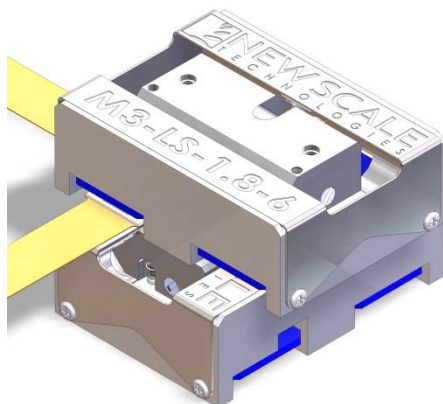
Eliminating the need for external controllers, M3 smart modules offer the smallest system size and easiest integration into OEM systems. They operate on 3.3 V DC input, accept high-level motion commands, and hold position with power off.



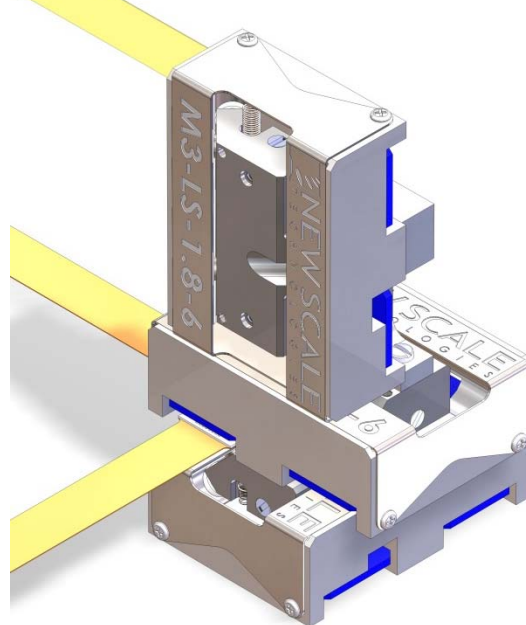
**M3-LS-1.8-6 Linear Smart Stage**



**M3-LS-1.8-6 X-Y configuration**

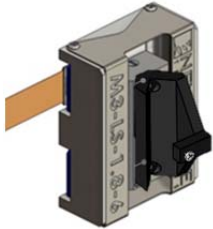


**M3-LS-1.8-6 X-Y-Z configuration**

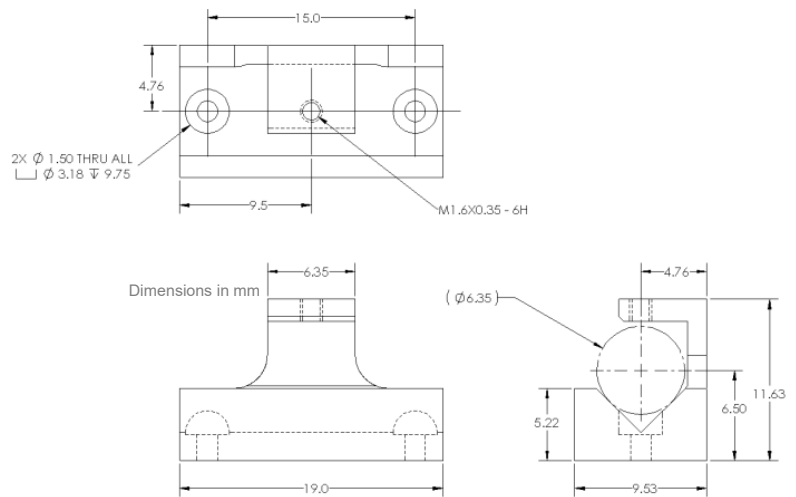


## M3-LS for electrophysiology

With its high resolution, repeatability and lateral stability, the M3-LS makes an ideal backlash-free motorized micro drive for electrode positioning in chronic recording. The EP-clamp-6.35 pipette holder clamp facilitates easy removal and replacement of the pipette holder in the recording chamber. Low EMI ensures non-interference with electrode recording.



## EP-clamp-6.35

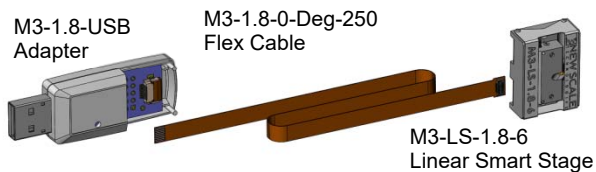


## Developer's Kits

M3-LS developer's kits provide easy evaluation and prototyping of one-axis M3-LS Linear Smart Stage systems. Developer's kits are available from New Scale and select reps and distributors.

Contact New Scale regarding additional stages, brackets and flex cables for use with the developer's kit to create 2-axis and 3-axis systems, or to inquire about volume pricing or customization of M3-LS smart stage systems.

### Developer's Kit DK-M3-LS-1.8-6



## Ordering information

Developer's Kit	Description
<b>DK- M3-LS-1.8-6</b>	<b>M3-LS-1.8 Developer's Kit with 6 mm travel</b> <ul style="list-style-type: none"> <li>One M3-LS-1.8-6 Linear Smart Stage</li> <li>One M3-1.8-USB Adapter</li> <li>M3-1.8-0-Deg-250 straight flex cable, 250 mm long</li> <li>M3-1.8-90-Deg-250 angled flex cable, 250 mm long</li> <li>New Scale Pathway™ Software on separate USB</li> <li>Mounting hardware kit</li> </ul>
Additional Components	Description
<b>M3-LS-1.8-6</b>	<b>Linear Smart Stage with 6 mm travel</b> Stage, no cables
<b>M3-1.8-0-Deg-250</b>	<b>Flex cable for M3-LS stage</b> Straight, 250 mm length
<b>M3-1.8-90-Deg-250</b>	<b>Flex cable for M3-LS stage</b> Right angle at one end, 250 mm length
<b>M3-1.8-Y-Bracket</b>	<b>Bracket for Y-axis smart stage</b> Affixes Y-axis smart stage to X-axis smart stage
<b>M3-1.8-Z-Bracket</b>	<b>Bracket for Z-axis smart stage</b> Affixes Z-axis smart stage to X- or Y-axis smart stage
<b>EP-clamp-6.35</b>	<b>Pipette holder clamp</b> Suitable for pipette holders with body dia. 0.25" (6.35mm) e.g. models 67944x from A.M. Systems

## Additional information

Visit the website to download STEP files, the integration guide and command and control reference guide for M3-LS Linear Smart Stages: <http://www.newscaletech.com/downloads/software-cad-manuals.php> (registration required).