PIMag™ VC Linear Actuator

COST-EFFECTIVE WITH HIGH DYNAMICS

- 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

V-273

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

<table>
<thead>
<tr>
<th>Active axes</th>
<th>X</th>
</tr>
</thead>
</table>

Motion and positioning

<table>
<thead>
<tr>
<th>Travel range</th>
<th>20 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated sensor</td>
<td>Optical linear encoder</td>
</tr>
<tr>
<td>Servo update rate</td>
<td>10 kHz</td>
</tr>
<tr>
<td>Open-loop resolution</td>
<td>10 nm typ.</td>
</tr>
<tr>
<td>Closed-loop resolution</td>
<td>100 nm typ.</td>
</tr>
<tr>
<td>Linearity error, closed-loop</td>
<td>1 % typ.</td>
</tr>
<tr>
<td>Repeatability</td>
<td>±500 nm typ.</td>
</tr>
<tr>
<td>Straightness of travel</td>
<td>±20 µm ±5</td>
</tr>
<tr>
<td>Velocity, open-loop</td>
<td>250 mm/s max.</td>
</tr>
<tr>
<td>Velocity, closed-loop</td>
<td>200 mm/s</td>
</tr>
</tbody>
</table>

Mechanical properties

| Bearing / guiding | Linear guiding |
| Moved mass | 56 (59 with force sensor) g typ. |

Drive properties

| 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 mH |
| Force constant | 8 N/A typ. |
| Motor constant | 2 N/W1/2 |
| 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 |

Miscellaneous

| 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 | >107 cycles min. |
| Recommended controller | C-413 |

* With C-413 controller.
** Allowable average value for continuous operation, not to be exceeded.
PIMag™ VC Vertical Linear Actuator

COMPACT WITH INTEGRATED POSITION SENSOR

V-900KPI

- Travel range 1.5 mm
- High scanning frequencies, fast step-and-settle
- Integrated linear encoder, 0.1 µm resolution
- Wear-free flexure guiding for long lifetime
- Compact design

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PIMag™ C-413 digital 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, micromanipulation.
### Preliminary data

<table>
<thead>
<tr>
<th>V-900KPIC</th>
<th>Unit</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active axes</td>
<td>Z</td>
<td></td>
</tr>
</tbody>
</table>

#### Motion and positioning

- **Travel range**: 1.5 mm
- **Integrated sensor**: Optical linear encoder
- **Servo update rate**: 10* kHz
- **Open-loop resolution**: 10* nm typ.
- **Closed-loop resolution**: 100 nm typ.
- **Closed-loop linearity error**: ±1% typ.
- **Repeatability**: ±500 nm typ.
- **Straightness of travel**: ±5 µm typ.
- **Maximum velocity, open-loop**: 250 mm/s
- **Velocity, closed-loop**: 45 mm/s

#### Mechanical properties

- **Moved mass**: 10 g typ.
- **Average push / pull force**: 0.5 N nominal
- **Maximum push / pull force**: 0.8 N max.
- **Force constant**: 4 N/A typ.

#### Drive properties

- **Motor type**: PIMag™ voice coil drive
- **Magnet material**: NdFeB (N38SH)
- **Coil resistance**: 8.8 Ω typ.
- **Coil inductance**: 0.8 mH typ.
- **Average continuous current**: 120** mA max.
- **Peak current (max. 3 s)**: 200 mA

#### Miscellaneous

- **Operating temperature range**: 10 to 45 °C
- **Material**: Aluminum
- **Mass**: 40 g ±5 %
- **Cable length**: 0.2 m
- **Motor / sensor connection**: Molex 12-pin
- **Lifetime**: >10⁸ cycles min.
- **Recommended controller**: C-413 (plug adapter required)

* With C-413 controller.
** Allowable average value for continuous operation, not to be exceeded.

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V-900KPIC, dimensions in mm

*The settling time for a 100 µm step is approx. 50 ms.*
PIMag™ Motion Controller

CONTROL OF FORCE, POSITION AND VELOCITY

Digital motion controller for PIMag™ Voice Coil drives
2 motor channels, 4 sensor channels. PID controller for force, position and velocity. Servo update rate selectable between 5 to 10 kHz

Force control
With the force control, PIMag™ actuators and stages can be operated at a defined holding and feed force. Force and position sensors are read and the sensor values are processed simultaneously. Thus it is possible to add a secondary position or velocity control loop to the force control. PI offers PIMag™ actuators with additional force sensor. The models C-413.20A / .2GA provide analog input sockets for external force sensors

Extensive functionality
Data recorder: Recording of operating data such as motor current, velocity, position or position error. Wave generator: Saves and outputs periodical motion profiles. Auto zero function defines holding current level at which the drive in open-loop operation outputs a force of 0 N , e.g. for compensating gravity. ID chip support: Identifies the connected stages and simplifies configuration and exchange of stages. Supports direction-sensing reference point switches. Extensive software support, e.g. for LabVIEW, dynamic libraries for Windows and Linux

Interfaces
USB 2.0, SPI for sending commands. Digital inputs and outputs for automation. Optional analog inputs and outputs, e.g. for sensors, for sending commands or for position feedback

Specifications

<table>
<thead>
<tr>
<th>Preliminary data</th>
<th>C-413.20 / C-413.20A</th>
<th>C-413.2G / C-413.2GA</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>PIMag™ motion controller for voice coil drives, 2 channels C-413.20 / .20A: OEM board C-413.2G / .2GA: Device with case</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor channels</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor channels</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motion and control</td>
<td>PID controller for force, position and velocity; parameter change on-the-fly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servo characteristics</td>
<td>100 µs to 200 µs, selectable in 4 steps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profile generator</td>
<td>Trapezoidal velocity profile, setting of maximum velocity and acceleration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encoder input</td>
<td>SPI sensor interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference point switches</td>
<td>4 × TTL, direction-sensing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical properties</td>
<td>Max. output voltage</td>
<td>24</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Max. output current</td>
<td>±1.5</td>
<td>A, closed-loop</td>
</tr>
</tbody>
</table>
Interface and operation

Communication interfaces
- USB 2.0, real time SPI

Motor connector
- Sub- D 15- pin (f)

I/ O port
- 2 x analog inputs, -10 to 10 V, 16 bit, 1 kHz
  (only C-413.20A and C-413.2GA)
- 2 x analog outputs, -10 to 10 V, 17 bit, 1 kHz
  (only C-413.20A and C-413.2GA)
- 6 x digital outputs
  (open collector, voltage range 5 V to 24 V,
   33 kΩ internal pull- up to 5 V)
- 4 x digital input
  (5 V TTL level, to 24 V max. input voltage, 10 kΩ input resistance)

Command set
- PI General Command Set (GCS)

User software
- PIMikroMove

Software drivers
- LabVIEW driver, dynamic libraries for Windows and Linux

Supported functionality
- Point- to- point motion; data recorder; wave generator; auto zero; ID chip detection

Miscellaneous

Operating voltage
- External power supply 24V, included in scope of delivery

Max. operating current
- 2 A

Operating temperature range
- 5 to 50 °C

Max. mass
- 0.3 kg

Dimensions
- 188 × 28 × 105 (C-413.2G / .2GA)
- 160 × 18 × 100 (C-413.20 / .20A)

Order Information

C-413.20
PIMag™ Motion Controller, 2 Channels, USB Interface, OEM Board, Force Control Option

C-413.20A
PIMag™ Motion Controller, 2 Channels, USB Interface, Analog Inputs, OEM Board, Force Control Option

C-413.2G
PIMag™ Motion Controller, 2 Channels, USB Interface, Bench- Top Device, Force Control Option

C-413.2GA
PIMag™ Motion Controller, 2 Channels, USB Interface, Analog Inputs, Bench- Top Device, Force Control Option

Ask about custom designs!

Drawings / Images

C-413 with case, dimensions in mm