

# PIMag® High-Load Linear Stage

High Performance and Cost Efficiency, Linear Motor



## V-412

- Width 116 mm
- Travel range to 610 mm
- Nominal force 33 N
- Incremental or absolute linear encoder
- Precision recirculating ball bearings, load capacity to 400 N
- Covering strip on the side for protection against particles

### Reference-class linear stage

A new linear stage family with linear motors expands PI's product portfolio for industrial solutions. High-performance ironless linear motors, heavy-duty recirculating ball bearings, and precision linear encoders are used. The covering strip on the side and the purge air connection prevent contamination by particles.

### Pioneering design

Compared to the competition, the recirculating ball bearings of the V-412 series offer a higher load capacity and allow higher dynamics. The high resolution of the encoders allows improved tracking performance, smaller tracking error, and improved settling times. For maximum flexibility, it is possible to choose between incremental and absolute encoders. Absolute encoders supply explicit position information that enables immediate determination of the position. This means that referencing is not required during switch-on, which increases efficiency and safety during operation.

### PIMag® magnetic direct drive

3-phase magnetic direct drives do not use mechanical components in the drivetrain, they transmit the drive force to the motion platform directly and without friction. The drives reach high velocities and accelerations. Ironless motors are particularly suitable for positioning tasks with the highest demands on precision because there is no undesirable interaction with the permanent magnets. This allows smooth running even at the lowest velocities and at the same time, there is no vibration at high velocities. Nonlinearity in control behavior is avoided and any position can be controlled easily. The drive force can be set freely.

### Application fields

Laser cutting, Scanning, Digital printing, Electronics assembly and inspection, AOI (Automatic Optical Inspection), Automation, Flat screen manufacturing. Applications with high demands on dynamics, precision, smooth scan motion, short settling times, and low tracking error.

## Specifications

Motion	V-412.03	V-412.05	V-412.09	V-412.13	Unit	Tolerance
Active axes	X	X	X	X		
Travel range	52	102	204	305	mm	
Pitch / yaw	±9	±14	±19	±29	μrad	max.
Straightness / flatness	±1.5	±2.5	±4	±6	μm	max.
Velocity, unloaded	2000	2000	2000	2000	mm/s	max.
Positioning accuracy, uncalibrated	±3	±4	±8	±10	μm	typ.

Motion	V-412.17	V-412.21	V-412.25	Unit	Tolerance
Active axes	X	X	X		
Travel range	407	508	610	mm	
Pitch / yaw	±39	±48	±58	μrad	max.
Straightness / flatness	±8	±9	±10	μm	max.
Velocity, unloaded	2000	2000	2000	mm/s	max.
Positioning accuracy, uncalibrated	±12	±14	±15	μm	typ.

Encoder options	V-412.xxx211Ex	V-412.xxx025Ex	Unit	Tolerance
Integrated sensor	Incremental linear encoder	Absolute-measuring linear encoder		
Sensor signal	Sin/cos, 1 V peak-peak, 20 μm signal period	EnDat 2.2		
Design resolution	0.0003	0.001	μm	
Minimum incremental motion	5	10	nm	typ.
Bidirectional repeatability	±0.5	±0.5	μm	typ.
Limit switches	Hall effect, N/C contact, 5 V, NPN	–		

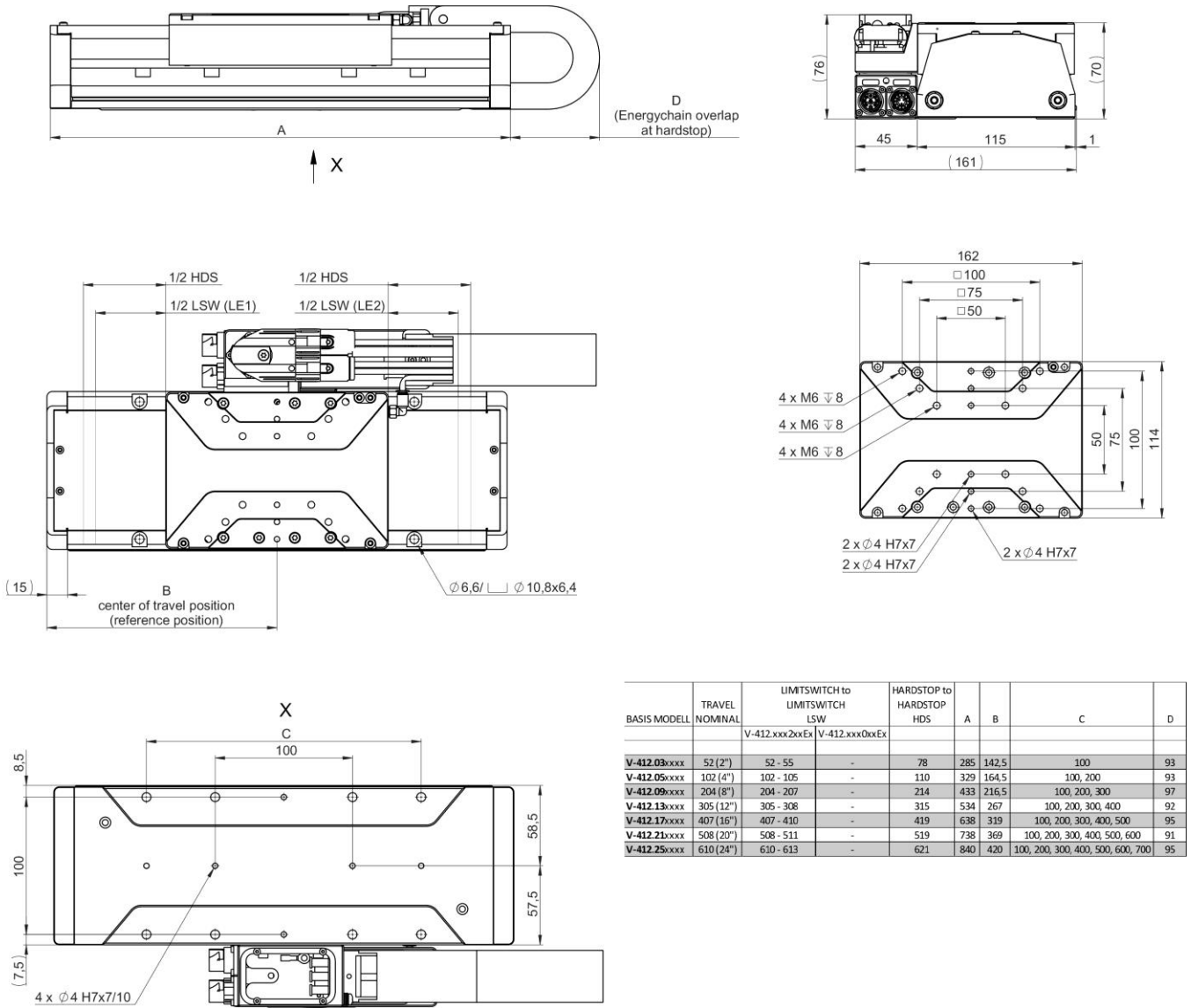
Mechanical properties	V-412.xxxxxx	Unit	Tolerance
Guide type	Recirculating ball bearing guide		
Load capacity in Z	400	N	max.
Permissible lateral force	200	N	max.
Permissible torque in $\theta_x$	20	N·m	max.
Permissible torque in $\theta_y$	15	N·m	max.
Permissible torque in $\theta_z$	20	N·m	max.

Drive properties	V-412.xx6	Unit	Tolerance
Drive type	Ironless 3-phase linear motor		
Intermediate circuit voltage, RMS	300	V DC	max.
Peak force	151	N	typ.
Nominal force	33	N	typ.
Peak current, RMS	7.55	A	typ.
Nominal current, RMS	2.39	A	typ.
Force constant, RMS	19.9	N/A	typ.
Motor constant	4	N/√W	typ.
Electrical time constant	0.19	ms	
Resistance phase-phase	8.69	Ω	typ.
Inductance phase-phase	1.4	mH	typ.
Back EMF phase-phase	8.1	V-s/m	max.
Pole pitch N-N	30.5	mm	

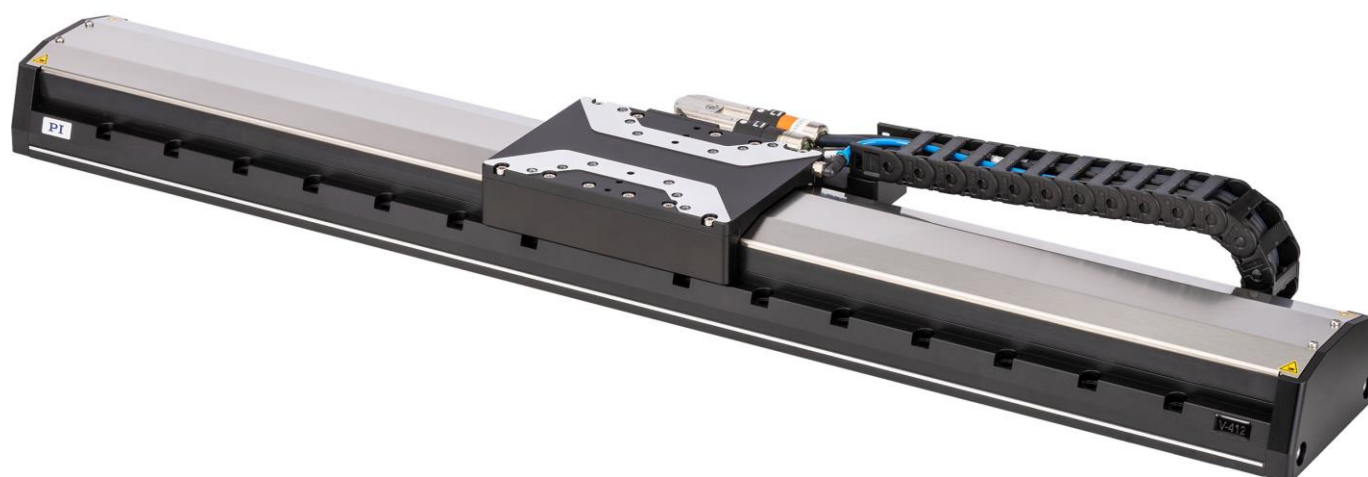
Miscellaneous	V-412	Unit	Tolerance
Material	Aluminum, black anodized stainless steel		
Overall mass	V-412.03 (52 mm travel range): 5.0 V-412.05 (102 mm travel range): 5.6 V-412.09 (204 mm travel range): 6.7 V-412.13 (305 mm travel range): 7.9 V-412.17 (407 mm travel range): 9.0 V-412.21 (508 mm travel range): 10.2 V-412.25 (610 mm travel range): 11.3	kg	±5 %
Moved mass	1.7	kg	±5 %
MTBF	20000	h	
Connector	M17 (motor) M17 (linear encoder) Fitting for purge air hose with outside diameter 4 mm		
Recommended controllers	ACS modular controller		

Connecting cables are not in the scope of delivery and must be ordered separately.

## Drawings / Images



V-412, dimensions in mm



*V-412 with 610 mm travel range.*

## Ordering Information

### **V-412.036025E0**

PIMag® high-load linear stage, 52 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, ironless 3-phase linear motor, to 300 V

### **V-412.036025E1**

PIMag® high-load linear stage, 52 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, drag chain, ironless 3-phase linear motor, to 300 V

### **V-412.036211E0**

PIMag® high-load linear stage, 52 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, ironless 3-phase linear motor, to 300 V

### **V-412.036211E1**

PIMag® high-load linear stage, 52 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, drag chain, ironless 3-phase linear motor, to 300 V

### **V-412.056025E0**

PIMag® high-load linear stage, 102 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, ironless 3-phase linear motor, to 300 V

### **V-412.056025E1**

PIMag® high-load linear stage, 102 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, drag chain, ironless 3-phase linear motor, to 300 V

### **V-412.056211E0**

PIMag® high-load linear stage, 102 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, ironless 3-phase linear motor, to 300 V

**V-412.056211E1**

PIMag® high-load linear stage, 102 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, drag chain, ironless 3-phase linear motor, to 300 V

**V-412.096025E0**

PIMag® high-load linear stage, 204 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, ironless 3-phase linear motor, to 300 V

**V-412.096025E1**

PIMag® high-load linear stage, 204 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, drag chain, ironless 3-phase linear motor, to 300 V

**V-412.096211E0**

PIMag® high-load linear stage, 204 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, ironless 3-phase linear motor, to 300 V

**V-412.096211E1**

PIMag® high-load linear stage, 204 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, drag chain, ironless 3-phase linear motor, to 300 V

**V-412.136025E0**

PIMag® high-load linear stage, 305 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, ironless 3-phase linear motor, to 300 V

**V-412.136025E1**

PIMag® high-load linear stage, 305 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, drag chain, ironless 3-phase linear motor, to 300 V

**V-412.136211E0**

PIMag® high-load linear stage, 305 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, ironless 3-phase linear motor, to 300 V

**V-412.136211E1**

PIMag® high-load linear stage, 305 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, drag chain, ironless 3-phase linear motor, to 300 V

**V-412.176025E0**

PIMag® high-load linear stage, 407 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, ironless 3-phase linear motor, to 300 V

**V-412.176025E1**

PIMag® high-load linear stage, 407 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, drag chain, ironless 3-phase linear motor, to 300 V

**V-412.176211E0**

PIMag® high-load linear stage, 407 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, ironless 3-phase linear motor, to 300 V

**V-412.176211E1**

PIMag® high-load linear stage, 407 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, drag chain, ironless 3-phase linear motor, to 300 V

**V-412.216025E0**

PIMag® high-load linear stage, 508 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, ironless 3-phase linear motor, to 300 V

**V-412.216025E1**

PIMag® high-load linear stage, 508 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, drag chain, ironless 3-phase linear motor, to 300 V

**V-412.216211E0**

PIMag® high-load linear stage, 508 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, ironless 3-phase linear motor, to 300 V

**V-412.216211E1**

PIMag® high-load linear stage, 508 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, drag chain, ironless 3-phase linear motor, to 300 V

**V-412.256025E0**

PIMag® high-load linear stage, 610 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, ironless 3-phase linear motor, to 300 V

**V-412.256025E1**

PIMag® high-load linear stage, 610 mm travel range, 116 mm width, 400 N load capacity, absolute linear encoder with EnDat 2.2 signal transmission, 1 nm sensor resolution, drag chain, ironless 3-phase linear motor, to 300 V

**V-412.256211E0**

PIMag® high-load linear stage, 610 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, ironless 3-phase linear motor, to 300 V

**V-412.256211E1**

PIMag® high-load linear stage, 610 mm travel range, 116 mm width, 400 N load capacity, incremental linear encoder with sin/cos signal transmission, 20 µm signal period, drag chain, ironless 3-phase linear motor, to 300 V