

# M-403 Linear Stage Series, Leadscrew-Type

## High-Resolution Leadscrew-Driven Translation Stages with Stepper and DC-Motors



M-403 linear stage versions (from left): the M-403.1PD, M-403.2PD, M-403.4PD, M-403.6PD and M-403.8PD provide travel ranges from 25 to 200 mm.

- For Cost-Sensitive Applications
- Modular System M-403, M-404, M-413, M-414
- Preloaded Precision Leadscrew
- Travel Range 25 to 200 mm
- Min. Incremental Motion 0.2  $\mu\text{m}$
- Resolution to 0.017  $\mu\text{m}$
- Stress-Relieved Aluminum Base for Highest Stability

The optimum choice from a modular system of high-value, low-cost components makes the M-403 family of linear stages very attractive and economical. These stages are lead-screw-driven and provide a minimum incremental motion to 0.2  $\mu\text{m}$ . They are designed with a precision-machined, high-density, stress-relieved aluminum base for exceptional stability and minimum weight. M-403 stages are available with travel ranges from 25 mm to 200 mm.

### Application Examples

- Quality control
- Semiconductor test equipment
- Precision automation
- Metrology
- Data storage test
- Research & development

### High Load and Maintenance Free

All models of the M-403 family are equipped with high-precision linear guiding rails and recirculating ball bearings. Their high load capacity allows them to carry up to 20 kg and to push/pull up to 50 N. The recirculating ball bearings are maintenance free and immune to the cage migration which can plague crossed roller bearings.

### Three Motor Drives

The top-of-the-line M-403.xPD versions feature the high-performance ActiveDrive™ system. This design, developed by PI, has a high-efficiency PWM servo-amplifier mounted side by side with the DC-Motor and offers several advantages:

- Increased efficiency, by eliminating power losses between the amplifier and motor
- Reduced cost of ownership and improved reliability,

because no external driver is required

- Elimination of PWM amplifier noise radiation, by mounting the amplifier and motor together in a single, electrically shielded case

The M-403.xDG models are equipped with a DC-Motor with zero-backlash gearhead and a shaft-mounted optical encoder, providing a minimum incremental motion of 0.2  $\mu\text{m}$ .

The M-403.x2S models feature a direct-drive, 2-phase stepper motor, providing a resolution of 0.1  $\mu\text{m}$  per step and very smooth operation.

### Direction-Sensing Origin Switch

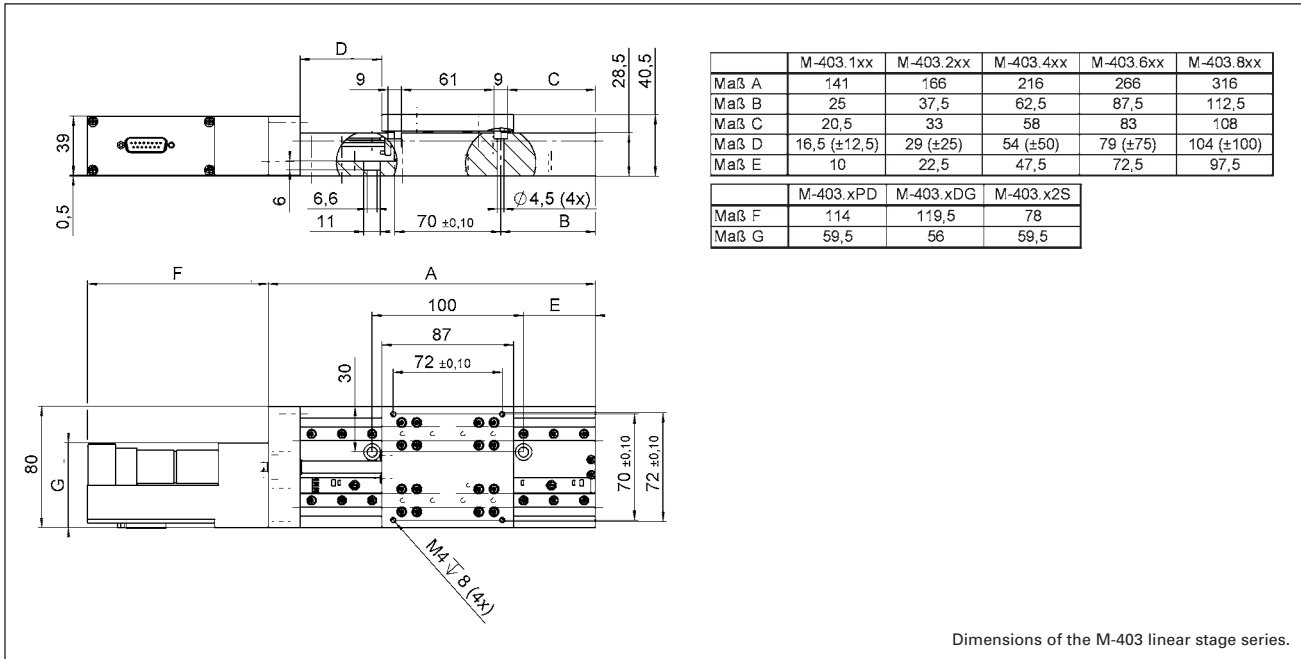
Integrated, high-precision, non-contact Hall-effect origin and limit switches with direction sensing on the origin switch protect your equipment and increase versatility in automation applications.

### Low Cost of Ownership

The combination of these stages with the networkable, single channel C-862 Mercury™ controller offers high performance for a very competitive price in both single and multi-axis configurations.

### Ordering Information

- M-403.1PD**  
Linear Translation Stage, 80 mm Wide, 25 mm Travel Range, DC-Motor/ActiveDrive™
- M-403.1DG**  
Linear Translation Stage, 80 mm Wide, 25 mm Travel Range, DC-Motor
- M-403.12S**  
Linear Translation Stage, 80 mm Wide, 25 mm Travel Range, Stepper Motor
- M-403.2PD**  
Linear Translation Stage, 80 mm Wide, 50 mm Travel Range, DC-Motor/ActiveDrive™
- M-403.2DG**  
Linear Translation Stage, 80 mm Wide, 50 mm Travel Range, DC-Motor
- M-403.22S**  
Linear Translation Stage, 80 mm Wide, 50 mm Travel Range, Stepper Motor
- M-403.4PD**  
Linear Translation Stage, 80 mm Wide, 100 mm Travel Range, DC-Motor/ActiveDrive™
- M-403.4DG**  
Linear Translation Stage, 80 mm Wide, 100 mm Travel Range, DC-Motor
- M-403.42S**  
Linear Translation Stage, 80 mm Wide, 100 mm Travel Range, Stepper Motor
- M-403.6PD**  
Linear Translation Stage, 80 mm Wide, 150 mm Travel Range, DC-Motor/ActiveDrive™
- M-403.6DG**  
Linear Translation Stage, 80 mm Wide, 150 mm Travel Range, DC-Motor
- M-403.62S**  
Linear Translation Stage, 80 mm Wide, 150 mm Travel Range, Stepper Motor
- M-403.8PD**  
Linear Translation Stage, 80 mm Wide, 200 mm Travel Range, DC-Motor/ActiveDrive™
- M-403.8DG**  
Linear Translation Stage, 80 mm Wide, 200 mm Travel Range, DC-Motor
- M-403.82S**  
Linear Translation Stage, 80 mm Wide, 200 mm Travel Range, Stepper Motor



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Tutorial: Piezo-electrics in Positioning

Capacitive Position Sensors

Piezo Drivers & Nanopositioning Controllers

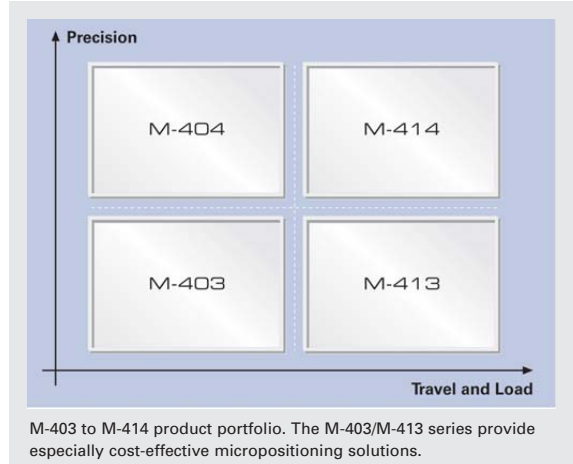
**Hexapods / Micropositioning**

Photonics Alignment Solutions

Motion Controllers

Ceramic Linear Motors & Stages

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# M-404 Linear Stage Series, Ball Screw-Type

## High-Precision Ball-Screw-Driven Translation Stages with Stepper and DC-Motors



M-404 linear stage versions (from front to back): the M-403.1PD, M-403.2PD, M-403.4PD, M-403.6PD and M-403.8PD provide travel ranges from 25 to 200 mm.

- High-Precision Components
- Modular System M-403, M-404, M-413, M-414
- Recirculating Ball Screw Provides High Speed & Long Lifetime
- Travel Range 25 to 200 mm
- Min. Incremental Motion 0.1 μm
- Resolution to 0.012 μm
- Stress-Relieved Aluminum Base for Highest Stability

The modular M-404 family of linear stages provides high-performance at a very attractive price. The integrated low-friction ball-screws combine high duty-cycles and velocities with minimum incremental motion of 0.1 μm. These stages are designed with a precision-machined, high-density, stress-relieved aluminum base for exceptional stability and minimum weight. Travel ranges from 25 mm to 200 mm are available.

### High Load and Maintenance Free

All models of the M-404 family are equipped with high-precision

linear guiding rails and recirculating ball bearings. Their high load capacity allows them to carry up to 20 kg and to push/pull up to 50 N. The recirculating ball bearings are maintenance free and immune to the cage migration which can plague crossed roller bearings.

### Three Motor Drives

The top-of-the-line M-404.xPD versions feature the high-performance ActiveDrive™ system. This design, developed by PI, has a high-efficiency PWM servo-amplifier mounted side by side with the DC-Motor and offers several advantages:

- Increased efficiency, by eliminating power losses between the amplifier and motor
- Reduced cost of ownership and improved reliability, because no external driver is required
- Elimination of PWM amplifier noise radiation, by mounting the amplifier and motor together in a single, electrically shielded case

The M-404.xDG models are equipped with a DC-Motor with zero-backlash gearhead and a shaft-mounted optical encoder, providing a minimum incremental motion of 0.1 μm.

The M-404.x2S models feature a direct-drive, 2-phase stepper motor with zero vibration, providing a resolution of 0.1 μm steps.

### Direction-Sensing Origin Switch

Integrated, high-precision, non-contact Hall-effect origin and limit switches with direction sensing on the origin switch protect your equipment and increase versatility in automation applications.

### Low Cost of Ownership

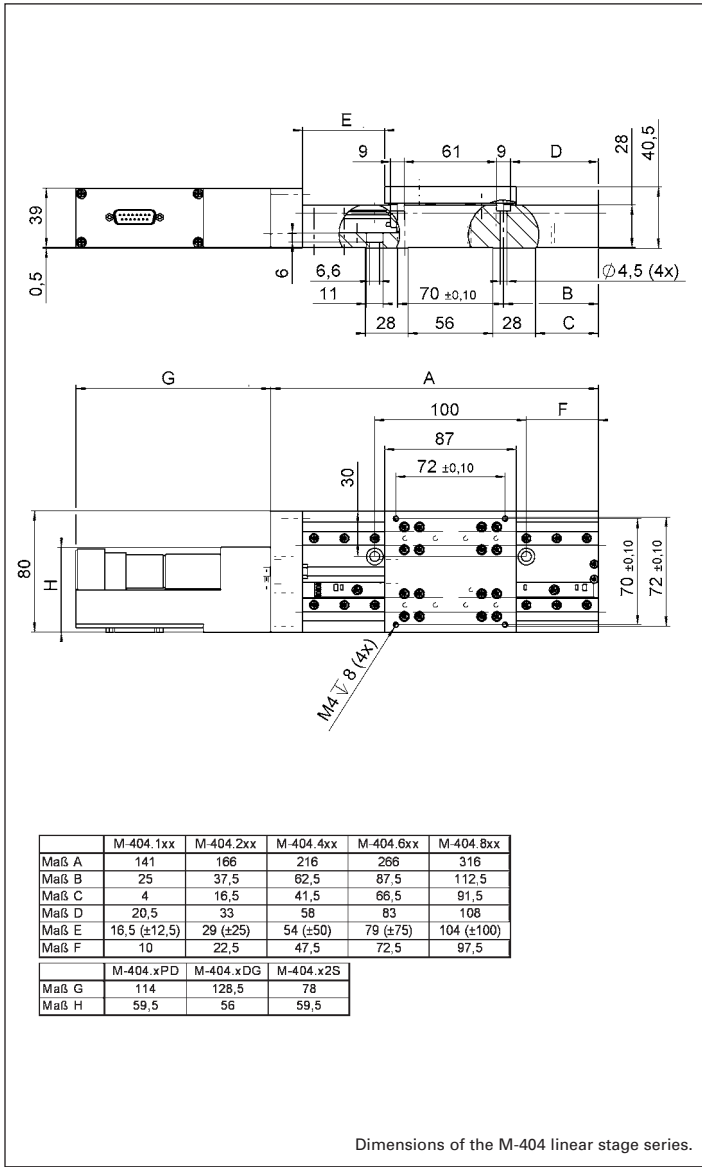
These PI stages are especially cost effective in high performance, high-duty-cycle applications, when combined with the with the networkable C-862 Mercury™ controller.

### Ordering Information

- M-404.1PD**  
Precision-Linear Stage, 80 mm Wide, 25 mm Travel Range, ActiveDrive™
- M-404.1DG**  
Precision-Linear Stage, 80 mm Wide, 25 mm Travel Range, DC-Motor
- M-404.12S**  
Precision-Linear Stage, 80 mm Wide, 25 mm Travel Range, Stepper Motor
- M-404.2PD**  
Precision-Linear Stage, 80 mm Wide, 50 mm Travel Range, ActiveDrive™
- M-404.2DG**  
Precision-Linear Stage, 80 mm Wide, 50 mm Travel Range, DC-Motor
- M-404.22S**  
Precision-Linear Stage, 80 mm Wide, 50 mm Travel Range, Stepper Motor
- M-404.4PD**  
Precision-Linear Stage, 80 mm Wide, 100 mm Travel Range, ActiveDrive™
- M-404.4DG**  
Precision-Linear Stage, 80 mm Wide, 100 mm Travel Range, DC-Motor
- M-404.42S**  
Precision-Linear Stage, 80 mm Wide, 100 mm Travel Range, Stepper Motor
- M-404.6PD**  
Precision-Linear Stage, 80 mm Wide, 150 mm Travel Range, ActiveDrive™
- M-404.6DG**  
Precision-Linear Stage, 80 mm Wide, 150 mm Travel Range, DC-Motor
- M-404.62S**  
Precision-Linear Stage, 80 mm Wide, 150 mm Travel Range, Stepper Motor
- M-404.8PD**  
Precision-Linear Stage, 80 mm Wide, 200 mm Travel Range, ActiveDrive™
- M-404.8DG**  
Precision-Linear Stage, 80 mm Wide, 200 mm Travel Range, DC-Motor
- M-404.82S**  
Precision-Linear Stage, 80 mm Wide, 200 mm Travel Range, Stepper Motor

### Application Examples

- Quality control
- Semiconductor test equipment
- Precision automation
- Metrology
- Data storage test
- Research & development



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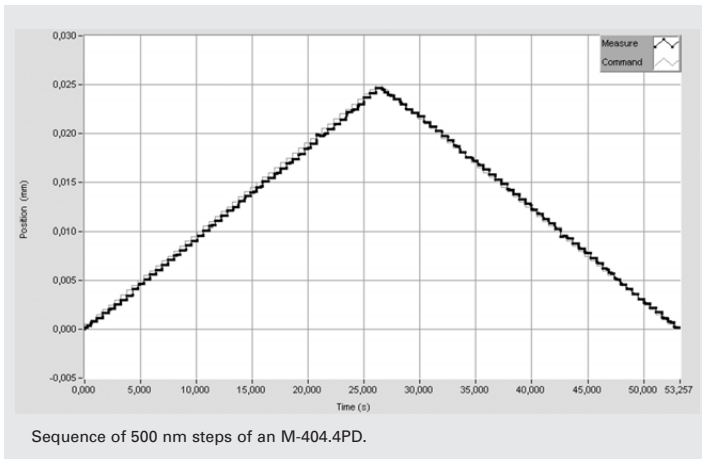
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**Technical Data**

Models	M-403.1PD	M-403.1DG	M-403.12S	M-403.2PD	M-403.2DG	M-403.22S	M-403.4PD	M-403.4DG
Active Axes	X	X	X	X	X	X	X	X
<b>Motion and positioning</b>								
Travel range	25	25	25	50	50	50	100	100
Integrated sensor	Rotary encoder	Rotary encoder		Rotary encoder	Rotary encoder		Rotary encoder	Rotary encoder
Sensor resolution	4000	2000		4000	2000		4000	2000
Design resolution	0.25	0.0175	0.1	0.25	0.0175	0.1	0.25	0.0175
Min. incremental motion	0.25	0.2	0.2	0.25	0.2	0.2	0.25	0.2
Backlash	1	6	2	1	6	2	1	6
Unidirectional repeatability	1	1	1	1	1	1	1	1
Pitch	200	200	200	200	200	200	200	200
Yaw	200	200	200	200	200	200	200	200
Max. velocity	10*	2.5	3	10*	2.5	3	10*	2.5
Origin repeatability	1	1	1	1	1	1	1	1
<b>Mechanical properties</b>								
Spindle pitch	1	1	1	1	1	1	1	1
Gear ratio		28.444			28.444			28.444
Motor resolution			10000**			10000**		
Stiffness in motion direction	3500	3500	3500	3500	3500	3500	3500	3500
Load	200	200	200	200	200	200	200	200
Push-/Pullforce	50	50	50	50	50	50	50	50
Self inhibition	50	50	50	50	50	50	50	50
Lateral force	100	100	100	100	100	100	100	100
<b>Drive Properties</b>								
Drive type	DC-Motor, ActiveDrive™	DC-Motor, gearhead	2-phase stepper-motor	DC-Motor, ActiveDrive™	DC-Motor, gearhead	2-phase stepper-motor	DC-Motor, ActiveDrive™	DC-Motor, gearhead
Operating voltage	24	0-12	24	24	0-12	24	24	0-12
Electrical power	26	2.5		26	2.5		26	2.5
<b>Miscellaneous</b>								
Operating temperature range	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65
Material	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)
Mass	1.7	1.7	1.7	1.8	1.8	1.8	2	2
Cable length	3	3	3	3	3	3	3	3
Connector	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)
Recommended controller/driver	C-843; C-862	C-843; C-862	C-630; C-600	C-843; C-862	C-843; C-862	C-630; C-600	C-843; C-862	C-843; C-862

Models	M-404.1PD	M-404.1DG	M-404.12S	M-404.2PD	M-404.2DG	M-404.22S	M-404.4PD	M-404.4DG
Active Axes	X	X	X	X	X	X	X	X
<b>Motion and positioning</b>								
Travel range	25	25	25	50	50	50	100	100
Integrated sensor	Rotary encoder	Rotary encoder		Rotary encoder	Rotary encoder		Rotary encoder	Rotary encoder
Sensor resolution	4000	2000		4000	2000		4000	2000
Design resolution	0.25	0.0116	0.1	0.25	0.0116	0.1	0.25	0.0116
Min. incremental motion	0.25	0.1	0.2	0.25	0.1	0.2	0.25	0.1
Backlash	0.5	2	2	0.5	2	2	0.5	2
Unidirectional repeatability	0.5	1	1	0.5	1	1	0.5	1
Pitch	75	75	75	75	75	75	75	75
Yaw	75	75	75	75	75	75	75	75
Max. velocity	50	1.5	3	50	1.5	3	50	1.5
Origin repeatability	1	1	1	1	1	1	1	1
<b>Mechanical properties</b>								
Spindle pitch	1	1	1	1	1	1	1	1
Gear ratio		42.92063			42.92063			42.92063
Motor resolution			10000**			10000**		
Stiffness in motion direction	3500	3500	3500	3500	3500	3500	3500	3500
Load	200	200	200	200	200	200	200	200
Push-/Pullforce	50	50	50	50	50	50	50	50
Self inhibition	40	50	50	40	50	50	40	50
Lateral force	100	100	100	100	100	100	100	100
<b>Drive Properties</b>								
Drive type	DC-Motor, ActiveDrive™	DC-Motor, gearhead	2-phase stepper-motor	DC-Motor, ActiveDrive™	DC-Motor, gearhead	2-phase stepper-motor	DC-Motor, ActiveDrive™	DC-Motor, gearhead
Operating voltage	24	0-12	24	24	0-12	24	24	0-12
Electrical power	26	2.5		26	2.5		26	2.5
<b>Miscellaneous</b>								
Operating temperature range	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65
Material	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)
Mass	1.8	1.8	1.8	1.9	1.9	1.9	2.2	2.2
Cable length	3	3	3	3	3	3	3	3
Connector	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)
Recommended controller/driver	C-843; C-862	C-843; C-862	C-630; C-600	C-843; C-862	C-843; C-862	C-630; C-600	C-843; C-862	C-843; C-862

\* Max. recommendet velocity      \*\* 2-phase stepper; 10,000 microsteps with C-600/C-630 controller

M-403.42S	M-403.6PD	M-403.6DG	M-403.62S	M-403.8PD	M-403.8DG	M-403.82S	Units	Tolerance
X	X	X	X	X	X	X		
100	150	150	150	200	200	200	mm	
	Rotary encoder	Rotary encoder		Rotary encoder	Rotary encoder			
	4000	2000		4000	2000			
0.1	0.25	0.0175	0.1	0.25	0.0175	0.1	µm	typ.
0.2	0.25	0.2	0.2	0.25	0.2	0.2	µm	typ.
2	1	6	2	1	6	2	µm	typ.
1	1	1	1	1	1	1	µm	typ.
200	200	200	200	200	200	200	µrad	typ., over 100 mm
200	200	200	200	200	200	200	µrad	typ., over 100 mm
3	10*	2.5	3	10*	2.5	3	mm/s	
1	1	1	1	1	1	1	µm	typ.
1	1	1	1	1	1	1	mm/rev.	
		28.444			28.444			
10000**			10000**			10000**	Steps/rev.	
3500	3500	3500	3500	3500	3500	3500	N/mm	
200	200	200	200	200	200	200	N	Max.
50	50	50	50	50	50	50	N	
50	50	50	50	50	50	50	N	Min.
100	100	100	100	100	100	100	N	Max.
2-phase stepper-motor	DC-Motor, ActiveDrive™	DC-Motor, gearhead	2-phase stepper-motor	DC-Motor, ActiveDrive™	DC-Motor, gearhead	2-phase stepper-motor		
24	24	0-12	24	24	0-12	24	V	
	26	2.5		26	2.5		W	nominal
-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	°C	
Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)		
2	2.2	2.2	2.2	2.5	2.5	2.5	kg	±5 %
3	3	3	3	3	3	3	m	±10 mm
Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)		
C-630; C-600	C-843; C-862	C-843; C-862	C-630; C-600	C-843; C-862	C-843; C-862	C-630; C-600		
M-404.42S	M-404.6PD	M-404.6DG	M-404.62S	M-404.8PD	M-404.8DG	M-404.82S	Units	Tolerance
X	X	X	X	X	X	X		
100	150	150	150	200	200	200	mm	
	Rotary encoder	Rotary encoder		Rotary encoder	Rotary encoder			
	4000	2000		4000	2000			
0.1	0.25	0.0116	0.1	0.25	0.0116	0.1	µm	typ.
0.2	0.25	0.1	0.2	0.25	0.1	0.2	µm	typ.
2	0.5	2	2	0.5	2	2	µm	typ.
1	0.5	1	1	0.5	1	1	µm	typ.
75	75	75	75	75	75	75	µrad	typ., over 100 mm
75	75	75	75	75	75	75	µrad	typ., over 100 mm
3	50	1.5	3	50	1.5	3	mm/s	
1	1	1	1	1	1	1	µm	±20 %
1	1	1	1	1	1	1	mm/rev.	
		42.92063			42.92063			
10000**			10000**			10000**	Steps/rev.	
3500	3500	3500	3500	3500	3500	3500	N/mm	±20 %
200	200	200	200	200	200	200	N	Max.
50	50	50	50	50	50	50	N	Max.
50	40	50	50	40	50	50	N	Min.
100	100	100	100	100	100	100	N	Max.
2-phase stepper-motor	DC-Motor, ActiveDrive™	DC-Motor, gearhead	2-phase stepper-motor	DC-Motor, ActiveDrive™	DC-Motor, gearhead	2-phase stepper-motor		
24	24	0-12	24	24	0-12	24	V	
	26	2.5		26	2.5		W	nominal
-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65		
Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)		
2.2	2.3	2.3	2.3	2.6	2.6	2.6	kg	±5 %
3	3	3	3	3	3	3	m	±10 mm
Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)		
C-630; C-600	C-843; C-862	C-843; C-862	C-630; C-600	C-843; C-862	C-843; C-862	C-630; C-600		

# M-413 Linear Stage Series, Leadscrew-Type

## High-Load Leadscrew-Driven Translation Stages with Stepper and DC-Motors



M-413.2PD high-load linear stage with 200 mm travel range.

- For Cost-Sensitive Applications
- Modular System M-403, M-404, M-413, M-414
- Preloaded Precision Leadscrew
- Travel Range 100 to 300 mm
- Min. Incremental Motion 0.2 µm
- Resolution to 0.017 µm
- Stress-Relieved Aluminum Base for Highest Stability

The optimum choice from a modular system of high-value, low-cost components makes the M-413 family of linear stages very attractive and economical. These stages are lead-screw-driven and provide a minimum incremental motion to 0.2 µm. They are designed with a precision-machined, high-density, stress-relieved aluminum base for exceptional stability and minimum weight. M-413 stages are available with travel ranges from 100 mm to 300 mm.

### Application Examples

- Quality control
- Semiconductor test equipment
- Precision automation
- Metrology
- Data storage test
- Research & development

### High Load and Maintenance Free

All models of the M-413 family are equipped with high-precision linear guiding rails and recirculating ball bearings. Their high load capacity allows them to carry up to 50 kg and to push/pull up to 50 N. The recirculating ball bearings are maintenance free and immune to the cage migration which can plague crossed roller bearings.

### Three Motor Drives

The top-of-the-line M-413.xPD versions feature the high-performance ActiveDrive™ system. This design, developed by PI, has a high-efficiency PWM servo-amplifier mounted side by side with the DC-Motor and offers several advantages:

- Increased efficiency, by eliminating power losses between the amplifier and motor
- Reduced cost of ownership and improved reliability,

### Ordering Information

**M-413.1PD**  
Linear Translation Stage, 120 mm Wide, 100 mm Travel Range, ActiveDrive™

**M-413.1DG**  
Linear Translation Stage, 120 mm Wide, 100 mm Travel Range, DC-Motor

**M-413.12S**  
Linear Translation Stage, 120 mm Wide, 100 mm Travel Range, Stepper Motor

**M-413.2PD**  
Linear Translation Stage, 120 mm Wide, 200 mm Travel Range, ActiveDrive™

**M-413.2DG**  
Linear Translation Stage, 120 mm Wide, 200 mm Travel Range, DC-Motor

**M-413.22S**  
Linear Translation Stage, 120 mm Wide, 200 mm Travel Range, Stepper Motor

**M-413.3PD**  
Linear Translation Stage, 120 mm Wide, 300 mm Travel Range, ActiveDrive™

**M-413.3DG**  
Linear Translation Stage, 120 mm Wide, 300 mm Travel Range, DC-Motor

**M-413.32S**  
Linear Translation Stage, 120 mm Wide, 300 mm Travel Range, Stepper Motor

because no external driver is required

- Elimination of PWM amplifier noise radiation, by mounting the amplifier and motor together in a single, electrically shielded case

The M-413.xDG models are equipped with a DC-Motor with zero-backlash gearhead and a shaft-mounted optical encoder, providing a minimum incremental motion of 0.2 µm.

The M-413.x2S models feature a direct-drive, 2-phase stepper motor with zero vibration, providing a resolution of 0.1 µm

per step and very smooth operation.

### Direction-Sensing Origin Switch

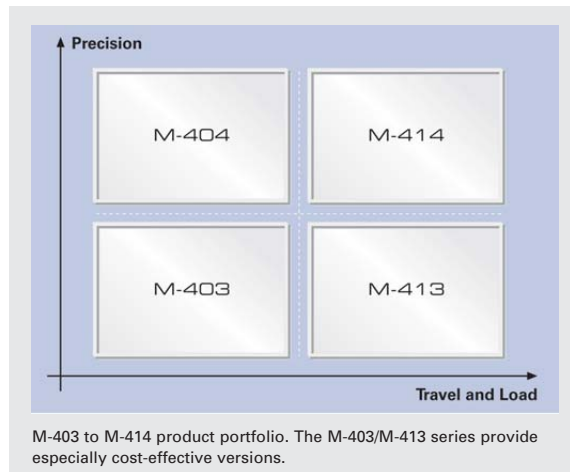
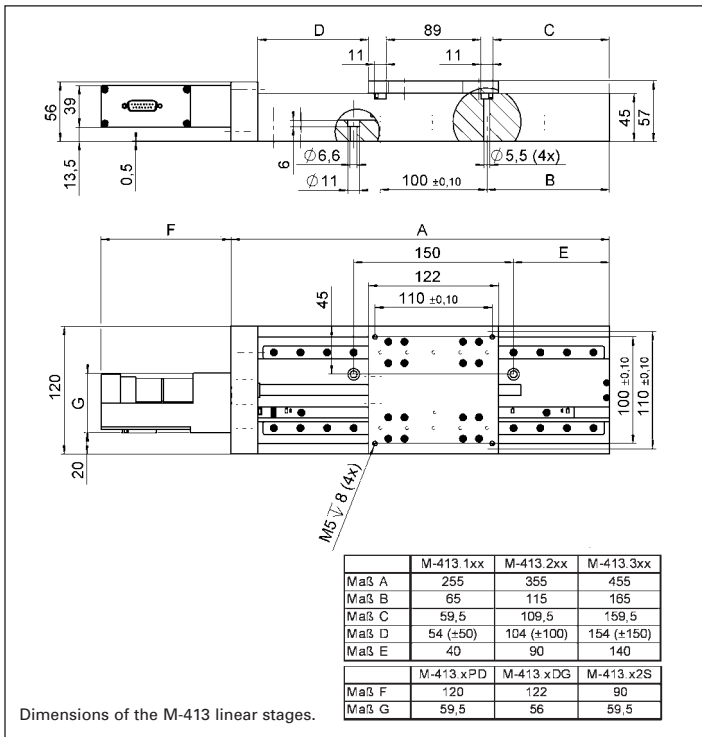
Integrated, high-precision, non-contact Hall-effect origin and limit switches with direction sensing on the origin switch protect your equipment and increase versatility in automation applications.

### Low Cost of Ownership

The combination of these stages with the networkable, single channel C-862 Mercury™ controller offers high performance for a very competitive price in both single and multi-axis configurations.

### Technical Data

Models	M-413.1PD
Active Axes	X
<b>Motion and positioning</b>	
Travel range	100
Integrated sensor	Rotary encoder
Sensor resolution	4000
Design resolution	0.25
Min. incremental motion	0.25
Backlash	2
Unidirectional repeatability	1
Pitch	300
Yaw	300
Max. velocity	10*
Origin repeatability	1
<b>Mechanical properties</b>	
Spindle pitch	1
Gear ratio	
Motor resolution	
Stiffness in motion direction	6000
Load	500
Push-/Pullforce	50
Self inhibition	50
Lateral force	200
<b>Drive Properties</b>	
Drive type	DC-Motor, ActiveDrive™
Operating voltage	24
Electrical power	42
<b>Miscellaneous</b>	
Operating temperature range	-20 to +65
Material	Al (black anodized)
<b>Mass</b>	
Cable length	3
Connector	Sub-D 15 (m)
Recommended controller/driver	C-843; C-862
* Max. recommendet velocity	



- Piezo Actuators
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M-413.1DG	M-413.12S	M-413.2PD	M-413.2DG	M-413.22S	M-413.3PD	M-413.3DG	M-413.32S	Units	Tolerance
X	X	X	X	X	X	X	X		
100	100	200	200	200	300	300	300	mm	
Rotary encoder		Rotary encoder	Rotary encoder		Rotary encoder	Rotary encoder			
2000		4000	2000		4000	2000			
0.0175	0.1	0.25	0.0175	0.1	0.25	0.0175	0.1	µm	typ.
0.2	0.2	0.25	0.2	0.2	0.25	0.2	0.2	µm	typ.
6	2	2	6	2	2	6	2	µm	typ.
1	1	1	1	1	1	1	1	µm	typ.
300	300	300	300	300	300	300	300	µrad	typ., over 100 mm
300	300	300	300	300	300	300	300	µrad	typ., over 100 mm
2.5	3	10*	2.5	3	10*	2.5	3	mm/s	
1	1	1	1	1	1	1	1	µm	±20 %
1	1	1	1	1	1	1	1	mm/rev.	
28.444			28.444			28.444			
	10000**			10000**			10000**	Steps/rev.	
6000	6000	6000	6000	6000	6000	6000	6000	N/mm	±20 %
500	500	500	500	500	500	500	500	N	Max.
50	50	50	50	50	50	100	100	N	Max.
50	50	50	50	50	50	100	100	N	Min.
200	200	200	200	200	200	200	200	N	Max.
DC-Motor, gearhead	2-phase stepper-motor	DC-Motor, ActiveDrive™	DC-Motor, gearhead	2-phase stepper-motor	DC-Motor, ActiveDrive™	DC-Motor, gearhead	2-phase stepper-motor		
0-12	24	24	0-12	24	24	0-12	24	V	
3.6	0	42	3.6	0	42	3.6	0	W	nominal
-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	°C	
Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)		
		5.4	5.2	5.4				kg	±5 %
3	3	3	3	3	3	3	3	m	±10 mm
Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)		
C-843; C-862	C-630; C-600	C-843; C-862	C-843; C-862	C-630; C-600	C-843; C-862	C-843; C-862	C-630; C-600		

\*\* 2-phase stepper; 10,000 microsteps with C-600/C-630 controller



# M-414 Linear Stage Series, Ball Screw-Type High-Load Ball-Screw-Driven Precision-Translation Stages with Stepper and DC-Motors



M-414.2PD High load linear stage with 200 travel range.

- High-Precision Components
- Modular System M-403, M-404, M-413, M-414
- Recirculating Ball Screw Provides High Speed & Long Lifetime
- Travel Range 100 to 300 mm
- Min. Incremental Motion 0.2 µm
- Resolution to 0.023 µm
- Stress-Relieved Aluminum Base for Highest Stability

The modular M-414 family of linear stages provides high-performance at a very attractive price. The integrated low-friction ball-screws combine high duty-cycles and velocities with minimum incremental motion of 0.2 µm. These stages are designed with a precision-machined, high-density, stress-relieved aluminum base for exceptional stability. M-414 are available with travel ranges from 100 mm to 300 mm.

### High Load and Maintenance Free

All models of the M-414 family are equipped with high-precision linear guiding rails and recirculating ball bearings.

### Application Examples

- Quality control
- Semiconductor test equipment
- Precision automation
- Metrology
- Data storage test
- Research & development

Their high load capacity allows them to carry up to 50 kg and to push/pull up to 50 N. The recirculating ball bearings are maintenance free and immune to the cage migration which can plague crossed roller bearings.

### Three Motor Drives

The top-of-the-line M-414.xPD versions feature the high-performance ActiveDrive™ system. This design, developed by PI, has a high-efficiency PWM servo-amplifier mounted side by side with the DC-Motor and offers several advantages:

- Increased efficiency, by eliminating power losses between the amplifier and motor
- Reduced cost of ownership and improved reliability, because no external driver is required
- Elimination of PWM amplifier noise radiation, by mounting the amplifier and motor together in a single, electrically shielded case

### Ordering Information

**M-414.1PD**  
Precision-Linear Stage, 120 mm Wide, 100 mm Travel Range, ActiveDrive™

**M-414.1DG**  
Precision-Linear Stage, 120 mm Wide, 100 mm Travel Range, DC-Motor

**M-414.12S**  
Precision-Linear Stage, 120 mm Wide, 100 mm Travel Range, Stepper Motor

**M-414.2PD**  
Precision-Linear Stage, 120 mm Wide, 200 mm Travel Range, ActiveDrive™

**M-414.2DG**  
Precision-Linear Stage, 120 mm Wide, 200 mm Travel Range, DC-Motor

**M-414.22S**  
Precision-Linear Stage, 120 mm Wide, 200 mm Travel Range, Stepper Motor

**M-414.3PD**  
Precision-Linear Stage, 120 mm Wide, 300 mm Travel Range, ActiveDrive™

**M-414.3DG**  
Precision-Linear Stage, 120 mm Wide, 300 mm Travel Range, DC-Motor

**M-414.32S**  
Precision-Linear Stage, 120 mm Wide, 300 mm Travel Range, Stepper Motor

The M-414.xDG models are equipped with a DC-Motor with zero-backlash gearhead and a shaft-mounted optical encoder, providing a minimum incremental motion of 0.2 µm.

The M-414.x2S models feature a direct-drive, 2-phase stepper motor with zero vibration, providing a resolution of 0.1 µm steps.

### Direction-Sensing Origin Switch

Integrated, high-precision, non-contact Hall-effect origin and limit switches with direction sensing on the origin switch protect your equipment

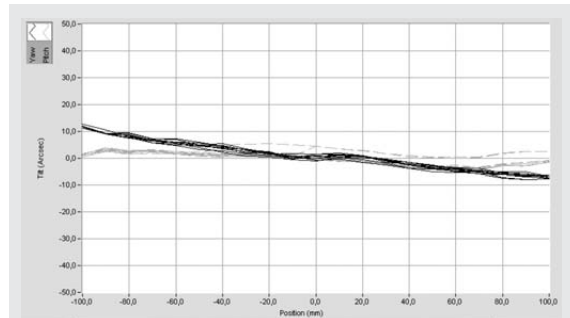
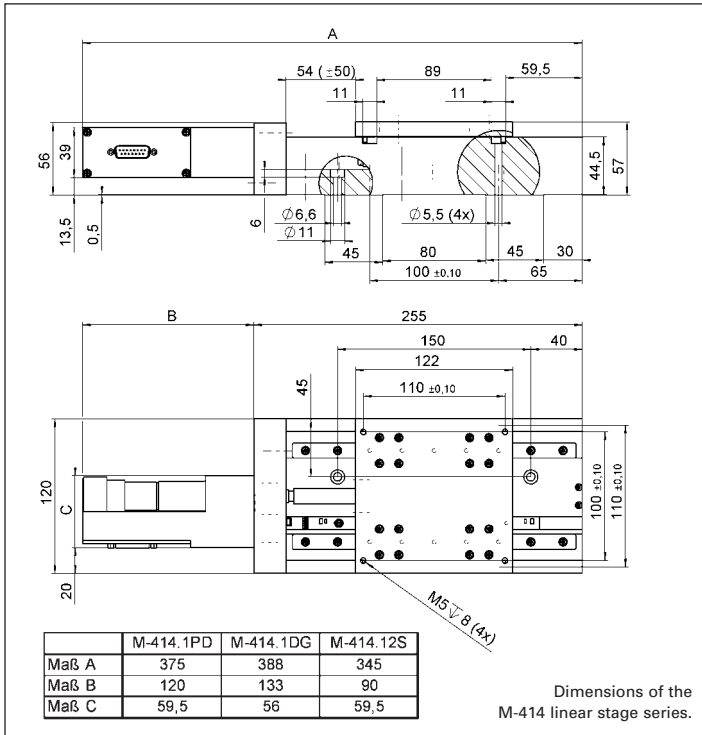
and increase versatility in automation applications.

### Low Cost of Ownership

These PI stages are especially cost effective in high performance, high-duty-cycle applications, when combined with the networkable C-862 Mercury™ controller.

### Technical Data

Models	M-414.1PD
Active Axes	X
<b>Motion and positioning</b>	
Travel range	100
Integrated sensor	Rotary encoder
Sensor resolution	4000
Design resolution	0.5
Min. incremental motion	0.25
Backlash	0.5
Unidirectional repeatability	0.5
Pitch	100
Yaw	100
Max. velocity	100
Origin repeatability	1
<b>Mechanical properties</b>	
Spindle pitch	2
Gear ratio	
Motor resolution	
Stiffness in motion direction	6000
Load	500
Push-/Pullforce	50
Self inhibition	50
Lateral force	200
<b>Drive Properties</b>	
Drive type	DC-Motor, ActiveDrive™
Operating voltage	24
Electrical power	42
<b>Miscellaneous</b>	
Operating temperature range	-20 to +65
Material	Al (black anodized)
<b>Mass</b>	
Cable length	3
Connector	Sub-D 15 (m)
Recommended controller/driver	C-843; C-862
* Max. recommendet velocity	



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X	X	X	X	X	X	X	X		
100	100	200	200	200	300	300	300	mm	
Rotary encoder		Rotary encoder	Rotary encoder		Rotary encoder	Rotary encoder			
2000		4000	2000		4000	2000			
0.0232	0.2	0.25	0.0175	0.1	0.25	0.0175	0.1	µm	typ.
0.1	0.2	0.25	0.1	0.2	0.25	0.1	0.2	µm	typ.
4	2	2	6	2	2	6	2	µm	typ.
1	1	0.5	1	1	0.5	1	1	µm	typ.
100	100	100	100	100	100	100	100	µrad	typ., over 100 mm
100	100	100	100	100	100	100	100	µrad	typ., over 100 mm
3	6	100	3	6	100	3	6	mm/s	
1	1	1	1	1	1	1	1	µm	±20 %
2	2	2	2	2	2	2	2	mm/rev.	
42.9206			42.9206			42.9206			
	10000**			10000**			10000**	Steps/rev.	
6000	6000	6000	6000	6000	6000	6000	6000	N/mm	±20 %
500	500	500	500	500	500	500	500	N	Max.
50	50	50	50	50	50	100	100	N	Max.
50	50	50	50	50	50	100	100	N	Min.
200	200	200	200	200	200	200	200	N	Max.
DC-Motor, gearhead	2-phase stepper-motor	DC-Motor, ActiveDrive™	DC-Motor, gearhead	2-phase stepper-motor	DC-Motor, ActiveDrive™	DC-Motor, gearhead	2-phase stepper-motor		
0-12	24	24	0-12	24	24	0-12	24	V	
3.6	0	42	3.6	0	42	3.6	0	W	nominal
-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	-20 to +65	°C	
Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)		
		5.4	5.2	5.4				kg	±%
3	3	3	3	3	3	3	3	m	±10 mm
Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)		
C-843; C-862	C-630; C-600	C-843; C-862	C-843; C-862	C-630; C-600	C-843; C-862	C-843; C-862	C-630; C-600		

\*\* 2-phase stepper; 10,000 microsteps with C-600/C-630 controller

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### Program Overview

- Piezoelectric Actuators
- Piezo Nanopositioning Systems and Scanners
- Active Optics / Tip-Tilt Platforms
- Capacitive Sensors
- Piezo Electronics: Amplifiers and Controllers
- Hexapods
- Micropositioners
- Positioning Systems for Fiber Optics, Photonics and Telecommunications
- Motor Controllers
- PLine® High-Speed Ceramic Linear Motors

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