

V-106 QuickScan™ High-Dynamics Scanner Voice-Coil Drive with Direct Position Measurement



V-106.11S and V-106.14S high-dynamics scanning stages with voice coil drives

- **Fast Scanning and Positioning**
- **Travel Ranges of 20 mm and 6 mm**
- **Linear Encoder Provides 0.1 μm Resolution, 0.2 μm Repeatability**
- **Scanning Frequency to Tens of Hz**
- **Velocity up to 270 mm/s**
- **PCI-Card Controller with On-Board Amplifiers Available**

QuickScan™ micropositioning stages of the V-106 series were designed for high-dynamics precision scanning and positioning applications, like those in biotechnology and fiber optics. They are based on zero-friction voice coil drives (linear motors), which, combined with high-precision linear encoders, offer a position resolution of 0.1 μm and minimal step size of 0.2 μm.

V-106 micropositioning stages achieve significantly higher dynamics than leadscrew-based units. The specially design-

ed voice coil drive system makes possible scanning frequencies of some tens of hertz. With an applied load of 90 grams, the scan frequency of the V-106.11S is still 20 Hz over a travel range of 1 mm. The excellent dynamic characteristics are advantageous not only for scanning applications: positioning tasks see them as short settling times like 75 ms for 5 mm with a 90 gram load.

Direct Drive and Direct Metrology—Precise Motion

The design of the V-106 is based on three key precision components:

- A frictionless voice-coil (linear motor) drive
- A non-contacting direct-motion metrology linear encoder for sub-micron repeatability
- Precision cross-roller bearings for ultra-straight and smooth motion

Unlike leadscrew-driven translation stages, the voice-coil lin-

ear-motor in the V-106 is frictionless, quiet and not subject to wear and tear. In addition, it provides higher dynamics, speed, acceleration and responsiveness (step-and-settle)—ideal features for high-throughput applications. The embedded drive also reduces the length considerably compared to conventional motor/screw-driven stages.

For highly repeatable motion, a non-contacting optical linear encoder with 0.1 μm resolution is mounted inside the stage and feeds position information back to the motion controller.

The integrated, non-contact reference switch increases versatility in automation applications.

Versatile PCI Board Controller

V-106 voice coil stages can be controlled by the C-843 digital controller in PCI plug-in-board format. C-843 controllers are equipped with on-board linear servo-amplifiers for precise control of up to four axes. This lowers system costs and simplifies setup by eliminating additional external amplifiers and cables.

Ordering Information

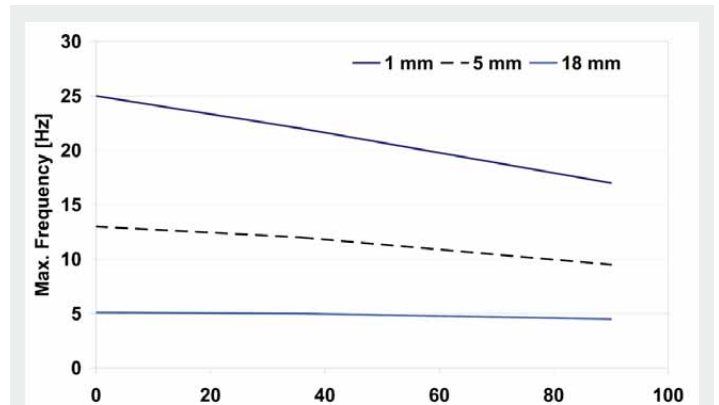
V-106.11S
QuickScan Voice Coil Scanning Stage, 6 mm

V-106.14S
QuickScan Voice Coil Scanning Stage, 20 mm

Frictionless Voice Coil Linear Drives

High-accuracy voice coil linear drives work on the same principle as electromagnetic loudspeakers. However, for precision positioning applications, they must provide much higher forces and high stability to hold a position without jitter. They must also be designed for closed-loop operation to allow for precise positioning.

These zero-friction magnetic linear drives, characterized by their excellent dynamics, are ideally suited for scanning applications requiring travel ranges in the millimeter to centimeter range. PI offers voice coil drives in V-106 standard systems; custom systems are available on request.



V-106.14S maximum scanning frequency for different loads and scan amplitudes for example 18 mm scans with up to 90 g load at >4 Hz frequency are feasible. The velocity is up to 270 mm/s

M-683 PLine® Precision Micro Translation Stage

Low-Profile & High-Speed with Ultrasonic Piezomotors, Direct Position Metrology



M-683.2U4 (50 mm) low-profile translation stage with integrated high-speed ceramic linear motors

- Max. Velocity 350 mm/s
- Low Profile: Only 21 mm Height
- Compact XY Combination Possible
- Up to 6 N Force Generation
- Direct Metrology Linear Encoder, 0.1 µm Resolution
- Travel Range 50 mm
- Excellent Guiding Accuracy Through Crossed Roller Bearings
- PLine®: Non-Magnetic and Vacuum-Compatible Working

Principle

- Self Locking at Rest

M-683 precision micropositioning stages make use of PLine® ultrasonic piezo linear motors enabling a compact design and low profile. An integrated linear encoder enables closed-loop control with 0.1 µm resolution. The M-683 translation stages use paired

crossed-roller bearings mounted on ground-aluminum profiles for better guiding accuracy. Integrated U-164 PLine® linear motors provide push forces to 6 N and a maximum velocity of up to 350 mm/s. A vacuum version is available. The stages can be arranged to form compact XY systems. If an additional Z-axis is required, the M-110 micro-stage series (see page 4-22) is recommended due to its higher holding force. The M-683 design is scalable and can be extended to provide longer travel ranges to 300 mm.

Limit and Reference Switches

For the protection of your equipment, non-contact limit and reference switches are installed. The reference switch supports advanced automation applications with high precision.

Advantages of PLine® Micro Positioning Systems

PLine® ultrasonic ceramic drives provide several advantages over classical motors and drivers:

- Higher Accelerations, up to 5 g
- Speeds up to 500 mm/s
- Small Form Factor
- Self-Locking when Powered Down
- No Shafts, Gears or Other Rotating Parts
- No Lubricants
- Non-Magnetic and Vacuum Compatible Operating Principle

Optimized Controller and Drive Electronics

For optimum performance the highly specialized C-867 motion controller (see page 4-116) is recommended. This dedicated piezo motor controller also integrates the drive electronics which PLine® motors require to generate the ultrasonic oscillations for the piezo-ceramic element.

Furthermore, the controller has a number of special characteristics, including continuous automatic drive frequency adjustment, dynamic parameter switching for optimized high-speed motion and settling behavior and some other features to address the requirements of ultrasonic motors. The broad-band encoder input (50 MHz) supports the outstanding high accelerations and velocities of PLine® drives at high resolutions.

Optionally, for use with third party servo controllers, the C-185 analog drive electronics (stand-alone unit) (see page 1-36) is available. It accepts an analog ±10 V signal to control the motor velocity. For optimum performance the driver must be tuned together with

Ordering Information

M-683.2U4
PLine® High-Speed Linear Stage, 50 mm, 6 N

M-683.2V4
PLine® High-Speed Linear Stage, 50 mm, 6 N, Vacuum Compatible to 10⁻⁶ hPA

Accessories:

M-110.05
Adapter bracket for vertical mount of M-110 stages on M-683 stages

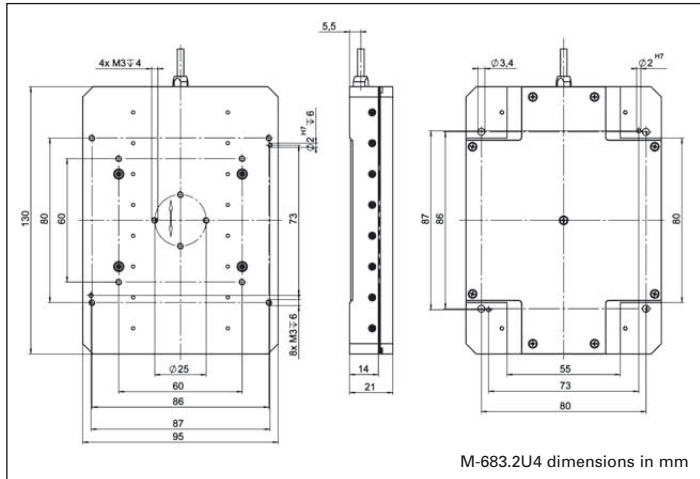
the mechanics and should be ordered at the same time as the motor/stage.

Patent Protection

The products described in this document are in part protected by the following patents:
US Pat. No. 6,765,335
German Patent No. 10154526

Application Examples

- Biotechnology
- Micromanipulation
- Microscopy
- Quality assurance testing
- Metrology
- Semiconductor testing
- Mass storage device testing
- R&D
- Photonics packaging



Technical Data

Model	M-683.2U4	Tolerance
Active axes	X	
Motion and positioning		
Travel range	50 mm	
Integrated sensor	Linear encoder	
Sensor resolution	0.1 μm	
Min. incremental motion	0.3 μm	typ.
Bidirectional repeatability	$\pm 1 \mu\text{m}$	typ.
Unidirectional repeatability	0.2 μm	typ.
Pitch	$\pm 150 \mu\text{rad}$	typ.
Yaw	$\pm 50 \mu\text{rad}$	typ.
Max. velocity	350 mm/s	
Reference switch repeatability	1 μm	typ.
Mechanical properties		
Max. load capacity	50 N	
Max. push / pull force	6 N	
Max. holding force	6 N	
Drive properties		
Motor type	2 x U-164 PILine® ultrasonic piezo drive	
Operating Voltage	60 V_{rms} *	
Electrical power	15 W**	nominal
Power consumption	1.5 A**	
Reference Switch	optical	
Limit Switches	Hall-effect	
Miscellaneous		
Operating temperature range	0 to +50 °C	
Material	Al (black anodized)	
Dimensions	130 x 95 x 21 mm	
Mass	0.65 kg	$\pm 5 \%$
Cable length	1.5 m	$\pm 10 \text{ mm}$
Connector	MDR, 14-pin	
Recommended controller	C-867 PILine® controller incl. drive electronics	

*Power to the motor is supplied by the drive electronics, which runs on 12 V DC, or by the controller (24 V).

**For drive electronics

Data for vacuum version may differ. M-683.2V4: Delivery includes 1 m cable (vacuum), feedthrough an 1.5 m cable (air).

Precision Stage with Linear Piezo Drive

FAST, SELF-LOCKING, LOW PROFILE



M-664

- Travel range 25 mm
- Only 15 mm profile height
- Linear encoder with 100 nm resolution
- Max. velocity 400 mm/s
- Self-locking at rest, no heat generation, no servo jitter

Precision-class micro translation stage

Integrated piezo-ceramic direct drive. Compact XY combinations available

PILine® piezo ultrasonic drive

Self-locking, with no heat generation at rest. Excellent start/stop dynamics. Crossed roller bearings. Non-contact limit and reference point switches

Direct-metrology linear encoder

High accuracy and repeatability

Application fields

Research and industry. For micromanipulation, quality assurance testing, biotechnology

Related Products

M-663 Ultra-compact Linear Stage
M-683 Dynamic Micropositioning Stage
M-122 Miniature Linear Stage
M-126 Precision Micro-Translation Stage
C-867 Controller for PILine®

Valid patents

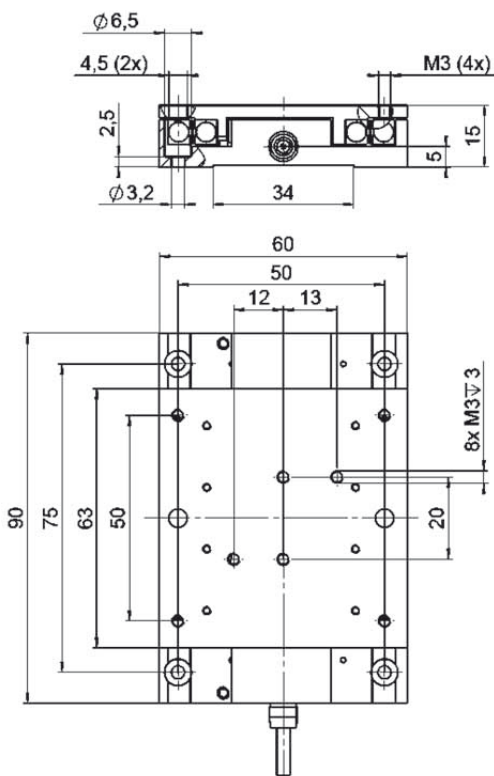
US Pat. No. 6,765,335B2
European Patent No. 1267425B1

Accessories

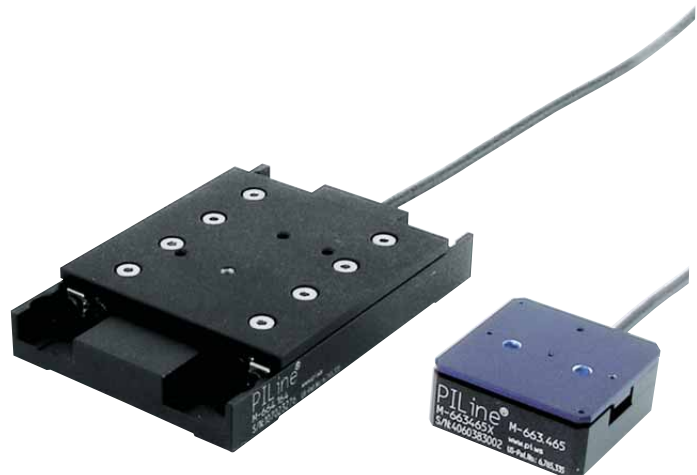
M-664.AP1 Adapter Plate for XY-mounting of M-664, 4 mm high

	M-664.164	Tolerance
Active axes	X	
Motion and positioning		
Travel range	25 mm	
Integrated sensor	Linear encoder	
Sensor resolution	0.1 μm	
Min. incremental motion	0.6 μm	typ.
Bidirectional repeatability	$\pm 1 \mu\text{m}$	typ.
Unidirectional repeatability	$\pm 0.2 \mu\text{m}$	typ.
Pitch	$\pm 75 \mu\text{rad}$	typ.
Yaw	$\pm 50 \mu\text{rad}$	typ.
Velocity	400 mm/s	max.
Reference point switch repeatability	1 μm	typ.
Mechanical properties		
Load capacity	25 N	max.
Push/pull force	2.5 N	max.
Holding force	2.5 N	max.
Drive properties		
Motor type	P-664 PILine® Ultrasonic Piezo Drive	
Limit and reference point switches	Hall-effect	
Miscellaneous		
Operating temperature range	0 to +50 °C	
Material	Al (black anodized)	
Dimensions	90 x 60 x 15 mm	
Mass	0.225 kg	$\pm 5 \%$
Cable length	1.5 m	$\pm 10 \text{ mm}$
Connector	MDR, 14-pin	
Recommended controller/driver	C-867 controller/driver	

Ask about custom designs!



M-664, dimensions in mm



The smallest closed-loop linear stages with self-locking PILine® drive: M-664 (right) and M-663 (left)

Linear Actuators & Motors

Nanopositioning & Piezoelectrics

Nanometrology

Hexapod Systems

Linear Stages Translation (X)

Appendix