

## 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

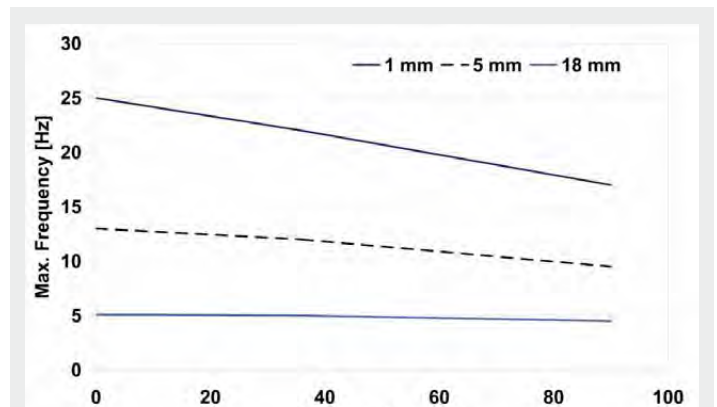
**V-106.11S**  
QuickScan Voice Coil Scanning Stage, 6 mm

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

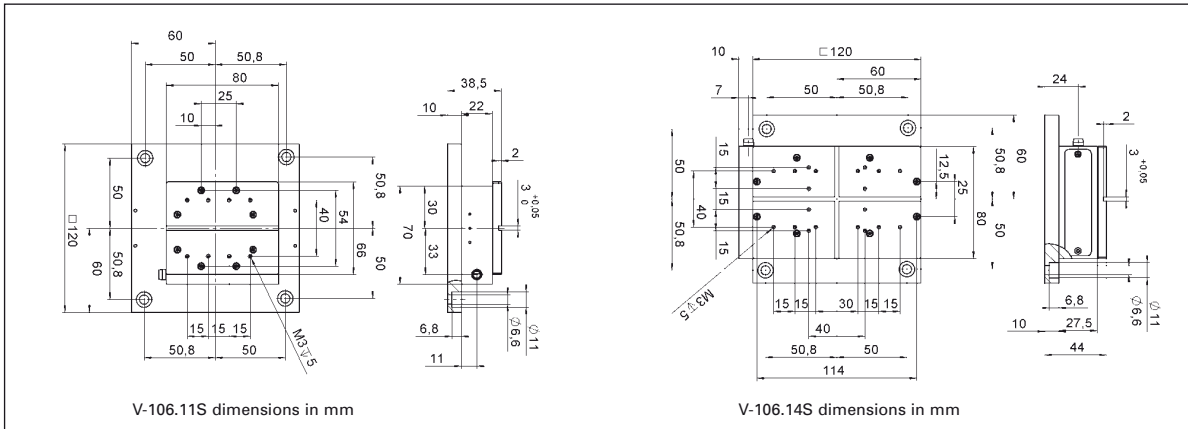
### Frictionless Voice Coil Linear Drives

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



V-106.11S dimensions in mm

V-106.14S dimensions in mm

Technical Data

Model	V-106.11S	V-106.14S	Units	Tolerances
Active axes	X	X		
<b>Motion and positioning</b>				
Travel range	6	20	mm	
Integrated sensor	Linear encoder	Linear encoder		
Sensor resolution	0.1	0.1	μm	
Design resolution	0.1	0.1	μm	
Minimum incremental motion	0.2	0.2	μm	typ.
Backlash	0.2	0.2	μm	typ.
Unidirectional repeatability	0.2	0.2	μm	typ.
Pitch	50	50	μrad	typ.
Yaw	50	50	μrad	typ.
Max. velocity*	240	270	mm/s	
Reference repeatability	1	1	μm	typ.
<b>Mechanical properties</b>				
Mass moved	102	172	g	typ.
Load	36	81	N	max.
Push-/pull force**	5	3.3	N	max.
Push-/pull force with C-843**	2.3	1.5	N	max.
Lateral force	18	40	N	max.
<b>Drive properties</b>				
Drive type	Voice coil	Voice coil		
Continuous average current	0.42	0.42	A	nominal
Peak current	1.8	1.8	A	max. (3s)
Average force	1.2	0.8	N	nominal
Coil resistance	10	10	Ω	typ.
Coil inductance	100	100	μH	typ.
Force constant	2.88	1.92	N/A	
Voltage generation constant	36.1	24	Vs/m	
<b>Miscellaneous</b>				
Operating temperature range	0–55	0–55	°C	
Body material	Al	Al		
Mass (without cable)	800	1000	g	±5%
Cable length	0.3	0.3	m	±10 mm
Connectors	Sub-D 15 (m)	Sub-D 15 (m)		
Recommended controller / driver	C-843	C-843 (p. 4-120)		

\*With C-843 controller  
 \*\*The C-843 controller provides 8 V and 0.8 A max. and therefore limits the push/pull force  
 See Notes (Technical Data) for further information page 4-67 ff

Linear Actuators & Motors

Nanopositioning / Piezoelectrics

Nanometrology

Micropositioning

Hexapod 6-Axis Systems / Parallel Kinematics

Linear Stages

Translation (X)

Vertical (Y)

Multi-Axis

Rotary & Tilt Stages

Accessories

Servo & Stepper Motor Controllers

Single-Channel

Hybrid

Multi-Channel

Micropositioning Fundamentals

Index

## PIMag™ VC Linear Actuator

COST-EFFECTIVE WITH HIGH DYNAMICS



### V-273

- Travel ranges to 20 mm
- Velocity to 250 mm/s
- Integrated linear encoder, 0.1 μm resolution
- Optional force sensor with 5 mN resolution
- Optional: Weight force compensation

#### OEM linear actuator

PIMag™ voice coil magnetic drive, high velocity and high dynamics. Low wear and high lifetime. Integrated linear encoder for reliable position control and repeatable accuracy. 10 kHz servo update rate. Optional force sensor for applying defined forces. Easy integration by coupling the guided load to the moving runner

#### C-413 digital PIMag™ motion controller for position and force control

2 channels (position control) or 1 channel (simultaneous position and force control). Controlled output current

up to 1.5 A at 24 V, 150 kHz. USB interface for sending commands, digital I/Os, SPI interface. Plug & Play: ID chip for reading stage parameters. Available as OEM board or bench-top device. PIMikroMove user software, compatible with PI General Command Set (GCS)

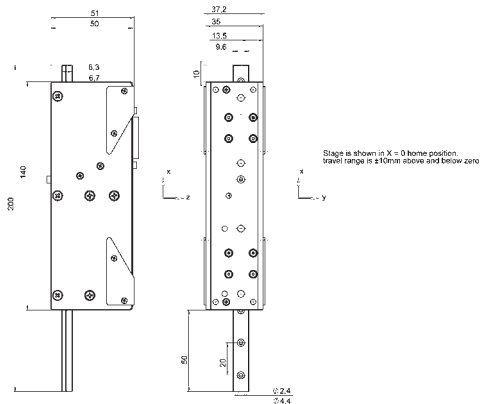
#### Fields of application

OEM drives in automation. For fast handling tasks and precision positioning in the micrometer range, micro-manipulation

Preliminary data	V-273	Unit	Tolerance
Active axes	X		
<b>Motion and positioning</b>			
Travel range	20	mm	
Integrated sensor	Optical linear encoder		
Servo update rate	10*	kHz	
Open-loop resolution	10*	nm	typ.
Closed-loop resolution	100	nm	typ.
Linearity error, closed-loop	1	%	typ.
Repeatability	±500	nm	typ.
Straightness of travel	±20	µm	±5
Velocity, open-loop	250	mm/s	max.
Velocity, closed-loop	200	mm/s	
<b>Mechanical properties</b>			
Bearing / guiding	Linear guiding		
Moved mass	56 (59 with force sensor)	g	typ.
<b>Drive properties</b>			
Motor type	PIMag™ voice coil drive, moving coil		
Magnet material	N52 (NdFeB)		
Coil resistance	16	Ω	typ., at 20 °C
Coil inductance	6	mH	typ., at 20 °C
Time constant	0.375	ms	
Mutual inductance	8	Vs/m	
Force constant	8	N/A	typ.
Motor constant	2	N/W <sup>1/2</sup>	
Current constant	0.125	A/N	
Average continuous current	400**	mA	max.
Peak current (max. 3 s)	800	mA	
Average push / pull force	3	N	nominal
Power dissipation with 100 % duty cycle	2.25	W	
Maximum push / pull force	8	N	max.
Power dissipation with 10 % duty cycle	16	W	
<b>Miscellaneous</b>			
Operating temperature range	10 to 60	°C	
Material	Aluminum		
Mass	565	g	±5 %
Cable length	1	m	
Motor / sensor connection	Sub-D 15 (m)		
Lifetime	>10 <sup>7</sup>	cycles	min.
Recommended controller	C-413		

\* With C-413 controller.

\*\* Allowable average value for continuous operation, not to be exceeded.



V-273, dimensions in mm



Optional force sensor on V-273