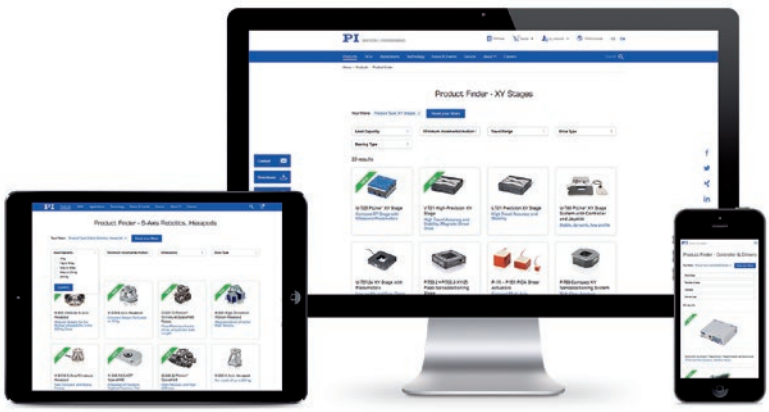
PI


PIGLIDE
REPEATABILITY
BALL SCREW
VOICE COIL
MICRO
AIR BEARING
POSITIONING
PRECISION POSITIONING
AND MOTION CONTROL
NANOPOSITIONING
ENGINEERED SYSTEMS
DIRECT DRIVE
ACCURACY
LINEAR MOTOR
HIGH DYNAMICS
PIMAG®

Precision Positioning and Motion Control



Product Finder Online – What is the easiest way for you to find the best positioning solution?

The printed catalog is a major showcase for PI and, as well as presenting the entire product range, it also acts as a reference for all of our motion solutions. However, to take advantage of the latest products and developments, we recommend using the product finder on the PI website www.pi.ws.

How to use the product finder:

Select the product type specified by the axes of motion required. Selection of more criteria expands or shortens the list of results. Select more than one filter at a time, for example, to find positioning stages designed for higher load capacity, too.

INTRODUCTION

PRODUCTS

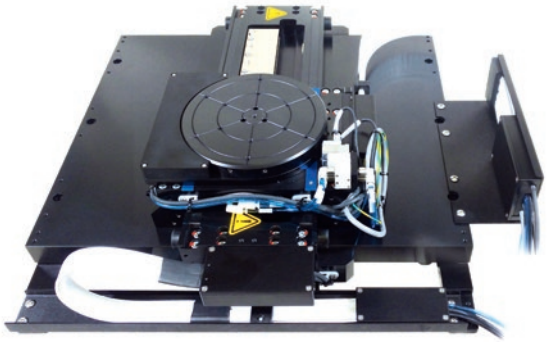
More information, step-files and downloads are available from our website www.pi.ws.
All data subject to change without notice, ©PI 2018.

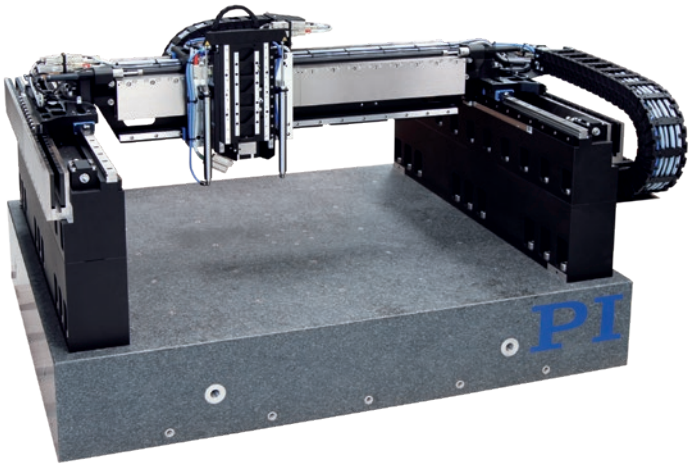
Markets and Applications

SEMICONDUCTOR PRODUCTION AND INSPECTION

The automation of process steps in production and inspection is steadily on the increase. At the same time, the requirements to accuracy required in motion and positioning are growing. Today, in many industrial areas accuracy levels are needed as they were needed just a few years ago in research institutions. PI with its linear stages, rotation stages, and lifting stages, as well as more complex multi-axis kinematics, offers excellent solutions for industrial applications in many growing markets and even for very general automation tasks with challenging specifications.

The requirements to the straightness and flatness, and the precision are particularly high in the production and inspection of semiconductors or circuit boards. High dynamics of the motion axis are required for an optimized throughput. In this case, a standard A-311 stage with a 200 mm × 200 mm travel range in XY carries a customized rotation stage. All stages have air bearings to warrant the best flatness and direct drives for precision and high dynamics positioning. In addition, it is possible to hold a stable position



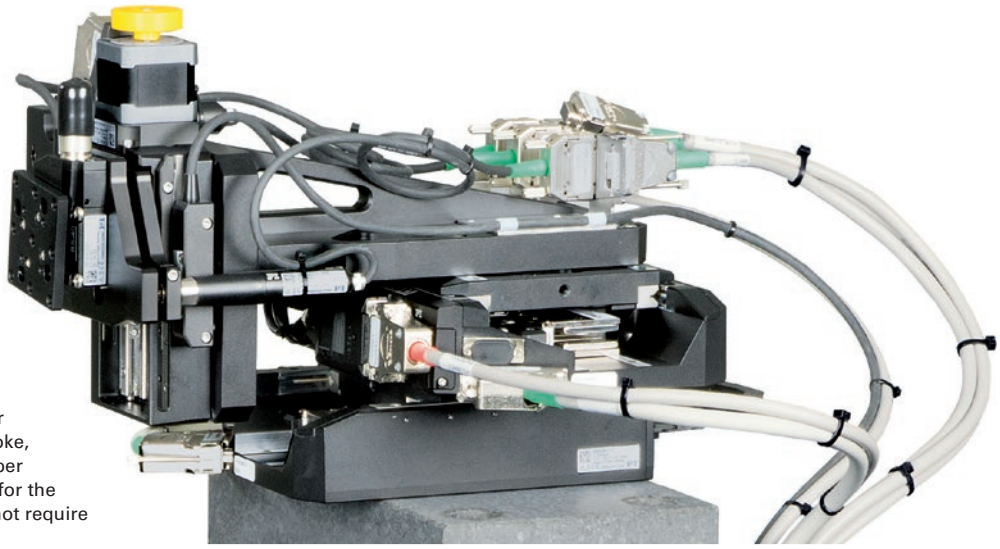


The semiconductor industry often requires very specific solutions, e.g., for wire or ball bonders. PI's Gantry systems are an ideal basis for customized adaptations. The strokes and the stacking height can be varied almost arbitrarily, the configuration of the motors provides extremely high accelerations of up to 5 g and this ensures the highest productivity in the application. Control features of ACS motion controllers such as “Input Shaping” help to build a stable system which actively suppresses possible vibrations

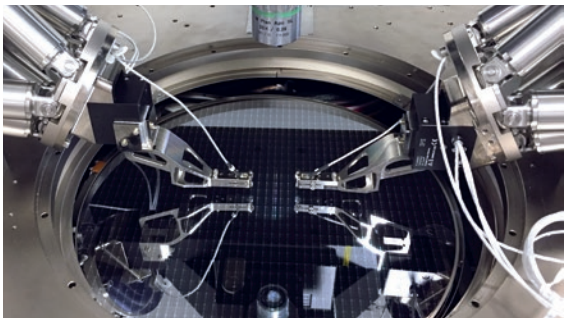
Wafer inspection system with integrated linear motor axes for fast precision XY scanning. Stepper motor axis for fine vertical position of the inspection equipment

PHOTONICS PACKAGING AND OPTICAL ALIGNMENT

During production and inspection of components with optical data transmission, it is important to align fibers or fiber arrays for optimum connection with the highest possible accuracy. Position tolerances way under 50 nm are usual and multi-channel inputs and outputs require simultaneous alignment in several axes.



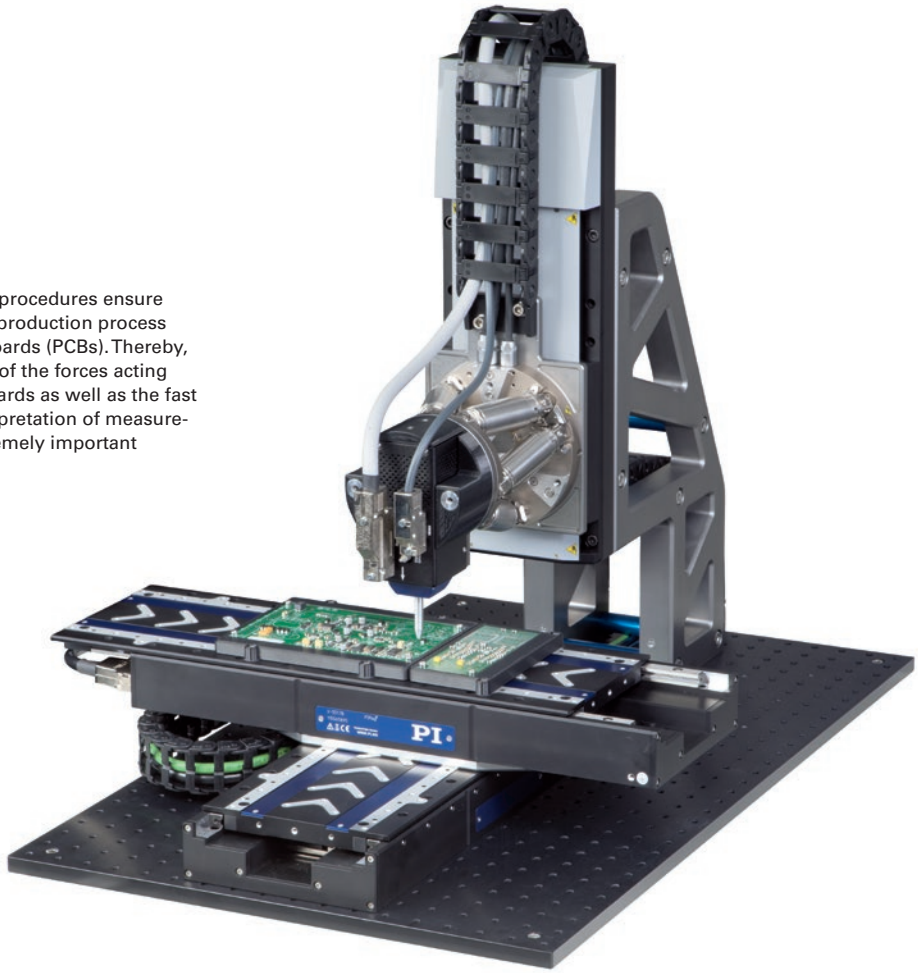
In this multi-axis system for wafer inspection and photonics alignment, high speed linear motor stages are used for the long xy stroke, while mechanical stages with stepper motors and screw drives are used for the other degrees of freedom that do not require too high dynamics



18-axis double alignment system provides fast NxM alignment of SiP devices in wafer probers. Cascade Microtech's pioneering CM300xi photonics-enabled engineering wafer probe station integrates PI's parallel-kinematic Fast Multichannel Photonics Alignment systems for high throughput, wafer-safe, nano-precision optical probing of on-wafer Silicon Photonics devices. (Image: Cascade Microtech, a FormFactor company)

In photonics, automated alignment is the key to high throughput and outstanding quality. The basis of this optical alignment system is a very stiff XYZ set-up consisting of three motorized linear stages and a P-616 NanoCube® piezo nanopositioner. The low overall height simplifies integration in limited installation space. The motorized drives make longer travel ranges possible and at the same time, the NanoCube® nanopositioner ensures fast scanning motion and dynamic compensation of drift effects. Flexure guides and all-ceramic insulated PICMA® actuators guarantee a long lifetime. Because all drives are equipped with position sensors, it is possible for example, to reliably prevent collisions with expensive silicon wafers

Markets and Applications



Automated testing procedures ensure quality, e.g., in the production process of printed circuit boards (PCBs). Thereby, the precise control of the forces acting on the sensitive boards as well as the fast capturing and interpretation of measurement data are extremely important

INDUSTRIAL MANUFACTURING

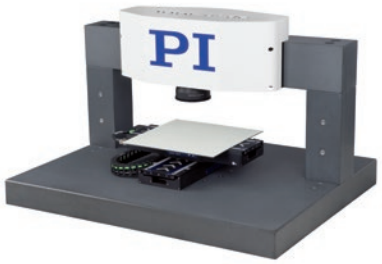
The field of industrial manufacturing and assembly offers the widest range of applications for the PI micropositioning stages. In many applications the precision requirements keep growing for industrial application.

For example, digital printing becomes more and more common. The accuracy of the separate dots needs to be better than 20 µm to be recognized as equidistant by the human eye. This requires motion technology providing an accuracy typically 10 times higher meaning 2 µm, as well as motion with constant speed, good straightness and flatness.

Another example is force-controlled testing of a touch screen, a keyboard or electronic car keys, as well as the control of force with which small parts are being assembled. Here, PI offers advanced solutions for those markets using its proprietary voice coil and force sensor technologies.

LASER MATERIAL PROCESSING

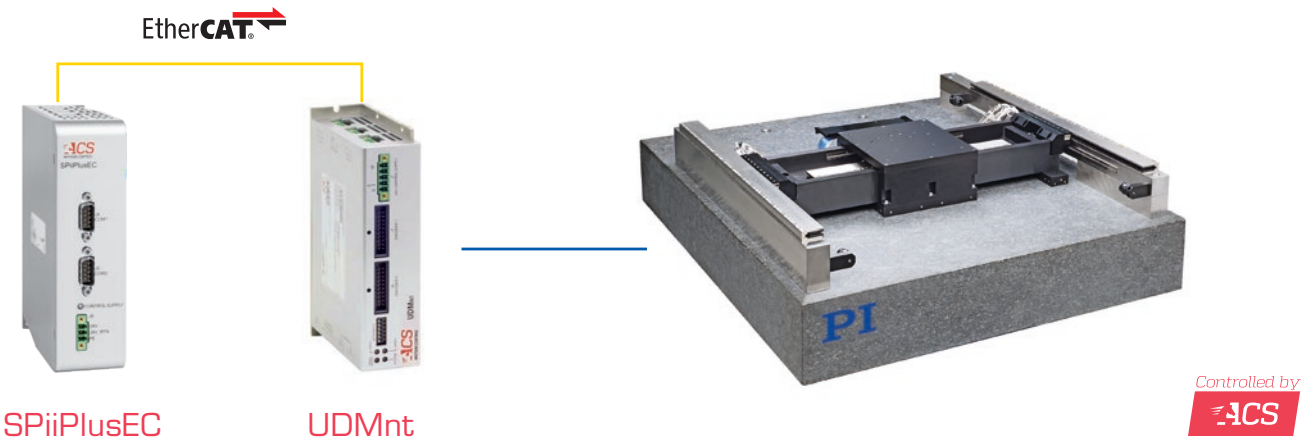
Laser cutting for example, often requires lowest tracking errors while following the arbitrary path of the customer's workpiece. This means very dynamic multi-axis motion that is ideally realized by using linear motor solutions which combine dynamics and accuracy. An additional vertical motion is typically realized using a ball screw stage. For improved dynamics in the Z-direction, a linear motor axis can be equipped with a mechanical, magnetic or pneumatic weight balance. These applications can be served with standard linear stages with a debris protection or with fully customized solutions.



PI's dynamic positioning systems combined with ACS motion controllers become fast, productive systems which, with the help of lasers, can label, mark, rip, cut, or drill

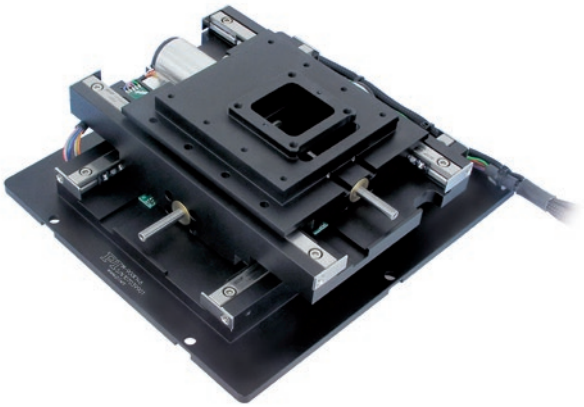
Building Highly Productive Laser Systems

ACS Motion Control, as part of the PI group, allows to supply highly sophisticated Motion Controller and Universal Drive Modules for the control of laser processing applications. Control of the laser power and the triggering of the laser is done by the LCMV2 Laser Control Module. A dedicated software to create a custom specific Human Machine Interface (HMI) is available as well. Additionally integrating a 3rd party galvo scanner allows to decouple the high and the low frequencies of motion: The high frequencies will be covered by the galvo scanner and the low frequency motions will be executed by PI linear stages. The resulting possibilities for the overlapping motion of the scanner and stages are practically unlimited and allow to create best-productivity systems with high-precision motion without any stitching errors.

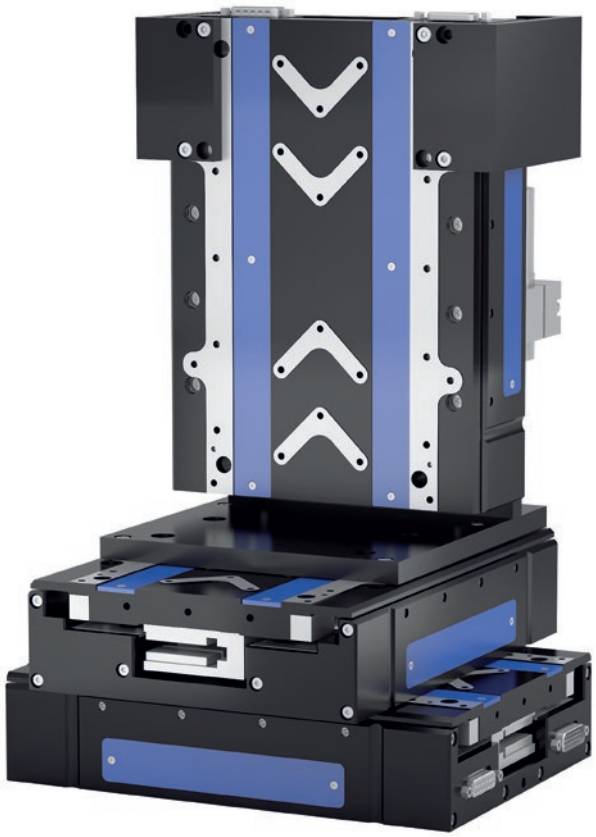


ACS Motion Control and PI motion systems are perfectly matched to each other. A solution from a single-source supplier does not just offer the customer sophisticated positioning technology and high-performance control solutions, but also faster start-up and high flexibility when implementing new requirements

Markets and Applications



Typical 2-axis setup with clear aperture for the scanning of larger surfaces



3-axis combination of linear motor stages. The vertical axis uses weight compensation and it can, therefore, move with high dynamics while, at the same time, offering the best positioning accuracy

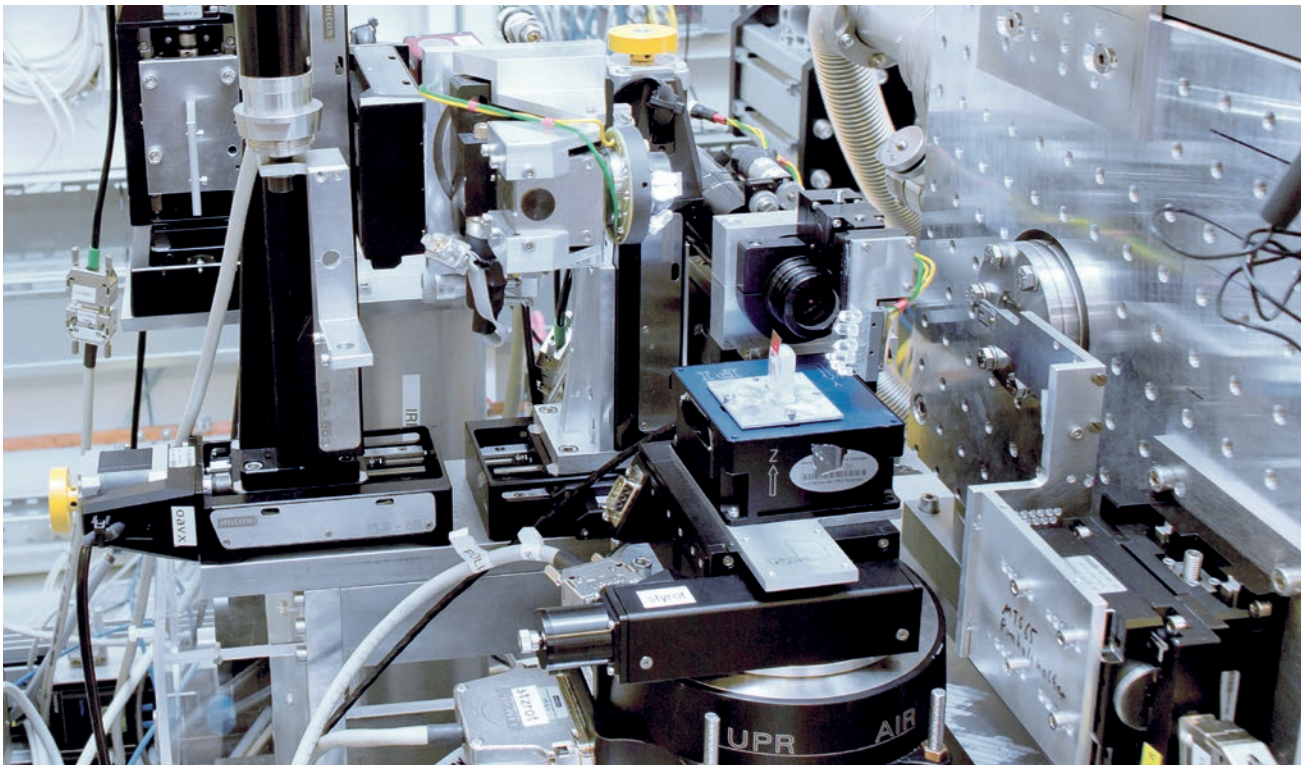
AUTOMATED OPTICAL INSPECTION (AOI)

The field of optical inspection widens as the requirements in quality assurance are growing higher and higher. There are different ways of inspecting devices like PCB, electronic components, and medical samples.

The easiest way is to move from **point to point**, stop, and take a picture. This requires fast step-and-settle times and a high stability when on target position. To cover large surfaces will take a long time.

To increase productivity, it is very common to do a **meander scan**. While one axis generates a motion with constant speed, the perpendicular axis moves one step to the next line. Pictures are taken during the constant speed motion which leads to high requirements in straightness and flatness of those stages.

In many cases an additional Z-stage is used for autofocusing during the scan. Those Z-stages typically carry the objective and have to execute a high-bandwidth, very fast short-stroke motion. Depending on the requirements in stroke, PI offers different solution for the vertical systems.



The sample positioning setup inside the holography endstation uses a variety of PI's motorized translation and rotary stages, as well as piezo stages for ultra-fine positioning (Image: M. Osterhoff, Institute for X-Ray Physics, Georg-August-University Göttingen)

BASIC RESEARCH, SCIENTIFIC INSTRUMENTATION

Why scientists rely on PI: Creativity for Research and Development. Many scientific publications cite PI systems because they are an important prerequisite for successful research and development projects. Customized designs for university research are everyday business for PI, also for environmental conditions such as UHV to 10^{-10} hPa, radiation, or strong temperature changes down to the cryogenic range. The spectrum reaches from completely new designs to small modifications of standard products for a better adaptation to the application. Important fields of research are, for example, beamline instrumentation, micro systems and nanotechnology.

Compact linear translation stage that features two separate moving plates on one guiding

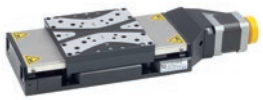
Hybrid drive, consisting of electric motor and piezo actuator, for optimum positioning accuracy and minimum path deviation

Motorized Standard Products Overview

Linear Actuators

- Optional force control
- Screw or voice coil drive
- Compact




Linear Stages

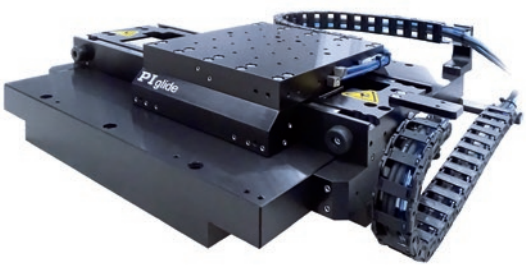
- Travel range up to several 100 mm
- Screw or direct drive
- Mechanical or air bearing
- Incremental or absolute encoders
- Vacuum or clean room compatible

Rotary Stages

- 360° or goniometer stages
- Worm or direct drive
- Mechanical or air bearing
- Incremental or absolute encoders
- Vacuum or clean room compatible


XY Stages

- Screw or direct drive
- Mechanical or air bearing
- Incremental or absolute encoders
- Optional aperture

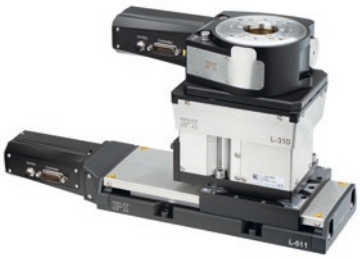


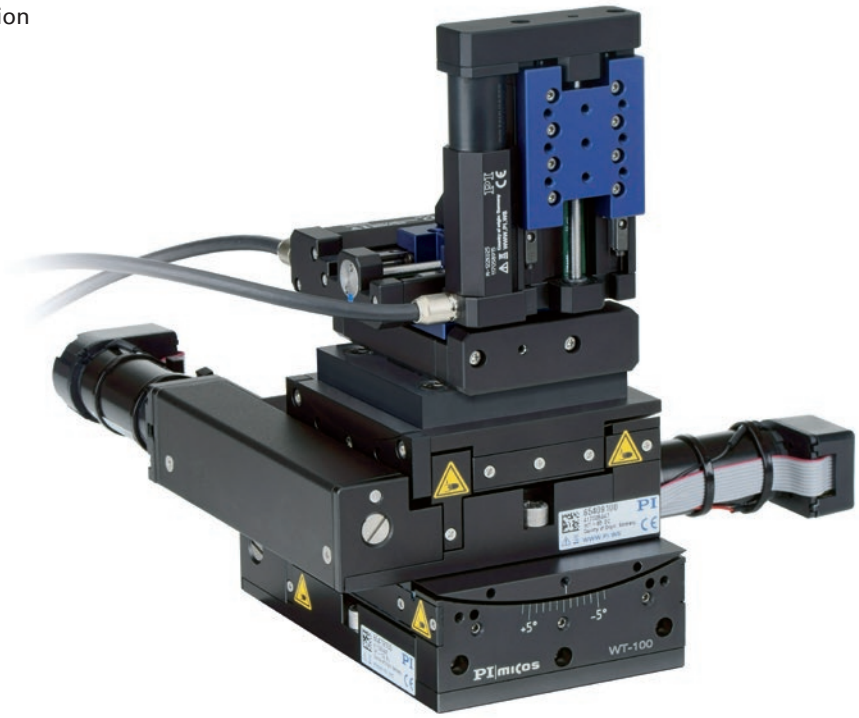
Broad Range of Standard Axes

The PI Group has many years of experience in the development and construction of highly complex motion systems with the highest precision classes. The experience gained over the years, mainly from customized solutions, has been transferred to the standard products. As a result, a broad spectrum of standard positioning systems has been established, which offers many options within the individual series such as variable travel ranges, different motors, or adaptations to different ambient conditions such as a vacuum and clean-room environments. Today, the use of PI positioning systems is very common in robust industrial environments with high demands on lifetime and productivity.

Stacked Systems Configured from Standard Products

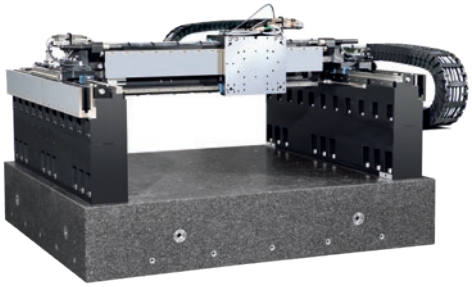
- Flexible
- Fast to adapt to custom application
- Cost-efficient solution





Integrated System Solutions

- Gantries with industrial motion controllers
- Fast multi-channel photonics alignment systems

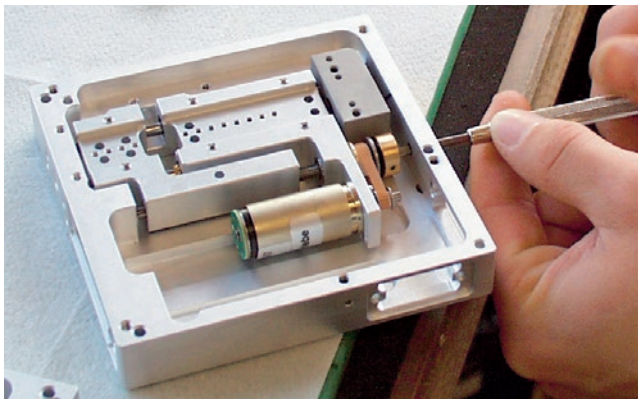


Technological Depth for Optimized Products

From Standard to Custom Products

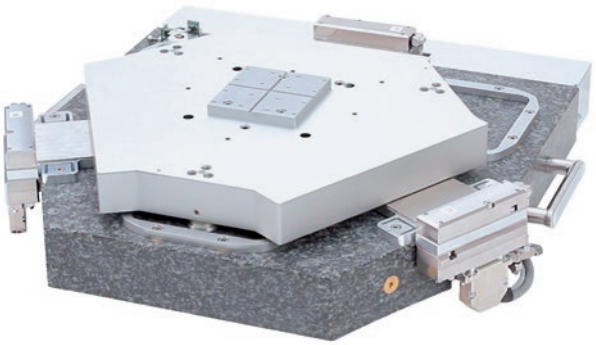
Customization on all levels of integration

PI's proprietary technological know-how and vertically integrated production are the basis for the successful development of customized motion systems from scratch. All technologies can be adapted specifically to an application. Examples range from a PIMag® voice coil drive for integration into an OEM system, to complex multi-axis positioning setups, to fully integrated, turn-key system solutions.



Individual assembly of a stage

PI produces core components in-house for its precision positioning systems. This applies to sensors, electronics, and motors as well as certain milled parts with particularly low tolerances



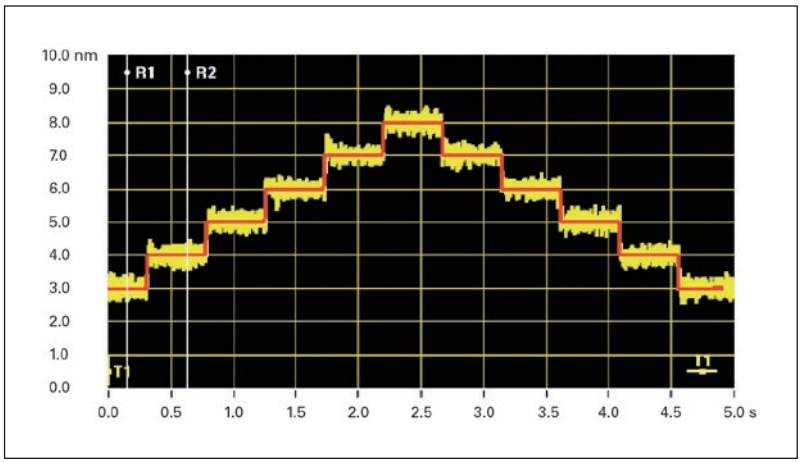
PI's own development of guiding technologies allows the design of individual solutions. Linear guiding technologies such as flexures for small displacements, air bearings for extreme requirements on travel accuracy, or magnetic levitation for the highest demands in up to six degrees of freedom are developed in-house. Leveraging of long-standing piezo technology at PI Ceramic, PI is able to manufacture ceramic bearings in its own facilities. For many requirements, mechanical bearings in different precision grades from highly qualified suppliers are used

Systems From a Single Source

The controller technology of ACS Motion Control ensures that even complex industrial applications can be managed by one single source. This means that PI can offer ideal solutions from one single source to meet the demands of the most diverse industries, which all need reliable, durable technology with increasing levels of precision.

Modular multi-axis controllers from ACS for automation control are based on an internal EtherCAT network. This modular technology allows to control stages needing a bus voltage from 24 VDC up to 560 VDC and a peak current of 5 A up to 90 A. The ACS control technologies are designed especially for direct drives such as voice coils and linear motors in the best possible way enabling fast settling times, high speed stability and low jitter

OEM controllers from PI meet customers' requirements in every aspect. They are available for any drive technology and can be adapted to include special functions such as force control



Positioning stages with PIMag® linear motor and with PIOne measuring system allow minimum incremental motion and the highest precision such as for example, the V-551.xD linear stage. The diagram shows steps from 1 nm and the idle noise of <±0.4 nm. In the linear motor axes, this precision can be combined with long travel ranges, high velocities, and accelerations

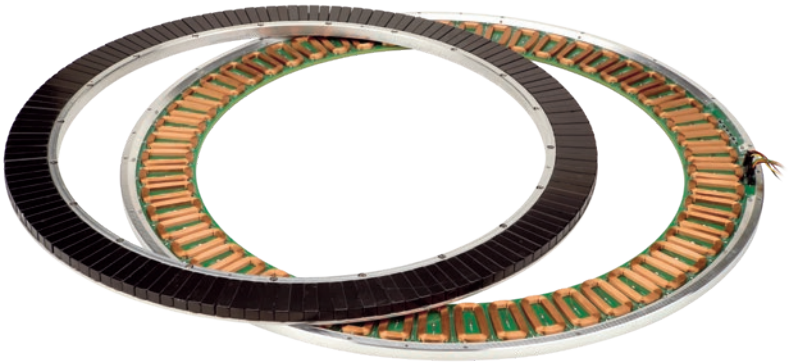
Compact motion control solutions permit the control of individual axes with different drive technologies such as stepper, DC or linear motors and piezo-based drives. The modular design allows a subsequent adaptation of the network while using one common control interface

Technological Depth for Optimized Products

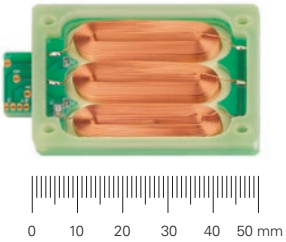
From Standard to Custom Products

In-House Technological Expertise

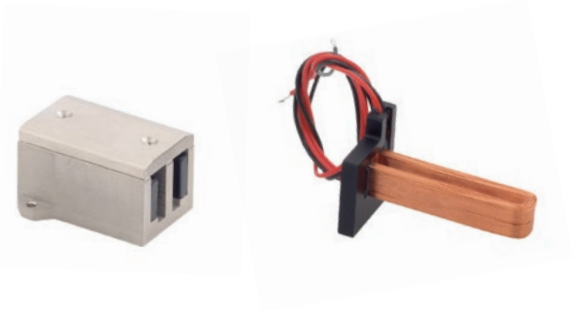
All decisive technologies required for the drive or motor, the measuring system, the motion controller, and the guiding system, are available in-house. To serve industrial applications, in-house development and the production capabilities of PIMag® magnetic drive and Plglide air bearing technologies are essential. PI also has production capabilities for high-end mechanical parts such as the milling of components with lowest tolerances.



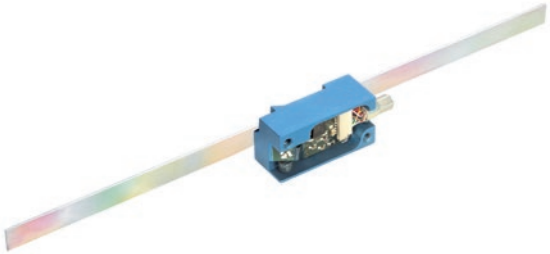
Commercially available torque motors offer very high torque but only limited apertures. This customized PIMag® torque motor has a particularly large aperture and it positions with high dynamics and stability while needing minimal installation space. It can be integrated as a rotation stage on top of a PI hexapod



PIMag® linear motors with or without iron core are the result of in-house development. In this way, specific properties of the stages and axes can be influenced directly. PI is in a position to develop customized linear motor and voice coil solutions not only for standard products but also for customized OEM solutions, where special features are needed. In most cases, the form factor of such a motor will be customized and adapted to the customers' needs



PIMag® voice coil drives can be designed with a particularly compact size and they can be directly integrated into the customers' application. The PIMag® technology and dedicated simulation tools allow to optimize the force-to-size ratio for a required form factor

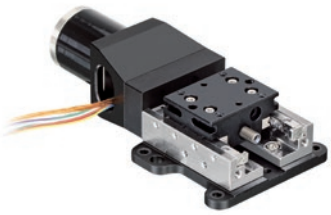


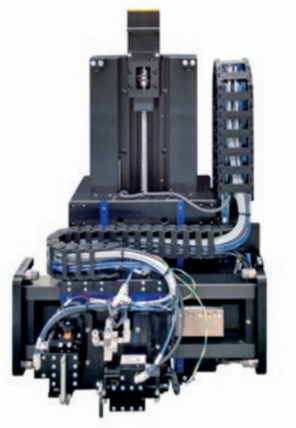
The highly precise PIOne linear encoder, one of PI's own measurement systems, permits a signal period to 0.5 µm. In the controller, sine/cosine signals are evaluated which allow for a very high position measurement accuracy of down to a fraction of a nanometer

Custom Examples Picture Wall

56 motors, 16 motion controllers, and 20 tons weight make the system for Microscopy and Quality Assurance (MiQA). The unique system integrates hexapods, rotation stages, goniometers, and a custom sample stage and will be used in a beamline for X-ray microscopy and the qualification of X-ray optics. Virtually all available PI technologies are combined here in a highly specialized solution providing the best possible accuracy for this application, resulting in 80 nm at the tool center point over multiple stacked axes

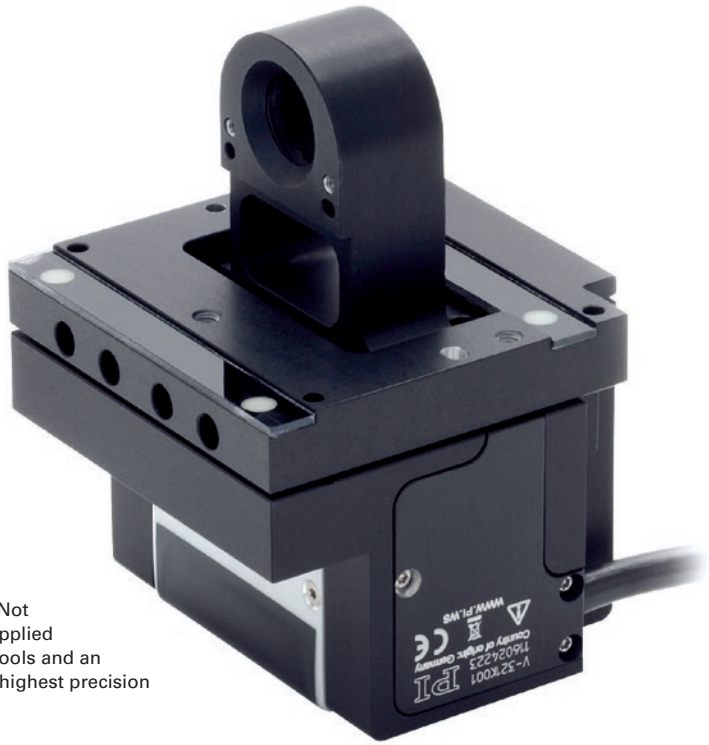
Focusses an objective in space: Linear stage for the "Mars 2020" NASA mission



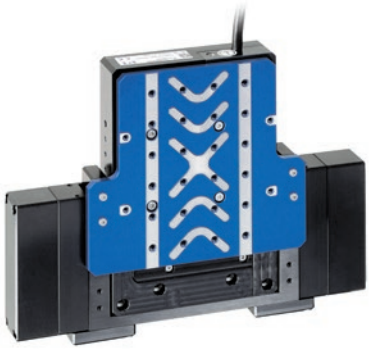


Coordinate measuring machines (CMM) and metrology tools use a variety of design architectures, including moving gantries, static gantries, cantilevered XYZ, and many others. The most common type of CMM is composed of three orthogonal axes (X, Y, and Z) operating in a three-dimensional coordinate system. Each axis has a position encoder that indicates the position of that axis. The machine will read the input from the touch probe, as directed by the operator or computer program. The machine then utilizes the X, Y, and Z coordinates of each of these discrete points to determine size and position of the part being measured

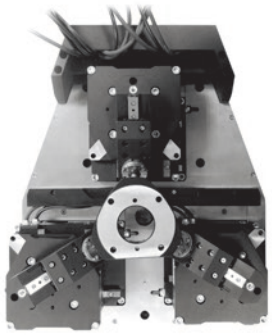
Custom Examples Picture Wall



Complete autofocus system with PIMag® voice coil drive. Not only the voice coil stage is supplied by PI but also the alignment tools and an alignment routine to warrant highest precision assembly of the payload



The dynamics and precision of voice coil or linear motor stages is required in vertical direction as well. For an improved position stability PI offers various solutions for a counter balance system which can be based on springs, magnetic solutions and pneumatic cylinders. The picture shows a modified V-528 standard product with PIMag® direct drive and gravity compensation for vertical applications. The compensation is done by a constant force spring and is adjusted precisely to the customers payload



Customized parallel-kinematics stage with six degrees of freedom. The PIMag® linear motors ensure high dynamics and precision as required in optical alignment or fiber alignment. The solution is based on 3 XY stages which are driven by linear motors that allow high dynamics for the precision alignment. The SpaceFAB parallel kinematic allows a very flat design with long strokes in x and y. In comparison to a PI Hexapod, the footprint of the SpaceFAB is relatively large, and the hexapod is better suited for longer vertical strokes

The PI Group – A Strong Partner for Industry and Research

The PI headquarters in Karlsruhe, Germany, manifests the continuous growth. In front, the 2017 Technology Center

Over the last four decades, PI (Physik Instrumente) has developed into the leading manufacturer of nanopositioning technology. The key element and motivation of the entrepreneurial behavior have always remained the same: Finding the best possible solution for the customer.

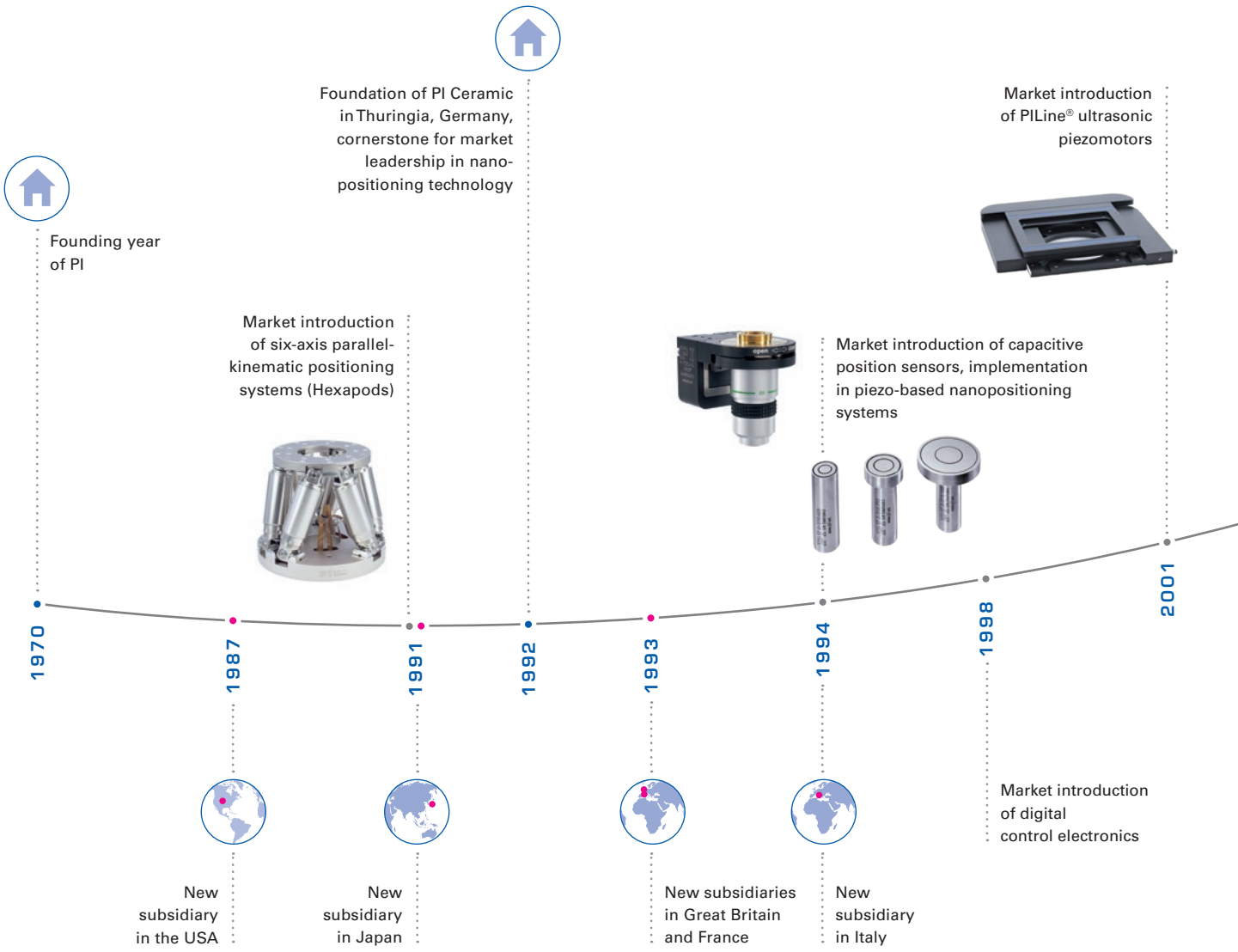
PI is well known for the quality of its products and has been one of the leading players in the global market for precision positioning technology for many years. One of the most important building blocks for this is the team spirit within the international PI family, which is based on mutual understanding and support that goes beyond international borders and functional restrictions.

PI is a privately owned company with healthy growth, more than 1000 employees worldwide and a flexible, vertically integrated organization, which enables PI to fulfill almost any request in the field of innovative precision positioning technology. The foremost priority for PI is to be a reliable and highly qualified partner for the customer.

The PI Group Milestones

A Success Story

Well known for the high quality of its products, PI (Physik Instrumente) has been one of the leading players in the global market for precision positioning technology for many years. PI has been developing and manufacturing standard and OEM products with piezo or motor drives for more than 40 years. In addition to four locations in Germany, the PI Group is represented internationally by fifteen sales and service subsidiaries. All of our customers worldwide can rely on this.



2002

Market introduction of the PICMA® multilayer piezo actuators

New subsidiary in China

2004

Market introduction of the NEXLINE® high-performance piezo linear drives

2007

Market introduction of NEXACT® piezo linear drives

2011

Acquisition of majority shares in miCos GmbH, Eschbach, Germany

New subsidiaries in Korea and Singapore

2014

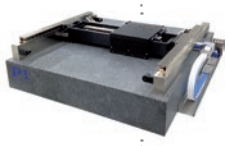
Market introduction of the magnetic PIMag® direct drives

Market introduction of Q-Motion® and PiezoMikes

2015

Introduction ofair bearings

Acquisition of Nelson Air Corp., USA



New subsidiaries in Taiwan and the Netherlands

2016

Acquisition of majority shares in ACS Motion Control

Expert Consulting

Time for qualified technical consultation is crucial for the success of high-tech projects

The PI Group can respond precisely to what customers want: Specific requirements can often only be satisfied by customized solutions – solutions that can be found by unconventional and creative thinking. Together with the customers, PI plans and realizes individual solutions for the most varied applications and integration levels. And that means that PI's customers can always be sure that they will get the best solution every time.

Customers directly benefit from:

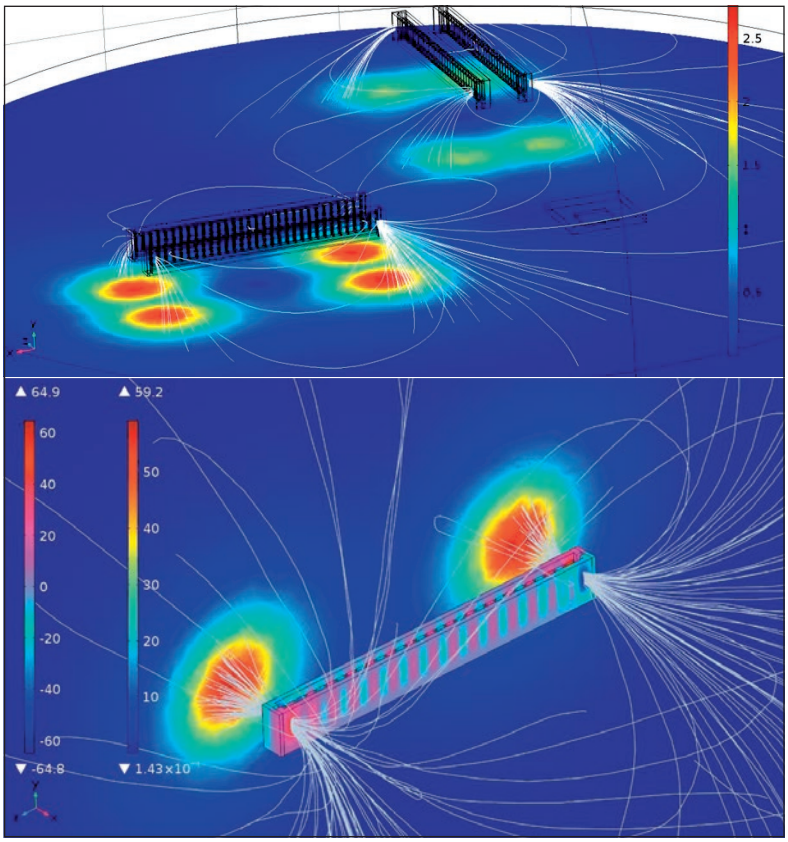
Highly Qualified Consultancy Through Trained Specialists

Individual advice often is key to solve a complex problem. PI sales engineers are ready to come on site with all the time necessary for a solid understanding of the topic. Or they will gladly meet at the PI head office. All PI sales engineers have a background in natural sciences or engineering, and have up to 20 years of experience in optical, micro- or nanopositioning technology.

International Support

PI subsidiaries and distributors in many countries across the world guarantee global support – a decisive advantage, especially for globally operating customers. PI has its own sales and service offices in all important markets. Moreover, the company maintains testing devices for nanometrology on three continents. PI Shanghai and PI USA have additional development and manufacturing resources that allow rapid local reaction to custom-engineered specifications.

Engineering Design Expertise and Customization



Core Technologies

- In-house manufacturing of piezo components and piezo actuators
- Magnetic direct drives: linear motors and voice coils
- Air bearings, magnetic and flexure guides
- Comprehensive range of piezo motor technologies
- Nanometrology sensors
- Parallel-kinematic systems for positioning in six axes (Hexapods)
- Motion control technology
- Software

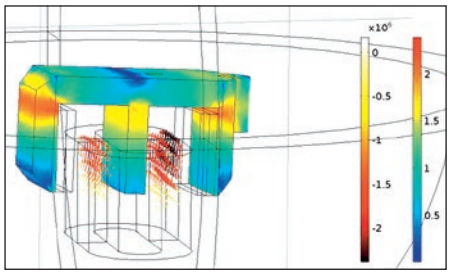
The development and customized design of electromagnetic direct drives that are used for high-resolution motion and positioning tasks require a scientific approach to the technology. The images show the analysis of magnetic fields down to a magnitude of 5 µT that were used to select the optimum position of the drive components within an application

Unique Technological Breadth

The technological diversity of the PI Group is unrivalled all over the world. PI develops, manufactures, and qualifies all its core technologies itself. PI is therefore not dependent on components available on the market. That puts PI in a position to offer its customers the most advanced products for motion and positioning tasks – without technological restriction.

Customized Solutions

With this background, PI develops positioning solutions with innovative drive technologies for high-tech applications worldwide. PI covers the whole motion range from finger-tip sized nanopositioners to large-scale stages with long travel ranges, through their plethora of differ-ent drive and guiding systems.



Calculation of the magnetic flux density and currents for a novel voice coil drive allowing multiple degrees of freedom

Production Capabilities

PI's flexibility in serial production allows for fast adaptation of both processes and quantities

A modern production management and an integrated management system allow PI to guarantee the high quality of its products, processes, and services. The continual improvement of organization and processes is an integral part of the corporate culture. KAIZEN workshops and an active innovation management are important elements for achieving this.

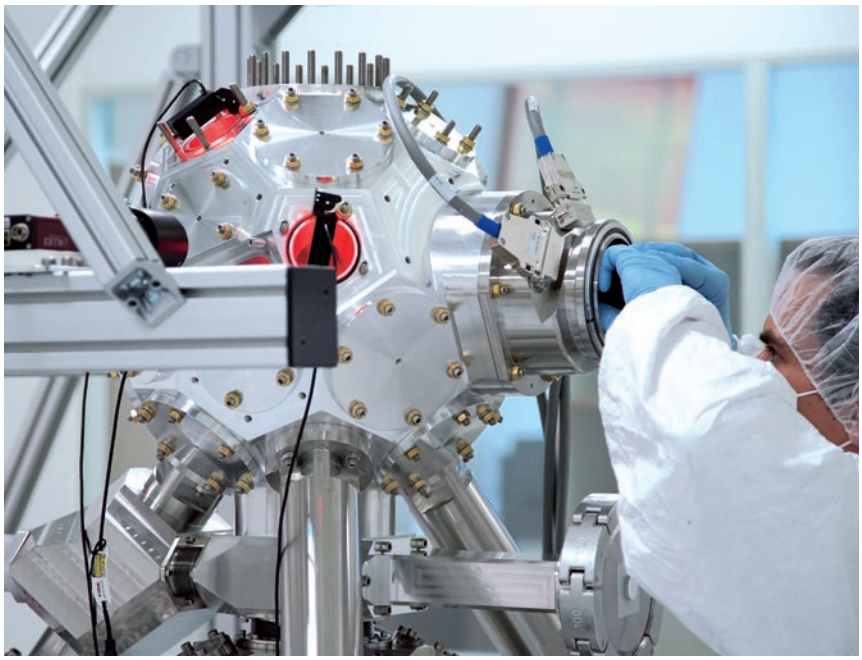
The production processes for the standard range are made flexible by the fractal production structure and it is therefore possible to manufacture even large series with full process control. Active, system-based requirements management makes it possible to dispense with comprehensive storage facilities.

Vertical Production Range and Production Capacity

The product spectrum ranging from the two-ton hexapod to the 10-gram nanopositioner requires PI to have the equipment and technologies at its disposal that allow the systems to be manufactured, assembled, and qualified.

- 13,000 m² of overall production space
- 5,000 m² for cleanrooms
- Air-conditioned and vibration-proof measuring conditions
- Vacuum chambers for startup and residual gas analysis
- Measuring technology with traceable, calibrated measuring equipment
- Monitoring of piezo actuator technology from material composition to final inspection
- In-house manufacturing of positioning sensors
- Production hall with measuring technology for heavy loads
- Fractal production organization

Vacuum Know-How

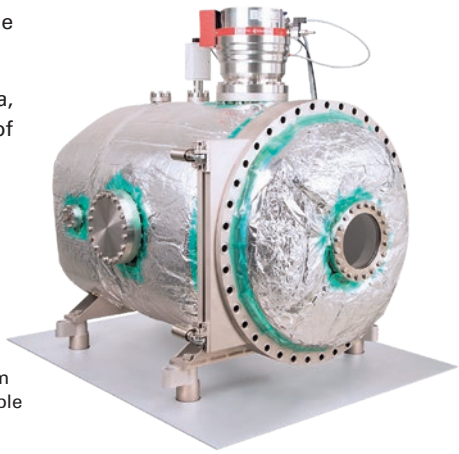


PI offers high-precision solutions for positioning in vacuum conditions to 10^{-10} hPa. Positioning solutions in a vacuum follow clearly defined constraints. This applies to the limited installation space, as well as prevention of contamination and excessive heat input.

Selection of the optimum drive technology for the respective application and the mechanical design must be matched exactly to the required load capacity and velocity as well as the intended operating and planned duty cycles.

The handling regulations for vacuum positioning systems are just as important as the design principles. Cleanrooms are available for assembling larger parts. Suitable packaging and the corresponding instructions for the recipient are part of shipping.

Vacuum chambers are available in several sizes with vacuum levels down to 10^{-10} hPa, where start-up and measurement of outgassing, but also interferometric measuring of position accuracy under real operating conditions is possible.



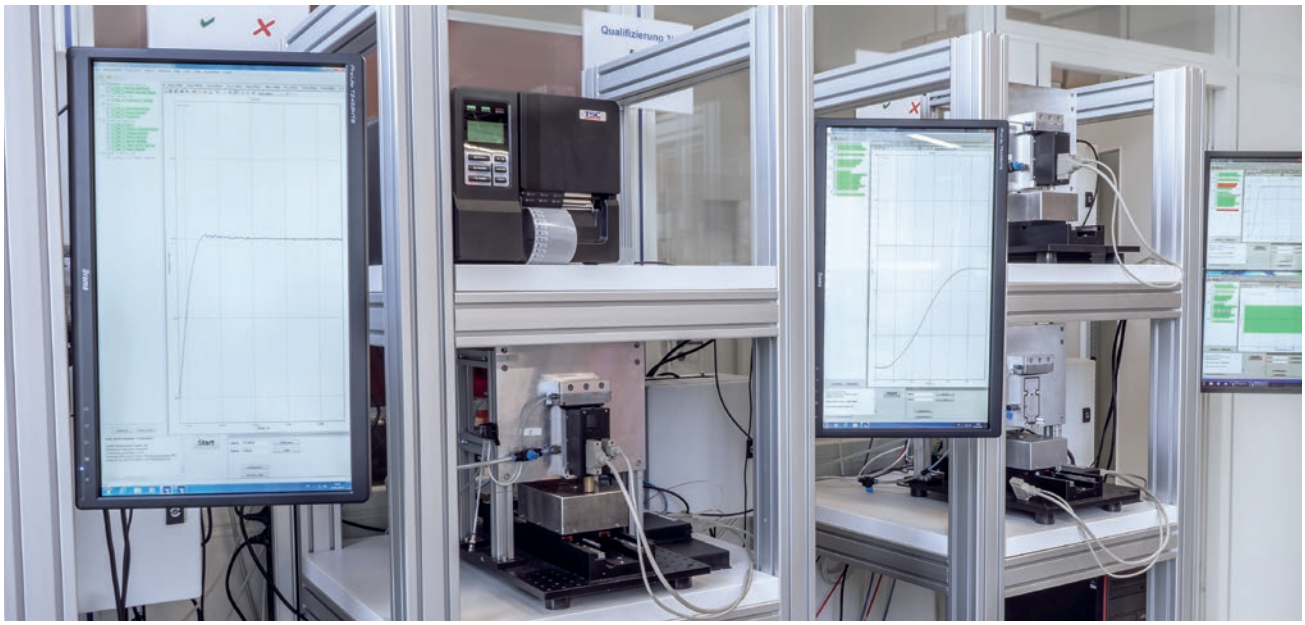
At PI, several vacuum chambers are available in various sizes

From 1-off to Series:
OEM Users Benefit From Maximum Flexibility

PI serves both the research and industrial markets. The complete control over the design and manufacturing process provides our customers with significant competitive advantages. Optimized processes allow PI to deliver customized products in quantities up to several 100,000 units per year at low cost and right on time. The range of OEM products offered by the PI Group varies widely, ranging from "bare" actuators and sensors to highly integrated parallel-kinematic positioning systems. Evaluation of pre-production run samples, test procedures, production processes and quality management are all included in the development process.

Services

- Global account management: Close proximity to the customer thanks to international presence
- Risk assessment from design to delivery
- Depending on the task: From the drive to the turnkey system
- Copy exactly policy
- Preparation of internal and external certification
- Production of series of several 10,000 units in the shortest time
- Sustainable spare parts service
- Manufacturing and testing capacities from functional samples to mass production



Standardized performance control with full documentation of individual measurement charts

Global Service and After-Sales

On-site training is key to optimize and maximize the potential of new PI systems

Start-Up, User Training and Life Long Support

PI is dedicated to supporting its customers right from the initial consultation through to when a customer has purchased a PI system. Beyond that, PI's services division is committed to ensuring that every aspect of owning a PI system is catered for.

Global Coverage

Supported by 4 Global Service Hubs in Asia, China, Europe and USA, with field product specialists working from these hubs, PI is able to support all technologies and customer applications via this global services team.

PI's Standard On-Site Services

- Set up and Commissioning – On-site support to un-box, set-up and commission the PI system
- Training Program – User training on software and programming, through to optimization of system performance
- Maintenance Systems Health Check – Preventative maintenance to prolong the life of the motion device
- Support – Ongoing remote and on-site support to maximize system uptime and provide maintenance for the whole life of any system

Contracted Services

Customers subscribing to Contractual Support Services will receive commitment from PI to achieving agreed Service Levels. These include responding to the customer's first contact and providing remote technical support, through to response times for a PI expert to be on site, either to repair or replace a defective unit.

Extended Warranty

Most customer applications require PI's systems to be operational beyond the standard warranty period. Extending the warranty for additional year(s), is simply extending the customers peace of mind and PI's commitment that the product will not fail due to poor workmanship or faulty materials. Should a customer's system then fail due to these conditions, PI will cover the costs to repair or replace it.

Preferred Solutions for High-Precision Automation Tasks





Application Examples	Major Requirements	Translation Stages see p. 28 ff	Z-Stages see p. 126 ff	XY-Stages, Gantry Systems see p. 138 ff, see p. 260 ff	Rotation & Goniometer Stages see p. 162 ff	Linear Actuators see p. 200 ff
Autofocus	High dynamics High repeatability Compact size High precision	L-505 L-509 L-511 MTS-65 V-522 V-524 V-528				V-900KPIC
Automated Optical Inspection (AOI)	Good precision High dynamics	L-402 L-412 L-417 L-505 V-412 V-417	L-310 UPL-120	V-731 V-738 V-741	L-611 PRS-200 UPR-100 UPR-120	
Biotechnology / Life Science and Microscopy	High dynamics High repeatability Good precision	L-402 L-505 L-509 L-511 M-403 M-404 M-413 M-414 MTS-65 V-551		L-731 L-738 L-741 V-731 V-738 V-741	L-611 PRS-200 UPR-100 UPR-120 UPR-120 Air	V-900KPIC
Digital Printing	High dynamics	V-412 V-417 V-508 V-522 V-524 V-528				
Electronics Manufacturing	High dynamics Constant velocity Position stability	L-402 L-412 L-417 V-412 V-417 V-508 V-551		A-311 A-322 Gantry	UPR-100 UPR-120	L-220 L-239 V-273 V-275 V-277
Flatpanel Inspection	Best straightness and flatness Constant velocity High repeatability	A-110 A-121 A-123 V-412 V-417				
Laser Cutting	High precision Long stroke High dynamics	L-412 L-417 L-509 L-511 V-408 V-412 V-417	L-310 UPL-120	A-321 Gantry L-731 L-738 L-741 V-731 V-738 V-741	L-611 PRS-200 UPR-100 UPR-120	
Laser Marking	Compact size High precision High repeatability	HPS-170 M-110 M-122.2DD1 MTS-65 V-408 V-508 V-522 V-524 V-528	L-310 UPL-120	A-311 L-731 L-741 V-731 V-741	L-611 M-116 PRS-200 UPR-100 UPR-120	
Machine Tooling / Fast Tooling	High dynamics Compact size Constant velocity	A-131				
Medical Industry	High repeatability Good precision Best straightness and flatness	A-131 L-505 M-403 M-404 M-413 M-414 V-508 V-551	L-310 UPL-120	L-731 L-738 L-741 V-731 V-738 V-741	L-611 PRS-200 UPR-100 UPR-120 UPR-120 Air	V-900KPIC
Metrology and Testing	Best straightness and flatness Constant velocity High dynamics	A-110 A-121 A-123 HPS-170 M-406 M-511 M-521 M-531 V-508 V-522 V-524 V-528 V-551	L-310 UPL-120	L-731 L-738 L-741 V-731 V-738 V-741	A-62x L-611 PRS-200 UPR-100 UPR-120 UPR-120 Air WT-85 WT-100 WT-90 WT-120	V-273 V-275 V-277
Optical Alignment	High repeatability High dynamics Compact size	A-141 L-505 L-509 L-511 M-110 M-122.2DD1 M-511 M-521 M-531	L-310 UPL-120		A-62x L-611 M-060 M-061 M-062 M-116 PRS-200 UPR-100 UPR-120 WT-85 WT-100 WT-90 WT-120	L-220 L-239 M-227 M-228 M-229 M-230 M-232 M-235 M-238





Application Examples	Major Requirements	Translation Stages see p. 28 ff	Z-Stages see p. 126 ff	XY-Stages, Gantry Systems see p. 138 ff, see p. 260 ff	Rotation & Goniometer Stages see p. 162 ff	Linear Actuators see p. 200 ff
Photonics Probing & Packaging	Compact size High repeatability High dynamics	A-110 A-121 A-123 A-141 L-505 M-403 M-404 M-413 M-414 M-511 M-521 M-531 V-408 V-522 V-524 V-528 V-551	L-306 L-310 M-501 UPL-120	L-731 L-738 L-741 V-731 V-738 V-741	L-611 PRS-200 WT-85 WT-100 WT-90 WT-120	
Precision Micro Assembly	Most compact size Dynamic motion High duty cycles	A-141 L-402 L-406 L-408 L-505 M-110 M-122.2DD1 M-406	L-310 UPL-120	L-738 V-738	DT-34 DT-80 L-611 M-060 M-061 M-062 M-116 PRS-200 RS-40 UPR-100 UPR-120 UPR-120 Air WT-85 WT-100 WT-90 WT-120	L-220 L-239 V-273 V-275 V-277 V-900KPIC
Sample Inspection	Best straightness and flatness Force control	A-110 A-121 A-123 HPS-170 LS-180 M-511 M-521 M-531	L-310 UPL-120	Gantry	A-62x L-611 PRS-200 UPR-100 UPR-120 UPR-120 Air WT-85 WT-100 WT-90 WT-120	V-273 V-275 V-277 V-900KPIC
Scanning	High repeatability High dynamics Constant velocity Position stability	A-110 A-121 A-123 A-131 A-141 V-408 V-412 V-417 V-508 V-522 V-524 V-528 V-551		A-311 A-322 V-731 V-738 V-741	A-62x	
Scientific Instrumentation	Versatility Networkable solutions Compact size	HPS-170 L-402 L-406 L-408 L-505 L-509 L-511 LS-180 M-110 M-122.2DD1 M-406 M-511 M-521 M-531 MTS-65 V-408 V-522 V-524 V-528 VT-80	L-306 L-310 M-501 UPL-120	A-311 A-322 Gantry L-731 L-738 L-741 V-731 V-738 V-741	A-62x DT-34 DT-80 L-611 M-060 M-061 M-062 M-116 PRS-200 RS-40 UPR-100 UPR-120 UPR-120 Air	L-220 L-239 M-227 M-228 M-229 M-230 M-232 M-235 M-238
Semiconductor	High dynamics High precision Position stability Constant velocity	HPS-170 LS-180 V-522 V-524 V-528 V-551	L-306 L-310 M-501 UPL-120	A-311 A-322 Gantry L-731 L-738 L-741 V-731 V-738 V-741	L-611 PRS-200 UPR-100 UPR-120 UPR-120 Air	L-220 L-239

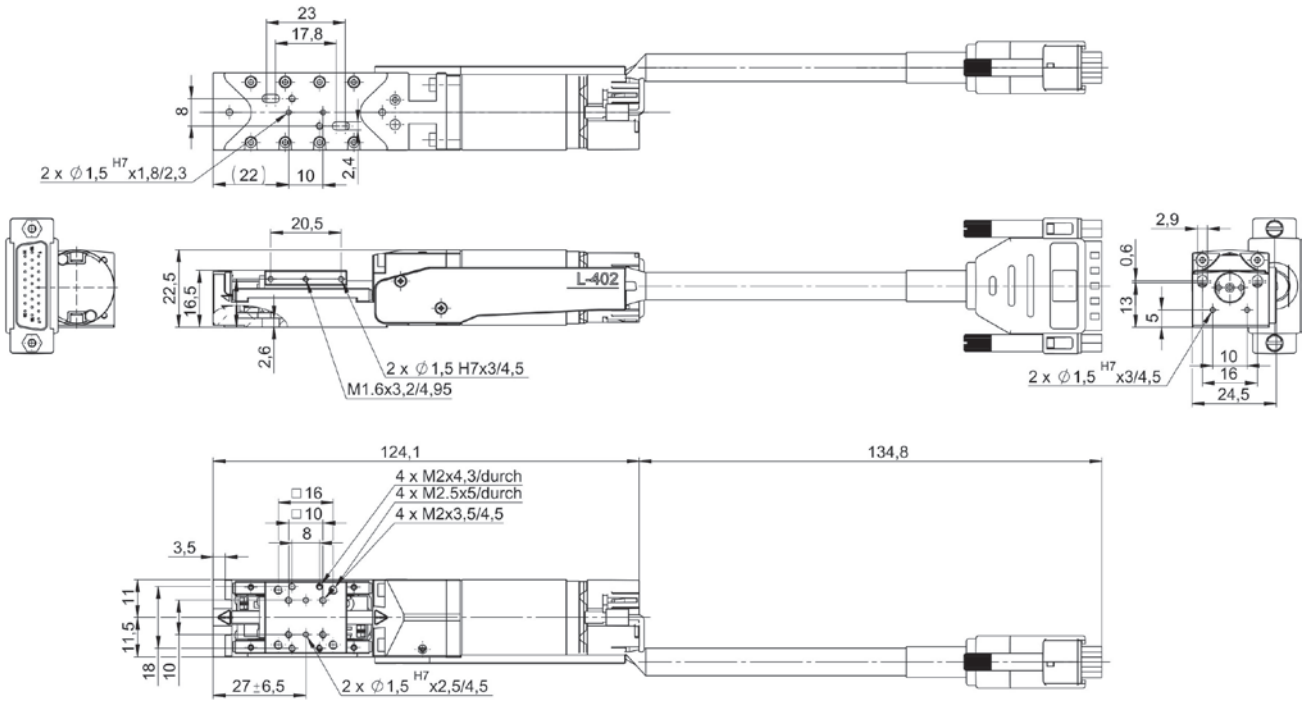
Translation Stages

L-402 Miniature Linear Stage

With DC or Stepper Motor

- Travel range 13 mm
- Unidirectional repeatability to 0.5 µm
- Velocity to 5 mm/s
- Load capacity to 1 kg
- Integrated reference point and limit switch
- Crossed roller guides, anti-creep
- Directly mountable XY and XYZ combinations

L-402.10DD, dimensions in mm



Applications

- Automation
- Precision Micro Assembly
- Scientific Instrumentation

>> Incremental Encoder
>> Vacuum-Compatible Versions

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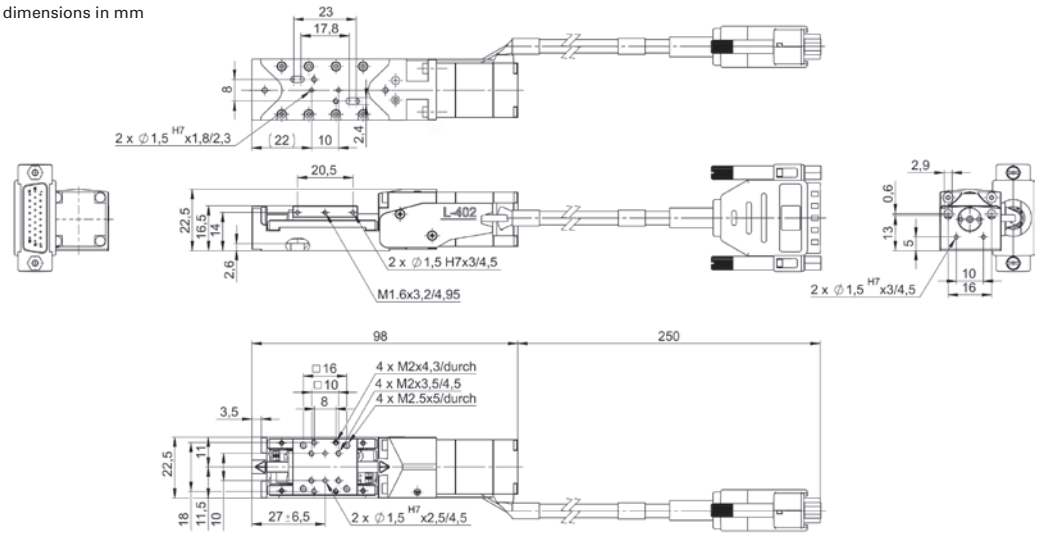
	L-402.10DD	L-402.10SD	Unit	Tolerance
Motion and positioning				
Travel range	13	13	mm	
Integrated sensor	Rotary encoder	–		
Design resolution	0.122	2.5 (full step)	µm	
Sensor resolution rotary encoder	4096	–	Cts./rev.	
Minimum incremental motion	1	0.5	µm	typ.
Unidirectional repeatability	1	0.5	µm	typ.
Bidirectional repeatability	±5	±5	µm	typ.
Pitch	±175	±175	µrad	typ.
Yaw	±125	±125	µrad	typ.
Straightness	±3	±3	µm	typ.
Flatness	±3	±3	µm	typ.
Velocity	5	5	mm/s	max.
Reference and limit switches	Optical	Optical		
Mechanical properties				
Drive screw	Leadscrew	Leadscrew		
Drive screw pitch	0.5	0.5	mm	
Load capacity	10	10	N	max.
Push/pull force	10	10	N	max.
Holding force	10	10	N	max.
Permissible lateral force	5	5	N	max.
Permissible torque in θ_X, θ_Y, θ_Z	1	1	N·m	max.
Drive properties				
Motor type	DC motor	2-phase stepper motor		
Step resolution	–	200	Full steps/rev.	
Operating voltage, nominal	24	24	V	nom.
Operating voltage, max.	48	48	V	max.
Miscellaneous				
Operating temperature range	5 to 40	5 to 40	°C	
Material	Aluminum, anodized, stainless steel	Aluminum, anodized, stainless steel		
Mass	0.16	0.15	kg	
Cable length	0.135	0.25	m	±10 mm
Connector	HD Sub-D 26 (m)	HD Sub-D 26 (m)		
Recommended controllers	C-863 (single axis)	C-663.12 (single axis)		

All cables required for operation with the ordered controller are included in the scope of delivery. The cable length is 3 m.
Motion controllers for >1 axis are available on www.pi.ws. Ask about custom designs!

L-402.10SD, dimensions in mm

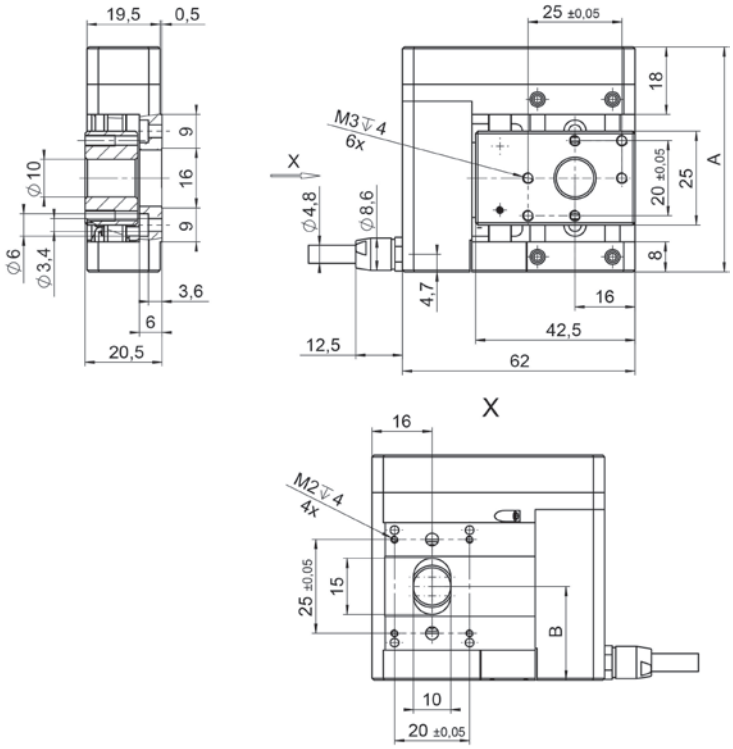


M-110 / M-111 / M-112 Compact Linear Stage

XY(Z) Combinations with a Variety of Drives and Travel Ranges

- Very compact due to folded drive
- Stepper motors and closed-loop DC motors
- Sliding thread and ball screws
- Noncontact reference and limit switches
- XY setups can be mounted directly
- Larger quantities available quickly

M-11x.xxx1, dimensions in mm



	A	B
M-110.1DG1 M-110.2DG1 M-110.12S1 M-110.22S1	60	25
M-111.1DG1 M-111.2DG1 M-111.12S1 M-111.22S1	70	30
M-112.1DG1 M-112.2DG1 M-112.12S1 M-112.22S1	80	35

Applications

- Automation
- Precision Micro Assembly
- Scientific Instrumentation

>> Incremental Encoder

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	M-110.1DG1 M-111.1DG1 M-112.1DG1	M-110.12S1 M-111.12S1 M-112.12S1	M-110.2DG1 M-111.2DG1 M-112.2DG1	M-110.22S1 M-111.22S1 M-112.22S1	Unit	Tolerance
Motion and positioning						
Travel range	5 / 15 / 25	5 / 15 / 25	5 / 15 / 25	5 / 15 / 25	mm	
Integrated sensor	Rotary encoder	–	Rotary encoder	–		
Sensor resolution	2048		2048		Cts./rev.	
Design resolution (1)	0.0069	0.00029	0.0086	0.00036	µm	
Min. incremental motion (1)	0.05	0.02	0.2	0.2	µm	typ.
Backlash	2	2	4	4	µm	typ.
Unidirectional repeatability	0.25	0.25	0.15	0.15	µm	typ.
Pitch / yaw	±50 / ±150 / ±150	±50 / ±150 / ±150	±50 / ±150 / ±150	±50 / ±150 / ±150	µrad	
Velocity	1 / 1.5 / 1.5	1 / 1 / 1	1.5 / 2 / 2	1 / 1 / 1	mm/s	max.
Mechanical properties						
Drive screw type	Leadscrew	Leadscrew	Ball screw	Ball screw		
Drive screw pitch	0.4	0.4	0.5	0.5	mm	
Gear ratio	256:9	256:9	256:9	256:9		
Step resolution	–	24	–	24	Full steps/ rev.	
Load capacity	30 / 30 / 20	30 / 30 / 20	30 / 30 / 20	30 / 30 / 20	N	max.
Push/pull force	10	10	10	10	N	max.
Holding force	10	10	10	10	N	max.
Permissible lateral force	15 / 10 / 10	15 / 10 / 10	15 / 10 / 10	15 / 10 / 10	N	max.
Drive properties						
Motor type	DC gear motor	2-phase stepper motor	DC gear motor	2-phase stepper motor		
Operating voltage	0 to ±12	–	0 to ±12	–	V	
Motor power	0.52 / 1.75 / 1.75	1.5	0.52 / 1.75 / 1.75	1.5	W	
Nominal current per phase	160 / 320 / 320	250	160 / 320 / 320	250	mA	
Reference and limit switches	Hall effect	Hall effect	Hall effect	Hall effect		
Miscellaneous						
Operating temperature range	–20 to 65	–20 to 65	–20 to 65	–20 to 65	°C	
Material	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)		
Mass	0.25 / 0.27 / 0.3	0.25 / 0.27 / 0.3	0.25 / 0.27 / 0.3	0.25 / 0.27 / 0.3	kg	
Cable length	0.5	0.5	0.5	0.5	m	
Connection	HD Sub-D 26 (m)	HD Sub-D 26 (m)	HD Sub-D 26 (m)	HD Sub-D 26 (m)		
Recommended controllers	C-863 C-884	C-663.12	C-863 C-884	C-663.12		

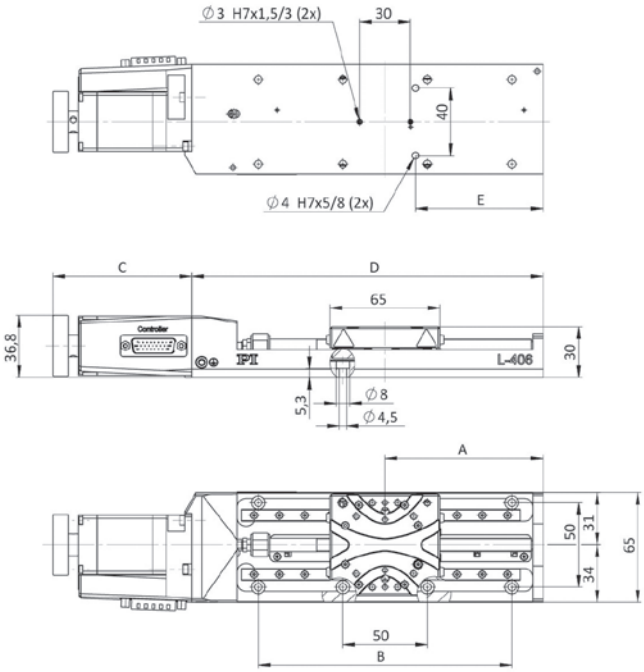
(1) With recommended controller.
Ask about custom designs!

L-406 Compact Linear Stage

For Loads up to 10 kg

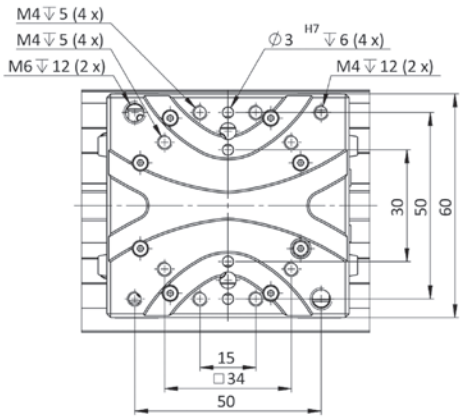
- Travel ranges from 26 mm to 102 mm (1″ to 4″)
- Stepper motor or DC servo motor with and without gearhead
- Direction-sensing reference point switch
- Integrated optical limit switches

L-406, dimensions in mm



	A	B	C	D	E
L-406.10SD00	55,5	–	82	132	62,5
L-406.20SD00	68,5	100	82	158	75,5
L-406.40SD00	93,5	150	82	208	75,5

Detail drawing of the L-406 motion platform, dimensions in mm



	A	B	C	D	E
L-406.10DG10	55,5	–	73,5	132	62,5
L-406.20DG10	68,5	100	73,5	158	75,5
L-406.40DG10	93,5	150	73,5	208	75,5

Applications

- Automation
- Precision Micro Assembly
- Scientific Instrumentation

>> Incremental Encoder
>> Vacuum-Compatible Versions

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	L-406.10DD10 L-406.20DD10 L-406.40DD10	L-406.10DG10 L-406.20DG10 L-406.40DG10	L-406.10SD00 L-406.20SD00 L-406.40SD00	Unit	Tolerance
	Linear stage with DC motor and rotary encoder	Linear stage with DC gear motor and rotary encoder	Linear stage with stepper motor		
Motion and positioning					
Travel range	26 / 52 / 102	26 / 52 / 102	26 / 52 / 102	mm	
Integrated sensor	Rotary encoder	Rotary encoder	–		
Sensor resolution rotary encoder	4096	2048	–	Cts./rev.	
Design resolution	0.244	0.0165	5 (full step)	µm	
Minimum incremental motion	0.5	0.2	0.2	µm	typ.
Unidirectional repeatability	0.5	0.5	0.5	µm	typ.
Bidirectional repeatability	±5	±5	±5	µm	typ.
Pitch / yaw	±70 / ±90 / ±100	±70 / ±90 / ±100	±70 / ±90 / ±100	µrad	typ.
Straightness / flatness	±2 / ±4 / ±6	±2 / ±4 / ±6	±2 / ±4 / ±6	µm	typ.
Max. velocity	20	3	20	mm/s	max.
Reference and limit switches	Optical	Optical	Optical		
Mechanical properties					
Guide type	Recirculating ball bearing	Recirculating ball bearing	Recirculating ball bearing		
Drive screw type	Leadscrew	Leadscrew	Leadscrew		
Drive screw pitch	1	1	1	mm	
Gear ratio	–	2401:81	–		
Load capacity	100	100	100	N	max.
Push/pull force	15	100	50	N	max.
Permissible lateral force	50	50	50	N	max.
Holding force	15	100	50	N	max.
Permissible torque in θ_X, θ_Y, θ_Z	7.5	7.5	7.5	N·m	max.
Drive properties					
Motor type	DC motor	DC gear motor	2-phase stepper motor		
Step resolution	–	–	200	Full steps/ rev.	
Operating voltage, nominal	24	24	24	V	nom.
Operating voltage, max.	48	48	48		max.
Miscellaneous					
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum, steel	Aluminum, steel	Aluminum, steel		
Mass	0.8 / 0.9 / 1.0	0.8 / 0.9 / 1.0	0.8 / 0.9 / 1.0	kg	±5 %
Moved mass	0.16	0.16	0.16	kg	±5 %
Connector	HD Sub-D 26 (m)	HD Sub-D 26 (m)	HD Sub-D 26 (m)		
Recommended controllers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

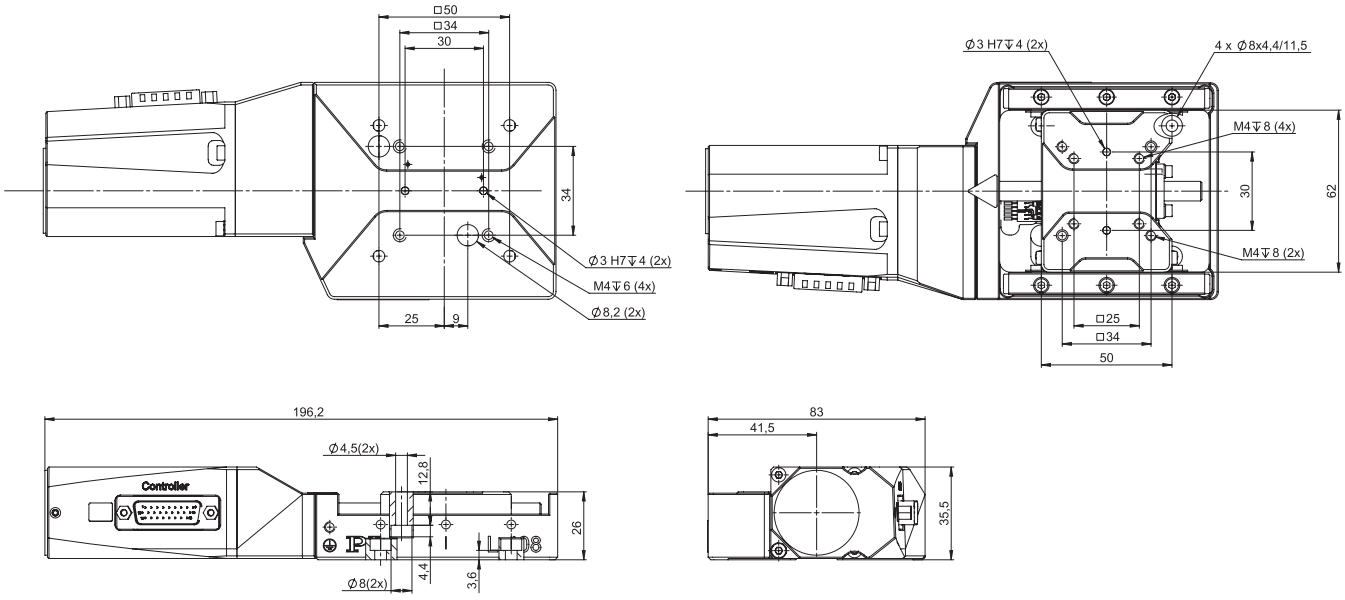
All cables required for operation with the ordered controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

L-408 Compact Linear Stage

For Loads up to 200 N

- Travel range 25 mm
- Stepper motor, DC or DC gear motor
- Precision sliding-thread spindle
- Crossed roller guides for high load capacity and precision, anti-creep
- Integrated optical limit switches
- Optical reference point switch with direction sensing

L-408.503232 and L-408.504232, dimensions in mm



Applications

- Automation
- Precision Micro Assembly
- Scientific Instrumentation

>> Incremental Encoder

Technology Glossary ..... page 290

	L-408.504232	L-408.503232	L-408.501200	Unit	Tolerance
Motion and positioning					
Travel range	25	25	25	mm	max.
Integrated sensor	Rotary encoder	Rotary encoder	–		
Sensor resolution	2048	4096	–	Cts./rev.	
Design resolution	0.008	0.122	2.5	µm	
Minimum incremental motion	0.1	0.5	0.1	µm	typ.
Unidirectional repeatability	0.5	0.5	0.5	µm	typ.
Bidirectional repeatability	±5	±5	±5	µm	typ.
Pitch / yaw	±100	±100	±100	µrad	typ.
Straightness / flatness	±2	±2	±2	µm	typ.
Max. velocity	1.1	10	10	mm/s	max.
Reference and limit switches	Hall effect	Hall effect	Hall effect		
Reference point switch repeatability	1	1	1	µm	typ.
Mechanical properties					
Guide type	Crossed roller guide with anti-creep system	Crossed roller guide with anti-creep system	Crossed roller guide with anti-creep system		
Drive screw	Leadscrew	Leadscrew	Leadscrew		
Drive screw pitch	0.5	0.5	0.5	mm	
Gear ratio	2401:81	–	–		
Push/pull force	50	50	40	N	max.
Holding force	50	50	40	N	max.
Load capacity	200	200	200	N	max.
Permissible lateral force	100	100	100	N	max.
Permissible torque in θ_X	15	15	15	N·m	max.
Permissible torque in θ_Y, θ_Z	10	10	10	N·m	max.
Drive properties					
Motor type	DC gear motor	DC motor	2-phase stepper motor		
Operating voltage, nominal	24	24	24	V	nom.
Operating voltage, max.	48	48	48	V	max.
Step resolution	–	–	200	Full steps/ rev.	
Miscellaneous					
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum black anodized, steel	Aluminum black anodized, steel	Aluminum black anodized, steel		
Mass	0.87	0.87	0.98	kg	±5 %
Moved mass	0.155	0.155	0.155	kg	±5 %
Connector	HD Sub-D 26	HD Sub-D 26	HD Sub-D 26		
Recommended controllers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

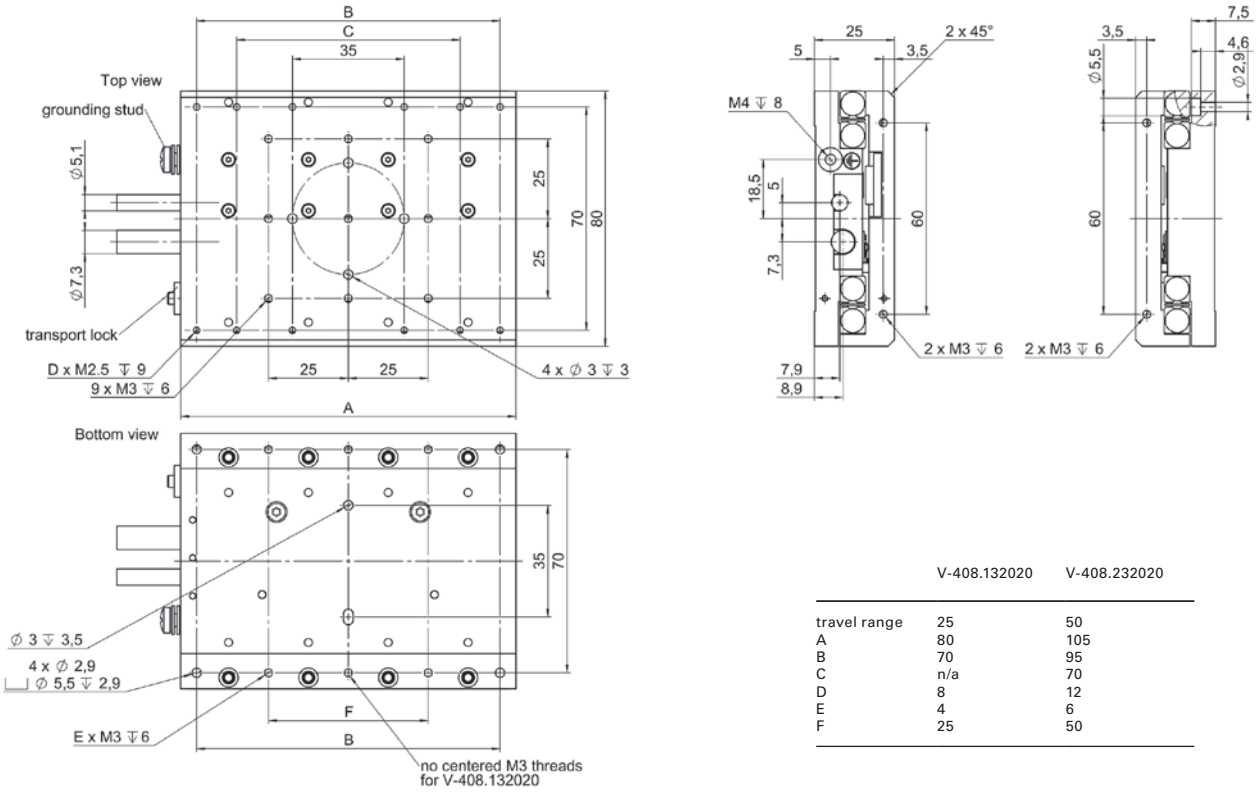
All cables required for operation with the ordered controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

V-408 PIMag® Linear Stage

Inexpensive, with Linear Motor

- Iron core 3-phase linear motor
- Crossed roller bearings for high load capacity, anti-creep
- Minimum incremental motion 20 nm
- Bidirectional repeatability ±0.1 µm
- Compact design
- Low price

V-408, dimensions in mm



	V-408.132020	V-408.232020
travel range	25	50
A	80	105
B	70	95
C	n/a	70
D	8	12
E	4	6
F	25	50

Applications

- Automation
- Laser Cutting
- Laser Marking
- Photonics
- Scanning
- Scientific Instrumentation

>> Linear Encoder
>> PIMag® Magnetic Linear Motors

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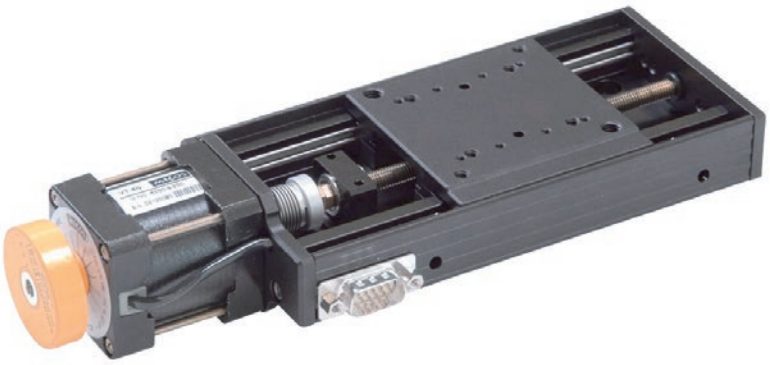
	V-408	Unit	Tolerance
Motion and positioning			
Travel range	V-408.132020: 25 V-408.232020: 50	mm	
Integrated Sensor	Incremental linear encoder		
Sensor signal period	80	µm	
Sensor resolution	10 (1)	nm	typ.
Min. incremental motion	20	nm	typ.
Bidirectional repeatability	±0.1	µm	typ.
Pitch / Yaw	±150	µrad	typ.
Straightness / flatness	±4	µm	typ.
Velocity	V-408.132020: 1.2 V-408.232020: 1.5	m/s	max.
Mechanical properties			
Load capacity in Z	80	N	max.
Permissible lateral force	80	N	max.
Permissible torque in θ_X	2.3	N·m	max.
Permissible torque in θ_Y, θ_Z	1.3	N·m	max.
Moved mass	V-408.132020: 0.23 V-408.232020: 0.3	kg	
Mass without cable	V-408.132020: 0.5 V-408.232020: 0.65	kg	
Overall mass	V-408.132020: 0.79 V-408.232020: 0.94	kg	
Guide type	Crossed roller guide with anti-creep system		
Drive properties			
Drive type	PIMag® Linear motor, iron core, 3-phase		
Intermediate circuit voltage	48	V DC	max.
Peak force	14	N	typ.
Nominal force	5	N	typ.
Peak current, effective	3.2	A	typ.
Nominal current, effective	1.1	A	typ.
Force constant, effective	4.60	N/A	typ.
Resistance phase-phase	1.23	Ω	typ.
Inductance phase-phase	0.97	mH	typ.
Back EMF phase-phase	2.81	V·s/m	max.
Pole pitch N-N	18	mm	
Miscellaneous			
Operating temperature range	10 to 50	°C	
Humidity	20 – 90 % rel., not condensing		
Material	Aluminum, black anodized		
Motor connector	HD Sub-D 26 (m)		
Sensor connection	Sub-D 15 (f)		
Cable length	2	m	
Recommended controllers	C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller		

(1) interpolated
Ask about custom designs!

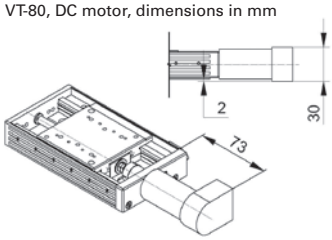
VT-80 Linear Stage

Basic Version for Universal Use

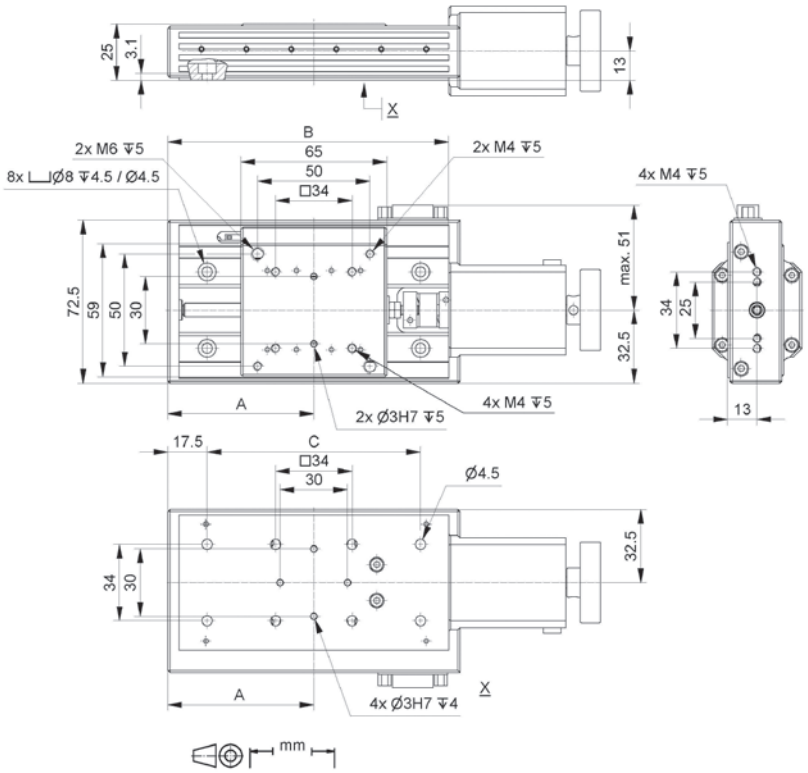


- Travel ranges from 25 to 300 mm (1 to 12″)
- Low profile design
- Max. velocity to 20 mm/s
- Load capacity to 5 kg
- Compact XY combinations

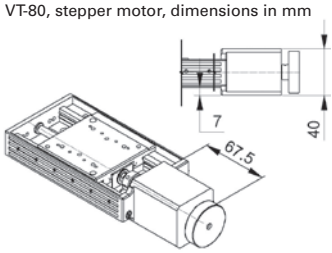
VT-80, DC motor, dimensions in mm



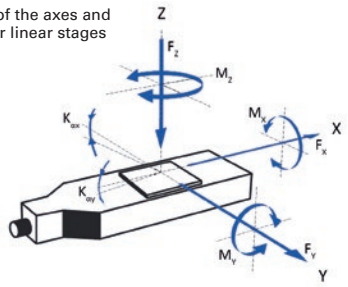
VT-80, dimensions in mm



VT-80, stepper motor, dimensions in mm



Direction of the axes and torques for linear stages



	A (mm)	B (mm)	C (mm)
25 mm	52.5	100	70
50 mm	65	125	95
75 mm	77.5	150	120
100 mm	90	175	145
150 mm	115	225	195
200 mm	140	275	245
300 mm	190	375	345

Applications

- Automation
- Scientific Instrumentation

>> **Incremental Encoder**

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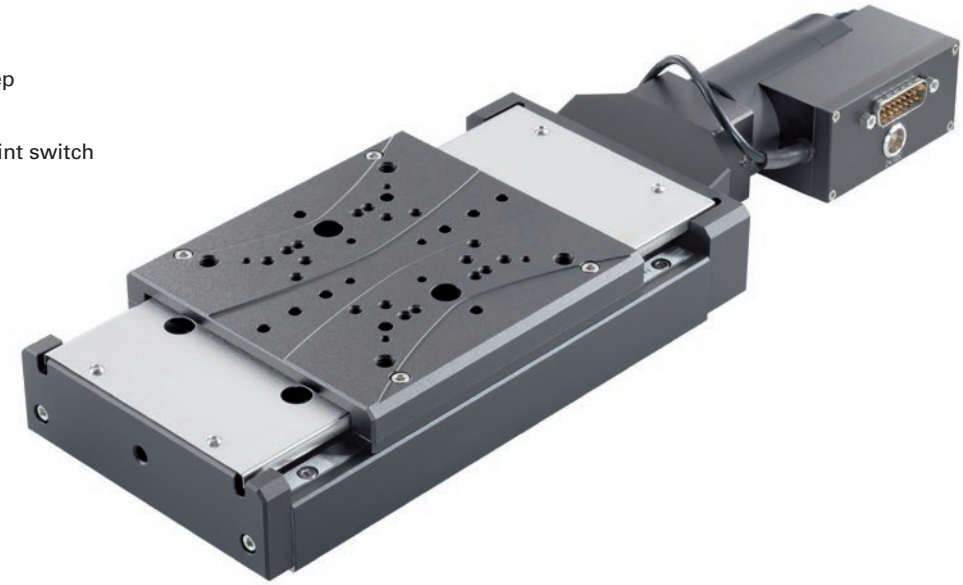
	623091x0	623092x0	Unit	Tolerance
	Linear stage with DC motor and rotary encoder	Linear stage with stepper motor		
Motion and positioning				
Travel range	25 / 50 / 75 / 100 / 150 / 200 / 300	25 / 50 / 75 / 100 / 150 / 200 / 300	mm	
Integrated sensor	Rotary encoder, incremental	–		
Design resolution	0.5	5 (full step)	µm	
Sensor resolution	2000	–	Cts./rev.	
Minimum incremental motion	0.5	0.2	µm	typ.
Unidirectional repeatability	0.8	0.4	µm	typ.
Bidirectional repeatability	±10	±10	µm	typ.
Pitch	±100 / ±110 / ±120 / ±130 / ±150 / ±170 / ±210	±100 / ±110 / ±120 / ±130 / ±150 / ±170 / ±210	µrad	typ.
Yaw	±150	±150	µrad	typ.
Straightness / flatness	±8 / ±10 / ±11 / ±12 / ±14 / ±20 / ±35	±8 / ±10 / ±11 / ±12 / ±14 / ±20 / ±35	µm	
Max. velocity	20	20	mm/s	
Mechanical properties				
Guide type	Recirculating ball bearing	Recirculating ball bearing		
Drive screw type	Leadscrew	Leadscrew		
Drive screw pitch	1	1	mm	
Load capacity	50	50	N	max.
Push/pull force	40	40	N	max.
Permissible lateral force	30	30	N	max.
Holding force, power off	40	40	N	max.
Permissible torque M_x in X	2.5	2.5	N·m	max.
Permissible torque M_y in Y	5	5	N·m	max.
Permissible torque M_z in Z	2.5	2.5	N·m	max.
Drive properties				
Motor type	DC motor	2-phase stepper motor		
Operating voltage	24	24	V	nom.
Operating voltage	48	48	V	max.
Step resolution	–	200	Full steps/ rev.	
Limit switches	2 × mechanical	2 × mechanical		
Miscellaneous				
Operating temperature range	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized	Aluminum, black anodized		
Mass	0.55 / 0.65 / 0.7 / 0.75 / 0.85 / 0.95 / 1.25	0.55 / 0.65 / 0.7 / 0.75 / 0.85 / 0.95 / 1.25	kg	±5 %
Moved mass	0.13 / 0.14 / 0.14 / 0.15 / 0.15 / 0.15 / 0.15	0.16 / 0.16 / 0.17 / 0.17 / 0.17 / 0.18 / 0.18	kg	±5 %
Connector	HD Sub-D 15 (m)	HD Sub-D 15 (m)		
Recommended controllers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

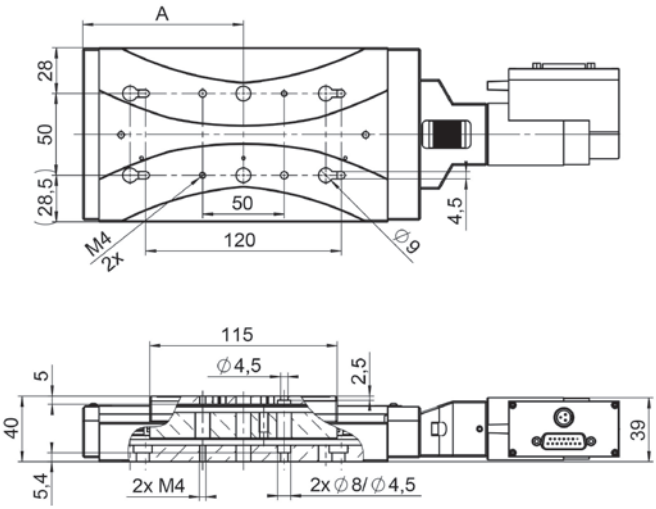
M-406 Precision Linear Stage

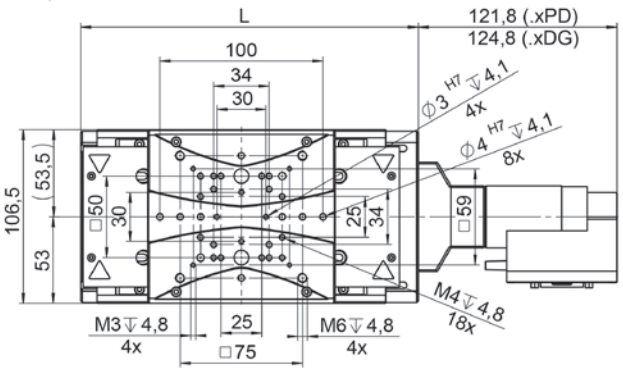
High Travel Accuracy and Inexpensive

- Travel ranges to 150 mm
- Crossed roller guides, anti-creep
- DC servo motor drive
- Direction-sensing reference point switch



M-406, dimensions in mm





	A	L
M-406.2xx	98,5	207
M-406.4xx	123,5	257
M-406.6xx	148,5	307

Applications

- Metrology / Testing
- Precision Micro Assembly
- Scientific Instrumentation

>> **ActiveDrive**

>> **Incremental Encoder**

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	M-406.2DG M-406.4DG M-406.6DG	M-406.2PD M-406.4PD M-406.6PD	Unit	Tolerance
Motion and positioning				
Travel range	50 / 100 / 150	50 / 100 / 150	mm	
Integrated sensor	Rotary encoder	Rotary encoder		
Sensor resolution	2000	4000	Cts./rev.	
Design resolution	0.0085	0.125	µm	
Minimum incremental motion	0.1	0.25	µm	
Unidirectional repeatability	0.2	0.2	µm	
Backlash	2	2	µm	
Crosstalk, angular error	±25 / ±50 / ±75	±25 / ±50 / ±75	µrad	
Velocity	1	15	mm/s	max.
Mechanical properties				
Drive screw pitch	0.5	0.5	mm	
Gear ratio	29.6:1	–		
Load capacity	200	200	N	max.
Push/pull force	50 / 50	50 / 50	N	max.
Lateral force	150	150	N	max.
Drive properties				
Motor type	DC gear motor	DC motor with PWM control		
Operating voltage	0 to ±12	24	V	
Motor power	3	30	W	
Reference and limit switches	Hall effect	Hall effect		
Miscellaneous				
Operating temperature range	–20 to 65	–20 to 65	°C	
Material	Aluminum, steel	Aluminum, steel		
Mass	2.1 / 2.4 / 2.8	2.1 / 2.4 / 2.8	kg	
Connector	Sub-D 15, incl. 3 m cable	Sub-D 15, incl. 3 m cable		
Recommended controllers	C-863 C-884	C-863 C-884		

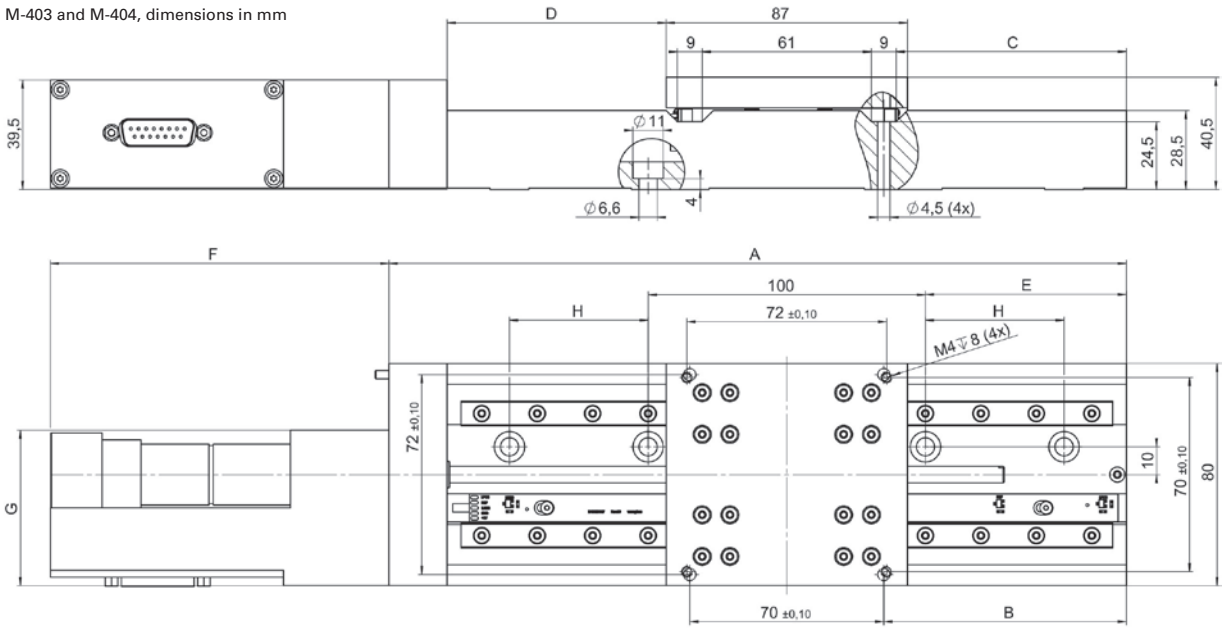
Ask about custom designs!

M-403 Precision Translation Stage

Inexpensive and Flexible Thanks to Large Number of Drives and Travel Range Variants

- Inexpensive cost-optimized design for precise positioning
- Travel ranges from 25 mm to 200 mm
- Resolution to 0.018 µm
- Min. incremental motion to 0.2 µm
- Preloaded precision leadscrew
- M-413 and M-414 versions for higher load requirements

M-403 and M-404, dimensions in mm



	M-403.1xx M-404.1xx	M-403.2xx M-404.2xx	M-403.4x M-404.4xx	M-403.6xx M-404.6xx	M-403.8xx M-404.8xx
A	141	166	216	266	316
B	25	37,5	62,5	87,5	112,5
C	20,5	33	58	83	108
D	16,5 (±12,5)	29 (±25)	54 (±50)	79 (±75)	104 (±100)
E	10	22,5	47,5	72,5	97,5
H	X	X	X	50	75

	M-403.xPD	M-403.xDG
F	114	119,5
G	59,5	56

	M-404.xPD	M-403.xDG
F	114	128,5
G	59,5	56

Applications

- Automation
- Biotechnology
- Medical Industry
- Photonics

>> ActiveDrive
>> Incremental Encoder

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	M-403.1PD M-403.2PD M-403.4PD M-403.6PD M-403.8PD	M-403.1DG M-403.2DG M-403.4DG M-403.6DG M-403.8DG	Unit	Tolerance
	with ActiveDrive	with DC gear motor		
Motion and positioning				
Travel range	25 / 50 / 100 / 150 / 200	25 / 50 / 100 / 150 / 200	mm	
Integrated sensor	Rotary encoder	Rotary encoder		
Sensor resolution	4000	2000	Cts./rev.	
Design resolution	0.25	0.018	µm	typ.
Minimum incremental motion	0.25	0.2	µm	typ.
Backlash	6	10	µm	typ.
Unidirectional repeatability	1	1	µm	typ.
Pitch	200	200	µrad	typ. over 100 mm
Yaw	200	200	µrad	typ. over 100 mm
Velocity	10 (1)	2.5	mm/s	max.
Reference point switch repeatability	1	1	µm	typ.
Mechanical properties				
Drive screw pitch	1	1	mm	
Gear ratio	–	2304:81		
Stiffness in motion direction	3.5	3.5	N/µm	±20 %
Load capacity (2)	200	200	N	max.
Push/pull force	50	50	N	max.
Lateral force	100	100	N	max.
Drive properties				
Drive type	DC motor, ActiveDrive	DC gear motor		
Operating voltage	24	0 to ±12	V	
Motor power	26	2.5	W	nominal
Miscellaneous				
Operating temperature range	–20 to 65	–20 to 65	°C	
Material	Al (black anodized)	Al (black anodized)		
Mass	1.7 / 1.8 / 2.1 / 2.2 / 2.5	1.7 / 1.8 / 2.1 / 2.2 / 2.5	kg	±5 %
Connector	Sub-D 15 (m), incl. 3 m cable	Sub-D 15 (m), incl. 3 m cable		
Recommended controllers / drivers	C-863 C-884	C-863 C-884		

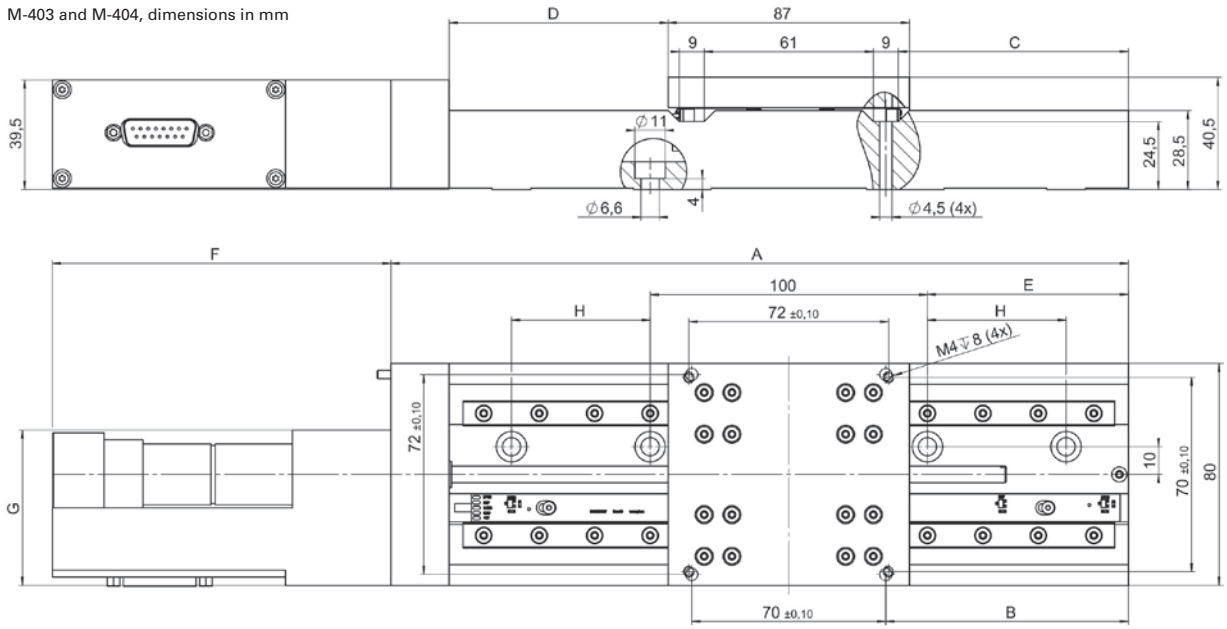
(1) Recommended velocity
(2) Load capacity: Max. possible normal load capacity, centered, vertical load (linear stage horizontal).

M-404 Precision Translation Stage

Inexpensive and Flexible Thanks to Large Number of Drives and Travel Range Variants

- Inexpensive cost-optimized design for precise positioning
- Travel ranges from 25 mm to 200 mm
- Resolution to 0.012 µm
- Min. incremental motion to 0.1 µm
- Ball screw for high velocities and number of cycles
- M-413 and M-414 versions for higher load requirements

M-403 and M-404, dimensions in mm



	M-403.1xx M-404.1xx	M-403.2xx M-404.2xx	M-403.4x M-404.4xx	M-403.6xx M-404.6xx	M-403.8xx M-404.8xx
A	141	166	216	266	316
B	25	37,5	62,5	87,5	112,5
C	20,5	33	58	83	108
D	16,5 (±12,5)	29 (±25)	54 (±50)	79 (±75)	104 (±100)
E	10	22,5	47,5	72,5	97,5
H	X	X	X	50	75

	M-403.xPD	M-403.xDG
F	114	119,5
G	59,5	56

	M-404.xPD	M-403.xDG
F	114	128,5
G	59,5	56

Applications

- Automation
- Biotechnology
- Medical Industry
- Photonics

>> ActiveDrive
>> Incremental Encoder

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	M-404.1PD M-404.2PD M-404.4PD M-404.6PD M-404.8PD	M-404.1DG M-404.2DG M-404.4DG M-404.6DG M-404.8DG	Unit	Tolerance
	with ActiveDrive	with DC gear motor		
Motion and positioning				
Travel range	25 / 50 / 100 / 150 / 200	25 / 50 / 100 / 150 / 200	mm	
Integrated sensor	Rotary encoder	Rotary encoder		
Sensor resolution	4000	2000	Cts./rev.	
Design resolution	0.25	0.012	µm	typ.
Minimum incremental motion	0.25	0.1	µm	typ.
Backlash	0.5	2	µm	typ.
Unidirectional repeatability	0.5	1	µm	typ.
Pitch	75	75	µrad	typ. over 100 mm
Yaw	75	75	µrad	typ. over 100 mm
Velocity	50	1.5	mm/s	max.
Reference point switch repeatability	1	1	µm	typ.
Mechanical properties				
Drive screw pitch	1	1	mm	
Gear ratio	–	2704:63		
Motor resolution	–	–	steps/rev.	
Stiffness in motion direction	3	3	N/µm	±20 %
Load capacity [1]	200	200	N	max.
Push/pull force	50	50	N	max.
Lateral force	100	100	N	max.
Drive properties				
Drive type	DC motor, ActiveDrive	DC gear motor		
Operating voltage	24	0 to ±12	V	
Motor power	26	2.5	W	nominal
Miscellaneous				
Operating temperature range	–20 to 65 °C	–20 to 65 °C		
Material	Al (black anodized)	Al (black anodized)		
Mass	1.8 / 1.9 /2.2 / 2.3 /2.6	1.8 / 1.9 /2.2 / 2.3 /2.6	kg	±5 %
Connector	Sub-D 15 (m), incl. 3 m cable	Sub-D 15 (m), incl. 3 m cable		
Recommended controllers / drivers	C-863 C-884	C-863 C-884		

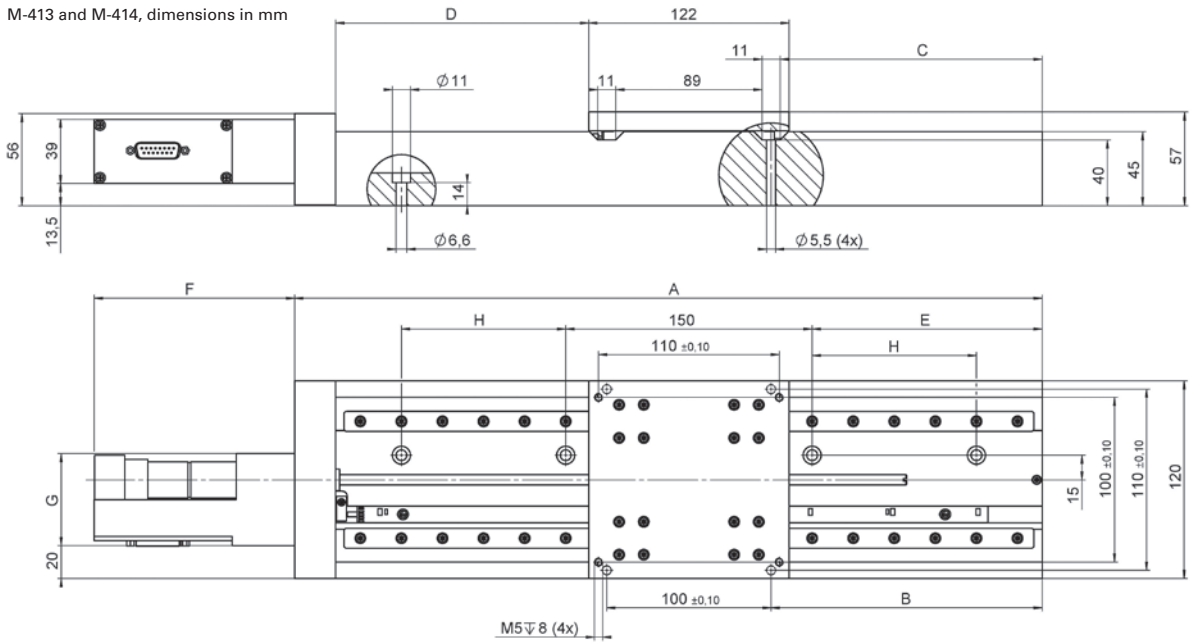
(1) Max. possible normal load capacity, centered, vertical load (linear stage horizontal).

M-413 High-Load Precision Stage

Inexpensive and Flexible Thanks to Large Number of Drives and Travel Range Variants for High Loads

- Very inexpensive, robust models
- Flexible modular system M-403, M-404, M-413, M-414
- Travel ranges from 100 to 300 mm
- Resolution to 0.018 µm
- Preloaded precision leadscrew
- Min. incremental motion 0.2 µm

M-413 and M-414, dimensions in mm



	M-413/414.1xx	M-413/414.2xx	M-413/414.3xx
A	255	355	455
B	65	115	165
C	59,5	109,5	159,5
D	54 (±50)	104 (±100)	154 (±150)
E	40	90	140
H	X	X	100

	M-413/414.xPD	M-413.xDG	M-414.xDG
F	120	122	133
G	59,5	56	59,5

Applications

- Automation
- Biotechnology
- Medical Industry
- Photonics

>> **ActiveDrive**

>> **Incremental Encoder**

Technology Glossary ..... **page 290**

	M-413.1PD M-413.2PD M-413.3PD	M-413.1DG M-413.2DG M-413.3DG	Unit	Tolerance
	with ActiveDrive	with DC gear motor		
Motion and positioning				
Travel range	100 / 200 / 300	100 / 200 / 300	mm	
Integrated sensor	Rotary encoder	Rotary encoder		
Sensor resolution	4000	2000	Cts./rev.	
Design resolution	0.25	0.018	µm	typ.
Minimum incremental motion	0.25	0.2	µm	typ.
Backlash	6	10	µm	typ.
Unidirectional repeatability	1	1	µm	typ.
Pitch / yaw (1)	300	300	µrad	typ. over 100 mm
Velocity	10 (2)	2.5	mm/s	max.
Reference point switch repeatability	1	1	µm	typ.
Mechanical properties				
Drive screw pitch	1	1	mm	
Gear ratio	–	2304:81		
Stiffness in motion direction	3.5	3.5	N/µm	±20 %
Load capacity	500	500	N	max.
Push/pull force	50	50	N	max.
Lateral force	200	200	N	max.
Drive properties				
Drive type	DC motor, ActiveDrive	DC gear motor		
Operating voltage	24	0 to ±12	V	
Motor power	70	3.6	W	nominal
Miscellaneous				
Operating temperature range	–20 to 65	–20 to 65	°C	
Material	Al (black anodized)	Al (black anodized)		
Mass	4.4 / 5.4 / 6.6	4.2 / 5.2 / 6.4	kg	±5 %
Connector	Sub-D 15 (m), incl. 3 m cable	Sub-D 15 (m), incl. 3 m cable		
Recommended controllers / drivers	C-863 C-884	C-863 C-884		

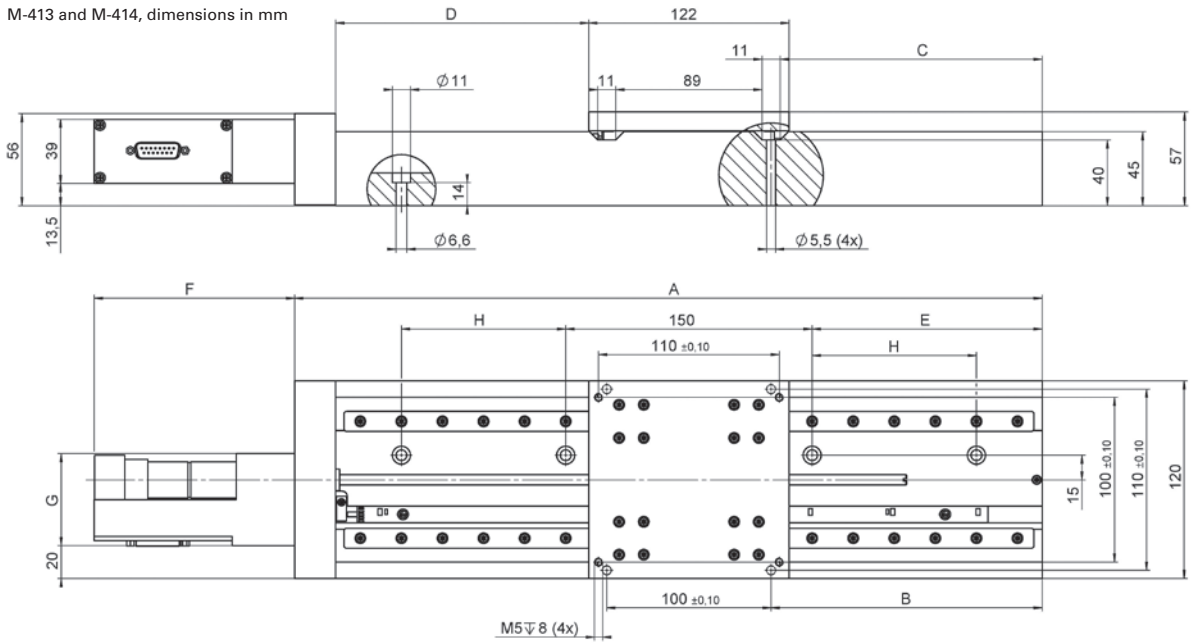
(1) This value applies to each 100 mm respectively for travel ranges greater than 100 mm.
(2) Recommended velocity

M-414 High-Load Precision Stage

Inexpensive and Flexible Thanks to Large Number of Drives and Travel Range Variants for High Loads

- Use of precision components
- Flexible modular system M-403, M-404, M-413, M-414
- Travel ranges from 100 mm to 300 mm
- Resolution to 0.023 µm
- Ball screw for high velocities and number of cycles
- Min. incremental motion 0.1 µm

M-413 and M-414, dimensions in mm



	M-413/414.1xx	M-413/414.2xx	M-413/414.3xx
A	255	355	455
B	65	115	165
C	59,5	109,5	159,5
D	54 (±50)	104 (±100)	154 (±150)
E	40	90	140
H	X	X	100

	M-413/414.xPD	M-413.xDG	M-414.xDG
F	120	122	133
G	59,5	56	59,5

Applications

- Automation
- Biotechnology
- Medical Industry
- Photonics

>> **ActiveDrive**

>> **Incremental Encoder**

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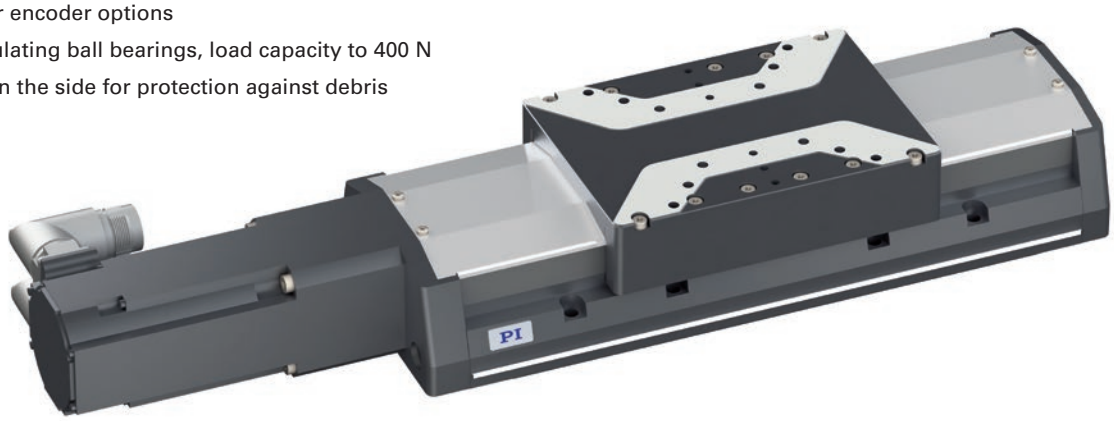
	M-414.1PD M-414.2PD M-414.3PD	M-414.1DG M-414.2DG M-414.3DG	Unit	Tolerance
	with ActiveDrive	with DC gear motor		
Motion and positioning				
Travel range	100 / 200 / 300	100 / 200 / 300	mm	
Integrated sensor	Rotary encoder	Rotary encoder		
Sensor resolution	4000	2000	Cts./rev.	
Design resolution	0.5	0.023	µm	typ.
Minimum incremental motion	0.5	0.1	µm	typ.
Backlash	0.5	4	µm	typ.
Unidirectional repeatability	0.5	1	µm	typ.
Pitch / yaw [1]	100	100	µrad	typ. over 100 mm
Velocity	100	3	mm/s	max.
Reference point switch repeatability	1	1	µm	typ.
Mechanical properties				
Drive screw pitch	2	2	mm	
Gear ratio	–	42.9206		
Stiffness in motion direction	8	8	N/µm	±20 %
Load capacity	500	500	N	max.
Push/pull force	100	50	N	max.
Lateral force	200	200	N	max.
Drive properties				
Drive type	DC motor, ActiveDrive	DC gear motor		
Operating voltage	24	0 to ±12	V	
Motor power	70	3.6	W	nominal
Miscellaneous				
Operating temperature range	–20 to 65	–20 to 65	°C	
Material	Al (black anodized)	Al (black anodized)		
Mass	4.4 / 5.4 / 6.6	4.2 / 5.2 / 6.4	kg	±5 %
Connector	Sub-D 15 (m), incl. 3 m cable	Sub-D 15 (m), incl. 3 m cable		
Recommended controllers / drivers	C-863 C-884	C-863 C-884		

(1) This value applies to each 100 mm respectively for travel ranges greater than 100 mm.

L-412 High-Load Linear Stage

High Performance and Cost Efficiency, Drive Screw

- Width 116 mm
- Travel range to 610 mm
- Precision ball screw
- Incremental or absolute rotary encoder options
- Additional linear encoder options
- Precision recirculating ball bearings, load capacity to 400 N
- Covering strip on the side for protection against debris



Reference-class linear stage

PI has extended its product portfolio for industrial solutions with a new family of precision linear ball-screw stages. Various versions are availablewith high-performance synchronous servo motors, heavy-duty recirculating ball bearings, and precision rotary and linear encoders. An optional holding brake allows use as a vertical axis. The stage's internal ball screw can be relubricated externally thus removing the need to disassemble the stage. This provides a higher reliability and longer lifetime when compared to stages requiring additional effort in relubrication. It is also possible to integrate such lubrication into a customer's central lubrication system. The protective side seal and the purge air connection prevent contamination by debris entering the stage.

Synchronous servo motor

These motors have high positioning accuracy and overload capacity over a large rotation speed range. High torque and low inertia ensure high dynamic operation of the stage. The motor provides an adaptable cable exit, allowing the user to be flexible with their cable positioning strategies in their machine. The long lifetime, high performance and robustness of these servo motors produce excellent results in applications in precision industrial automation.

Options

- Holding brake (L-412.xxxxxxB)
- Various rotary and linear encoders, absolute and incremental
- Versions with linear encoder with optional drag chain and connection box (L-412.xxxxxxE1) or without drag chain (L-412.xxxxxxE0)
- Foldback kits to reduce overall length available on request
- Certification and calibration available on request

Class leading design

When compared to current market offerings, the new L-412 series of stages provides users with a higher specification recirculating ball bearing that offers higher load carrying capacity and dynamic performance. The standard motor offers a high resolution resulting in improved motion tracking errors and refined move and settle performance.

Applications

- Automated Optical Inspection (AOI)
- Electronics Manufacturing
- Automation
- Laser Cutting

>> Absolute Encoder
>> Incremental Encoder

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	L-412.03	L-412.05	L-412.09	L-412.13	Unit	Tolerance
Motion						
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	300	300	300	300	mm/s	max.
Positioning accuracy (uncalibrated)	±5	±6	±8	±10	µm	max.

	L-412.17	L-412.21	L-412.25	Unit	Tolerance
Motion					
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	300	300	300	mm/s	max.
Positioning accuracy (uncalibrated)	±12	±14	±16	µm	max.

	L-412.xxx232 basic option	L-412.xxx244	L-412.xxx054	Unit	Tolerance
Encoder options					
Integrated sensor	Incremental rotary encoder	Absolute rotary encoder, single turn	Absolute rotary encoder, multiturn		
Sensor signal	A/B quadrature, RS-422	EnDat 2.1	EnDat 2.1		
Sensor resolution	20000	8192	8192	Cts./rev.	
Design resolution	0.25	0.6	0.6	µm	
Minimum incremental motion	1	2	2	µm	
Bidirectional repeatability	±1	±3	±3	µm	max.
Limit switches	Hall effect, 5 V NPN	Hall effect, 5 V NPN	–		
Sensor connection	M23	M23	M23		

	L-412.xxx212Ex	L-412.xxx211Ex	L-412.xxx025Ex	Unit	Tolerance
Encoder options					
Integrated sensor	Incremental linear encoder Additional rotary encoder, see basic option	Incremental linear encoder Additional rotary encoder, see basic option	Absolute-measuring linear encoder Additional rotary encoder, see basic option		
Sensor signal	A/B quadrature, RS-422	Sin/cos, 1 V peak-peak, 20 µm signal period	EnDat 2.2		
Design resolution	0.05	–	0.001	µm	
Minimum incremental motion	300	50	50	nm	typ.
Bidirectional repeatability	±0.5	±0.5	±0.5	µm	max.
Limit switches	Hall effect, 5 V NPN	Hall effect, 5 V NPN	–		
Sensor connection	Sub-D 15 (m)	M17	M17		

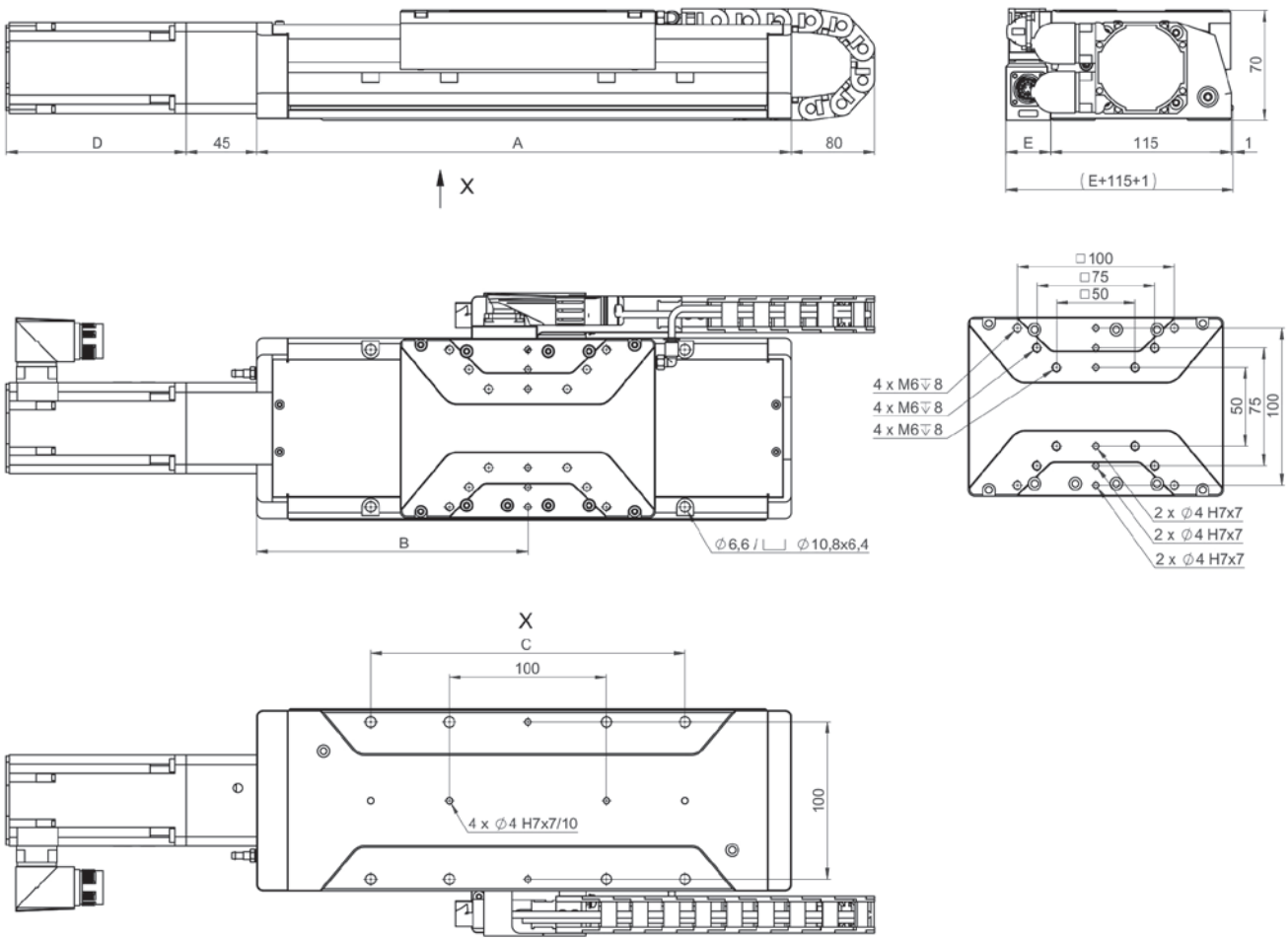
	L-412.xxxxxx	L-412.xxxxxxB	Unit	Tolerance
Mechanical properties				
Guide type	Recirculating ball bearing	Recirculating ball bearing		
Drive screw type	Ball screw	Ball screw		
Holding brake	–	Electromagnetic safety brake		
Drive screw pitch	5	5	mm	
Push/pull force, power on	700	700	N	max.
Holding force, power off	–	500	N	typ.
Load capacity in Z	400	400	N	max.
Permissible lateral force	200	200	N	max.
Permissible torque in θ_X	20	20	N·m	max.
Permissible torque in θ_Y	15	15	N·m	max.
Permissible torque in θ_Z	20	20	N·m	max.

	L-412.xx9	Unit	Tolerance
Drive properties			
Drive type	Synchronous servo motor		
Intermediate circuit voltage, effective	320	V DC	max.
Peak torque	2.76	N·m	typ.
Nominal torque	0.7	N·m	typ.
Peak current, effective (RMS)	10.9	A	typ.
Nominal current, effective (RMS)	2.2	A	typ.
Torque constant, effective	0.32	N·m/A	typ.
Resistance phase-phase	5.22	Ω	typ.
Inductance phase-phase	9.7	mH	typ.
Back EMF phase-phase	20.4	V/kRPM	max.
Number of pole pairs	3		

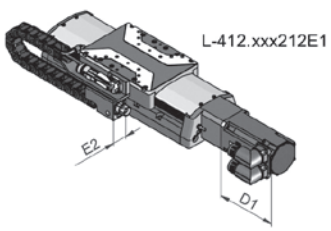
	L-412	Unit	Tolerance
Miscellaneous			
Material	Aluminum, black anodized stainless steel		
Overall mass	L-412.03 (52 mm travel range): 6.4 L-412.05 (102 mm travel range): 6.9 L-412.09 (204 mm travel range): 7.9 L-412.13 (305 mm travel range): 8.9 L-412.17 (407 mm travel range): 9.8 L-412.21 (508 mm travel range): 10.8 L-412.25 (610 mm travel range): 11.8	kg	±5 %
Moved mass	1.4	kg	±5 %
MTBF	20000	h	
Connection	M23 (motor) M23 (rotary encoder) optional connection for linear encoder Fitting for purge air hose with outside diameter 4 mm Funnel-type grease nipple for spindle lubrication		
Limit switch connection	M8 8-pin		
Recommended controllers	ACS modular controller		

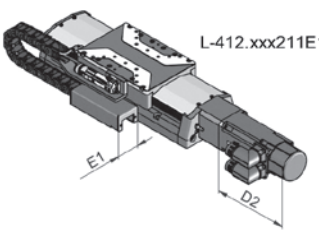
Connecting cables are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

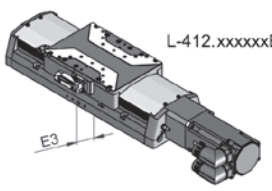
L-412, dimensions in mm

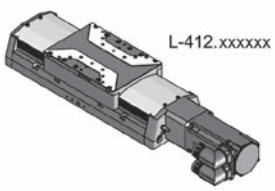


	TRAVEL	A	B	C	D			E	
					D1 L-412.xxxxxxxx	D2 L-412.xxxxxxxxB	E1 L-412.xxxxxxEO	E2 L-412.xxx211E1	E3 L-412.xxx212E1
L-417.03xxxx	52 (4″)	290	147,5	100	114,5	148,5	44	28,5	28
L-417.05xxxx	102 (4″)	340	172,5	100, 200	114,5	148,5	44	28,5	28
L-417.09xxxx	204 (8″)	445	225	100, 200, 300	114,5	148,5	44	28,5	28
L-417.13xxxx	305 (12″)	545	275	100, 200, 300, 400	114,5	148,5	44	28,5	28
L-417.17xxxx	407 (16″)	645	325	100, 200, 300, 400, 500	114,5	148,5	44	28,5	28
L-417.21xxxx	508 (20″)	745	375	100, 200, 300, 400, 500, 600	114,5	148,5	44	28,5	28
L-417.25xxxx	610 (24″)	850	427,5	100, 200, 300, 400, 500, 600, 700	114,5	148,5	44	28,5	28





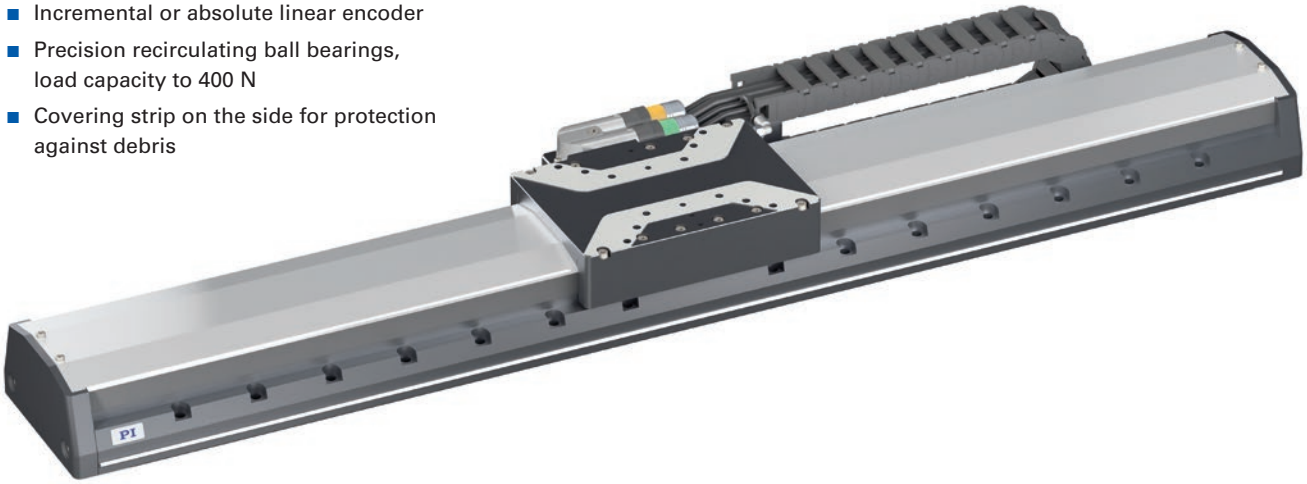




V-412 PIMag® High-Load Linear Stage

High Performance and Cost Efficiency, Linear Motor

- 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 debris



Reference-class linear stage

PI has extended its product portfolio for industrial solutions with a new family of precision linear motor stages. Various versions are available with high-performance linear motors, heavy-duty recirculating ball bearings, and precision linear encoders. The protective side seal and the purge air connection prevent contamination by debris entering the stage.

PIMag® magnetic direct drive

3-phase magnetic direct drives do not use mechanical components in the drive-train, they transmit the drive force to the motion platform directly and without friction. The ironless linear motors 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 is in comparison to iron core linear motors which exhibit 'cogging'. This allows smooth running even at low velocities and no vibration at high velocities.

Class leading design

When compared to current market offerings, the new V-412 series of stages provides users with a higher specification recirculating ball bearing that offers higher load carrying capacity and dynamic performance. The encoder options offer a high resolution resulting in improved motion tracking errors and refined move and settle performance. For full flexibility the user can select either incremental or absolute types. Absolute types remove the requirement to home the stage during startup and provide additional benefits including reduced collision risks during operation.

Applications

- Automated Optical Inspection (AOI)
- Digital Printing
- Electronics Manufacturing
- Flatpanel Inspection
- Automation
- Laser Cutting
- Scanning

>> Absolute Encoder
>> Linear Encoder
>> PIMag® Magnetic Linear Motors

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	V-412.03	V-412.05	V-412.09	V-412.13	Unit	Tolerance
Motion						
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.

	V-412.17	V-412.21	V-412.25	Unit	Tolerance
Motion					
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.

	V-412.xxx211Ex	V-412.xxx025Ex	Unit	Tolerance
Encoder options				
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, 5 V NPN	–		

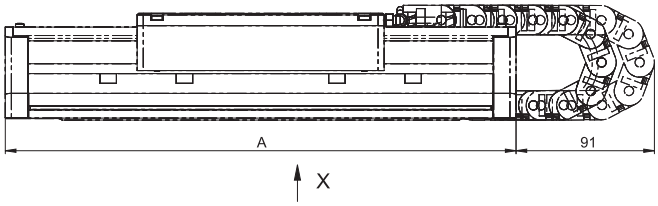
	V-412.xxxxxx	V-412.xxxxxxB	Unit	Tolerance
Mechanical properties				
Guide type	Recirculating ball bearing	Recirculating ball bearing		
Load capacity in Z	400	400	N	max.
Permissible lateral force	200	200	N	max.
Permissible torque in θ_X	20	20	N·m	max.
Permissible torque in θ_Y	15	15	N·m	max.
Permissible torque in θ_Z	20	20	N·m	max.

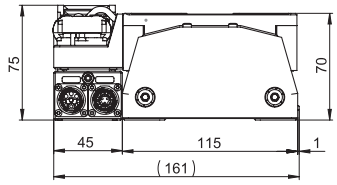
	V-412.xx6	Unit	Tolerance
Drive properties			
Drive type	Ironless 3-phase linear motor		
Intermediate circuit voltage, effective	300	V DC	max.
Peak force	151	N	typ.
Nominal force	33	N	typ.
Peak current, effective (RMS)	10.6	A	typ.
Nominal current, effective (RMS)	2.3	A	typ.
Force constant, effective	14.1	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	

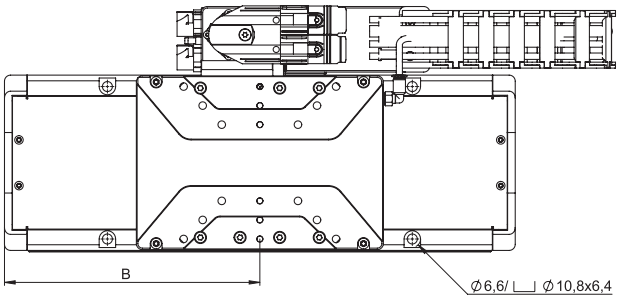
	V-412	Unit	Tolerance
Miscellaneous			
Material	Aluminum, black anodized stainless steel		
Overall mass	V-412.03 (52 mm travel range): 5.0 V-412.05 (102 mm travel range): 5.6 V-412.09 (204 mm travel range): 6.7 V-412.13 (305 mm travel range): 7.9 V-412.17 (407 mm travel range): 9.0 V-412.21 (508 mm travel range): 10.2 V-412.25 (610 mm travel range): 11.3	kg	±5 %
Moved mass	1.7	kg	±5 %
MTBF	20000	h	
Connection	M17 (motor) M17 (linear encoder) Fitting for purge air hose with outside diameter 4 mm		
Recommended controllers	C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller		

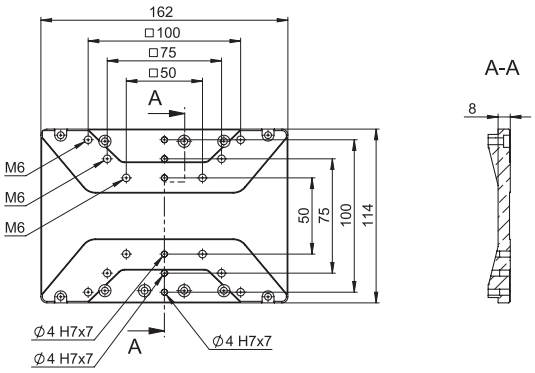
Connecting cables are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

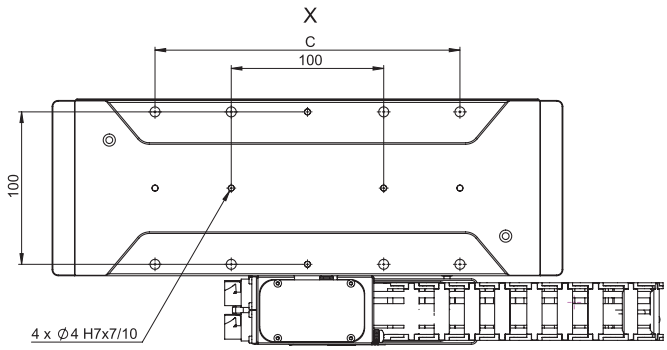
V-412, dimensions in mm









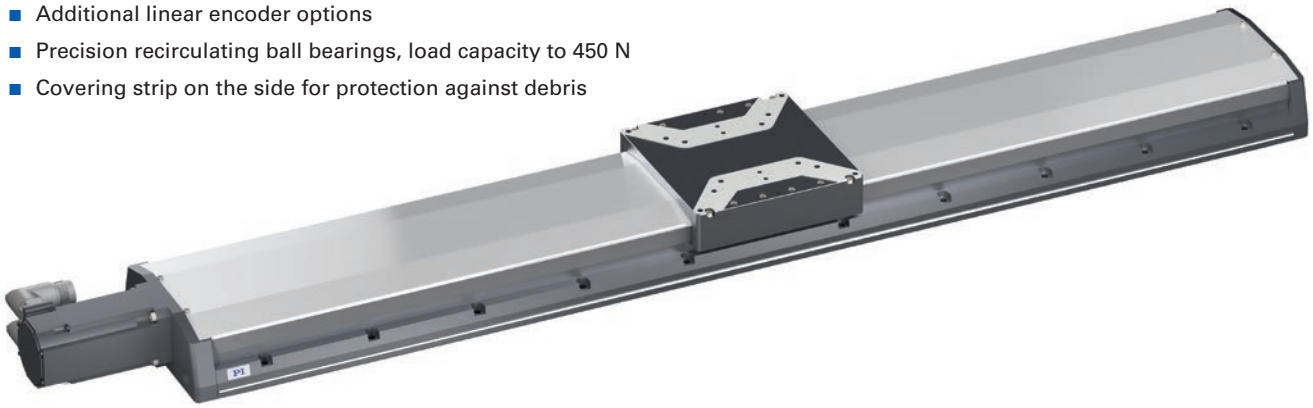


	TRAVEL	A	B	C
V-412.03xxxx	52 (2″)	285	142,5	100
V-412.05xxxx	102 (4″)	335	167,5	100, 200
V-412.09xxxx	204 (8″)	440	220	100, 200, 300
V-412.13xxxx	305 (12″)	540	270	100, 200, 300, 400
V-412.17xxxx	407 (16″)	640	320	100, 200, 300, 400, 500
V-412.21xxxx	508 (20″)	740	370	100, 200, 300, 400, 500, 600
V-412.25xxxx	610 (24″)	845	422,5	100, 200, 300, 400, 500, 600, 700

L-417 High-Load Linear Stage

High Performance and Cost Efficiency, Drive Screw

- Width 166 mm
- Travel range to 813 mm
- Precision ball screw
- Incremental or absolute rotary encoder options
- Additional linear encoder options
- Precision recirculating ball bearings, load capacity to 450 N
- Covering strip on the side for protection against debris



Reference-class linear stage

PI has extended its product portfolio for industrial solutions with a new family of precision linear ball-screw stages. Various versions are available with high-performance synchronous servo motors, heavy-duty recirculating ball bearings, and precision rotary and linear encoders. An optional holding brake allows use as a vertical axis. The stage's internal ball screw can be relubricated externally thus removing the need to disassemble the stage. This provides a higher reliability and longer lifetime when compared to stages requiring additional effort in relubrication. It is also possible to integrate such lubrication into a customer's central lubrication system. The protective side seal and the purge air connection prevent contamination by debris entering the stage.

Synchronous servo motor

These motors have high positioning accuracy and overload capacity over a large rotation speed range. High torque and low inertia ensure high dynamic operation of the stage. The motor provides an adaptable cable exit, allowing the user to be flexible with their cable positioning strategies in their machine. The long lifetime, high performance and robustness of these servo motors produce excellent results in applications in precision industrial automation.

Options

- Holding brake (L-417.xxxxxxB)
- Various rotary and linear encoders, absolute and incremental
- Versions with linear encoder with optional drag chain and connection box (L-417.xxxxxxE1) or without drag chain (L-417.xxxxxxE0)
- Foldback kits to reduce overall length available on request
- Certification and calibration available on request

Class leading design

When compared to current market offerings, the new L-417 series of stages provides users with a higher specification recirculating ball bearing that offers higher load carrying capacity and dynamic performance. The standard motor offers a high resolution resulting in improved motion tracking errors and refined move and settle performance.

Applications

- Automated Optical Inspection (AOI)
- Electronics Manufacturing
- Automation
- Laser Cutting

>> Absolute Encoder
>> Incremental Encoder

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	L-417.05	L-417.09	L-417.13	L-417.17	Unit	Tolerance
Motion						
Travel range	102	204	305	407	mm	
Pitch / yaw	±14	±19	±29	±35	µrad	max.
Straightness / flatness	±2.5	±4	±6	±8	µm	max.
Velocity, unloaded	300	300	300	300	mm/s	max.
Positioning accuracy (uncalibrated)	±6	±8	±10	±12	µm	max.

	L-417.21	L-417.25	L-417.33	Unit	Tolerance
Motion					
Active axes	X	X	X		
Travel range	508	610	813	mm	
Pitch / yaw	±40	±45	±50	µrad	max.
Straightness / flatness	±9	±10	±12	µm	max.
Velocity, unloaded	300	300	250	mm/s	max.
Positioning accuracy (uncalibrated)	±14	±16	±18	µm	max.

	L-417.xxx232 basic option	L-417.xxx244	L-417.xxx054	Unit	Tolerance
Encoder options					
Integrated sensor	Incremental rotary encoder	Absolute rotary encoder, single turn	Absolute rotary encoder, multiturn		
Sensor signal	A/B quadrature, RS-422	EnDat 2.1	EnDat 2.1		
Sensor resolution	20000	8192	8192	Cts./rev.	
Design resolution	0.25	0.6	0.6	µm	
Minimum incremental motion	1	2	2	µm	
Bidirectional repeatability	±1	±3	±3	µm	max.
Limit switches	Hall effect, 5 V NPN	Hall effect, 5 V NPN	–		
Sensor connection	M23	M23	M23		

	L-417.xxx212Ex	L-417.xxx211Ex	L-417.xxx025Ex	Unit	Tolerance
Encoder options					
Integrated sensor	Incremental linear encoder Additional rotary encoder, see basic option	Incremental linear encoder Additional rotary encoder, see basic option	Absolute-measuring linear encoder Additional rotary encoder, see basic option		
Sensor signal	A/B quadrature, RS-422	Sin/cos, 1 V peak-peak, 20 µm signal period	EnDat 2.2		
Design resolution	0.05	–	0.001	µm	
Minimum incremental motion	300	50	50	nm	typ.
Bidirectional repeatability	±0.5	±0.5	±0.5	µm	max.
Limit switches	Hall effect, 5 V NPN	Hall effect, 5 V NPN	–		
Sensor connection	Sub-D 15 (m)	M17	M17		

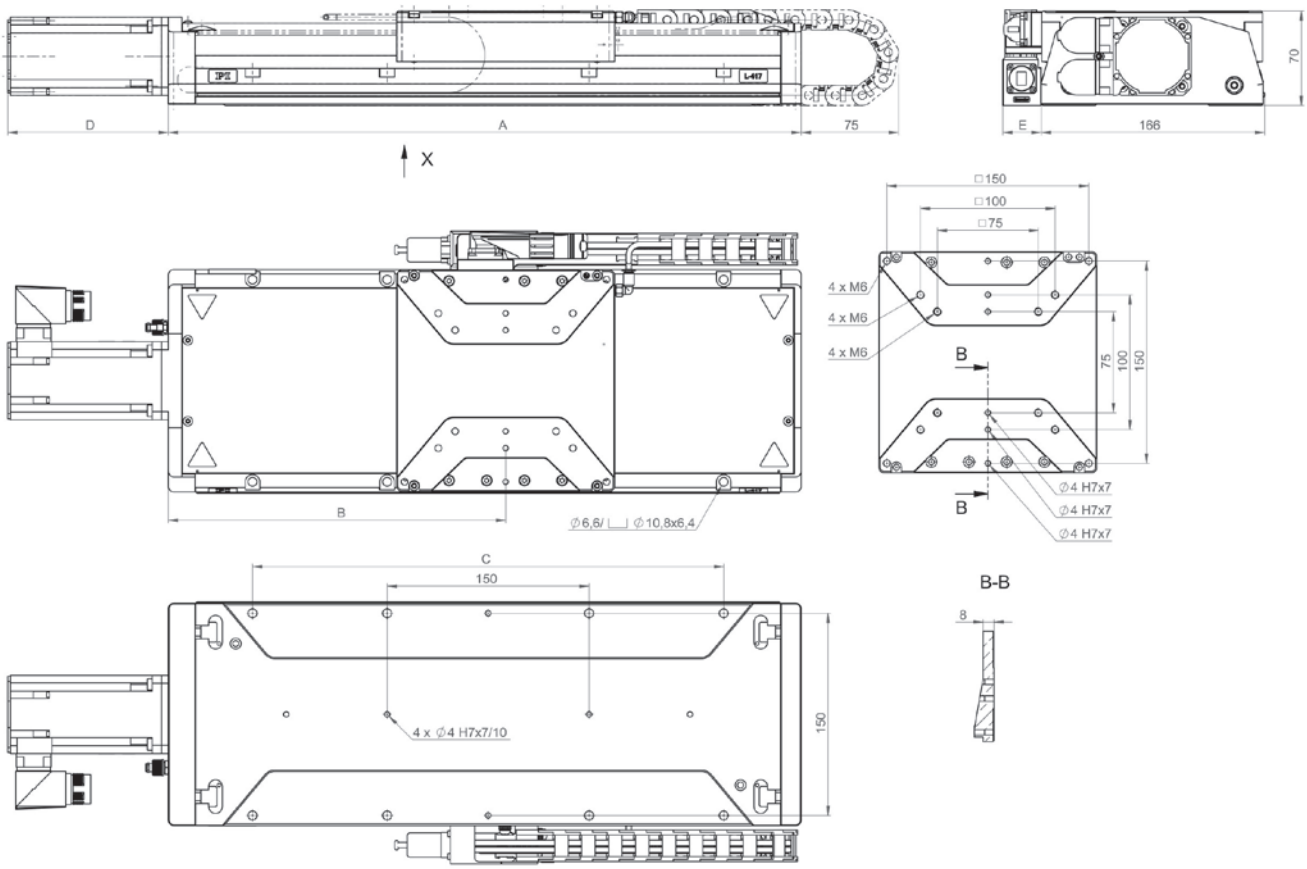
	L-417.xxxxxx	L-417.xxxxxxB	Unit	Tolerance
Mechanical properties				
Guide type	Recirculating ball bearing	Recirculating ball bearing		
Drive screw type	Ball screw	Ball screw		
Holding brake	–	Electromagnetic safety brake		
Drive screw pitch	5	5	mm	
Push/pull force, power on	700	700	N	max.
Holding force, power off	–	500	N	typ.
Load capacity in Z	450	450	N	max.
Permissible lateral force	250	250	N	max.
Permissible torque in θ_X	40	40	N·m	max.
Permissible torque in θ_Y	30	30	N·m	max.
Permissible torque in θ_Z	40	40	N·m	max.

	L-417.xx9	Unit	Tolerance
Drive properties			
Drive type	Synchronous servo motor		
Intermediate circuit voltage, effective	320	V DC	max.
Peak torque	2.76	N·m	typ.
Nominal torque	0.7	N·m	typ.
Peak current, effective (RMS)	10.9	A	typ.
Nominal current, effective (RMS)	2.2	A	typ.
Torque constant, effective	0.32	N·m/A	typ.
Resistance phase-phase	5.22	Ω	typ.
Inductance phase-phase	9.7	mH	typ.
Back EMF phase-phase	20.4	V/kRPM	max.
Number of pole pairs	3		

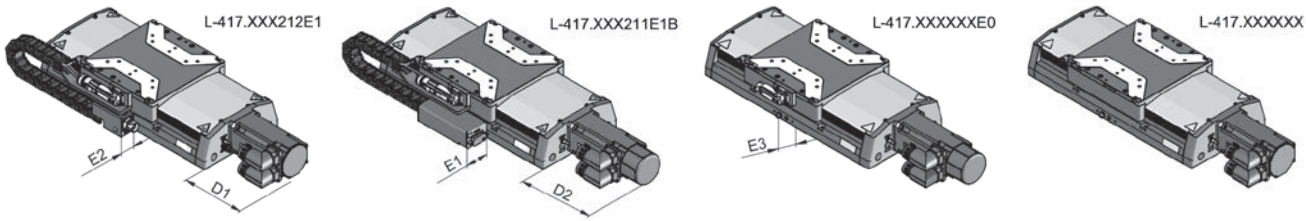
	L-417	Unit	Tolerance
Miscellaneous			
Material	Aluminum, black anodized stainless steel		
Overall mass	L-417.05 (102 mm travel range): 9.3 L-417.09 (204 mm travel range): 10.8 L-417.13 (305 mm travel range): 12.2 L-417.17 (407 mm travel range): 13.7 L-417.21 (508 mm travel range): 15.1 L-417.25 (610 mm travel range): 16.5 L-417.33 (813 mm travel range): 19.4	kg	±5 %
Moved mass	2.4	kg	±5 %
MTBF	20000	h	
Connection	M23 (motor) M23 (rotary encoder) optional connection for linear encoder Fitting for purge air hose with outside diameter 4 mm Funnel-type grease nipple for spindle lubrication		
Limit switch connection	M8 8-pin		
Recommended controllers	ACS modular controller		

Connecting cables are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

L-417, dimensions in mm



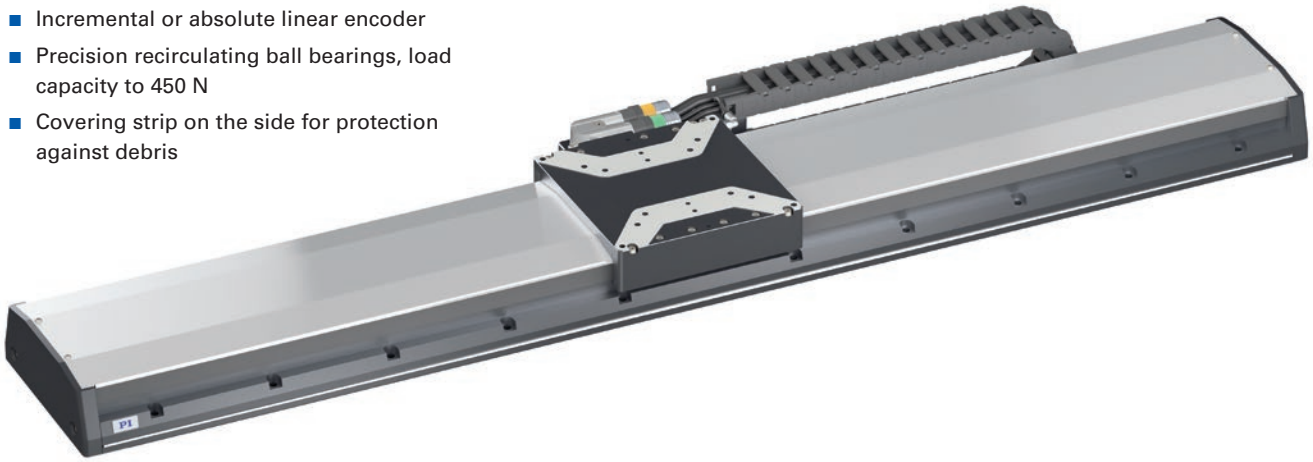
	TRAVEL	A	B	C	D			E	
					D1 L-417.xxxxxxxx	D2 L-417.xxxxxxxxB	E1 L-417.xxxxxxEO	E2 L-417.xxx211E1	E3 L-417.xxx212E1
L-417.05xxxx	102 (4″)	356	198	150	119,5	153,5	44	28,5	28
L-417.09xxxx	204 (8″)	470	250,5	150, 350	119,5	153,5	44	28,5	28
L-417.13xxxx	305 (12″)	570	300,5	150, 350	119,5	153,5	44	28,5	28
L-417.17xxxx	407 (16″)	670	350,5	150, 350, 550	119,5	153,5	44	28,5	28
L-417.21xxxx	508 (20″)	775	403	150, 350, 550	119,5	153,5	44	28,5	28
L-417.25xxxx	610 (24″)	875	453	150, 350, 550, 750	119,5	153,5	44	28,5	28
L-417.33xxxx	813 (32″)	1080	555,5	150, 350, 550, 750, 950	119,5	153,5	44	28,5	28



V-417 PIMag® High-Load Linear Stage

High Performance and Cost Efficiency, Linear Motor

- Width 166 mm
- Travel range to 813 mm
- Nominal force 87 N
- Incremental or absolute linear encoder
- Precision recirculating ball bearings, load capacity to 450 N
- Covering strip on the side for protection against debris



Reference-class linear stage

PI has extended its product portfolio for industrial solutions with a new family of precision linear motor stages. Various versions are available with high-performance linear motors, heavy-duty recirculating ball bearings, and precision linear encoders. The protective side seal and the purge air connection prevent contamination by debris entering the stage.

PIMag® magnetic direct drive

3-phase magnetic direct drives do not use mechanical components in the drive-train, they transmit the drive force to the motion platform directly and without friction. The ironless linear motors 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 is in comparison to iron core linear motors which exhibit 'cogging'. This allows smooth running even at low velocities and no vibration at high velocities.

Class leading design

When compared to current market offerings, the new V-417 series of stages provides users with a higher specification recirculating ball bearing that offers higher load carrying capacity and dynamic performance. The encoder options offer a high resolution resulting in improved motion tracking errors and refined move and settle performance. For full flexibility the user can select either incremental or absolute types. Absolute types remove the requirement to home the stage during startup and provide additional benefits including reduced collision risks during operation.

Applications

- Automated Optical Inspection (AOI)
- Digital Printing
- Electronics Manufacturing
- Flatpanel Inspection
- Automation
- Laser Cutting
- Scanning

>> Absolute Encoder
>> Linear Encoder
>> PIMag® Magnetic Linear Motors

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	V-417.05	V-417.09	V-417.13	V-417.17	Unit	Tolerance
Motion						
Travel range	102	204	305	407	mm	
Pitch / yaw	±14	±19	±29	±39	µrad	max.
Straightness / flatness	±2.5	±4	±6	±8	µm	max.
Velocity, unloaded	2000	2000	2000	2000	mm/s	max.
Positioning accuracy (uncalibrated)	±4	±8	±10	±12	µm	typ.

	V-417.21	V-417.25	V-417.33	Unit	Tolerance
Motion					
Active axes	X	X	X		
Travel range	508	610	813	mm	
Pitch / yaw	±40	±45	±50	µrad	max.
Straightness / flatness	±9	±10	±12	µm	max.
Velocity, unloaded	2000	2000	2000	mm/s	max.
Positioning accuracy (uncalibrated)	±14	±15	±17	µm	typ.

	V-417.xxx211Ex	V-417.xxx025Ex	Unit	Tolerance
Encoder options				
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, 5 V NPN	–		

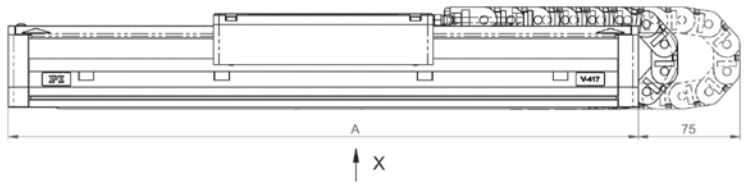
	V-417.xxxxxx	V-417.xxxxxxB	Unit	Tolerance
Mechanical properties				
Guide type	Recirculating ball bearing	Recirculating ball bearing		
Load capacity in Z	450	450	N	max.
Permissible lateral force	250	250	N	max.
Permissible torque in θ_X	40	40	N·m	max.
Permissible torque in θ_Y	30	30	N·m	max.
Permissible torque in θ_Z	40	40	N·m	max.

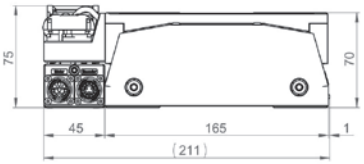
	V-417.xx6	Unit	Tolerance
Drive properties			
Drive type	Ironless 3-phase linear motor		
Intermediate circuit voltage, effective	300	V DC	max.
Peak force	300	N	typ.
Nominal force	87	N	typ.
Peak current, effective (RMS)	15	A	typ.
Nominal current, effective (RMS)	4.4	A	typ.
Force constant, effective	19.9	N/A	typ.
Motor constant	8.4	N/√W	typ.
Electrical time constant	0.35	ms	
Resistance phase-phase	3.6	Ω	typ.
Inductance phase-phase	1.2	mH	typ.
Back EMF phase-phase	16	V·s/m	max.
Pole pitch N-N	30	mm	

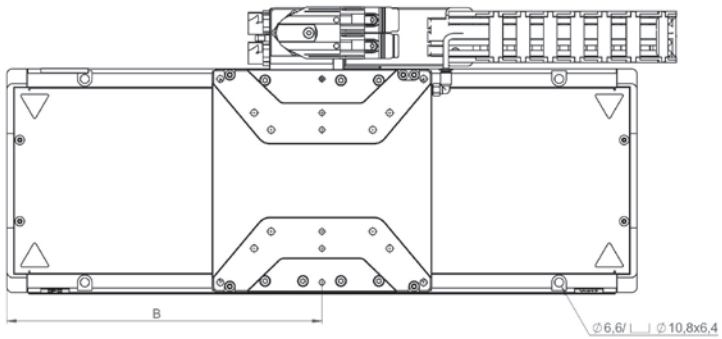
	V-417	Unit	Tolerance
Miscellaneous			
Material	Aluminum, black anodized stainless steel		
Overall mass	V-417.05 (102 mm travel range): 9.3 V-417.09 (204 mm travel range): 11.2 V-417.13 (305 mm travel range): 13.0 V-417.17 (407 mm travel range): 14.8 V-417.21 (508 mm travel range): 16.6 V-417.25 (610 mm travel range): 18.4 V-417.33 (610 mm travel range): 21.1	kg	±5 %
Moved mass	2.8	kg	±5 %
MTBF	20000	h	
Connection	M17 (motor) M17 (linear encoder) Fitting for purge air hose with outside diameter 4 mm		
Recommended controllers	C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller		

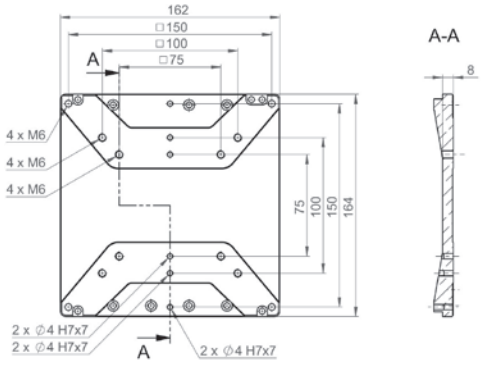
Connecting cables are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

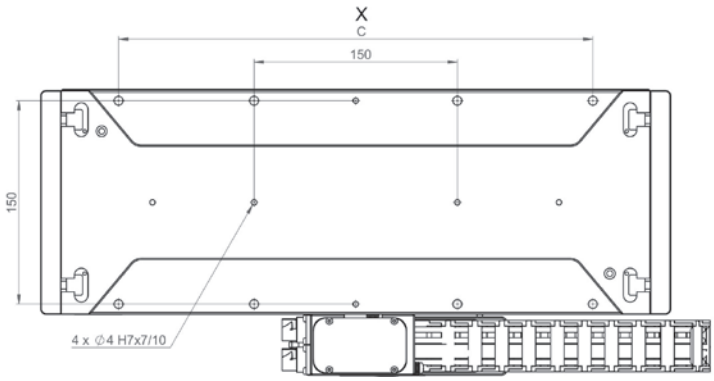
V-417, dimensions in mm











	TRAVEL	A	B	C
V-417.05XXXX	102 (4")	360	180	150
V-417.09XXXX	204 (8")	465	232,5	150, 350
V-417.13XXXX	305 (12")	565	282,5	150, 350
V-417.17XXXX	407 (16")	665	332,5	150, 350, 550
V-417.21XXXX	508 (20")	770	385	150, 350, 550
V-417.25XXXX	610 (24")	870	435	150, 350, 550, 750
V-417.33XXXX	813 (32")	1075	537,5	150, 350, 550, 750, 950

LS-180 Linear Stage for Heavy Loads

Robust Design for Industrial Use

- Travel ranges from 155 mm to 508 mm (6″ to 20″)
- Max. velocity to 150 mm/s
- Load capacity to 1000 N
- Optional linear encoder for direct position measurement

Reference-class linear stage

Recirculating ball bearings for high travel accuracy and load capacity. Precision ball screw with 5 mm pitch. Stress-relieved aluminum base for highest stability. Noncontact inductive limit switches.

Highly accurate position measuring with incremental linear encoder

Noncontact optical linear encoders measure the actual position directly at the motion platform with the greatest accuracy so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring.

Recirculating ball bearings

When carefully assembled, recirculating ball bearings are distinguished by a beneficial combination of high load capacity, lifetime, maintenance-free operation, and guiding accuracy. The moving part of the stages is supported by four preloaded linear ball bearing units which run on two guide rails. Each bearing unit is made up of two independent rows of circulating ball bearings.

Drive types

- Closed-loop DC servo motor with rotary encoder on the motor shaft
- 2-phase stepper motor for high torque even at low velocities and high resolution

Minimum incremental motion

In conjunction with the SMC Hydra controller, versions with stepper motor and integrated linear encoder achieve repeatable minimum incremental motion in the range of the sensor resolution. The same configuration achieves constant low velocities of a few sensor increments per second.

Applications

- Sample Inspection
- Scanning
- Scientific Instrumentation
- Semiconductor

>> Linear Encoder

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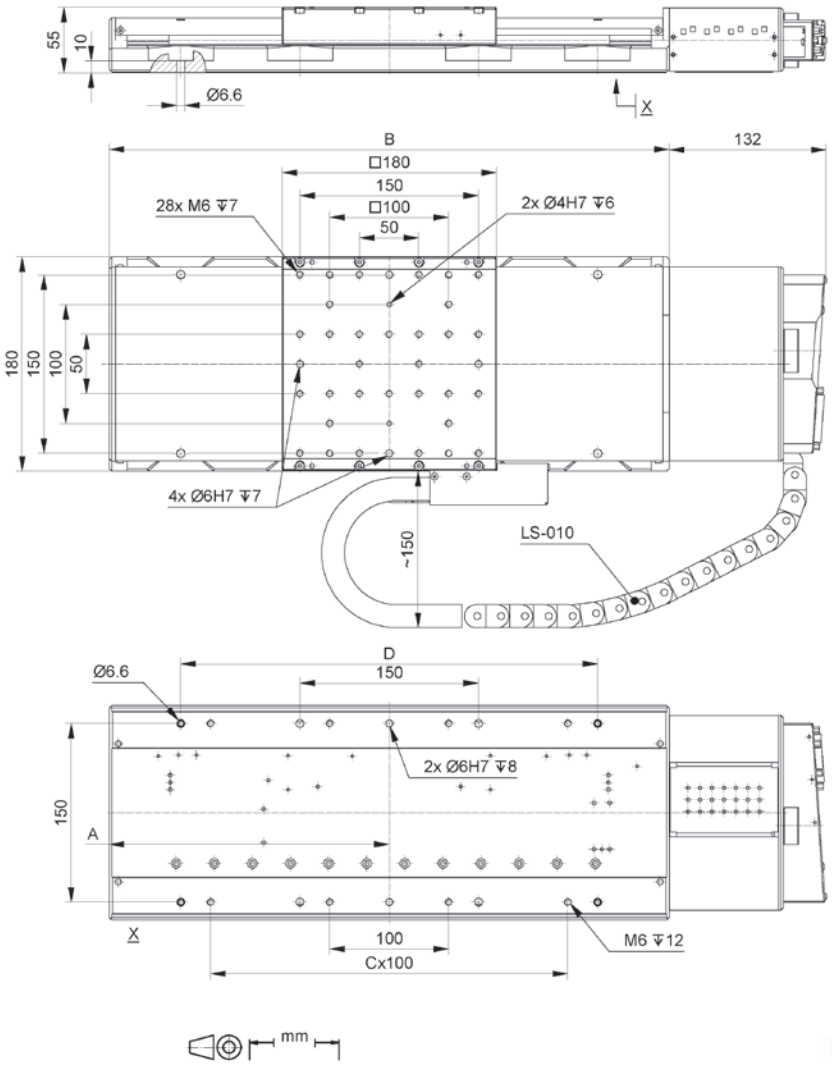
	624091x0	624091x1	624092x0	624092x1-0001	Unit	Tolerance
	Linear stage with DC motor and rotary encoder	Linear stage with DC motor, linear and rotary encoder	Linear stage with stepper motor	Linear stage with stepper motor and linear encoder		
Motion and positioning						
Travel range	155 / 205 / 305 / 508	155 / 205 / 305 / 508	155 / 205 / 305 / 508	155 / 205 / 305 / 508	mm	
Integrated sensor	Rotary encoder	Linear and rotary encoder	–	Linear encoder		
Sensor signal rotary encoder	A/B quadrature, RS-422	A/B quadrature, RS-422	–	–		
Sensor signal linear encoder	–	A/B quadrature, RS-422	–	Sin/cos, 1 V peak-peak, 20 µm signal period		
Design resolution	0.25	0.05	25	0.005	µm	
Sensor resolution rotary encoder	20000	20000	–		Counts/ rev.	
Sensor resolution linear encoder	–	0.05	–	–	µm	
Minimum incremental motion	0.5	0.1	0.5	0.1	µm	typ.
Unidirectional repeatability	0.5	0.1	0.5	0.1	µm	typ.
Bidirectional repeatability	±2.5	±0.1	±2.5	±0.1	µm	typ.
Pitch	±40 / ±50 / ±60 / ±80	±40 / ±50 / ±60 / ±80	±40 / ±50 / ±60 / ±80	±40 / ±50 / ±60 / ±80	µrad	typ.
Yaw	±50	±50	±50	±50	µrad	typ.
Straightness	±2 / ±3 / ±4 / ±6	±2 / ±3 / ±4 / ±6	±2 / ±3 / ±4 / ±6	±2 / ±3 / ±4 / ±6	µm	typ.
Flatness	±2 / ±3 / ±4 / ±6	±2 / ±3 / ±4 / ±6	±2 / ±3 / ±4 / ±6	±2 / ±3 / ±4 / ±6	µm	typ.
Max. velocity	150	150	75	75	mm/s	
Mechanical properties						
Guide type	Recirculating ball bearing	Recirculating ball bearing	Recirculating ball bearing	Recirculating ball bearing		
Drive screw type	Ball screw	Ball screw	Ball screw	Ball screw		
Drive screw pitch	5	5	5	5	mm	
Load capacity	1000	1000	1000	1000	N	max.
Push/pull force	800	800	800	800	N	max.
Holding force, power off	20	20	50	50	N	max.
Permissible lateral force	500	500	500	500	N	max.
Permissible torque M_x in θ_X	250	250	250	250	N·m	max.
Permissible torque M_y in θ_Y	132	132	132	132	N·m	max.
Permissible torque M_z in θ_Z	125	125	125	125	N·m	max.

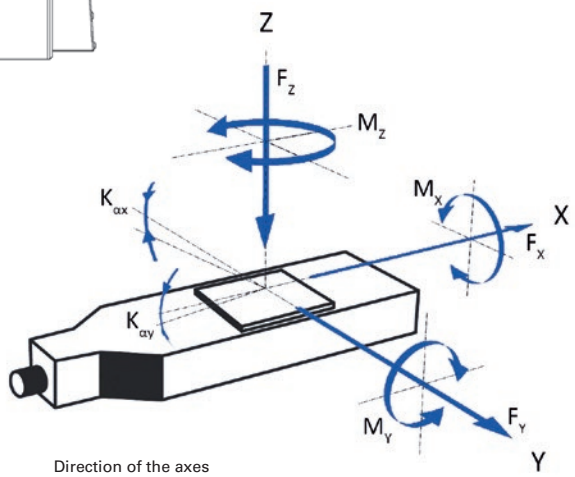
	624091x0	624091x1	624092x0	624092x1-0001	Unit	Tolerance
Drive properties						
Motor type	DC motor	DC motor	2-phase stepper motor	2-phase stepper motor		
Operating voltage, nominal	24	24	48	48	V	nom.
Operating voltage, max.	48	48	48	48	V	max.
Peak current, effective	3.8	3.8	2	2	A	typ.
Electrical time constant	6	6			ms	
Resistance phase-phase	0.62	0.62	2.4	2.4	Ω	typ.
Inductance phase-phase	0.13	0.13	2.87	2.87	mH	typ.
Back EMF phase-phase	0.00349	0.00349			V/kRPM	max.
Step resolution			200	200	Full steps/ rev.	
Limit switches	Inductive	Inductive	Inductive	Inductive		
Miscellaneous						
Operating temperature range	5 to 40	5 to 40	5 to 40	0 to 55	°C	
Material	Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel		
Mass	7.8 / 8.4 / 9.4 / 10.6	8.5 / 9.1 / 10.3 / 11.5	8.3 / 8.9 / 9.9 / 11.0	9.0 / 9.6 / 10.8 / 12	kg	±5 %
Moved mass	2.2	2.2	2.2	2.2	kg	±5 %
Connection	Sub-D 25 (m)	Motor: Sub-D 25 (m) Sensor: Sub-D 9 (m)	Sub-D 25 (m)	Motor: Sub-D 25 (m Sensor: Sub-D 9 (m)		
Recommended controllers	C-863 (single axis) with C-863.AD11 line driver C-884 (to 6 axes) with C-863.AD11 line driver C-885 with C-863.20C885 (to 40 axes) and C-863.AD11 line driver ACS modular controller	C-863 (single axis) with C-863.AD11 line driver C-884 (to 6 axes) with C-863.AD11 line driver C-885 with C-863.20C885 (to 40 axes) and C-863.AD11 line driver ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

Ask about custom designs!
Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.

LS-180, dimensions in mm, LS-010: Cable for linear encoder



Travel range/mm	A	B	C	D
155	235	470	3	350
205	260	520	3	350
305	310	620	5	450
508	410	820	5	650



Direction of the axes
and torques for linear stages

L-505 Compact Linear Stage

With DC or Stepper Motor

- Travel ranges 13 or 26 mm
- Stepper motor or DC servo motor with and without gearhead
- Velocity to 15 mm/s
- Load capacity to 30 N
- Integrated reference point and limit switch

Product overview

Compact linear stage with low-backlash fine-threaded leadscrews and ball guides. Directly mountable XY combination. Integrated reference point and limit switches: Hall effect.

The linear stage is available in two design variants:

- Narrow, long variant with direct fixed drive (flange motor).
- Wide, compact variant with belt drive (folded drivetrain). These variants are marked by an "F" at the end of the item number.

Drive types

- DC motor with or without gearhead
- Stepper motor with or without gearhead

Variants with DC motor are equipped with an incremental linear encoder. This is optional in the case of stepper motor variants.

Highly accurate position measuring with incremental linear encoder

Noncontact optical linear encoders measure the actual position directly at the motion platform with the greatest accuracy so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring.

Applications

- Autofocus
- Biotechnology
- Automation
- Medical Industry
- Precision Micro Assembly

>> Linear Encoder

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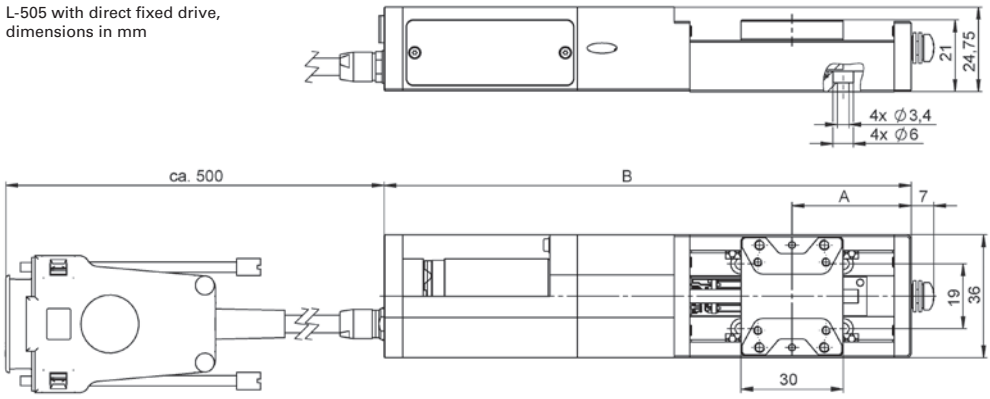
L-505 with DC motor	L-505.013212 L-505.013212F L-505.023212 L-505.023212F	L-505.014212F L-505.024212F	Unit	Tolerance
	Linear stage with DC motor and linear encoder	Linear stage with DC gear motor and linear encoder		
Active axes	X	X		
Motion and positioning				
Travel range	13 / 26	13 / 26	mm	
Integrated sensor	Incremental linear encoder	Incremental linear encoder		
Sensor signal linear encoder	A/B quadrature, RS-422	A/B quadrature, RS-422		
Design resolution	0.05	0.05	µm	
Sensor resolution linear encoder	0.05	0.05	µm	
Minimum incremental motion	0.1	0.5	µm	typ.
Unidirectional repeatability	0.1	0.25	µm	typ.
Bidirectional repeatability	±0.15	±0.25	µm	typ.
Pitch / yaw	±50 / ±75	±50 / ±75	µrad	typ.
Straightness / flatness	±0.5 / ±1	±0.5 / ±1	µm	typ.
Max. velocity	L-505.xxxxxx: 15 L-505.xxxxxxF: 7.5	1	mm/s	
Reference and limit switches	Hall effect	Hall effect		
Reference point switch repeatability	<4	<4	µm	typ.
Mechanical properties				
Guide type	Ball guide	Ball guide		
Drive screw type	Leadscrew	Leadscrew		
Drive screw pitch	0.5	0.5	mm	
Load capacity	30	30	N	max.
Permissible lateral force	30	30	N	max.
Push/pull force	20	20	N	max.
Holding force, power off	20	20	N	typ.
Permissible torque M_x in θ_X	L-505.01: 7 L-505.02: 9	L-505.01: 7 L-505.02: 9	N·m	max.
Permissible torque M_y in θ_Y	L-505.01: 6 L-505.02: 8	L-505.01: 6 L-505.02: 8	N·m	max.
Permissible torque M_z in θ_Z	L-505.01: 6 L-505.02: 8	L-505.01: 6 L-505.02: 8	N·m	max.
Drive properties				
Motor type	DC motor	DC gear motor		
Operating voltage, nominal	24	12	V	nom.
Operating voltage, max.	48	24	V	max.
Miscellaneous				
Operating temperature range	5 to 40	5 to 40	°C	
Material	anodized aluminum, stainless steel	anodized aluminum, stainless steel		
Mass	0.4	0.4	kg	±5 %
Moved mass	0.07	0.07	kg	±5 %
Connection	HD Sub-D 26 (m)	HD Sub-D 26 (m)		
Recommended controllers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller		

L-505 with stepper motor	L-505.011200 L-505.011200F L-505.021200 L-505.021200F	L-505.011212 L-505.011212F L-505.021212 L-505.021212F	L-505.01A200F L-505.02A200F	L-505.01A212F L-505.02A212F	Unit	Tolerance
	Linear stage with stepper motor	Linear stage with stepper motor and linear encoder	Linear stage with stepper motor and gearhead	Linear stage with stepper motor, gearhead and linear encoder		
Active axes	X	X				
Motion and positioning						
Travel range	13 / 26	13 / 26	13 / 26	13 / 26	mm	
Integrated sensor	–	Incremental linear encoder	–	Incremental linear encoder		
Sensor signal linear encoder	–	A/B quadrature, RS-422	–	A/B quadrature, RS-422		
Design resolution	2.5 (full step)	0.005	0.732 (full step)	0.005	µm	
Sensor resolution linear encoder	–	0.005	–	0.005	µm	
Minimum incremental motion	0.1	0.05	0.2	0.05	µm	typ.
Unidirectional repeatability	0.3	0.1	0.3	0.1	µm	typ.
Bidirectional repeatability	±2.5	±0.15	±2.5	±0.15	µm	typ.
Pitch / yaw	±50 / ±75	±50 / ±75	±50 / ±75	±50 / ±75	µrad	typ.
Straightness / flatness	±0.5 / ±1	±0.5 / ±1	±0.5 / ±1	±0.5 / ±1	µm	typ.
Max. velocity	L-505.xxxxxx: 10 L-505.xxxxxxF: 7.5	L-505.xxxxxx: 10 L-505.xxxxxxF: 7.5	0.75	0.75	mm/s	
Reference and limit switches	Hall effect	Hall effect	Hall effect	Hall effect		
Reference point switch repeatability	<4	<4	<4	<4	µm	typ.
Mechanical properties						
Guide type	Ball guide	Ball guide	Ball guide	Ball guide		
Drive screw type	Leadscrew	Leadscrew	Leadscrew	Leadscrew		
Drive screw pitch	0.5	0.5	0.5	0.5	mm	
Load capacity	30	30	30	30	N	max.
Permissible lateral force	30	30	30	30	N	max.
Push/pull force	20	20	20	20	N	max.
Holding force, power off	20	20	20	20	N	typ.
Permissible torque M_x in θ_X	L-505.01: 7 L-505.02: 9	L-505.01: 7 L-505.02: 9	L-505.01: 7 L-505.02: 9	L-505.01: 7 L-505.02: 9	N·m	max.
Permissible torque M_y in θ_Y	L-505.01: 6 L-505.02: 8	L-505.01: 6 L-505.02: 8	L-505.01: 6 L-505.02: 8	L-505.01: 6 L-505.02: 8	N·m	max.
Permissible torque M_z in θ_Z	L-505.01: 6 L-505.02: 8	L-505.01: 6 L-505.02: 8	L-505.01: 6 L-505.02: 8	L-505.01: 6 L-505.02: 8	N·m	max.
Drive properties						
Motor type	2-phase stepper motor	2-phase stepper motor	2-phase stepper motor with gear-head	2-phase stepper motor with gear-head		
Operating voltage, nominal	24	24	24	24	V	nom.
Operating voltage, max.	48	48	48	48	V	max.
Step resolution	200	200	24	24	Full steps/ rev.	

L-505 with stepper motor	L-505.011200 L-505.011200F L-505.021200 L-505.021200F	L-505.011212 L-505.011212F L-505.021212 L-505.021212F	L-505.01A200F L-505.02A200F	L-505.01A212F L-505.02A212F	Unit	Tolerance
Miscellaneous						
Operating temperature range	5 to 40	5 to 40	5 to 40	5 to 40	°C	
Material	anodized aluminum, stainless steel	anodized aluminum, stainless steel	anodized aluminum, stainless steel	anodized aluminum, stainless steel		
Mass	0.4	0.4	0.4	0.4	kg	±5 %
Moved mass	0.07	0.07	0.07	0.07	kg	±5 %
Connection	HD Sub-D 26 (m)	HD Sub-D 26 (m)	HD Sub-D 26 (m)	HD Sub-D 26 (m)		
Recommended controllers	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

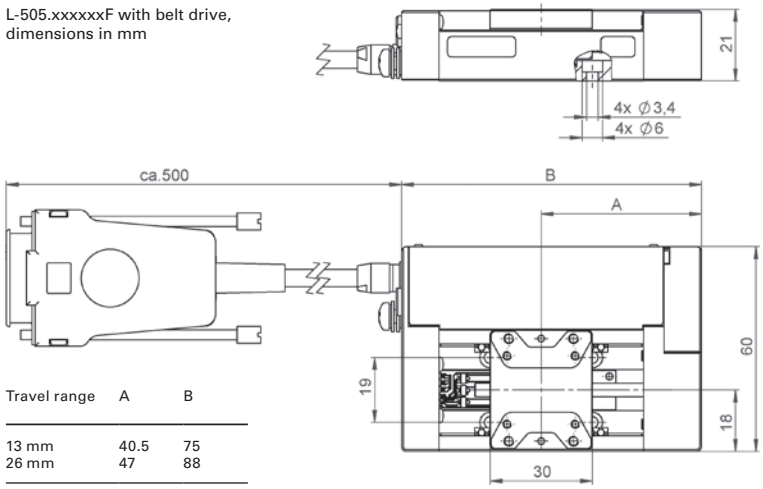
All cables required for operation with the ordered controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Custom designs or different specifications on request.

L-505 with direct fixed drive, dimensions in mm



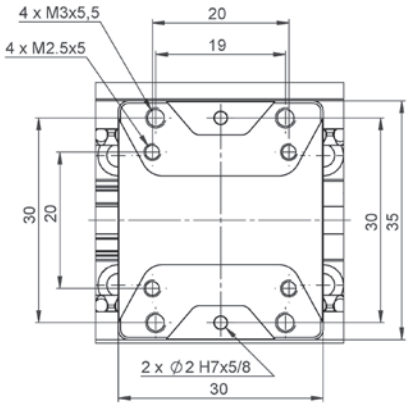
Travel range	A	B
13 mm	28.5	136
26 mm	35	149

L-505.xxxxxxF with belt drive, dimensions in mm



Travel range	A	B
13 mm	40.5	75
26 mm	47	88

L-505 motion platform, dimensions in mm

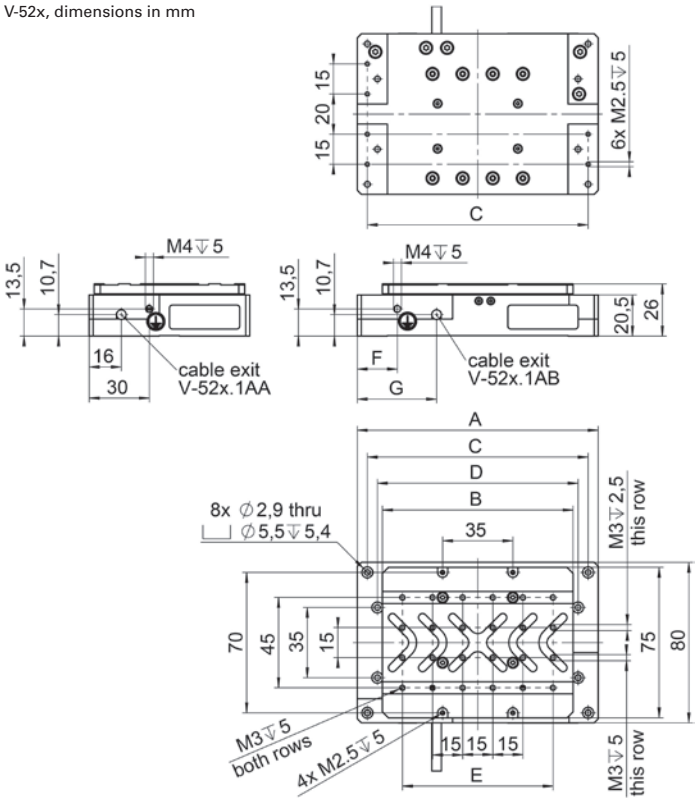


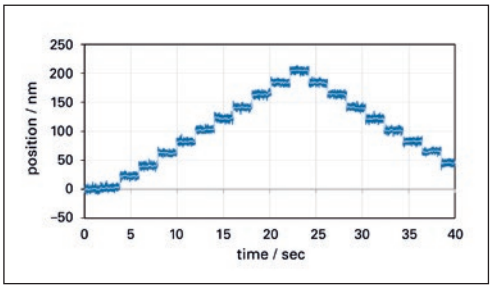
V-522 / V-524 / V-528
High-Dynamics PIMag® Linear Stage

Voice Coil-Direct Drive with Direct Position Measurement

- Fast scanning and positioning
- Travel ranges 5 mm, 10 mm, 20 mm
- Scanning frequencies of more than 10 Hz
- Max. velocity 250 mm/s
- Crossed roller bearings for the highest precision, anti-creep

V-52x, dimensions in mm





The V-522 reliably performs 20-nm repeatable steps

	A	B	C	D	E	F	G
V-522.1AA	80	65	70	70	–	–	–
V-522.1AB	80	65	70	70	–	15	23
V-524.1AA	90	75	80	70	–	–	–
V-524.1AB	90	75	80	70	–	15	25,5
V-528.1AA	120	95	110	100	75	–	–
V-528.1AB	120	95	110	100	75	20	39,5

Applications

- Autofocus
- Digital Printing
- Laser Marking
- Metrology / Testing
- Photonics
- Scanning
- Scientific Instrumentation
- Semiconductor

>> Linear Encoder
>> PIMag® Voice Coil

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	V-522.1AA V-522.1AB	V-524.1AA V-524.1AB	V-528.1AA V-528.1AB	Unit	Tolerance
Motion and positioning					
Active axes	X				
Travel range	5	10	20	mm	
Integrated Sensor	Optical, incremental	Optical, incremental	Optical, incremental		
Sensor resolution	10	10	10	nm	
Min. incremental motion	20	20	20	nm	typ.
Unidirectional repeatability	20	20	20	nm	
Bidirectional repeatability	±120	±120	±120	nm	typ.
Reference point switch repeatability	<1	<1	<1	µm	
Pitch	±50	±50	±50	µrad	max.
Yaw	±50	±50	±50	µrad	max.
Straightness	0.5	0.5	0.5	µm	max.
Flatness	0.5	0.5	0.5	µm	max.
Velocity	250	250	250	mm/s	max.
Mechanical properties					
Load capacity in Z	100	100	100	N	max.
Moved mass	131	137	150	g	
Overall mass	460	500	580	g	
Drive properties					
Drive type	voice coil	voice coil	voice coil		
Nominal force	4	3.8	2.9	N	nominal
Nominal current	1.3	1.3	1.3	A	nominal
Peak current	3	3	3	A	max. (3s)
Force constant	3.4	2.9	2.3	N/A	typ.
Motor constant	1.3	1.1	0.85	N/(√W)	typ.
Coil resistance	7.2	7.2	7.2	Ω	typ.
Coil inductance	1.7	1.7	1.7	mH	typ.
Time constant	0.32	0.32	0.32	ms	
Miscellaneous					
Housing material	Aluminum, black anodized	Aluminum, black anodized	Aluminum, black anodized		
Cable length	2	2	2	m	±10 mm
Cable exit	V-52x.1AA: cable exit in X V-52x.1AB: cable exit in Y	V-52x.1AA: cable exit in X V-52x.1AB: cable exit in Y	V-52x.1AA: cable exit in X V-52x.1AB: cable exit in Y		
Voltage / sensor connection	Sub-D 15 (m)	Sub-D 15 (m)	Sub-D 15 (m)		
Lifetime	20000	20000	20000	km	
Operating temperature range	18 to 45	18 to 45	18 to 45	°C	
Relative humidity during operation	20 to 80	20 to 80	20 to 80	%	
Recommended controllers	C-413 (single axis) ACS modular controller	C-413 (single axis) ACS modular controller	C-413 (single axis) ACS modular controller		

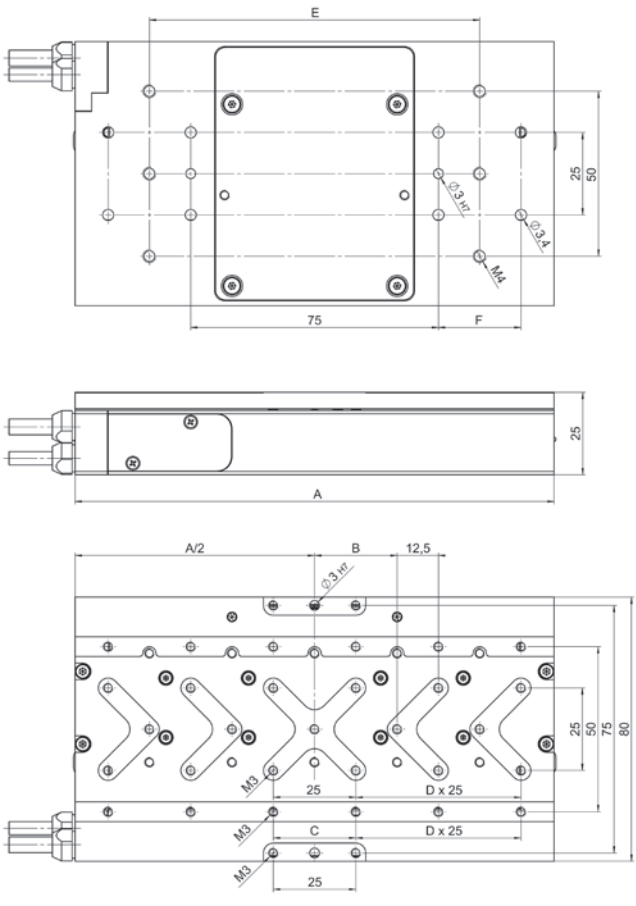
Ask about custom designs!

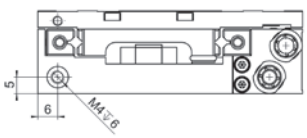
V-508 PIMag® Precision Linear Stage

Versatile options for adapting to requirements

- Travel ranges 80, 170, and 250 mm
- Ironless or iron core linear motor
- Incremental or absolute linear encoder, various resolutions
- Compact cross section: 80 mm × 25 mm
- Crossed roller bearings for high load capacity, anti-creep

V-508, dimensions in mm





Travel	80 V-508.3xxxxx	170 V-508.6xxxxx	250 V-508.9xxxxx
A	145	235	315
B	25	25	12.5
C	25	25	–
D	2	4	5
E	100	100 / 200	100 / 200
F	25	37,5	50

Applications

- Digital Printing
- Electronics Manufacturing
- Laser Marking
- Medical Industry
- Metrology / Testing
- Scanning

>> Absolute Encoder
>> Linear Encoder
>> PIMag® Magnetic Linear Motors

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	V-508.2	V-508.6	V-508.9	Unit	Tolerance
Motion and positioning					
Active axes	X	X	X		
Travel range	80	170	250	mm	
Pitch / yaw	±100	±200	±300	µrad	max.
Straightness / flatness	±4	±10	±20	µm	max.
Velocity, unloaded	1	1	1	m/s	max.
Acceleration, unloaded	5	5	5	m/s²	max.
Mechanical properties					
Load capacity in Z	100	100	100	N	max.
Moved mass	0.35	0.55	0.8	kg	
Overall mass	1.1	1.6	2.1	kg	
Guide type	Crossed roller guide with anti-creep system	Crossed roller guide with anti-creep system	Crossed roller guide with anti-creep system		

	V-508.x3	V-508.x5	V-508.xB	Unit	Tolerance
Encoder options					
Integrated sensor	Incremental linear encoder	PIOne incremental linear encoder	Absolute encoder		
Sensor signal	Sin/cos, 1 V peak-peak, 80 µm signal period	Sin/cos, 1 V peak-peak, 2 µm signal period	BiSS-C		
Sensor resolution	10 (1)	0.2 (1)	78	nm	typ.
Minimum incremental motion	20	0.5	160	nm	typ.
Bidirectional repeatability	±0.1	±0.05	±0.15		typ.

	V-508.xx1	V-508.xx2	Unit	Tolerance
Drive properties				
Drive type	Linear motor, ironless, 3-phase	Linear motor, iron core, 3-phase		
Intermediate circuit voltage, effective	48	48	V DC	
Peak force	12	14	N	typ.
Nominal force	3	4	N	typ.
Peak current, effective	3.2	3.2	A	typ.
Nominal current, effective	0.7	1.1	A	typ.
Force constant, effective	4.28	4.81	N/A	typ.
Resistance phase-phase	2.96	1.23	Ω	typ.
Inductance phase-phase	0.63	0.97	mH	typ.
Back EMF phase-phase	5.36	3.02	V·s/m	max.
Pole pitch N-N	20	18	mm	

	V-508
Miscellaneous	
Operating temperature range	10 °C to 50 °C
Humidity	20 – 90 % rel., not condensing
Material	Aluminum, black anodized
Motor connector	HD Sub-D 26 (m)
Sensor connection	Sub-D 15 (f)
Cable length	2 m
Recommended controllers	C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller

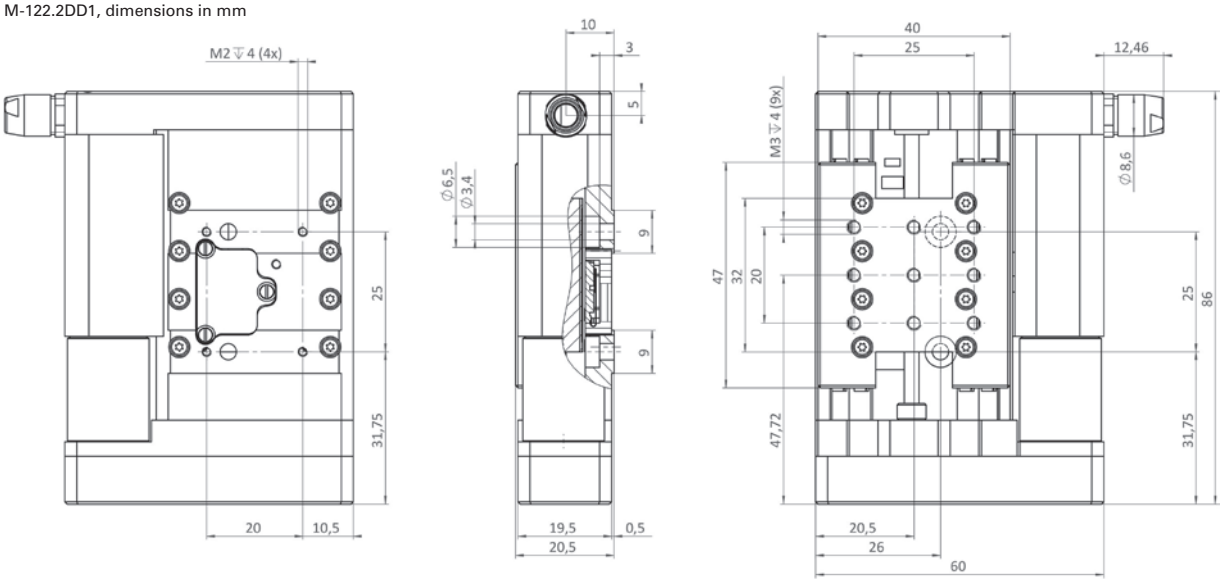
(1) interpolated
Ask about custom designs!

M-122.2DD1 Micro Translation Stage

Compact Linear Stage with Direct Position Measuring

- Travel range 25 mm
- Integrated linear encoder option for highest accuracy with 0.1 µm resolution
- Min. incremental motion 0.2 µm
- Max. velocity 20 mm/s
- Ball screw for high velocities and number of cycles

M-122.2DD1, dimensions in mm



Applications

- Automation
- Laser Marking
- Optical Alignment
- Precision Micro Assembly
- Scientific Instrumentation

>> Linear Encoder

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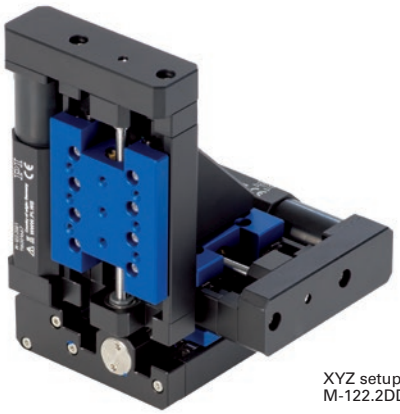
	M-122.2DD1	Unit	Tolerance
Motion and positioning			
Travel range	25	mm	
Integrated sensor	Linear encoder		
Sensor resolution	0.1	µm	
Design resolution	0.1	µm	typ.
Minimum incremental motion	0.2	µm	typ.
Backlash	0.2	µm	typ.
Unidirectional repeatability	0.15	µm	typ.
Pitch	±150	µrad	typ.
Yaw	±150	µrad	typ.
Velocity	20	mm/s	max.
Reference point switch repeatability	1	µm	typ.
Mechanical properties			
Drive screw	Ball screw		
Stiffness in motion direction	0.25	N/µm	
Load capacity	50	N	max.
Push/pull force	20	N	max.
Lateral force	25	N	max.
Drive properties			
Motor type	DC motor		
Operating voltage	0 to ±12	V DC	
Motor power	2.25	W	
Drive screw pitch	0.5	mm	
Reference and limit switches	Hall effect		
Miscellaneous			
Cable length	0.5	m	
Operating temperature range	10 to 50	°C	
Material	Aluminum, steel		
Mass	0.22	kg	
Recommended controllers	C-863 C-884		

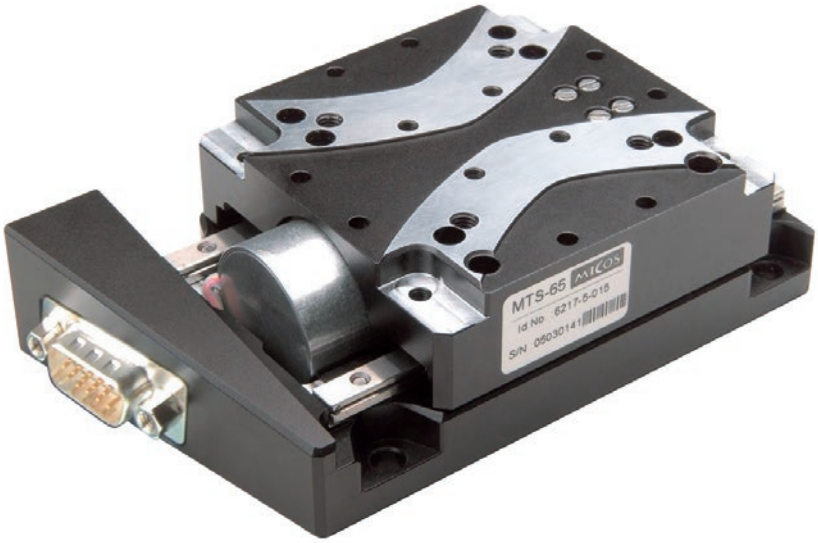


XYZ setup consisting of three M-122.2DD1 microtranslation stages.

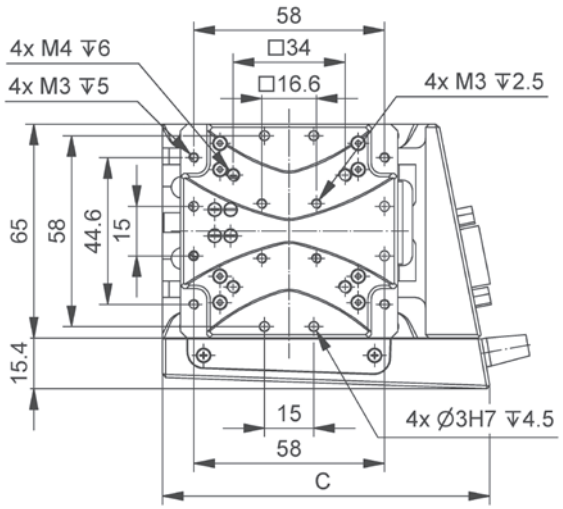
MTS-65 Miniature Linear Stage

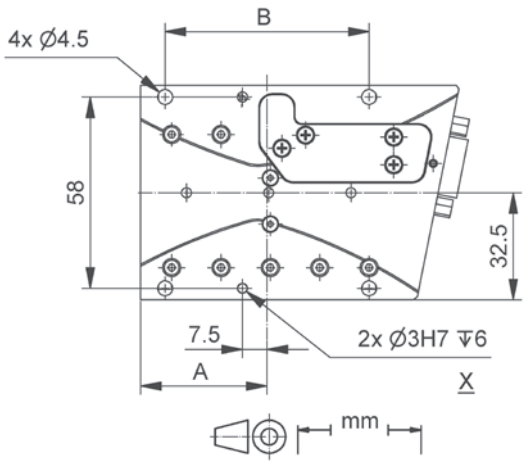
Robust Design for Industrial Use

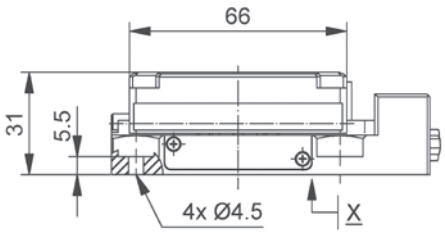
- Travel ranges to 52 mm (2″)
- Repeatability to 0.1 µm
- Load capacity to 2 kg



MTS-65, dimensions in mm







Travel range/mm	13	26	52
A / mm	38.5	45	62
B / mm	62	75	105
C / mm	99.5	112.5	147.5

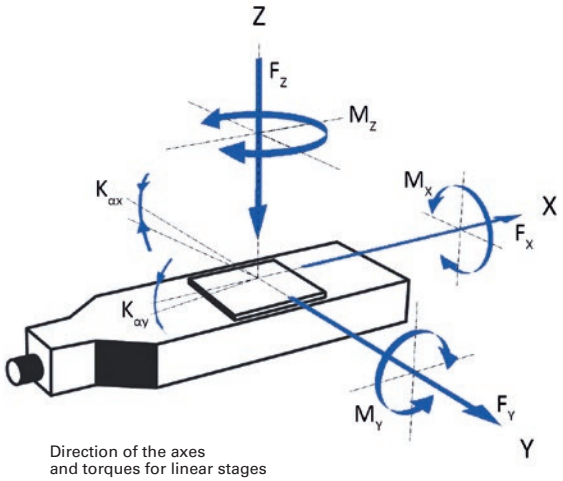
Applications

- Autofocus
- Biotechnology
- Automation
- Laser Marking
- Scientific Instrumentation

Technology Glossary ..... **page 290**

	621792x03	Unit	Tolerance
Active axes	X		
Motion and positioning			
Travel range	13 / 26 / 52	mm	
Design resolution	5 (full step)	µm	
Minimum incremental motion	0.1	µm	typ.
Unidirectional repeatability	0.2	µm	typ.
Bidirectional repeatability	±5.0	µm	typ.
Straightness	±1.0 / ±2.0 / ±3.0	µm	typ.
Flatness	±1.0 / ±2.0 / ±3.0	µm	typ.
Pitch	±40 / ±60 / ±80	µrad	typ.
Yaw	±40	µrad	typ.
Max. velocity	8	mm/s	max.
Mechanical properties			
Drive screw type	Ball screw		
Drive screw pitch	1	mm	
Load capacity	10	N	max.
Push/pull force	3	N	max.
Holding force, power off	3	N	typ.
Permissible lateral force	10	N	max.
Permissible torque M_x in X	0.4	N·m	max.
Permissible torque M_y in Y	0.6	N·m	max.
Permissible torque M_z in Z	0.4	N·m	max.
Drive properties			
Motor type	2-phase stepper motor		
Operating voltage, nominal	24	V	nom.
Operating voltage, max.	48	V	max.
Step resolution	200	Full steps/ rev.	
Limit switches	Optical		
Miscellaneous			
Operating temperature range	5 to 40	°C	
Material	Aluminum, black anodized		
Mass	0.4 / 0.6 / 0.8	kg	±5 %
Connector	HD Sub-D 15 (m)		
Recommended controllers	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!



Direction of the axes
and torques for linear stages

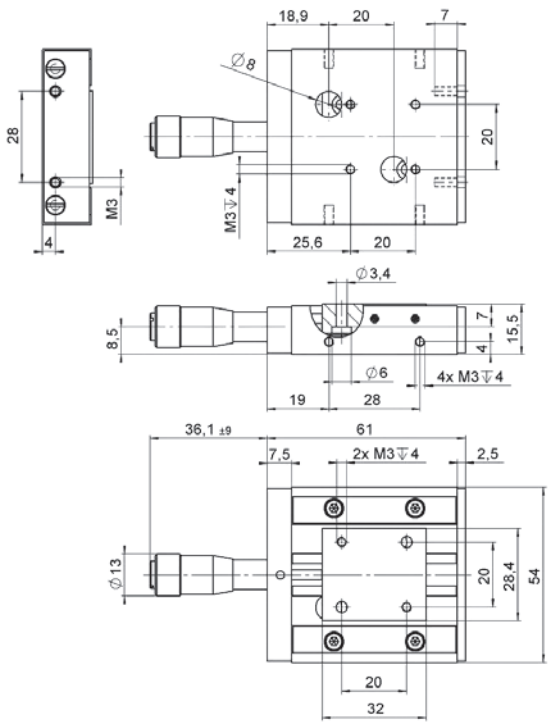
M-105 / M-106 Microtranslation Stage

Precision Crossed Roller Guides, PiezoMike Option, XY(Z) Combinations

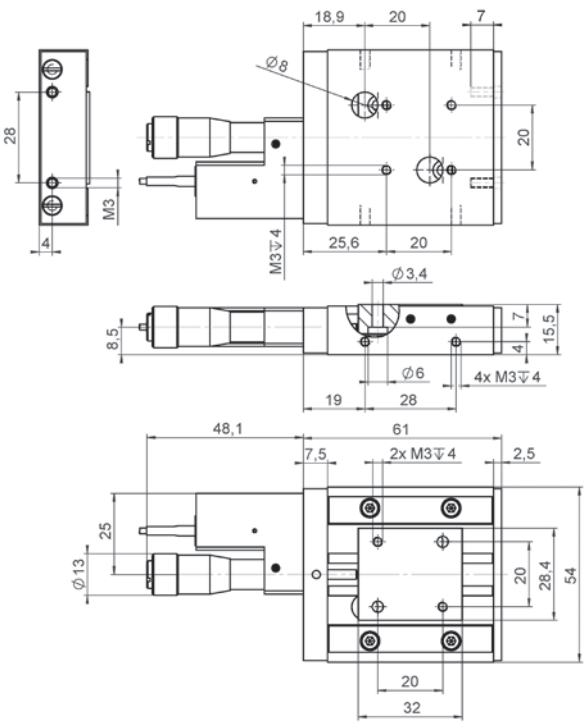
- Travel range to 18 mm
- All-stainless-steel construction
- XY and XYZ combinations
- Resolution to 0.1 µm
- Optional PiezoMike with 10 nm resolution
- Optional motor drives

The M-105 and M-106 linear stages are available in X, XY, and XYZ configurations, and allow travel ranges of up to 18 mm. They have crossed roller bearings that allow a guiding accuracy of better than 2 µm. The carriage is preloaded against the precision micrometer screw with springs to suppress backlash. With the XYZ version, the Z axis is mounted with an adapter bracket so that the load acts in the direction of the spring preload.

M-105.10, dimensions in mm



M-105.1P, dimensions in mm



Applications

- Manual sample manipulation

	M-105.10*	M-105.1P*	M-106.10*	Unit	Tolerance
Travel range	18	18	5	mm	
Piezo fine travel range	–	30	–	µm	
Min. incremental motion (piezo drive)	–	0.01	–	µm	
Minimum incremental motion (micrometer screw)**	1	1	0.1	µm	
Backlash	2	2	2	µm	
Straightness	2	2	2	µm	
Flatness	2	2	2	µm	
Load capacity	100	100	100	N	max.
Push/pull force	20 / 4	20 / 4	20 / 4	N	max.
Lateral force	25	25	25	N	max.
Drive	M-626.00	P-854.00	M-653.00		
Drive screw pitch (coarse / fine)	0.5 / –	0.5 / –	0.4 / 0.02	mm/rev.	
Mass	0.32	0.38	0.33	kg	
Housing material	St	St	St		
Recommended piezo driver	–	E-610, E-500 system	–		

* Versions M-105.2x, M-106.2x and M-105.3x, M-106.x0 are combinations of basic .1x. versions

** Motorized versions achieve up to 50 nm.

L-509 Precision Linear Stage

Compact Design, for Loads to 10 kg

- Travel ranges from 26 to 102 mm (1" to 4")
- Repeatability to 0.1 µm
- Optional with Direct-Measuring Linear Encoder
- ActiveDrive DC, DC, BLDC, and DC gear motors
- Stepper motors
- Direction-sensing reference point switch

Applications

- Autofocus
- Biotechnology
- Automation
- Laser Cutting
- Optical Alignment
- Scientific Instrumentation

>> ActiveDrive
>> Linear Encoder
>> Vacuum-Compatible Versions

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Stages with stepper motor and ActiveDrive DC motor	L-509.xxADxx	L-509.xxSD00 / L-509.xASD00	Unit	Tolerance
Motion				
Active axes	X	X		
Travel range	L-509.1xADxx: 26 L-509.2xADxx: 52 L-509.4xADxx: 102	L-509.1xSDxx: 26 L-509.2xSDxx: 52 L-509.4xSDxx: 102	mm	
Pitch / yaw	L-509.1xADxx: ±60 L-509.2xADxx: ±90 L-509.4xADxx: ±120	L-509.1xSDxx: ±60 L-509.2xSDxx: ±90 L-509.4xSDxx: ±120	µrad	typ.
Straightness / flatness	L-509.1xADxx: 2 L-509.2xADxx: 4 L-509.4xADxx: 8	L-509.1xSDxx: 2 L-509.2xSDxx: 4 L-509.4xSDxx: 8	µm	typ.
Velocity	50	20	mm/s	max.

	L-509.xxADxx	L-509.xxSD00	L-509.xASD00	Unit	Tolerance
Positioning					
Integrated sensor	L-509.xxAD10: Incremental rotary encoder L-509.xxAD00: Incremental linear encoder	–	Incremental linear encoder		
Sensor signal	A/B quadrature, TTL	–	Sin/cos, 1 V peak-peak, 20 µm signal period		
Design resolution	L-509.xxAD10: 0.061 L-509.xxAD00: 0.05	5.0	0.005	µm	
Sensor resolution rotary encoder	L-509.xxAD10: 16384	–	–	Cts./rev.	
Sensor resolution linear encoder	L-509.xxAD00: 0.05	–	0.005	µm	
Resolution stepper motor	–	200	200	Full steps/ rev.	
Minimum incremental motion	L-509.xxAD10: 0.8 L-509.xxAD00: 0.2	0.1	0.02	µm	typ.
Unidirectional repeatability	L-509.xxAD10: 0.2 L-509.xxAD00: 0.1	0.3	0.1	µm	typ.
Bidirectional repeatability	L-509.xxAD10: ±0.5 L-509.14AD00: ±0.3 L-509.24AD00: ±0.2 L-509.44AD00: ±0.2	±1	±0.2	µm	typ.
Reference and limit switches	Optical	Optical	Optical		

	L-509.xxADxx / L-509.xxSD00 / L-509.xASD00	Unit	Tolerance
Mechanical properties			
Drive screw type	Crossed roller guide with anti-creep system		
Drive screw pitch	1	mm	
Guide type	Recirculating ball bearings		
Holding force, power off	L-509.xxADxx: 20 L-509.xxSD00 / L-509.xASD00: 60	N	typ.
Push/pull force F_x, power on	60	N	max.
Permissible lateral force	50	N	max.
Load capacity	100	N	max.
Permissible torque M_x in θ_X	30	N·m	max.
Permissible torque M_y in θ_Y	25	N·m	max.
Permissible torque M_z in θ_Z	20	N·m	max.

Stages with stepper motor and ActiveDrive DC motor	L-509.xxADxx	L-509.xxSD00 / L-509.xASD00	Unit	Tolerance
Drive properties				
Motor type	ActiveDrive DC motor (PWM)	Stepper motor, 2-phase		
Operating voltage, nominal	24	24	V	nom.
Operating voltage, max.	24	48	V	max.

	L-509.xxADxx	L-509.xxSD00	L-509.xASD00	Unit	Tolerance
Miscellaneous					
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum, steel	Aluminum, steel	Aluminum, steel		
Mass	L-509.10AD10: 1.4 L-509.20AD10: 1.5 L-509.40AD10: 1.7 L-509.14AD00: 1.4 L-509.24AD00: 1.6 L-509.44AD00: 1.8	L-509.10SD00: 1.4 L-509.20SD00: 1.5 L-509.40SD00: 1.7	L-509.1ASD00: 1.5 L-509.2ASD00: 1.6 L-509.4ASD00: 1.8	kg	±5 %
Moved mass, unloaded	L-509.x0AD10: 0.22 L-509.14AD00: 0.24 L-509.24AD00: 0.24 L-509.44AD00: 0.25	0.22	L-509.1ASD00: 0.24 L-509.2ASD00: 0.24 L-509.4ASD00: 0.25	kg	±5 %
Connection	1 × Sub-D 15 (m) (motor/sensor)	1 × HD Sub-D 26 (m) (motor)	1 × HD Sub-D 26 (m) (motor) 1 × Sub-D 9 (m) (sensor)		
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

Stages with DC motor and BLDC motor	L-509.xxDG10	L-509.xx3111 / L-509.xx3132	L-509.xx5132	Unit	Tolerance
Motion					
Active axes	X	X	X		
Travel range	L-509.10DG10: 26 L-509.20DG10: 52 L-509.40DG10: 102	L-509.023xxx: 26 L-509.033xxx: 52 L-509.053xxx: 102	L-509.025132: 26 L-509.035132: 52 L-509.055132: 102	mm	
Pitch / yaw	L-509.10DG10: ±60 L-509.20DG10: ±90 L-509.40DG10: ±120	L-509.023xxx: ±60 L-509.033xxx: ±90 L-509.053xxx: ±120	L-509.025132: ±60 L-509.035132: ±90 L-509.055132: ±120	µrad	typ.
Straightness / flatness	L-509.10DG10: 2 L-509.20DG10: 4 L-509.40DG10: 8	L-509.023xxx: 2 L-509.033xxx: 4 L-509.053xxx: 8	L-509.025132: 2 L-509.035132: 4 L-509.055132: 8	µm	typ.
Velocity	3	50	50	mm/s	max.

	L-509.xxDG10	L-509.xx3111	L-509.xxx132	Unit	Tolerance
Positioning					
Integrated sensor	Incremental rotary encoder	Incremental linear encoder	Incremental rotary encoder		
Sensor signal	A/B quadrature, TTL	Sin/cos, 1 V peak-peak, 20 µm signal period	A/B quadrature, TTL		
Design resolution	0.008	0.005	0.05	µm	
Sensor resolution rotary encoder	4096	–	20000	Cts./rev.	
Sensor resolution linear encoder	–		–	µm	
Minimum incremental motion	0.1	0.1	0.5	µm	typ.
Unidirectional repeatability	0.1	0.1	0.2	µm	typ.
Bidirectional repeatability	±2	±0.2	±0.5	µm	typ.
Reference and limit switches	Optical	Optical	Optical		

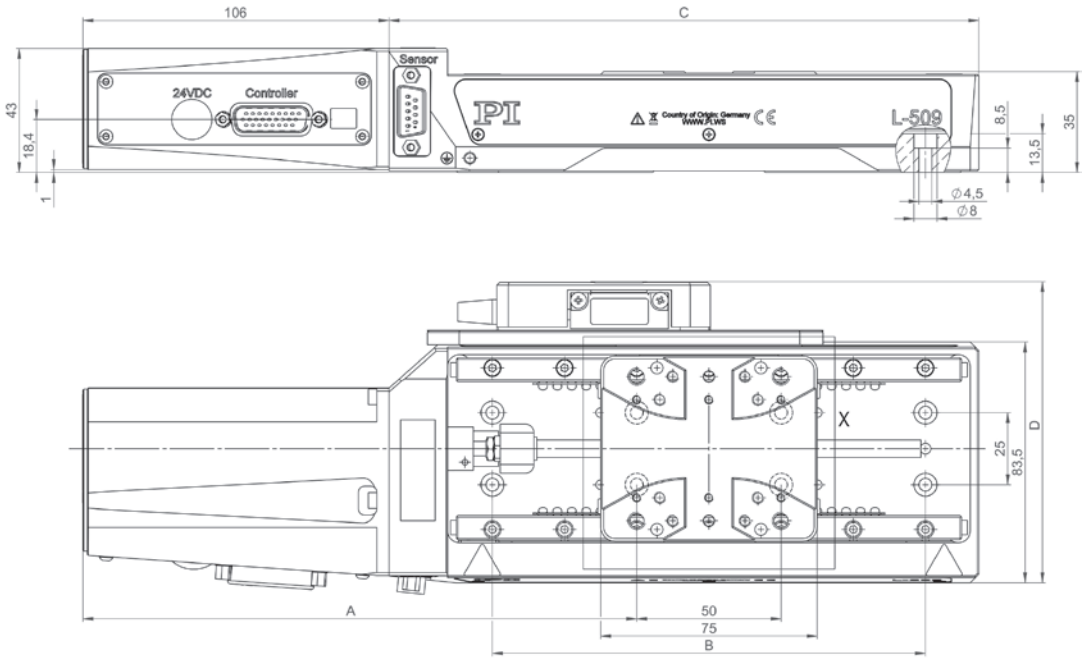
	L-509.xxDG10	L-509.xx3xxx L-509.xx5xxx	Unit	Tolerance
Mechanical properties				
Drive screw type	Crossed roller guide with anti-creep system	Crossed roller guide with anti-creep system		
Drive screw pitch	1	1	mm	
Gear ratio	2401:81	–		
Guide type	Recirculating ball bearings	Recirculating ball bearings		
Holding force, power off	L-509.10DG10: 40 L-509.20DG10: 60 L-509.40DG10: 60	20	N	typ.
Push/pull force F_x, power on	60	60	N	max.
Permissible lateral force	50	50	N	max.
Load capacity	100	100	N	max.
Permissible torque M_x in θ_X	30	30	N·m	max.
Permissible torque M_y in θ_Y	25	25	N·m	max.
Permissible torque M_z in θ_Z	20	20	N·m	max.

	L-509.xxDG10	L-509.xx3xxx	L-509.xx5xxx	Unit	Tolerance
Drive properties					
Motor type	DC motor (with gearhead)	DC motor	Brushless DC motor, 3-phase		
Operating voltage, nominal	24	24	24	V	nom.
Operating voltage, max.	48	48	48	V	max.

Stages with DC motor and BLDC motor	L-509.xxDG10	L-509.xx3xxx	L-509.xx5132	Unit	Tolerance
Miscellaneous					
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum, steel	Aluminum, steel	Aluminum, steel		
Mass	L-509.10DG10: 1.4 L-509.20DG10: 1.6 L-509.40DG10: 1.9	L-509.023xxx: 1.2 L-509.033xxx: 1.3 L-509.053xxx: 1.5	L-509.025132: 1.4 L-509.035132: 1.5 L-509.055132: 1.7	kg	±5 %
Moved mass, unloaded	0.22	L-509.023111: 0.24 L-509.033111: 0.24 L-509.053111: 0.25	0.22	kg	±5 %
Connection	1 × HD Sub-D 26 (m) (motor/sensor)	1 × HD Sub-D 26 (m) (motor) L-509.xx3111 additional: 1 × Sub-D 9 (m) (sensor)	1 × HD Sub-D 26 (m) (motor/sensor)		
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller		

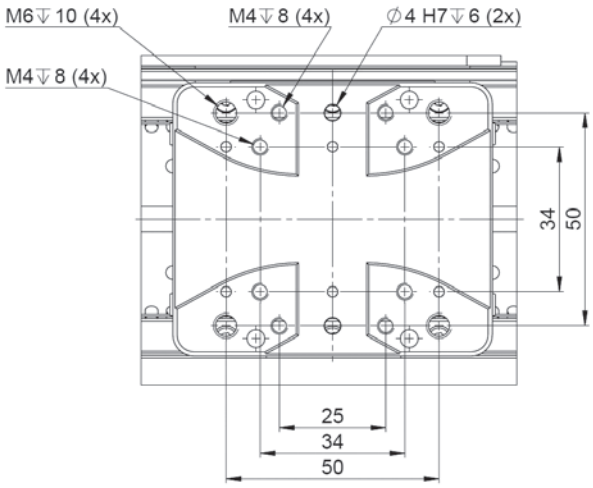
All cables required for operation with the ordered controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

L-509 versions with DC and BLDC motor, dimensions in mm

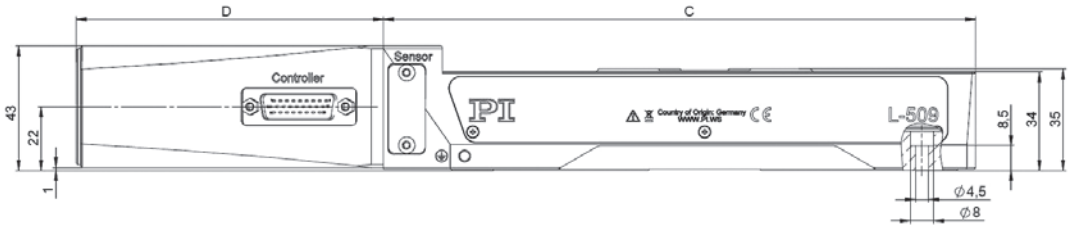


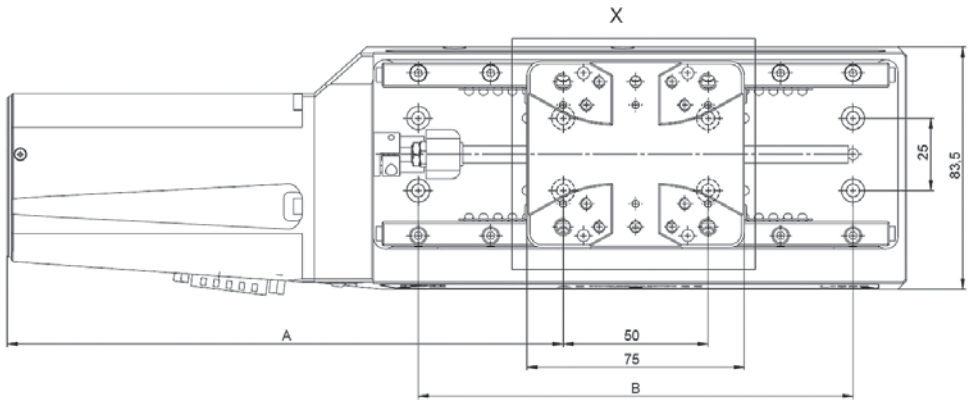
	A	B	C	D
L-509.023111	157.3	100	135.3	104.4
L-509.023132	157.3	100	135.3	–
L-509.025132	157.3	100	135.3	–
L-509.033111	166.8	100	154.3	104.4
L-509.033132	166.8	100	154.3	–
L-509.035132	166.8	100	154.3	–
L-509.053111	191.8	150	204.3	104.4
L-509.053132	191.8	150	204.3	–
L-509.055132	191.8	150	204.3	–

Detail drawing of the L-509 motion platform



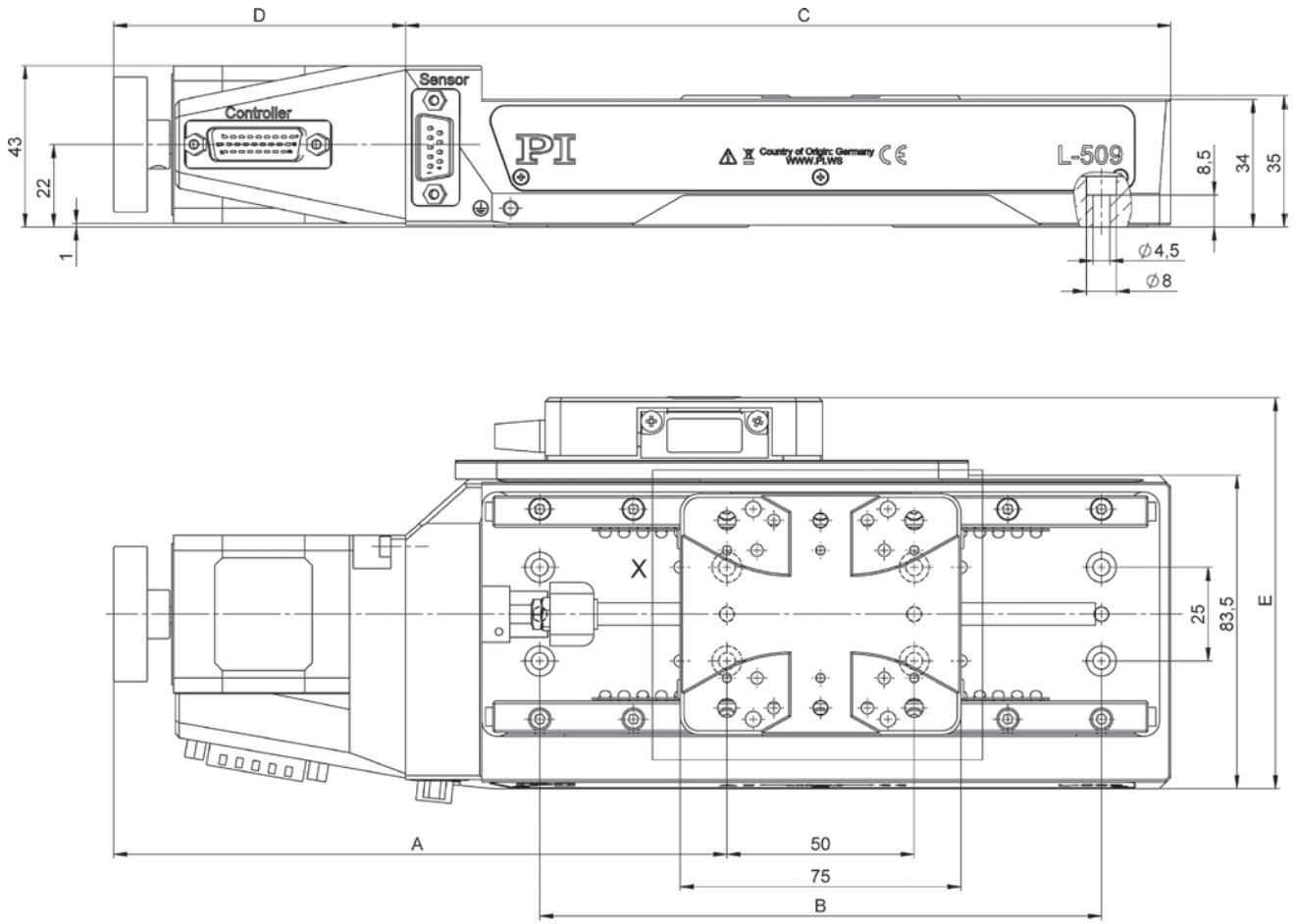
L-509 versions with DC gear motor, dimensions in mm





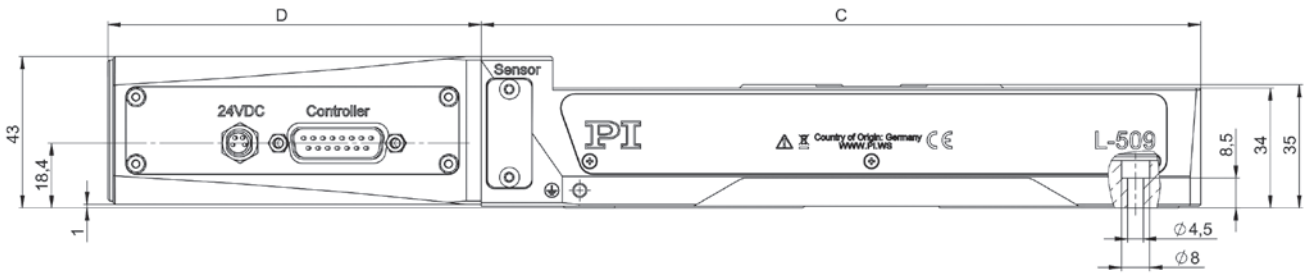
	A	B	C	D
L-509.10DG10	157.3	100	135.3	106
L-509.20DG10	166.8	100	154.3	106
L-509.40DG10	191.8	150	204.3	106

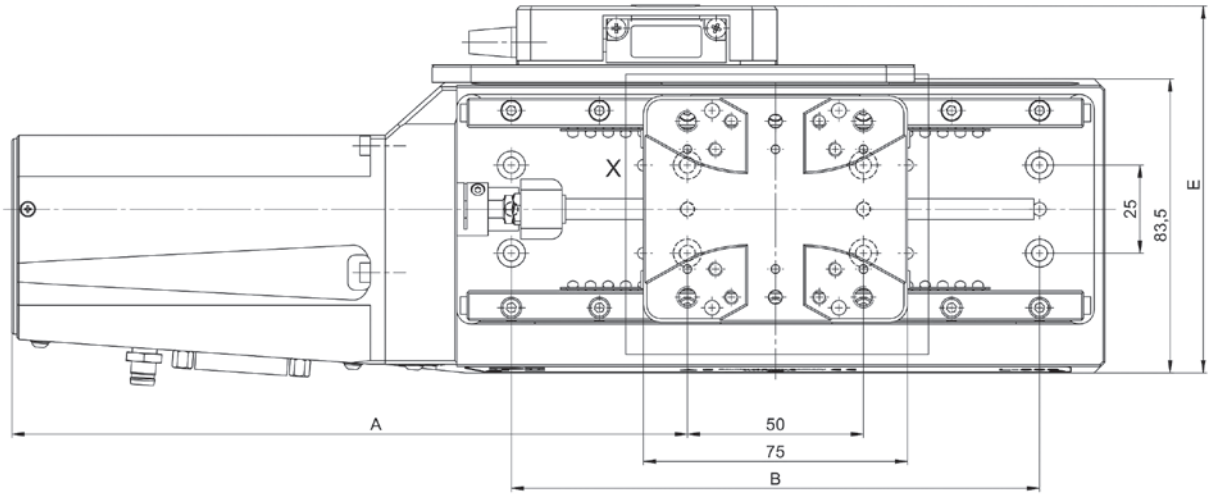
L-509 versions with stepper motor, dimensions in mm



	A	B	C	D	E
L-509.10SD00	129.3	100	135.3	78	–
L-509.1ASD00	129.3	100	135.3	78	104.2
L-509.20SD00	138.8	100	154.3	78	–
L-509.2ASD00	138.8	100	154.3	78	104.2
L-509.40SD00	163.8	150	204.3	78	–
L-509.4ASD00	163.8	150	204.3	78	104.2

L-509 versions with ActiveDrive DC motor, dimensions in mm





	A	B	C	D	E
L-509.10AD10	157.3	100	135.3	106	–
L-509.14AD00	157.3	100	135.3	106	104.2
L-509.20AD10	166.8	100	154.3	106	–
L-509.24AD00	166.8	100	154.3	106	104.2
L-509.40AD10	191.8	150	204.3	106	–
L-509.44AD00	191.8	150	204.3	106	104.2

L-511 High-Precision Linear Stage

High Travel Accuracy

- Travel ranges to 155 mm (6")
- Repeatability to 0.1 µm
- ActiveDrive DC, DC, BLDC, and DC gear motors
- Stepper motors
- Optional linear encoder for direct position measurement
- Direction-sensing reference point switch

Reference-class linear stage

Recirculating ball bearings for high travel accuracy and load capacity. Precision ball screw with 2 mm pitch. Stress-relieved aluminum base for highest stability. Noncontact limit switches. Noncontact optical reference point switch with direction sensing in the middle of the travel range.

Highly accurate position measuring with incremental linear encoder

Noncontact optical linear encoders measure the actual position directly at the motion platform with the greatest accuracy so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring.

Minimum incremental motion and slow motion

In conjunction with the SMC Hydra controller, versions with stepper motor and integrated linear encoder (L-511.xASD00) achieve repeatable minimum incremental motion in the range of the sensor resolution. The same configuration achieves constant low velocities of a few sensor increments per second.

Drive types

- .xxAD variant: ActiveDrive DC motor for high velocity: Control via pulse-width-modulated (PWM) signals, the operating voltage is attained via an amplifier integrated in the motor housing.
- .xxDG variant: DC servo motor with gearhead for high torques and resolution at low motor power
- .xxSD variant: 2-phase stepper motor for low velocity and high resolution
- .xx3xxx variant: DC motor
- .xx5xxx variant: Brushless DC motor

Position measurement

- Integrated rotary encoder on the motor shaft (xxAD10, xxDG10, xxxx32).
- Incremental linear encoder (xxAD00, xASD00, xxxx11).

Applications

- Autofocus
- Biotechnology
- Automation
- Laser Cutting
- Optical Alignment
- Scientific Instrumentation

>> ActiveDrive
>> Linear Encoder
>> Vacuum-Compatible Versions

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Stages with stepper motor and ActiveDrive DC motor	L-511.xxADxx	L-511.xxSD00 / L-511.xASD00	Unit	Tolerance
Motion				
Active axes	X	X		
Travel range	L-511.2xADxx: 52 L-511.4xADxx: 102 L-511.6xADxx: 155	L-511.2xSD00: 52 L-511.4xSD00: 102 L-511.6xSD00: 155	mm	
Pitch / yaw	L-511.2xADxx: ±40 L-511.4xADxx: ±60 L-511.6xADxx: ±70	L-511.2xSD00: ±40 L-511.4xSD00: ±60 L-511.6xSD00: ±70	µrad	typ.
Straightness / flatness	L-511.2xADxx: ±1.5 L-511.4xADxx: ±2.5 L-511.6xADxx: ±3.0	L-511.2xSD00: ±1.5 L-511.4xSD00: ±2.5 L-511.6xSD00: ±3.0	µm	typ.
Velocity	90	45	mm/s	max.

	L-511.xxADxx	L-511.xxSD00	L-511.xASD00	Unit	Tolerance
Positioning					
Integrated sensor	L-511.xxAD10: Incremental rotary encoder L-511xxAD00: Incremental linear encoder	–	Incremental linear encoder		
Sensor signal	A/B quadrature, TTL	–	Sin/cos, 1 V peak-peak, 20 µm signal period		
Design resolution	L-511.xxAD10: 0.122 L-511.xxAD00: 0.05	10.0	0.005	µm	
Sensor resolution rotary encoder	L-511.xxAD10: 16384	–	–	Cts./rev.	
Sensor resolution linear encoder	L-511.xxAD00: 0.05	–	0.005	µm	
Resolution stepper motor	–	200	200	Full steps/ rev.	
Minimum incremental motion	L-511.xxAD10: 0.488 L-511.xxAD00: 0.1	0.2	0.02	µm	typ.
Unidirectional repeatability	L-511.xxAD10: 0.488 L-511.xxAD00: 0.1	0.2	0.1	µm	typ.
Bidirectional repeatability	L-511.xxAD10: ±1.250 L-511.xxAD00: ±0.2	±2	±0.2	µm	typ.
Reference and limit switches	Optical	Optical	Optical		

	L-511.xxADxx / L-511.xxSD00 / L-511.xASD00	Unit	Tolerance
Mechanical properties			
Drive screw type	Ball screw		
Drive screw pitch	2	mm	
Guide type	Recirculating ball bearings		
Holding force, power off	L-511.xxADxx: 20 L-511.xxSD00 / L-511.xASD00: 60	N	typ.
Push/pull force F_x, power on	100	N	max.
Permissible lateral force	250	N	max.
Load capacity	500	N	max.
Permissible torque M_x in θ_X	60	N·m	max.
Permissible torque M_y in θ_Y	30	N·m	max.
Permissible torque M_z in θ_Z	30	N·m	max.

Stages with stepper motor and ActiveDrive DC motor	L-511.xxADxx	L-511.xxSD00 / L-511.xASD00	Unit	Tolerance
Drive properties				
Motor type	ActiveDrive DC motor (PWM)	Stepper motor, 2-phase		
Operating voltage, nominal	24	24	V	nom.
Operating voltage, max.	24	48	V	max.

	L-511.xxADxx	L-511.xxSD00	L-511.xASD00	Unit	Tolerance
Miscellaneous					
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum, stainless steel	Aluminum, stainless steel	Aluminum, stainless steel		
Mass	L-511.2xADxx: .2.5 L-511.40AD10: 2.8 L-511.60AD10: 3.3 L-511.44AD00: 2.7 L-511.64AD00: 3.5	L-511.20SDxx: 2.4 L-511.40SDxx: 2.6 L-511.60SDxx: 3.1	L-511.2ASDxx: 2.4 L-511.4ASDxx: 2.6 L-511.6ASDxx: 3.1	kg	±5 %
Moved mass, unloaded	L-511.2xADxx: 0.6 L-511.4xADxx: 0.6 L-511.6xADxx: 0.65	L-511.20SDxx: 0.6 L-511.40SDxx: 0.6 L-511.60SDxx: 0.65	L-511.2ASDxx: 0.6 L-511.4ASDxx: 0.6 L-511.6ASDxx: 0.65	kg	±5 %
Connection	1 × Sub-D 15 (m) (motor/sensor)	1 × HD Sub-D 26 (m) (motor)	1 × HD Sub-D 26 (m) (motor) 1 × Sub-D 9 (m) (sensor)		
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

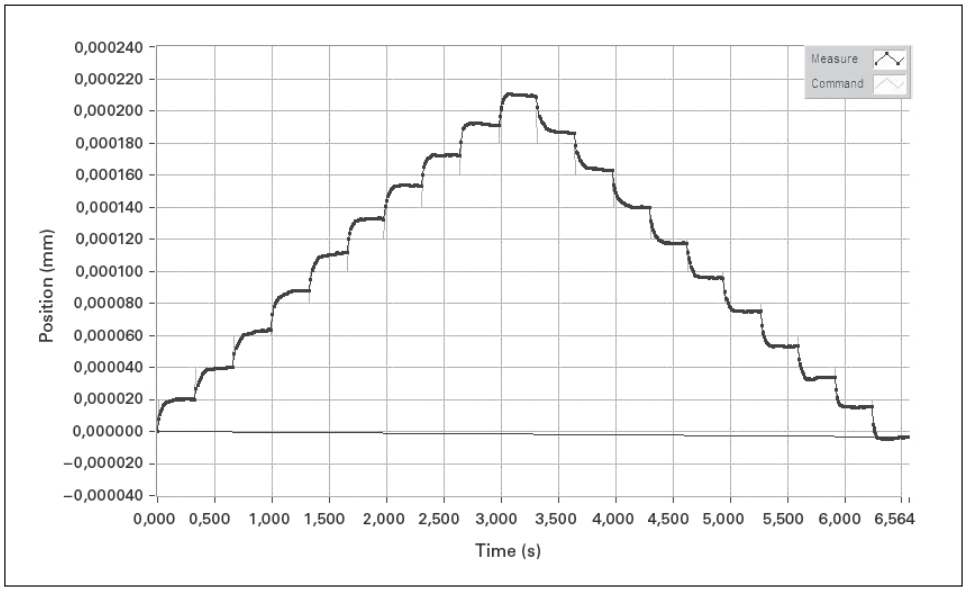
Stages with DC motor and BLDC motor	L-511.xxDG10	L-511.xx3111 / L-511.xx3132 L-511.xx5111 / L-511.xx5132	Unit	Tolerance
Motion				
Active axes	X	X		
Travel range	L-511.20DG10: 52 L-511.40DG10: 102 L-511.60DG10: 155	L-511.03xxxx: 52 L-511.05xxxx: 102 L-511.07xxxx: 155	mm	
Pitch / yaw	L-511.20DG10: ±40 L-511.40DG10: ±60 L-511.60DG10: ±70	L-511.03xxxx: ±40 L-511.05xxxx: ±60 L-511.07xxxx: ±70	µrad	typ.
Straightness / flatness	L-511.20DG10: ±1.5 L-511.40DG10: ±2.5 L-511.60DG10: ±3.0	L-511.03xxxx: ±1.5 L-511.05xxxx: ±2.5 L-511.07xxxx: ±3.0	µm	typ.
Velocity	6	90	mm/s	max.

	L-511.xxDG10	L-511.xx3111 / L-511.xx5111	L-511.xx3132 / L-511.xx5132	Unit	Tolerance
Positioning					
Integrated sensor	Incremental rotary encoder	L-511.xx3111: Incremental linear encoder L-511.xx5111: Incremental rotary encoder, incremental rotary encoder	Incremental rotary encoder		
Sensor signal	A/B quadrature, TTL	Linear encoder: Sin/cos, 1 V peak-peak, 20 µm signal period Rotary encoder: A/B quadrature, TTL	A/B quadrature, TTL		
Design resolution	0.017	L-511.xx3111: 0.005 L-511.xx5111: 0.05	0.1	µm	
Sensor resolution rotary encoder	4096	20000	20000	Cts./rev.	
Sensor resolution linear encoder	–	L-511.xx3111: 0.005 L-511.xx5111: 0.05	0.1	µm	
Minimum incremental motion	0.1	0.1	0.2	µm	typ.
Unidirectional repeatability	0.2	0.1	0.2	µm	typ.
Bidirectional repeatability	±2	±0.1	±1.25	µm	typ.
Reference and limit switches	Optical	Optical	Optical		

	L-511.xxDG10	L-511.xx3xxx / L-511.xx5xxx	Unit	Tolerance
Mechanical properties				
Drive screw type	Ball screw	Ball screw		
Drive screw pitch	2	2	mm	
Gear ratio	2401:81	–		
Guide type	Recirculating ball bearings	Recirculating ball bearings		
Holding force, power off	100	20	N	typ.
Push/pull force F_x, power on	100	100	N	max.
Permissible lateral force	250	250	N	max.
Load capacity	500	500	N	max.
Permissible torque M_x in θ_X	60	60	N·m	max.
Permissible torque M_y in θ_Y	30	30	N·m	max.
Permissible torque M_z in θ_Z	30	30	N·m	max.

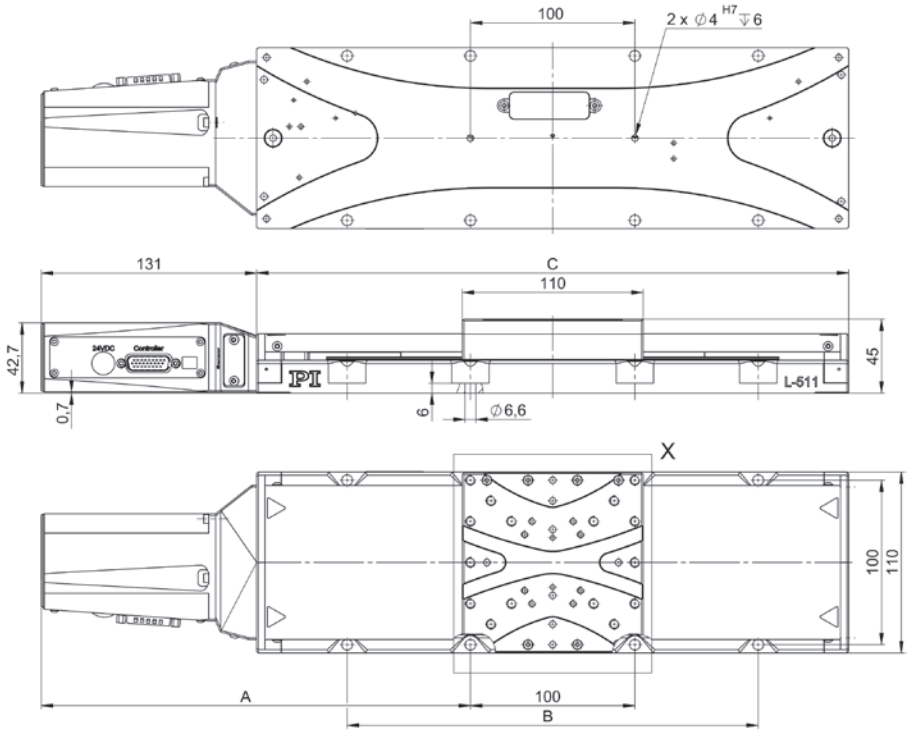
Stages with DC motor and BLDC motor	L-511.xxDG10	L-511.xx3xxx	L-511.xx5xxx	Unit	Tolerance
Drive properties					
Motor type	DC motor (with gearhead)	DC motor	Brushless DC motor, 3-phase		
Operating voltage, nominal	24	24	24	V	nom.
Operating voltage, max.	48	48	48	V	max.
Miscellaneous					
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Mass	L-511.20DG10: 2.5 L-511.40DG10: 2.7 L-511.60DG10: 2.9	L-511.033xxx: 2.5 L-511.053xxx: 2.6 L-511.073xxx: 3.1	L-511.035xxx: 2.4 L-511.055xxx: 2.7 L-511.075xxx: 3.0	kg	±5 %
Moved mass, unloaded	L-511.20DG10: 0.6 L-511.40DG10: 0.6 L-511.60DG10: 0.65	L-511.033xxx: 0.6 L-511.053xxx: 0.6 L-511.073xxx: 0.65	L-511.035xxx: 0.6 L-511.055xxx: 0.6 L-511.075xxx: 0.65	kg	±5 %
Connection	1 × HD Sub-D 26 (m) (motor/sensor)	L-511.xx3111: 1 × HD Sub-D 26 (m) (motor), 1 × Sub-D 9 (m) (sensor) L-511.xx3132: 1 × HD Sub-D 26 (m) (motor/sensor)	L-511.xx5111: 1 × HD Sub-D 26 (m) (motor/sensor), 1 × Sub-D 9 (m) (sensor) L-511.xx5132: 1 × HD Sub-D 26 (m) (motor/sensor)		
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	L-511.xx5111: C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller L-511.xx5132 additional: SMC Hydra (double axis)		

All cables required for operation with the ordered controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!



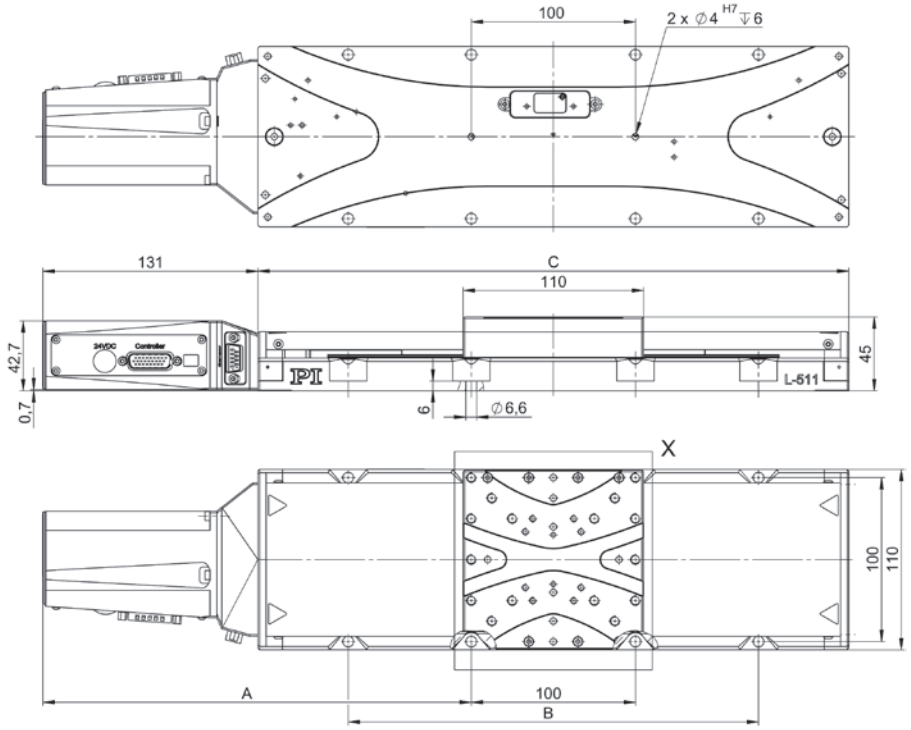
The L-511 reliably performs repeatable 20-nm steps with the linear encoder and SMC Hydra motion controller

L-511 versions with DC and BLDC motor, and rotary encoder, dimensions in mm



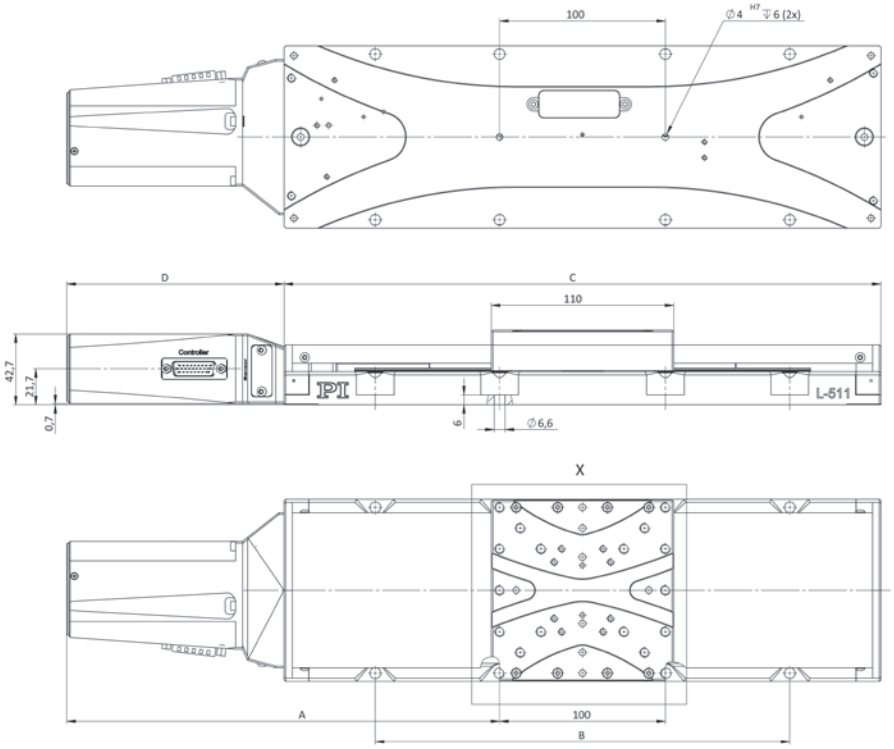
	A	B	C
L-511.033132	186	–	210
L-511.035132	186	–	210
L-511.053132	211	–	260
L-511.055132	211	–	260
L-511.073132	261	250	360
L-511.075132	261	250	360

L-511 versions with DC and BLDC motor, and linear encoder, dimensions in mm



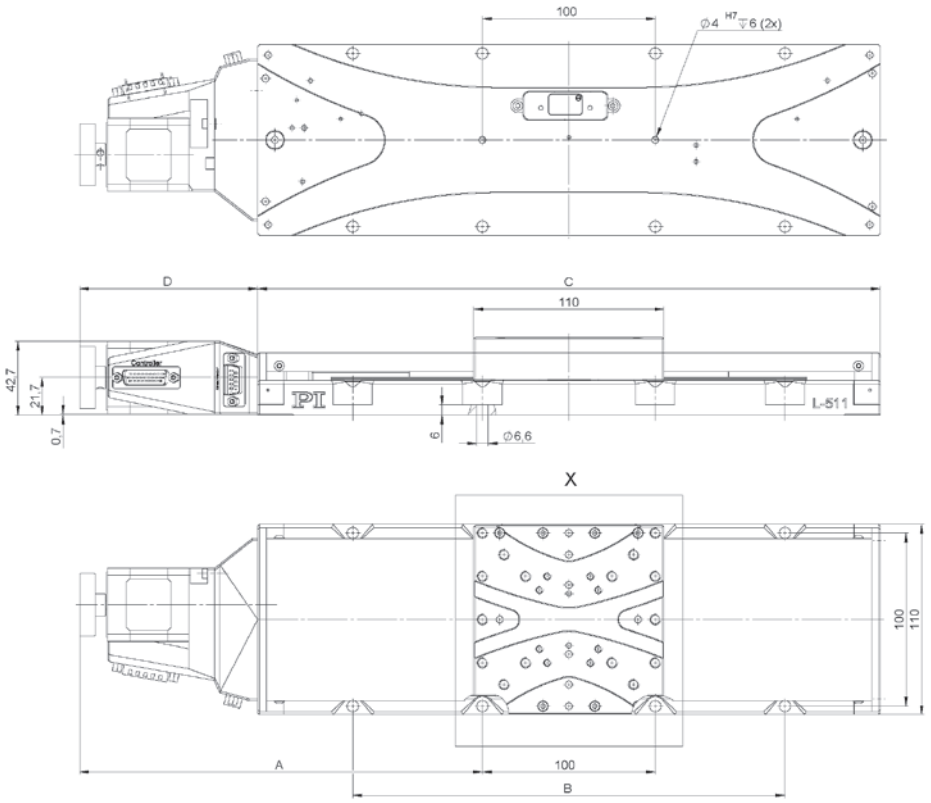
	A	B	C
L-511.033111	186	–	210
L-511.053111	211	–	260
L-511.073111	261	250	360
L-511.035111	186	–	210
L-511.055111	211	–	260
L-511.075111	261	250	360

L-511 versions with DC gear motor, dimensions in mm



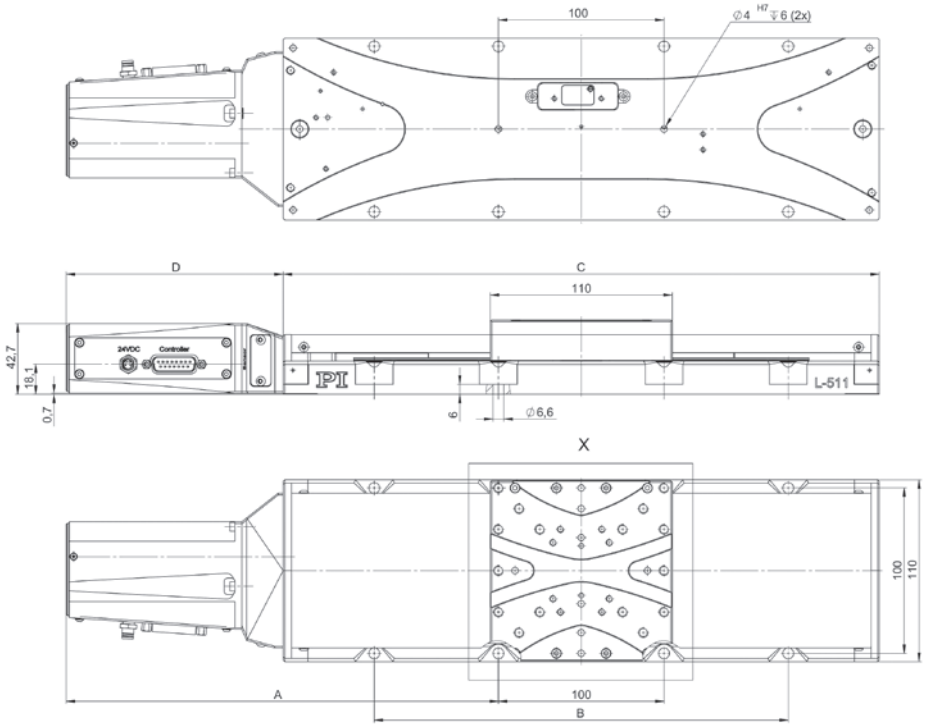
	A	B	C	D
L-511.20DG10	186	–	210	131
L-511.40DG10	211	–	260	131
L-511.60DG10	261	250	360	131

L-511 versions with stepper motor, dimensions in mm



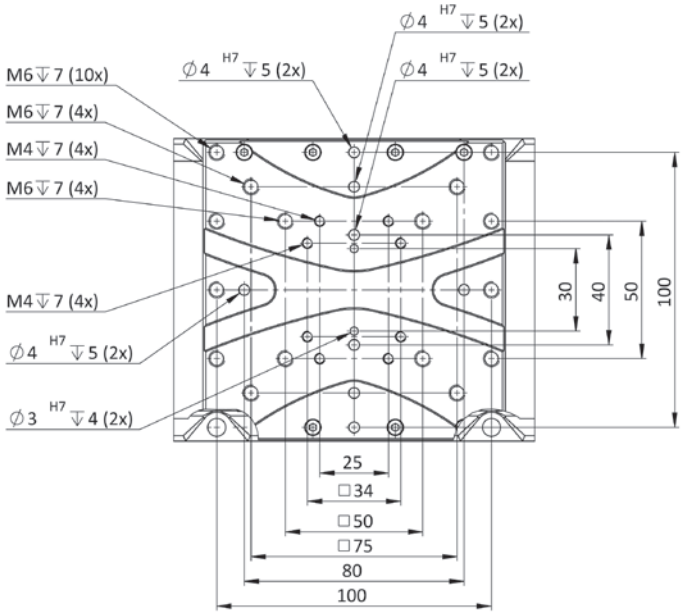
	A	B	C	D
L-511.20SD00	158	–	210	103
L-511.2ASD00	158	–	210	103
L-511.40SD00	183	–	260	103
L-511 4ASD00	183	–	260	103
L-511.6OSD00	233	250	360	103
L-511.6ASD00	233	250	360	103

L-511 versions with ActiveDrive DC motor, dimensions in mm



	A	B	C	D
L-511.20AD10	186	–	210	131
L-511.24AD00	186	–	210	131
L-511.40AD10	211	–	260	131
L-511.44AD00	211	–	260	131
L-511.60AD10	261	250	360	131
L-511.64AD00	261	250	360	131

Detail drawing of the L-511 motion platform, dimensions in mm



V-551 PIMag® Precision Linear Stage

High Velocity and Precision due to Magnetic Direct Drive

- Travel ranges to 230 mm
- Velocity up to 0.5 m/s
- Absolute encoder with 1 nm resolution
- Highest precision with PIOne linear encoder: Minimum incremental motion 0.5 nm
- High guiding accuracy
- Compact design with 160 mm width
- Crossed roller guide, anti-creep

Reference-class linear stage

Thanks to the smooth-running precision linear guides with crossed roller bearings, the linear stage is particularly suitable for scanning applications with constant velocity. The anti-creep system reliably prevents cage creep. The guides have high load capacity and high precision under all operating conditions.

Direct position measurement

Position measuring takes place directly at the motion platform with the highest accuracy so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring. The high-resolution PIOne encoder was developed by PI and, with corresponding processing of the measured values, allows a position resolution of much less than one nanometer. The optical and noncontact PIOne encoders are based on an interferometric measuring principle. Due to the short signal period and the high quality of the signals, the linearity error of PIOne encoders is less than 1 %. PIOne encoders support direction sensing when evaluating a reference signal. 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 avoid-ed and any position can be controlled easily. The drive force can be set freely.

Applications

- Biotechnology
- Electronics Manufacturing
- Medical Industry
- Metrology / Testing
- Photonics
- Scanning
- Semiconductor

>> Absolute Encoder
>> Linear Encoder
>> PIMag® Magnetic Linear Motors

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	V-551.2x	V-551.4x	V-551.7x	Unit	Tolerance
Motion and positioning					
Active axes	X	X	X		
Travel range	60	130	230	mm	
Pitch	±50	±100	±100	µrad	typ.
Yaw	±50	±50	±50	µrad	typ.
Straightness	±1	±1	±2	µm	typ.
Flatness	±2	±2	±2	µm	typ.
Velocity	0.5	0.5	0.5	m/s	max.
Mechanical properties					
Load capacity in Z	150	150	150	N	max.
Load capacity in Y	50	50	50	N	max.
Moved mass	2.2	2.7	4.9	kg	
Overall mass	4.2	5.5	9.7	kg	
Linear guide	Crossed roller bearing with anti-creep system	Crossed roller bearing with anti-creep system	Crossed roller bearing with anti-creep system		

	V-551	Unit	Tolerance
Drive properties			
Drive type	PIMag® linear motor, ironless, 3-phase		
Intermediate circuit voltage	110 *	V DC	max.
Peak force	180	N	typ.
Nominal force	27	N	typ.
Peak current, effective	10	A	typ.
Nominal current, effective	1.5	A	typ.
Force constant, effective	18	N/A	typ.
Resistance per phase	3.15	Ω	typ.
Inductance per phase	0.9	mH	typ.
Back EMF phase-phase	16	V·s/m	max.

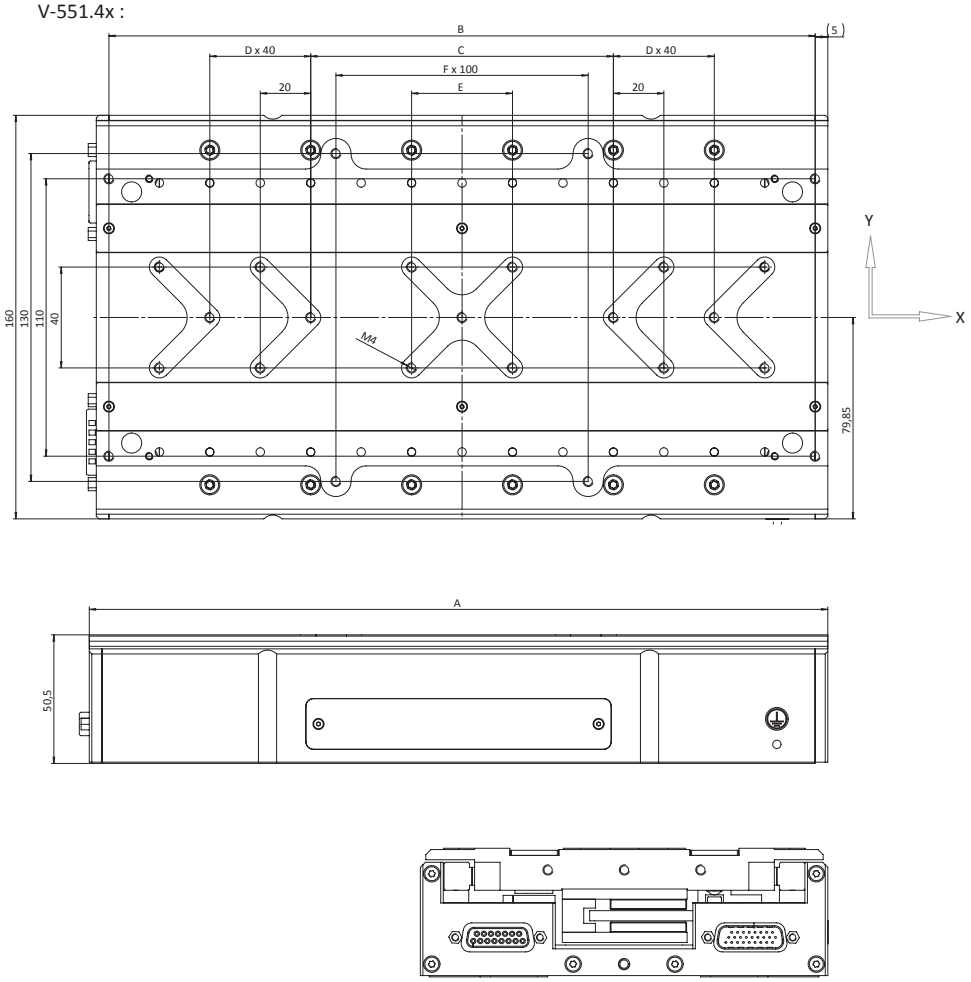
	V-551.xB	V-551.xD
Encoder options		
Integrated Sensor	Absolute encoder	PIOne incremental linear encoder
Sensor signal	BiSS-C	Sin/cos, 1 V peak-peak, 2 µm signal period
Sensor resolution	1 nm	0.2 nm**
Min. incremental motion	2 nm	0.5 nm
Unidirectional repeatability	0.02 µm	0.02 µm
Bidirectional repeatability	±0.05 µm	±0.05 µm
Travel range limit	Limits are set via software; additional mechanical stop buffers.	Hall effect limit switches
Reference point switch	–	Encoder index
Reference point switch repeatability	–	<1 µm

	V-551
Miscellaneous	
Operating temperature range	10 °C to 50 °C
Humidity	20 – 90 % rel., not condensing
Material	Aluminum, black anodized
Motor connector	HD Sub-D 26 (m)
Sensor connection	Sub-D 15 (f)
Recommended controllers	C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller

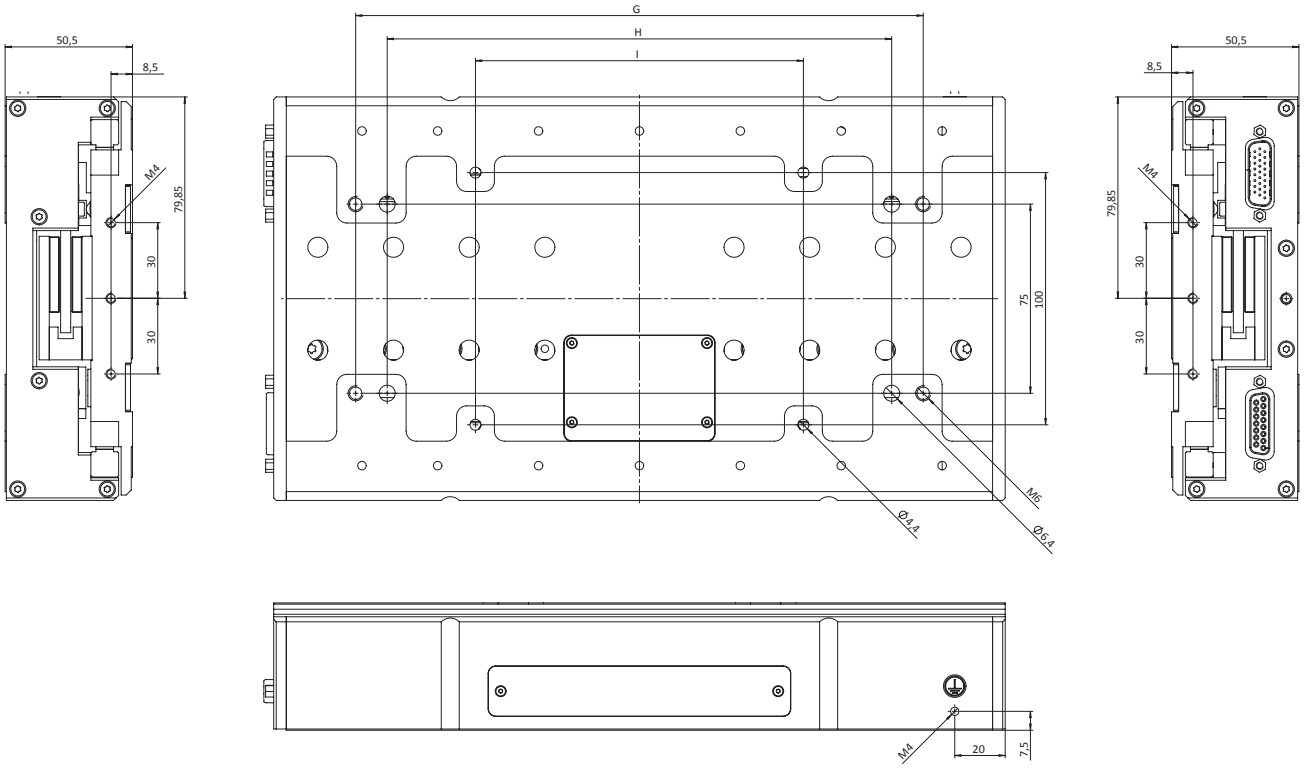
* 24 V DC with C-891.120200 Ask about custom designs.
** interpolated

V-551, dimensions in mm

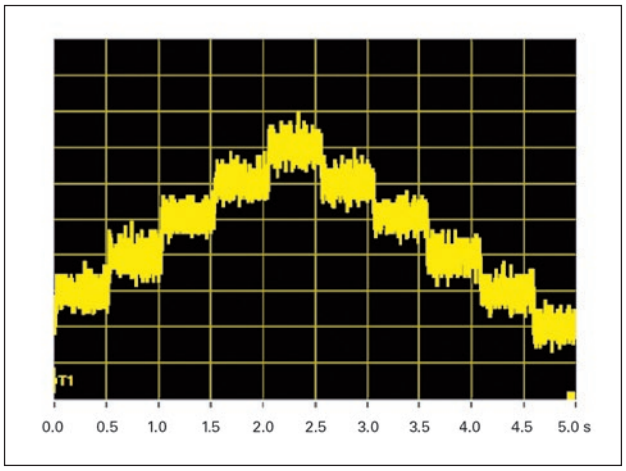
V-551.4x :



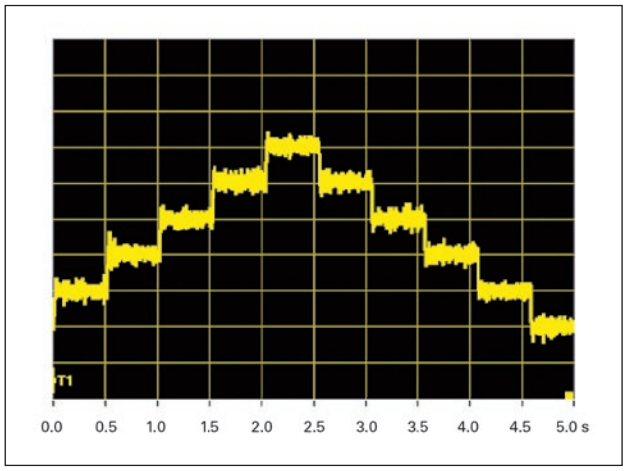
	V-551.2x	V-551.4x	V-551.7x
Stroke	60	130	230
A	220	290	450
B	210	280	440
C	60	120	120
D	1	1	3
E	–	40	40
F	1	1	3



	V-551.2x	V-551.4x	V-551.7x
G	125	225	225
H	175	200	250
I	130	130	190



A V-551.4D with PIOne linear encoder performs a sequence of 0.5-nm steps.



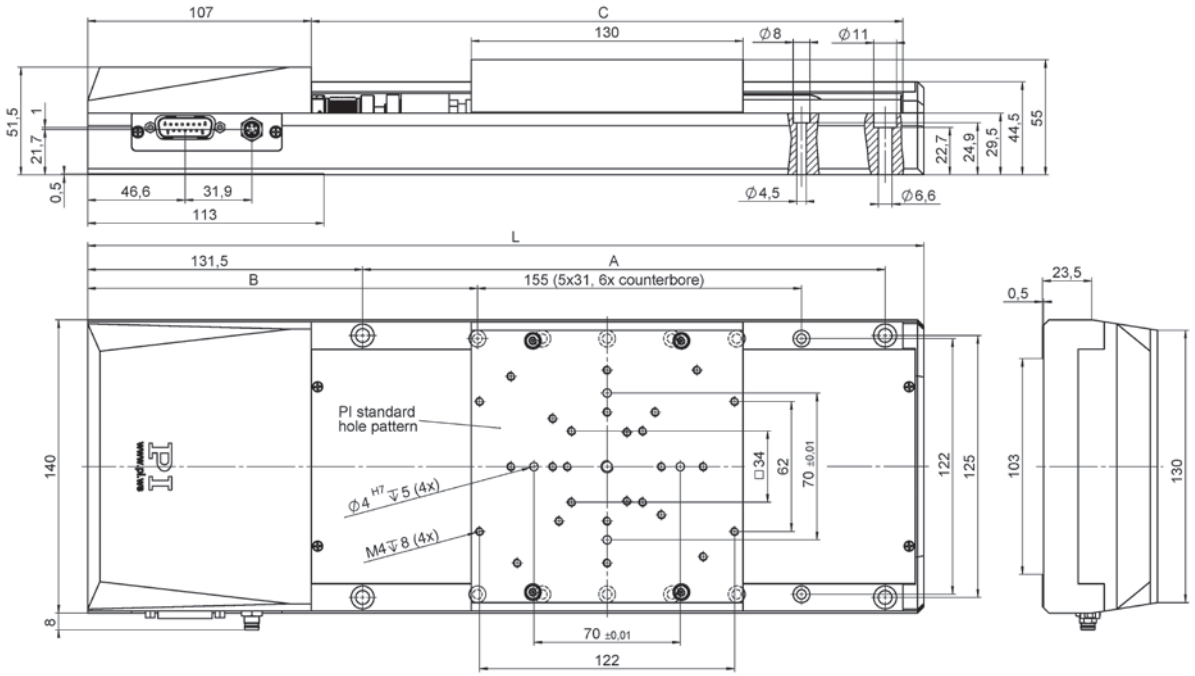
A V-551.4D with PIOne linear encoder performs a sequence of 1-nm steps.

M-511 / M-521 / M-531
High-Precision Linear Stage

High Travel Accuracy, Long Travel Ranges, Many Motor Variants

- Travel ranges 102, 204, and 306 mm (4″, 8″, 12″)
- Max. velocity to 100 mm/s
- Encoder resolution 50 nm
- Load capacity to 100 kg
- Zero-play ball screw
- XY and XYZ combinations

M-511, M-521, M-531, dimensions in mm



	L	A	B	C
M-511.xx1	400	250	186,5	283
M-521.xx1	500	350	236,5	383
M-531.xx1	600	450	286,5	483

Applications

- Metrology / Testing
- Optical Alignment
- Photonics
- Sample Inspection
- Scientific Instrumentation

>> ActiveDrive
>> Linear Encoder

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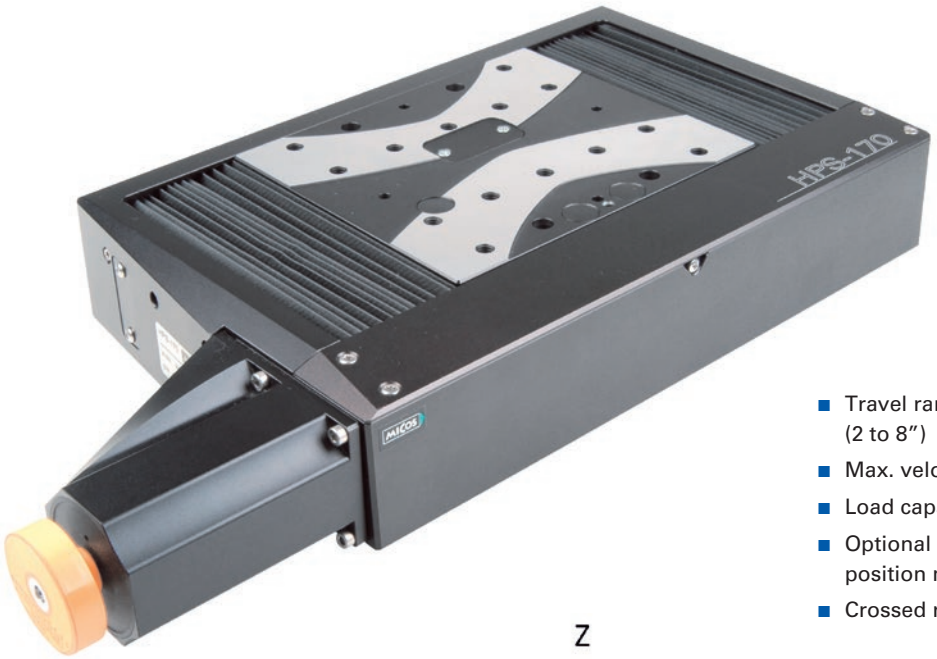
	M-5x1.DD1 / M-5x1.DD2	M-5x1.EC / M-5x1.PD1	M-5x1.DG1 / M-5x1.PG1	Unit	Tolerance
Motion and positioning					
Travel range	M-511: 102 (4″) / M-521: 204 (8″) / M-531: 306 (12″)	M-511: 102 (4″) / M-521: 204 (8″) / M-531: 306 (12″)	M-511: 102 (4″) / M-521: 204 (8″) / M-531: 306 (12″)	mm	
Integrated sensor	Linear encoder	Rotary encoder	Rotary encoder		
Sensor resolution linear encoder	0.05			µm	
Sensor resolution rotary encoder	–	4096	2048	Cts./rev.	
Design resolution	0.05	0.488	0.033	µm	typ.
Minimum incremental motion	0.1	0.5	0.4	µm	typ.
Unidirectional repeatability	0.1	0.5	0.4	µm	typ.
Bidirectional repeatability	±0.2	–	–	µm	typ.
Backlash	–	1	1	µm	typ.
Pitch / yaw per 100 mm	±35	±35	±35	µrad	typ.
Straightness / flatness per 100 mm	1	1	1	µm	
Velocity	50	100	6	mm/s	max.
Mechanical properties					
Drive screw pitch of ball screw	2	2	2	mm	
Gear ratio	–	–	$(28/12)^4$ ~ 29.6:1		
Load capacity	1000	1000	1000	N	max.
Push/pull force	80	80	80	N	max.
Permissible lateral force	200	200	200	N	max.
Drive properties					
Motor type	DC motor with PWM control	DC motor with PWM control*	DC gear motor		
Motor resolution	–	–	–	steps/rev.	
Guide	Recirculating ball bearings	Recirculating ball bearings	Recirculating ball bearings		
Operating voltage	24	24	M-5x1.DG1: 0 to ±12 M-5x1.PG1: 24	V	
Motor power	30	60	3	W	nom.
Torque	80	70	5	mN·m	nom.
Reference and limit switches	Hall effect	Hall effect	Hall effect		
Miscellaneous					
Operating temperature range	10 to 50	–20 to 65	–20 to 65	°C	
Material	Aluminum, black anodized				
Mass	5 (M-511) / 6.1 (M-521) / 7.2 (M-531)	5 (M-511) / 6.1 (M-521) / 7.2 (M-531)	5 (M-511) / 6.1 (M-521) / 7.2 (M-531)	kg	±5 %
Connector	Sub-D 15, 3 m incl. cable	Sub-D 15, 3 m incl. cable	Sub-D 15, 3 m incl. cable		
Recommended controllers	C-863 C-884	C-863 C-884	C-863 C-884		

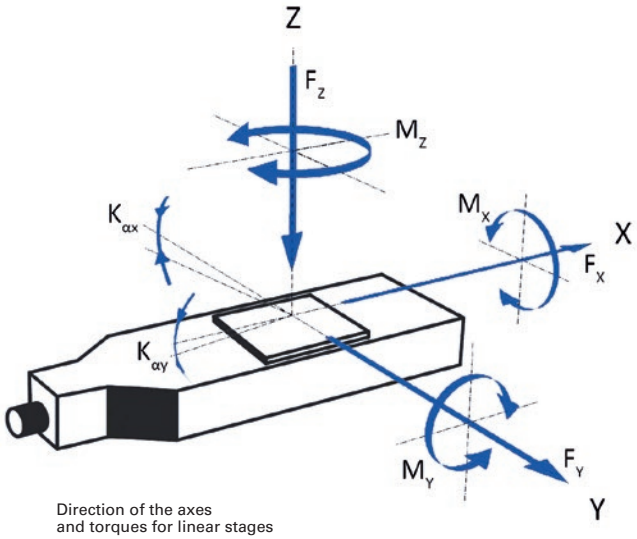
* M-5xx.EC: Brushless DC motor with integrated block commutation (PWM control).
Ask about custom designs!

HPS-170
High-Precision Linear Stage for Heavy Loads

Excellent Repeatability and Travel Accuracy



- Travel ranges from 52 to 205 mm (2 to 8″)
- Max. velocity to 100 mm/s
- Load capacity to 35 kg
- Optional linear encoder for direct position measurement
- Crossed roller guide, anti-creep



Direction of the axes
and torques for linear stages

Applications

- Laser Marking
- Metrology / Testing
- Sample Inspection
- Semiconductor

>> ActiveDrive
>> Linear Encoder

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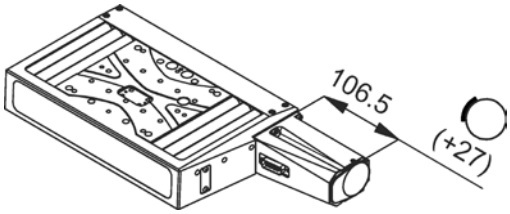
	626291x00	626291x10	626292x00	626292x10-0001	Unit	Tolerance
	Linear stage with DC motor and rotary encoder	Additionally with linear encoder	Linear stage with stepper motor	Additionally with linear encoder		
Active axes	X		X			
Motion and positioning						
Travel range	52 / 102 / 155 / 205		52 / 102 / 155 / 205		mm	
Integrated sensor	Rotary encoder	Rotary and linear encoder	–	Linear encoder		
Sensor signal rotary encoder	A/B quadrature, RS-422	A/B quadrature, RS-422	–			
Sensor signal linear encoder	–	A/B quadrature, RS-422	–	Sin/cos, 1 V peak-peak, 20 µm signal period		
Design resolution	0.1	0.05	10 (full step)	0.005	µm	
Sensor resolution rotary encoder	20000	20000	–		Cts./rev.	
Sensor resolution linear encoder	–	0.05	–	–	µm	typ.
Minimum incremental motion	0.2	0.2	0.2	0.05	µm	typ.
Unidirectional repeatability	0.2	0.2	0.2	0.05	µm	typ.
Bidirectional repeatability	±2	±0.2	±2	±0.05	µm	typ.
Pitch	±20 / ±25 / ±30 / ±35	±20 / ±25 / ±30 / ±35	±20 / ±25 / ±30 / ±35	±20 / ±25 / ±30 / ±35	µrad	typ.
Yaw	±40	±40	±40	±40	µrad	typ.
Straightness / flatness	±0.75 / ±1 / ±2 / ±3	±0.75 / ±1 / ±2 / ±3	±0.75 / ±1 / ±2 / ±3	±0.75 / ±1 / ±2 / ±3	µrad	typ.
Max. velocity	100	100	35	35	mm/s	
Mechanical properties						
Guide type	Crossed roller guide with anti-creep system	Crossed roller guide with anti-creep system	Crossed roller guide with anti-creep system	Crossed roller guide with anti-creep system		
Drive screw type	Ball screw	Ball screw	Ball screw	Ball screw		
Drive screw pitch	2	2	2	2	mm	
Load capacity	350	350	350	350	N	max.
Push/pull force	100	100	150	150	N	max.
Holding force	20	20	60	60	N	max.
Permissible lateral force	150	150	150	150	N	max.
Permissible torque M_x in θ_X	400	400	400	400	Nm	max.
Permissible torque M_y in θ_Y	300	300	300	300	Nm	max.
Permissible torque M_z in θ_Z	300	300	300	300	Nm	max.
Drive properties						
Motor type	DC motor	DC motor	2-phase stepper motor	2-phase stepper motor		
Operating voltage, nominal	24	24	24	24	V	nom.
Operating voltage, max.	48	48	48	48	V	nom.
Peak current, effective	3.8	3.8	1.2	1.2	A	typ.
Torque constant, effective	0.03	0.03			N·m/A	typ.
Electrical time constant	6	6			ms	
Resistance phase-phase	0.62	0.62	3.3	3.3	Ω	typ.
Inductance phase-phase	0.13	0.13	2.8	2.8	mH	typ.
Back EMF phase-phase	0.00349	0.00349			V/kRPM	max.
Limit switches	mechanical	mechanical	mechanical	mechanical		

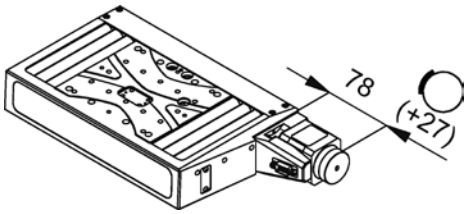
	626291x00	626291x10	626292x00	626292x10-0001	Unit	Tolerance
	Linear stage with DC motor and rotary encoder	Additionally with linear encoder	Linear stage with stepper motor	Additionally with linear encoder		
Miscellaneous						
Operating temperature range	5 to 40	5 to 40	5 to 40	5 to 40	°C	
MTBF	10000	10000	–	–	h	
Material	Aluminum, steel	Aluminum, steel	Aluminum, steel	Aluminum, steel		
Mass	5.1 / 5.8 / 6.6 / 7.5	5.1 / 5.8 / 6.6 / 7.5	5 / 5.7 / 6.5 / 7.4	5 / 5.7 / 6.5 / 7.4	kg	±5 %
Moved mass	1.1	1.4	1.1	1.4		
Connection	Sub-D 15 (m)	Motor: Sub-D 15 (m) Sensor: Sub-D 9 (m)	Sub-D 15 (m)	Motor: Sub-D 15 (m) Sensor: Sub-D 9 (m)		
Recommended controllers	C-863 (single axis) with C-863.AD12 line driver C-884 (to 6 axes) with C-863.AD12 line driver C-885 with C-863.20C885 (to 40 axes) and C-863.AD12 line driver ACS modular controller	C-863 (single axis) with C-863.AD12 line driver C-884 (to 6 axes) with C-863.AD12 line driver C-885 with C-863.20C885 (to 40 axes) and C-863.AD12 line driver ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

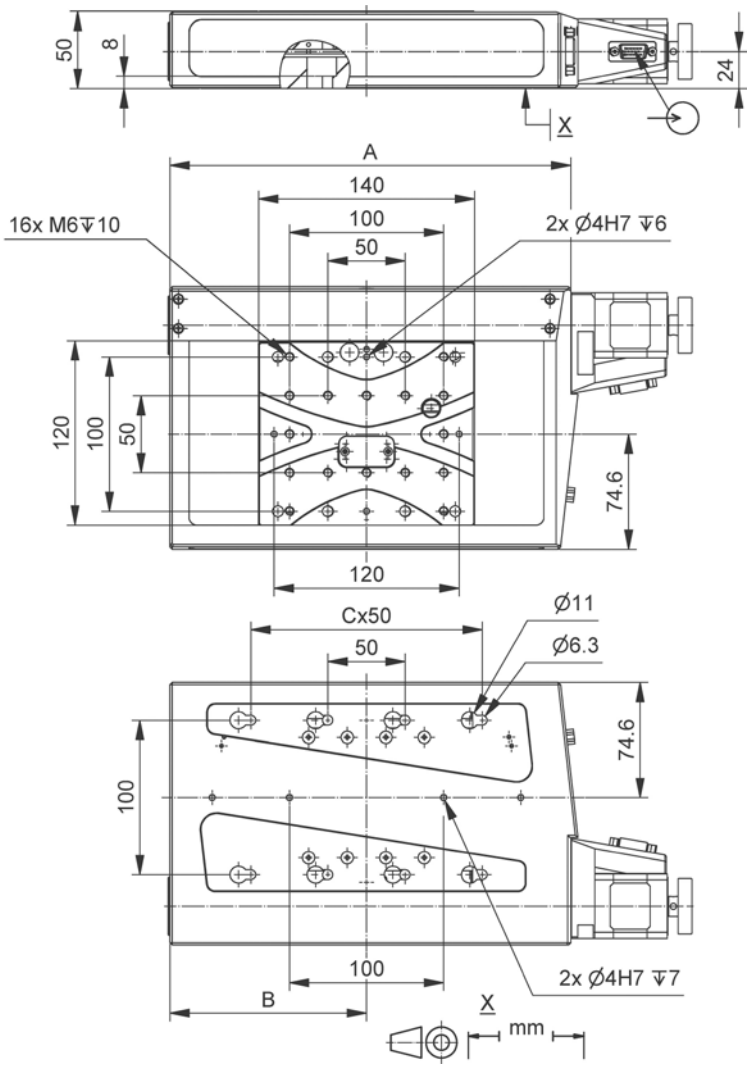
HPS-170, DC motor, dimensions in mm



HPS-170, stepper motor, dimensions in mm



HPS-170, dimensions in mm



Travel range/mm	52	102	155	205
A/mm	261	311	381	456
B/mm	127.5	152.5	187.5	225
C/mm	3	3	3	6

A-141 PIglide MB Miniature Linear Stage with Air Bearings

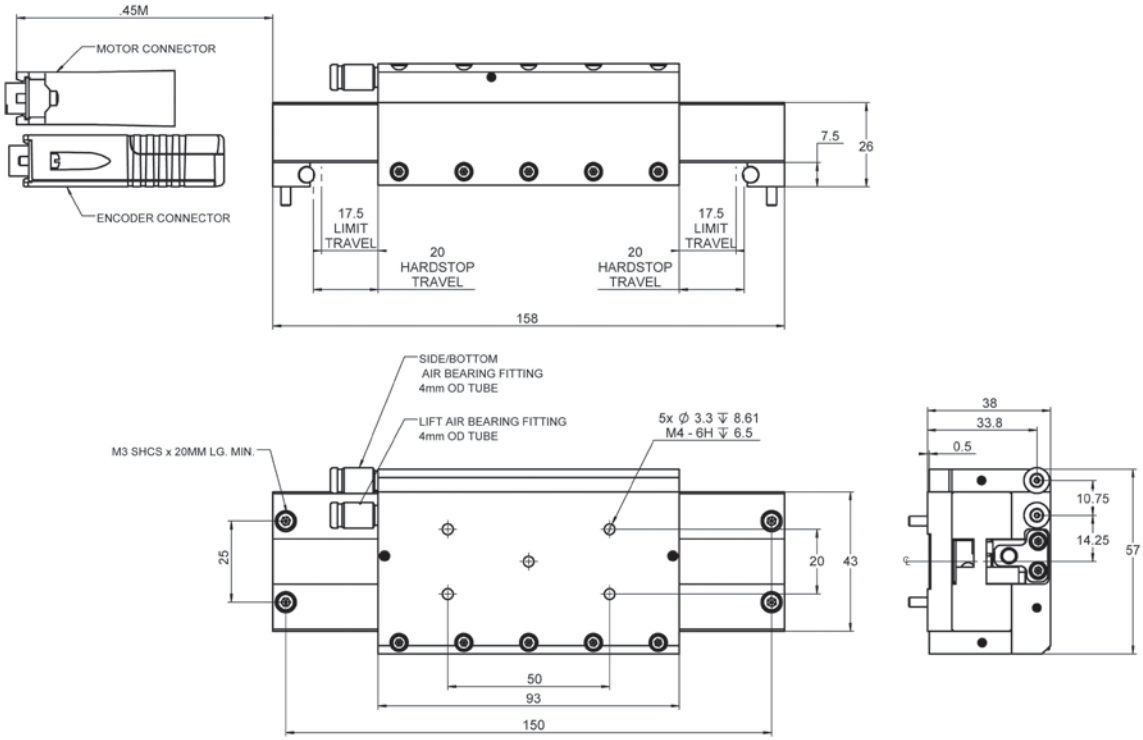
High Performance, Cleanroom Compatible, Customizable

- Size of the motion platform 57 mm × 93 mm
- Low profile 38 mm
- Travel ranges to 35 mm
- Load capacity to 3 kg
- Velocity to 0.25 m/sec
- Acceleration to 3.5 m/s²

Accessories and options

- PIglide filter and air preparation kits
- Single and multi-axis motion controller
- XY setups and individual configurations
- Counterbalance options for vertical (Z) orientations
- Base plates made of granite and systems for reducing vibration

A-141.035A1, dimensions in mm



Applications

- Precision Micro Assembly
- Scanning
- Photonics
- Optical Alignment

>> Air bearings
>> Linear encoder
>> Linear motor

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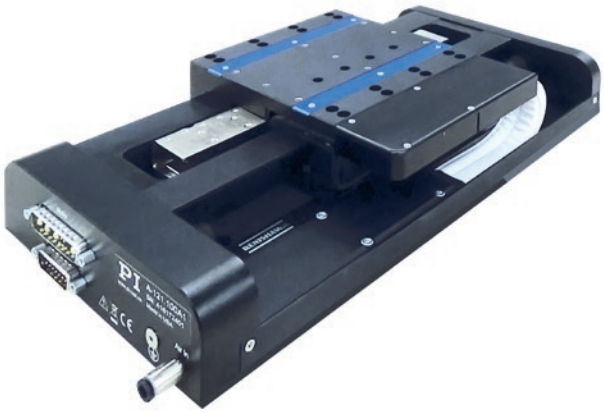
	A-141	Unit	Tolerance
Motion			
Active axes	X		
Travel range	35	mm	
Pitch / yaw [1] over the entire travel range	10	µrad	max.
Straightness / flatness [1] over the entire travel range	0.5	µm	max.
Velocity [2], unloaded	0.25	m/s	max.
Acceleration [2], unloaded	3.5	m/s²	max.
Mechanical properties			
Load capacity in z [3]	3	kg	max.
Moved mass	0.3	kg	
Overall mass	0.6	kg	
Guide type	Air bearing		
Drive properties			
Drive type	Linear motor, ironless, 3-phase		
Intermediate circuit voltage, effective	48, nominal 80, max.	V DC	
Peak force	2.3	N	typ.
Nominal force	0.58	N	typ.
Force constant, effective	2.1	N/A	typ.
Resistance phase-phase	22.4	Ω	typ.
Inductivity phase-phase	1.0	mH	typ.
Back EMF phase-phase	0.7	V·s/m	max.
Cabling	Internal, no moving cable		
Positioning			
Integrated sensor	Incremental linear encoder with travel range limits and home index		
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period		
Sensor resolution	1.2 nm [4]		
Bidirectional repeatability	±0.1 µm [4]		
Accuracy, uncompensated [5]	±2.0 µm		
Accuracy, with error compensation [5]	±0.25 µm		
Miscellaneous			
Operating pressure [6]	65±5 psi (450±35 kPa)		
Air consumption	<1.0 SCFM (28 SLPM)		
Air quality	Clean (unfiltered to 1.0 µm or better) – ISO 8573-1 class 1 Oil free – ISO 8573-1 class 1 Dry (–15 °C dew point) – ISO 8573-1 class 3		
Materials	Hardcoat aluminum, stainless steel fasteners		

(1) Dependent on the flatness of the surface, on which the stage is mounted.
(2) Can be limited by the payload, controller or drive.
(3) Assumes payload CG is centered no more than 50 mm above the motion platform. The stage is designed for horizontal operation only.
(4) Assumes 16384x interpolation. Contact PI for the use of other factors.
(5) Improved accuracy can be obtained with controller-based error compensation. The stage must be ordered with a controller from PI to reach these values. Accuracy values assume short-term duration and do not consider the long-term effects of thermal drift on the stage.
(6) To protect the stage against damage, it is recommended to connect an air pressure sensor to the E-Stop input of the controller.

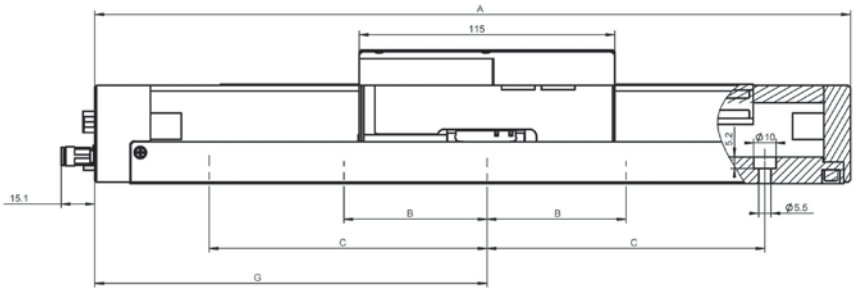
A-121 Plglide AT1 Linear Stage with Air Bearings

High Performance Small Footprint Nanopositioning Stage

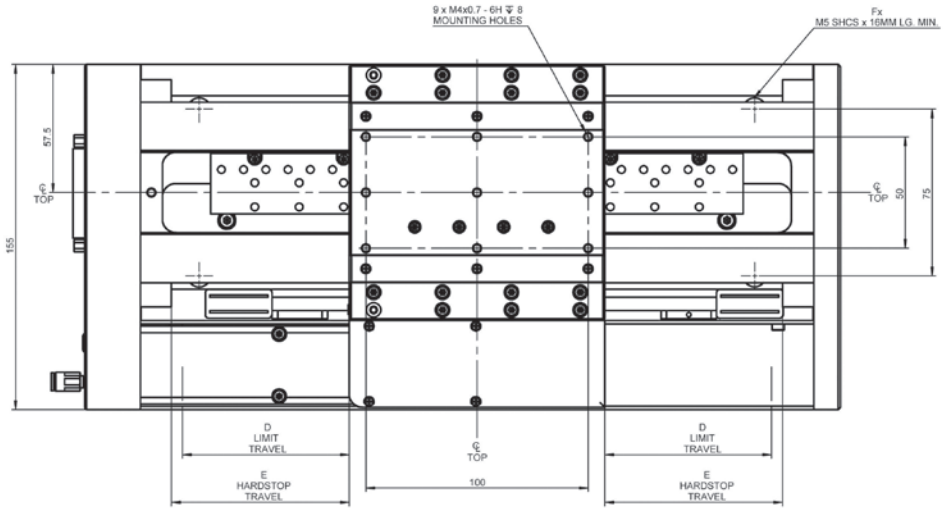


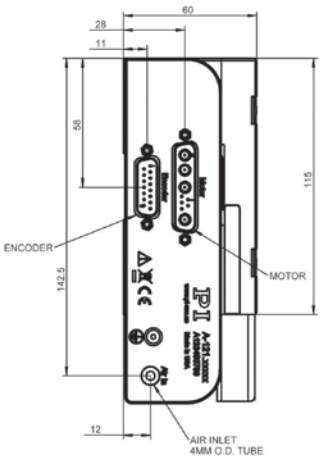
- Ideal for scanning applications or high-precision positioning
- Cleanroom compatible
- Size of the motion platform 115 mm × 115 mm
- Travel ranges to 350 mm
- Low profile from 60 mm
- Resolution to 1 nm
- Best flatness / straightness
- Counterbalance options for vertical assembly

A-121, dimensions in mm



MODEL	A	B	C	D	E	F	G
A-121.050	240		75	25	30	4	126.5
A-121.100	290		100	50	55	4	151.5
A-121.150	340		125	75	80	6	176.5
A-121.200	390		150	100	105	6	201.5
A-121.250	440		150	125	130	6	226.5
A-121.350	540	100	200	175	180	10	276.5





Applications

- Sample Inspection
- Scanning
- Metrology / Testing
- Photonics
- Flatpanel Inspection

>> Air bearings
>> Linear encoder
>> Linear motor

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	A-121.050	A-121.100	A-121.150	A-121.200	A-121.250	A-121.350	Unit	Tolerance
Motion								
Active axes	X	X	X	X	X	X		
Travel range	50	100	150	200	250	350	mm	
Pitch / yaw [1]	12	12	15	20	25	35	µrad	max.
Straightness / flatness [1]	±0.5	±0.5	±0.5	±0.75	±0.75	±1.25	µm	max.
Straightness / flatness per 25 mm travel range [1]	0.1	0.1	0.1	0.1	0.1	0.1	µm	max.
Velocity, unloaded [2]	1	1	1	1	1	1	m/s	max.
Acceleration, unloaded [2]	20	20	20	20	20	20	m/s²	max.
Mechanical properties								
Load capacity in z [3]	100	100	100	100	100	100	N	max.
Load capacity in y [3]	40	40	40	40	40	40	N	max.
Moved mass	1.2	1.2	1.2	1.2	1.2	1.2	kg	
Overall mass	3.5	4.2	4.5	5.2	5.7	6.8	kg	
Guide type	Air bearing	Air bearing	Air bearing	Air bearing	Air bearing	Air bearing		

	A-121	Unit	Tolerance
Drive properties			
Drive type	Linear motor, ironless, 3-phase		
Intermediate circuit voltage, effective	48, nominal 80, max.	V DC	
Peak force	33.2	N	typ.
Nominal force	11.1	N	typ.
Force constant, effective	6.67	N/A	typ.
Resistance phase-phase	6.3	Ω	typ.
Inductivity phase-phase	1.0	mH	typ.
Back EMF phase-phase	7.7	V·s/m	max.
Cabling	External, moving cable		

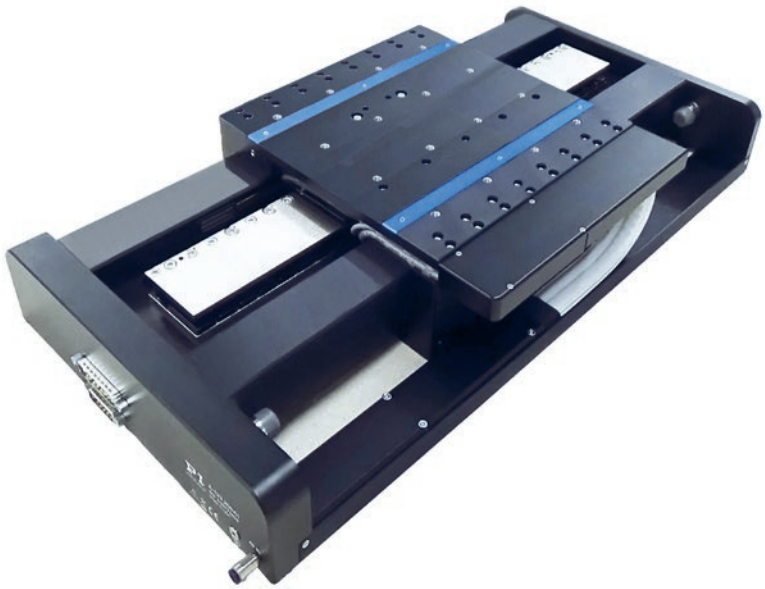
	A-121.xxxA	A-121.xxxB	A-121.xxxC
Positioning			
Integrated Sensor	Incremental linear encoder	Absolute encoder	Incremental linear encoder
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period	BiSS-C	A/B quadrature, TTL
Sensor resolution	1.2 nm [4]	1 nm	50 nm
Bidirectional repeatability	A-121.050: ±0.25 µm [4] A-121.100: ±0.25 µm [4] A-121.150: ±0.25 µm [4] A-121.200: ±0.25 µm [4] A-121.250: ±0.25 µm [4] A-121.350: ±0.50 µm [4]	A-121.050: ±0.25 µm A-121.100: ±0.25 µm A-121.150: ±0.25 µm A-121.200: ±0.25 µm A-121.250: ±0.25 µm A-121.350: ±0.50 µm	A-121.050: ±0.25 µm A-121.100: ±0.25 µm A-121.150: ±0.25 µm A-121.200: ±0.25 µm A-121.250: ±0.25 µm A-121.350: ±0.50 µm
Accuracy, uncompensated [5]	A-121.050: ±1.0 µm A-121.100: ±1.0 µm A-121.150: ±1.5 µm A-121.200: ±2.0 µm A-121.250: ±2.0 µm A-121.350: ±3.0 µm	A-121.050: ±1.5 µm A-121.100: ±1.5 µm A-121.150: ±1.5 µm A-121.200: ±1.5 µm A-121.250: ±1.5 µm A-121.350: ±1.5 µm	A-121.050: ±1.0 µm A-121.100: ±1.0 µm A-121.150: ±1.5 µm A-121.200: ±2.0 µm A-121.250: ±2.0 µm A-121.350: ±3.0 µm
Accuracy, with error compensation [5]	A-121.050: ±0.50 µm A-121.100: ±0.50 µm A-121.150: ±0.50 µm A-121.200: ±0.50 µm A-121.250: ±0.50 µm A-121.350: ±1.0 µm	A-121.050: ±0.5 µm A-121.100: ±0.5 µm A-121.150: ±0.5 µm A-121.200: ±0.5 µm A-121.250: ±0.5 µm A-121.350: ±0.5 µm	A-121.050: ±0.50 µm A-121.100: ±0.50 µm A-121.150: ±0.50 µm A-121.200: ±0.50 µm A-121.250: ±0.50 µm A-121.350: ±1.0 µm

	A-121
Miscellaneous	
Operating pressure [6]	65 to 75 psi (450 to 520 kPa)
Air consumption	<1.0 SCFM (28 SLPM)
Air quality	Clean (filtered to 1.0 µm or better) – ISO 8573-1 Class 1 Oil free – ISO 8573-1 Class 1 Dry (–15 °C dew point) – ISO 8573-1 Class 3
Materials	Hardcoat aluminum, stainless steel fasteners

(1) Dependent on the flatness of the surface, on which the stage is mounted.
(2) Can be limited by the payload, controller or drive.
(3) Assumes payload CG is centered no more than 50 mm above the motion platform.
(4) Assumes 16384x interpolation. Contact PI for the use of other factors.
(5) Improved accuracy can be obtained with controller-based error compensation. The stage must be ordered with a controller from PI to reach these values. Accuracy values assume short-term duration and do not consider the long-term effects of thermal drift on the stage.
(6) To protect the stage against damage, it is recommended to connect an air pressure sensor to the Motion-Stop input of the controller.

A-123 Plglide AT3 Linear Stage with Air Bearings

High Performance Nanopositioning Stage



- Ideal for scanning applications or high-precision positioning
- Cleanroom compatible
- Size of the motion platform 210 mm × 210 mm
- Travel ranges 50 mm to 750 mm
- Resolution to 1 nm

Product Overview

The stages in the Plglide are equipped with a servo drive linear motor with preloaded air bearings and integrated linear encoder. The combination of these noncontact components results in a frictionless motion platform that offers the highest performance, quality, and lifetime. A high-force linear motor can drive the stage to top speed within a few milliseconds, and the high-capacity bearings can support payloads up to 60 kg. The laterally opposed, actively preloaded air bearing design in this model allows mounting in any orientation.

Application fields

Plglide positioning systems are ideally suited for many high-precision applications such as metrology, photonics, and precision scanning in semiconductor or flat panel display manufacturing. Thanks to the friction-free motion, no particles are formed, which makes Plglide stages ideal for cleanroom applications.

Accessories and options

- Encoder
- Plglide filter and air preparation kits
- Single and multi-axis motion controller
- XY setups and individual configurations
- Cable track variations
- Options with counterweight for vertical (Z) orientation
- Customizations available
- Base plates made of granite and systems for reducing vibration

Applications

- Sample Inspection
- Scanning
- Metrology / Testing
- Photonics
- Flatpanel Inspection

>> Air bearings
>> Linear encoder
>> Linear motor

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	A-123.050	A-123.100	A-123.150	A-123.200	A-123.350	A-123.500	A-123.750	Unit	Tolerance
Motion									
Active axes	X	X	X	X	X	X	X		
Travel range	50	100	150	200	350	500	750	mm	
Pitch / yaw (1)	5	10	15	15	20	25	35	µrad	max.
Straightness / flatness (1)	±0.5	±0.5	±0.5	±1	±1.5	±1.5	±2.5	µm	max.
Straightness / flatness per 25 mm travel range (1)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	µm	max.
Velocity, unloaded (2)	1	1	1	1	1	1	1	m/s	max.
Acceleration, unloaded (2)	30	30	30	30	30	30	30	m/s²	max.
Mechanical properties									
Load capacity in z (3)	590	590	590	590	590	590	590	N	max.
Load capacity in y (3)	295	295	295	295	295	295	295	N	max.
Moved mass	5	5	5	5	5	5	5	kg	
Overall mass	14	15.5	16.5	18	21.5	25	32	kg	
Guide type	Air bearing	Air bearing	Air bearing	Air bearing	Air bearing	Air bearing	Air bearing		

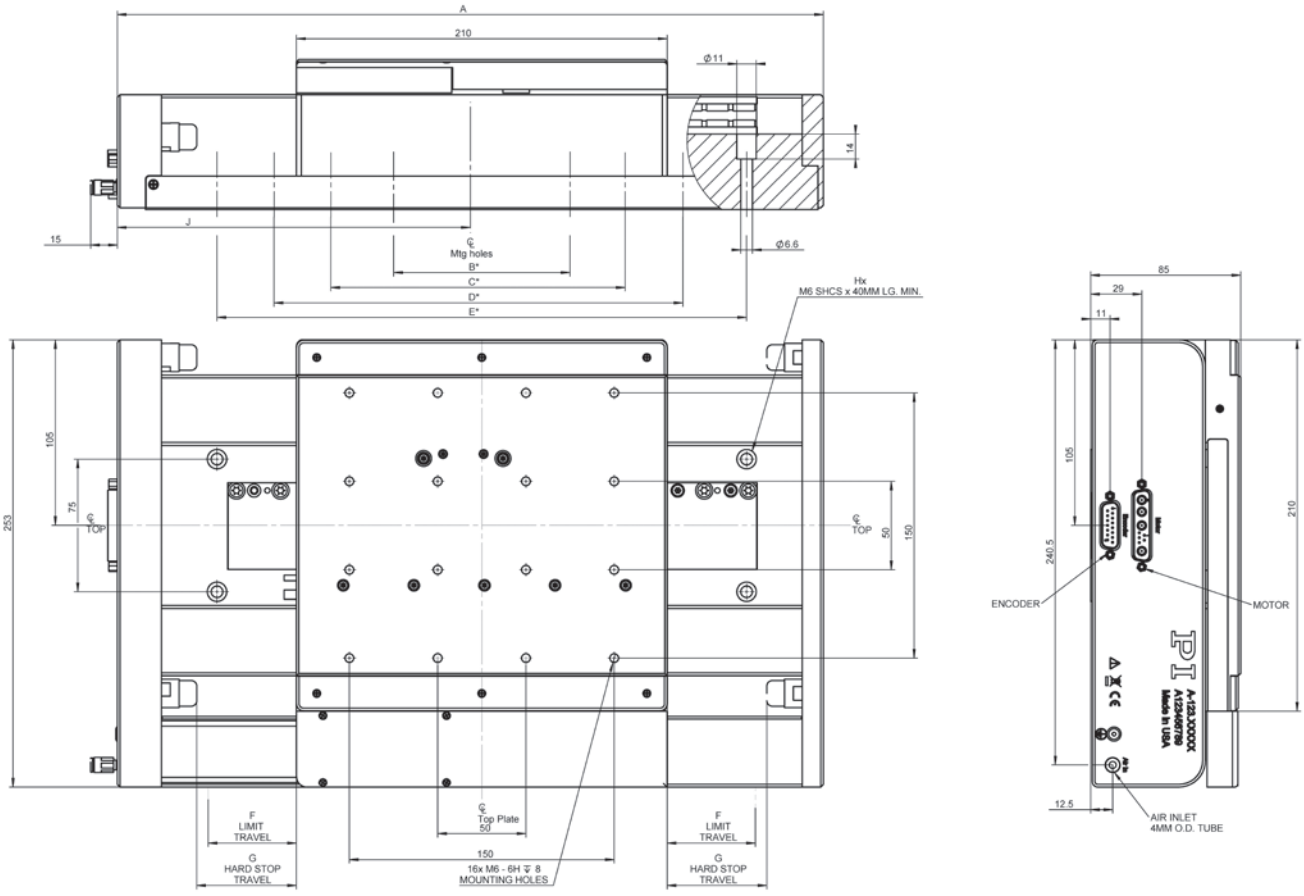
	A-123	Unit	Tolerance
Drive properties			
Drive type	Linear motor, ironless, 3-phase		
Intermediate circuit voltage, effective	48, nominal 80, max.	V DC	
Peak force	298	N	typ.
Nominal force	87.5	N	typ.
Force constant, effective	19.9	N/A	typ.
Resistance phase-phase	3.6	Ω	typ.
Inductivity phase-phase	1.2	mH	typ.
Back EMF phase-phase	16	V·s/m	max.
Cabling	External, moving cable		

	A 123.xxxA	A 123.xxxB	A 123.xxxC
Positioning			
Integrated Sensor	Incremental linear encoder	Absolute encoder	Incremental linear encoder
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period	BiSS-C	A/B quadrature, TTL
Sensor resolution	1.2 nm (4)	1 nm	50 nm
Bidirectional repeatability	A-123.050: ±0.25 µm (4) A-123.100: ±0.25 µm (4) A-123.150: ±0.25 µm (4) A-123.200: ±0.25 µm (4) A-123.350: ±0.5 µm (4) A-123.500: ±0.5 µm (4) A-123.750: ±0.75 µm (4)	A-123.050: ±0.25 µm A-123.100: ±0.25 µm A-123.150: ±0.25 µm A-123.200: ±0.25 µm A-123.350: ±0.5 µm A-123.500: ±0.5 µm A-123.750: ±0.75 µm	A-123.050: ±0.25 µm A-123.100: ±0.25 µm A-123.150: ±0.25 µm A-123.200: ±0.25 µm A-123.350: ±0.5 µm A-123.500: ±0.5 µm A-123.750: ±0.75 µm
Accuracy, uncompensated (5)	A-123.050: ±1 µm A-123.100: ±1 µm A-123.150: ±1.5 µm A-123.200: ±2 µm A-123.350: ±3 µm A-123.500: ±3.5 µm A-123.750: ±5 µm	A-123.050: ±1.5 µm A-123.100: ±1.5 µm A-123.150: ±1.5 µm A-123.200: ±1.5 µm A-123.350: ±1.5 µm A-123.500: ±1.5 µm A-123.750: ±1.5 µm	A-123.050: ±1 µm A-123.100: ±1 µm A-123.150: ±1.5 µm A-123.200: ±2 µm A-123.350: ±3 µm A-123.500: ±3.5 µm A-123.750: ±5 µm
Accuracy, with error compensation (5)	A-123.050: ±0.5 µm A-123.100: ±0.5 µm A-123.150: ±0.5 µm A-123.200: ±0.5 µm A-123.350: ±1 µm A-123.500: ±1 µm A-123.750: ±1.5 µm	A-123.050: ±1.5 µm A-123.100: ±1.5 µm A-123.150: ±1.5 µm A-123.200: ±1.5 µm A-123.350: ±1.5 µm A-123.500: ±1.5 µm A-123.750: ±1.5 µm	A-123.050: ±0.5 µm A-123.100: ±0.5 µm A-123.150: ±0.5 µm A-123.200: ±0.5 µm A-123.350: ±1 µm A-123.500: ±1 µm A-123.750: ±1.5 µm

	A-123
Miscellaneous	
Operating pressure (6)	75 to 85 psi (515 to 585 kPa)
Air consumption	<1.0 SCFM (28 SLPM)
Air quality	Clean (filtered to 1.0 µm or better) – ISO 8573-1 Class 1 Oil free – ISO 8573-1 Class 1 Dry (–15 °C dew point) – ISO 8573-1 Class 3
Materials	Hardcoat aluminum, stainless steel fasteners

(1) Dependent on the flatness of the surface, on which the stage is mounted.
(2) Can be limited by the payload, controller or drive.
(3) Assumes payload CG is centered no more than 50 mm above the motion platform.
(4) Assumes 16384x interpolation. Contact PI for the use of other factors.
(5) Improved accuracy can be obtained with controller-based error compensation. The stage must be ordered with a controller from PI to reach these values. Accuracy values assume short-term duration and do not consider the long-term effects of thermal drift on the stage.
(6) To protect the stage against damage, it is recommended to connect an air pressure sensor to the Motion-Stop input of the controller.

A-123, dimensions in mm



MODEL	A	B*	C*	D*	E*	F	G	Hx	J	Moving Mass	Total Mass
A-123.050	350				250	25	31.5	4	181.5	5 kg	14 kg
A-123.100	400	100			300	50	56.5	8	206.5	5 kg	15.5 kg
A-123.150	450	100			350	75	81.5	8	231.5	5 kg	16.5 kg
A-123.200	500	100			400	100	106.5	8	256.5	5 kg	18 kg
A-123.350	650	100	325		550	175	181.5	12	331.5	5 kg	21.5 kg
A-123.500	800	100	300	500	700	250	256.5	16	406.5	5 kg	25 kg
A-123.750	1050	100	400	700	1000	375	381.5	16	531.5	5 kg	32 kg

*The mounting holes are symmetric around the center line located at “J”

A-110 Plglide LC Linear Stage with Air Bearings

High-Performance Nanopositioning System for a Good Price

- Ideal for scanning applications or high-precision positioning
- Cleanroom compatible
- Size of the motion platform 160 mm × 200 mm
- Travel ranges to 400 mm
- Load capacity to 100 N
- Best flatness / straightness

Product Overview

Plglide positioning systems have a magnetic linear motor, magnetically preloaded air bearings and an optical linear encoder: Noncontact and friction-free motion for the highest accuracy and reliability.

Accessories and options

- Encoder
- Plglide Filter and Air Preparation Kits
- Single and multi-axis motion controller
- XY setups and individual configurations
- Base plates made of granite and systems for reducing vibration

Applications

- Sample Inspection
- Scanning
- Metrology / Testing
- Photonics
- Flatpanel Inspection

>> Air bearings
>> Linear encoder
>> Linear motor

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	A-110.050xx	A-110.100xx	A-110.200xx	A-110.300xx	A-110.400xx	Unit	Tolerance
Motion							
Active axes	X	X	X	X	X		
Travel range	50	100	200	300	400	mm	
Pitch / yaw [1]	10	20	30	40	50	µrad	max.
Straightness / flatness [1]	±1	±1	±1.5	±2	±2.5	µm	max.
Straightness / flatness per 10 mm travel range [1]	±10	±10	±10	±10	±10	nm	max.
Velocity, unloaded [2]	0.5	0.5	1	1	1	m/s	max.
Acceleration, unloaded [2]	10	10	30	30	30	m/s²	max.
Mechanical properties							
Load capacity in z [3]	100	100	100	100	100	N	max.
Moved mass	2.5	2.5	2.6	2.6	2.6	kg	
Overall mass	6.3	7.5	11	12	14	kg	
Guide type	Air bearing	Air bearing	Air bearing	Air bearing	Air bearing		

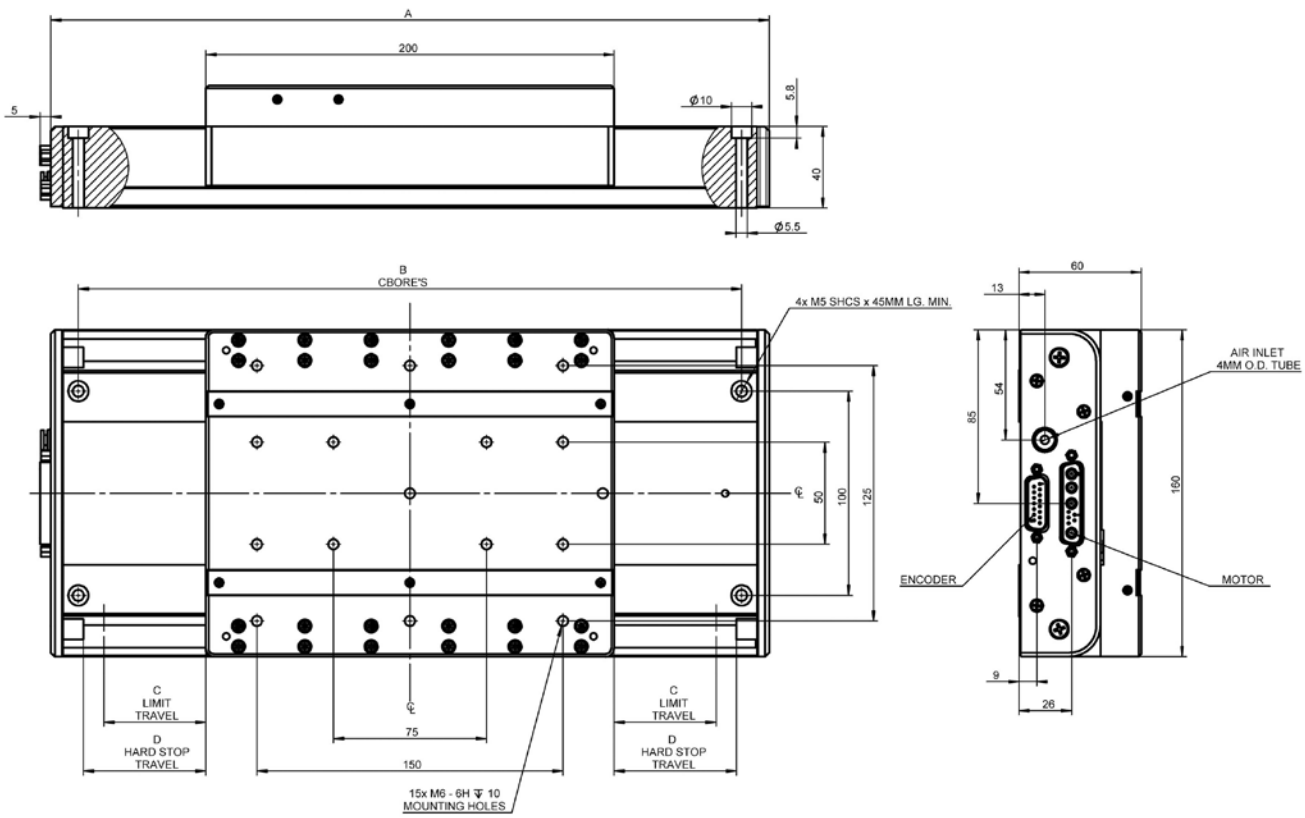
	A-110.050xx A-110.100xx	A-110.200xx A-110.300xx A-110.400xx	Unit	Tolerance
Drive properties				
Drive type	Linear motor, ironless, 3-phase	Linear motor, ironless, 3-phase		
Intermediate circuit voltage, effective 60, max.	48, nominal	48, nominal 60, max.	V DC	
Peak force	25	85	N	typ.
Nominal force	9.2	39	N	typ.
Force constant, effective	4.2	12.3	N/A	typ.
Resistance phase-phase	8.2	3.6	Ω	typ.
Inductivity phase-phase	2.7	1.24	mH	typ.
Back EMF phase-phase	4.2	10.1	V·s/m	max.
Cabling	Internal, no moving cable	External, moving cable		

	A-110.xxxA	A-110.xxxB	A-110.xxxC
Positioning			
Integrated Sensor	Incremental linear encoder	Absolute encoder	Incremental linear encoder
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period	BiSS-C	A/B quadrature, TTL
Sensor resolution	1.2 nm [4]	1 nm	50 nm
Bidirectional repeatability	±0.5 µm [4]	±0.5 µm	±0.5 µm
Accuracy, uncompensated [5]	A-110.050: ±1 µm A-110.100: ±1.5 µm A-110.200: ±2 µm A-110.300: ±3 µm A-110.400: ±4 µm	A-110.050: ±1.5 µm A-110.100: ±1.5 µm A-110.200: ±1.5 µm A-110.300: ±1.5 µm A-110.400: ±1.5 µm	A-110.050: ±1 µm A-110.100: ±1.5 µm A-110.200: ±2 µm A-110.300: ±3 µm A-110.400: ±4 µm
Accuracy, with error compensation [5]	A-110.050: ±1 µm A-110.100: ±1 µm A-110.200: ±1 µm A-110.300: ±1.5 µm A-110.400: ±1.5 µm	A-110.050: ±0.5 µm A-110.100: ±0.5 µm A-110.200: ±0.5 µm A-110.300: ±0.5 µm A-110.400: ±0.5 µm	A-110.050: ±1 µm A-110.100: ±1 µm A-110.200: ±1 µm A-110.300: ±1.5 µm A-110.400: ±1.5 µm

	A-110
Miscellaneous	
Operating pressure [6]	60 to 70 psi (415 to 485 kPa)
Air consumption	<1.0 SCFM (28 SLPM)
Air quality	Clean (filtered to 1.0 µm or better) – ISO 8573-1 Class 1 Oil free – ISO 8573-1 Class 1 Dry (–15 °C dew point) – ISO 857-1 Class 3
Materials	Hardcoat aluminum, stainless steel fasteners

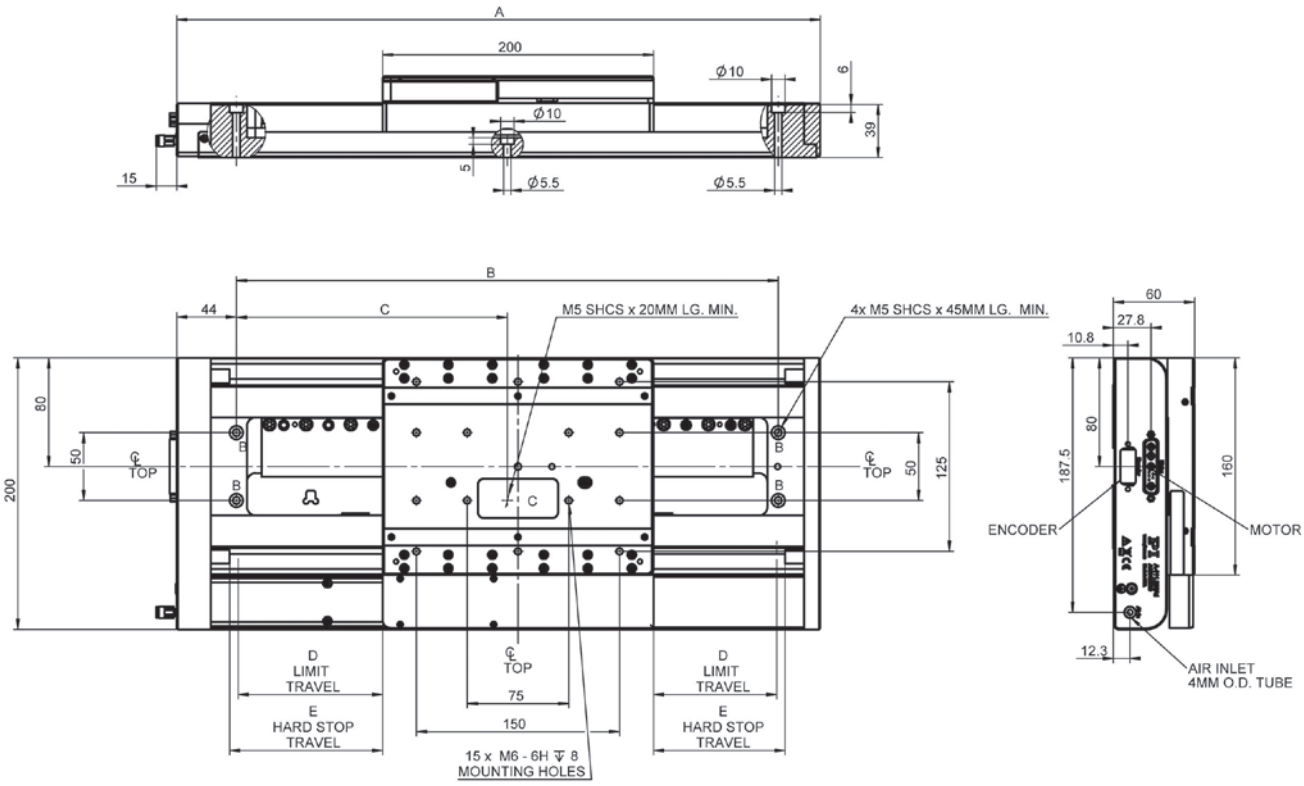
(1) Dependent on the flatness of the surface, on which the stage is mounted.
(2) Can be limited by the payload, controller or drive.
(3) Assumes payload CG is centered no more than 50 mm above the motion platform. The stage is designed for horizontal operation only.
(4) Assumes 16384x interpolation. Contact PI for the use of other factors.
(5) Improved accuracy can be obtained with controller-based error compensation. The stage must be ordered with a controller from PI to reach these values. Accuracy values assume short-term duration and do not consider the long-term effects of thermal drift on the stage.
(6) To protect the stage against damage, it is recommended to connect an air pressure sensor to the Motion-Stop input of the controller.

A-110.050 and A-110.100, dimensions in mm



	A	B	C	D
A-110.050	302	275	25	35
A-110.100	352	325	50	60

A-110.200, A-110.300 and A-110.400, dimensions in mm



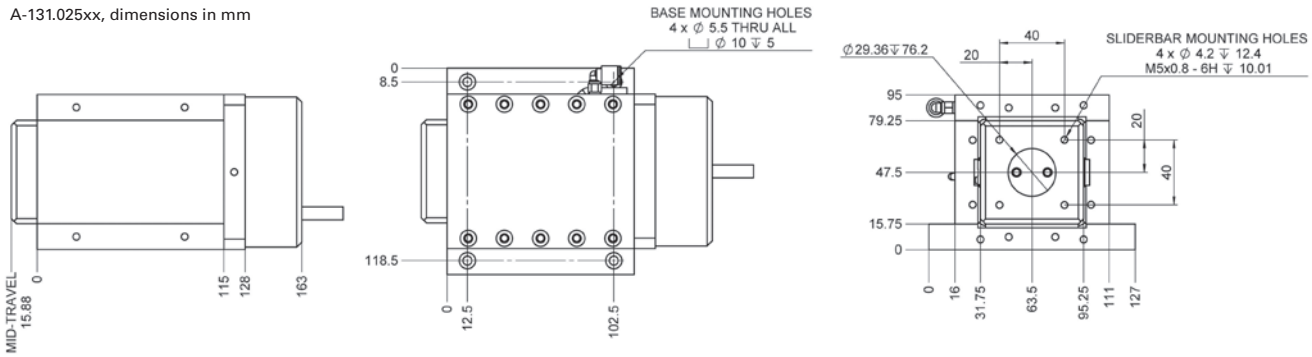
MODEL	A	B	C	D	E
A-110.200	475	400	200	102	105
A-110.300	575	500	250	152	155
A-110-400	675	600	300	202	205

A-131 PIglide VC Voice Coil Linear Stage with Air Bearings

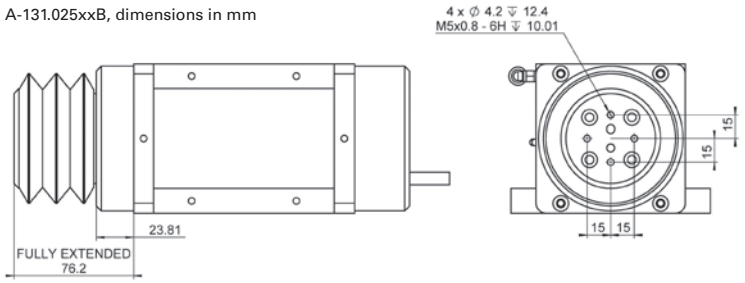
High-Performance Miniature Nanopositioning System

- Ideal for scanning applications or high-precision positioning
- Cleanroom compatible
- Travel ranges to 25 mm
- Load capacity to 100 N
- Acceleration to 80 m/s²
- Best flatness / straightness

A-131.025xx, dimensions in mm



A-131.025xxB, dimensions in mm



Applications

- Medical Industry
- Scanning
- Machine Tool / Fast Tool

>> Air bearings
>> Linear encoder
>> Voice Coil Drives

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	A-131	Unit	Tolerance
Motion			
Active axes	X		
Travel range	25	mm	
Pitch [1]	10	µrad	max.
Yaw [1]	10	µrad	max.
Straightness / flatness [1]	±0.125	µm	max.
Velocity, unloaded [2]	1	m/s	max.
Acceleration, unloaded [2]	80	m/s²	max.
Mechanical properties			
Load capacity in z [3]	100	N	max.
Moved mass	0.85	kg	
Overall mass	3.6	kg	
Guide type	Air bearing		
Drive properties			
Drive type	Brushless voice coil drive, ironless, 1 phase		
Intermediate circuit voltage, effective	48, nominal 80, max.	V DC	
Peak force	70.4	N	typ.
Nominal force	22.3	N	typ.
Force constant, effective	6.9	N/A	typ.
Resistance	2.7	Ω	typ.
Inductivity (at 1000 Hz)	1.4	mH	typ.
Back EMF	6.9	V·s/m	
Nominal power	28	W	max.
Cabling	Internal, no moving cable		

	A-131.025A1x	A-131.025D1x	A-131.025F1x
Positioning			
Integrated sensor	Incremental linear encoder	Incremental linear encoder	Incremental linear encoder
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period	A/B quadrature, TTL	A/B quadrature, TTL
Sensor resolution	1.2 nm [4]	100 nm [5]	500 nm [5]
Bidirectional repeatability	±0.1 µm [4]	±0.1 µm	±0.1 µm
Accuracy [6]	0.2 µm	0.2 µm	0.2 µm
Reference point switch	Home index	Home index	Home index
Reference point switch repeatability	±1 encoder step	±1 encoder step	±1 encoder step

	A-131
Miscellaneous	
Operating pressure [7]	75 to 85 psi (520 to 585 kPa)
Air consumption	<1.0 SCFM (28 SLPM)
Air quality	Clean (filtered to 1.0 µm or better) – ISO 8573-1 Class 1 Oil free – ISO 857-1 Class 1 Dry (–15 °C dew point) – ISO 8573-1 Class 3
Materials	Hardcoat aluminum, stainless steel fasteners

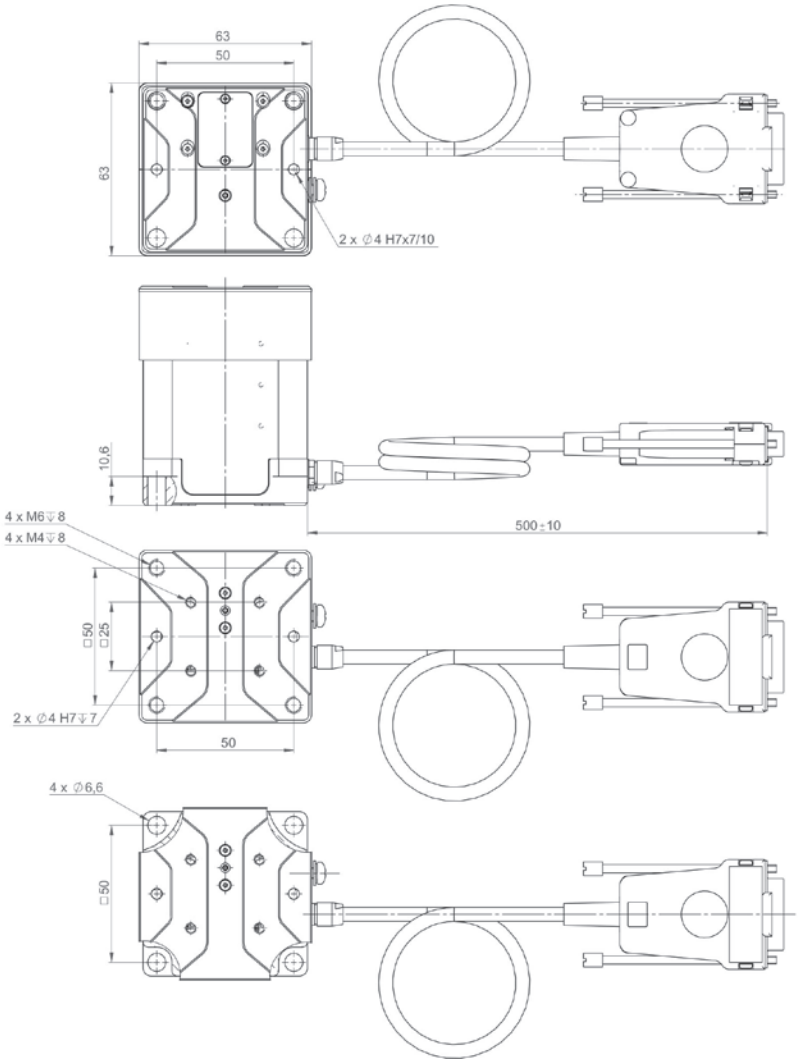
(1) Dependent on the flatness of the surface, on which the stage is mounted.
(2) Can be limited by the payload, controller or drive.
(3) Assumes that the center of gravity is centered no more than 50 mm from the motion platform.
(4) Assumes 16384x interpolation. Contact PI for the use of other factors.
(5) Alternative resolutions on request. Higher resolutions can limit the velocity.
(6) Improved accuracy can be obtained with controller-based error compensation. The stage must be ordered with a controller from PI to reach these values.
(7) To protect the stage against damage, it is recommended to connect an air pressure sensor to the Motion-Stop input of the controller.

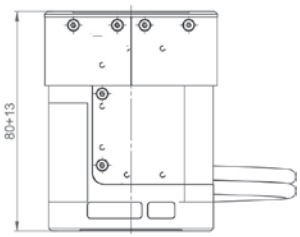
L-306 Compact Precision Z Stage

Compact Design, Multi-Axis Combinations

- Compact design: Surface 63 mm × 63 mm
- Stepper motors and closed-loop DC motors
- Optional linear encoder for direct position measurement
- Crossed roller guides, anti-creep
- Noncontact reference and limit switches

L-306, dimensions in mm





Applications

- General Automation
- Photonics
- Scientific Instrumentation
- Semiconductor

>> Linear Encoder

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	L-306.011100	L-306.011112	L-306.013112	Unit	Tolerance
	Z stage with 2-phase stepper motor	Z stage with 2-phase stepper motor, linear encoder with A/B quadrature signal transmission	Z stage with DC motor, linear encoder with A/B quadrature signal transmission		
Motion and positioning					
Travel range	13	13	13	mm	
Integrated sensor	–	Incremental linear encoder	Incremental linear encoder		
Sensor resolution	–	5	50	nm	
Design resolution	2.5	0.005	0.05	µm	
Minimum incremental motion	2.5	0.1	0.1	µm	typ.
Unidirectional repeatability	0.5	0.1	0.1	µm	typ.
Bidirectional repeatability	±2	±0.5	±0.5	µm	typ.
Pitch	±175	±175	±175	µrad	typ.
Yaw	±150	±150	±150	µrad	typ.
Straightness / flatness	±3	±3	±3	µm	typ.
Velocity	5	5	5	mm/s	max.
Reference and limit switches	Optical	Optical	Optical		
Mechanical properties					
Guide type	Crossed roller guide with anti-creep system	Crossed roller guide with anti-creep system	Crossed roller guide with anti-creep system		
Drive screw type	Ball screw	Ball screw	Ball screw		
Drive screw pitch	0.5	0.5	0.5	mm	
Push/pull force	20	20	20	N	max.
Holding force, power off	20	20	20	N	typ.
Permissible lateral force	10	10	10	N	max.
Load capacity	20	20	20	N	max.
Permissible torque in θ_X, θ_Y	1	1	1	N·m	max.
Permissible torque in θ_Z	2	2	2	N·m	max.
Drive properties					
Motor type	2-phase stepper motor	2-phase stepper motor	DC motor		
Miscellaneous					
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Humidity	20 – 80 % rel., not condensing	20 – 80 % rel., not condensing	20 – 80 % rel., not condensing		
Material	Anodized aluminum, steel	Anodized aluminum, steel	Anodized aluminum, steel		
Mass	0.6	0.6	0.6	kg	±5 %
Moved mass	0.18	0.18	0.18	kg	±5 %
Connection	HD Sub-D 26 (m) (motor)	HD Sub-D 26 (m) (motor and encoder)	HD Sub-D 26 (m) (motor and encoder)		
Cable length	0.5	0.5	0.5	m	
Recommended controllers	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller		

All cables required for operation with the ordered controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

L-310 Precision Z Stage

Compact Multi-Axis Combinations with Linear and Rotation Stages

- Travel range 26 mm (1")
- High-resolution encoder
- ActiveDrive DC, DC, BLDC, and stepper motors
- Zero-play ball screw
- MTBF 10000 h
- Self-locking to 10 kg

Precision-class Z stage

High guiding accuracy and stiffness due to ball screws and crossed roller guides. Stress-relieved aluminum base for highest stability. Vacuum versions available on request. Noncontact limit and reference point switches (Hall effect). Reference point switch with direction sensing in the middle of the travel range.

Highly accurate position measuring with incremental linear encoder

Noncontact optical linear encoders measure the actual position directly at the motion platform with the greatest accuracy so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring.

Minimum incremental motion and slow motion

In conjunction with the SMC Hydra controller, versions with stepper motor and integrated linear encoder (L-310.xASD) achieve repeatable minimum incremental motion in the range of the sensor resolution. The same configuration attains constant low velocities of a few sensor increments per second.

Drive types

- .xxSD variant: 2-phase stepper motor for high torque even at low velocities and high resolution.
- .xxAD variant: ActiveDrive DC motor for high velocity: Control via pulse-width-modulated (PWM) signals, the operating voltage is attained via an amplifier integrated in the motor housing.
- .023xxx variant: DC servo motor
- .025xxx variant: Brushless DC motor (BLDC) for high rotational velocity. Smooth running and low wear, therefore higher lifetime.

Position measurement

- Versions with DC motor: Rotary encoder
- Optional: Integrated linear encoder, installed centrically.

Applications

- General Automation
- Photonics
- Scientific Instrumentation
- Semiconductor

>> ActiveDrive
>> Linear Encoder
>> Vacuum-Compatible Versions

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	L-310	Unit	Tolerance
Motion			
Active axis	Z		
Travel range	26	mm	
Pitch / yaw	±150	µrad	typ.
Straightness / flatness	±3	µm	typ.
Velocity	L-310.2xAD: 20 L-310.2xSD: 15 L-310.02xxxx: 50	mm/s	max.

	L-310.2ASD L-310.023211	L-310.24AD L-310.xxx212	L-310.20AD L-310.xxx232	L-310.20SD	Unit	Tolerance
Positioning						
Design resolution	0.005	0.05	L-310.20AD: 0.061 L-310.023232: 0.061 L-310.025232: 0.05	5	µm	
Integrated sensor	Incremental linear encoder	Incremental linear encoder L-310.025212 additional rotary encoder	Rotary encoder	–		
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period	A/B quadrature, TTL	A/B quadrature, TTL	–		
Sensor resolution rotary encoder	–	L-310.025212: 20000	L-310.20AD: 16384 L-310.023232: 16384 L-310.025232: 20000	–	Cts./rev.	
Sensor resolution linear encoder		0.05		–	µm	
Minimum incremental motion	L-310.2ASD: 0.05 L-310.023211: 0.2	L-310.24AD: 0.3 L-310.xxx212: 0.2	0.3	0.3	µm	typ.
Unidirectional repeatability	L-310.2ASD: 0.1 L-310.023211: 0.2	L-310.24AD: 0.3 L-310.xxx212: 0.2	0.3	0.3	µm	typ.
Bidirectional repeatability	±0.2	±0.2	±2	±2	µm	typ.
Limit switches	Hall effect	Hall effect	Hall effect	Hall effect		
Reference point switch repeatability	2	2	2	2	µm	typ.

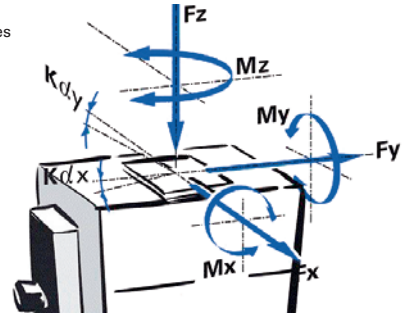
	L-310	Unit	Tolerance
Mechanical properties			
Drive screw	Ball screw		
Drive screw pitch	1	mm	
Guide	Crossed roller guide with anti-creep system		
Holding force, power off	L-310.2xAD: 30 / L-310.2xSD: 50 / L-310.02xxxx: 30	N	max.
Permissible lateral force, F_x	100	N	max.
Permissible lateral force, F_y	50	N	max.
Permissible torque in θ_X (M_x)	40	N·m	max.
Permissible torque in θ_Y (M_y)	80	N·m	max.
Permissible torque in θ_Z (M_z)	80	N·m	max.

	L-310.xxSD	L-310.xxAD	L-310.xx3xxx	L-310.xx5xxx	Unit	Tolerance
Drive properties						
Motor type	2-phase stepper motor	DC motor with PWM control	DC motor	BLDC motor		
Operating voltage, nominal	24	24	24	24	V	nom.
Operating voltage, max.	48	48	48	48	V	max.
Step resolution	200	–	–	–	Full steps/rev.	

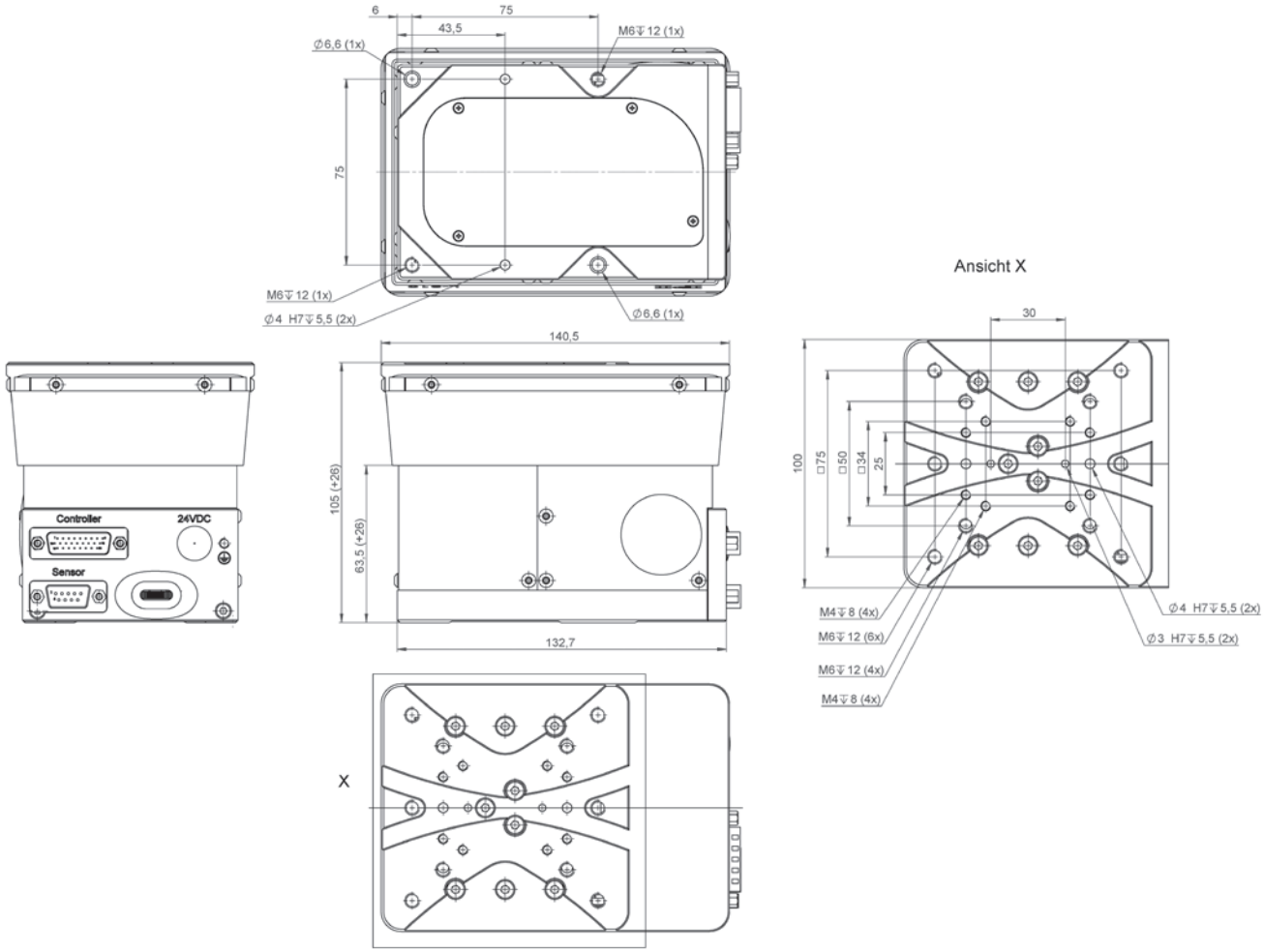
	L-310.20SD	L-310.2ASD	L-310.023xxx L-310.2xAD	L-310.025xxx	Unit	Tolerance
Miscellaneous						
Operating temperature range	5 to 40	5 to 40	5 to 40	5 to 40	°C	
Material	Al (black anodized)	Al (black anodized)	Al (black anodized)	Al (black anodized)		
MTBF	–	–	–	10000	h	
Mass	2.7	2.8	2.7	2.7	kg	±5 %
Moved mass, unloaded	0.9	0.9	0.9	0.9	kg	±5 %
Connection	HD Sub-D 26 (m)	HD Sub-D 26 (m) (motor) Sub-D 9 (m) (sensor)	L-310.2xAD: Sub-D 15 (m) L-310.023232: HD Sub-D 26 (m) L-310.023211: HD Sub-D 26 (m) (motor), Sub-D 9 (m) (sensor)	HD Sub-D 26 (m)		
Recommended controllers / drivers	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller		

All cables required for operation with the ordered controller are included in the scope of delivery. The cable length is 3 m.
Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

Direction of the axes and torques for Z stages



L-310, dimensions in mm

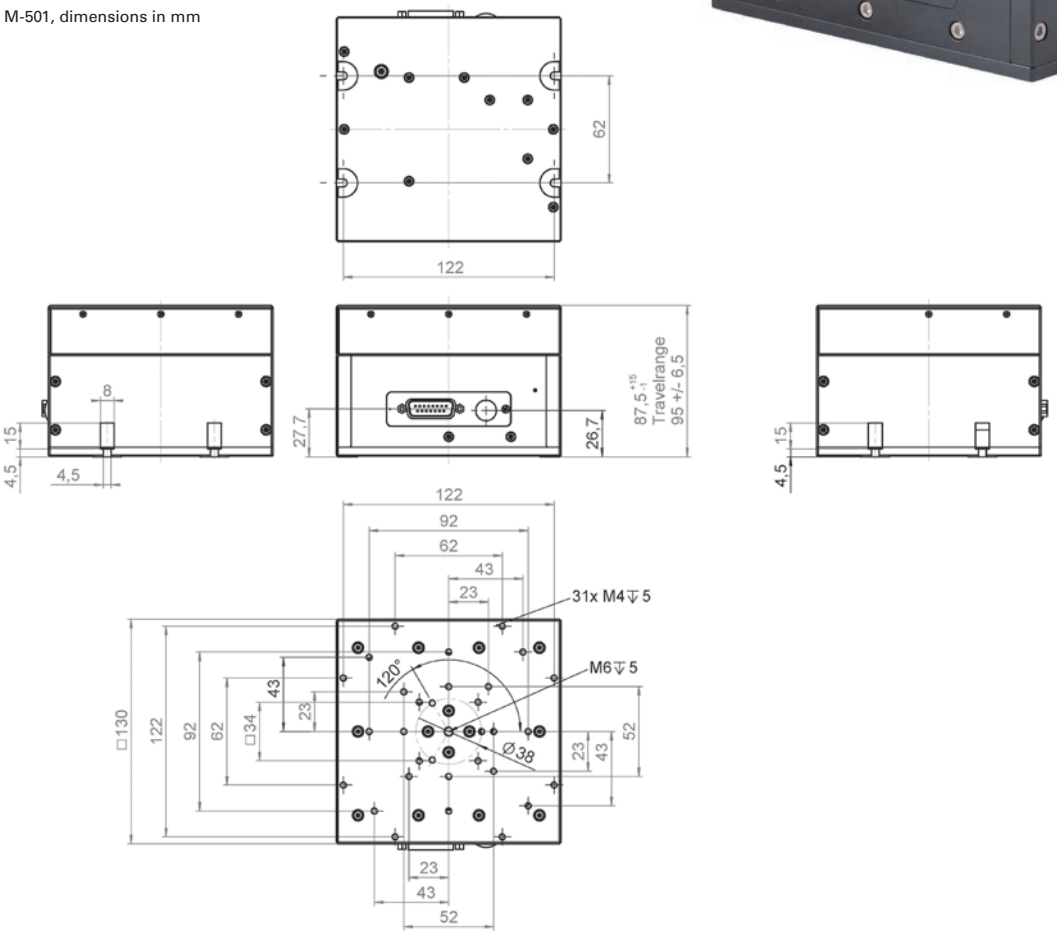


M-501 Precision Z Stage

Compact XYZ Combinations with M-511 Translation Stage Series

- Extremely high-resolution encoder
- ActiveDrive motor
- Zero-play ball screws
- Noncontact limit and reference point switches
- Stress-relieved aluminum base for highest stability
- Self-locking to 10 kg

M-501, dimensions in mm



Applications

- General Automation
- Photonics
- Scientific Instrumentation
- Semiconductor

>> ActiveDrive
>> Incremental Encoder

Technology Glossary ..... page 290

	M-501.1PD	M-501.1DG	Unit	Tolerance
Active axes	Z	Z		
Motion and positioning				
Travel range	12.5	12.5	mm	
Integrated sensor	Rotary encoder	Rotary encoder		
Sensor resolution	40960	2048	Cts./rev.	
Design resolution	0.024	0.005	µm	
Minimum incremental motion	<0.1	<0.1	µm	
Unidirectional repeatability	0.1	0.1	µm	
Pitch	±150	±150	µrad	
Yaw	±150	±150	µrad	
Velocity	3	1	mm/s	max.
Reference point switch repeatability	1	1	µm	
Mechanical properties				
Drive screw pitch	1	1	mm	
Gear ratio	80/26 (belt drive)	80/26 (belt drive); $(28/12)^4$:1 ~ 29.6:1 gearhead		
Load capacity	50	100	N	max.
Holding force	20	100	N	max.
Drive properties				
Motor type	DC motor with PWM control (ActiveDrive)	DC gear motor		
Operating voltage	24	0 to ±12	V	
Motor power	17	4	W	
Reference and limit switches	Hall effect	Hall effect		
Miscellaneous				
Operating temperature range	10 to 50	–20 to 50	°C	
Material	Al (black anodized)	Al (black anodized)		
Mass	2.6	2.6	kg	±5 %
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes)	C-863 (single axis) C-884 (up to 6 axes)		

Ask about custom designs!

UPL-120 Precision Z Stage

Excellent Accuracy for High Loads

- Travel range 13 mm (1/2")
- Unidirectional repeatability to 0.05 µm
- Load capacity to 20 kg
- Integrated optical limit switches
- Available with direct-measuring encoder
- Crossed roller guide, anti-creep

Reference-class Z stage

Extremely accurate and reliable positioning. Crossed roller guides for smooth feed at high loads. Stress-relieved aluminum base for highest stability. Drive variants with DC motor and 2-phase stepper motor. Noncontact limit switches.

Highly accurate position measuring with incremental linear encoder

Noncontact optical linear encoders measure the actual position directly at the motion platform with the greatest accuracy so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring.

Crossed roller guide

With crossed roller guides, the point contact of the balls in ball guides is replaced by line contact of the hardened rollers. Consequently, they are considerably stiffer and need less preload, which reduces friction and allows smoother running. Crossed roller guides are also distinguished by high guiding accuracy and load capacity. Force-guided rolling element cages prevent cage creep.

Applications

- General Automation
- Photonics
- Scientific Instrumentation
- Semiconductor

>> Linear Encoder

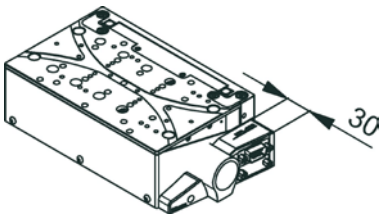
Technology Glossary ..... page 290

	6635911030	6635921030	6635911130	6635921130-0001	Unit	Tolerance
	Z stage with DC motor and rotary encoder	Z stage with stepper motor	Z stage with DC motor, linear and rotary encoder	Z stage with stepper motor and linear encoder		
Active axes	Z	Z	Z	Z		
Motion and positioning						
Travel range	13	13	13	13	mm	
Integrated sensor	Rotary encoder	–	Linear encoder Rotary encoder	Linear encoder		
Sensor signal rotary encoder	A/B quadrature, RS-422	–	A/B quadrature, RS-422	–		
Sensor signal linear encoder	–	–	A/B quadrature, RS-422	Sin/cos, 1 V peak-peak, 20 µm signal period		
Design resolution	0.013	1.34	0.05	0.005	µm	
Sensor resolution rotary encoder	20000	–	20000	–	Cts./rev.	
Sensor resolution linear encoder	–	–	0.05	–	µm	
Minimum incremental motion	0.1	0.1	0.1	0.05	µm	typ.
Unidirectional repeatability	0.1	0.1	0.1	0.05	µm	typ.
Bidirectional repeatability	±2	±2	±0.1	±0.05	µm	typ.
Pitch	±100	±100	±100	±100	µrad	typ.
Yaw	±100	±100	±100	±100	µrad	typ.
Straightness	±3.0	±3.0	±3.0	±3.0	µm	typ.
Flatness	±3.0	±3.0	±3.0	±3.0	µm	typ.
Velocity	6	3	6	3	mm/s	max.
Reference point switch repeatability	<1	<1	<1	<1	µm	typ.
Mechanical properties						
Guide type	Crossed roller guide with anti-creep system	Crossed roller guide with anti-creep system	Crossed roller guide with anti-creep system	Crossed roller guide with anti-creep system		
Drive screw type	Ball screw	Ball screw	Ball screw	Ball screw		
Drive screw pitch	1	1	1	1	mm	
Gear ratio	2911:780	2911:780	2911:780	2911:780		
Push/pull force, power on	200	200	200	200	N	max.
Holding force, power off	40	80	40	80	N	typ.
Load capacity	200	200	200	200	N	max.
Permissible lateral force F_y in Y	150	150	150	150	N	max.
Permissible torque M_x in θ_x	130	130	130	130	N·m	max.
Permissible torque M_y in θ_y	38	38	38	38	N·m	max.
Permissible torque M_z in θ_z	150	150	150	150	N·m	max.

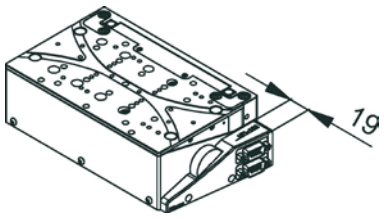
	6635911030	6635921030	6635911130	6635921130-0001	Unit	Tolerance
Drive properties						
Motor type	DC motor	2-phase stepper motor	DC motor	2-phase stepper motor		
Step resolution	–	200	–	200	Full steps/ rev.	
Operating voltage, nominal	24	24	24	24	V	nom.
Operating voltage, max.	48	48	48	48	V	max.
Limit switches	Optical	Optical	Optical	Optical		
Miscellaneous						
Operating temperature range	5 to 40	5 to 40	5 to 40	5 to 40	°C	
Mass	2.4	2.3	2.4	2.4	kg	±5 %
Moved mass	1.3	1.3	1.3	1.3	kg	±5 %
Material	Aluminum, black anodized	Aluminum, black anodized	Aluminum, black anodized	Aluminum, black anodized		
Connection	HD Sub-D 15 (m)	HD Sub-D 15 (m)	Motor: HD Sub-D 15 (m) Sensor: Sub-D 9 (m)	Motor: HD Sub-D 15 (m) Sensor: Sub-D 9 (m)		
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

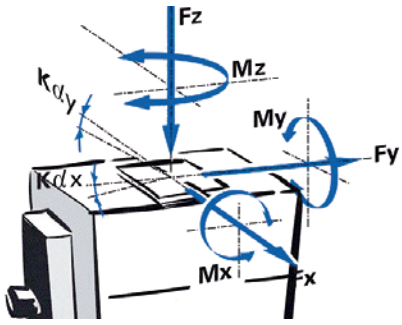
UPL-120, DC motor, dimensions in mm



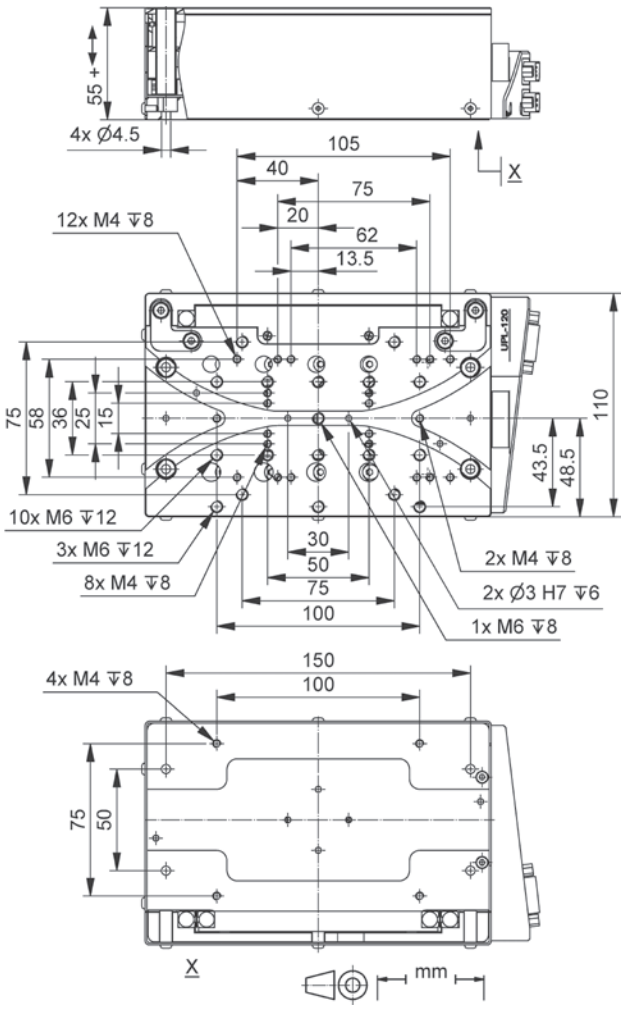
UPL-120, stepper motor, dimensions in mm



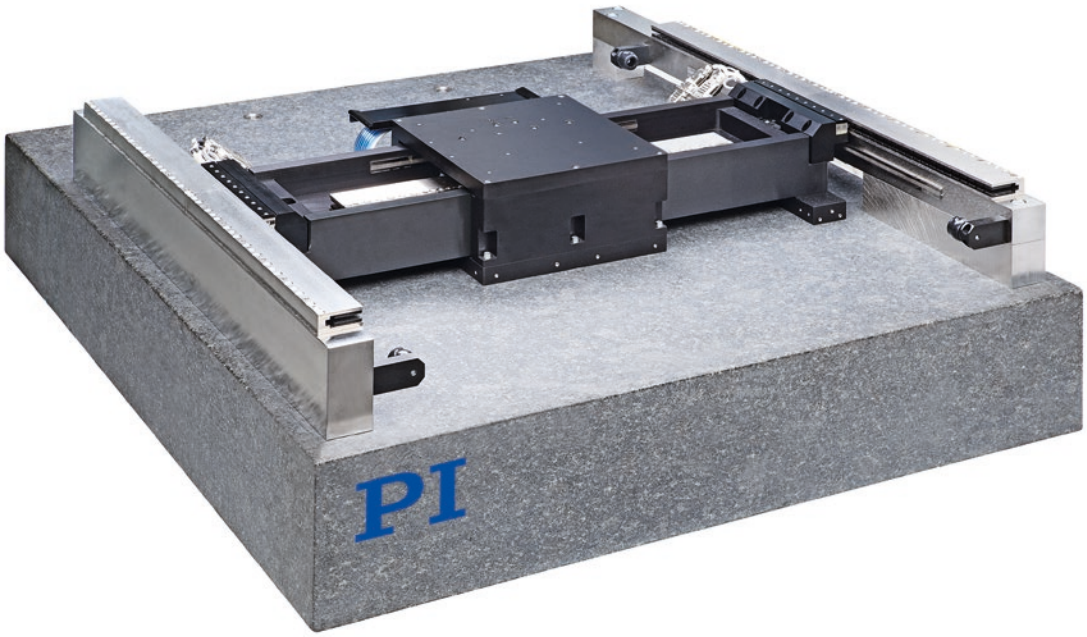
Direction of the axes and torques for Z stages



UPL-120, dimensions in mm



XY Stages



L-731 Precision XY Stage

High Travel Accuracy and Stability

- Travel range 205 mm × 205 mm (8″)
- Unidirectional repeatability to 0.05 µm
- Velocity to 90 mm/s
- 2-phase stepper motor or DC motors
- Incremental encoder with 1 nm resolution
- Rotary encoder with 20000 impulses/ revolution
- Crossed roller guide, anti-creep

Highly accurate position measuring with incremental linear encoder

Noncontact optical linear encoders measure the actual position directly at the motion platform with the greatest accuracy so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring. Optical limit and reference point switches.

Crossed roller guide

With crossed roller guides, the point contact of the balls in ball guides is replaced by line contact of the hardened rollers. Consequently, they are considerably stiffer and need less preload, which reduces friction and allows smoother running. Crossed roller guides are also distinguished by high guiding accuracy and load capacity. Force-guided rolling element cages prevent cage creep.

Drive types

- 2-phase stepper motor for high torque even at low velocities and higher resolution
- DC motor for high velocity constancy, low vibration, and high velocities

Other travel ranges on request.

Applications

- Biotechnology
- Laser Cutting
- Laser Marking
- Medical Industry
- Metrology / Testing

>> Incremental Encoder

Technology Glossary ..... page 290

Stages with DC motor	L-731.093111 / L-731.093112 / L-731.093132	Unit	Tolerance
Motion			
Active axes	X, Y		
Travel range	205 × 205	mm	
Angular error xry (pitch)	±50	µrad	typ.
Angular error xrz (yaw)	±30	µrad	typ.
Angular error yrx (pitch)	±40	µrad	typ.
Angular error yrz (yaw)	±30	µrad	typ.
Straightness / flatness	±2	µm	typ.
Orthogonality	±96.963	µrad	typ.
Velocity	L-731.093111 / L-731.093112: 50 L-731.093132: 90	mm/s	max.

Stages with DC motor	L-731.093111	L-731.093112	L-731.093132	Unit	Tolerance
Positioning					
Integrated sensor	Incremental linear encoder	Incremental linear encoder	Incremental rotary encoder		
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period	A/B quadrature, TTL	A/B quadrature, TTL		
Design resolution	0.001	0.01	0.1	µm	
Sensor resolution rotary encoder	–	–	20000	Cts./rev.	
Minimum incremental motion	0.1	0.5	0.8	µm	typ.
Unidirectional repeatability	0.1	0.5	0.8	µm	typ.
Bidirectional repeatability	±0.5	±0.5	±2.5	µm	typ.
Reference point switch repeatability	<1	<1	<1	µm	typ.
Reference and limit switches	Optical	Optical	Optical		

Stages with DC motor	L-731.093xxx	Unit	Tolerance
Mechanical properties			
Drive screw type	Ball screw		
Drive screw pitch	2	mm	
Guide type	Crossed roller guide with anti-creep system		
Load capacity	200	N	max.
Permissible torque M_x in θ_X	125	N·m	max.
Permissible torque M_y in θ_Y	125	N·m	max.
Permissible torque M_z in θ_Z	125	N·m	max.
Drive properties			
Motor type	DC motor		
Operating voltage, nominal	24	V	nom.
Operating voltage, max.	48	V	max.

Stages with DC motor	L-731.093111	L-731.093112 / L-731.093132	Unit	Tolerance
Miscellaneous				
Operating temperature range	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized	Aluminum, black anodized		
Mass	16	16	kg	±5 %
Moved mass in X, unloaded	12	12	kg	±5 %
Moved mass in Y, unloaded	3.5	3.5	kg	±5 %
Connection	2 × HD Sub-D 26 (m) (motor) 2 × Sub-D 15 (f) (sensor)	2 × HD Sub-D 26 (m) (motor/sensor)		
Recommended controllers / drivers	SMC Hydra (double axis) C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller		

Stages with stepper motor	L-731.40SD / L-731.44SD / L-731.4ASD	Unit	Tolerance
Motion			
Active axes	X, Y		
Travel range	205 × 205	mm	
Angular error xry (pitch)	±50	µrad	typ.
Angular error xrz (yaw)	±30	µrad	typ.
Angular error yrx (pitch)	±40	µrad	typ.
Angular error yrz (yaw)	±30	µrad	typ.
Straightness / flatness	±2	µm	typ.
Orthogonality	±96.963	µrad	typ.
Velocity	45	mm/s	max.

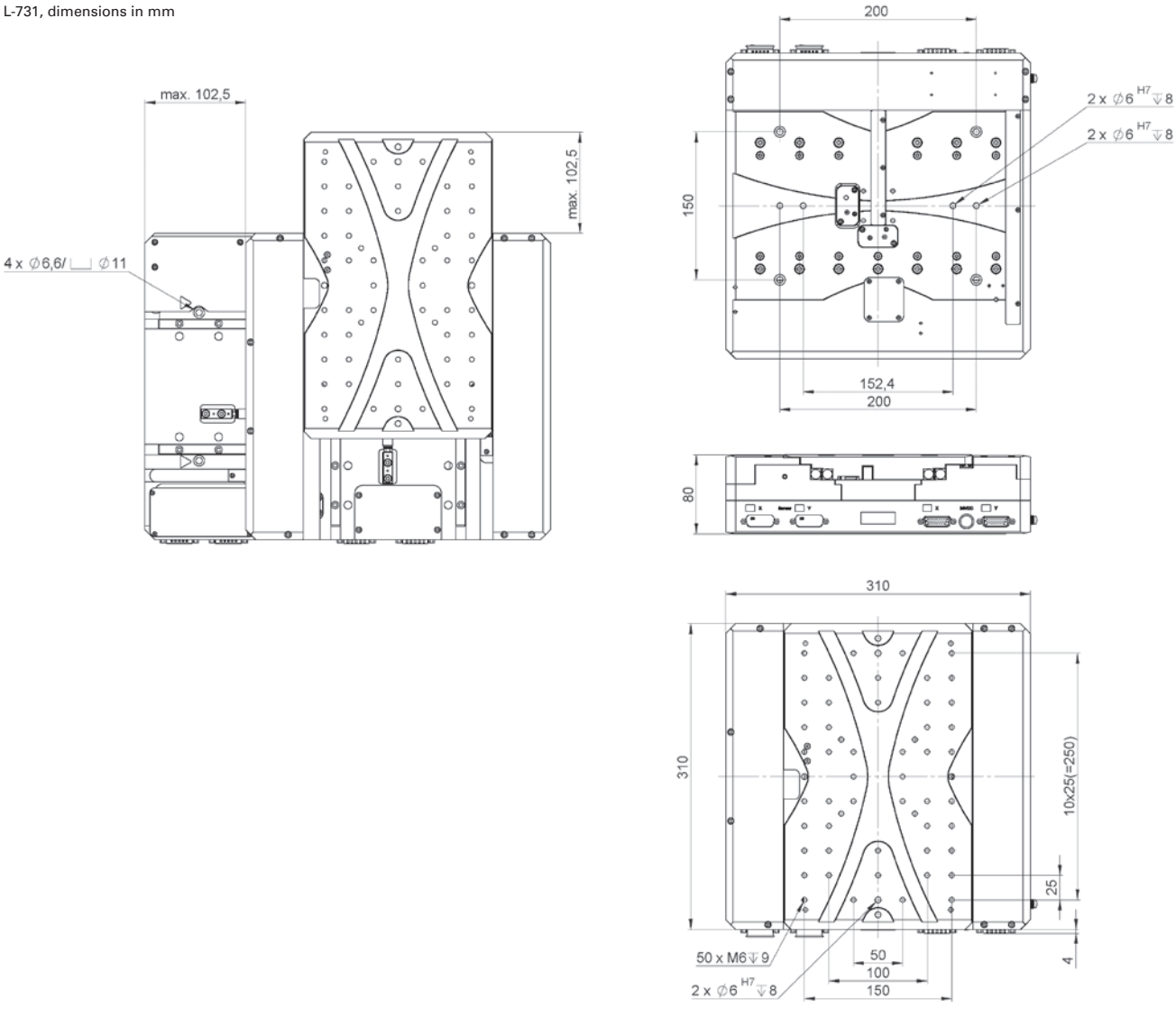
Stages with stepper motor	L-731.40SD	L-731.44SD	L-731.4ASD	Unit	Tolerance
Positioning					
Integrated sensor	–	Incremental linear encoder	Incremental linear encoder		
Sensor signal	–	A/B quadrature, TTL	Sin/cos, 1 V peak-peak, 20 µm signal period		
Design resolution	10.0	0.01	0.001	µm	
Minimum incremental motion	1	0.05	0.05	µm	typ.
Unidirectional repeatability	1	0.05	0.05	µm	typ.
Bidirectional repeatability	±2.5	±0.5	±0.5	µm	typ.
Reference and limit switches	Optical	Optical	Optical		

Stages with stepper motor	L-731.4xSD	Unit	Tolerance
Mechanical properties			
Drive screw type	Ball screw		
Drive screw pitch	2	mm	
Guide type	Crossed roller guide with anti-creep system		
Load capacity	200	N	max.
Permissible torque M_x in θ_X	125	N·m	max.
Permissible torque M_y in θ_Y	125	N·m	max.
Permissible torque M_z in θ_Z	125	N·m	max.
Drive properties			
Motor type	Stepper motor, 2-phase		
Operating voltage, nominal	24	V	nom.
Operating voltage, max.	48	V	max.
Stepper motor	200	Full steps/ rev.	

Stages with stepper motor	L-731.40SD / L-731.44SD	L-731.4ASD	Unit	Tolerance
Miscellaneous				
Operating temperature range	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized	Aluminum, black anodized		
Mass	15.5	15.5	kg	±5 %
Moved mass in X, unloaded	12	12	kg	±5 %
Moved mass in Y, unloaded	3.5	3.5	kg	±5 %
Connection	L-731.40SD: 2 × HD Sub-D 26 (m) (motor) L-731.44SD: 2 × HD Sub-D 26 (m) (motor/sensor)	2 × HD Sub-D 26 (m) (motor) 2 × Sub-D 15 (f) (sensor)		
Recommended controllers / drivers	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	SMC Hydra (double axis) ACS modular controller		

All cables required for operation with the ordered controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

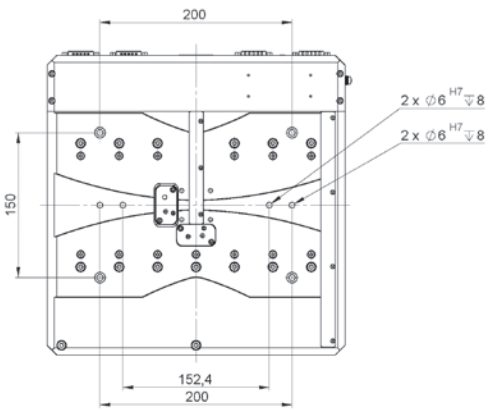
L-731, dimensions in mm



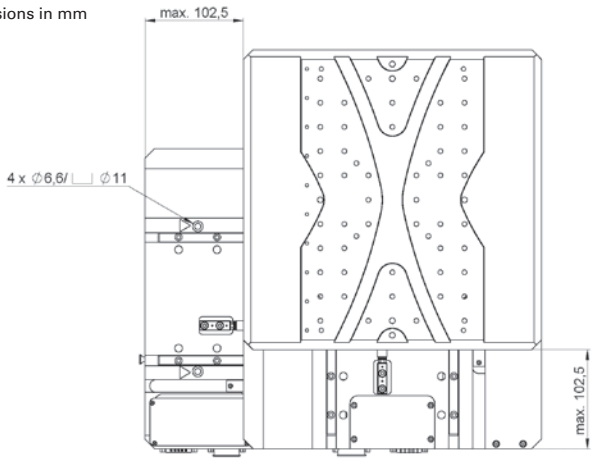
V-731 PIMag® High-Precision XY Stage

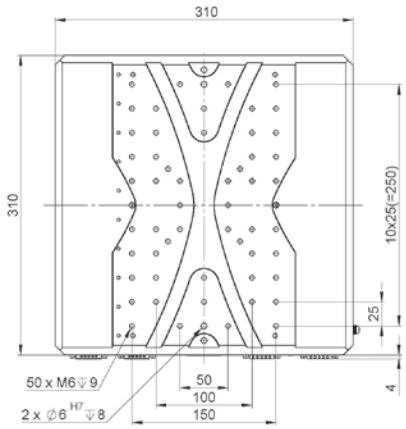
High Travel Accuracy and Stability, Magnetic Direct Drive

- Travel range 205 mm × 205 mm (8″)
- Unidirectional repeatability to 0.1 µm
- Ironless 3-phase linear motor
- Velocity to 200 mm/s
- Incremental linear encoder with 1 nm resolution
- Crossed roller guides, anti-creep



V-731, dimensions in mm





Applications

- Automated Optical Inspection (AOI)
- Biotechnology
- Laser Cutting
- Laser Marking
- Medical Industry
- Metrology / Testing
- Scanning

>> Incremental Encoder
>> PIMag® Magnetic Linear Motors

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	V-731.096111	Unit	Tolerance
Motion and positioning			
Active axes	X, Y		
Travel range	205 × 205	mm	
Integrated sensor	Incremental linear encoder		
Design resolution	0.001	µm	
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period		
Minimum incremental motion	0.02	µm	typ.
Unidirectional repeatability	0.1	µm	typ.
Bidirectional repeatability	±0.25	µm	typ.
Angular error xry (pitch)	±50	µrad	typ.
Angular error xrz (yaw)	±30	µrad	typ.
Angular error yrx (pitch)	±40	µrad	typ.
Angular error yrz (yaw)	±30	µrad	typ.
Orthogonality	±96.963	µrad	typ.
Straightness / flatness	±2	µm	typ.
Velocity	200	mm/s	max.
Acceleration in X, without load	5	m/s²	max.
Acceleration in Y, without load	15	m/s²	max.
Reference and limit switches	Optical		
Mechanical properties			
Load capacity	50	N	max.
Permissible torque in θ_X, θ_Y	125	N·m	max.
Permissible torque in θ_Z	125	N·m	max.
Guide	Crossed roller guide with anti-creep system		
Drive properties			
Motor type	Ironless 3-phase linear motor		
Operating voltage, nominal	48	V	nom.
Operating voltage, max.	48	V	max.
Peak force	80	N	max.
Nominal force	29	N	typ.
Peak current, effective	5	A	typ.
Nominal current, effective	1.5	A	typ.
Force constant, effective	19.9	N/A	typ.
Motor constant	4.89	N/√W	typ.
Electrical time constant	0.4	ms	
Resistance phase-phase	11	Ω	typ.
Inductance phase-phase	3.6	mH	typ.
Back EMF phase-phase	16	V·s/m	max.
Pole pitch N-N	30	mm	
Miscellaneous			
Operating temperature range	5 to 40	°C	
Material	Aluminum, black anodized		
Moved mass in X	15.4	kg	±5 %
Moved mass in Y	5.6	kg	±5 %
Overall mass	19.4	kg	±5 %
MTBF	20000	h	
Connection	2 × HD Sub-D 26 (m) (motor) 2 × Sub-D 15 (f) (sensor)		
Recommended controller	SMC Hydra (double axis) C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller		

All cables required for operation with the ordered controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

L-741 Precision XY Stage

High Travel Accuracy and Stability, 305 × 305 mm Travel Range

- Travel range 305 mm × 305 mm (12")
- Unidirectional repeatability to 0.05 µm
- Velocity to 90 mm/s
- 2-phase stepper motors or DC motors
- Incremental linear encoder with 1 nm resolution
- Rotary encoder with 20000 impulses/revolution
- Crossed roller guide, anti-creep

Highly accurate position measuring with incremental linear encoder

Noncontact optical linear encoders measure the actual position directly at the motion platform with the greatest accuracy so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring. Optical limit and reference point switches.

Crossed roller guide

With crossed roller guides, the point contact of the balls in ball guides is replaced by line contact of the hardened rollers. Consequently, they are considerably stiffer and need less preload, which reduces friction and allows smoother running. Crossed roller guides are also distinguished by high guiding accuracy and load capacity. Force-guided rolling element cages prevent cage creep.

Drive types

- 2-phase stepper motor for high torque even at low velocities and higher resolution
- DC motor for high velocity constancy, low vibration, and high velocities

Other travel ranges on request.

Applications

- Biotechnology
- Laser Cutting
- Laser Marking
- Medical Industry
- Metrology / Testing

>> Incremental Encoder

Technology Glossary ..... page 290

Stages with DC motor	L-741.133111 / L-741.133112 / L-741.133132	Unit	Tolerance
Motion			
Active axes	X, Y		
Travel range	305 × 305	mm	
Angular error xry (pitch)	±60	µrad	typ.
Angular error xrz (yaw)	±40	µrad	typ.
Angular error yrx (pitch)	±60	µrad	typ.
Angular error yrz (yaw)	±40	µrad	typ.
Straightness / flatness	±4	µm	typ.
Orthogonality	±96.963	µrad	typ.
Velocity	L-741.133111 / L-741.133112: 50 L-741.133132: 90	mm/s	max.

Stages with DC motor	L-741.133111	L-741.133112	L-741.133132	Unit	Tolerance
Positioning					
Integrated sensor	Incremental linear encoder	Incremental linear encoder	Incremental rotary encoder		
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period	A/B quadrature, TTL	A/B quadrature, TTL		
Design resolution	0.001	0.01	0.1	µm	
Sensor resolution rotary encoder	–	–	20000	Cts./rev.	
Minimum incremental motion	0.1	0.5	0.8	µm	typ.
Unidirectional repeatability	0.1	0.5	0.8	µm	typ.
Bidirectional repeatability	±0.5	±0.5	±2.5	µm	typ.
Reference point switch repeatability	<1	<1	<1	µm	typ.
Reference and limit switches	Optical	Optical	Optical		

Stages with DC motor	L-741.133xxx	Unit	Tolerance
Mechanical properties			
Drive screw type	Ball screw		
Drive screw pitch	2	mm	
Guide type	Crossed roller guide with anti-creep system		
Load capacity	200	N	max.
Permissible torque M_x in θ_X	125	N·m	max.
Permissible torque M_y in θ_Y	125	N·m	max.
Permissible torque M_z in θ_Z	125	N·m	max.
Drive properties			
Motor type	DC motor		
Operating voltage, nominal	24	V	nom.
Operating voltage, max.	48	V	max.

Stages with DC motor	L-741.133111	L-741.133112 / L-741.133132	Unit	Tolerance
Miscellaneous				
Operating temperature range	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized	Aluminum, black anodized		
Mass	28	28	kg	±5 %
Moved mass in X, unloaded	20.2	20.2	kg	±5 %
Moved mass in Y, unloaded	6.1	6.1	kg	±5 %
Connection	2 × HD Sub-D 26 (m) (motor) 2 × Sub-D 15 (f) (sensor)	2 × HD Sub-D 26 (m) (motor/sensor)		
Recommended controllers / drivers	SMC Hydra (double axis) C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller		

Stages with stepper motor	L-741.131100 / L-741.131111 / L-741.131112	Unit	Tolerance
Motion			
Active axes	X, Y		
Travel range	305 × 305	mm	
Angular error xry (pitch)	±60	µrad	typ.
Angular error xrz (yaw)	±40	µrad	typ.
Angular error yrx (pitch)	±60	µrad	typ.
Angular error yrz (yaw)	±40	µrad	typ.
Straightness / flatness	±4	µm	typ.
Orthogonality	±96.963	µrad	typ.
Velocity	45	mm/s	max.

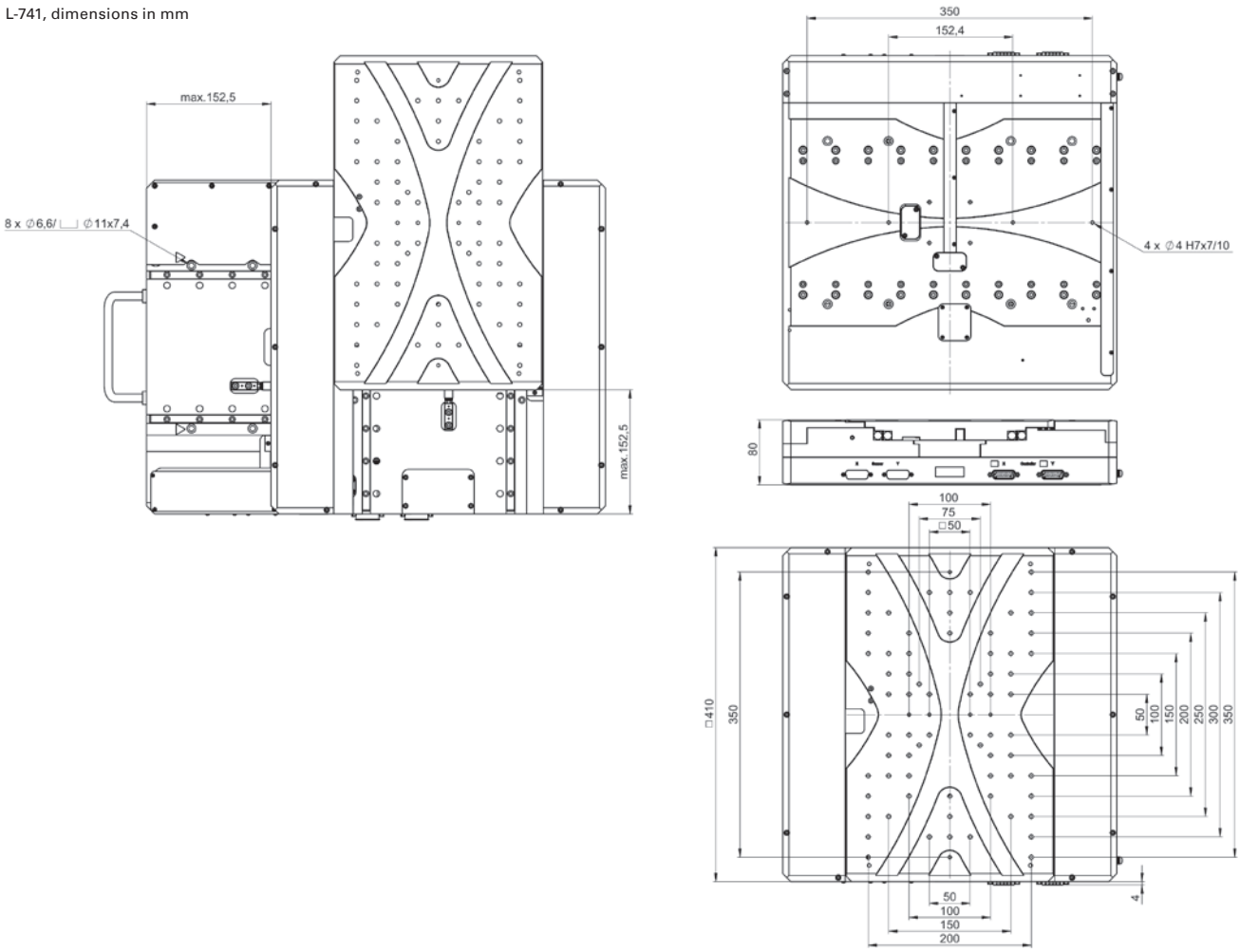
Stages with stepper motor	L-741.131100	L-741.131111	L-741.131112	Unit	Tolerance
Positioning					
Integrated sensor	–	Incremental linear encoder	Incremental linear encoder		
Sensor signal	–	Sin/cos, 1 V peak-peak, 20 µm signal period	A/B quadrature, TTL		
Design resolution	10.0	0.001	0.01	µm	
Sensor resolution rotary encoder	–	–	–	Cts./rev.	
Sensor resolution linear encoder	–	0.001	0.01	µm	
Minimum incremental motion	1	0.05	0.05	µm	typ.
Unidirectional repeatability	1	0.05	0.05	µm	typ.
Bidirectional repeatability	±2.5	±0.5	±0.5	µm	typ.
Reference point switch repeatability	<1	<1	<1	µm	typ.
Reference and limit switches	Optical	Optical	Optical		

Stages with stepper motor	L-741.131xxx	Unit	Tolerance
Mechanical properties			
Drive screw type	Ball screw		
Drive screw pitch	2	mm	
Guide type	Crossed roller guide with anti-creep system		
Load capacity	200	N	max.
Permissible torque M_x in θ_X	125	N·m	max.
Permissible torque M_y in θ_Y	125	N·m	max.
Permissible torque M_z in θ_Z	125	N·m	max.
Drive properties			
Motor type	Stepper motor, 2-phase		
Operating voltage, nominal	24	V	nom.
Operating voltage, max.	48	V	max.
Step resolution	200	Full steps/rev.	

Stages with stepper motor	L-741.131100 / L-741.131112	L-741.131111	Unit	Tolerance
Miscellaneous				
Operating temperature range	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized	Aluminum, black anodized		
Mass	27.5	27.5	kg	±5 %
Moved mass in X, unloaded	19.9	19.9	kg	±5 %
Moved mass in Y, unloaded	6.1	6.1	kg	±5 %
Connection	L-741.131100. 2 × HD Sub-D 26 (m) (motor) L-741.131112. 2 × HD Sub-D 26 (m) (motor/sensor)	2 × HD Sub-D 26 (m) (motor) 2 × Sub-D 15 (f) (sensor)		
Recommended controllers / drivers	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	SMC Hydra (double axis) ACS modular controller		

All cables required for operation with the ordered controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

L-741, dimensions in mm

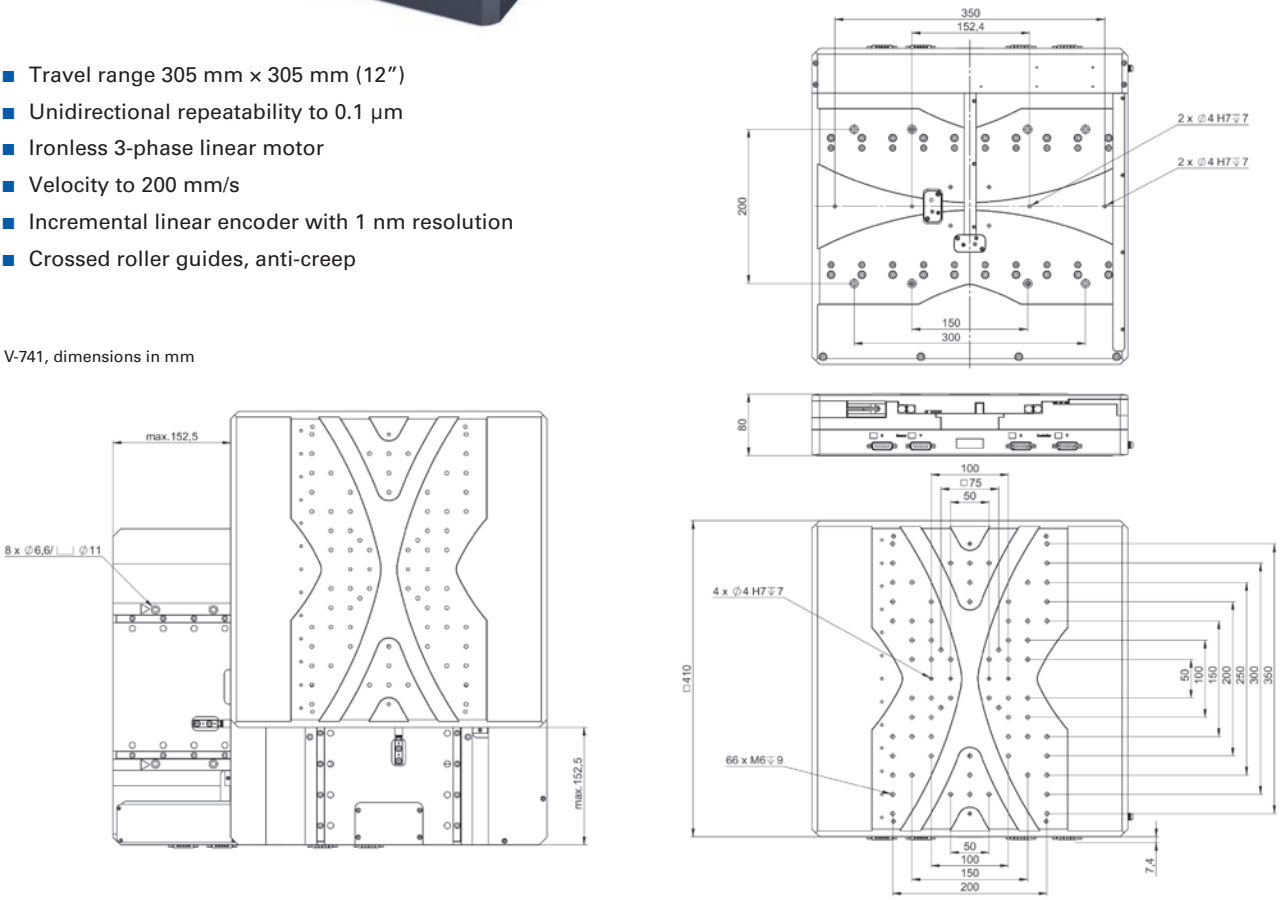


V-741 PIMag® High-Precision XY Stage

High Travel Accuracy and Stability, 305 mm × 305 mm Travel Range, Magnetic Direct Drive

- Travel range 305 mm × 305 mm (12″)
- Unidirectional repeatability to 0.1 µm
- Ironless 3-phase linear motor
- Velocity to 200 mm/s
- Incremental linear encoder with 1 nm resolution
- Crossed roller guides, anti-creep

V-741, dimensions in mm



Applications

- Automated Optical Inspection (AOI)
- Biotechnology
- Laser Cutting
- Laser Marking
- Medical Industry
- Metrology / Testing
- Scanning

>> Linear Encoder
>> PIMag® Magnetic Linear Motors

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	V-741.136111	Unit	Tolerance
Motion and positioning			
Active axes	X, Y		
Travel range	305 × 305	mm	
Integrated sensor	Incremental linear encoder		
Design resolution	0.001	µm	
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period		
Minimum incremental motion	0.02	µm	typ.
Unidirectional repeatability	0.1	µm	typ.
Bidirectional repeatability	±0.25	µm	typ.
Angular error xry (pitch)	±70	µrad	typ.
Angular error xrz (yaw)	±50	µrad	typ.
Angular error yrx (pitch)	±60	µrad	typ.
Angular error yrz (yaw)	±50	µrad	typ.
Orthogonality	±96.963	µrad	typ.
Straightness / flatness	±3	µm	typ.
Velocity	200	mm/s	max.
Acceleration in X, without load	3	m/s²	max.
Acceleration in Y, without load	9	m/s²	max.
Reference and limit switches	Optical		
Mechanical properties			
Load capacity	50	N	max.
Permissible torque in θ_X, θ_Y	125	N·m	max.
Permissible torque in θ_Z	125	N·m	max.
Guide	Crossed roller guide with anti-creep system		
Drive properties			
Motor type	Ironless 3-phase linear motor		
Operating voltage, nominal	48	V	nom.
Operating voltage, max.	48	V	max.
Peak force	80	N	max.
Nominal force	29	N	typ.
Peak current, effective	5	A	typ.
Nominal current, effective	1.5	A	typ.
Force constant, effective	19.9	N/A	typ.
Motor constant	4.89	N/√W	typ.
Electrical time constant	0.4	ms	
Resistance phase-phase	11	Ω	typ.
Inductance phase-phase	3.6	mH	typ.
Back EMF phase-phase	16	V·s/m	max.
Pole pitch N-N	30	mm	
Miscellaneous			
Operating temperature range	5 to 40	°C	
Material	Aluminum, black anodized		
Moved mass in X	25.5	kg	±5 %
Moved mass in Y	9.2	kg	±5 %
Overall mass	33	kg	±5 %
MTBF	20000	h	
Connection	2 × HD Sub-D 26 (m) (motor) 2 × Sub-D 15 (f) (sensor)		
Recommended controller	SMC Hydra (double axis) C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller		

All cables required for operation with the ordered controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

L-738 Precision XY Stage

Clear Aperture, High Travel Accuracy, and Stability

- Travel range 102 mm × 102 mm (4″)
- Large aperture, 150 mm × 150 mm
- Unidirectional repeatability to 0.05 µm
- Velocity to 90 mm/s
- 2-phase stepper motors, DC motors
- Incremental linear encoder with 1 nm resolution

Highly accurate position measuring with incremental linear encoder

Noncontact optical linear encoders measure the actual position directly at the motion platform with the greatest accuracy so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring. Optical reference points and limit switches.

Recirculating ball bearings

When carefully assembled, recirculating ball bearings are distinguished by a beneficial combination of high load capacity, lifetime, maintenance-free operation, and guiding accuracy. The moving part of the stages is supported by four preloaded linear ball bearing units which run on two guide rails. Each bearing unit is made up of two independent rows of circulating ball bearings.

Drive types

- 2-phase stepper motor for high torque even at low velocities and higher resolution
- DC motor for high velocity constancy, low vibration, and high velocities

Applications

- Biotechnology
- Laser Cutting
- Laser Marking
- Medical Industry
- Metrology / Testing

>> Incremental Encoder

Technology Glossary ..... page 290

Stages with DC motor	L-738.053111 / L-738.053112 / L-738.053132	Unit	Tolerance
Motion			
Active axes	X, Y		
Travel range	102 × 102	mm	
Angular error xry (pitch)	±40	µrad	typ.
Angular error xrz (yaw)	±20	µrad	typ.
Angular error yrx (pitch)	±40	µrad	typ.
Angular error yrz (yaw)	±20	µrad	typ.
Straightness / flatness	±2	µm	typ.
Orthogonality	±96.963	µrad	typ.
Velocity	L-738.053111 / L-738.053112: 50 L-738.053132: 90	mm/s	max.

Stages with DC motor	L-738.053111	L-738.053112	L-738.053132	Unit	Tolerance
Positioning					
Integrated sensor	Incremental linear encoder	Incremental linear encoder	Incremental rotary encoder		
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period	A/B quadrature, TTL	A/B quadrature, TTL		
Design resolution	0.001	0.01	0.1	µm	
Sensor resolution rotary encoder	–	–	20000	Cts./rev.	
Minimum incremental motion	0.1	0.1	0.4	µm	typ.
Unidirectional repeatability	0.1	0.1	0.4	µm	typ.
Bidirectional repeatability	±0.5	±0.5	±2	µm	typ.
Reference point switch repeatability	<1	<1	<1	µm	typ.
Reference and limit switches	Optical	Optical	Optical		

Stages with DC motor	L-738.053xxx	Unit	Tolerance
Mechanical properties			
Drive screw type	Ball screw		
Drive screw pitch	2	mm	
Guide type	Recirculating ball bearing		
Holding force, power off	20	N	typ.
Push/pull force F_x, F_y power on	100	N	max.
Load capacity	200	N	max.
Permissible torque M_x in θ_X	130	N·m	max.
Permissible torque M_y in θ_Y	130	N·m	max.
Permissible torque M_z in θ_Z	90	N·m	max.
Drive properties			
Motor type	DC motor		
Operating voltage, nominal	24	V	nom.
Operating voltage, max.	48	V	max.

Stages with DC motor	L-738.053111	L-738.053112 / L-738.053132	Unit	Tolerance
Miscellaneous				
Operating temperature range	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized	Aluminum, black anodized		
Mass	24	24	kg	±5 %
Moved mass in X, unloaded	14.6	14.6	kg	±5 %
Moved mass in Y, unloaded	5.8	5.8	kg	±5 %
Connection	2 × HD Sub-D 26 (m) (motor) 2 × Sub-D 15 (f) (sensor)	2 × HD Sub-D 26 (m) (motor/sensor)		
Recommended controllers / drivers	SMC Hydra (double axis) C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller		

Stages with stepper motor	L-738.051100 / L-738.051111 / L-738.051112	Unit	Tolerance
Motion			
Active axes	X, Y		
Travel range	102 × 102	mm	
Angular error xry (pitch)	±40	µrad	typ.
Angular error xrz (yaw)	±20	µrad	typ.
Angular error yrx (pitch)	±40	µrad	typ.
Angular error yrz (yaw)	±20	µrad	typ.
Straightness / flatness	±2	µm	typ.
Orthogonality	±96.963	µrad	typ.
Velocity	35	mm/s	max.

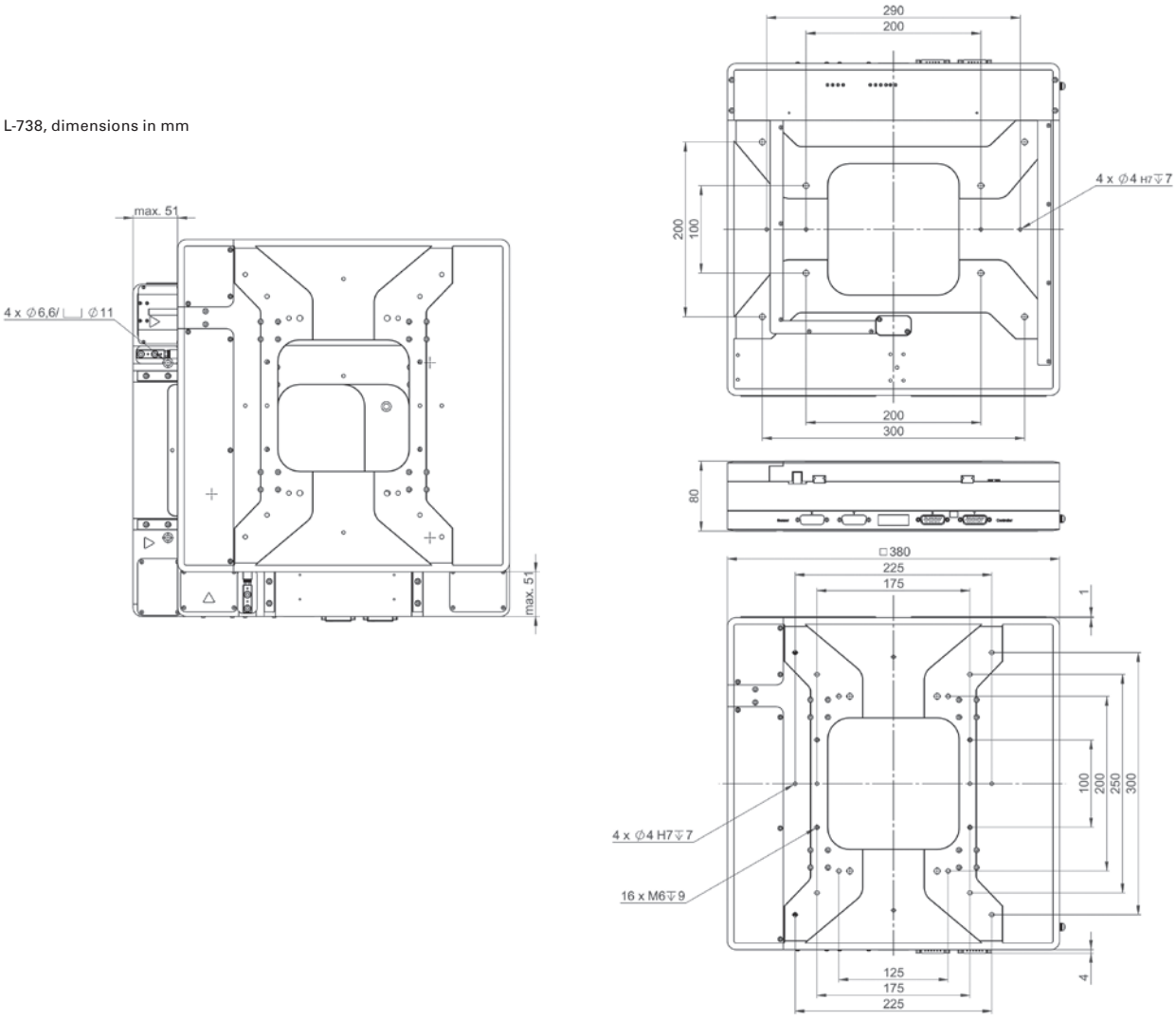
Stages with stepper motor	L-738.051100	L-738.051111	L-738.051112	Unit	Tolerance
Positioning					
Integrated sensor	–	Incremental linear encoder	Incremental linear encoder		
Sensor signal	–	Sin/cos, 1 V peak-peak, 20 µm signal period	A/B quadrature, TTL		
Design resolution	10.0	0.001	0.01	µm	
Minimum incremental motion	0.2	0.05	0.05	µm	typ.
Unidirectional repeatability	0.2	0.05	0.05	µm	typ.
Bidirectional repeatability	±2	±0.5	±0.5	µm	typ.
Reference point switch repeatability	<1	<1	<1	µm	typ.
Reference and limit switches	Optical	Optical	Optical		

Stages with stepper motor	L-738.051xxx	Unit	Tolerance
Mechanical properties			
Drive screw type	Ball screw		
Drive screw pitch	2	mm	
Guide type	Recirculating ball bearing		
Holding force, power off	60	N	typ.
Push/pull force F_X, F_Y power on	100	N	max.
Load capacity	200	N	max.
Permissible torque M_x in θ_X	130	N·m	max.
Permissible torque M_y in θ_Y	130	N·m	max.
Permissible torque M_z in θ_Z	90	N·m	max.
Drive properties			
Motor type	Stepper motor, 2-phase		
Operating voltage, nominal	24	V	nom.
Operating voltage, max.	48	V	max.
Step resolution	200	Full steps/rev.	

Stages with stepper motor	L-738.051100	L-738.051111	L-738.051112	Unit	Tolerance
Miscellaneous					
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized	Aluminum, b lack anodized	Aluminum, black anodized		
Mass	22	22	22	kg	±5 %
Moved mass in X, unloaded	13.8	13.8	13.8	kg	±5 %
Moved mass inY, unloaded	5.8	5.8	5.8	kg	±5 %
Connection	2 × HD Sub-D 26 (m) (motor)	2 × HD Sub-D 26 (m) (motor) 2 × Sub-D 15 (f) (sensor)	2 × HD Sub-D 26 (m) (motor/ sensor)		
Recommended controllers / drivers	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	SMC Hydra (double axis) ACS modular controller	C-663.12 (single axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

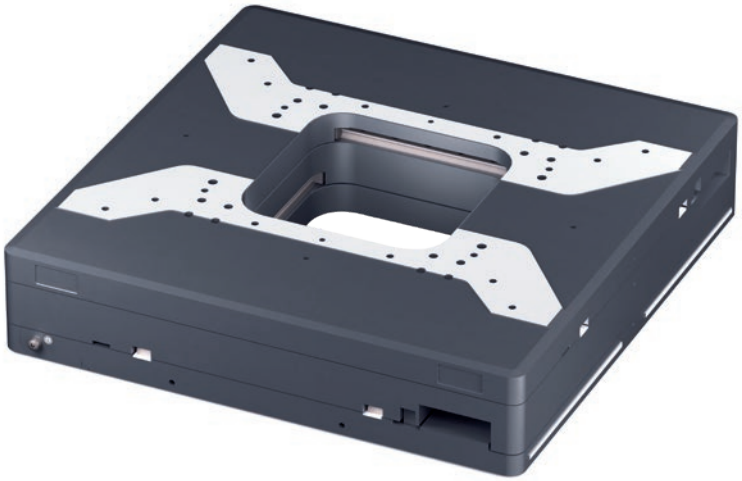
All cables required for operation with the ordered controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

L-738, dimensions in mm



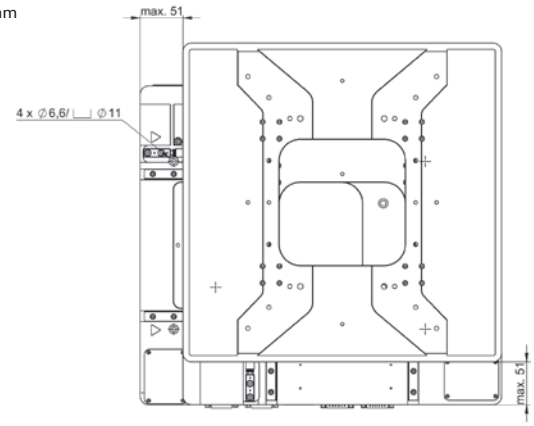
V-738 PIMag® High-Precision XY Stage

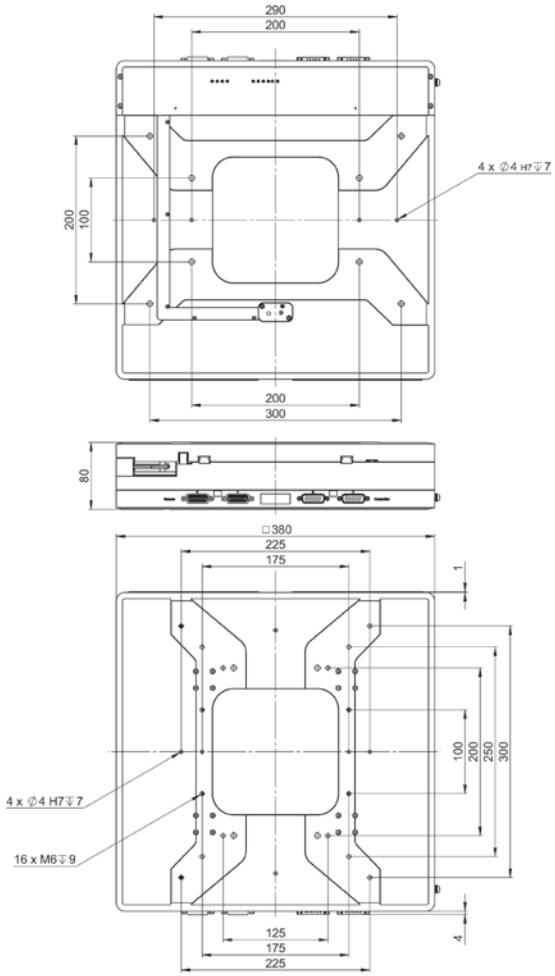
Clear Aperture, High Travel Accuracy and Stability, Magnetic Direct Drive



- Travel range 102 mm × 102 mm (4")
- Large aperture, 150 mm × 150 mm
- Unidirectional repeatability to 0.1 µm
- Velocity to 500 mm/s
- Ironless 3-phase linear motor
- Incremental linear encoder with 1 nm resolution

V-738, dimensions in mm





Applications

- Automated Optical Inspection (AOI)
- Biotechnology
- Laser Cutting
- Laser Marking
- Medical Industry
- Metrology / Testing
- Scanning

>> Incremental Encoder
>> PIMag® Magnetic Linear Motors

Technology Glossary ..... page 290

	V-738.056111	Unit	Tolerance
Motion and positioning			
Travel range	102 × 102	mm	
Integrated sensor	Incremental linear encoder		
Design resolution	0.001	µm	
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period		
Minimum incremental motion	0.02	µm	typ.
Unidirectional repeatability	0.1	µm	typ.
Bidirectional repeatability	±0.25	µm	typ.
Angular error xry (pitch)	±40	µrad	typ.
Angular error xrz (yaw)	±20	µrad	typ.
Angular error yrx (pitch)	±40	µrad	typ.
Angular error yrz (yaw)	±20	µrad	typ.
Straightness / flatness	±2	µm	typ.
Orthogonality	±96.963	µrad	typ.
Velocity	500	mm/s	max.
Acceleration in X, Y, without load	10	m/s^2	max.
Reference and limit switches	Optical		
Mechanical properties			
Load capacity	100	N	max.
Permissible torque in θ_X, θ_Y	130	N·m	max.
Permissible torque in θ_Z	90	N·m	max.
Guide	Recirculating ball bearing		
Drive properties			
Motor type	Ironless 3-phase linear motor		
Operating voltage, nominal	48	V	nom.
Operating voltage, max.	48	V	max.
Peak force	200	N	max.
Nominal force	87	N	typ.
Peak current, effective	15	A	typ.
Nominal current, effective	4.4	A	typ.
Motor constant	71	N/√W	typ.
Electrical time constant	0.4	ms	
Resistance phase-phase	3.6	Ω	typ.
Inductance phase-phase	1.2	mH	typ.
Back EMF phase-phase	16	V·s/m	max.
Pole pitch N-N	30	mm	
Miscellaneous			
Operating temperature range	5 to 40	°C	
Material	Aluminum, black anodized		
Moved mass in X, unloaded	16.8	kg	±5 %
Moved mass in Y, unloaded	8	kg	±5 %
Overall mass	24	kg	±5 %
Connection	2 × HD Sub-D 26 (m) (motor) 2 × Sub-D 15 (f) (sensor)	h	
Recommended controller	SMC Hydra (double axis) C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller		

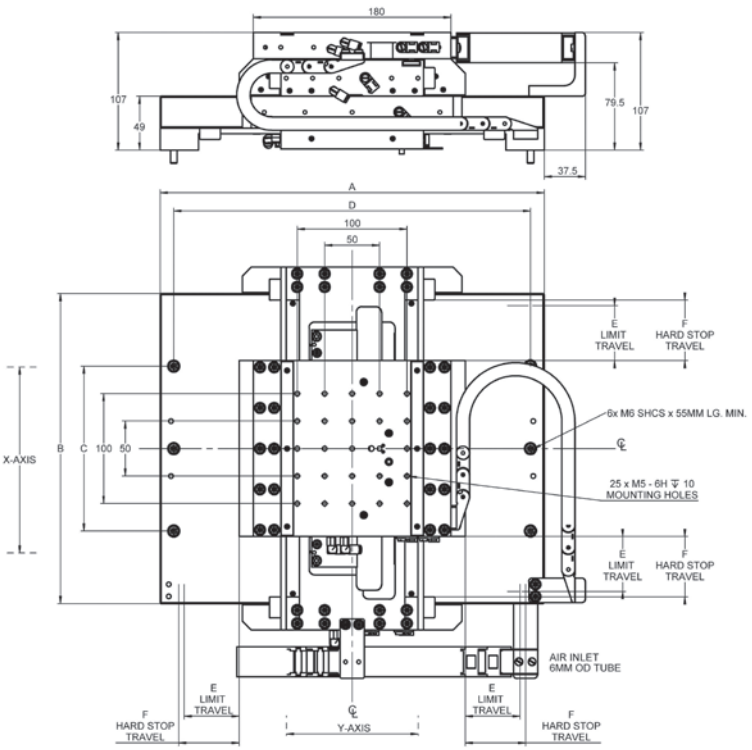
All cables required for operation with the ordered controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

A-311 Plglide IS Planar Scanner with Air Bearing

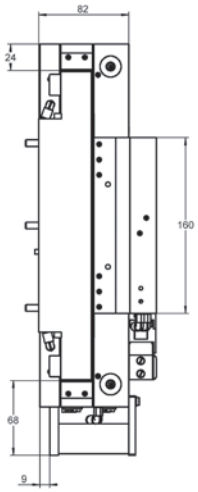
High-Performance, Compact XY Nanopositioning System

- Ideal for scanning applications or high-precision positioning
- Cleanroom compatible
- Travel ranges to 200 mm × 200 mm
- Load capacity to 147 N
- Low profile
- Resolution to 1 nm
- Optional granite base plates

A-311.xxx, dimensions in mm



	A	B	C	D	E	F
A-311.Dxx	300	232	100	275	25	30
A-311.Axx	350	282	150	325	50	55
A-311.Bxx	400	332	200	375	75	80
A-311.Cxx	450	382	250	425	100	105



Applications

- Electronics Manufacturing
- Laser Marking
- Scanning
- Scientific Instrumentation
- Semiconductor

>> Absolute Encoder
>> Incremental Encoder
>> Plglide Air Bearing Technology
>> PIMag® Magnetic Linear Motors

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	A-311.Dxx	A-311.Axx	A-311.Bxx	A-311.Cxx	Unit	Tolerance
Motion						
Travel range	50 × 50	100 × 100	150 × 150	200 × 200	mm	
Pitch [1]	20	30	40	50	µrad	max.
Yaw [1]	5	10	15	20	µrad	max.
Straightness [1]	±0.25	±0.25	±0.5	±0.5	µm	max.
Straightness per 10 mm travel range [1]	±10	±10	±10	±10	nm	max.
Flatness [1]	±0.5	±0.5	±1	±1	µm	max.
Flatness per 10 mm travel range [1]	±10	±10	±10	±10	nm	max.
XY orthogonality	25	25	25	25	µrad	max.
Velocity, unloaded [2]	2	2	2	2	m/s	max.
Acceleration of the upper axis, unloaded [2]	27.5	27.5	27.5	27.5	m/s²	max.
Acceleration of the lower axis, unloaded [2]	15	13	11	10	m/s²	max.
Mechanical properties						
Load capacity in z [3]	147	147	147	147	N	max.
Moved mass, upper axis	3	3	3	3	kg	
Moved mass, lower axis	5.5	6.5	7.5	8.5	kg	
Overall mass	14.5	18.5	22.5	27.5	kg	

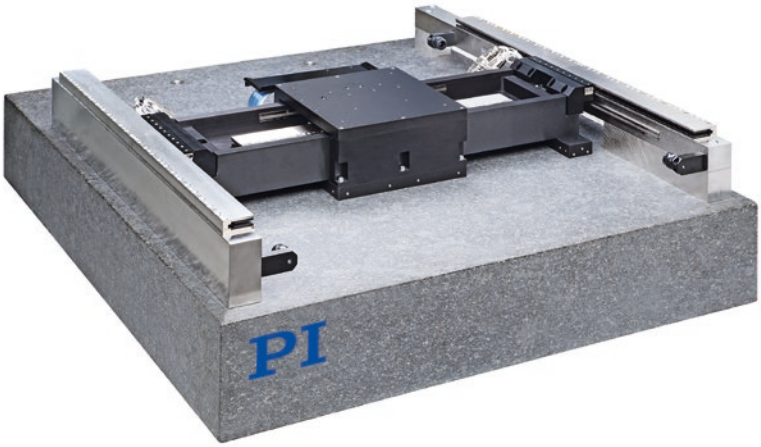
	A-311.xAx	A-311.xBx	A-311.xCx
Positioning			
Integrated sensor	Incremental linear encoder	Absolute encoder	Incremental linear encoder
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period	BiSS-C	A/B quadrature, TTL
Sensor resolution	1.2 nm [4]	1 nm	50 nm
Bidirectional repeatability	±0.05 µm [4]	±0.05 µm	±0.05 µm
Accuracy, uncompensated [5]	A-311.Dxx: ±1 µm A-311.Axx: ±1.5 µm A-311.Bxx: ±2 µm A-311.Cxx: ±2.5 µm	A-311.Axx: ±1.5 µm A-311.Axx: ±1.5 µm A-311.Axx: ±1.5 µm A-311.Axx: ±1.5 µm	A-311.Dxx: ±1 µm A-311.Axx: ±1.5 µm A-311.Bxx: ±2 µm A-311.Cxx: ±2.5 µm
Accuracy, with error compensation [5]	±0.5 µm	±0.5 µm	±0.5 µm

	A-311	Unit	Tolerance
Drive properties			
Drive type	Linear motor, ironless, 3-phase		
Intermediate circuit voltage, effective	48, nominal 80, max.	V DC	
Peak force	85	N	typ.
Nominal force	39	N	typ.
Force constant, effective	12.3	N/A	typ.
Resistance phase-phase	3.6	Ω	
Inductivity phase-phase	1.24	mH	
Back EMF phase-phase	10.1	V·s/m	max.
Cabling	External, movable drag chain		
Miscellaneous			
Operating pressure [6]	60 to 70 psi (415 to 485 kPa)		
Air consumption	<2 SCFM (56 SLPM)		
Air quality	see A-322 datasheet, next page		
Materials	Hardcoat aluminum, stainless steel fasteners		

(1) Dependent on the flatness of the surface, on which the stage is mounted.
(2) Can be limited by the payload, controller or drive.
(3) Assumes payload CG is centered no more than 50 mm above the motion platform. The stage is designed for horizontal operation only.
(4) Assumes 16384x interpolation. Contact PI for the use of other factors.
(5) Improved accuracy can be obtained with controller-based error compensation. The stage must be ordered with a controller from PI to reach these values. Accuracy values assume short-term duration and do not consider the long-term effects of thermal drift on the stage.
(6) To protect the stage against damage, it is recommended to connect an air pressure sensor to the Motion-Stop input of the controller.
All specifications apply per axis, if not otherwise described.

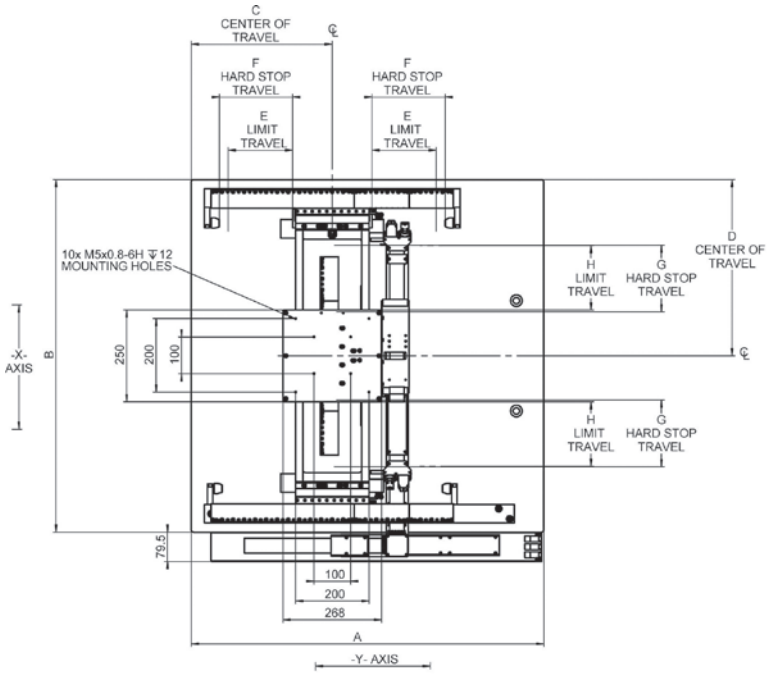
A-322 Plglide HS Planar Scanner with Air Bearing

XY Positioning System with 1 nm Resolution

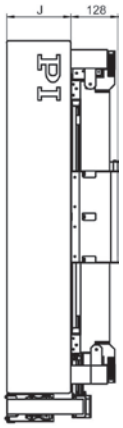


- Ideal for scanning applications or high-precision positioning
- Cleanroom compatible
- Travel ranges to 500 mm × 1000 mm
- Load capacity to 245 N
- Resolution to 1 nm
- Velocity up to 2 m/s

A-322.xxx, dimensions in mm



	A	B	C	D	E	F	G	H	J
A-322.Axx	960	960	348	480	175	200	182	175	175
A-322.Bxx	1110	960	459	480	250	275	182	175	175
A-322.Cxx	1110	1110	459	555	250	275	257	250	250
A-322.Dxx	1610	1110	709	555	500	525	257	250	250



Applications

- Electronics Manufacturing
- Laser Cutting
- Scanning
- Scientific Instrumentation
- Semiconductor

>> Absolute Encoder
>> Plglide Air Bearing Technology
>> PIMag® Magnetic Linear Motors

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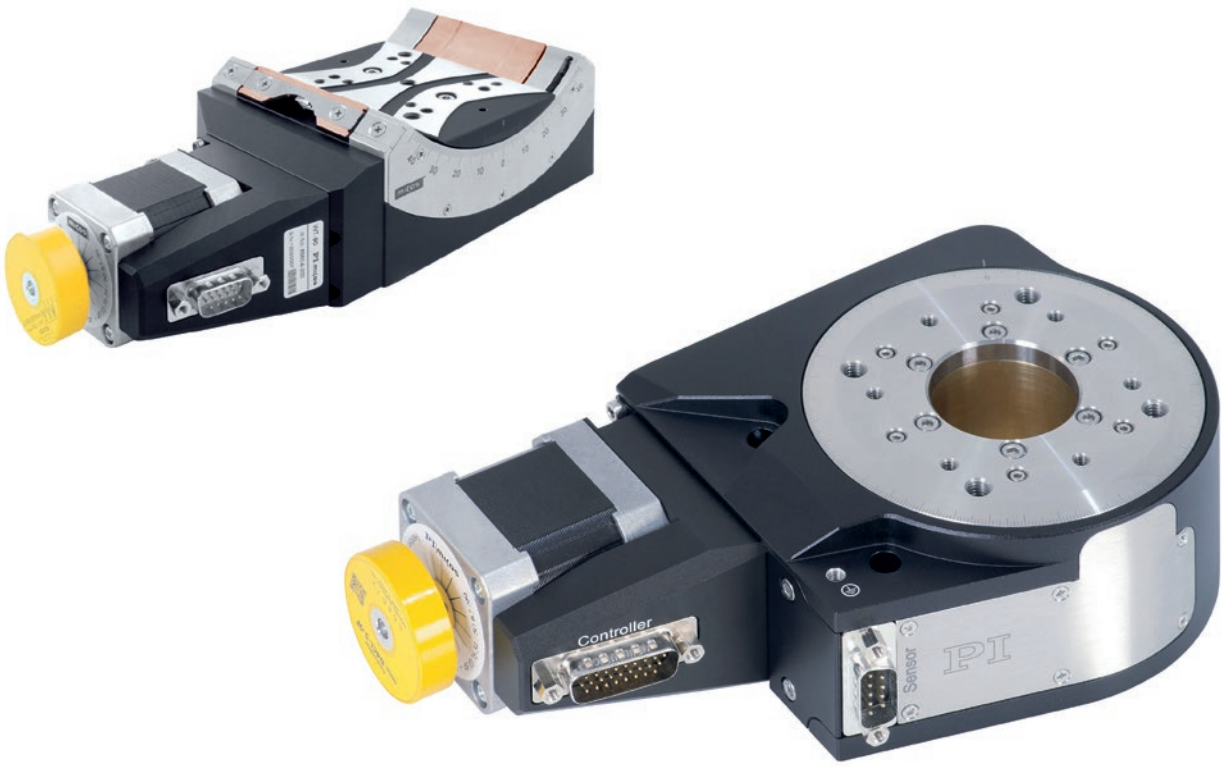
	A-322.Axx	A-322.Bxx	A-322.Cxx	A-322.Dxx	Unit	Tolerance
Motion and positioning						
Active axes	X, Y	X, Y	X, Y	X, Y		
Travel range (bridge axis × gantry axis)	350 × 350	350 × 500	500 × 500	500 × 1000	mm	
Integrated sensors	Absolute Encoders	Absolute Encoders	Absolute Encoders	Absolute Encoders		
Sensor resolution	1	1	1	1	nm	
Bidirectional repeatability	±0.08	±0.08	±0.08	±0.08	µm	max.
Accuracy*	±0.5	±0.5	±0.5	±0.5	µm	max.
Pitch	15	20	30	40	µrad	max.
Yaw*	5	5	7	7	µrad	max.
Straightness*	±0.5	±0.5	±1	±1	µm	max.
Straightness per 10 mm travel range*	±10	±10	±10	±10	nm	max.
Flatness	±0.5	±1	±1.5	±2.5	µm	max.
Flatness per 10 mm travel range	±10	±10	±10	±10	nm	max.
XY orthogonality	25	25	25	25	µrad	max.
Velocity**	2	2	2	2	m/s	max.
Acceleration, bridge axis**	20	20	20	20	m/s^2	max.
Acceleration, gantry axis**	15	15	12	12	m/s^2	max.
Mechanical properties						
Load capacity in Z***	245	245	245	245	N	max.
Moved mass, bridge axis	14	14	14	14	kg	
Moved mass, gantry axis	40	40	43	43	kg	
Overall mass	610	700	1075	1525	kg	
Guide type	Air bearings	Air bearings	Air bearings	Air bearings		

	A-322		
Drive properties			
Drive type	Linear motor, ironless, 3-phase, 1 × to bridge axis, 2 × to gantry axis		
Intermediate circuit voltage, effective	48, nominal 80, max.	VDC	
Peak force #	298	N	typ.
Nominal force #	87	N	typ.
Force constant, effective #	19.9	N/A	typ.
Resistance phase-phase #	3.6	Ω	
Inductivity phase-phase #	1.2	mH	
Back EMF phase-phase #	16	V·s/m	max.
Cabling	moved ribbon cable, cleanroom compatible		
Motion and positioning			
Operating pressure ##	80 psi (552 kPa)		
Air consumption with external vacuum supply	<2 SCFM (56 SLPM)		
Air consumption with internal vacuum supply	<3.2 SCFM (100 SLPM)		
Vacuum	10.8 psi (74.7 kPa), <0.5 SCFM (14 SLPM)		
Air quality	Clean (filtered to 1.0 µm or better) – ISO 8573-1 Class 1 Oil free – ISO 8573-1 Class 1 Dry (–15 °C dew point) – ISO 8573-1 Class 3		
Materials	Hardcoat aluminum and nickel-plated steel with stainless steel mounting material, granite base		

* Improved accuracy can be obtained with controller-based error compensation. Stage must be ordered with controller. Accuracy values assume short-term time duration and do not consider the long-term effects of thermal drift on the stage.
** Unloaded. Can be limited by the insulating system payload, controller or drive.
*** Assumes payload CG is centered no more than 50 mm above the stage table.
# Specifications for the drive apply per motor. Two motors are located at the gantry axis.
To protect the stage against damage, it is recommended to connect an air pressure sensor to the Motion-Stop input of the controller.
All specifications apply per axis, if not otherwise described.

Rotation Stages

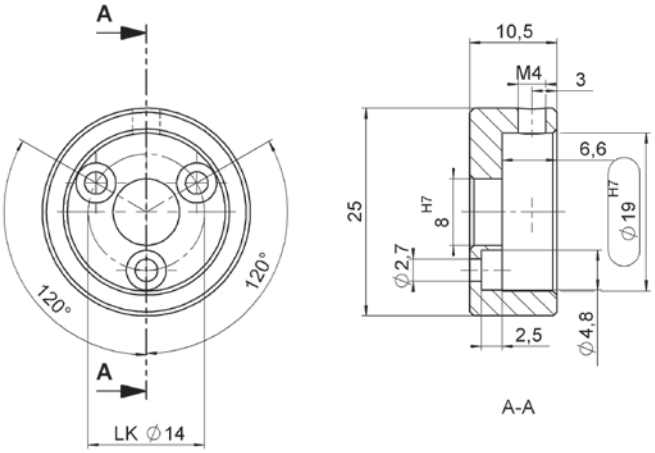


M-116 Precision Rotation Stage

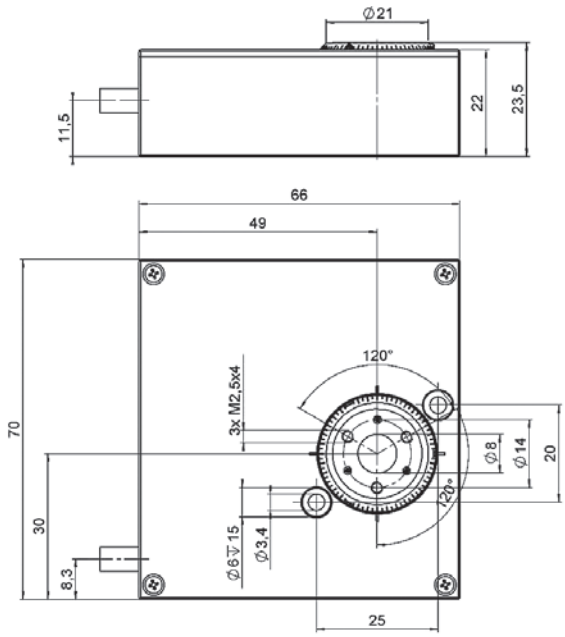
Compact, for Multi-Axis Combinations with M-110

- Compact Design
- Unlimited travel range
- Clear aperture for transmitted-light applications
- Backlash-compensated worm drive
- Compact multi-axis combinations with M-110
- Noncontact reference point switch

Dimensions of the M-116.AL1 lens adapter for 0.5" optic devices such as polarizers. Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.



M-116, dimensions in mm



Applications

- Automation
- Precision Micro Assembly
- Scientific Instrumentation

>> Incremental Encoder

Technology Glossary ..... page 290

	M-116.DG	M-116.DGH	Unit	Tolerance
Active axes	Rotation	Rotation		
Motion and positioning				
Rotation range	>360	>360	°	
Integrated sensor	Rotary encoder	Rotary encoder		
Sensor resolution	2048	2048	Cts./rev.	
Design resolution	2.45 (0.00013)	3.16 (0.00018)	µrad (°)	
Minimum incremental motion	50	25	µrad	
Backlash	1000	500	µrad	
Unidirectional repeatability	12	10	µrad	
Velocity	20	20	°/s	max.
Mechanical properties				
Worm gear ratio	44:1	44:1		
Gear ratio	28.444:1	22.0335:1		
Load capacity / axial force	±15	±15	N	
Max. torque (θ_X, θ_Y)	±1.5	±1.5	N·m	max.
Max. torque clockwise (θ_Z)	0.4	0.4	N·m	max.
Max. torque counterclockwise (θ_Z)	0.8	0.8	N·m	max.
Drive properties				
Motor type	DC gear motor	DC gear motor		
Operating voltage	0 to ±12	0 to ±12	V	
Motor power	1.75	1.75	W	
Reference point switch	Optical	Optical		
Miscellaneous				
Operating temperature range	–20 to 65	–20 to 65	°C	
Material	Aluminum	Aluminum		
Mass	0.4	0.4	kg	
Recommended controllers / drivers	C-863 C-884	C-863 C-884		

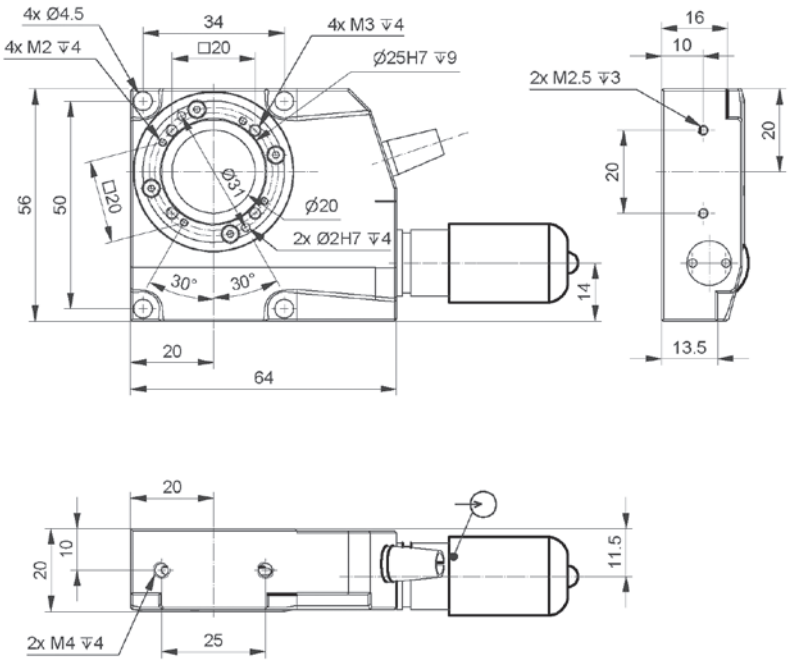
Ask about custom designs!

RS-40 Compact Rotation Stage

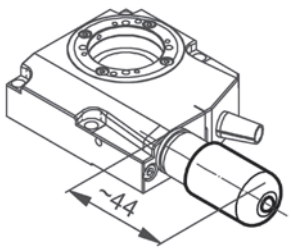
Precision Positioning

- Unlimited travel range
- Repeatability to 87 µrad
- 20 mm Ø aperture
- Reference point switch

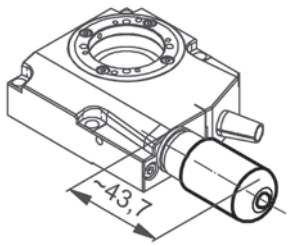
RS-40 rotation stage, dimensions in mm



RS-40 rotation stage, DC motor, dimensions in mm



RS-40 rotation stage, stepper motor, dimensions in mm



Applications

- Automation
- Precision Micro Assembly
- Scientific Instrumentation

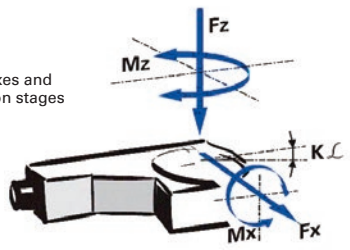
>> Incremental Encoder

Technology Glossary ..... page 290

	321691001-0000	321692001	Unit	Tolerance
	With DC motor	With stepper motor		
Active axes	Rotation	Rotation		
Motion and positioning				
Rotation range	>360	>360	°	
Design resolution	0.45	38	µrad	
Sensor resolution rotary encoder	2048	–	Cts./rev.	
Minimum incremental motion	87	87	µrad	typ.
Unidirectional repeatability	87	87	µrad	typ.
Bidirectional repeatability	±700	±700	µrad	typ.
Angular velocity	7	5	°/s	max.
Eccentricity	±5	±5	µm	typ.
Flatness	±5	±5	µm	typ.
Wobble	±35	±35	µrad	typ.
Mechanical properties				
Bearing	Ball bearings	Ball bearings		
Gear ratio	76:1	76:1		
Worm gear ratio	90:1	90:1		
Load capacity / axial force	20	20	N	max.
Permissible lateral force	5	5	N	max.
Holding torque in θ_Z, power off	0.20	0.20	N·m	typ.
Permissible torque M_x in θ_X, θ_Y	2	2	N·m	max.
Torque M_Z in θ_Z, power on	0.2	0.2	N·m	max.
Moment of inertia	0.0155	0.0155	kg·mm²	±20 %
Drive properties				
Motor type	DC motor	2-phase stepper motor		
Operating voltage, nominal	12	24	V	nom.
Operating voltage, max.	24	24	V	max.
Nominal current, effective	0.04	–	A	typ.
Peak current, effective	0.16	–	A	typ.
Torque constant, effective	0.00826	–	N·m/A	typ.
Electrical time constant	35	–	ms	
Resistance phase-phase	60	12.5	Ω	typ.
Inductance phase-phase	0.4	6.3	mH	typ.
Back EMF phase-phase	–	4.4	V/kRPM	max.
Reference point switch	Hall effect	Hall effect		
Miscellaneous				
Operating temperature range	5 to 40	5 to 40	°C	
Material	Aluminum	Aluminum		
Mass	0.4	0.4	kg	
Moved mass	0.088	0.088	kg	
MTBF	10000	10000	h	
Connection	Sub-D 15 (m)	HD Sub-D 15 (m)		
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

Direction of the axes and torques for rotation stages

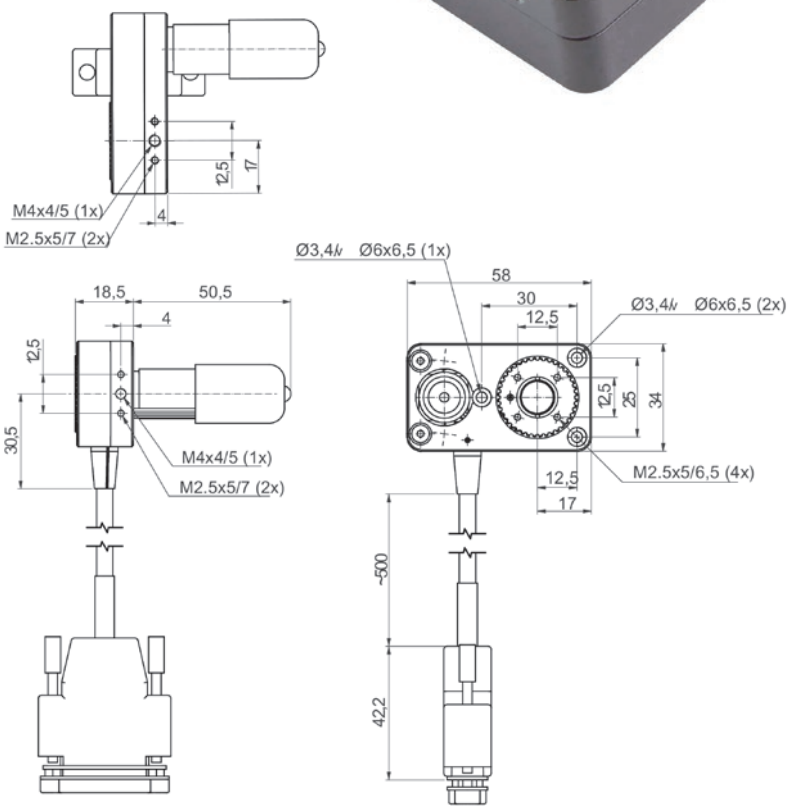


DT-34 Miniature Rotation Stage

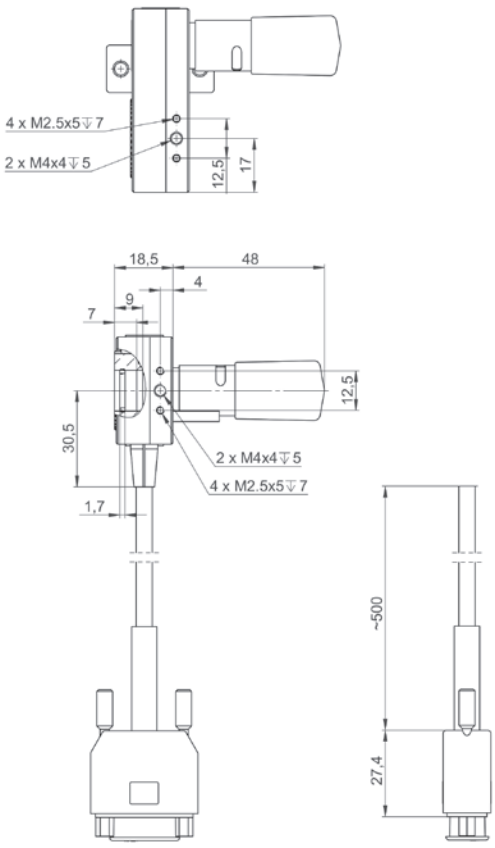
Compact Dimensions, with DC or Stepper Motor

- Clear aperture, 10 mm Ø
- Compact design
- Unidirectional repeatability to 350 µrad
- Angular velocity to 675 °/s
- Integrated optical reference point switch

DT-34 with DC motor, dimensions in mm



DT-34 with stepper motor, dimensions in mm



Applications

- Automation
- Precision Micro Assembly
- Scientific Instrumentation

>> Incremental Encoder

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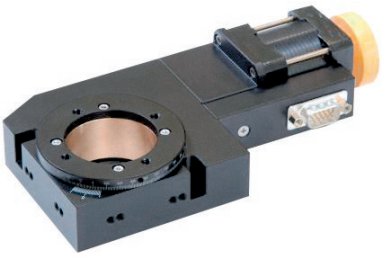
	3215910030	3215920030-0000	Unit	Tolerance
	With DC motor	With stepper motor		
Active axes	θ_Z	θ_Z		
Motion and positioning				
Rotation range	360	360	°	
Design resolution	69.62	1724.8	µrad	
Integrated sensor	Rotary encoder	–		
Sensor resolution rotary encoder	2048	–	Cts./rev.	
Minimum incremental motion	700	350	µrad	typ.
Unidirectional repeatability	700	350	µrad	typ.
Bidirectional repeatability	±1400	±1000	µrad	typ.
Angular velocity	675	195	°/s	max.
Eccentricity	±50	±50	µm	typ.
Flatness	±8	±8	µm	typ.
Wobble	±100	±100	µrad	typ.
Reference point switch	Optical	Optical		
Mechanical properties				
Bearing	Ball bearings	Ball bearings		
Worm gear ratio	24986:567	774566:5103		
Load capacity / axial force F_Z	15	15	N	max.
Permissible lateral force F_X, F_Y	2.5	2.5	N	max.
Permissible torque M_x in θ_X, θ_Y	2.5	2.5	N·m	max.
Drive properties				
Drive torque	0.9	0.3	N·m	max.
Motor type	DC motor	2-phase stepper motor		
Operating voltage, nominal	12	12	V	nom.
Operating voltage, max.	48	48	V	max.
Step resolution	–	24	Full steps/ rev.	
Miscellaneous				
Operating temperature range	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized	Aluminum, black anodized		
Mass	0.15	0.15	kg	±5 %
Moved mass	0.1	0.1	kg	±5 %
Connection	Sub-D 15 (m)	Sub-D 15 (m)		
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

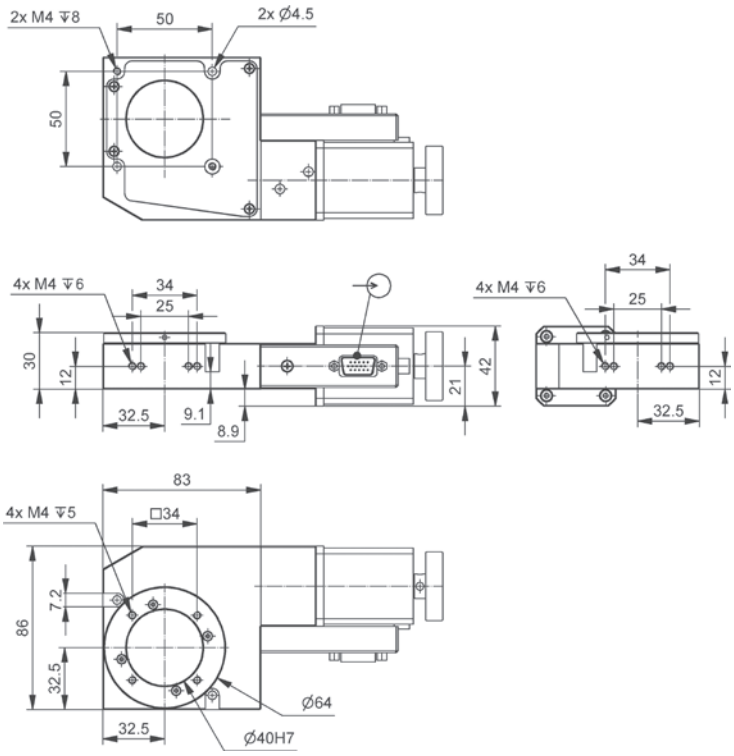
DT-80 Compact Rotation Stage

Large clear aperture

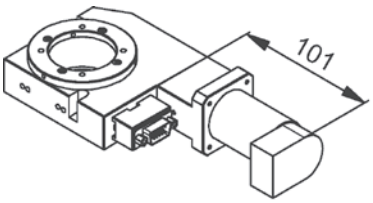


- Unlimited travel range
- Repeatability to 175 µrad
- Maximum velocity 40°/s
- Reference point switch

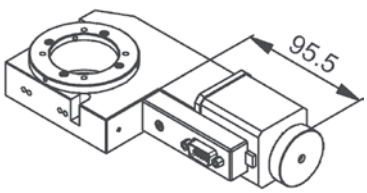
DT-80 rotation stage, dimensions in mm



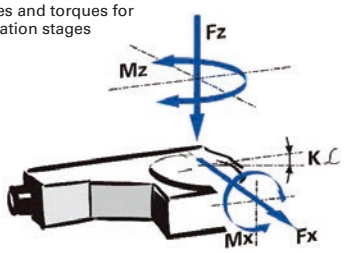
DT-80 rotation stage, DC motor, dimensions in mm



RS-80 rotation stage, stepper motor, dimensions in mm



Direction of the axes and torques for rotation stages



Applications

- Automation
- Precision Micro Assembly
- Scientific Instrumentation

>> Incremental Encoder

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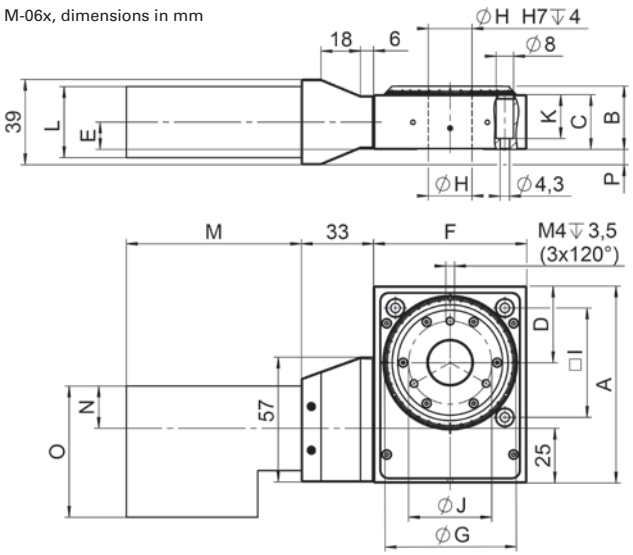
	64439100	64439200	Unit	Tolerance
	With DC motor	With stepper motor*		
Active axes	θ_Z	θ_Z		
Motion and positioning				
Rotation range	>360	>360	°	
Design resolution	17.453	174.53	µrad	
Integrated sensor	Rotary encoder	–		
Sensor resolution rotary encoder	2000	–	Cts./rev.	
Minimum incremental motion	69.8	69.8	µrad	typ.
Unidirectional repeatability	175	175	µrad	typ.
Bidirectional repeatability	±3491	±3491	µrad	typ.
Angular velocity	40	30	°/s	max.
Eccentricity	±30	±30	µm	typ.
Flatness	±30	±30	µm	typ.
Wobble	±100	±100	µrad	typ.
Mechanical properties				
Worm gear ratio	180:1	180:1		
Load capacity / axial force	20	20	N	max.
Permissible lateral force	10	10	N	max.
Permissible torque M_x in θ_X, θ_Y	5	5	N·m	max.
Drive properties				
Drive torque	0.1	0.1	N·m	max.
Guide type	Ball bearings	Ball bearings		
Motor type	DC motor	2-phase stepper motor		
Operating voltage, nominal	24	24	V	nom.
Operating voltage, max.	48	48	V	max.
Reference point switch	mechanical	mechanical		
Miscellaneous				
Operating temperature range	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized, red bronze	Aluminum, black anodized, red bronze		
Mass	0.8	0.8	kg	±5 %
Moved mass, unloaded	0.3	0.3	kg	±5 %
Connection	HD Sub-D 15 (m)	HD Sub-D 15 (m)		
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

* Max. 1.7 A/phase; 200 full step/rev.
Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

M-060 / M-061 / M-062
Precision Rotation Stage

Unlimited Travel Range

M-06x, dimensions in mm



- Unlimited travel range
- Very high resolution
- Max. velocity 90°/s
- Backlash-compensated worm drive
- ActiveDrive or DC motor
- Direction-sensing reference point switch

DIMENSIONS	M-060.PD	M-060.DG	M-061.PD	M-061.DG	M-062.PD	M-062.DG
A	90	90	130	130	150	150
B	29	29	34	34	42	42
C	25	25	30	30	38	38
D	35	35	55	55	65	65
E	12,5	12,5	15	15	21,5	21,5
F	70	70	110	110	130	130
G	60	60	100	100	120	120
H	20	20	35	35	45	45
I	50	50	90	90	110	110
J	38	38	50	50	60	60
K	20	20	20	20	28	25
L	39	34	39	34	39	34
M	80,8	83,8	80,8	83,8	80,8	83,8
N	19	15	19	15	19	15
O	59,3	51	59,3	51	59,3	51
P	7	7	4,5	4,5	–	–

Applications

- Optical Alignment
- Precision Micro Assembly
- Scientific Instrumentation

>> ActiveDrive
>> Incremental Encoder

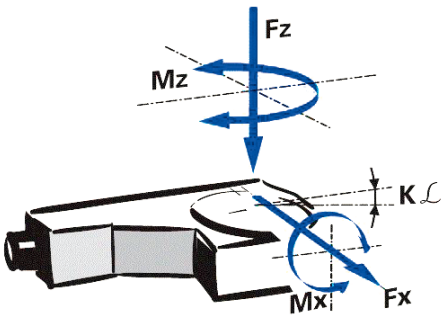
Technology Glossary ..... page 290

	M-060.PD / M-061.PD / M-062.PD	M-060.DG / M-061.DG / M-062.DG	Unit	Tolerance
Active axes	Rotation	Rotation		
Motion and positioning				
Rotation range	>360	>360	°	
Integrated sensor	Rotary encoder	Rotary encoder		
Sensor resolution	4000	2000	Cts./rev.	
Design resolution	32 (0.0018) / 17.5 (0.001) / 15 (0.0008)	2.1 (0.00012) / 1.2 (6.9 × 10^{-5}) / 0.96 (5.5 × 10^{-5})	µrad (°)	
Minimum incremental motion	32 / 17.5 / 15	6.3 / 6 / 5	µrad	
Backlash	200 / 200 / 240	200 / 200 / 240	µrad	
Unidirectional repeatability	50 / 50 / 60	50 / 50 / 60	µrad	
Velocity	90	16 / 9 / 7.5	°/s	max.
Mechanical properties				
Worm gear ratio	50:1 / 90:1 / 110:1	50:1 / 90:1 / 110:1		
Gear ratio	–	$(28/12)^4$:1		
Load capacity / axial force	±500 / ±550 / ±650	±500 / ±550 / ±650	N	
Max. torque θ_X, θ_Y	±6 / ±6 / ±7	±6 / ±6 / ±7	N·m	max.
Max. torque θ_Z	±4 / ±6 / ±8	±4 / ±6 / ±8	N·m	max.
Drive properties				
Motor type	DC motor, ActiveDrive	DC gear motor		
Operating voltage	24	0 to ±12	V	
Motor power	30	3	W	
Reference point switch	Hall effect	Hall effect		
Miscellaneous				
Operating temperature range	–10 to 40	–10 to 40	°C	
Material	Aluminum	Aluminum		
Mass	0.94 / 1.88 / 2.76	0.94 / 1.88 / 2.76	kg	
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes)	C-863 (single axis) C-884 (up to 6 axes)		

L-611 Precision Rotation Stage

High Travel Accuracy

- Unlimited travel range
- Very high resolution
- Maximum velocity 200°/s
- Optional angle measuring system for direct position measurement
- ActiveDrive DC, DC, BLDC, and stepper motors
- Direction-sensing reference point switch



Direction of the axes and torques for rotation stages

Applications

- Medical Industry
- Metrology / Testing
- Photonics
- Precision Micro Assembly
- Sample Inspection

>> ActiveDrive
>> Incremental Encoder
>> Vacuum-Compatible Versions

Technology Glossary ..... page 290

	L-611	Unit	Tolerance
Motion			
Active axes	θ_Z		
Rotation range	>360	°	
Wobble	±15	µrad	
Flatness	±1	µm	
Eccentricity	±2.5	µm	
Angular velocity	L-611.xxSD: 50 L-611.xxAD: 200 L-611.99xxxx: 200	°/s	max.

	L-611.9ASD L-611.993261	L-611.94AD	L-611.90AD L-611.xxx232	L-611.90SD	Unit	Tolerance
Positioning						
Integrated sensor	Incremental angle measuring system	Incremental angle measuring system	Rotary encoder	–		
Sensor signal	Sin/cos, 1 V peak-peak	A/B quadrature, TTL	A/B quadrature, TTL	–		
Sensor resolution rotary encoder	–	–	20000	–	Cts./rev.	
Sensor resolution angle measuring system	9000	9000	–	–	Lines/ revolution	
Design resolution	0.174	3.49	3.49	349	µrad	
Minimum incremental motion	L-611.9ASD: 0.87 L-611.993261: 3.5	17.45	35	8.72	µrad	typ.
Unidirectional repeatability	L-611.9ASD: 0.87 L-611.993261: 3.5	17.45	35	20	µrad	typ.
Bidirectional repeatability	±3.5	±17.45	±175	±175	µrad	typ.
Reference point switch	Hall effect	Hall effect	Hall effect	Hall effect		
Reference point switch repeatability	<2	<2	<2	<2	µm	typ.

	L-611	Unit	Tolerance
Mechanical properties			
Bearing	Ball bearings		
Worm gear ratio	90:1		
Load capacity / axial force	100	N	max.
Permissible lateral force	50	N	max.
Permissible torque M_x in θ_X, θ_Y	40	N·m	max.
Permissible torque M_z in θ_z	3	N·m	max.
Moment of inertia	770	kg·mm²	±20 %

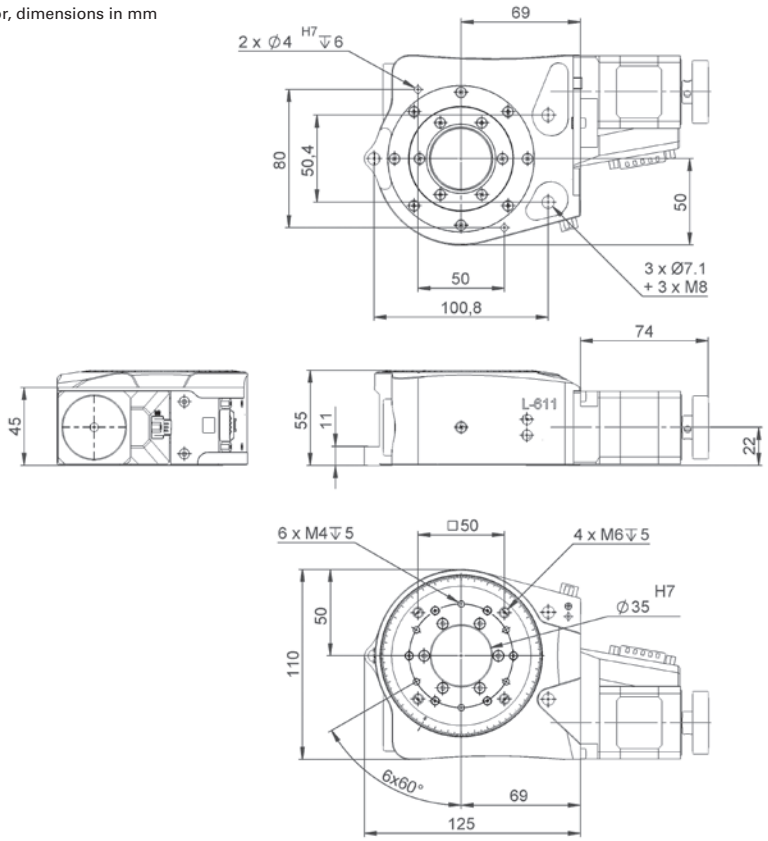
	L-611.xxSD	L-611.xxAD	L-611.xx3xxx	L-611.xx5xxx	Unit	Tolerance
Drive properties						
Motor type	2-phase stepper motor *	DC motor with PWM control	DC motor	BLDC motor		
Operating voltage, nominal	24	24	24	24	V	nom.
Operating voltage, max.	48	24	48	48	V	max.
Motor resolution	200	–	–	–	Full steps/ rev.	

	L-611.9xSD	L-611.xxAD	L-611.993xxx	L-611.995232	Unit	Tolerance
Miscellaneous						
Operating temperature range	5 to 40	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized, stainless steel, red bronze	Aluminum, black anodized, stainless steel, red bronze	Aluminum, black anodized, stainless steel, red bronze	Aluminum, black anodized, stainless steel, red bronze		
Mass	2.6	2.6	2.6	2.6	kg	±5 %
Moved mass	1.1	1.1	1.1	1.1	kg	±5 %
Connection	HD Sub-D 26 (m) L-611.9ASD additional Sub-D 9 (m) (sensor)	Sub-D 15 (m)	HD Sub-D 26 (m) L-611.993261 additional Sub-D 9 (m) (sensor)	HD Sub-D 26 (m)		
Recommended controllers / drivers	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller		

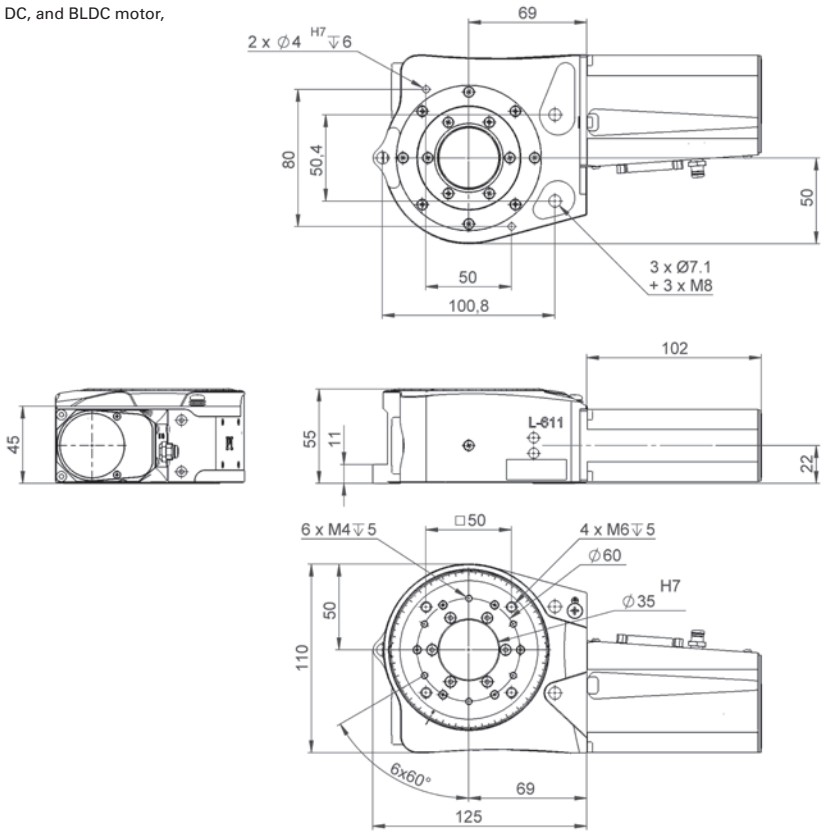
* Max. 1.2 A/phase

All cables required for operation with the recommended controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

L-611 with stepper motor, dimensions in mm

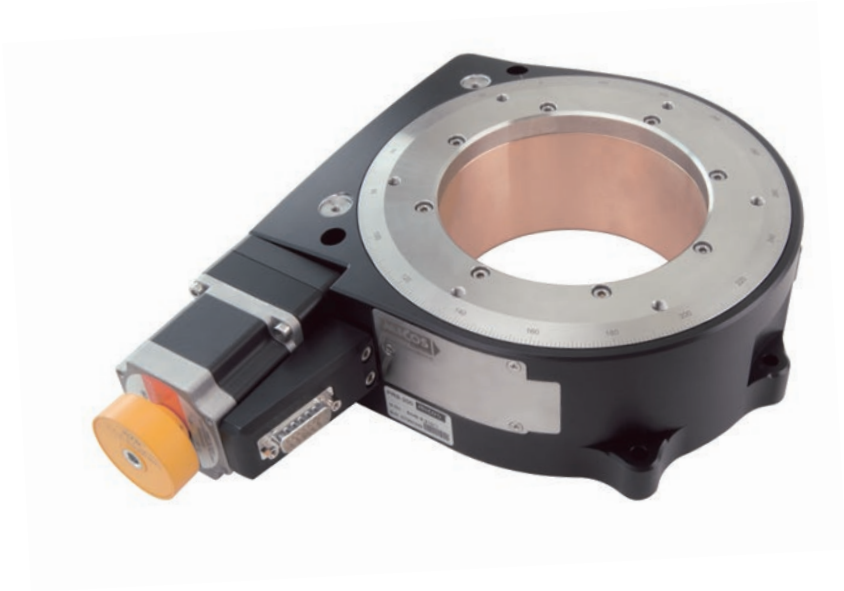


L-611 with ActiveDrive, DC, and BLDC motor, dimensions in mm



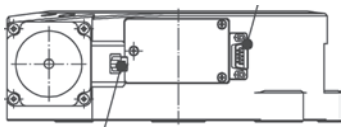
PRS-200 Precision Rotation Stage

Large Aperture, High Travel Accuracy

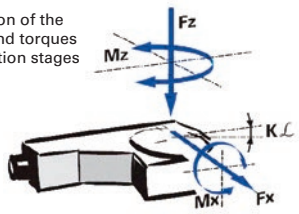


- Unlimited travel range
- Repeatability to 0.5 µrad
- Load capacity to 50 kg
- Option: Direct position measurement with angle measuring system

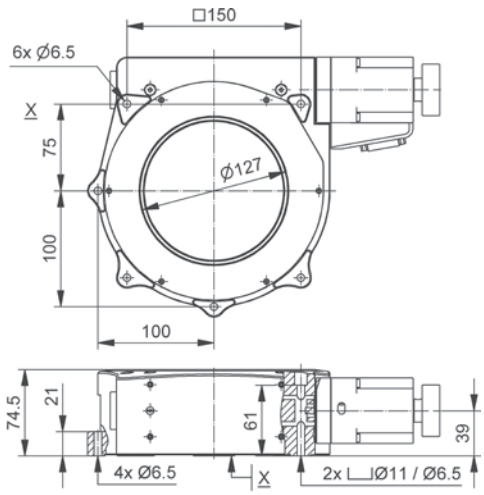
PRS-200 precision rotation stage, connection for angle measuring system



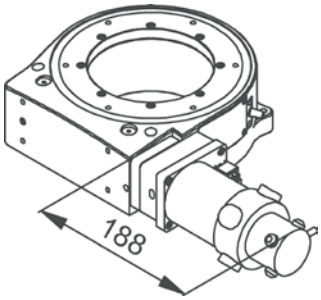
Direction of the axes and torques fo rotation stages



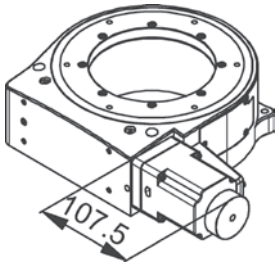
PRS-200 precision rotation stage, dimensions in mm

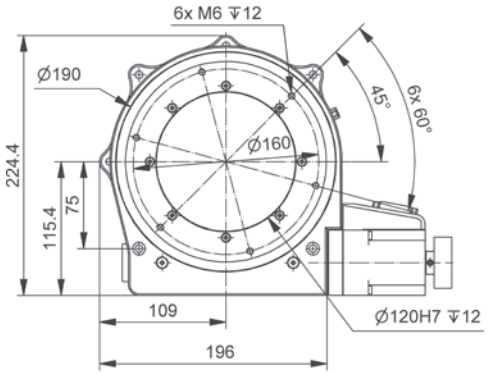


PRS-200 precision rotation stage, DC motor, dimensions in mm



PRS-200 precision rotation stage, stepper motor, dimensions in mm





Applications

- Medical Industry
- Metrology / Testing
- Photonics
- Precision Micro Assembly
- Sample Inspection

>> Incremental Encoder
>> Vacuum-Compatible Versions

Technology Glossary ..... page 290

	6449911011	6449921011	6449921111	Unit	Tolerance
	With DC motor	With stepper motor	With stepper motor and angle measuring system		
Active axes	θ_Z	θ_Z	θ_Z		
Motion and positioning					
Rotation range	>360	>360	>360	°	
Integrated sensor	Rotary encoder		Incremental angle measuring system		
Sensor signal	A/B quadrature, RS-422	–	Sin/cos, 1 V peak-peak		
Sensor resolution rotary encoder	20000	–	–	Cts./rev.	
Sensor resolution angle measuring system	–	–	23600	Lines/ revolution	
Design resolution	1.75	175.00	0.017	µrad	
Minimum incremental motion	8.72	8.72	0.50	µrad	typ.
Unidirectional repeatability	17.44	17.44	0.5	µrad	typ.
Bidirectional repeatability	±175	±175	±5	µrad	typ.
Wobble	±17.5	±17.5	±17.5	µrad	typ.
Flatness	±1	±1	±1	µm	typ.
Eccentricity	±2.5	±2.5	±2.5	µm	typ.
Angular velocity	75	35	35	°/s	max.
Mechanical properties					
Bearing	Crossed roller bearings	Crossed roller bearings	Crossed roller bearings		
Torque, power on	4	4	4	N·m	max.
Worm gear ratio	180:1	180:1	180:1		
Load capacity / axial force	500	500	500	N	max.
Permissible lateral force	200	200	200	N	max.
Permissible torque in θ_X, θ_Y	60	60	60	N·m	max.
Permissible torque in θ_Z	4	4	4	N·m	max.
Drive properties					
Motor type	DC motor	2-phase stepper motor	2-phase stepper motor		
Operating voltage, nominal	24	48	48	V	nom.
Operating voltage, max.	48	48	48	V	max.
Limit switches	2 × Hall effect	2 × Hall effect	2 × Hall effect		
Miscellaneous					
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized, stainless steel, red bronze	Aluminum, black anodized, stainless steel, red bronze	Aluminum, black anodized, stainless steel, red bronze		
Mass	8	8	8.7	kg	±5 %
Moved mass, unloaded	4.3	4.3	4.7	kg	±5 %
Connection	Sub-D 7W2 (m) (motor) M23 12-pin (m) (sensor)	Sub-D 15 (m)	Sub-D 15 (m) (motor) HD Sub-D 26 (m) (sensor)		
Recommended controllers / drivers	C-863 (single axis) with C-863.AD12 line driver C-884 (to 6 axes) with C-863.AD12 line driver C-885 with C-863.20C885 (to 40 axes) and C-863.AD12 line driver ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

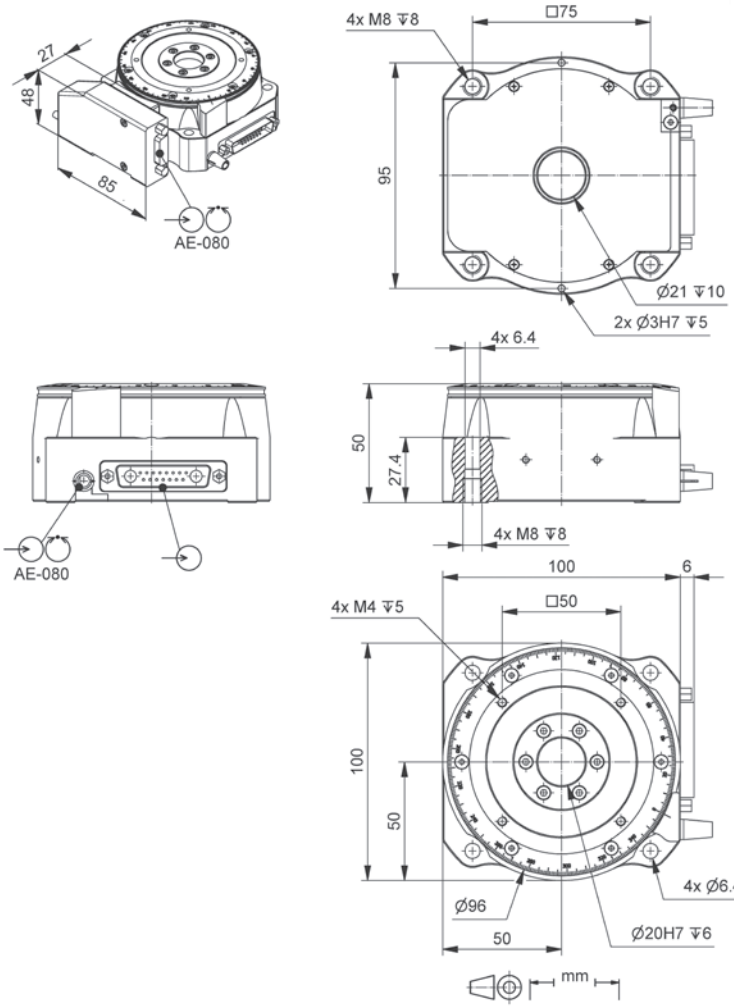
Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

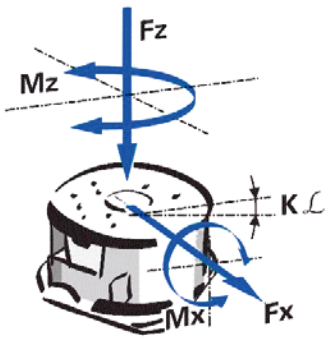
UPR-100 Ultraprecision Rotation Stage

High Dynamics due to Magnetic Drive, High Stability

- Unlimited travel range
- Velocity to 360 °/s
- Repeatability to 1.4 µrad
- Clear aperture with 20 mm diameter
- Direct drive

UPR-100 ultraprecision rotation stage, dimensions in mm





Directions of the axes and torques for rotation stages

Applications

- Automation
- Biotechnology
- Medical Industry
- Metrology / Testing
- Precision Micro Assembly
- Sample Inspection
- Scientific Instrumentation
- Semiconductor

>> Incremental Encoder
>> Torque Motor

Technology Glossary ..... page 290

	680591111	Unit	Tolerance
Motion and positioning			
Active axes	θ_Z		
Travel range	>360	°	
Integrated sensor	Incremental angle measuring system		
Sensor signal	Sin/cos, 1 V peak-peak		
Sensor resolution	15744	Lines/ revolution	
Minimum incremental motion	1.4	µrad	typ.
Unidirectional repeatability	1.4	µrad	typ.
Bidirectional repeatability	±1.75	µrad	typ.
Flatness	±2.5	µm	typ.
Eccentricity	±3.5	µm	typ.
Wobble	±25	µrad	typ.
Angular velocity	360	°/s	max.
Reference point switch	Encoder index		
Mechanical properties			
Bearing	Crossed roller bearings		
Torque, power on	0.25	N·m	
Load capacity / axial force	20	N	max.
Permissible lateral force	15	N	max.
Permissible torque in θ_X, θ_Y	5	N·m	max.
Drive properties			
Drive type	Ironless 3-phase torque motor		
Intermediate circuit voltage	48	V DC	max.
Nominal current, effective	1.2	A	typ.
Peak current, effective	3.8	A	typ.
Torque constant, effective	0.13	N·m/A	typ.
Motor constant	0.04	N·m/√W	typ.
Electrical time constant	0.1	ms	
Resistance phase-phase	6.6	Ω	typ.
Inductance phase-phase	0.7	mH	typ.
Back EMF phase-phase	0.67	V/kRPM	max.
Number of pole pairs	14		
Miscellaneous			
Operating temperature range	5 to 40	°C	
MTBF	20000	h	
Material	Aluminum, black anodized		
Mass	1.2	kg	±5 %
Moved mass	0.4	kg	±5 %
Connection	Sub-D 17W2 (motor) HD Sub-D 26 (m) (sensor)		
Recommended controller	SMC Hydra (double axis) C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller		

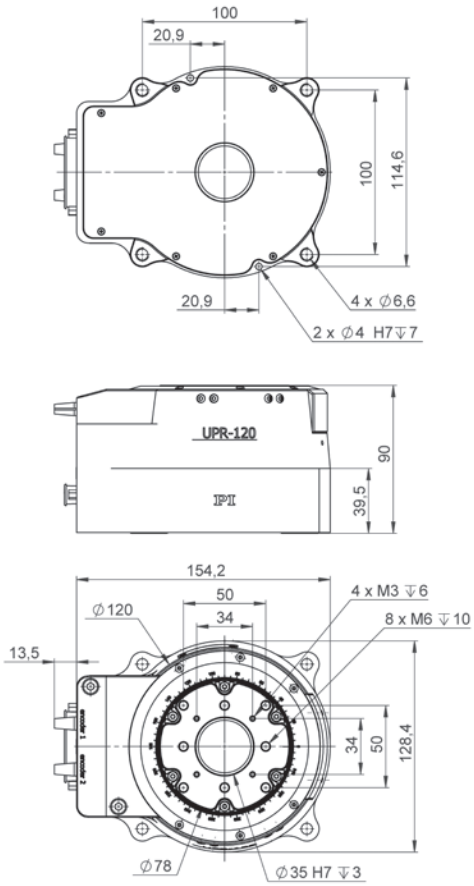
Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

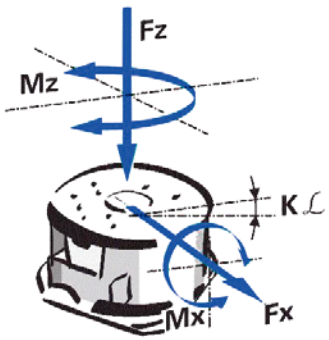
UPR-120 Ultraprecision Rotation Stage

Excellent Stability and Travel Accuracy

- Unlimited travel range
- Velocity to 360 °/s
- Incremental angle measuring system with 0.017 µrad resolution
- Clear aperture with 35 mm diameter
- Cleanroom compatible
- Direct drive

UPR-120, dimensions in mm





Directions of the axes and torques for rotation stages

Applications

- Biotechnology
- Automation
- Medical Industry
- Metrology / Testing
- Precision Micro Assembly
- Sample Inspection
- Scientific Instrumentation
- Semiconductor

>> Incremental Encoder
>> Torque Motor

Technology Glossary ..... page 290

	6808911130	Unit	Tolerance
Motion and positioning			
Active axes	θ_Z		
Travel range	>360	°	
Integrated sensor	Incremental angle-measuring system		
Sensor signal	Sin/cos, 1 V peak-peak		
Sensor resolution	15744	Lines/ revolution	
Minimum incremental motion	1.4	µrad	typ.
Unidirectional repeatability	1.4	µrad	typ.
Bidirectional repeatability	±1.4	µrad	typ.
Flatness	±1	µm	typ.
Eccentricity	±3	µm	typ.
Wobble	±25	µrad	typ.
Angular velocity	360	°/s	max.
Reference point switch	Encoder index		
Limit switches	Optical		
Mechanical properties			
Bearing	Crossed roller bearings		
Torque, power on	0.5	N·m	
Load capacity / axial force	200	N	max.
Permissible lateral force	100	N	max.
Drive properties			
Drive type	Iron-core 2-phase torque motor		
Intermediate circuit voltage	48	V DC	max.
Nominal current, effective	7.7	A	typ.
Torque constant, effective	0.26	N·m/A	typ.
Resistance phase-phase	2.2	Ω	typ.
Inductance phase-phase	1.17	mH	typ.
Back EMF phase-phase	0.18	V·s/rad	max.
Miscellaneous			
Operating temperature range	5 to 40	°C	
Material	Aluminum, black anodized		
MTBF	20000	h	
Mass	6	kg	±5 %
Moved mass	0.8	kg	±5 %
Connection	Sub-D 9W4 (m) (motor) Sub-D 15 (m) (sensor)		
Recommended controller	SMC Hydra (double axis) C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller		

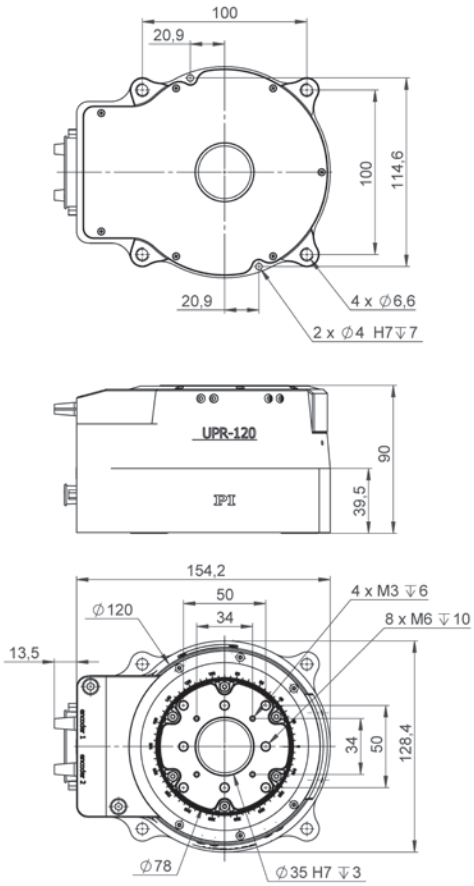
Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

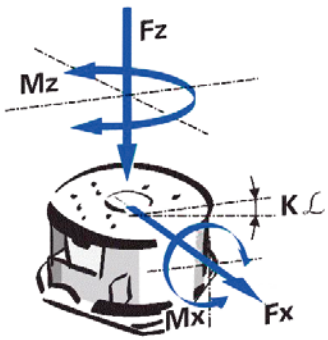
UPR-120 Air Ultraprecision Rotation Stage with Air Bearing

Excellent Stability and Travel Accuracy

- Unlimited travel range
- Velocity to 360 °/s
- Incremental angle measuring system with 0.017 µrad resolution
- Clear aperture with 35 mm diameter
- Air bearings for optimized flatness
- Cleanroom compatible
- Direct drive

UPR-120, dimensions in mm





Directions of the axes and torques for rotation stages

Applications

- Biotechnology
- Automation
- Medical Industry
- Metrology / Testing
- Precision Micro Assembly
- Sample Inspection
- Scientific Instrumentation
- Semiconductor

>> Air Bearing
>> Incremental Encoder
>> Torque Motor

Technology Glossary ..... page 290

	6824911130	Unit	Tolerance
Motion and positioning			
Active axes	θ_Z		
Travel range	>360	°	
Integrated sensor	Incremental angle-measuring system		
Sensor signal	Sin/cos, 1 V peak-peak		
Sensor resolution	15744	Lines/ revolution	
Minimum incremental motion	0.35	µrad	typ.
Unidirectional repeatability	0.7	µrad	typ.
Bidirectional repeatability	±0.7	µrad	typ.
Flatness	±0.05	µm	typ.
Eccentricity	±0.1	µm	typ.
Wobble	±1.25	µrad	typ.
Angular velocity	360	°/s	max.
Reference point switch	Encoder index		
Limit switches	Optical		
Mechanical properties			
Bearing	Air bearing		
Torque, power on	0.7	N·m	
Load capacity / axial force	200	N	max.
Permissible lateral force	40	N	max.
Drive properties			
Drive type	Iron-core 2-phase torque motor		
Intermediate circuit voltage	48	V DC	max.
Nominal current, effective	7.7	A	typ.
Torque constant, effective	0.26	N·m/A	typ.
Resistance phase-phase	2.2	Ω	typ.
Inductance phase-phase	1.17	mH	typ.
Back EMF phase-phase	0.18	V·s/rad	max.
Miscellaneous			
Operating temperature range	5 to 40	°C	
Material	Aluminum, black anodized		
MTBF	20000	h	
Mass	6.5	kg	±5 %
Moved mass	1.1	kg	±5 %
Connection	Sub-D 9W4 (m) (motor) Sub-D 15 (m) (sensor)		
Recommended controller	SMC Hydra (double axis) C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller		

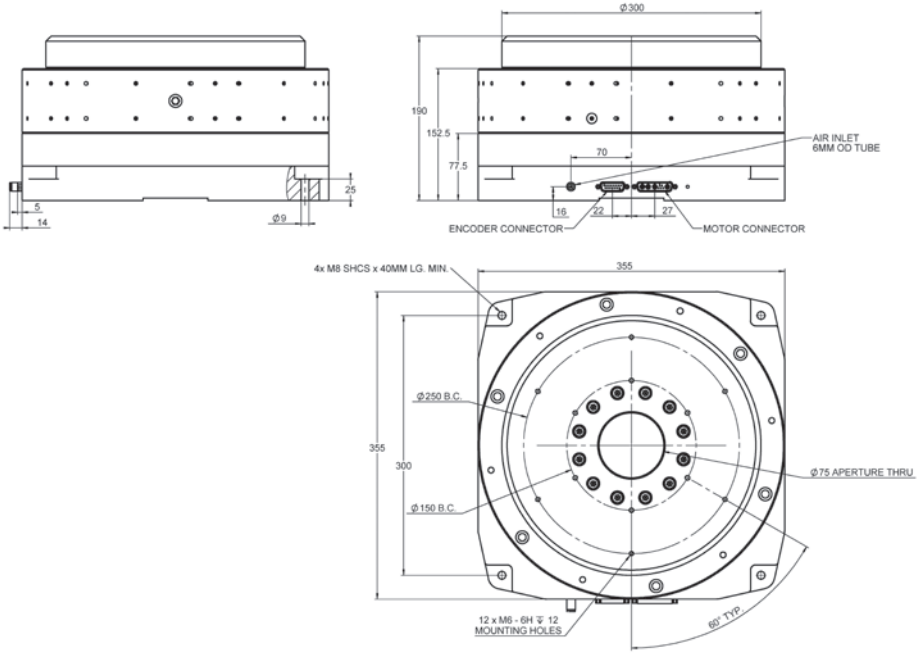
Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

A-62x PIglide RM Rotation Stage with Air Bearings

Friction-Free, Ideal for Indexing, Positioning, Scanning, Measuring Technology

- Cleanroom compatible
- Motion platform diameter from 50 mm to 300 mm
- Load capacity to 4170 N
- Eccentricity and flatness <200 nm
- Can be mounted vertically or horizontally

A-627.075xx, dimensions in mm



Applications

- Metrology / Testing
- Optical Alignment
- Sample Inspection
- Scanning
- Scientific Instrumentation

>> Absolute Encoder
>> Incremental Encoder
>> PIglide Air Bearing Technology
>> Torque Motor

Technology Glossary ..... page 290

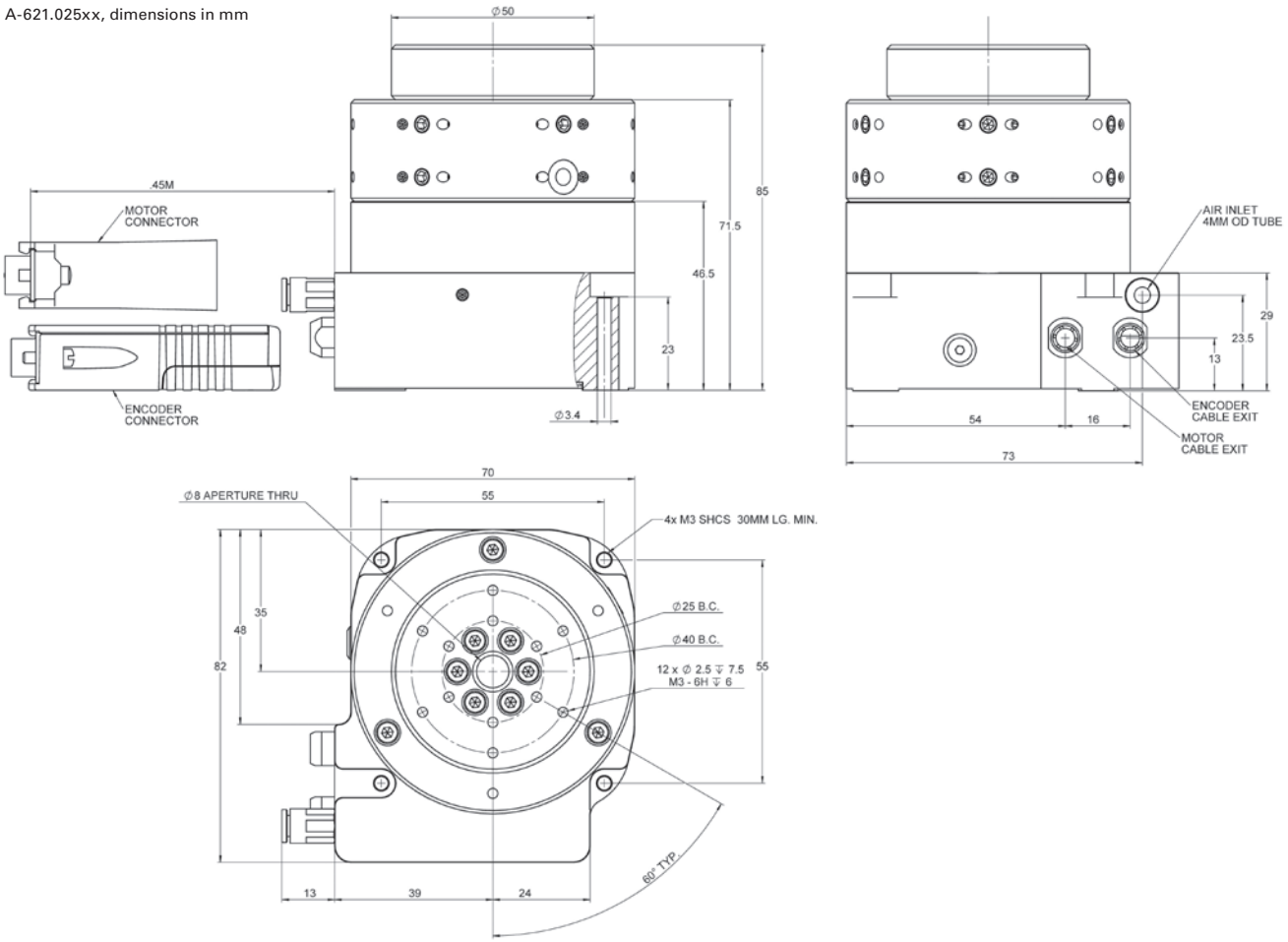
	A-621.025	A-623.025	A-623.050	A-624.050	A-627.075	Unit	Tolerance
Motion							
Travel range	unlimited, >360°	unlimited, >360°	unlimited, >360°	unlimited, >360°	unlimited, >360°		
Motion platform diameter	50	100	100	150	300	mm	
Journal length	25	25	50	50	75	mm	
Eccentricity [1]	300	175	175	100	75	nm	max.
Flatness	100	75	75	50	40	nm	max.
Wobble	5	3	3	2	1	µrad	max.
Mechanical properties							
Load capacity, axial	134	536	536	1206	4244	N	max.
Load capacity, radial	57	115	229	344	1203	N	max.
Load torque $M_{X,Y}$	0.57	1.7	4.52	22.6	141.3	N·m	max.
Axial stiffness	26	96	96	210	788	N/µm	
Radial stiffness	8	18	35	64	204	N/µm	
Moment of inertia	125	1485	1530	8790	210850	kg·mm²	
Moved mass	0.4	1.2	1.4	3.2	21.5	kg	
Overall mass	1.2	3.1	4.5	8.6	50	kg	
Guide type	Air bearing	Air bearing	Air bearing	Air bearing	Air bearing		
Drive properties							
Drive type	Torque motor, 3-phase, brushless, ironless, slotless	Torque motor, 3-phase, brushless, ironless, slotless	Torque motor, 3-phase, brushless, ironless, slotless	Torque motor, 3-phase, brushless, ironless, slotless	Torque motor, 3-phase, brushless, ironless, slotless		
Intermediate circuit voltage, effective	48, nominal 80, max.	48, nominal 80, max.	48, nominal 80, max.	48, nominal 80, max.	48, nominal 80, max.	V DC	
Peak torque	0.21	2.1	2.1	4.71	8.46	N·m	typ.
Nominal torque	0.07	0.7	0.7	1.57	2.82	N·m	typ.
Force constant, effective	0.03	0.26	0.26	0.59	0.61	N·m/A	typ.
Resistance phase-phase	2.7	4.2	4.2	6.7	4.5	Ω	
Inductance phase-phase	0.1	0.4	0.4	0.9	0.6	mH	
Back EMF phase-phase	4.1	31.8	31.8	71	74	V/kRPM	max.

	A-62x.xxxAx	A-62x.xxxBx	A-62x.xxxCx
Positioning			
Integrated sensor	Incremental angle measuring system	Absolute-measuring angle measuring system	Incremental angle measuring system
Sensor signal	Sin/cos, 1 V peak-peak	BiSS-C	A/B quadrature, TTL
Lines/revolution	A-621: 8192 A-623: 15744 A-624: 23600 A-627: 47200	–	A-621: 8192 A-623: 15744 A-624: 23600 A-627: 47200
Velocity [2]	A-621: 2500 RPM max. A-623: 1200 RPM max. A-624: 600 RPM max. A-627: 500 RPM max.	A-621: 2500 RPM max. A-623: 1200 RPM max. A-624: 600 RPM max. A-627: 500 RPM max.	A-621: 550 RPM max. [3] A-623: 300 RPM max. [3] A-624: 175 RPM max. [3] A-627: 75 RPM max. [3]
Sensor resolution	A-621: 0.047 µrad [4] A-623: 0.024 µrad [4] A-624: 0.016 µrad [4] A-627: 0.008 µrad [4]	A-621: 0.0015 µrad A-623: 0.0015 µrad A-624: 0.0015 µrad A-627: 0.0015 µrad	A-621: 1.94 µrad [5] A-623: 1.02 µrad [5] A-624: 0.68 µrad [5] A-627: 0.33 µrad [5]
Bidirectional repeatability	±4 µrad	±4 µrad	±4 µrad
Accuracy, with error compensation [6]	±8 µrad	±8 µrad	±8 µrad
Reference point switch	1 / revolution, differential pulse over one sensor signal period, 1 V peak-peak	–	1 / revolution, one count over one step of the encoder, synchronized to output signal

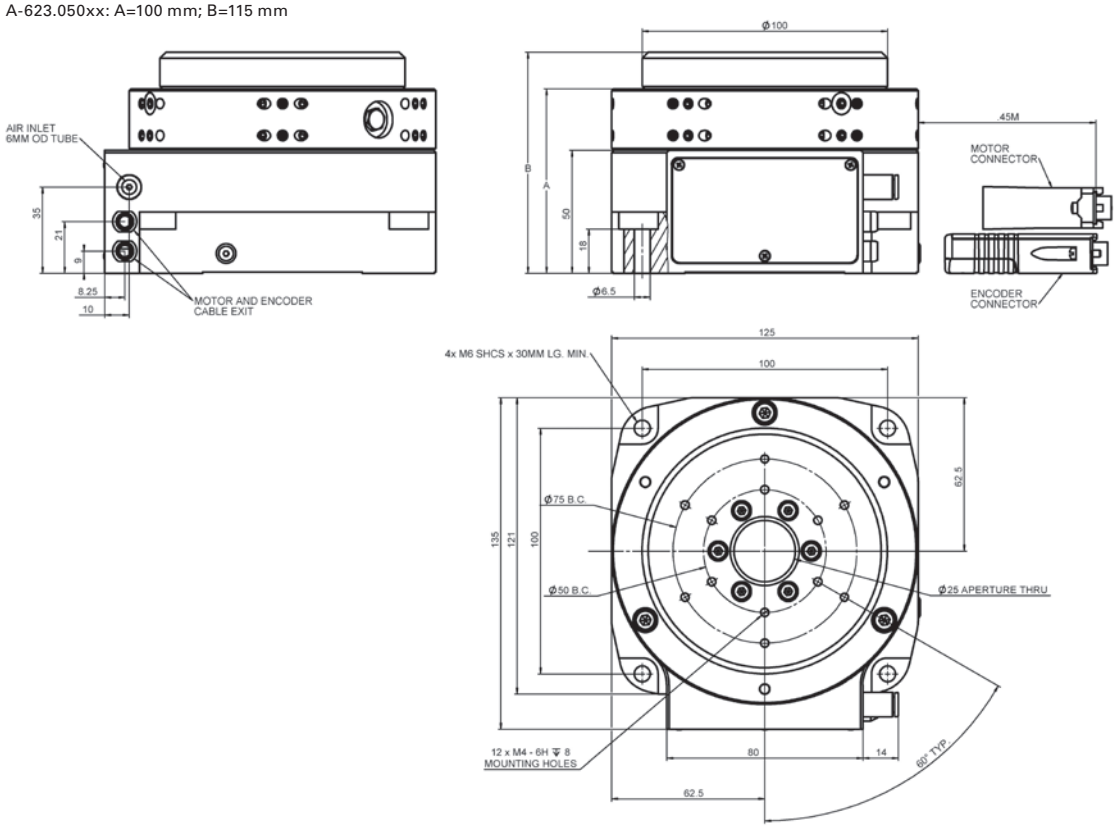
	A-62x
Miscellaneous	
Operating pressure [7]	75 to 85 psi (515 to 585 kPa)
Air consumption	<2 SCFM (56 SLPM)
Air quality	Clean (filtered to 1.0 µm or better) – ISO 8573-1 Class 1 Oil free – ISO 8573-1 Class 1 Dry (–15 °C dew point) – ISO 8573-1 Class 3
Materials [8]	Hardcoat aluminum, stainless steel fasteners

(1) Dependent on the quality of the underlying surface, the payload, orientation, and forces that act on the stage from the outside. Please contact PI for application-specific parameters. The specified values are static (no rotary motion during measuring) and without load.
(2) Can be limited by imbalance of the payload or the controller and the drive.
(3) Assumes a sampling rate of 50 MHz.
(4) Assumes 16384x interpolation. Contact PI for the use of other factors.
(5) Uses 400x interpolation. Alternative digital encoder resolutions on request. Please contact PI for a quote.
(6) The specified values are based on error compensation controlled by the controller. The stage must be ordered with a controller from PI to reach these values. Accuracy values assume short-term duration and do not consider the long-term effects of thermal drift on the stage.
(7) To protect the stage against damage, it is recommended to connect an air pressure sensor to the Motion-Stop input of the controller.
(8) Customer-specific materials such as rust-free steel on request. Please contact PI for a quote.

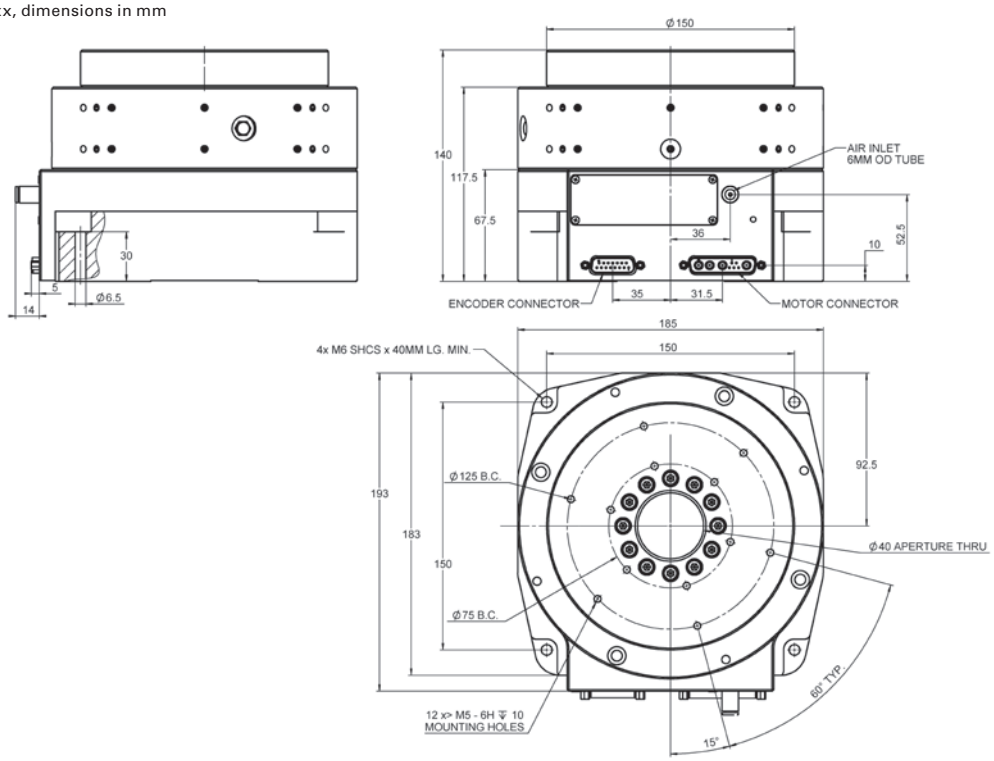
A-621.025xx, dimensions in mm



A-623.xxxxx, dimensions in mm
A-623.025xx: A=75 mm; B=90 mm
A-623.050xx: A=100 mm; B=115 mm



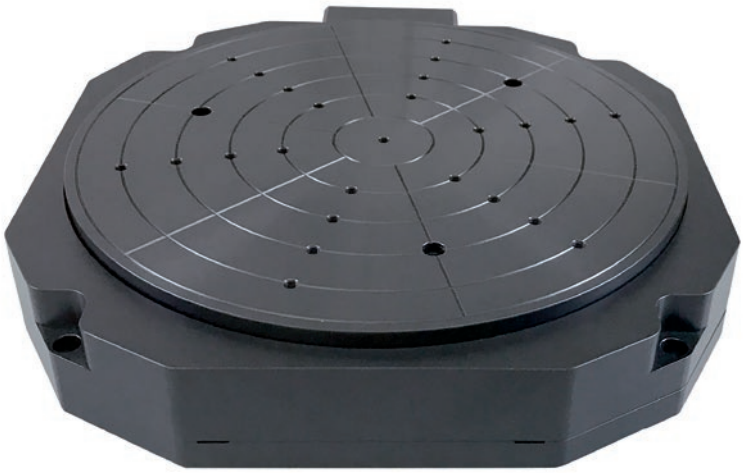
A-624.050xx, dimensions in mm



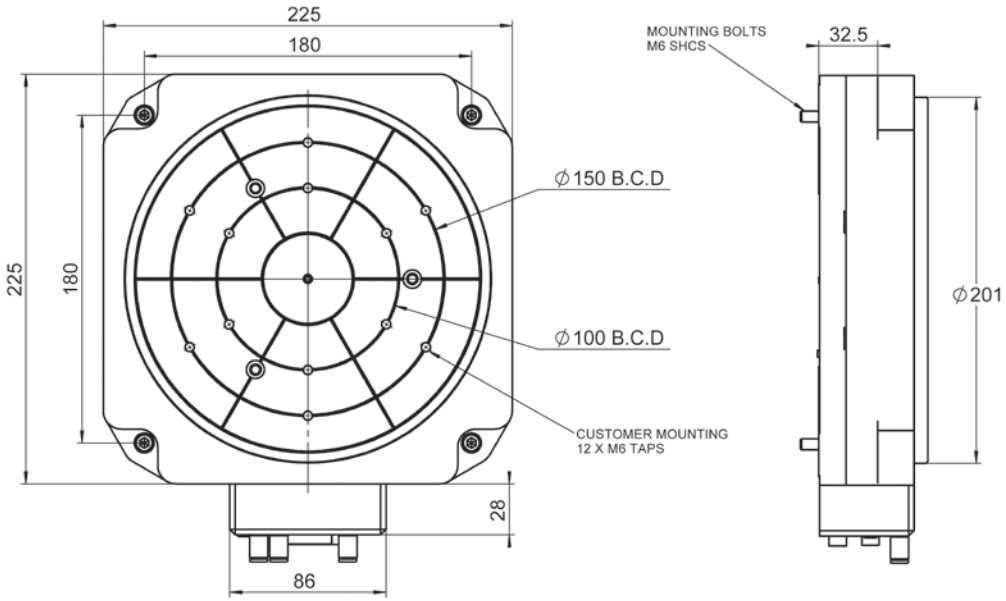
A-63x PIglide RL Low-Profile Rotation Stage with Air Bearing

Friction-Free, Motorized

- 200 mm or 300 mm motion platform diameter
- Low profile, 60 mm
- Eccentricity and flatness <100 nm
- Option for self-locking at rest by magnetic preload
- Direct Drive



A-635.x100 , dimensions in mm



Drawing for A-637.x100
available on www.pi.ws

Applications

- Metrology / Testing
- Optical Alignment
- Sample Inspection
- Scanning
- Scientific Instrumentation
- Semiconductor

>> Absolute Encoder
>> Incremental Encoder
>> PIglide Air Bearing Technology
>> Torque Motor

Technology Glossary ..... page 290

	A-635	A-637	Unit	Tolerance
Motion				
Travel range	unlimited, >360°	unlimited, >360°		
Motion platform diameter	200	300	mm	
Eccentricity [1]	100	100	nm	max.
Flatness [1]	50	50	nm	max.
Wobble [1]	2	1	µrad	max.
Mechanical properties				
Load capacity, axial [2]	200	500	N	max.
Load capacity, radial [2]	50	200	N	max.
Load torque, $M_{X,Y}$ [2]	5	10	N·m	max.
Moment of inertia	25820	72000	kg·mm²	
Moved mass	4.2	6.4	kg	
Overall mass	7.5	14	kg	
Guide type	Air bearing, magnetic preload	Air bearing, magnetic preload		

	A-63x	Unit	Tolerance
Drive properties			
Drive type	Torque motor, 3-phase, brushless, ironless, slotless		
Intermediate circuit voltage, effective	48, nominal 80, max.	V DC	
Peak torque	9	N·m	typ.
Nominal torque	3	N·m	typ.
Torque constant, effective	0.66	N·m/A	typ.
Resistance phase-phase	4.5	Ω	
Inductance phase-phase	0.6	mH	
Back EMF phase-phase	80	V/kRPM	max.

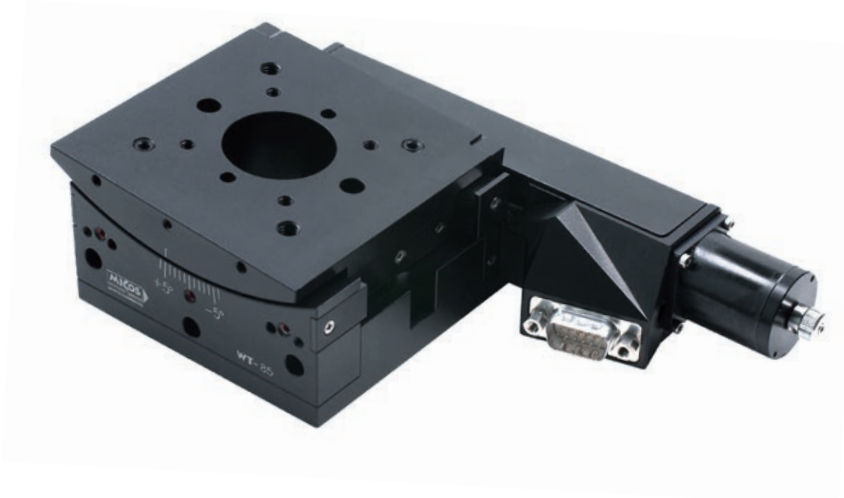
	A-63x.A100	A-63x.B100
Positioning		
Integrated sensor	Incremental angle-measuring system	Absolute angle-measuring system
Sensor signal	Sin/cos, 1 V peak-peak	BiSS-C
Lines/revolution	A-635: 31488 A-637: 47200	–
Velocity [3]	A-635: 500 rpm max. A-637: 500 rpm max.	A-635: 500 rpm max. A-637: 500 rpm max.
Sensor resolution	A-635: 0.05 µrad [4] A-637: 0.03 µrad [4]	A-635: 0.0015 µrad A-637: 0.0015 µrad
Bidirectional repeatability	±2 µrad	±2 µrad
Accuracy, with error compensation [5]	±6 µrad	±6 µrad
Reference point switch	1 / revolution, differential pulse over one sensor signal period, 1 V peak-peak	–

	A-63x
Miscellaneous	
Operating pressure [6]	75 to 85 psi (515 to 585 kPa)
Air consumption	<2 SCFM (56 SLPM)
Air quality	Clean (filtered to 1.0 µm or better) – ISO 8573-1 Class 1 Oil free – ISO 8573-1 Class 1 Dry (–15 °C dew point) – ISO 8573-1 Class 3
Materials	Hardcoat aluminum, stainless steel fasteners

(1) Dependent on the quality of the underlying surface, the payload, orientation, and forces that act on the stage from the outside. Please contact PI for application-specific parameters. The specified values are static (no rotary motion during measuring) and without load.
(2) The loads listed assume a supply pressure of 550 kPa (80 psi). Please contact PI if other pressures are required.
(3) May be limited by the payload, payload imbalance, controller or drive.
(4) Assumes 4096x interpolation. Contact PI for the use of other factors.
(5) The specified values are based on error compensation controlled by the controller. The stage must be ordered with an A-8xx series controller from PI to reach these values. Accuracy values assume short-term duration and do not consider the long-term effects of thermal drift on the stage.
(6) To protect the stage against damage, it is recommended to connect an air pressure sensor to the Motion-Stop input of the controller.

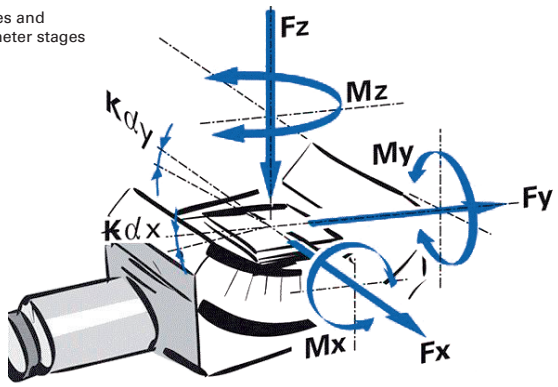
WT-85 Motorized Precision Goniometer

Compact, Clear Aperture

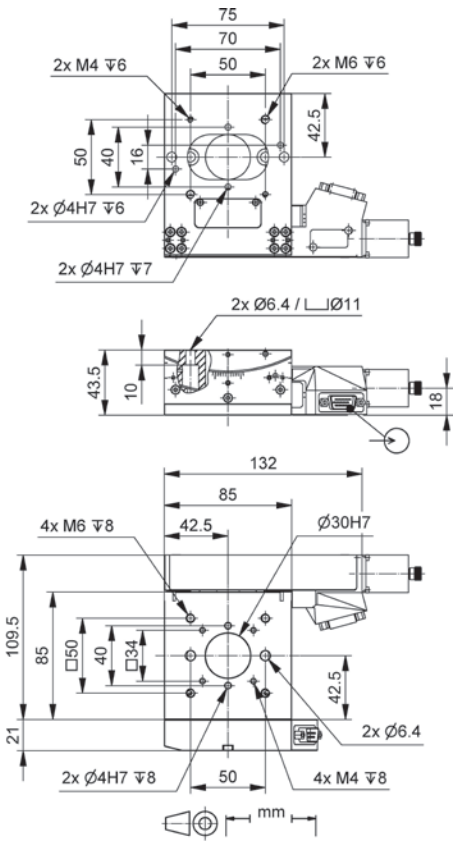


- Rotation range 10°
- Repeatability to 8.7 µrad
- Load capacity to 2 kg
- Option: Direct position measurement with angle measuring system
- Combination with WT-100 with common pivot point

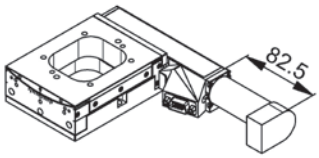
Direction of the axes and torques for goniometer stages



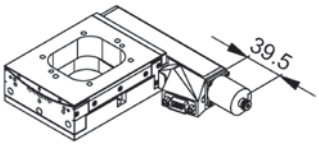
WT-85 goniometer stage, dimensions in mm



WT-85 goniometer stage, DC motor, dimensions in mm



WT-85 goniometer stage, stepper motor, dimensions in mm



Applications

- Sample Inspection
- Precision Micro Assembly
- Metrology / Testing
- Photonics
- Optical Alignment
- Scientific Instrumentation

>> Direct Metrology
>> Vacuum-Compatible Version

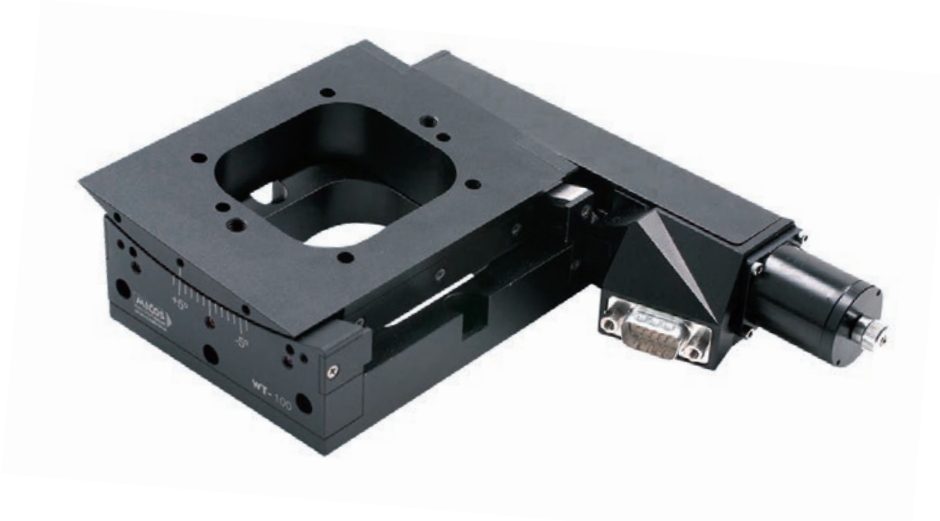
Technology Glossary ..... page 290

	65409100	65409101	65409200-0000	65409201-0001	Unit	Tolerance
	DC motor with rotary encoder	DC motor with angle measuring system and rotary encoder	Stepper motor	Stepper motor and angle measuring system		
Active axes	θ_X	θ_X	θ_X	θ_X		
Motion and positioning						
Rotation range	10	10	10	10	°	
Integrated sensor	Rotary encoder	Incremental angle measuring system Rotary encoder	–	Incremental angle measuring system		
Sensor signal rotary encoder	AB quadrature, RS-422	AB quadrature, RS-422	–	–		
Sensor signal angle measuring system		Sin/cos, 1 V peak-peak	–	Sin/cos, 1 V peak-peak		
Sensor signal periods angle measuring system	–	211	–	211	µrad	
Sensor resolution rotary encoder	2000	2000	–	–	Counts/ rev.	
Design resolution	4.65	2.11	46.5 (full step)	2.11	µrad	
Minimum incremental motion	17.5	2	17.5	2	µrad	typ.
Unidirectional repeatability	69.8	8.7	69.8	8.7	µrad	typ.
Bidirectional repeatability	±69.8	±8.7	±69.8	±8.7	µrad	typ.
Wobble	±125	±125	±125	±125	µrad	typ.
Angular velocity	15	15	7	7	°/s	max.
Limit switches	2 × mechanical	2 × mechanical	2 × mechanical	2 × mechanical		
Mechanical properties						
Drive screw type	Ball screw	Ball screw	Ball screw	Ball screw		
Drive screw pitch	1	1	1	1	mm	
Guide type	Ball bearings	Ball bearings	Ball bearings	Ball bearings		
Gear ratio	675:1	675:1	675:1	675:1		
Load capacity	20	20	20	20	N	max.
Torque M_x, power on	0.75	0.75	0.75	0.75	N·m	max.
Permissible lateral force	15	15	15	15	N	max.
Permissible torque in θ_y, θ_z	4	4	4	4	N·m	max.
Drive properties						
Motor type	DC motor	DC motor	2-phase stepper motor	2-phase stepper motor		
Operating voltage, nominal	24	24	24	24	V	nom.
Operating voltage, max.	48	48	48	48	V	max.
Step resolution	–	–	200	200	Full steps/rev.	
Miscellaneous						
Operating temperature range	5 to 40	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized	Aluminum, black anodized	Aluminum, black anodized	Aluminum, black anodized		
Mass	0.9	0.9	0.9	1.1	kg	±5 %
Connection	HD Sub-D 15 (m) (motor/sensor)	HD Sub-D 15 (m) (motor) Sub-D 9 (m) (sensor)	HD Sub-D 15 (m)	HD Sub-D 15 (m) (motor) Sub-D 9 (m) (sensor)		
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

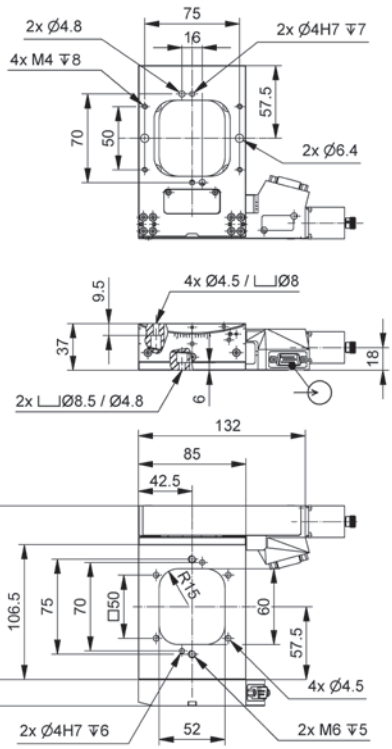
WT-100 Motorized Precision Goniometer

Compact, with Large Aperture

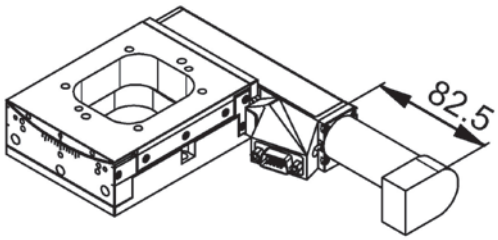


- Rotation range 10°
- Repeatability to 8.7 µrad
- Load capacity to 2 kg
- Option: Direct position measurement with angle measuring system
- Combination with WT-85 with common pivot point

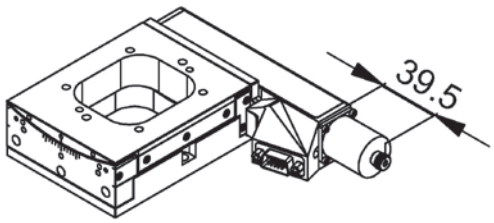
WT-100 goniometer stage, dimensions in mm



WT-100 goniometer stage, DC motor, dimensions in mm



WT-100 goniometer stage, stepper motor,dimensions in mm



Applications

- Sample Inspection
- Precision Micro Assembly
- Metrology / Testing
- Photonics
- Optical Alignment
- Scientific Instrumentation

>> Direct Metrology
>> Vacuum-Compatible Version

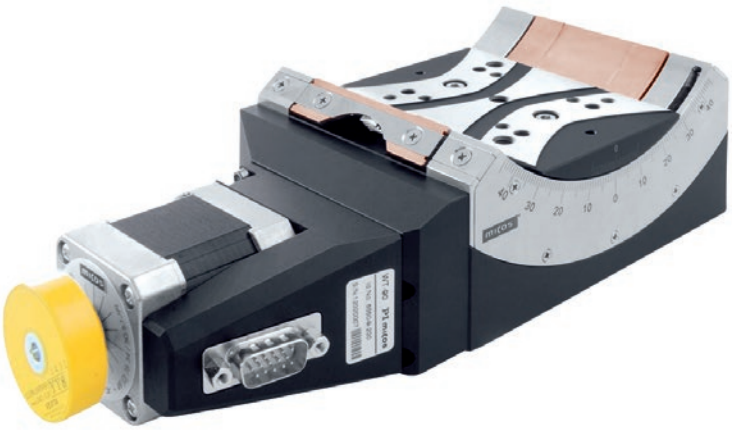
Technology Glossary ..... page 290

	65419100	65419101	65419200-0000	65419201-0001	Unit	Tolerance
	DC motor with rotary encoder	DC motor with angle measuring system and rotary encoder	With stepper motor	Stepper motor and angle measuring system		
Active axes	θ_X	θ_X	θ_X	θ_X		
Motion and positioning						
Rotation range	10	10	10	10	°	
Integrated sensor	Rotary encoder	Incremental angle measuring system Rotary encoder	–	Incremental angle measuring system		
Sensor signal rotary encoder	AB quadrature, RS-422	AB quadrature, RS-422	–	–		
Sensor signal angle measuring system	–	Sin/cos, 1 V peak-peak	–	Sin/cos, 1 V peak-peak		
Sensor signal periods angle measuring system	–	157	–	157	µrad	
Sensor resolution rotary encoder	2000	2000	–		Cts./rev.	
Design resolution	3.49	1.57	34.9	1.57	µrad	
Minimum incremental motion	17.5	8.7	17.5	8.7	µrad	typ.
Unidirectional repeatability	70	8.7	70	8.7	µrad	typ.
Bidirectional repeatability	±70	±8.7	±70	±8.7	µrad	typ.
Wobble	±125	±125	±125	±125	µrad	typ.
Angular velocity	15	15	7	7	°/s	max.
Limit switches	2 × mechanical	2 × mechanical	2 × mechanical	2 × mechanical		
Mechanical properties						
Drive screw type	Ball screw	Ball screw	Ball screw	Ball screw		
Drive screw pitch	1	1	1	1	mm	
Guide type	Ball bearings	Ball bearings	Ball bearings	Ball bearings		
Gear ratio	900:1	900:1	900:1	900:1		
Load capacity	20	20	20	20	N	max.
Permissible lateral force	15	15	15	15	N	max.
Permissible torque in θ_Y, θ_Z	4	4	4	4	N·m	max.
Drive properties						
Motor type	DC motor	DC motor	2-phase stepper motor	2-phase stepper motor		
Operating voltage, nominal	24	24	24	24	V	nom.
Operating voltage, max.	48	48	48	48	V	max.
Step resolution	–	–	200	200	Full steps/ rev.	
Miscellaneous						
Operating temperature range	5 to 40	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized, steel	Aluminum, black anodized, steel	Aluminum, black anodized, steel	Aluminum, black anodized, steel		
Mass	0.9	0.9	0.9	0.9	kg	±5 %
Connection	HD Sub-D 15 (m)	HD Sub-D 15 (m) (motor) Sub-D 9 (m) (sensor)	HD Sub-D 15 (m) (motor)	HD Sub-D 15 (m) (motor Sub-D 9 (m) (sensor)		
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

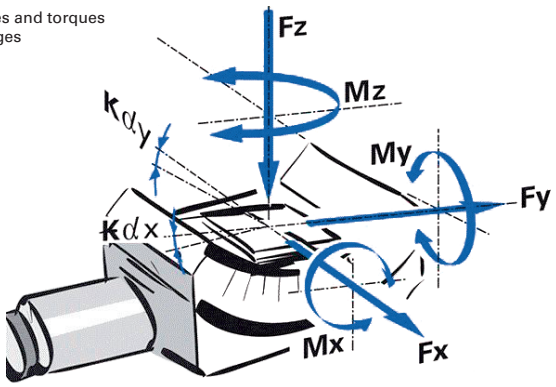
WT-90 Motorized Precision Goniometer

Long Travel Range

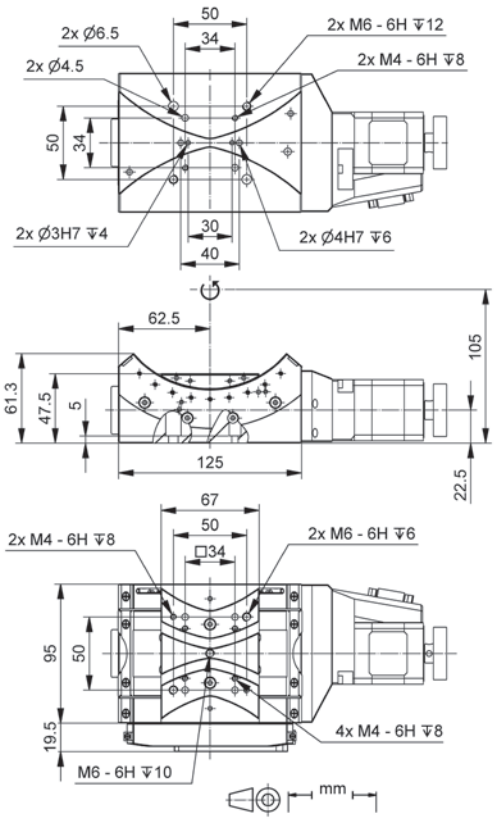


- Rotation range 90°
- Repeatability to 2.7 µrad
- Load capacity to 8 kg
- Option: Direct position measurement with angle measuring system
- Combination with WT-120 with common pivot point

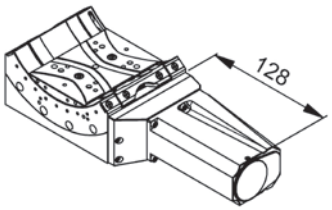
Direction of the axes and torques for goniometer stages



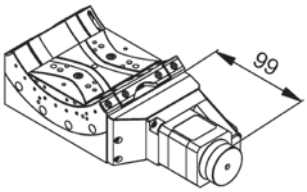
WT-90 goniometer stage, dimensions in mm



WT-90 goniometer stage, DC motor, dimensions in mm



WT-90 goniometer stage, stepper motor, dimensions in mm



Applications

- Sample Inspection
- Precision Micro Assembly
- Metrology / Testing
- Photonics
- Optical Alignment
- Scientific Instrumentation

>> Direct Metrology
>> Vacuum-Compatible Version

Technology Glossary ..... page 290

	65509100	65509200	65509201	Unit	Tolerance
	With DC motor	With stepper motor	With stepper motor and angle measuring system		
Active axes	θ_X	θ_X	θ_X		
Motion and positioning					
Rotation range	90	90	90	°	
Integrated sensor	Rotary encoder	–	Incremental angle measuring system		
Sensor signal rotary encoder	AB quadrature, RS-422	–	–		
Sensor signal angle measuring system		–	Sin/cos, 1 V peak-peak		
Sensor resolution rotary encoder	20000	–	–		
Sensor signal periods angle measuring system	–	–	269.3	µrad	
Design resolution	1.047	105	2.69	µrad	
Minimum incremental motion	52.4	4.8	2.7	µrad	typ.
Unidirectional repeatability	87	9.6	17.5	µrad	typ.
Bidirectional repeatability	±350	±175	±17.5	µrad	typ.
Wobble	±125	±125	±125	µrad	typ.
Angular velocity	15	10	10	°/s	max.
Limit switches	2 × mechanical	2 × mechanical	2 × mechanical		
Mechanical properties					
Guide type	Ball bearings	Ball bearings	Ball bearings		
Drive screw type	Worm gear	Worm gear	Worm gear		
Drive screw pitch				mm	
Worm gear ratio	300:1	300:1	300:1		
Torque, power on	2.5	2.5	2.5	N·m	max.
Holding torque, power off	2.5	2.5	2.5	N·m	max.
Load capacity	80	80	80	N	max.
Permissible lateral force	50	50	50	N	max.
Permissible torque in θ_Y, θ_Z	12	12	12	N·m	max.
Drive properties					
Motor type	DC motor	2-phase stepper motor	2-phase stepper motor		
Step resolution	–	200	200	Full steps/ rev.	
Miscellaneous					
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized, stainless steel, red bronze	Aluminum, black anodized, stainless steel, red bronze	Aluminum, black anodized, stainless steel, red bronze		
Mass	2.8	2.8	3	kg	±5 %
Connection	Sub-D 15 (m)	HD Sub-D 15 (m)	HD Sub-D 15 (m) (motor) Sub-D 9 (m) (sensor)		
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

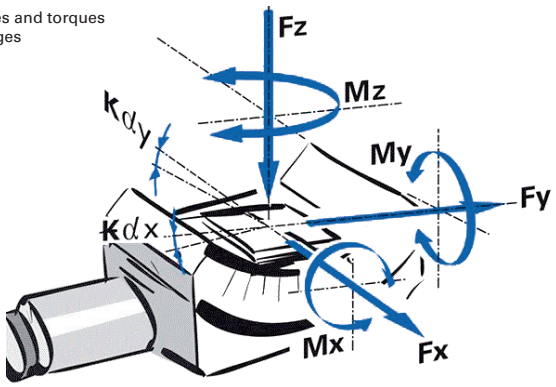
Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

WT-120 Motorized Precision Goniometer

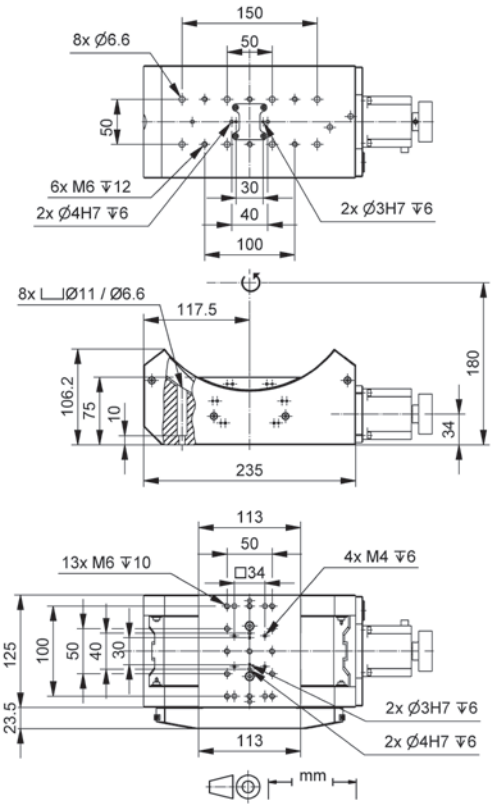
Long Travel Range, High Loads

- Rotation range 90°
- Repeatability to 17.5 µrad
- Load capacity to 20 kg
- Option: Direct position measurement with angle measuring system
- Combination with WT-90 with common pivot point

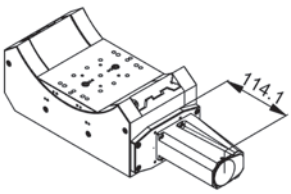
Direction of the axes and torques for goniometer stages



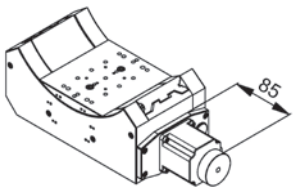
WT-120 goniometer stage, dimensions in mm



WT-120 goniometer stage, DC motor, dimensions in mm



WT-120 goniometer stage, stepper motor, dimensions in mm



Applications

- Sample Inspection
- Precision Micro Assembly
- Metrology / Testing
- Photonics
- Optical Alignment
- Scientific Instrumentation

>> Direct Metrology
>> Vacuum-Compatible Version

Technology Glossary ..... page 290

	65609110	65609200	65609211	Unit	Tolerance
	With DC motor	With stepper motor	With stepper motor and angle measuring system		
Active axes	θ_X	θ_X	θ_X		
Motion and positioning					
Rotation range	90	90	90	°	
Integrated sensor	Rotary encoder	–	Incremental angle measuring system		
Sensor signal rotary encoder	AB quadrature, RS-422	–	–		
Sensor signal angle measuring system		–	Sin/cos, 1 V peak-peak		
Sensor resolution rotary encoder	20000	–	–		
Sensor signal periods angle measuring system	–	–	150	µrad	
Design resolution	1.745	174.5	1.5	µrad	
Minimum incremental motion	69.8	69.8	17.5	µrad	typ.
Unidirectional repeatability	87	87	17.5	µrad	typ.
Bidirectional repeatability	±350	±350	±17.5	µrad	typ.
Wobble	±125	±125	±125	µrad	typ.
Angular velocity	30	25	25	°/s	max.
Limit switches	2 × mechanical	2 × mechanical	2 × mechanical		
Mechanical properties					
Guide type	Ball bearings	Ball bearings	Ball bearings		
Drive screw type	Worm gear	Worm gear	Worm gear		
Drive screw pitch				mm	
Worm gear ratio	180:1	180:1	180:1		
Torque, power on	8	8	8	N·m	max.
Load capacity	200	200	200	N	max.
Permissible lateral force	90	90	90	N	max.
Permissible torque in θ_Y, θ_Z	25	25	25	N·m	max.
Drive properties					
Motor type	DC motor	2-phase stepper motor	2-phase stepper motor		
Step resolution	–	200	200	Full steps/ rev.	
Miscellaneous					
Operating temperature range	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum, black anodized, stainless steel, red bronze	Aluminum, black anodized, stainless steel, red bronze	Aluminum, black anodized, stainless steel, red bronze		
Mass	11.5	11.5	11.5	kg	±5 %
Connection	Sub-D 15 (m)	LEMO ERA.3S.316 16-pin	LEMO ERA.3S.316 16-pin (motor) Sub-D 9 (m) (sensor)		
Recommended controllers / drivers	C-863 (single axis) with C-863.AD12 line driver C-884 (to 6 axes) with C-863.AD12 line driver C-885 with C-863.20C885 (to 40 axes) and C-863.AD12 line driver ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

Connecting cables for motor and sensor are not in the scope of delivery and must be ordered separately.
Ask about custom designs!

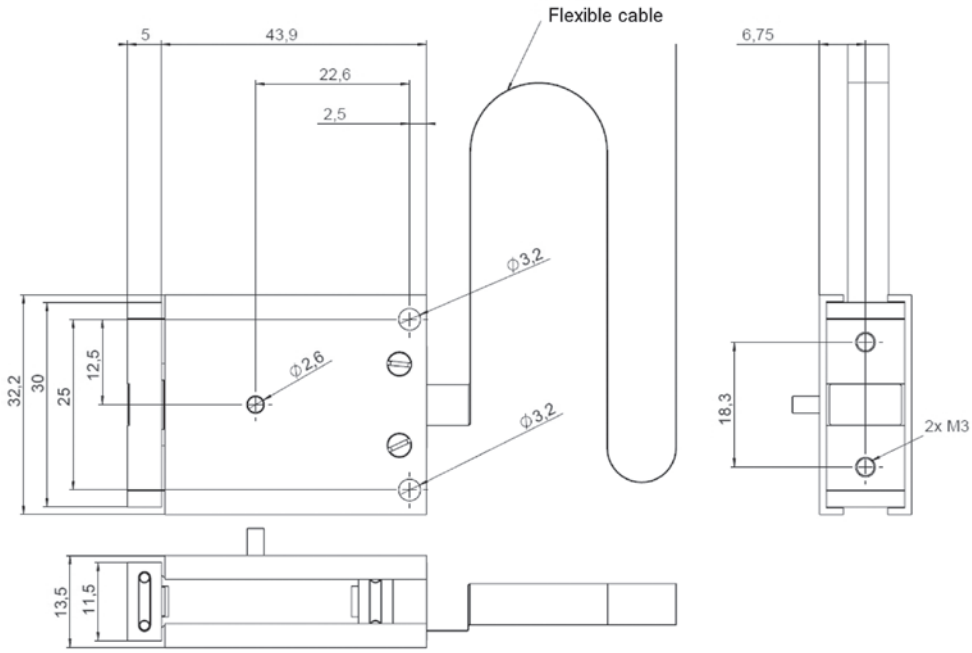
Linear Actuators

V-900KPIC PIMag® VC Vertical Linear Actuator

Compact with Integrated Position Sensor

- Travel range 1.5 mm
- High scanning frequencies, fast step-and-settle
- Integrated linear encoder with 0.1 µm resolution
- Wear-free flexure guide for long lifetime
- Compact dimensions
- OEM linear actuator

V-900KPIC, dimensions in mm



Applications

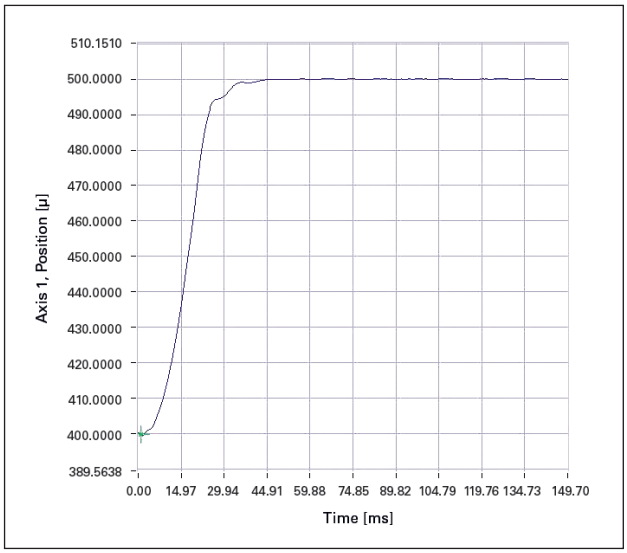
- Sample Inspection
- Precision Micro Assembly
- Electronics Manufacturing
- Metrology / Testing
- General Automation

>> Flexure Guiding System
>> Incremental Encoder
>> PIMag® Voice Coil

Technology Glossary ..... page 290

	V-900KPIC	Unit	Tolerance
Active axes	Z		
Motion and positioning			
Travel range	1.5	mm	
Integrated sensor	Optical linear encoder		
Servo update rate	10*	kHz	
Resolution, open loop	10*	nm	typ.
Resolution, closed loop	100	nm	typ.
Linearity error, closed loop	±1	%	typ.
Repeatability	±500	nm	typ.
Motion straightness	±5	µm	±5
Velocity, open loop	250	mm/s	max.
Velocity, closed loop	45	mm/s	
Mechanical properties			
Moved mass	10	g	typ.
Average push/pull force	0.5	N	nominal
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 pins		
Lifetime	>10^8	cycles	min.
Recommended controller	C-413 (plug adapter required)		

* With C-413 controller.
** Do not exceed for continuous operation.



The settling time for a 100 µm step is approx. 50 ms.

V-273 PIMag® Voice Coil Linear Actuator

High Dynamics and Inexpensive

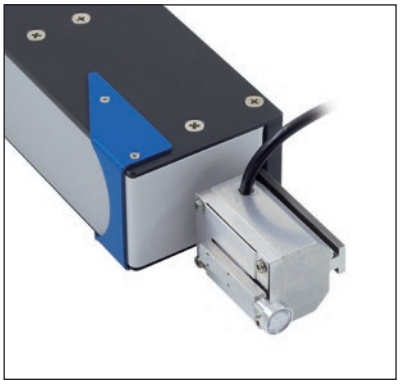
- Travel ranges to 20 mm
- Velocity to 100 mm/s
- Integrated linear encoder, 0.01 µm resolution
- Optional force sensor with 1 mN resolution

PIMag® Voice Coil

Voice coil drives consist of 2 essential components: A permanent magnet and a coil, which is located in the air gap of the magnetic field. When current flows through the coil, it moves in the magnetic field of the permanent magnet. The direction of motion depends on the polarity. Thanks to their low weight and friction-free drive principle, voice coil drives are particularly suitable for applications, which require high dynamics and high velocities at limited travel ranges. High scan frequencies and precision positioning are also possible with these drives, because they are free of the effects of hysteresis.

Highly accurate position measuring with incremental linear encoder

Noncontact optical linear encoders measure the actual position directly at the motion platform with the greatest accuracy so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring.



V-273.441 with force sensor

Applications

- Sample Inspection
- Precision Micro Assembly
- Electronics Manufacturing
- Metrology / Testing
- General Automation

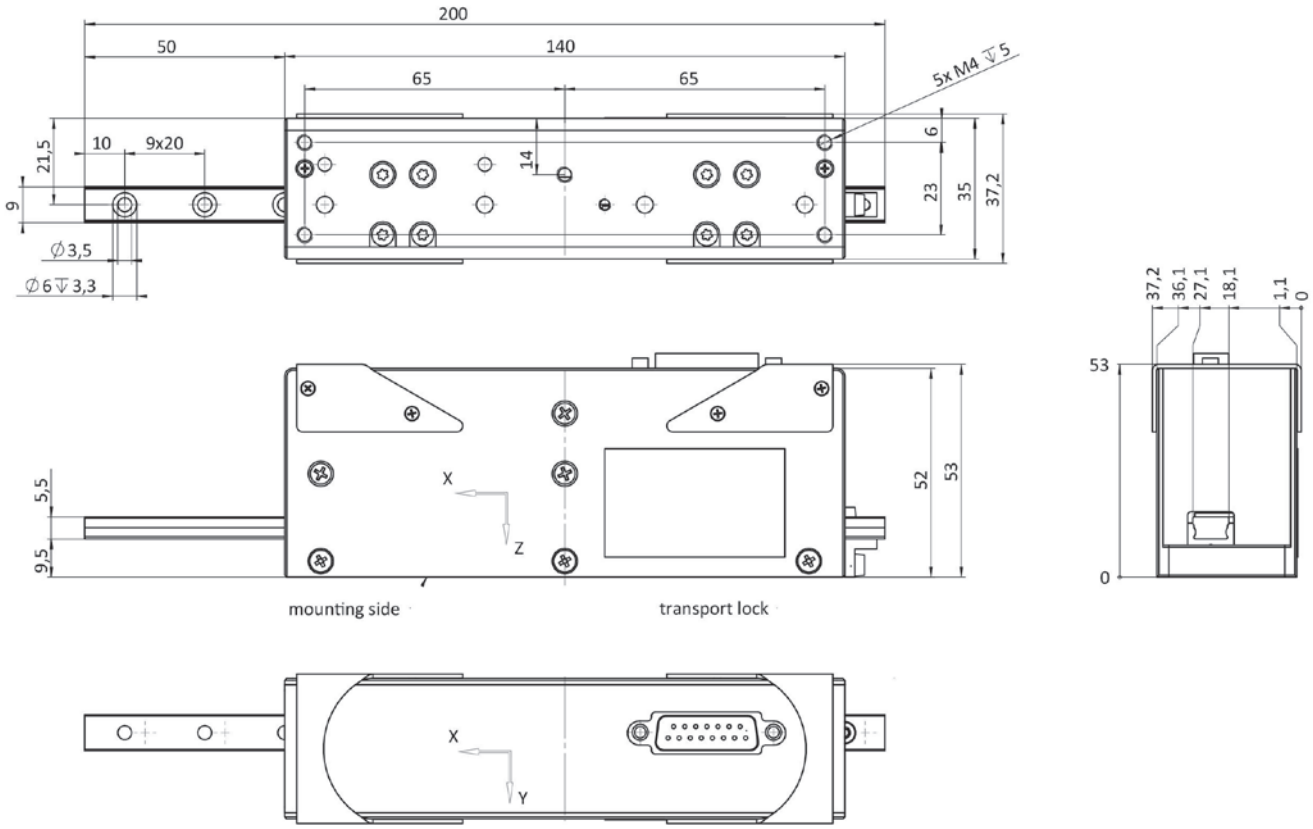
>> Incremental Encoder
>> PIMag® Voice Coil

Technology Glossary ..... page 290

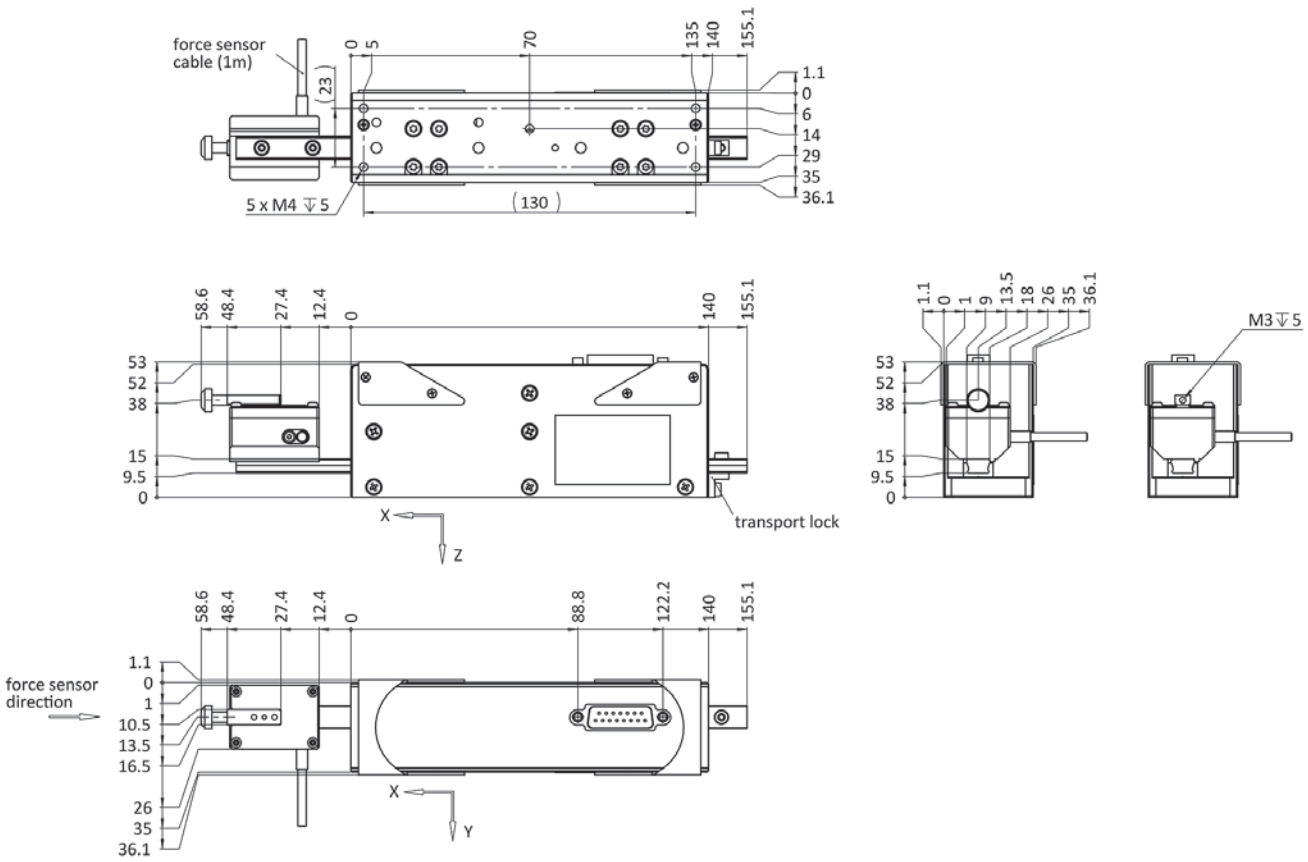
	V-273.440 V-273.441 with force sensor	Unit	Tolerance
Active axes	Z		
Motion and positioning			
Travel range	20	mm	
Integrated sensor	Optical linear encoder		
Sensor resolution	10 (1)	nm	max.
Minimum incremental motion	100	nm	typ.
Linearity error, closed loop	1	%	typ.
Repeatability	±0.5	µm	typ.
Velocity	100	mm/s	max.
Force sensor resolution (optional)	1	mN	max.
Smallest force step (optional)	5	mN	typ.
Mechanical properties			
Bearing / guide	Recirculating ball bearings		
Motion straightness	±20	µm	±5 %
Moved mass without load	100 (230 with force sensor)	g	typ.
Drive properties			
Motor type	PIMag® Voice Coil Drive, moving coil		
Coil resistance	16	Ω	typ., at 20 °C
Coil inductance	6	mH	typ., at 20 °C
Time constant	0.375	ms	
Back EMF	8	V·s/m	
Force constant	8	N/A	typ.
Motor constant	2	N/(√W)	
Current constant	0.125	A/N	typ.
Average continuous current	375 (2)	mA	max.
Peak current (max. 3 s)	800	mA	
Average push/pull force	3	N	nominal
Power dissipation of the coil with 100 % duty cycle	2.25	W	
Maximum push/pull force	6	N	max.
Miscellaneous			
Operating temperature range	10 to 60	°C	
Material	Aluminum		
Mass	660 (790 with force sensor)	g	±5 %
Cable length	1	m	
Motor / sensor connection	Sub-D 15 (m) with force sensor: 2 × Sub-D 15 (m)		
Lifetime	$>10^7$	cycles	min.
Recommended controller	C-413.2x		

(1) With C-413 controller.
(2) Do not exceed for continuous operation.

V-273.440, dimensions in mm



V-273.441, dimensions in mm



V-275 PIMag® Voice Coil Linear Actuator

High Dynamics, with Optional Force Control

- Push force up to 10 N
- Velocity to 600 mm/s
- Integrated linear encoder, 0.01 µm resolution
- Weight force compensation
- Optional force sensor with 1 mN resolution

PIMag® Voice Coil

Voice coil drives consist of 2 essential components: A permanent magnet and a coil, which is located in the air gap of the magnetic field. When current flows through the coil, it moves in the magnetic field of the permanent magnet. The direction of motion depends on the polarity. Thanks to their low weight and friction-free drive principle, voice coil drives are particularly suitable for applications, which require high dynamics and high velocities at limited travel ranges. High scan frequencies and precision positioning are also possible with these drives, because they are free of the effects of hysteresis.

Highly accurate position measuring with incremental linear encoder

Noncontact optical linear encoders measure the actual position directly at the motion platform with the greatest accuracy so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring.

Applications

- Sample Inspection
- Precision Micro Assembly
- Electronics Manufacturing
- Metrology / Testing
- General Automation

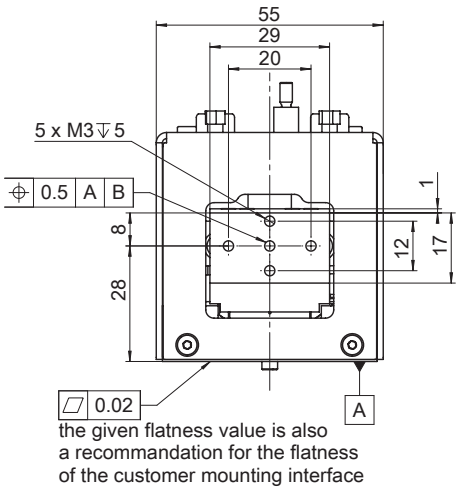
>> Incremental Encoder
>> PIMag® Voice Coil

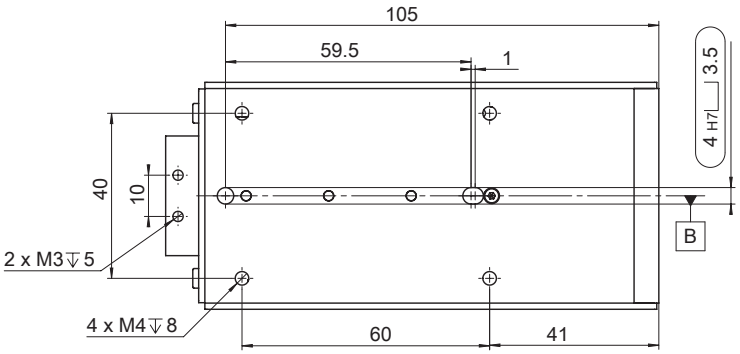
Technology Glossary ..... page 290

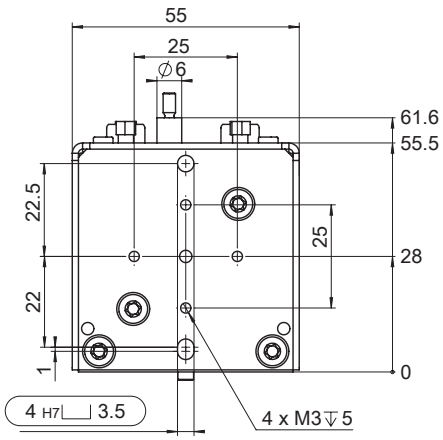
	V-275.430 V-275.431 with force sensor	Unit	Tolerance
Active axes	Z		
Motion and positioning			
Travel range	10	mm	
Integrated sensor	Optical linear encoder		
Sensor resolution	10 (1)	nm	max.
Minimum incremental motion	100	nm	typ.
Linearity error, closed loop	1	%	typ.
Repeatability	±0.5	µm	typ.
Velocity	600	mm/s	max.
Force sensor resolution (optional)	1	mN	max.
Smallest force step (optional)	5	mN	typ.
Mechanical properties			
Bearing / guide	Linear recirculating ball bearings		
Motion straightness	±5	µm	±5 %
Moved mass without load	150	g	typ.
Drive properties		µm	
Motor type	PIMag® voice coil drive, moving coil		
Coil resistance	5.7	Ω	typ., at 20 °C
Coil inductance	3.75	mH	typ., at 1 kHz
Time constant	0.65	ms	
Back EMF	10	V·s/m	
Force constant	10	N/A	typ.
Motor constant	4.2	N/(√W)	
Current constant	0.1	A/N	typ.
Average continuous current	700 (2)	mA	max.
Peak current (max. 3 s)	1500	mA	
Average push/pull force	7	N	nominal
Power dissipation of the coil with 100 % duty cycle	4	W	
Maximum push/pull force	15	N	max.
Miscellaneous			
Operating temperature range	10 to 60	°C	
Material	Aluminum		
Mass	800	g	±5 %
Cable length	3	m	
Motor / sensor connection	Sub-D 25 (m), with force sensor Sub-D 9 (m)		
Lifetime	$>10^7$	cycles	min.
Recommended controller	C-413.1x		

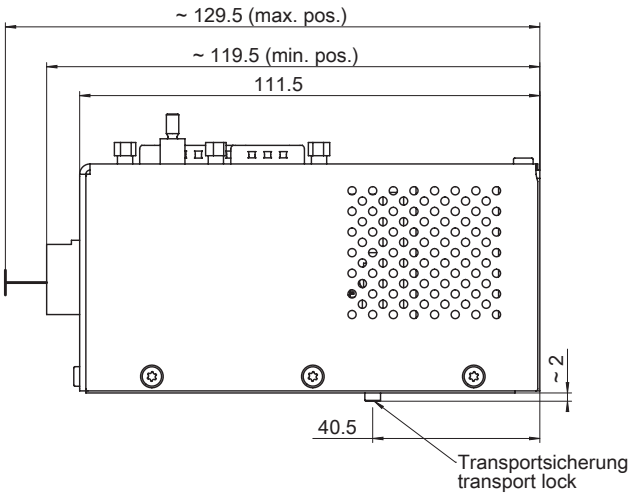
(1) With C-413 controller.
(2) Do not exceed for continuous operation.

V-275.430, dimensions in mm

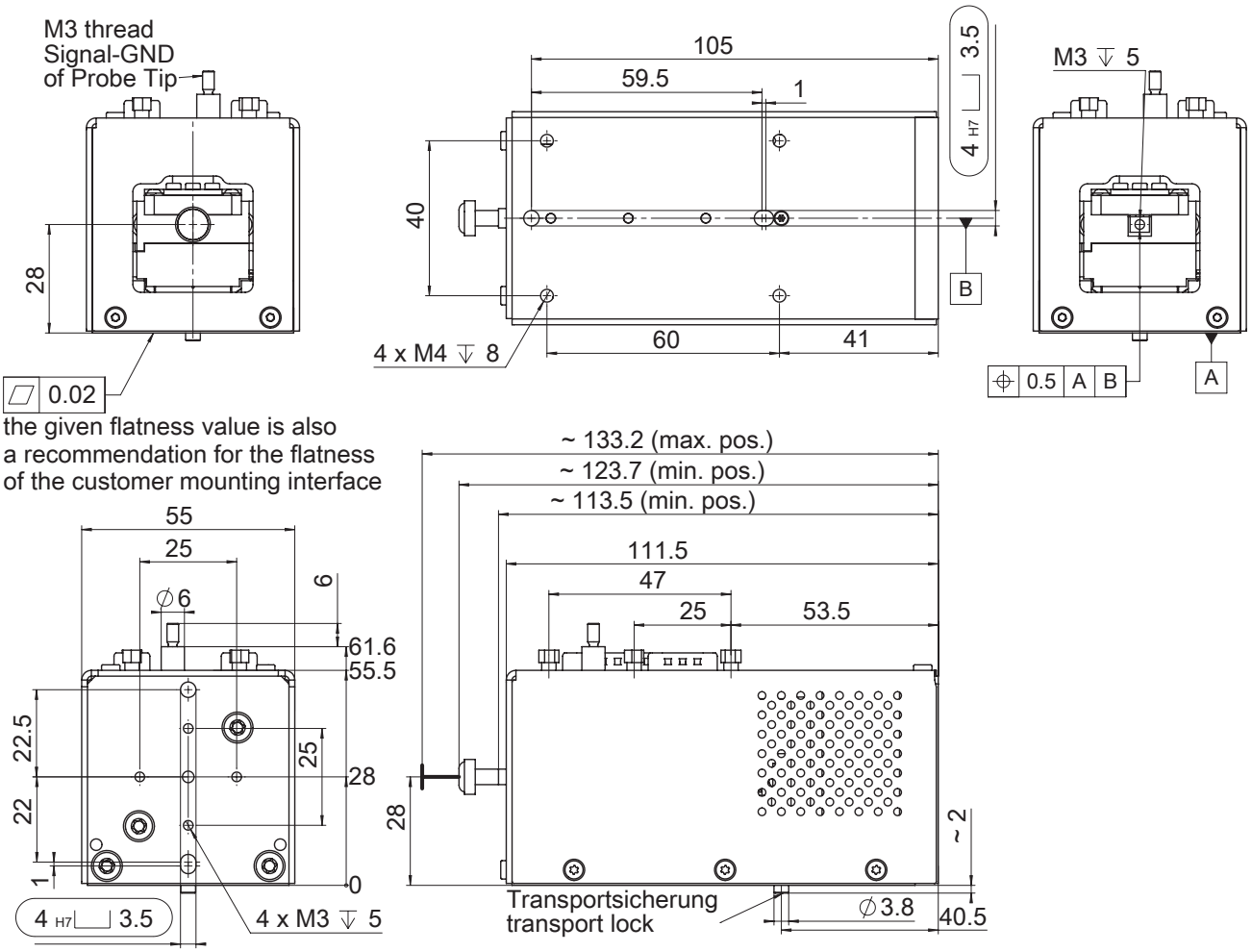








V-275.431, dimensions in mm



V-277 PIMag® High-Load Linear Actuator

Voice Coil Drive for High Velocity

- Force up to 20 N
- Velocity up to 750 mm/s
- Integrated linear encoder, 0.01 µm resolution
- Weight force compensation
- Optional force sensor with 1 mN resolution

PIMag® Voice Coil

Voice coil drives consist of 2 essential components: A permanent magnet and a coil, which is located in the air gap of the magnetic field. When current flows through the coil, it moves in the magnetic field of the permanent magnet. The direction of motion depends on the polarity. Thanks to their low weight and friction-free drive principle, voice coil drives are particularly suitable for applications, which require high dynamics and high velocities at limited travel ranges. High scan frequencies and precision positioning are also possible with these drives, because they are free of the effects of hysteresis.

Highly accurate position measuring with incremental linear encoder

Noncontact optical linear encoders measure the actual position directly at the motion platform with the greatest accuracy so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring.

Applications

- Sample Inspection
- Precision Micro Assembly
- Electronics Manufacturing
- Metrology / Testing
- General Automation

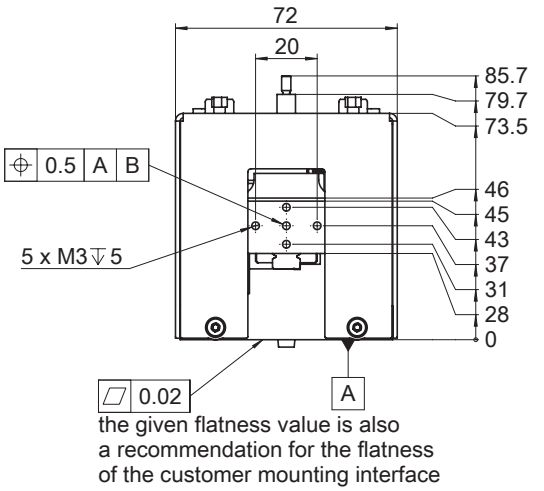
>> Incremental Encoder
>> PIMag® Voice Coil

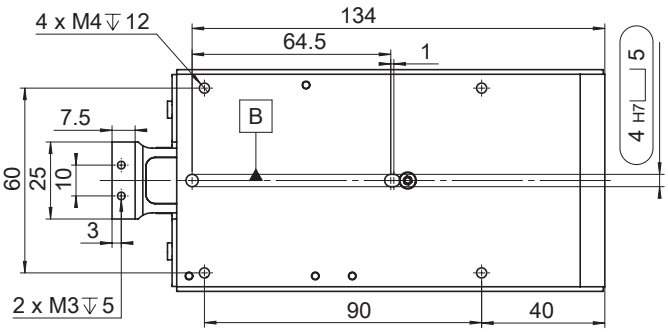
Technology Glossary ..... page 290

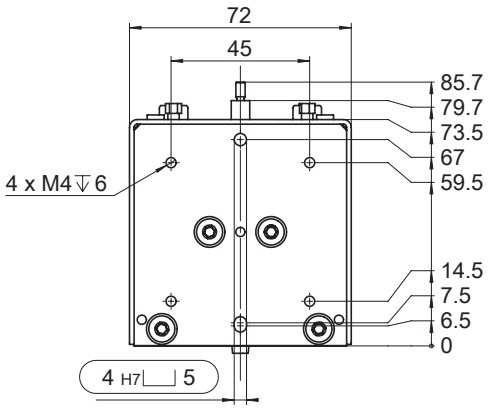
	V-277.630 V-277.631 with force sensor	Unit	Tolerance
Active axes	Z		
Motion and positioning			
Travel range	15	mm	
Integrated sensor	Optical linear encoder		
Sensor resolution	10 (1)	nm	max.
Minimum incremental motion	100	nm	typ.
Linearity error, closed loop	1	%	typ.
Repeatability	±0.5	µm	typ.
Velocity	750	mm/s	max.
Force sensor resolution	1	mN	max.
Force resolution, closed-loop	5	mN	typ.
Mechanical properties			
Bearing / guide	Linear recirculating ball bearings		
Motion straightness	±5	µm	±5 %
Moved mass without load	190	g	typ.
Drive properties			
Motor type	PIMag® voice coil drive, moving coil		
Coil resistance	6.3	Ω	typ., at 20 °C
Coil inductance	2.70	mH	typ., at 1 kHz, at 20 °C
Time constant	0.43	ms	typ.
Back EMF	14	V·s/m	
Force constant	13.5	N/A	typ.
Motor constant	5.6	N/(√W)	
Current constant	0.072	A/N	typ.
Average continuous current	740 (2)	mA	max.
Peak current (max. 3 s)	1500	mA	
Average push/pull force	10	N	nominal
Power dissipation of the coil with 100 % duty cycle	3.2	W	
Maximum push/pull force	20	N	max.
Miscellaneous			
Operating temperature range	10 to 60	°C	
Material	Aluminum		
Mass	1850	g	±5 %
Cable length	3	m	
Motor / sensor connection	Sub-D 25 (m), with force sensor Sub-D 9 (m)		
Lifetime	$>10^7$	cycles	min.
Recommended controller	C-413.1x		

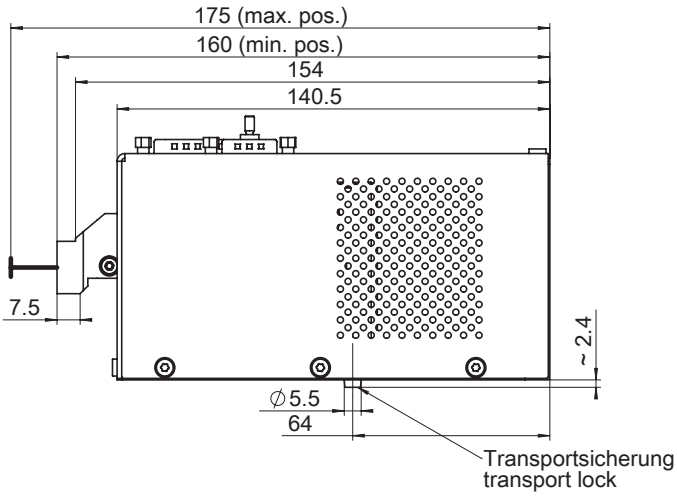
(1) With C-413 controller.
(2) Do not exceed for continuous operation.

V-277.630, dimensions in mm

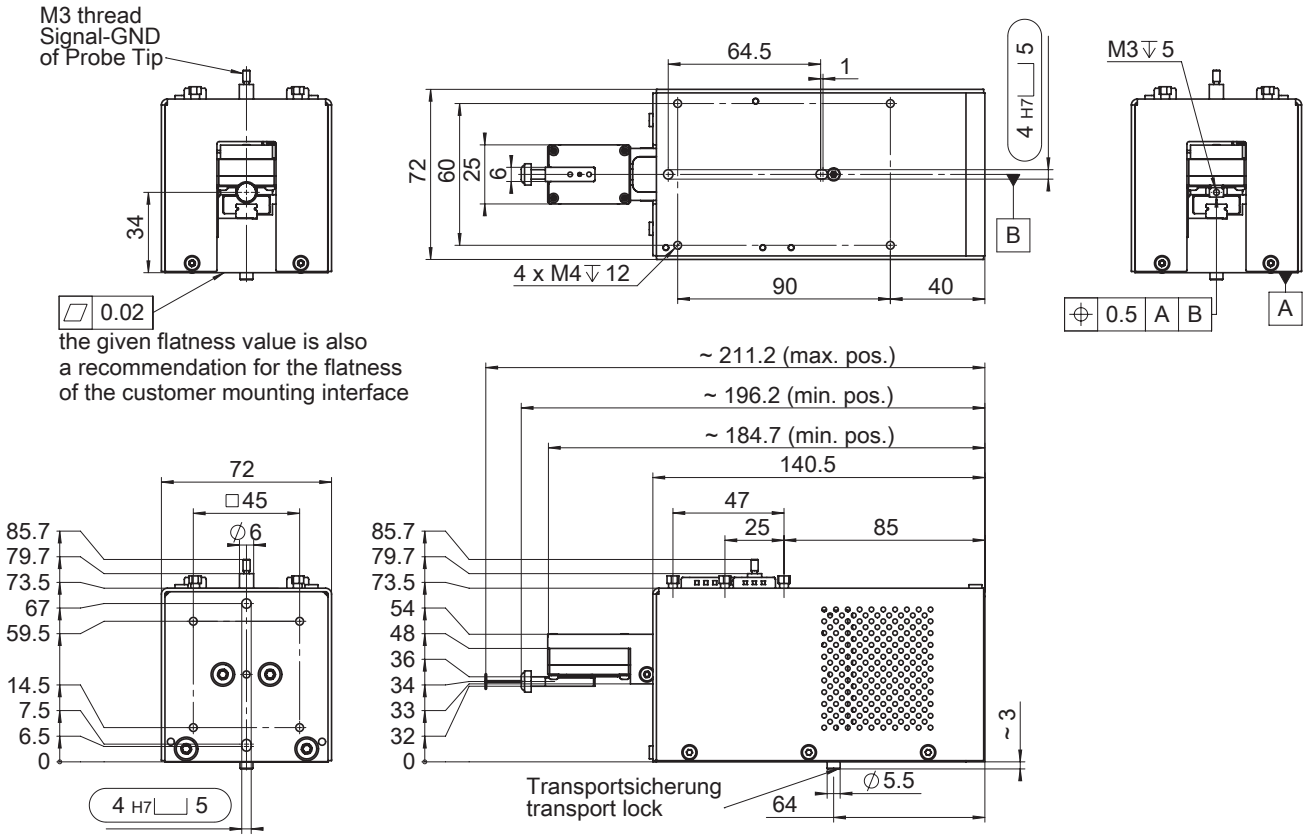








V-277.631, dimensions in mm

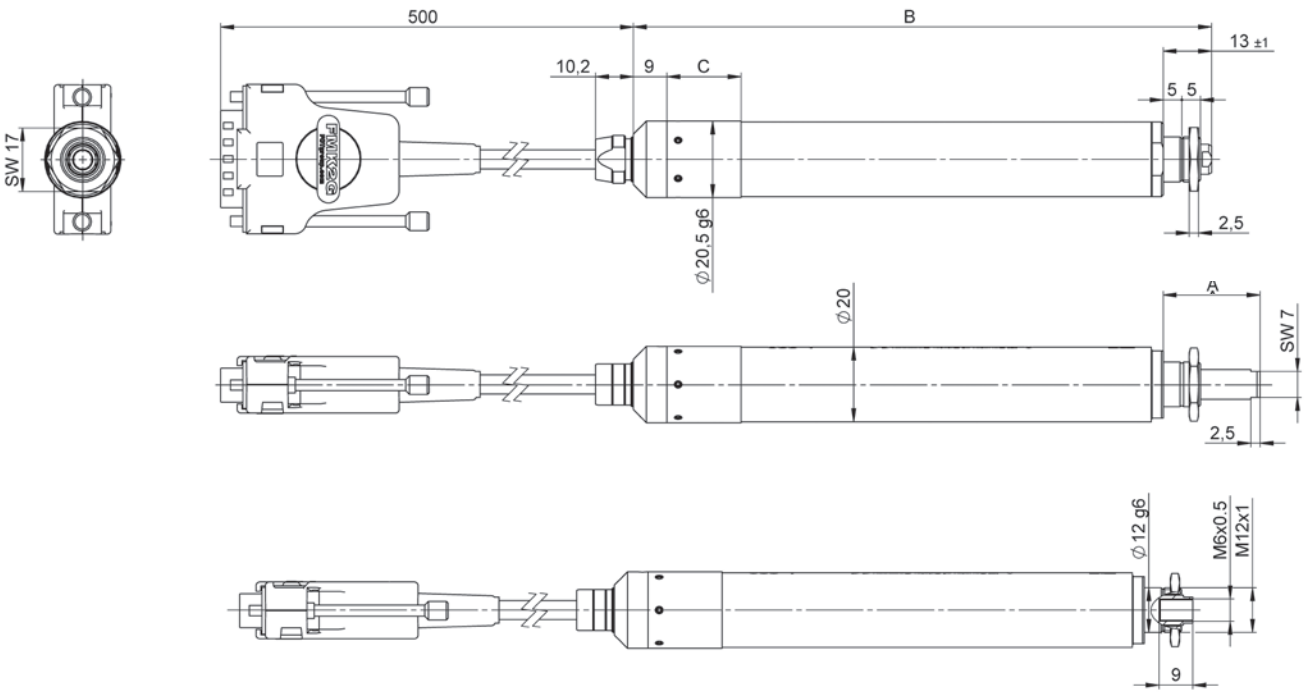


L-220 High-Resolution Linear Actuator

Suitable for a High Number of Cycles

- Forces up to 125 N
- Travel ranges 13 to 77 mm (½″ to 3″)
- DC or stepper motor
- Nonrotating tip
- Vacuum-compatible versions to 10^{-9} hPa on request

L-220, dimensions in mm



	Travel	A	B	C
L-220.10SG	13	26	148,3	13
L-220.10DG	13	26	155,2	19,9
L-220.20SG	26	39	161,5	13
L-220.20DG	26	39	168,4	19,9
L-220.50SG	52	65	186,6	13
L-220.50DG	52	65	193,5	19,9
L-220.70SG	77	90	211,6	13
L-220.70DG	77	90	218,5	19,9

Applications

- Electronics Manufacturing
- General Automation
- Optical Alignment
- Precision Micro Assembly
- Scientific Instrumentation
- Semiconductor

>> Incremental Encoder
>> Vacuum-Compatible Versions

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	L-220.x0DG	L-220.x0SG	Unit	Tolerance
	High precision, with DC gear motor	Stepper motor with gearhead		
Motion axes	X	X		
Motion and positioning				
Travel range	13 / 26 / 52 / 77	13 / 26 / 52 / 77	mm	
Integrated sensor	Rotary encoder	–		
Sensor resolution	2048	–	Cts./rev.	
Design resolution	0.022	0.55 (full step)	µm	typ.
Minimum incremental motion	0.1	0.1	µm	typ.
Unidirectional repeatability	0.5	0.5	µm	typ.
Bidirectional repeatability	±1	±1	µm	typ.
Velocity	3.5	0.8	mm/s	max.
Mechanical properties				
Drive screw type	Ball screw	Ball screw		
Thread pitch	1	1	mm	
Gear ratio	12493:567	387283:5103		
Motor resolution	–	384 (29184)*	Steps/rev.	
Push/pull force	125	125	N	max.
Holding force	80	125	N	typ.
Permissible lateral force	1	1	N	max.
Drive properties				
Motor type	DC motor with gearhead	2-phase stepper motor with gearhead		
Operating voltage, nominal	12	12	V	nom.
Operating voltage, max.	24	48	V	max.
Step resolution	–	24	Full steps/rev.	
Limit and reference point switches	Hall effect	Hall effect		
Miscellaneous				
Operating temperature range	5 to 40	5 to 40	°C	
Material	Stainless steel, red brass	Stainless steel, red brass		
Mass	0.21 / 0.23 / 0.26 /0.29	0.23 / 0.25 / 0.28 /0.32	kg	±5 %
Moved mass	0.02 / 0.02 / 0.025 / 0.030	0.02 / 0.02 / 0.025 / 0.030	kg	±5 %
Cable length	0.5	0.5	m	±10 mm
Connector	HD Sub-D 26 (m)	HD Sub-D 26 (m)		
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller		

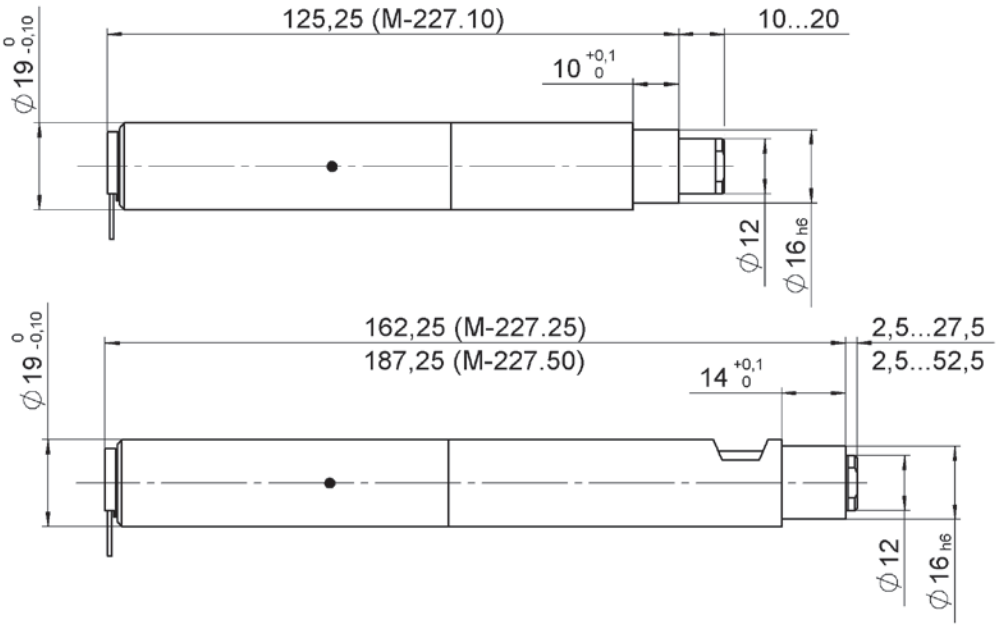
All cables required for operation with the recommended controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

M-227
High-Resolution Linear Actuator with DC Motor

With Optional Piezo Drive

- Min. incremental motion 0.05 µm
- Nonrotating end piece
- Flat tip included
- Subnanometer resolution with optional piezo drive
- For installing into mechanical systems with external limit switches

M-227, dimensions in mm



Applications

- General Automation

>> Incremental Encoder

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	M-227.10 M-227.25 M-227.50	Unit	Tolerance
Motion and positioning			
Travel range	10 / 25 / 50	mm	
Integrated sensor	Rotary encoder		
Sensor resolution	2048	Cts./rev.	
Design resolution	0.0035	µm	typ.
Minimum incremental motion	0.05	µm	typ.
Backlash	10	µm	typ.
Unidirectional repeatability	±0.1	µm	typ.
Velocity	0.75	mm/s	max.
Mechanical properties			
Drive screw	Leadscrew		
Thread pitch	0.5	mm	
Gear ratio	69.12:1		
Push/pull force [1]	40	N	max.
Permissible lateral force	0.1	N	max.
Drive properties			
Motor type	DC gear motor		
Operating voltage	0 to ±12	V	
Motor power	1.78	W	nominal
Miscellaneous			
Operating temperature range	–20 to 65	°C	
Material	Aluminum anodized, chrome steel		
Mass	0.16 / 0.22 / 0.26	kg	±5 %
Cable length	0.1 m + 3 m extension cable (included)	m	±10 mm
Connector	Sub-D 15		
Recommended controllers / drivers	C-863 C-884		

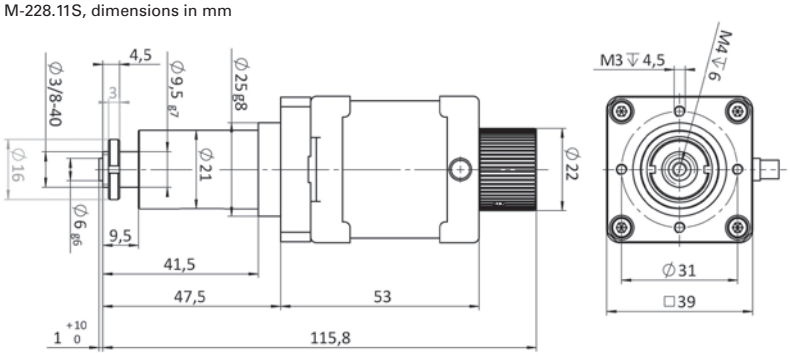
(1) Higher forces on request.
Ask about custom designs!

M-228 / M-229 High-Resolution Linear Actuator with Stepper Motor

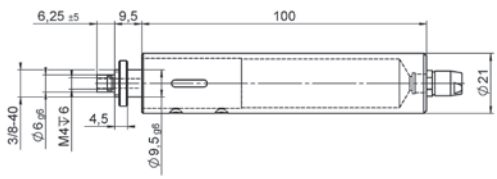
Compact and Extremely Inexpensive

- Travel ranges 10 and 25 mm
- High load capacity 80 N
- Resolution 0.36 nm with gearhead version
- Velocity to 4 mm/s
- Direct drive versions include handwheel
- Noncontact limit and reference point switches

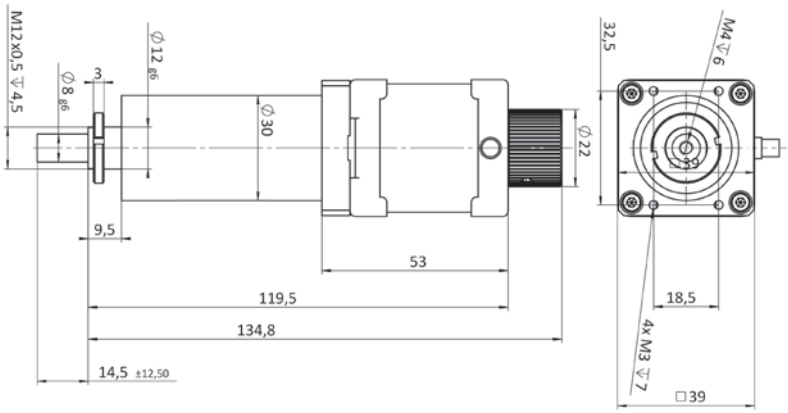
M-228.11S, dimensions in mm



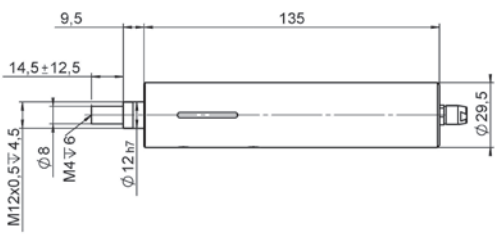
M-228.10S, dimensions in mm



M-229.26S, dimensions in mm



M-229.25S, dimensions in mm



Applications

- General Automation
- Scientific Instrumentation

>> Incremental Encoder

Technology Glossary ..... page 290

	M-228.10S	M-228.11S	M-229.25S	M-229.26S	Unit	Tolerance
	Slim design	Lower cost, higher velocity	Slim design	Lower cost, higher velocity		
Motion and positioning						
Travel range	10	10	25	25	mm	
Design resolution (1)	0.00036	0.00061	0.00036	0.00061	µm	typ.
Min. incremental motion (1)	1	1	1	1	µm	typ.
Backlash (2)	5	10	10	10	µm	typ.
Unidirectional repeatability	±2	±2	±2	±2	µm	typ.
Velocity	1.5	4	1.5	4	mm/s	max.
Reference point switch repeatability	1	1	1	1	µm	typ.
Mechanical properties						
Drive screw type	Leadscrew	Leadscrew	Leadscrew	Leadscrew		
Drive screw pitch	0.5	0.5	0.5	0.5	mm	
Gear ratio	256/9	–	256/9	–		
Push/pull force capacity	20	50	50	80	N	max.
Drive properties						
Motor type	2-phase stepper motor	2-phase stepper motor	2-phase stepper motor	2-phase stepper motor		
Step resolution	24	400	24	400	steps/rev.	
Nominal current per phase	250	850	1000	850	mA	max.
Limit and reference point switches	Hall effect	Hall effect	Hall effect	Hall effect		
Miscellaneous						
Operating temperature range	–20 to 65	–20 to 65	–20 to 65	–20 to 65	°C	
Material	Al (anodized), steel, brass	Al (anodized), steel, brass	Al (anodized), steel, brass	Al (anodized), steel, brass		
Mass	0.23	0.36	0.4	0.61	kg	±5 %
Cable length	0.5 m, incl. 3 m cable	0.6 m, incl. 3 m cable	0.5 m, incl. 3 m cable	0.6 m, incl. 3 m cable	m	±10 mm
Connector	Sub-D 15	Sub-D 15	Sub-D 15	Sub-D 15		
Recommended controller	C-663.12	C-663.12	C-663.12	C-663.12		

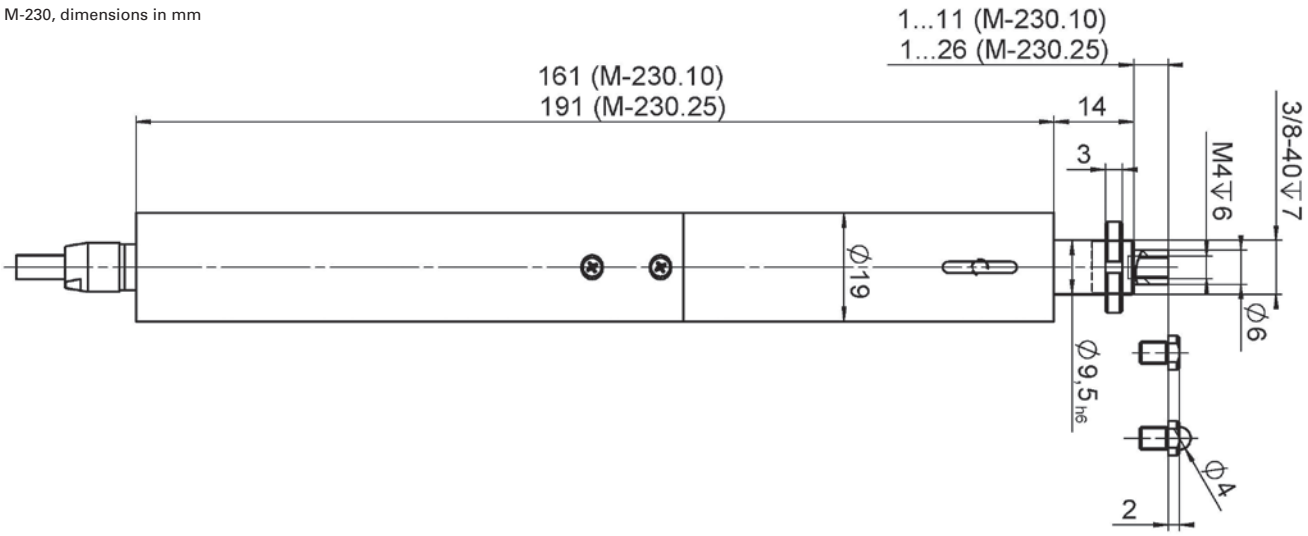
(1) With recommended controller.
(2) With preload.
Avoid lateral forces on the pusher!
Ask about custom designs!

M-230 High-Resolution Linear Actuator with DC Motor

Nonrotating Tip, Limit Switches

- Min. incremental motion 0.05 µm
- Travel ranges 10 and 25 mm
- Nonrotating end piece
- Velocity 0.8 mm/s
- MTBF >20000 h

M-230, dimensions in mm



Applications

- General Automation
- Optical Alignment
- Scientific Instrumentation

>> Incremental Encoder

Technology Glossary ..... page 290

	M-230.10 M-230.25	Unit	Tolerance
	High precision, with DC gear motor		
Motion and positioning			
Travel range	10 / 25	mm	
Integrated sensor	Rotary encoder		
Sensor resolution	2048	Cts./rev.	
Design resolution	0.0046	µm	typ.
Minimum incremental motion	0.05	µm	typ.
Backlash	2	µm	typ.
Unidirectional repeatability	±0.1	µm	typ.
Velocity	0.8	mm/s	max.
Reference point switch repeatability	1	µm	typ.
Mechanical properties			
Drive screw	Leadscrew		
Thread pitch	0.4	mm	
Gear ratio	42.92063:1		
Push/pull force capacity	70	N	max.
Permissible lateral force	30 / 20	N	max.
Drive properties			
Motor type	DC gear motor		
Operating voltage	0 to ±12	V	
Motor power	1.78	W	nominal
Limit and reference point switches	Hall effect		
Miscellaneous			
Operating temperature range	–20 to 65	°C	
Material	Al (anodized), steel, brass		
Mass	0.3 / 0.35	kg	±5 %
Connector	15-pin sub-D, incl. encoder driver		
Recommended controllers / drivers	C-863 C-884		

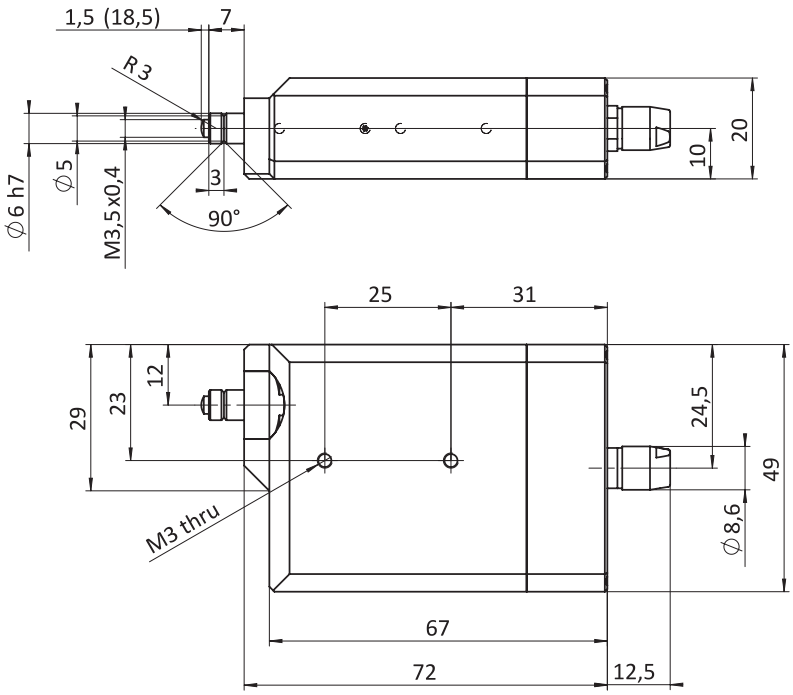
Ask about custom designs!

M-232 High-Resolution Linear Actuator with DC Motor

Compact due to Folded Drive

- Travel range 17 mm
- Min. incremental motion 0.1 µm
- Velocity to 1.5 mm/s
- Closed-loop DC motors
- Rotating end piece, rotating pusher
- MTBF >5000 h

M-232, dimensions in mm



Applications

- General Automation
- Optical Alignment
- Scientific Instrumentation

>> Incremental Encoder

Technology Glossary ..... page 290

	M-232.17	Unit	Tolerance
	High resolution, closed loop		
Motion and positioning			
Travel range	17	mm	
Integrated sensor	Rotary encoder		
Sensor resolution	2048	Cts./rev.	
Design resolution	0.007	µm	typ.
Minimum incremental motion	0.1	µm	typ.
Backlash	2	µm	typ.
Unidirectional repeatability	±0.2	µm	typ.
Velocity	1.5	mm/s	max.
Mechanical properties			
Drive screw	Leadscrew		
Thread pitch	0.4	mm	
Gear ratio	28.44444:1		
Motor resolution	–	steps/rev.	
Push/pull force	40	N	max.
Drive properties			
Motor type	DC gear motor		
Operating voltage	0 to ±12	V	
Motor power	1.78	W	
Limit switches	Hall effect		
Miscellaneous			
Operating temperature range	–20 to 65	°C	
Material	Aluminum anodized, chrome steel		
Mass	0.17	kg	±5 %
Cable length	0.5 + 3 m extension cable (included)	m	±10 mm
Connector	15-pin sub-D, incl. encoder driver		
Recommended controllers / drivers	C-863 C-884		

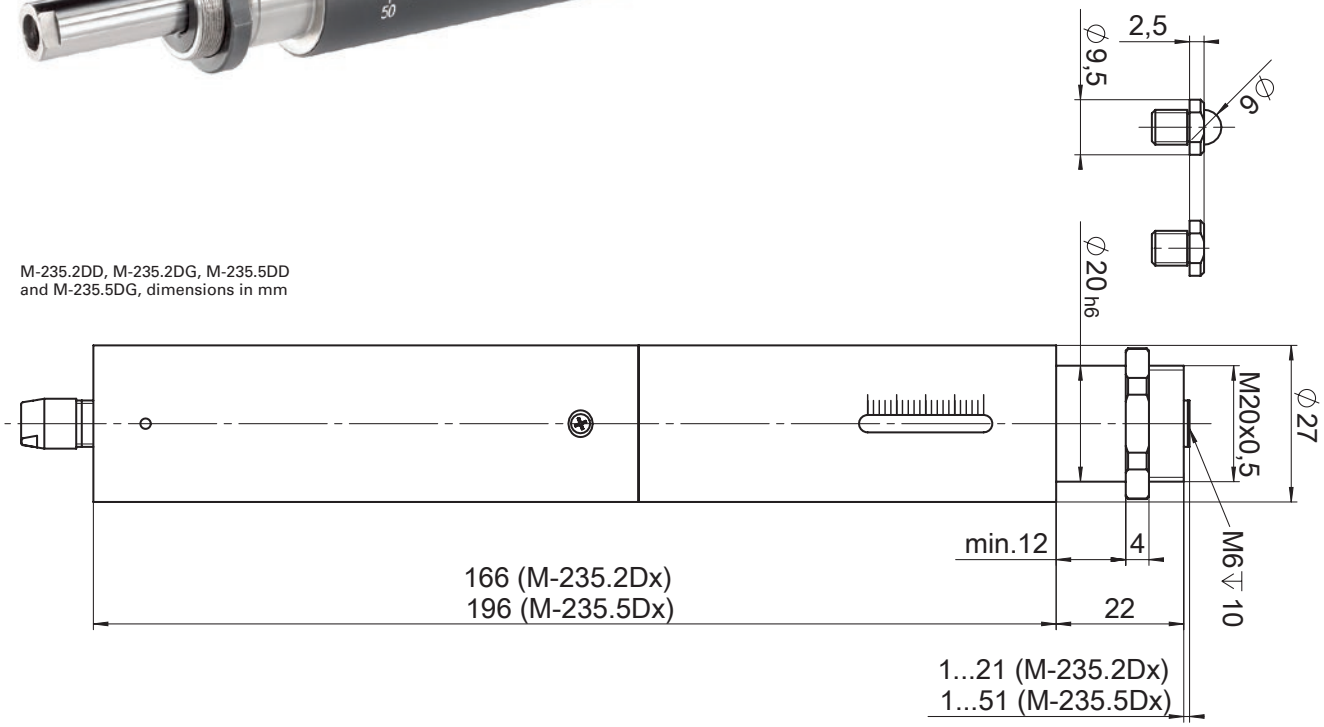
Avoid lateral forces on the pusher!
Ask about custom designs!

M-235 High-Resolution Linear Actuator with DC Motor

Highly Dynamic, High Forces up to 120 N

- Travel ranges 20 and 50 mm
- Min. incremental motion to 0.1 µm
- DC motor allows high velocities
- Push/pull force capacity to 120 N
- MTBF >10000 h
- Nonrotating end piece
- Recirculating ball screw

M-235.2DD, M-235.2DG, M-235.5DD and M-235.5DG, dimensions in mm



Applications

- General Automation
- Optical Alignment
- Scientific Instrumentation

>> Incremental Encoder

Technology Glossary ..... page 290

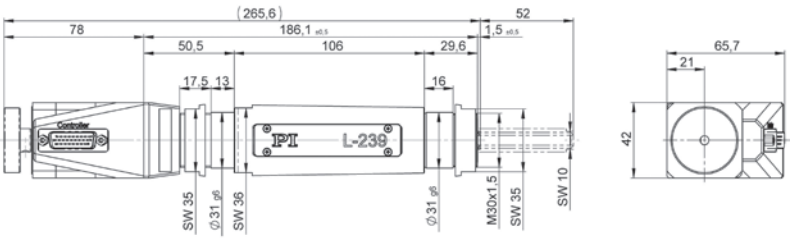
	M-235.2DG M-235.5DG	M-235.2DD M-235.5DD	Unit	Tolerance
	High precision, with DC gear motor	High dynamics		
Motion and positioning				
Travel range	20 / 50	20 / 50	mm	
Integrated sensor	Rotary encoder	Rotary encoder		
Sensor resolution	2048	2048	Cts./rev.	
Design resolution	0.016	0.5	µm	typ.
Minimum incremental motion	0.1	1.5	µm	typ.
Backlash	2	2	µm	typ.
Unidirectional repeatability	±0.1	±0.5	µm	typ.
Velocity	2	30	mm/s	max.
Mechanical properties				
Gear ratio	29.6:1	–		
Push/pull force	120	50	N	max.
Permissible lateral force	8	8	N	max.
Drive properties				
Motor type	DC gear motor	DC motor		
Operating voltage	0 to ±12	0 to ±12	V	
Motor power	4	17	W	nominal
Limit and reference point switches	Hall effect	Hall effect		
Miscellaneous				
Operating temperature range	–20 to 65	–20 to 65	°C	
Material	Aluminum anodized, chrome steel	Aluminum anodized, chrome steel		
Mass	0.55 / 0.7	0.5 / 0.65	kg	±5 %
Cable length	0.5 m, 3 m cables incl.	0.5 m, 3 m cables incl.	m	±10 mm
Connector	15-pin sub-D, incl. encoder driver	15-pin sub-D, incl. encoder driver		
Recommended controllers / drivers	C-863 C-884	C-863 C-884		

Ask about custom designs!

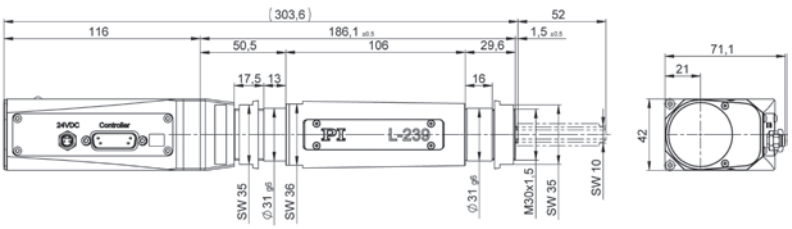
L-239 High-Load Linear Actuator

Dynamic, High-Resolution Precision Drive

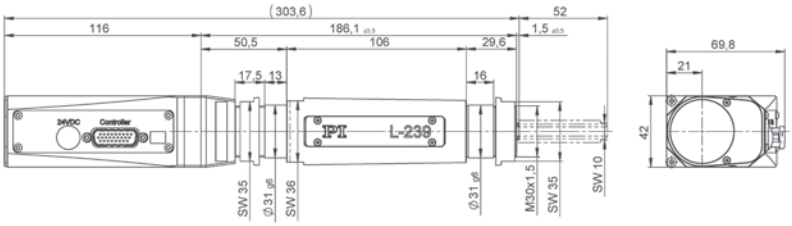
L-239.50SD with stepper motor, dimensions in mm



L-239.50AD with ActiveDrive DC motor, dimensions in mm

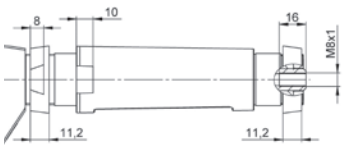


L-239.033232 with DC motor and L-239.035232 with brushless DC motor, dimensions in mm



- Robust design for industrial environments
- High feed force to 300 N
- Travel range 52 mm (2″)
- Minimum incremental motion 0.1 µm
- Velocity to 50 mm/s
- Preloaded, low-friction ball screw
- Vacuum-compatible versions to 10^{-9} hPa on request
- Stepper, DC and BLDC motors

L-239 shaft, dimensions in mm



Applications

- Electronics Manufacturing
- General Automation
- Optical Alignment
- Precision Micro Assembly
- Scientific Instrumentation
- Semiconductor

>> ActiveDrive
>> Incremental Encoder
>> Vacuum-Compatible Versions

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	L-239.50AD L-239.033232 L-239.035232	L-239.50SD	Unit	Tolerance
Motion				
Active axis	X	X		
Travel range	52	52	mm	
Velocity	50	25	mm/s	max.
Positioning				
Integrated sensor	Rotary encoder	–		
Sensor resolution	20000	–	Counts./rev.	
Design resolution	0.05	5 (full step)	µm	typ.
Minimum incremental motion	0.2	0.1	µm	typ.
Unidirectional repeatability	0.2	0.1	µm	typ.
Bidirectional repeatability	±1	±1	µm	typ.
Limit and reference point switches	Hall effect	Hall effect		
Mechanical properties				
Guide type	Recirculating ball bearings	Recirculating ball bearings		
Drive screw type	Ball screw	Ball screw		
Drive screw pitch	1	1	mm	
Push/pull force	300	300	N	max.
Holding force, power off	40	80		
Permissible lateral force	10	10	N	max.

	L-239.50AD	L-239.50SD	L-239.033232	L-239.035232	Unit	Tolerance
Drive properties						
Motor type	DC motor with PWM control	2-phase stepper motor	DC motor	BLDC motor		
Operating voltage, nominal	24	24	24	24	V	nom.
Operating voltage, max.	24	48	48	48		max.
Step resolution	–	200	–	–	Full steps/rev.	
Miscellaneous						
Operating temperature range	5 to 40	5 to 40	5 to 40	5 to 40	°C	
Material	Aluminum, stainless steel	Aluminum, stainless steel	Aluminum, stainless steel	Aluminum, stainless steel		
Mass	1.72	1.65	1.75	1.75	kg	±5 %
Moved mass	0.155	0.155	0.155	0.155	kg	±5 %
Connector	Sub-D 15 (m)	HD Sub-D 26 (m)	HD Sub-D 26 (m)	HD Sub-D 26 (m)		
Recommended controllers / drivers	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-663.12 (single axis) SMC Hydra (double axis) C-885 with C-663.12C885 (up to 20 axes) ACS modular controller	C-863 (single axis) C-884 (up to 6 axes) C-885 with C-863.20C885 (to 40 axes) ACS modular controller	C-891 (single axis) C-885 with C-891.10C885 (up to 20 axes) ACS modular controller		

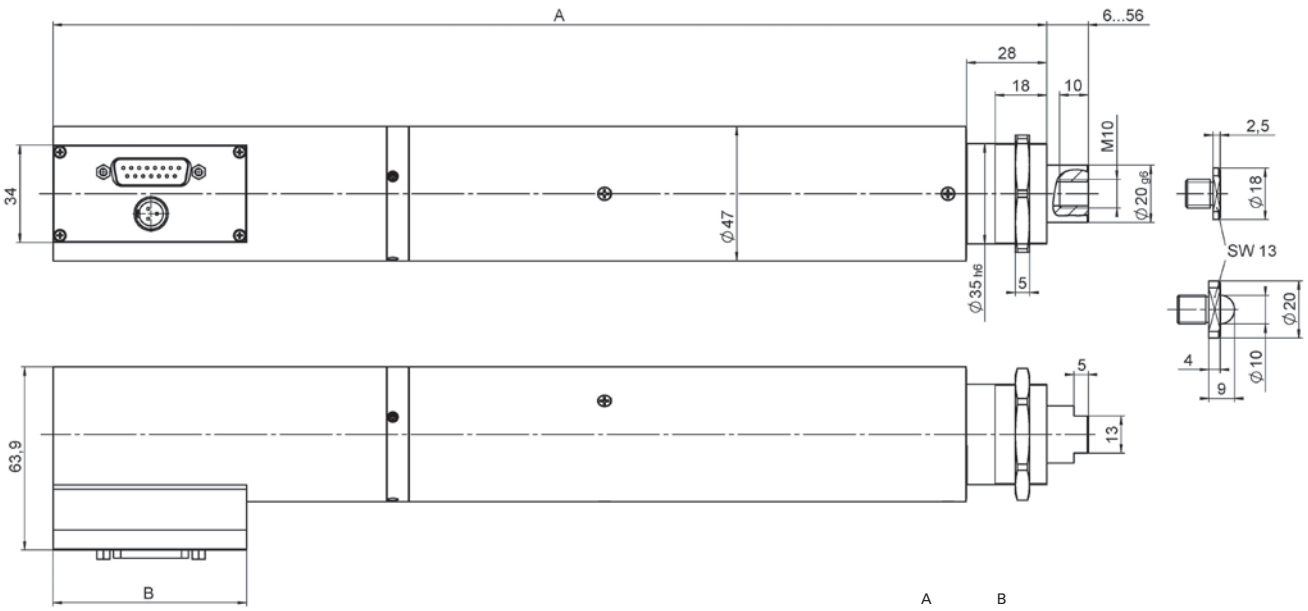
All cables required for operation with the recommended controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

M-238 High-Load Linear Actuator with DC Motor

Dynamic, High-Resolution Precision Drive

- Optional linear encoder for direct position measurement
- High load capacity to 400 N
- Travel range 50 mm
- Resolution to 0.1 µm
- Velocity to 30 mm/s
- Nonrotating end piece
- Recirculating ball screw

M-238, dimensions in mm



A	B
336,2	90
347,2	67,6

Applications

- General Automation
- Optical Alignment
- Scientific Instrumentation

>> ActiveDrive
>> Incremental Encoder
>> Linear Encoder

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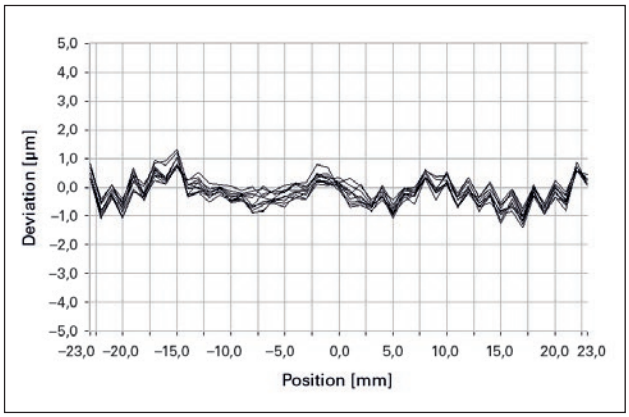
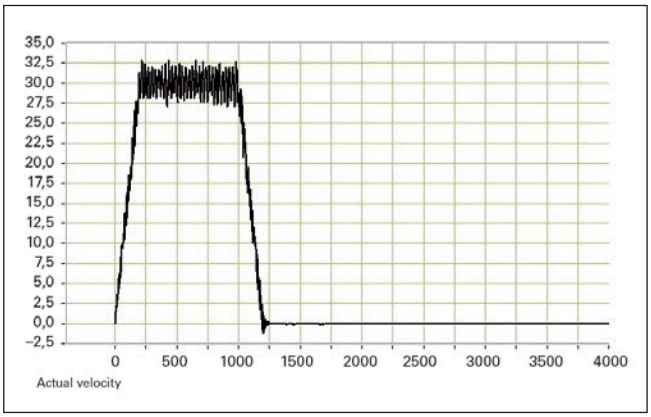
	M-238.5PG	M-238.5PL	Unit	Tolerance
	Rotary encoder on motor shaft	Highest precision with linear encoder		
Motion and positioning				
Travel range	50	50	mm	
Integrated sensor	Rotary encoder	Linear encoder		
Sensor resolution	4000 cts/rev	0.1 µm		
Design resolution	0.13	0.1	µm	typ.
Minimum incremental motion	0.5	0.3	µm	typ.
Backlash	3	1	µm	typ.
Unidirectional repeatability	±1	±0.3	µm	typ.
Velocity	30	30	mm/s	max.
Reference point switch repeatability	1	1	µm	typ.
Mechanical properties				
Drive screw pitch	2	2	mm	
Gear ratio	3.71:1	3.71:1		
Push/pull force	400	400	N	max.
Permissible lateral force	100	100	N	max.
Drive properties				
Motor type	DC motor, ActiveDrive	DC motor, ActiveDrive		
Motor voltage	24 V	24 V	V	
Motor power	80	80	W	nominal
Miscellaneous				
Operating temperature range	–10 to 50	–10 to 50	°C	
Material	Aluminum anodized, chrome steel	Aluminum anodized, chrome steel		
Mass	2.4	2.4	kg	±5 %
Cable length	3	3	m	±10 mm
Connector	Sub-D 15	Sub-D 15		
Recommended controllers / drivers	C-863 C-884	C-863 C-884		

Ask about custom designs!



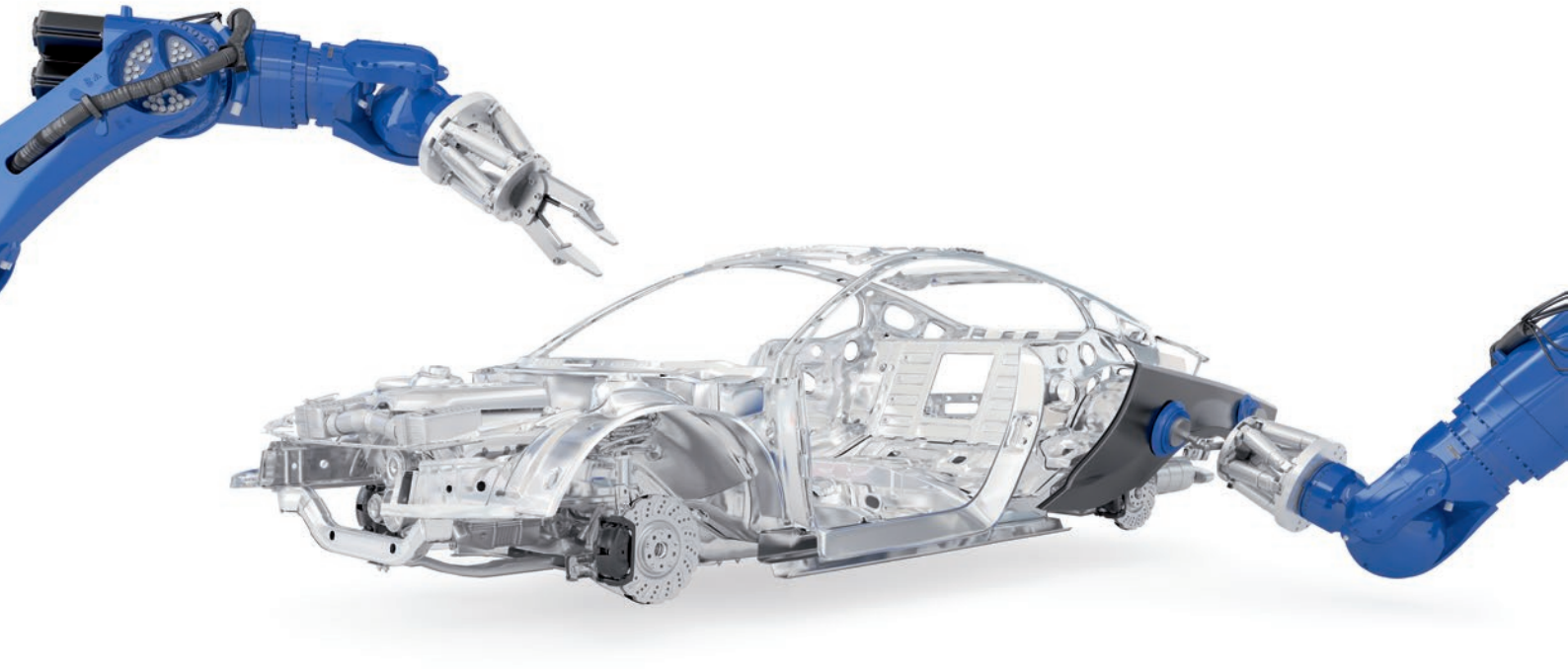
The repeatability of the M-238.5PL with linear encoder is less than 0.3 µm.



The velocity constancy of an M-238.5PL at 30 mm/s.

Motion Control

Solutions for Motion Centric Industrial Automation



Positioning and motion tasks in industrial automation such as those in assembly, semiconductor manufacturing, mechanical engineering, laser material processing, inspection systems or in additive manufacturing demand solutions that need to be robust and reliable. Submicrometer accuracy, exact position reproducibility, high dynamics, and throughput are just as essential. This is particularly the case with industry 4.0 where safety and simple networking options play an important role.

SMARTER MOTION AND POSITIONING

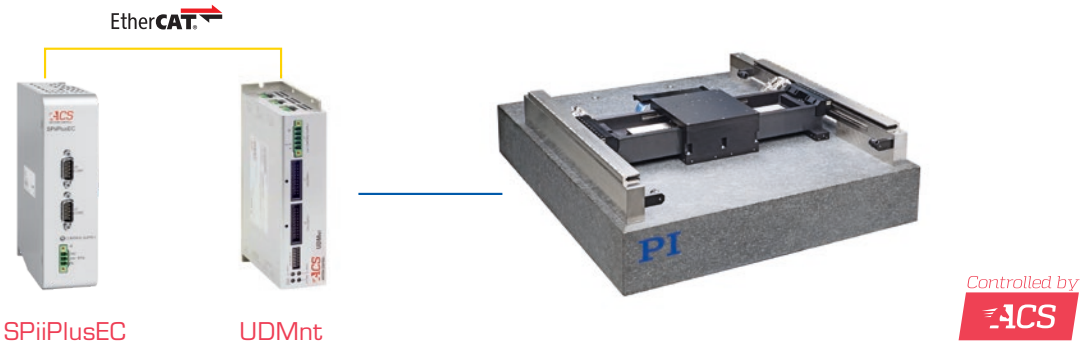
What makes a positioner and motion solution smart? What functions and features must a high-performance control solution offer to make smart motion and positioning possible? PI has identified the following list of basic requirements that make it possible to offer solutions for industrial applications that fulfill the high demands for precision and dynamics irrespective of the number of motion axes.

- Functional safety
- Communication via fieldbus interfaces
- Autotuning
- Synchronization of the individual axes in the system
- Multidimensional motion profiles
- 3-DOF compensation of the position error
- Yaw compensation for gantry solutions
- Suppression of system oscillation
- Robust control behavior
- Easy integration into the higher-level automation environment

COMPLETE SOLUTIONS FOR HIGH-THROUGHPUT AND HIGH-PRECISION MULTI-AXIS APPLICATIONS

Those requirements can only be fulfilled when the mechanics, drive technology, and control electronics of the positioning system are perfectly matched to each other.

A solution from a single-source supplier does not just offer the customer sophisticated positioning technology and high-performance control solutions, but also faster start-up and high flexibility when implementing new requirements.



HIGH-PERFORMANCE MOTION CONTROL SYSTEMS

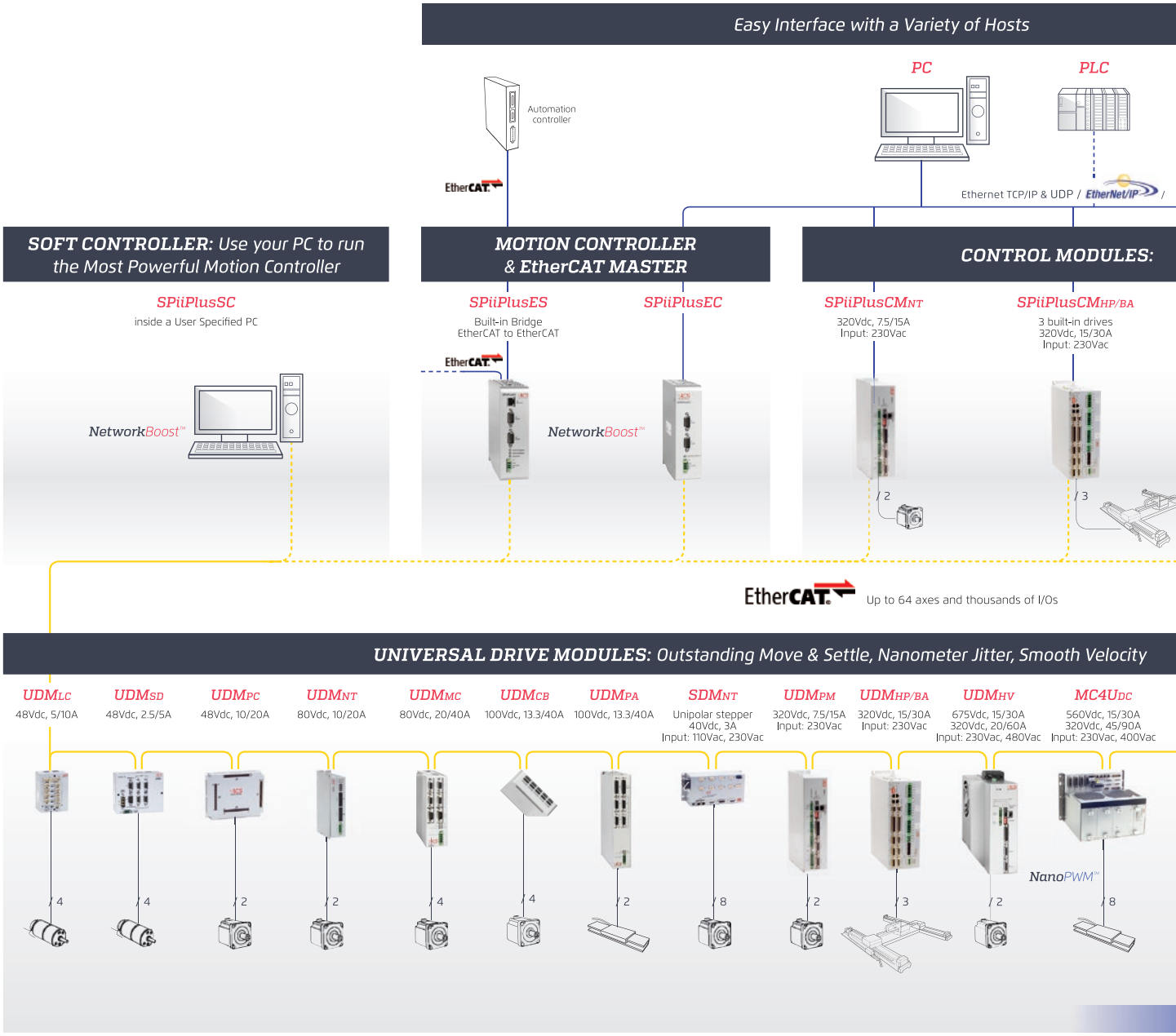
ACS Motion Control offers distributed-architecture motion control systems, completely modular, with components organized over three levels: The first level is the user interface. This is basically the host software and allows communication with the motion system.

The devices on the second level are called motion controllers. The motion controller is responsible for communication with the host software and also takes care of everything related to profile generation, trajectory, macros, diagnostics, and so on. The position commands are sent to the universal drive modules on the third level via an EtherCAT real-time network. In some products, the motion controller, the drives, and the power supplies are integrated into one housing. These products are called control modules.

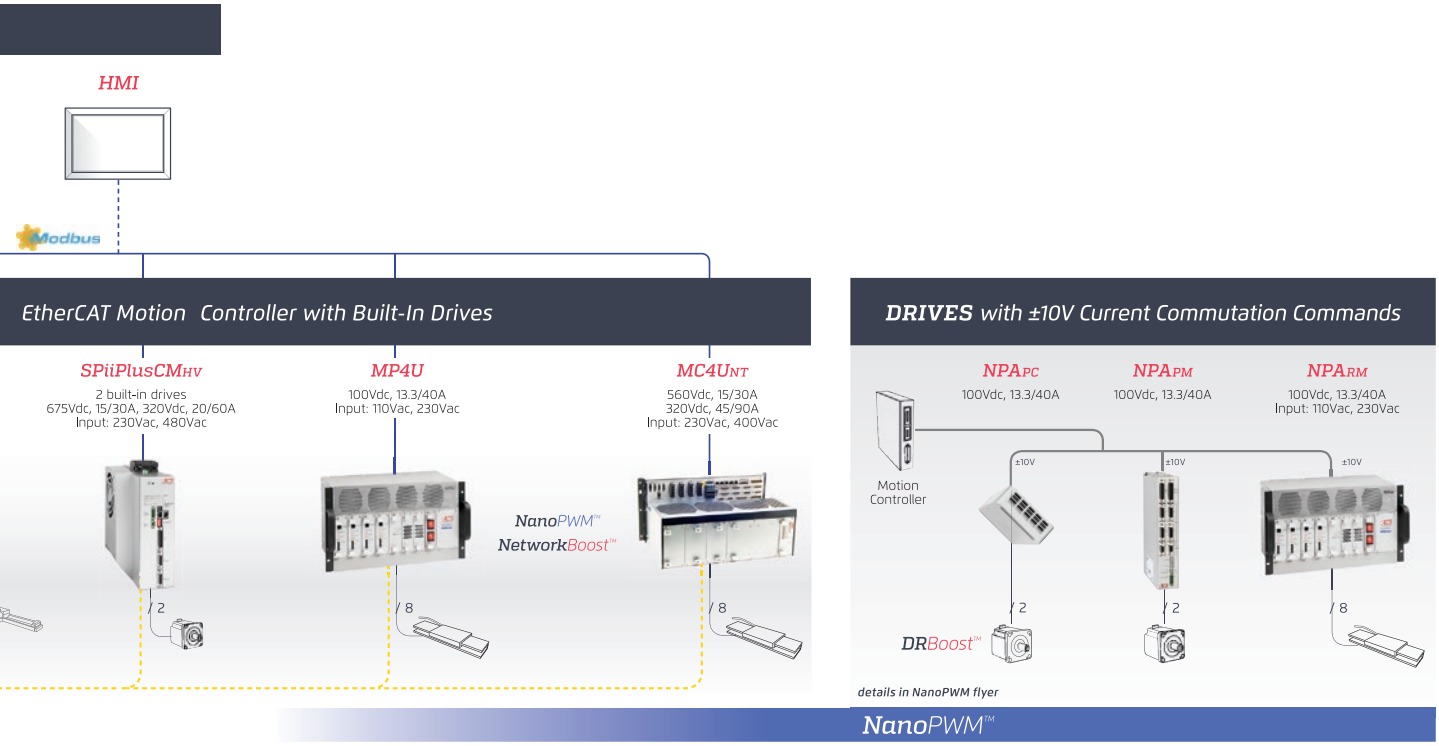
The universal drive modules on the third level include the digital servo processor (DSP). It performs the servo positioning of the axes. The drive modules power and actuate the motors, handle the feedback devices, manage the I/Os, and analyze the sensor signals for closed-loop positioning control.

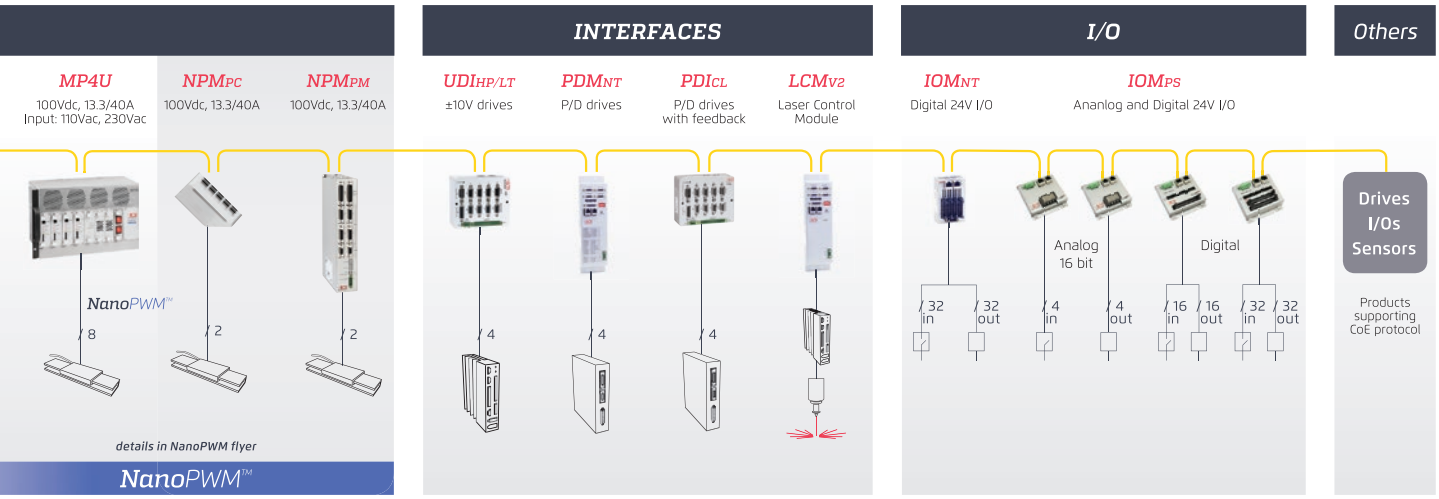
Overview of Available ACS Motion Control Modules

PI offers complete systems that implement the ACS motion control solutions



EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.


HMI
Modbus
EtherCAT Motion Controller with Built-In Drives
SPiiPlusCMHV
2 built-in drives
675Vdc, 15/30A, 320Vdc, 20/60A
Input: 230Vac, 480Vac
MP4U
100Vdc, 13.3/40A
Input: 110Vac, 230Vac
MC4UNT
560Vdc, 15/30A
320Vdc, 45/90A
Input: 230Vac, 400Vac
NanoPWM™
NetworkBoost™
/ 2
/ 8
/ 8
DRIVES with ±10V Current Commutation Commands
NPAPC
100Vdc, 13.3/40A
NPAPM
100Vdc, 13.3/40A
NPARM
100Vdc, 13.3/40A
Input: 110Vac, 230Vac
Motion Controller
±10V
DRBoost™
/ 2
/ 2
/ 8
details in NanoPWM flyer
NanoPWM™


MP4U
100Vdc, 13.3/40A
Input: 110Vac, 230Vac
NPMPC
100Vdc, 13.3/40A
NPMPM
100Vdc, 13.3/40A
NanoPWM™
/ 8
/ 2
/ 2
details in NanoPWM flyer
NanoPWM™
INTERFACES
UDIHP/LT
±10V drives
PDMNT
P/D drives
PDICL
P/D drives with feedback
LCMV2
Laser Control Module
/ 4
/ 4
/ 4
I/O
IOMNT
Digital 24V I/O
IOMPS
Ananlog and Digital 24V I/O
Analog 16 bit
Digital
/ 32 in
/ 32 out
/ 4 in
/ 4 out
/ 16 in
/ 16 out
/ 32 in
/ 32 out
Others
Drives I/Os Sensors
Products supporting CoE protocol

ACS Motion Control for Motion Centric Industrial Automation

Available Modules

EtherCAT® Motion Controller

SPiiPlusEC Powerful Motion Controller and EtherCAT® Network Manager
up to 64 axes and thousands of I/O's

SPiiPlusES High Performance Multi-Axis Controller with Built-in EtherCAT®-to-EtherCAT® Bridge
up to 64 axes and thousands of I/O's

SPiiPlusSC Software Based Powerful Motion Controller and EtherCAT® Network Manager
up to 64 axes and thousands of I/O's

Control Modules

MC4Unt Customized Multi-axis Control Using Standard Components
2 to 8 drives, wide power range

SPiiPlusCMnt 32-Axis EtherCAT® Master Control Module with 2 Built-in Drives
1, 2 drives 85 – 265 V-AC, up to 7.5/15 A

SPiiPlusCMhp/ba 32-Axis EtherCAT® Master Control Module with 3 Built-in Drives
1 to 3 drives, 85 – 265 V-AC, up to 15/30 A

SPiiPlusCMhv 32-Axis EtherCAT® Master Control Module with 2 Built-in High-Voltage Drives
1, 2 axes, 230 – 480 V-AC, up to 15/30 A, or 230 V-AC, 20/60 A

User Interface Software Applications

SPiiPlusSPC Smart Processing Commander
Machine Control Interface for High-Precision Laser Processing Applications

SPiiPlusSMC Smart Motion Commander
Customizable CNC HMI Platform for High-Precision Machining and Processing Applications

Drives with ±10 V Interface

NPApc Single/Dual Axis NanoPWM Drive with ±10 V Current Commutation Commands
1,2 drives, 12 – 100 V, up to 13.3/40 A, PCB mount

NPApm Single/Dual Axis NanoPWM Drive with ±10 V Current Commutation Commands
1,2 drives, 12 – 100 V, up to 13.3/40 A

NPArm 2 to 8 Axis NanoPWM Drive system with ±10V Current Commutation Commands and Power Supply
2 to 8 drives, up to 96 V, up to 13.3/40 A, rack mount

Interfaces

UDIhp/lt EtherCAT® Dual/Quad Axis Motor Drive Interface
2 to 4 axes, ±10 V interface to external motor drives

PDMnt EtherCAT® Quad Axis P/D Interface Module
4 axes, Pulse/Direction interface to external motor drives

PDIcl EtherCAT® Dual/Quad Axis Interface Module for P/D with Feedback
2, 4 axes, Pulse/Direction interface to external motor drives

IOMnt EtherCAT® Digital I/O Module
up to 32 digital inputs and outputs, 24 V-DC

ACS Motion Control
for Motion Centric Industrial Automation

Available Modules

Universal Drive Modules with 48 V DC

UDMlc EtherCAT® Dual/ Quad Axis Drive Module
2, 4 drives, 12 – 48 V, up to 5/10 A

UDMsd EtherCAT® Dual/ Quad Axis Drive Module
2, 4 drives, 12 – 48 V, up to 2.5/5 A

UDMpc EtherCAT® Single/ Dual Axis Drive Module
1, 2 drives, 24 – 48 V, up to 10/20 A, PCB mount

Universal Drive Modules with 80 V DC

UDMnt EtherCAT® Single/ Dual Axis Drive Module
1, 2 drives, 12 – 80 V, up to 10/20 A

UDMmc EtherCAT® Drive Module, Compact, Cost Effective
2, 4 drives, 12 – 80 V, up to 20/40 A

Universal Drive Modules with AC

UDMpm EtherCAT® Single/Dual Axis Drive Module
1, 2 drives, 85 – 265 V, up to 7.5/15 A

UDMhp/ba EtherCAT® Drive Module, Compact, Powerful
1 to 3 drives, 85 – 265 V-AC, up to 15/30 A

UDMhv EtherCAT® Single/ Dual Axis High Voltage Drive Module
1, 2 drives, 230 – 480 V-AC, up to 15/30 A or 230 V-AC 20/60 A

Universal Drive Modules with NanoPWM

NPMpc EtherCAT® Single/Dual Axis NanoPWM Drive Module
1, 2 drives, 12 – 100 V, up to 13.3/40 A, PCB mount

NPMpm EtherCAT® Single/Dual Axis NanoPWM Drive Module
1, 2 drives, 12 – 100 V, up to 13.3/40 A

Other Universal Drive Modules

UDMcb Economical EtherCAT® Single/Dual Axis Drive Module
1, 2 drives, up to 100 V, 13.3/40 A, PCB mount

UDMpa EtherCAT® Single/ Dual Axis Drive Module
1, 2 drives, up to 100 V, 13.3/40 A

Stepper Drive Module

SDMnt EtherCAT® 4/8 Axis Stepper Drive Module
4, 8 unipolar stepper motor drives, 40 V, 3 A

A-81x
PIglide Motion Controller for 1, 2 or 4 Axes

For Stages with Direct Drive, TCP/IP Interface

Controlled by ACS

- 1, 2, & 4 motion axes
- Fully integrated closed-loop servo control, amplifier module, and power supplies
- For voice coil drives, DC motors and brushless 3-phase motors
- Quiet PWM drives
- Encoder inputs support sine/cosine and BiSS-C
- 5 A continuous current / 10 A peak output current per axis

Overview

The A-81x motion controller series from PI offers a fully integrated electronics solution with controller, drives, and power supplies in a compact 19-inch rack unit. The A-81x controllers are designed and optimized for PIglide air bearing stages that are equipped with direct drive linear and rotation servo motors, and high-resolution encoders.

Standard options include inputs for incremental sine/cosine and absolute encoders that use the BiSS-C data protocol. Support for sine/cosine encoders has an integrated interpolation factor of 16384x. All controllers feature integrated flash memory for stored motion programs and parameters.

The A-81x controllers can be operated in stand-alone mode running stored programs, or controlled via an external PC. A PC is required for programming and startup. All software is supplied with the controller.

If the controller is purchased together with a PIglide air bearing stage or positioning system, PI will perform the servo tuning, startup of the controller, and error calibration, and supply a complete ready-to-use positioning system.

The A-81x motion controller features the state of the art ACS SPiiPlusEC motion controller and EtherCAT® master, and includes ServoBoost™ for up to eight axes of motion. ServoBoost™ provides better, more consistent servo performance that is insensitive to noise or changes in the system.

Options

- Absolute encoders or incremental encoders (can be combined individually according to customer specifications for all axes of the controller)
- G-Code programming
- Input shaping
- Additional control axes for external drives via EtherCAT®
- Alternative customized packaging for OEM designs

>> Extensive Software Package

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	A-811.21x00	A-812.21x00	A-814.21x00
Number of axes	1	2	4
Controller type	Closed-loop servo control (PID), parameter changing during operation	Closed-loop servo control (PID), parameter changing during operation	Closed-loop servo control (PID), parameter changing during operation
Servo-frequency position control	10 kHz	10 kHz	10 kHz
Servo frequency current control	20 kHz	20 kHz	20 kHz
Trajectory profiles	Point-to-point, jog, s-curve	Point-to-point, jog, s-curve, interpolated coordinated multi-axis profiles	Point-to-point, jog, s-curve, interpolated coordinated multi-axis profiles
Cooling	Fan on the side (continuous operation, constant speed)	Fan on the side (continuous operation, constant speed)	Fan on the side (continuous operation, constant speed)
Drive type	PWM	PWM	PWM
Motor types	Voice coil Brushed DC motor Brushless 3-phase motor with sine commutation	Voice coil Brushed DC motor Brushless 3-phase motor with sine commutation	Voice coil Brushed DC motor Brushless 3-phase motor with sine commutation
Encoder options (factory default) (Can be configured individually for combinations according to customer specifications)	Incremental sine/cosine ($1\ V_{pp}$) A/B quadrature (RS-422) (on request), Absolute encoder BiSS-C	Incremental sine/cosine ($1\ V_{pp}$) A/B quadrature (RS-422) (on request), Absolute encoder BiSS-C	Incremental sine/cosine ($1\ V_{pp}$) A/B quadrature (RS-422) (on request), Absolute encoder BiSS-C
Output current (per axis)	5 A continuous operation, 10 A peak	5 A continuous operation, 10 A peak	5 A continuous operation, 10 A peak
Interfaces			
Communication	Ethernet: TCP/IP, 100/1000 Mbps Ethernet/IP Modbus	Ethernet: TCP/IP, 100/1000 Mbps Ethernet/IP Modbus	Ethernet: TCP/IP, 100/1000 Mbps Ethernet/IP Modbus
User I/O (without reference and limit switch)	2 × digital input, 24 V DC, sink 2 × digital output, 24 V DC, source 1 × analog input, differential, 12 bit 1 × analog output, differential, 10 bit 1 × RS-422 high-speed output for position trigger (PEG)	2 × digital input, 24 V DC, sink 2 × digital output, 24 V DC, source 1 × analog input, differential, 12 bit 1 × analog output, differential, 10 bit 2 × RS-422 high-speed output for position trigger (PEG)	4 × digital input, 24 V DC, sink 4 × digital output, 24 V DC, source 2 × analog input, differential, 12 bit 2 × analog output, differential, 10 bit 4 × RS-422 high-speed output for position trigger (PEG)
Interlock / motion-stop	1 × 24 V DC sink	1 × 24 V DC sink	1 x 24 V DC sink
Connector interface	Rear panel connectors Sub-D for motor and signal connections IEC 60320 type C14 for power supply	Rear panel connectors Sub-D for motor and signal connections IEC 60320 type C14 for power supply	Rear panel connectors Sub-D for motor and signal connections IEC 60320 type C14 for power supply
Miscellaneous			
Power supply	120 – 240 V AC, single phase, 50 – 60 Hz (factory default), 600 W	120 – 240 V AC, single phase, 50 – 60 Hz (factory default), 600 W	120 – 240 V AC, single phase, 50 – 60 Hz (factory default), 600 W
Mass (approx.)	8.5 kg	8.5 kg	9.3 kg
Dimensions	19" rack unit, 483 mm × 88 mm × 487 mm (incl. handles)	19" rack unit, 483 mm × 88 mm × 487 mm (incl. handles)	19" rack unit, 483 mm × 88 mm × 487 mm (incl. handles)

A-82x
PIglide Motion Controller for 4, 6 or 8 Axes

For Stages with Direct Drive and High Power Requirements, TCP/IP Interface

- 4, 6 or 8 high-performance motion axes
- Fully integrated closed-loop servo control, amplifier module, and power supplies
- For voice coil drives, DC motors and brushless 3-phase motors
- Quiet PWM drives
- Encoder inputs support sine/cosine and BiSS-C
- 10 A continuous current / 20 A peak output current per axis

Controlled by ACS

Overview

The A-82x motion controller series from PI offers a fully integrated electronics solution with controller, drives, and power supplies in a compact 4-U-high 19-inch rack unit. The A-824 supplies continuous power of 2 kW. The A-82x controllers are designed and optimized for PIglide air bearing stages that are equipped with direct drive linear and rotation servo motors, and high-resolution encoders.

Standard options include inputs for incremental sine/cosine and absolute encoders that use the BiSS-C data protocol. Support for sine/cosine encoders has an integrated interpolation factor of 16384x. All controllers feature integrated flash memory for stored motion programs and parameters.

The A-82x controllers can be operated in stand-alone mode running stored programs, or controlled via an external PC. A PC is required for programming and startup. All software is supplied with the controller.

If the controller is purchased together with a PIglide air bearing stage or positioning system, PI will perform the servo tuning, startup of the controller, and error calibration, and supply a complete ready-to-use positioning system.

The A-82x motion controller features the state of the art ACS SPiiPlusEC motion controller and EtherCAT® master, and includes ServoBoost™ for up to eight axes of motion. ServoBoost™ provides better, more consistent servo performance that is insensitive to noise or changes in the system.

Options

- Absolute encoders or incremental encoders (can be combined individually according to customer specifications for all axes of the controller)
- G-Code programming
- Input shaping
- Additional control axes for external drives via EtherCAT®
- Alternative customized packaging for OEM designs

>> Extensive Software Package

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	A-824.21x00	A-826.21x00	A-828.21x00
Number of axes	4	6	8
Controller type	Closed-loop servo control (PID), parameter changing during operation	Closed-loop servo control (PID), parameter changing during operation	Closed-loop servo control (PID), parameter changing during operation
Servo-frequency position control	10 kHz	10 kHz	10 kHz
Servo frequency current control	20 kHz	20 kHz	20 kHz
Trajectory profiles	Point-to-point, jog, s-curve, interpolated coordinated multi-axis profiles	Point-to-point, jog, s-curve, interpolated coordinated multi-axis profiles	Point-to-point, jog, s-curve, interpolated coordinated multi-axis profiles
Cooling	Fan on the side (continuous operation, constant speed)	Fan on the side (continuous operation, constant speed)	Fan on the side (continuous operation, constant speed)
Drive type	PWM	PWM	PWM
Motor types	Voice coil Brushed DC motor Brushless 3-phase motor with sine commutation	Voice coil Brushed DC motor Brushless 3-phase motor with sine commutation	Voice coil Brushed DC motor Brushless 3-phase motor with sine commutation
Encoder options (factory default) (Can be configured individually for combinations according to customer specifications)	Incremental sine/cosine ($1\ V_{pp}$) A/B quadrature (RS-422) (on request), Absolute encoder BiSS-C	Incremental sine/cosine ($1\ V_{pp}$) A/B quadrature (RS-422) (on request), Absolute encoder BiSS-C	Incremental sine/cosine ($1\ V_{pp}$) A/B quadrature (RS-422) (on request), Absolute encoder BiSS-C
Interpolation factor sine/cosine encoder	4 x to 16384x (can be adjusted by software)	4 x to 16384x (can be adjusted by software)	4 x to 16384x (can be adjusted by software)
Output voltage	72 VDC	72 VDC	72 VDC
Output current (per axis)	10 A continuous operation, 20 A peak (<1 s)	10 A continuous operation, 20 A peak (<1 s)	10 A continuous operation, 20 A peak (<1 s)
Output power (total)	1100 W continuous operation 3900 W peak	1700 W continuous operation 3900 W peak	2000 W continuous operation 3900 W peak

	A-82x
Interfaces	
Communication	Ethernet: TCP/IP, 100/1000 Mbps Ethernet/IP Modbus
User I/O (without reference and limit switch)	4 × digital input, 24 V DC, sink 3 × digital output, 24 V DC, source 2 × analog input, differential, 12 bit 2 × analog output, differential, 10 bit 4 × RS-422 high-speed output for position trigger (PEG)
Interlock / motion-stop	1 × 24 V DC
Connector interface	Rear panel connectors Sub-D for motor and signal connections IEC 60320 type C20 for power supply

	A-824.2x00	A-826.21x00	A-828.21x00
Miscellaneous			
Power supply	200 – 240 V AC, single phase, 50 – 60 Hz	200 – 240 V AC, single phase, 50 – 60 Hz	200 – 240 V AC, single phase, 50 – 60 Hz
Mass (approx.)	13.6 kg	14.4 kg	15.2 kg
Dimensions	19" rack unit, 483 mm × 171 mm × 495 mm (incl. handles)	19" rack unit, 483 mm × 171 mm × 495 mm (incl. handles)	19" rack unit, 483 mm × 171 mm × 495 mm (incl. handles)

SMC Hydra Universal Motion Controller

For Electromagnetic Motors

- 2-D vector motion with linear interpolation, independent single-axis motion
- For DC servo and brushless DC motors (BLDC), linear and torque motors (2 / 3 phases), 2-phase stepper motors
- Digital inputs and outputs
- Optional: Encoder-based trigger output
- Optional: Position capture input: Position detection in real time via digital input
- Optional: Dynamic position correction
- Joystick operation via CAN bus

Compact SMC Hydra CM
2-axis motion controller

>> Extensive Software Package

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	SMC Hydra TT	SMC Hydra CM	SMC Hydra RM
Function	Motion controller for electromagnetic motors Benchtop device with integrated power supply	Motion controller for electromagnetic motors Compact device	Motion controller for electromagnetic motors 19" rack unit with integrated power supply
Axes	2	2	2 / 4
Sensor channels	2	2	2 / 4
Miscellaneous			
Operating voltage	90 – 260 V, integrated wide-range-input power supply	24 V / 48 V, external power supply (not in scope of delivery)	90 – 260 V, integrated wide-range-input power supply
Max. power consumption	300 W	120 W	1000 W
Max. current consumption	11 A	11 A	11 A
Operating temperature range	10 to 40 °C	10 to 40 °C	10 to 40 °C
Weight	2.65 kg	0.45 kg	6 kg
Dimensions	225 mm x 515 mm x 56 mm	76 mm x 156 mm x 56 mm	84 HP, 2 RU, 310 mm depth
Motion and control			
Supported functions	Linear vector motion, independent point-to-point motion. Automatic detection of the motor phase.		
Controller type	PID controller, also adaptive for position and velocity as well as velocity and acceleration feed-forward, parameter changing during operation		
Servo frequency	4 kHz		
Profile generator	Trapezoidal velocity profile, setting of maximum velocity and acceleration 2-D vector control with linear interpolation		
Encoder input	Analog signals (sin/cos) max. 150 kHz (line count) Digital signals (A/B differential via RS-422) max. 4 MHz (line count) Positioning range: $\pm 4.3*10^{12}$ mm / deg		
Stall detection	Position error, peak current, I^2t limit		
Microsteps per full step	3000		
Limit switches	2 per channel, 5 to 24 V (programmable polarity); N/O contact / N/C contact; NPN / PNP		
Reference point switch	Index signal of the encoder		
Motor brake	1 x per channel, TTL, configurable via software		
Electrical properties			
Maximum output voltage	24 V / 48 V		
Maximum output power per channel	200 W		
Maximum output current per channel	10 A_{rms}		
Safety features	Switch-off via external switch. Overload protection of the motor driver. Overheat protection of the motor (I2t). Overcurrent protection of the system.		
Interfaces and operation			
Communication interfaces	TCP/IP: 10/100 Mbit; RS-232: Sub-D 9 (m), 9.6 to 115.2 kBaud. Hydra RM: USB as well		
Motor connection per channel	Sub-D 15 (f)		
Sensor connection per channel	Sub-D 15 (f)		
I/O lines	6 inputs, opto decoupled, 5 – 24 V (2 each reserved per channel for limit switch) Input for motor switch-off on all axes, opto decoupled Open drain output (100 mA) 2 TTL outputs 4 analog outputs, 10-bit resolution, 0 to 3.3 V (not for Hydra TT) With DeltaStar interface as factory default option: Fast trigger output, max. 400 kHz, equidistant or from freely definable table (max. 3000 axis positions) Position capture input, max. 4 kHz (>3,000,000 axis positions) With the factory default DeltaStar Eco interface option: Trigger output, 2 kHz, equidistant, jitter 10 – 30 µs		
Command set	Venus-3 ASCII interpreter; dynamic library for PI General Command Set (GCS)		
User software	Venus-3 demo program LabVIEW (source code & executable) Terminal program (Venus-3 DLL) PIMikroMove via dynamic libraries for Windows		
Software drivers	LabVIEW drivers, dynamic libraries for Windows and Linux (GCS) GCS2 DLL 32/64-bit Venus3 DLL 32/64-bit / .net wrapper DLL incl. example source code		
Manual operation	Joystick via CAN bus (accessory)		

C-891 PIMag® Motion Controller for Magnetic Direct Drives

1 Axis, for 3-Phase Linear Motors with Medium Power Consumption

- Maximum average current consumption 3 A
- 20-kHz control bandwidth
- USB interface for sending commands and for configuration
- Digital inputs and outputs
- Optional analog input
- Encoder inputs: A/B or sine/cosine and BiSS-C

Digital motion controller for PIMag® linear motors

1 motor channel, 1 sensor channel. For three-phase linear motors, maximum current consumption 3A (rms) per phase. Sine-commutated operation, field-oriented current control. Automatic detection of the motor phase. PID controller for position and velocity. Servo update rate 20 kHz.

C-891.10C885 Plug-in module for C-885 PIMotionMaster

>> Extensive Software Package

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	C-891.120200
Function	PIMag® Motion Controller for 3-phase linear motors, sine-commutated, field-oriented current control
Motor channels	1
Sensor channels	1
Supported functions	Point-to-point motion. Data recorder. Wave generator. Automatic detection of the motor phase.
Safety features	Switch-off via external switch. Overload protection of the motor driver. Overheat protection of the motor. Overcurrent protection of the system.
Motion and control	
Controller type	PID controller for position and velocity, parameter changing during operation
Servo frequency	20 kHz
Profile generator	Trapezoidal velocity profile, setting of maximum velocity and acceleration
Encoder input	Analog (sin/cos) or digital signals (A/B differential, TTL, or BISS interface)
Reference and limit switches	TTL
Electrical properties	
Max. output voltage	24 V
Max. output current	3 A_{rms}
Interfaces and operation	
Communication interfaces	USB, RS-232
Motor connector	HD Sub-D 26 (f)
Sensor connection	Sub-D 15 (m)
I/O port	4 x digital input, 4 x digital output Optional analog input, –10 to 10 V
Command set	PI General Command Set (GCS)
User software	PIMikroMove
Application programming interfaces	API for C / C++ / C# / VB.NET / MATLAB / python, drivers for LabVIEW
Miscellaneous	
Operating voltage	24 V, external power supply included in the scope of delivery
Max. current consumption	4.5 A
Operating temperature range	5 to 40 °C
Max. mass	1.0 kg
Dimensions	190 mm x 83 mm x 110 mm (with rubber feet and connection for supply voltage: 206 mm x 83 mm x 112 mm)

Ask about custom designs!

C-885 PIMotionMaster

Rack with Processor and Interface Module for Modular Multi-Axis Controller System

- Easy configuration and startup
- Modular design for versatile expansion
- Efficient communication with the controller modules
- Greatly reduced wiring effort
- Saves space and costs

Easy installation

Plug-and-play installation of the controller modules in the C-885 PIMotionMaster. The processor and interface module communicates with the PIMikroMove software and with the controller modules. It detects the available controller module type automatically. Grouping the controller modules in one housing ensures internal communication and reduces the wiring effort because of the common power supply and external communication via a single USB or Ethernet interface.

Easy to expand

The system is easily scalable. An additional controller module can be inserted into any free slot and expands the overall system by the corresponding functions. Optional digital inputs and outputs can be installed for every controller module.

Controller modules

- C-863.20C885 DC Motor Controller Module, 2 Axes
- C-867.10C885 PILine® Controller Module
- E-861.11C885 NEXACT® Controller Module
- E-873.10C885 Q-Motion® Controller Module for C-885 PIMotionMaster
- C-663.12C885 Mercury Step Stepper Motor Controller Module

>> Extensive Software Package

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	C-885.R1	C-885.R2	C-885.R3
Function	9.5" chassis for C-885 PIMotionMaster	19" chassis for C-885 PIMotionMaster	19" chassis for C-885 PIMotionMaster
Number of card slots	1 C-885.Mx module (required) 4 controller modules (max.)	1 C-885.Mx module (required) 20 controller modules (max.)	1 C-885.Mx module (required) 19 controller modules (max.)
Dimensions	269.04 mm × 133.14 mm × 349.5 mm (incl. handles)	Without modules: 482.6 mm × 132.55 mm × 265.3 mm With modules: 482.6 mm × 132.55 mm × 278.55 mm	Without modules: 482.6 mm × 132.55 mm × 265.3 mm With modules: 482.6 mm × 132.55 mm × 278.55 mm
Operating voltage	24 V DC from external power supply	24 V DC from external power supply	24 V DC from external power supply also optional: 48 V DC from external power supply
Supply voltage for controller modules	24 V DC	24 V DC	24 V DC / 48 V DC
Current consumption, max.	32 A	32 A	32 A
Mass without modules	3.2 kg	2.9 kg	5.08 kg
Operating temperature range	10 to 40 °C	10 to 40 °C	10 to 40 °C

	C-885.M1	C-885.M2
Function	Digital Processor and Interface Module for C-885 PIMotionMaster	Digital Processor and Interface Module for C-885 PIMotionMaster
Communication interfaces	Ethernet, USB	Ethernet, USB
Command set	PI General Command Set (GCS)	PI General Command Set (GCS)
User software	PIMikroMove	PIMikroMove
Software drivers	LabVIEW drivers, dynamic libraries for Windows and Linux	LabVIEW drivers, dynamic libraries for Windows and Linux
Indicators	LEDs for Power, Error	LEDs for Power, Error
Operating temperature range	10 to 40°C	10 to 40°C
Mass	132 g	270 g
Dimensions	186.42 mm × 128.4 mm (3 RU) × 19.98 mm (4 HP)	186.42 mm × 128.4 mm (3 RU) × 19.98 mm (4 HP)

Ask about custom designs!

C-663.12
Mercury Step Stepper Motor Controller, 1 Axis

For Closed-Loop and Open-Loop Operation, HD Sub-D 26, 48 V

- High microstep resolution
- Operating voltage up to 48 V
- Closed-loop operation of 2-phase stepper motors
- Support for external sensors
- Daisy chain networking

C-663.12C885 Mercury Step Stepper Motor Controller Plug-in Module for C-885 PIMotionMaster

>> Extensive Software Package

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	C-663.12
Function	Mercury Step stepper motor controller
Drive types	2-phase stepper motor
Axes	1
Supported functions	Point-to-point motion. Startup macro. Data recorder for recording operating data such as velocity, position or position error. Internal safety circuitry: Watchdog timer. ID chip detection (for future use).
Motion and control	
Controller type	PID, parameter changing during operation
Servo cycle time	50 µs
Dynamics profile	Trapezoidal velocity profile
Microstep resolution	1/2048 full step
Encoder input	A/B quadrature, TTL, RS-422; 60 MHz
Limit switches	2 × TTL, programmable
Reference point switch	1 × TTL, programmable
Index switch	1 × RS-422 for index pulse
Stall detection	Automatic motor stop when a programmable position error is exceeded (only in conjunction with sensor)
Electrical properties	
Max. output voltage*	0 V to operating voltage, for direct control of stepper motors
Max. output power	60 W
Average output power	48 W
Power consumption, full load	48 W (max.)
Power consumption without load	3 W
Current limitation per motor phase	2.5 A
Interfaces and operation	
Communication interfaces	USB, RS-232
Motor / sensor connection	HD Sub-D 26 (f)
Controller network	Up to 16 units on a single interface**
I/O lines	4 analog / digital inputs (0 to 5 V / TTL), 4 digital outputs (TTL)
Command set	PI General Command Set (GCS)
User software	PIMikroMove
Application programming interfaces	API for C / C++ / C# / VB.NET / MATLAB / python, drivers for LabVIEW
Manual control	Joystick, Y-cable for 2-D motion, pushbutton box
Miscellaneous	
Operating voltage	24 to 48 V DC from external power supply (48 V DC power supply in scope of delivery)
Max. current consumption	40 mA without load (when supplied with 48 V) 80 mA without load (when supplied with 24 V)
Operating temperature range	5 to 50 °C (temperature protection switches off at excessively high temperatures)
Mass	0.48 kg
Dimensions	130 mm × 76 mm × 40 mm (incl. mounting rails)

* Depending on the power supply used
** 16 units with USB; 6 units with RS-232

C-863 Mercury Servo Controller

1 Axis, for DC Motors and Brushless DC Motors

- High-speed encoder input to 60 MHz
- Powerful macro programming language, e.g., for stand-alone operation
- Nonvolatile EEPROM for macros and parameters
- Data recorder
- Daisy chain networking
- Connection for joystick

C-863.20C885 2-Axes DC Motor Controller, Plug-in Module for C-885 PIMotionMaster

>> Extensive Software Package

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	C-863.11 / C-863.12
Function	DC motor control, servo control
Axes	1
Supported functions	Point-to-point motion. Startup macro. Data recorder for recording operating data such as motor voltage, velocity, position or position error. Internal safety circuitry: Watchdog timer. C-863.12 additional: ID chip detection
Motion and control	
Controller type	PID controller, parameter changing during operation
Servo cycle time	50 µs
Profile generator	Trapezoidal velocity profile
Encoder input	A/B quadrature single-ended or differential TTL signal acc. to RS-422; 60 MHz
Stall detection	Automatic motor stop when a programmable position error is exceeded
Limit switches	2 × TTL (programmable polarity)
Reference point switch	1 × TTL
Motor brake	1 × TTL, can be switched by software
Interfaces and operation	
Communication interfaces	USB; RS-232, Sub-D 9 (m)
Motor connection	C-863.11: Sub-D 15 (f) / C-863.12: HD Sub-D 26 (f)
Controller network	Up to 16 units** on a single interface
I/O lines	4 analog / digital inputs, 4 digital outputs (TTL), 5 V TTL
Command set	PI General Command Set (GCS)
User software	PIMikroMove
Application programming interfaces	API for C / C++ / C# / VB.NET / MATLAB / python, drivers for LabVIEW
Manual control	Joystick, Y cable for 2-D motion, pushbutton box

	C-863.11	C-863.12
Electrical properties		
Max. output voltage*	0 to ±15 V for direct control of DC motors	0 V to operating voltage, for direct control of DC motors
Max. output power	30 W	60 W
Average output power	45 W	48 W
Power consumption, full load	30 W	48 W
Power consumption without load	2 W	3 W
Current limitation	2 A	2.5 A
Miscellaneous		
Operating voltage	15 to 30 V from external power supply (15 V DC power supply in scope of delivery)	24 to 48 V DC from external power supply (48 V DC power supply in scope of delivery)
Max. current consumption	80 mA without load (when supplied with 24 V)	40 mA without load (when supplied with 48 V) 80 mA without load (when supplied with 24 V)
Operating temperature range	5 to 50 °C	5 to 50 °C (temperature protection switches off at excessively high temperatures)
Mass	0.3 kg	0.48 kg
Dimensions	130 mm × 76 mm × 40 mm (incl. mounting rails)	130 mm × 76 mm × 40 mm (incl. mounting rails)

* The output voltage depends on the connected power supply.
** 16 units with USB; 6 units with RS-232.

C-884.4DC / C-884.6DC
Motion Controller for DC Motors, 4 or 6 Axes

For Positioners with Closed-Loop DC Motor, USB, RS-232, TCP/IP, SPI, I/O, Joystick

- PID servo control with dynamic parameter switching
- Powerful macro programming language, e.g., for stand-alone operation
- Data recorder
- Integrated interfaces: USB, RS-232, Ethernet, SPI, I/O, joystick
- Trajectory support for 1 or 2 D motion patterns

Digital motion controller for DC servo motors

4 or 6 axes. Dual-core architecture for increased performance and flexibility by separating command processing and position control. Simple adaptation / extension possible for OEM products. Motion control of PI positioning systems with DC motors: Direct motor control, PWM control for PI positioning stages with integrated ActiveDrive amplifiers or integrated block commutation (brushless motors). Supports motor brake.

Motion profiles

Point-to-point, trapezoidal velocity profile. User-definable trajectories (e.g., circles, sine curves) from externally fed points.

Interfaces and communication

Interfaces: TCP/IP, USB and RS-232 for commands. A/B quadrature encoder input. TTL inputs for limit and reference point switches. I/O lines (analog/digital) for automation. USB interface for human interface devices.

Extensive functions, software support

Powerful macro command language. Nonvolatile macro storage, e.g., for stand-alone operation with autostart macro. Data recorder. ID chip detection for fast startup. PID controller, parameter changing during operation. Extensive software support, e.g., for LabVIEW, C, C++, MATLAB, python. PIMikroMove user software.

>> Extensive Software Package

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	C-884.4DC / C-884.6DC
Function	Position control for closed-loop DC motors
Processor	Dual core architecture. Controller on a DSP core, with extendable command interpreter in an ARM core under Linux
Axes	C-884.4DC: 4 / C-884.6DC: 6
Supported functions	Linear vector motion. Point-to-point motion. User-definable trajectories. Startup macro. PI Python. Data recorder for recording operating data such as motor voltage, velocity, position or position error. ID chip detection.
Motion and control	
Controller type	PID controller, parameter changing during operation
Servo cycle time	100 µs
Profile generator	Trapezoidal velocity profile
Encoder input	A/B quadrature (TTL differential according to RS-422), 50 MHz; BiSS interface
Stall detection	Automatic motor stop when a programmable position error is exceeded
Limit switches	2 × TTL per axis (programmable polarity)
Reference point switch	1 × TTL per axis
Motor brake	1 × TTL per axis, can be switched per software
Electrical properties	
Max. output voltage*	24 V
Max. output power	240 W
Current limitation	2.5 A per axis
Interfaces and operation	
Communication interfaces	TCP/IP: RJ45 / Ethernet; USB: Mini-USB type B; RS-232: Sub-D 9 (m); SPI: DisplayPort
Motor connector	Sub-D 15 (f)
I/O lines	4 analog inputs (–10 to 10 V), 4 digital outputs (5 V TTL) 4 digital outputs (5 V TTL)
Command set	PI General Command Set (GCS)
User software	PIMikroMove
Application programming interfaces	API for C / C++ / C# / VB.NET / MATLAB / python, drivers for LabVIEW
Manual control	USB interface for HID-compliant devices
Miscellaneous	
Operating voltage	External power supply 24 V / 5 A (120 W) included in the scope of delivery
Max. current consumption	C-884.4DC: 11 A / C-884.6DC: 16 A
Current consumption, no load	500 mA
Operating temperature range	5 to 50 °C
Mass	C-884.4DC: 1.77 kg / C-884.6DC: 1.97 kg
Dimensions	312 mm × 153.4 mm × 59.2 mm (incl. mounting rails)

* The output voltage depends on the connected power supply.

C-413 PIMag® Motion Controller

Control of Force, Position and Velocity

Digital motion controller for PIMag® voice coil drives

C-413.1: 1 motor channel, 2 sensor channels, for the V-275 and V-277 linear actuators; C-413.2: 2 motor channels, 4 sensor channels. PID controller for force, position, velocity. Servo update rate selectable between 5 to 10 kHz.

Force control

The force control allows operation of PIMag® drives and stages with a defined holding or feed force. The force and position sensors can be read simultaneously and the values processed. In addition to pure force control, subordinate position and velocity control is also an option. PI offers PIMag® actuators with a force sensor. The C-413.20A / .2GA models enable external force sensors to be read via analog inputs.

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 the holding current, at which the drive outputs a force of 0 N in open-loop operation, e.g., for compensating the weight force. ID chip support: Identifies the connected stages and simplifies configuration and exchangeability. Supports direction-sensing reference point switches. Extensive software support, e.g., for LabVIEW, dynamic libraries for Windows and Linux.

Interfaces

Depending on the version, commanding via TCP/IP, USB 2.0, SPI. Digital inputs and outputs for automation. Optional analog inputs and outputs, e.g., for sensors, commanding or position feedback.

- 1 or 2 motor channels
- Up to 4 sensor channels for 2 force and 2 position sensors each
- Depending on version, TCP/IP or USB interface for configuration and sending commands
- Depending on version, real-time SPI interface for sending commands
- Digital inputs and outputs
- Optional analog inputs and outputs

>> Extensive Software Package
>> PIMag® Voice Coil

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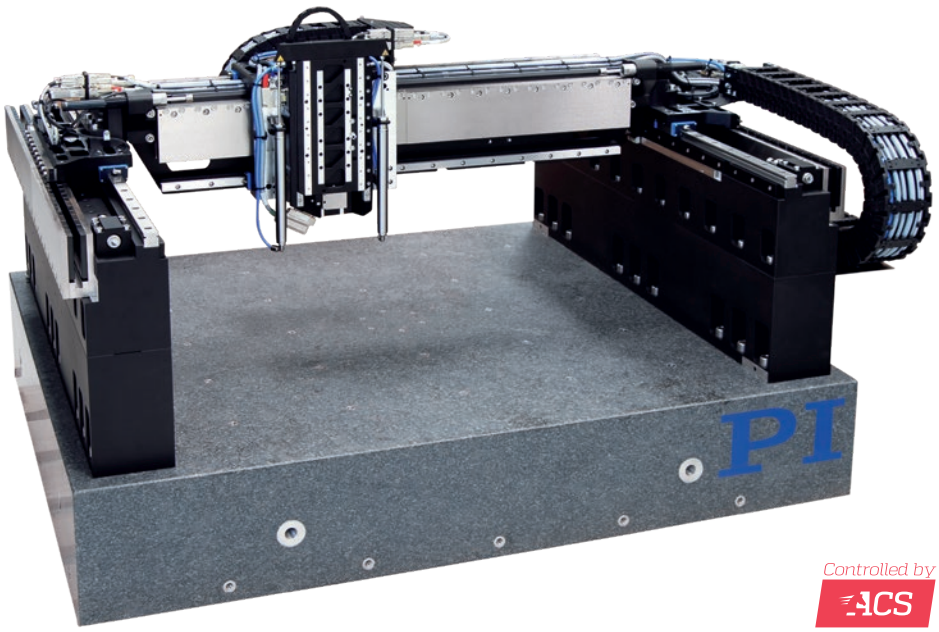
	C-413.1G	C-413.20 / C-413.20A C-413.2G / C-413.2GA
Function	PIMag® motion controller for voice coil drives, 1 channel, housed device	PIMag® motion controller for voice coil drives, 2 channels C-413.20/.20A: OEM board C-413.2G/.2GA: Housed device
Motor channels	1	2
Sensor channels	2	4
Motion and control		
Servo characteristics	PID controller for force, position and velocity; parameter changing during operation	PID controller for force, position and velocity; parameter changing during operation
Servo cycle time	100 µs to 200 µs, selectable in 4 steps	100 µs to 200 µs, selectable in 4 steps
Profile generator	Trapezoidal velocity profile, specification of the maximum velocity and acceleration	Trapezoidal velocity profile, specification of the maximum velocity and acceleration
Encoder input	SPI sensor interface	SPI sensor interface
Reference point switches	2 × TTL, direction-sensing	4 × TTL, direction-sensing
Electrical properties		
Max. output voltage	24 V	24 V
Max. output current	±1.5 A (regulated)	±1.5 A (regulated)
Interfaces and operation		
Communication interfaces	TCP/IP	USB 2.0, real time SPI
Motor / sensor connection	Sub-D 9 (f) for motor, Sub-D 25 (f) for sensor	Sub-D 15 (f) combined for motor and sensor
I/O port	2 × analog output, –10 to 10 V, 17 bit, 1 kHz 4 × digital input, 24 V 6 × digital output, 24 V	2 × analog input, –10 to 10 V, 16 bit, 1 kHz (only .20A and .2GA) 2 × analog output, –10 to 10 V, 17 bit, 1 kHz (only .20A und .2GA) 6 × digital outputs (open collector, voltage range 5 V to 24 V, 33 kΩ internal pull-up to 5 V) 4 × digital input (5 V TTL level, to 24 V max. input voltage, 10 kΩ input resistance)
Command set	PI General Command Set (GCS)	PI General Command Set (GCS)
User software	PIMikroMove	PIMikroMove
Application programming interfaces	API for C / C++ / C# / VB.NET / MATLAB / python, drivers for LabVIEW	API for C / C++ / C# / VB.NET / MATLAB / python, drivers for LabVIEW
Supported functions	Point-to-point motion. Data recorder. Wave generator. Auto zero. ID chip detection.	Point-to-point motion. Data recorder. Wave generator. Auto zero. ID chip detection.
Miscellaneous		
Operating voltage	24 V DC from external power supply (included)	24 V DC from external power adapter (included in the scope of delivery for C-413.2G and .2GA)
Max. current consumption	2 A	2 A
Operating temperature range	5 to 50 °C	5 to 50 °C
Mass	0.3 kg	0.3 kg
Dimensions	210 mm × 28 mm × 105 mm	189 mm × 28 mm × 105 mm (.2G/.2GA) 160 mm × 18 mm × 100 mm (.20/.20A)

Ask about custom designs!

Gantry Systems

Throughput, Precision and Reliability

Solutions for Motion-Centric Industrial Automation



XY and Gantry Systems from PI

Positioning and motion tasks in industrial automation such as those in assembly, semiconductor manufacturing, mechanical engineering, laser material processing, inspection systems or in additive manufacturing demand solutions that need to be robust and reliable.

PI offers a broad range of in-house drive and motion control technologies such as EtherCAT-based industrial controllers by ACS, where PI holds the major shares, or air bearing technology for optimized guiding accuracy. System engineering for customization and a global service and training network are added-value offers. PI is therefore the ideal partner for motion-centric industrial solutions.

Gantry Systems – High-Dynamic Precision Positioning in 3 Axes

- Linear motor or brushless drives, optionally with air bearings
- Individual travel ranges in XY up to 2 m
- Z-axis with pneumatic counterweight, DC or Stepper motor
- Piezomotor for fine adjustment
- Incremental or absolute encoders
- Controlled by ACS Motion Control

The specifications below are an example of what is feasible. Contact PI to discuss your requirements!

Applications

- Electronics Manufacturing
- Laser Cutting
- Sample Inspection

>> Absolute Encoder
>> Air Bearing
>> Linear Motor

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				Unit	Tolerance
Active axes	X	Y	Z		
Motion and positioning					
Travel range	508	508	155	mm	
Integrated sensor	Optical linear encoder, incremental	Optical linear encoder, incremental	Optical linear encoder, incremental		
Sensor resolution	0.002	0.002	0.002	µm	
Unidirectional repeatability	0.5	0.5	0.5	µm	typ.
Max. velocity*	3000	3000	2000	mm/s	typ.
Max. acceleration**	30	30	20	m/s^2	typ.
Mechanical properties					
Bearings	Ball bearing	Ball bearing	Cross roller bearings		
Load capacity	5			kg	max.
Motor type	Ironless linear motor	Ironless linear motor	Ironless linear motor with pneumatic counterbalance		

* Maximum speed based on stage capability. Maximum application velocity may be limited by system data rate and system resolution. Maximum speed of the z-axis is specified without pneumatic counterbalance.

** No load. Maximum acceleration of the z-axis is specified without pneumatic counterbalance.

Components & Accessories

A-10x Plglide RB Linear Air Bearing Module

Friction Free, Ideal for Positioning, Scanning, Metrology

- Ideal for scanning applications or high-resolution positioning
- Cleanroom compatible
- Size of the motion platform to 300 mm × 300 mm
- Travel ranges to 1 m
- Load capacity to 775 kg
- Straightness / flatness to 0.5 µm per 25 mm
- Pitch / roll / yaw to 1.2 µrad per 25 mm

Linear air bearings of the Plglide RB series are exactly right for applications that need smooth, precise, linear motion. The air bearing modules replace ball or crossed roller guides and are easy to integrate. They offer improved straightness, angular deviation, and repeatability compared to stage units with ball guides, especially for travel ranges longer than 100 mm.

Because air bearings are basically friction free, they work without stiction on approach or during operation, even under maximum load. Air bearings work without making contact and with purified air, and are virtually maintenance and wear free.

Accessories and options

- Air preparation kit
- Mounting Feet
- Custom configurations on request
- Several motion platforms on one guide
- Constructions with moving guide

Applications

- Sample Inspection
- Scanning
- Metrology / Testing
- Optical Alignment
- Flatpanel Inspection

>> Plglide Air Bearing Technology

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	Size of the motion platform / mm × mm	Travel range / mm	Vertical load capacity* / N	Lateral load capacity* / N
A-101	50 × 50	50 to 200	130	75
A-102	50 × 100	50 to 300	260	260
A-103	75 × 75	50 to 300	350	195
A-104	75 × 115	50 to 300	540	540
A-105	100 × 100	50 to 300	630	370
A-106	100 × 150	50 to 600	950	950
A-107	150 × 150	50 to 750	1580	790
A-108	200 × 200	50 to 1000	2950	1475
A-109	300 × 300	50 to 1000	7600	2210

	Travel ranges to 300 mm	Travel ranges to 600 mm	Travel ranges to 1000 mm
Straightness / flatness**	±1.25 µm	±2.5 µm	±5 µm
Straightness / flatness, per 25 mm travel range**	±0.25 µm	±0.25 µm	±0.25 µm
Position stability**	±0.05 µm	±0.05 µm	±0.05 µm
Pitch / yaw, per 25 mm travel range**	1.2 µrad	1.2 µrad	1.2 µrad
Pitch / yaw, overall**	10 µrad	20 µrad	30 µrad

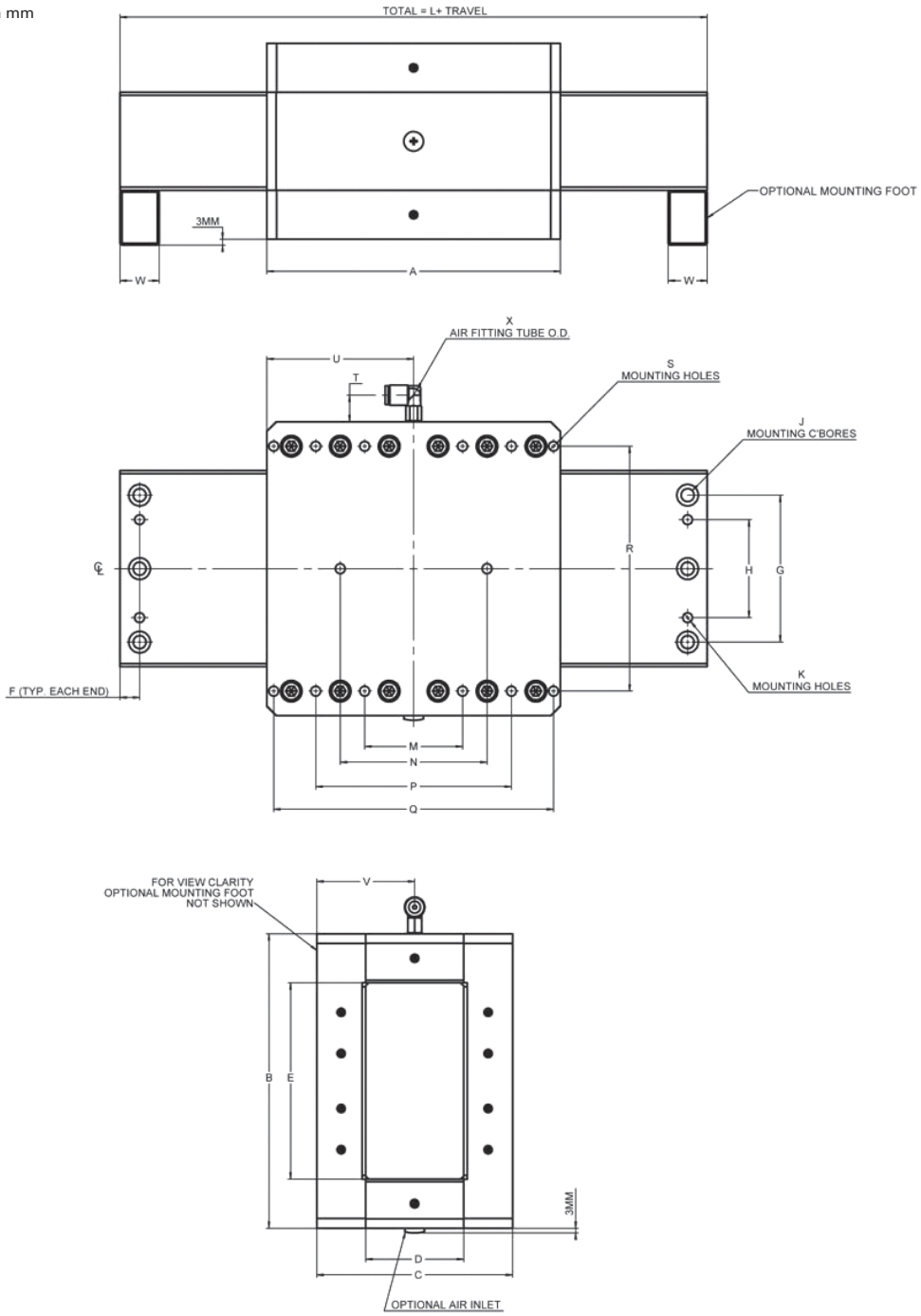
	A-10x.xxx
Operating pressure	80 psi (550 kPa) nominal
Air consumption	<1.0 SCFM (28 SLPM)
Air quality	Clean (filtered to 1.0 µm or better) – ISO 8573-1 Class 1 Oil free – ISO 8573-1 Class 1 Dry (–15 °C dew point) – ISO 8573-1 Class 3
Materials	Hardcoat aluminum, stainless steel fasteners

* The specified load capacities assume an operating pressure of 80 psi (550 kPa).
For an alternative operating pressure, contact PI for determining other load capacities.

** Precision specifications depending on load, orientation, and external forces on the bearing.
Contact PI for application-specific parameters.

Ask about custom designs!

A-10x.xxx, dimensions in mm



Model	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X
A-101	50	50	35	15	25	5	15	CL	4x M3 C'BORE	2x M3	80	15	40	N/A	N/A	40	6x M3	12	21	30	10	4 (5/32")
A-102	100	50	45	25	25	5	15	CL	4x M3 C'BORE	2x M3	130	15	40	60	N/A	40	10x M3	12	46	40	10	6 (1/4")
A-103	75	75	55	25	45	7.5	30	12.5	4x M5 C'BORE	2x M5	115	35	N/A	N/A	N/A	60	4x M5	14	37.5	47.5	15	6 (1/4")
A-104	115	75	75	45	45	7.5	30	12.5	4x M5 C'BORE	2x M5	155	50	N/A	N/A	N/A	60	4x M5	14	57.5	67.5	15	6 (1/4")
A-105	100	100	75	35	60	10	40	20	4x M6 C'BORE	2x M6	150	50	N/A	N/A	N/A	80	4x M6	14	50	37.5	20	6 (1/4")
A-106	150	100	100	60	60	10	40	20	4x M6 C'BORE	2x M6	200	50	N/A	110	N/A	80	8x M6	14	75	50	20	6 (1/4")
A-107	150	150	100	50	100	10	75	50	6x M6 C'BORE	4x M6	200	50	N/A	110	N/A	125	8x M6	14	75	50	20	6 (1/4")
A-108	200	200	130	70	140	10	100	50	6x M6 C'BORE	4x M6	250	50	N/A	150	N/A	170	8x M6	14	100	65	20	6 (1/4")
A-109	300	300	140	70	240	10	200	100	6x M6 C'BORE	4x M3	350	50	N/A	150	250	270	12x M6	14	150	65	20	6 (1/4")

A-10x.MNT Mounting Feet

For Mounting the Air Bearing Modules of the A-10x Series

- Hardcoat aluminum
- Matched exactly to the respective air bearing module

Model	Compatible with	Width / mm	Overall mass (one set) / kg
A-101.MNT	A-101.xxx	10	0.03
A-102.MNT	A-102.xxx	10	0.03
A-103.MNT	A-103.xxx	15	0.08
A-104.MNT	A-104.xxx	15	0.08
A-105.MNT	A-105.xxx	20	0.13
A-106.MNT	A-106.xxx	20	0.13
A-107.MNT	A-107.xxx	20	0.27
A-108.MNT	A-108.xxx	20	0.46
A-109.MNT	A-109.xxx	20	0.94

A-41x Plglide FPC:
Flat, Circular Air Bearing Modules

Friction-free, modular air bearings

- Diameters from 25 mm to 300 mm
- Load capacity to 15500 N
- Stiffness to 860 kN/mm
- Cleanroom compatible
- Mounting hardware, customizations, and accessories available

The Plglide Flat Pad Circular air bearing series is suitable for applications that require friction-free, accurate linear or planar motion. The modular concept of these air bearings allows the user to build their own motion system. Several bearings can be combined to increase the load capacity or to create multi-axis motion platforms.

Applications

- Sample Inspection
- Scanning
- Metrology / Testing
- Optical Alignment
- Flatpanel Inspection

>> Plglide Air Bearing Technology

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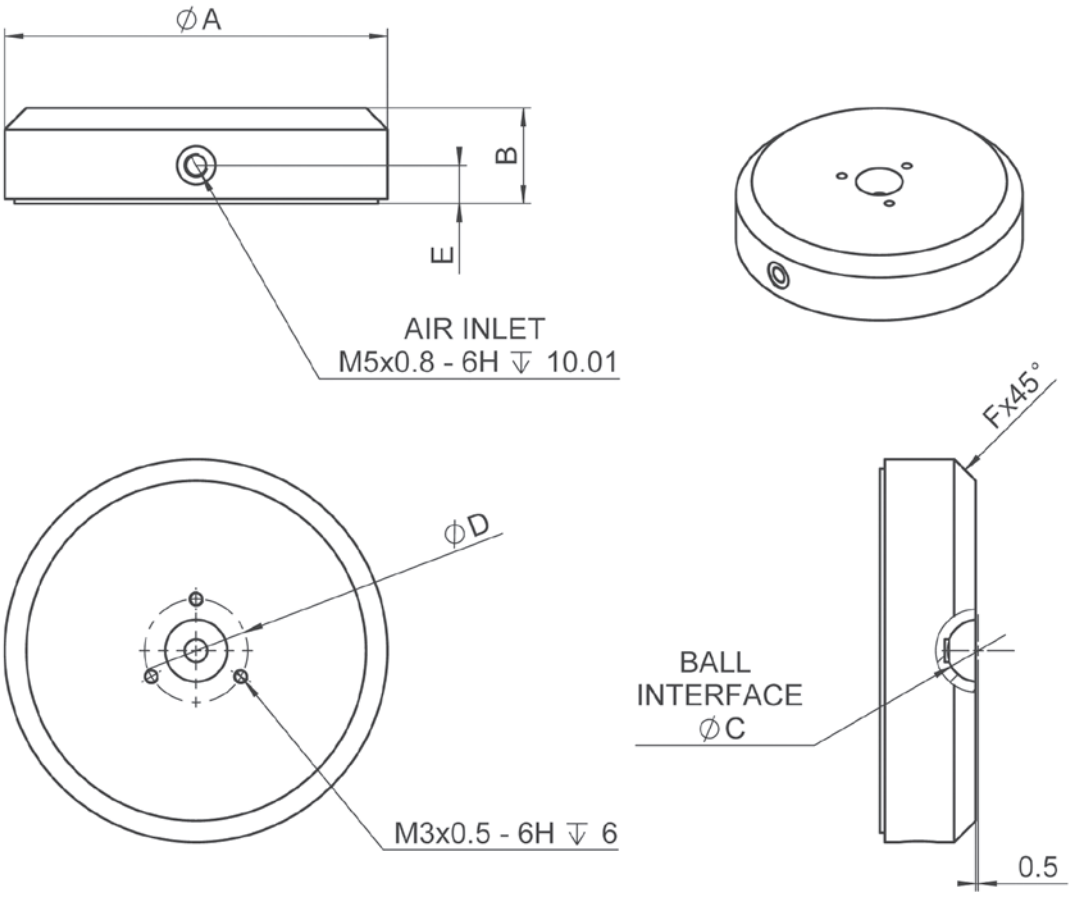
Part #	Diameter / mm	Ball interface diameter / mm	Load capacity / N	Stiffness / N/µm	Air consumption / l/h (SCFH)	Mass / g
A-411.025	25	13	88	17.5	60 (2)	16
A-411.040	40	13	220	28.0	60 (2)	42
A-411.050	50	13	330	52.5	85 (3)	66
A-411.065	65	13	660	78.8	115 (4)	171
A-411.080	80	13	1010	111	170 (6)	259
A-411.100	100	20	1710	175	170 (6)	505
A-411.125	125	20	2780	254	230 (8)	1105
A-411.150	150	20	4000	350	285 (10)	1590
A-411.200	200	20	7700	520	570 (20)	4040
A-411.300	300	20	15500	860	850 (30)	12000

Air supply	
Operating pressure	80 psi (550 kPa) nominal
Air quality	Clean (filtered to 1.0 µm or better) – ISO 8573-1 Class 1 Oil free – ISO 8573-1 Class 1 Dry (–15 °C dew point) – ISO 8573-1 Class 3
Miscellaneous	
Guideway surface flatness	<1µm / 300 mm
Nominal fly-height	10 – 15 µm
Materials	Hardcoat aluminum, stainless steel fasteners
Recommended guideway materials	Guideways are supplied by the customer. Granite, hardcoat aluminum, stainless steel, ceramics, nickel-plated steel, nickel-plated cast iron
Air bearing type	Discrete orifice

Mounting Hardware (sold separately)

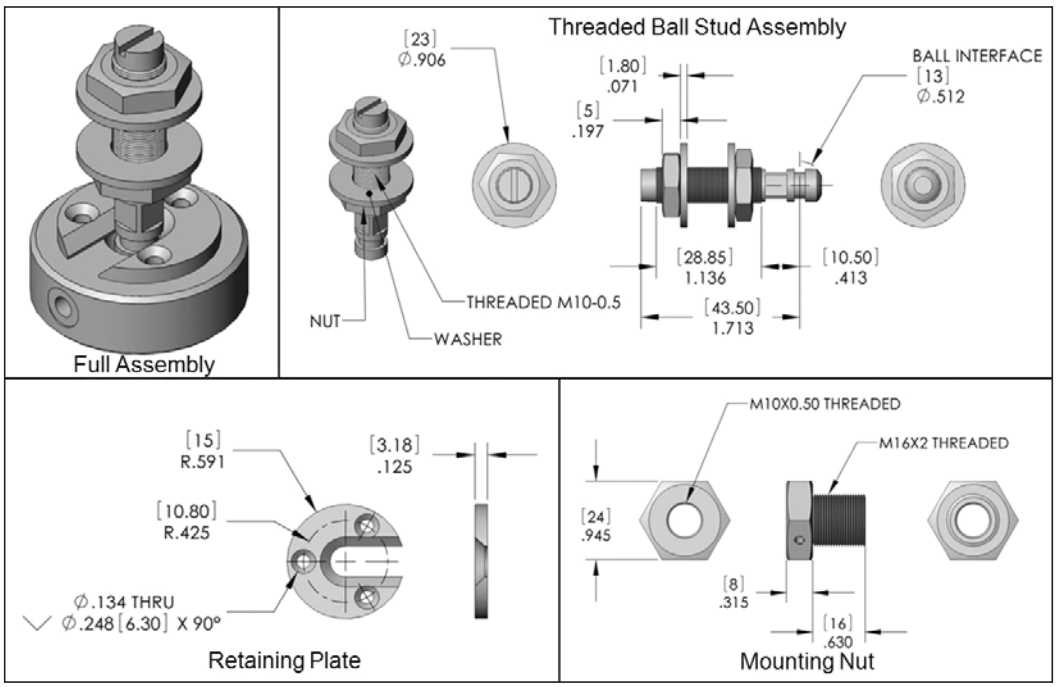
Part #	Description	Ball interface diameter
A-412.013S	Threaded ball stud assembly	13
A-412.013N	Mounting nut	13
A-412.013P	Retaining plate	13
A-412.020S	Threaded ball stud assembly	20
A-412.020N	Mounting nut	20
A-412.020P	Retaining plate	20

The loads listed assume a supply pressure of 550 kPa (80 psi). Please contact PI if other pressures are required.

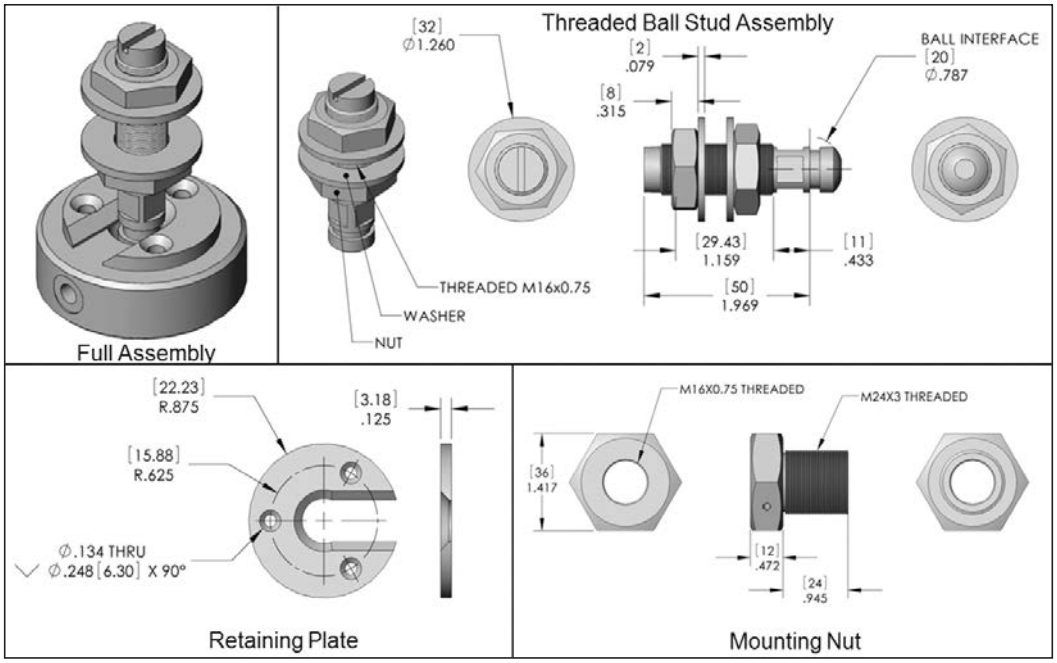


Model	A	B	C	D	E	F
A-411.025	25	13	13	N/A	6.4	1.5
A-411.040	40	13	13	21.6	7	1
A-411.050	50	13	13	21.6	7	1
A-411.065	65	20	13	21.6	8	1
A-411.080	80	20	13	21.6	8	4.5
A-411.100	100	25	20	31.6	9	6.4
A-411.125	125	35	20	31.6	9	6.4
A-411.150	150	35	20	31.6	9	6.4
A-411.200	200	66	20	31.6	9	25
A-411.300	300	66	20	31.6	9	25

Mounting hardware dimensions: 13 mm ball interface diameter



Mounting hardware dimensions: 20 mm ball interface diameter



A-60x PIglide RT Rotary Air Bearing Module

Frictionless, Nonmotorized

- Motion platform diameter from 50 mm to 300 mm
- Load capacity to 425 kg
- Eccentricity / flatness <200 nm
- Can be mounted vertically or horizontally
- Cleanroom compatible

Product Overview

The PIglide RT series of nonmotorized passive rotary air bearings are designed for accuracy, precision, high stiffness, and ease of use. They can be used in any orientation and are easy to integrate with motors and encoders for complete positioning solutions.

The bearings of the RT series offer superior eccentricity, flatness, and wobble performance. Because they are completely friction-free, they exhibit no break-away torque and no frictional resistance during operation. They are ideal for use in cleanrooms, require no maintenance or lubrication, and have unlimited lifetime.

Accessories and options

- Encoder for precise acquisition of stage angle during manual operation
- Mounting base for horizontal mounting onto optical tables and flat surfaces
- PIglide filter and air preparation kits
- Customized mounting flanges and square housings

Applications

- Sample Inspection
- Scanning
- Metrology / Testing
- Optical Alignment

>> PIglide Air Bearing Technology

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Size and loads	Motion platform diameter /mm	Journal length / mm	Load capacity [1] axial / radial /N	Permissible tip / tilt torque [1] / N·m	Stiffness axial / radial / N/µm
A-601.025	50	25	134 / 57	0.57	26 / 8
A-602.038	75	38	299 / 132	1.13	57 / 22
A-603.025	100	25	536 / 115	1.70	96 / 18
A-603.050	100	50	536 / 229	4.52	96 / 35
A-604.050	150	50	1206 / 344	22.6	210 / 64
A-604.090	150	90	1206 / 605	36.7	210 / 113
A-605.065	200	65	2144 / 577	39.6	385 / 110
A-605.100	200	100	2144 / 917	67.8	385 / 175
A-607.075	300	75	4244 / 1203	141.3	788 / 204
A-607.175	300	175	4244 / 2789	282.5	788 / 475

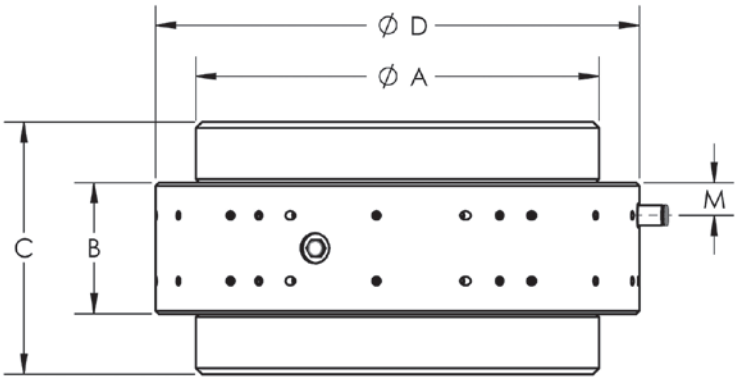
Performance specifications	Eccentricity [2] / nm	Flatness [2] / nm	Wobble [2] / µrad	Max. velocity [3] / rpm	Moment of inertia / kg·mm²	Rotating mass / kg	Overall mass / kg
A-601.025	300	100	5	3000	35	0.15	0.4
A-602.038	250	75	4	3000	231	0.4	1.2
A-603.025	175	75	2.5	3000	705	0.7	1.5
A-603.050	175	75	2.5	3000	750	0.8	2.5
A-604.050	100	50	2	3000	4715	2.1	5.4
A-604.090	100	50	2	3000	5050	2.6	8.2
A-605.065	100	50	1.5	2000	17900	4.6	11.6
A-605.100	100	50	1.5	2000	18800	5.3	16.3
A-607.075	75	40	1	1000	181900	19.4	38.1
A-607.175	75	40	1	1000	206700	26.0	59.0

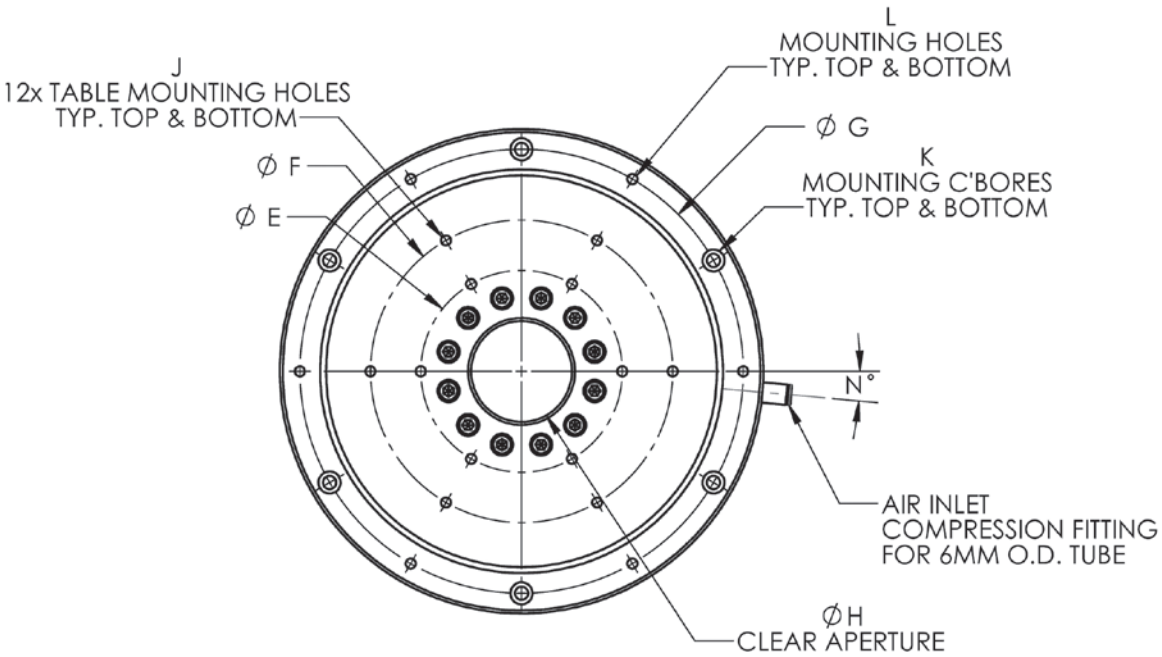
Optional encoders	Sensor signal	Sensor resolution / µrad	Max. velocity / rpm	Reference point switch
A-601.xxxH	A/B quadrature, differential, RS-422, 4 MHz	192	2500	1 / revolution, one count over one step of the encoder, synchronized to output signal
A-602.xxxH	A/B quadrature, differential, RS-422, max. 4 MHz	133	2000	1 / revolution, one count over one step of the encoder, synchronized to output signal
A-603.xxxH	A/B quadrature, differential, RS-422, max. 4 MHz	100	1500	1 / revolution, one count over one step of the encoder, synchronized to output signal
A-604.xxxH	A/B quadrature, differential, RS-422, max. 4 MHz	66.4	1000	1 / revolution, one count over one step of the encoder, synchronized to output signal
A-605.xxxH	A/B quadrature, differential, RS-422, max. 4 MHz	50	800	1 / revolution, one count over one step of the encoder, synchronized to output signal
A-607.xxxH	A/B quadrature, differential, RS-422, max. 4 MHz	33.5	500	1 / revolution, one count over one step of the encoder, synchronized to output signal

	A-60x
Miscellaneous	
Operating pressure	75 to 85 psi (515 to 585 kPa)
Air consumption	<2.0 SCFM (57 SLPM)
Air quality	Clean (filtered to 1.0 µm or better) – ISO 8573-1 Class 1 Oil free – ISO 8573-1 Class 1 Dry (–15 °C dew point) – ISO 8573-1 Class 3
Materials [4]	Hardcoat aluminum, stainless steel fasteners

(1 Capacities listed assume supply pressure of 80 psi. Please contact PI if other pressures are required.
(2) Precision specifications are dependent on quality of mounting base, payload, orientation, and external forces on the bearing. For application-specific parameters, please contact PI. Values shown are static (no rotational velocity during measurement).
(3) Velocity may be limited by the encoder option or payload imbalance. Please contact PI for further details.
(4) Alternate stage surface materials, such as stainless steel, are available. Please contact PI for a quote.

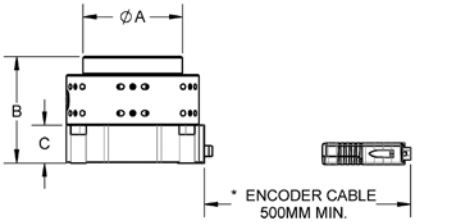
A-60x.xxx, dimensions in mm

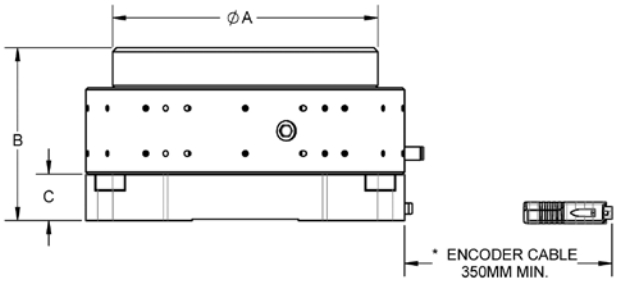


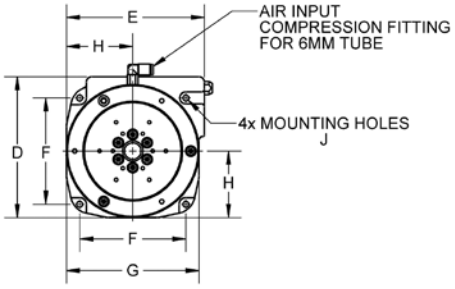


Model	A	B	C	D	E	F	G	H	J	K	L	M	N
A-601.025	50	25	50	70	25	40	60	8	M3x0.5, 6 DEEP	3x M3 SHCS, 30 LG. MIN	3x M3x0.5, 6 DEEP	6	30
A-602.038	75	38	65	100	30	50	87.5	12.5	M3x0.5, 6 DEEP	3x M4 SHCS, 40 LG. MIN	3x M4x0.7, 8 DEEP	9.5	30
A-603.025	100	25	55	125	50	75	112.5	25	M4x0.7, 8 DEEP	3x MS SHCS, 30 LG. MIN	3x M5x0.8, 10 DEEP	6	30
A-603.050	100	50	80	125	50	75	112.5	25	M4x0.7, 8 DEEP	3x MS SHCS, 50 LG. MIN	3x M5x0.8, 10 DEEP	12.5	30
A-604.050	150	50	95	185	75	125	170	40	M5x0.8, 10 DEEP	4x M6 SHCS, 50 LG. MIN	4x M6x1.0, 12 DEEP	12.5	68
A-604.090	150	90	135	185	75	125	170	40	M5x0.8, 10 DEEP	4x M6 SHCS, 90 LG. MIN	4x M6x1.0, 12 DEEP	22.5	68
A-605.065	200	65	125	240	100	150	220	60	M6x1.0, 12 DEEP	6x M6 SHCS, 70 LG. MIN	6x M6x1.0, 12 DEEP	16	5
A-605.100	200	100	160	240	100	150	220	60	M6x1.0, 12 DEEP	6x M6 SHCS, 100 LG. MIN	6x M6x1.0, 12 DEEP	23.5	5
A-607.075	300	75	150	355	150	250	330	75	M6x1.0, 12 DEEP	6x M8 SHCS, 80 LG. MIN	6x M8x1.25, 16 DEEP	17.3	5
A-607.175	300	175	250	355	150	250	330	75	M6x1.0, 12 DEEP	6x M8 SHCS, 150 LG. MIN	6x M8x1.25, 16 DEEP	58.5	5

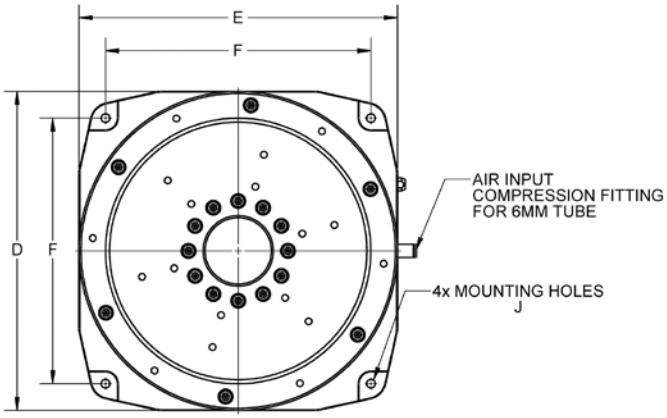
A-60x.xxxH and A-60x.xxxM, dimensions in mm







SIZES A-601 & A-602



SIZES A-603 THRU A-607

NOTES:
- REFER TO RT SERIES DRAWING FOR TABLETOP DETAIL
- ENCODER DETAIL APPLIES ONLY TO "H" MODEL

Model	A	B	C	D	E	F	G	H	J
A-601.025 M or H	50	65	26.5	82	74	55	70	35	M3 SHCS, 25 LG. MIN
A-602.038 M or H	75	80	28.5	106	104	80	100	50	M4 SHCS, 30 LG. MIN
A-603.025 M or H	100	65	25	135	125	100	-	-	M5 SHCS, 25 LG. MIN
A-603.050 M or H	100	90	25	135	125	100	-	-	M5 SHCS, 25 LG. MIN
A-604.050 M or H	150	100	27.5	185	185	150	-	-	M6 SHCS, 30 LG. MIN
A-604.090 M or H	150	140	27.5	185	185	150	-	-	M6 SHCS. 30 LG. MIN
A-605.065 M or H	200	130	35	240	240	200	-	-	M6 SHCS, 35 LG. MIN
A-605.100 M or H	200	165	35	240	240	200	-	-	M6 SHCS, 35 LG. MIN
A-607.075 M or H	300	155	42.5	355	355	300	-	-	M8 SHCS, 40 LG. MIN
A-607 175 M or H	300	255	42.5	355	355	300	-	-	M8 SHCS, 40 LG MIN

A-65x Plglide HB: Hemispherical Air Bearing

Friction-free, ideal for rotary motion on three axes

- Cleanroom compatible
- Low inertia
- Diameter up to 300 mm
- Rotatable in three directions
- Load capacity to 635 kg
- Tip / tilt range to ±45°
- Operating pressure from 30 psi to 90 psi (207 kPa to 621 kPa)
- Ideal for satellite control and simulation of weightlessness

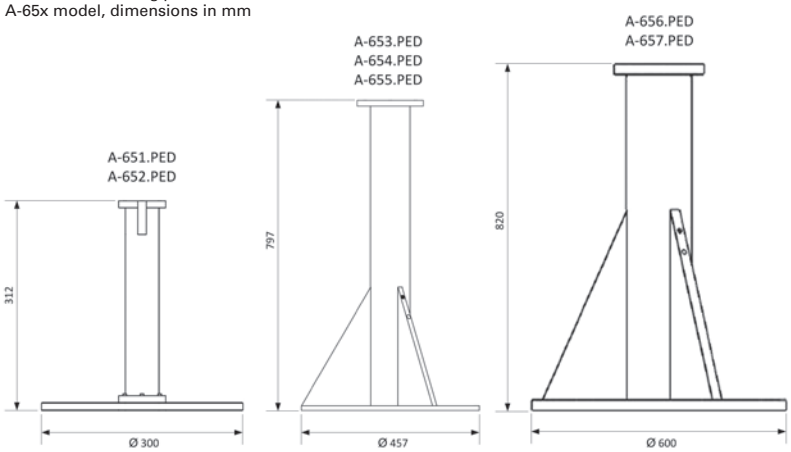
Overview

The spherical bearings, which are often used in research on weightlessness in satellites, are also used in systems for precision chip contacting and optical alignment. Due to the use of spherical bearings at both ends of the drive screw shaft, it is possible to build extremely stiff drive screws. This arrangement allows precision alignment of the drive screw shaft due to the motion of one spherical bearing relative to the other.

Accessories and options

- Air preparation kit
- Custom configurations on request

A-65x.PED Matching pedestal for each A-65x model, dimensions in mm



Model	Mass / kg	Compatible with
A-651.PED	3.1	A-651.xxx
A-652.PED	4.0	A-652.xxx
A-653.PED	16	A-653.xxx
A-654.PED	16	A-654.xxx
A-655.PED	17	A-655.xxx
A-656.PED	43	A-656.xxx
A-657.PED	44	A-657.xxx

Applications

- Semiconductor
- Optical Alignment
- Scientific Instrumentation

>> Plglide Air Bearing Technology

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Model	Sphere diameter / mm	Rotation range**/ °	Load capacity* / kg	Base mass / g	Sphere mass / g	Moment of inertia*** / g·m²
A-651	50	±45	15	115	70	0.02
A-652	75	±45	35	235	216	0.14
A-653	100	±45	65	550	475	0.58
A-654	150	±45	160	1350	1475	4.21
A-655	200	±45	265	2500	3350	17.2
A-656	250	±45	405	4000	5525	46.3
A-657	300	±45	635	6500	8100	103

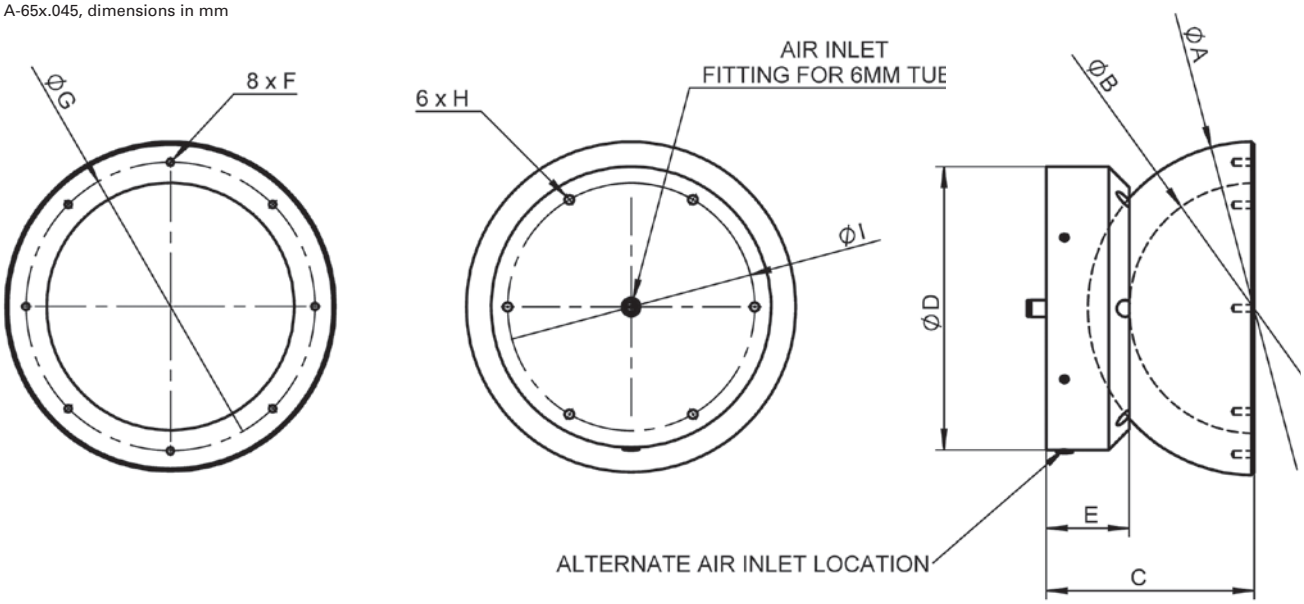
Operating pressure	**80 psi (550 kPa) nominal, 90 psi (621 kPa) maximum**
Air consumption	<1.0 SCFM (28 SLPM)
Air quality	Clean (filtered to 1.0 µm or better) – ISO 8573-1 Class 1 Oil free – ISO 8573-1 Class-1 Dry (–15 °C dew point) – ISO 8573-1 Class 3
Materials	Hardcoat aluminum, stainless steel fasteners alternative materials on request

* The specified load capacities assume an operating pressure of 80 psi (550 kPa).
For an alternative operating pressure, contact PI for determining other load capacities.

** Other travel ranges on request.

*** Around the center of the sphere.

A-65x.045, dimensions in mm

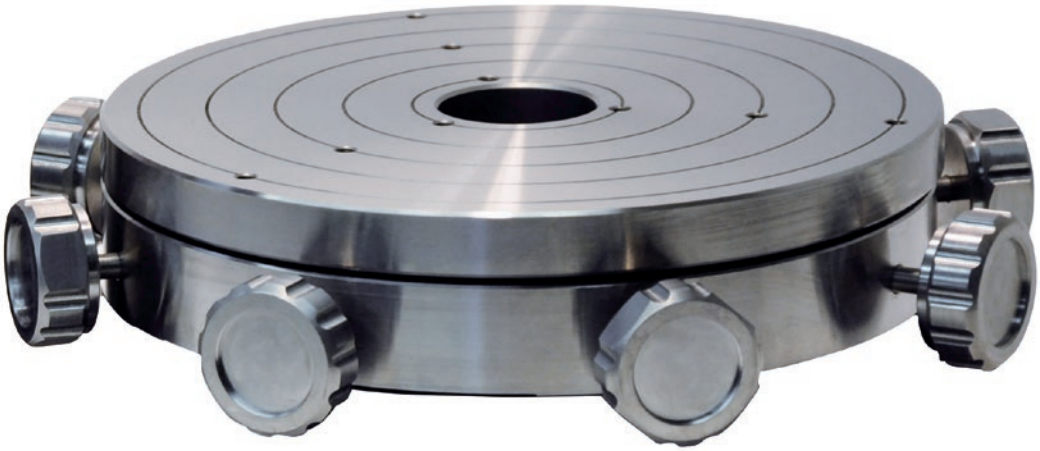


Model	A	B	C	D	E	F	G	H	I
A-651	50	30	42	55	23	M3	38	M3	45
A-652	75	50	55	70	27	M3	60	M3	60
A-653	100	70	70	100	30	M4	85	M4	85
A-654	150	110	95	140	40	M5	125	M5	125
A-655	200	150	125	170	50	M5	175	M5	150
A-656	250	200	150	210	55	M6	225	M6	190
A-657	300	250	175	250	65	M6	275	M6	230

A-60x.MTT Plglide Manual X-Y-Tilt Platform

Compatible with A-60x and A-62x

- Motion platform diameter 75 to 300 mm
- Manual operation
- 4 degrees of freedom: X, Y, θ_X, θ_Y
- Clear aperture
- Can be mounted directly onto an A-60x and A-62x



Applications

- Sample Inspection
- Metrology / Testing
- Optical Alignment

>> Plglide Air Bearing Technology

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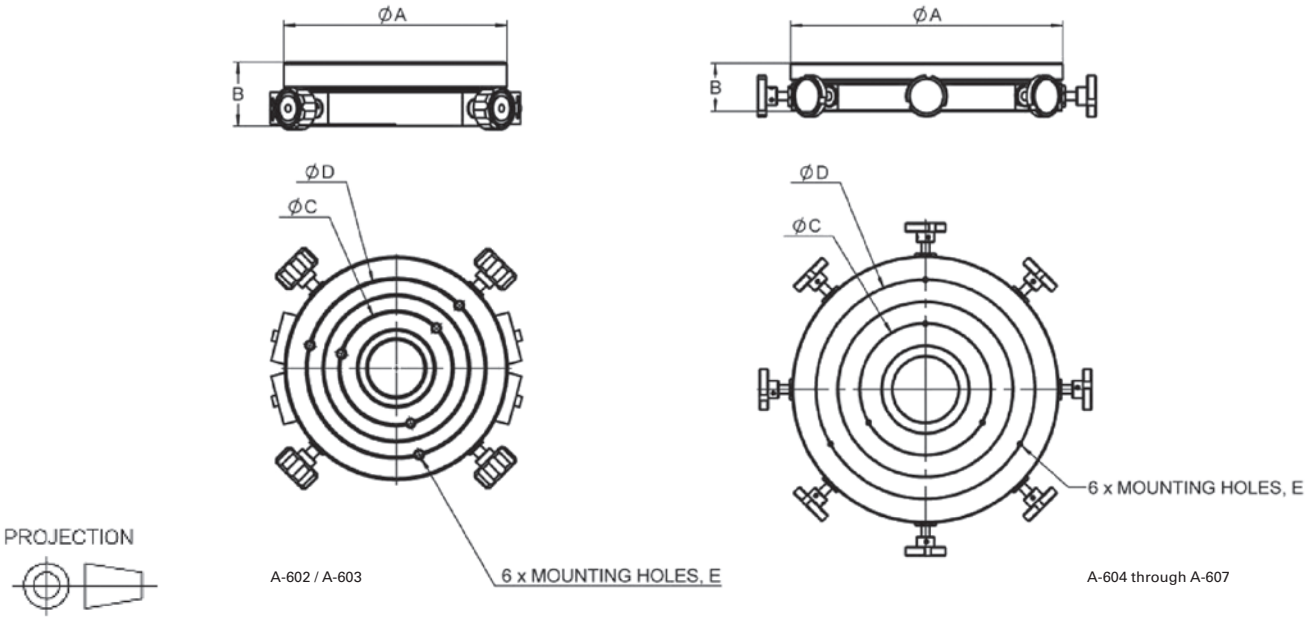
Model	Motion platform diameter /mm	Travel range X,Y	Travel range θ_X, θ_Y	Overall mass /kg	Moment of inertia /kg·mm²
A-602.MTT	75	±1.5 mm	±1.25°	0.8	620
A-603.MTT	100	±1.5 mm	±1.25°	1.5	2090
A-604.MTT	150	±3 mm	±1.25°	4	12900
A-605.MTT	200	±3 mm	±1.25°	8.6	52100
A-607.MTT	300	±3 mm	±1.25°	25	319000

Model	Motion platform diameter /mm	Compatible with A-60x	Compatible with A-62x
A-602.MTT	75	A-602.xxx	
A-603.MTT	100	A-603.xxx	A-623.xxx
A-604.MTT	150	A-604.xxx	A-624.xxx
A-605.MTT	200	A-605.xxx	
A-607.MTT	300	A-607.xxx	A-627.xxx

A-60x.MTT, dimensions in mm



Model	A	B	C	D	E
A-602.MTT	75	25	30	50	M3x0.5, 6 DEEP
A-603.MTT	100	30	50	75	M4x0.7, 8 DEEP
A-604.MTT	150	35	75	125	M5x0.8, 10 DEEP
A-605.MTT	200	45	100	150	M6x1.0, 12 DEEP
A-607.MTT	300	55	150	250	M6x1.0, 12 DEEP

A-80x Plglide Filter and Air Preparation Kits

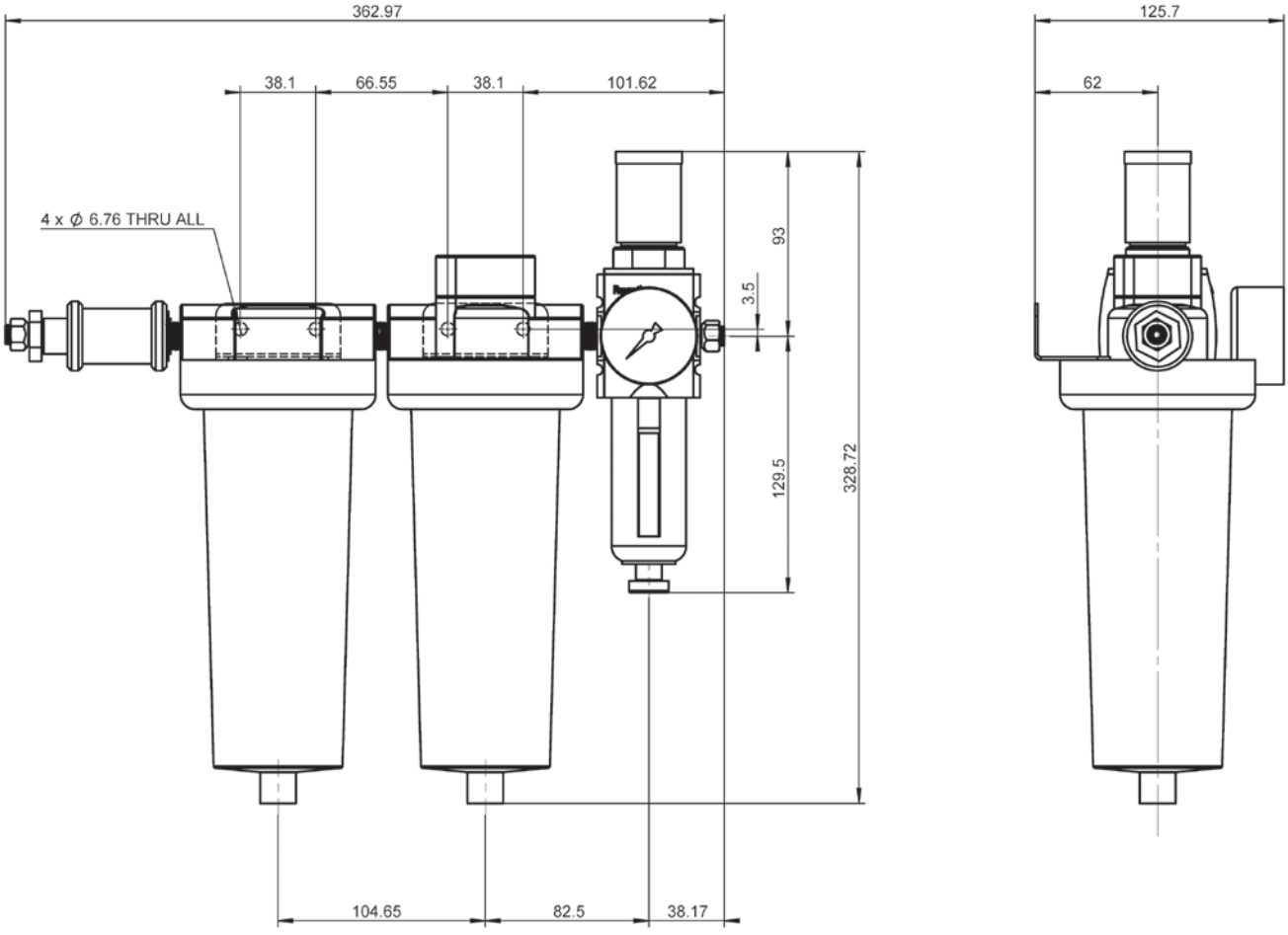
Multi-stage Filtration System with Pressure Regulation

- Cleans and filters the compressed air supply
- Controls the supply pressure
- Optional pressure switch
- Recommended for use with all Plglide air bearing products
- Customized adaptations possible

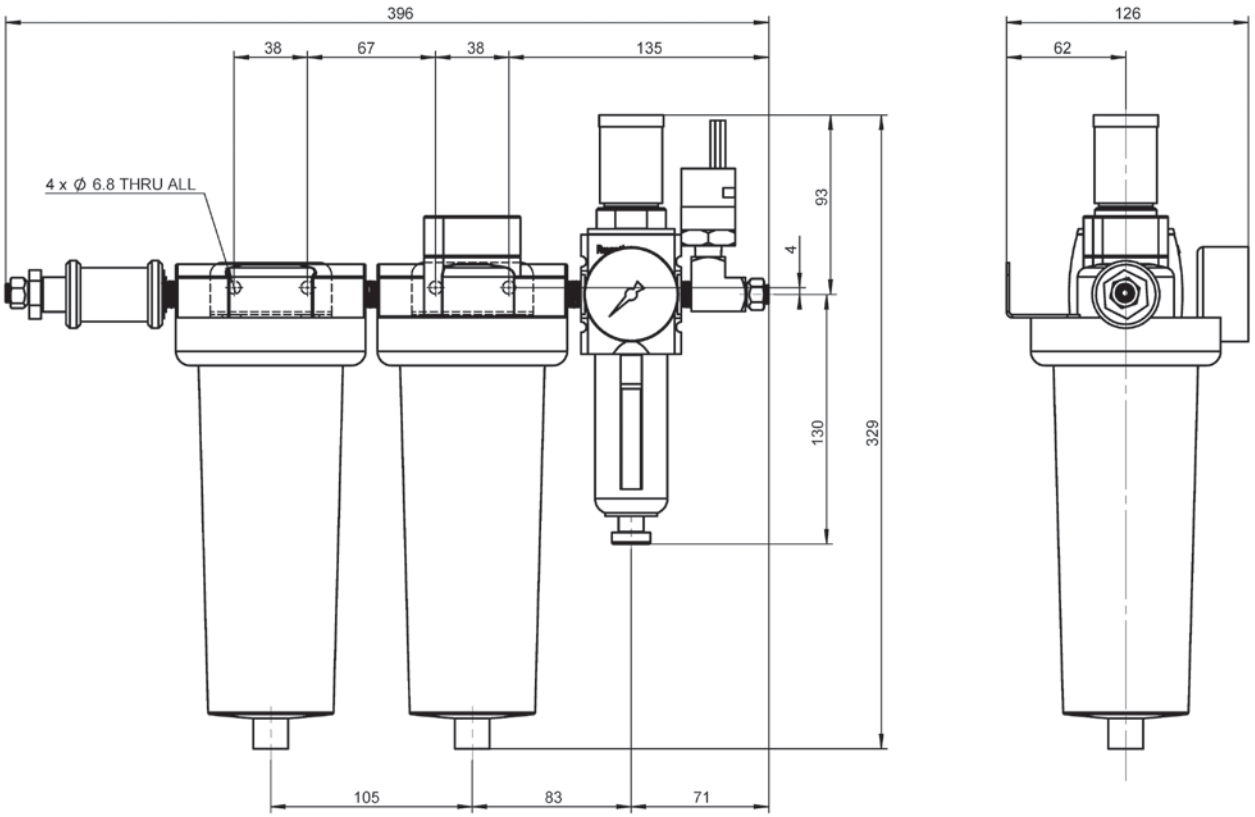
	A-801	A-802
Description	4-stage air preparation kit	2-stage air preparation kit
Air supply		
Maximum flow	60 SCFM (1680 SLPM)	10 SCFM (300 SLPM)
Compressed air supply quality (ISO 8573-1)	As desired	Class 3 or better
Max input pressure	150 psi (1035 kPa)	150 psi (1035 kPa)
Miscellaneous		
Primary construction	Aluminum	Polycarbonate
Mass	4.2 kg	0.7 kg
Options		
Option 1 pressure switch	1 = none	2 = N/O contact, adjustable threshold value
Option 2 Air input connection	0 = quick connection, 6 mm and 8 mm outer diameter in the scope of delivery	3 = quick connection 1/4″ and 3/8″ outer diameter in the scope of delivery
Option 3 Air output connection	0 = quick connection, 6 mm and 8 mm outer diameter in the scope of delivery	3 = quick connection 1/4″ and 3/8″ outer diameter in the scope of delivery

All modules require a compressed air supply with dry air according to ISO 8573-1 Class 3 or better (dew point no greater than 0°C).

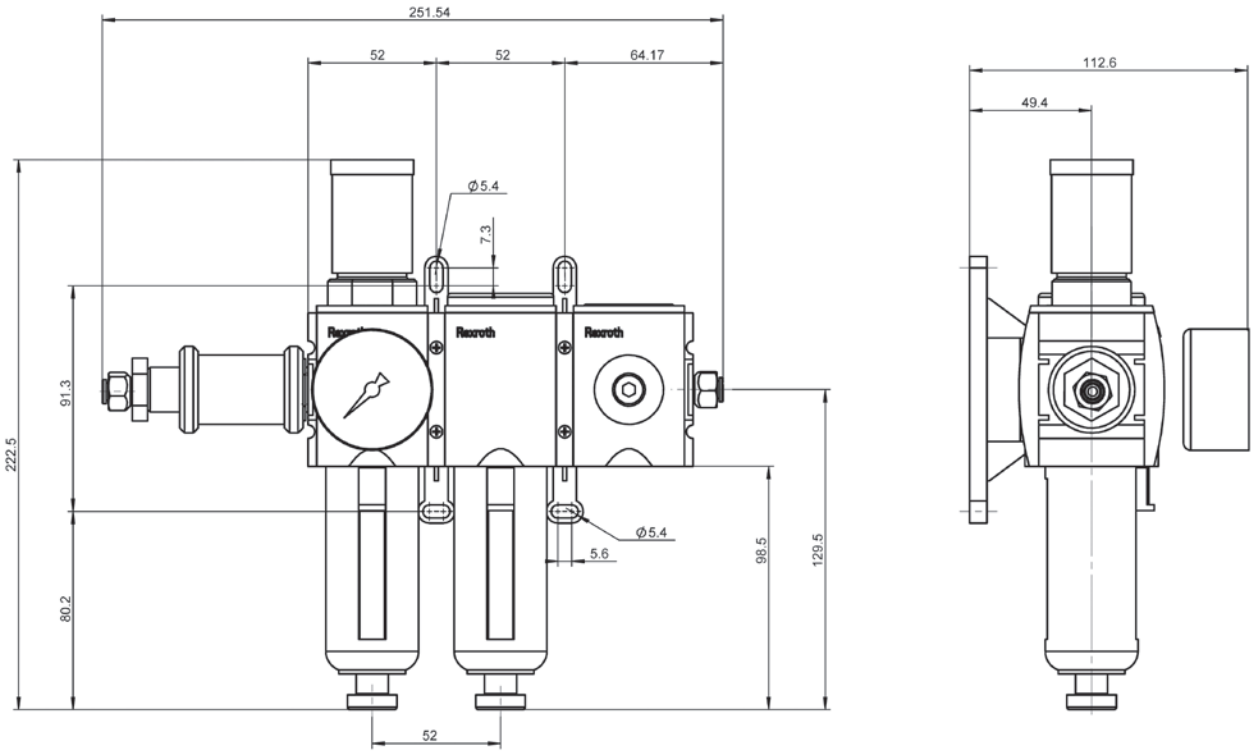
A-801.100, dimensions in mm



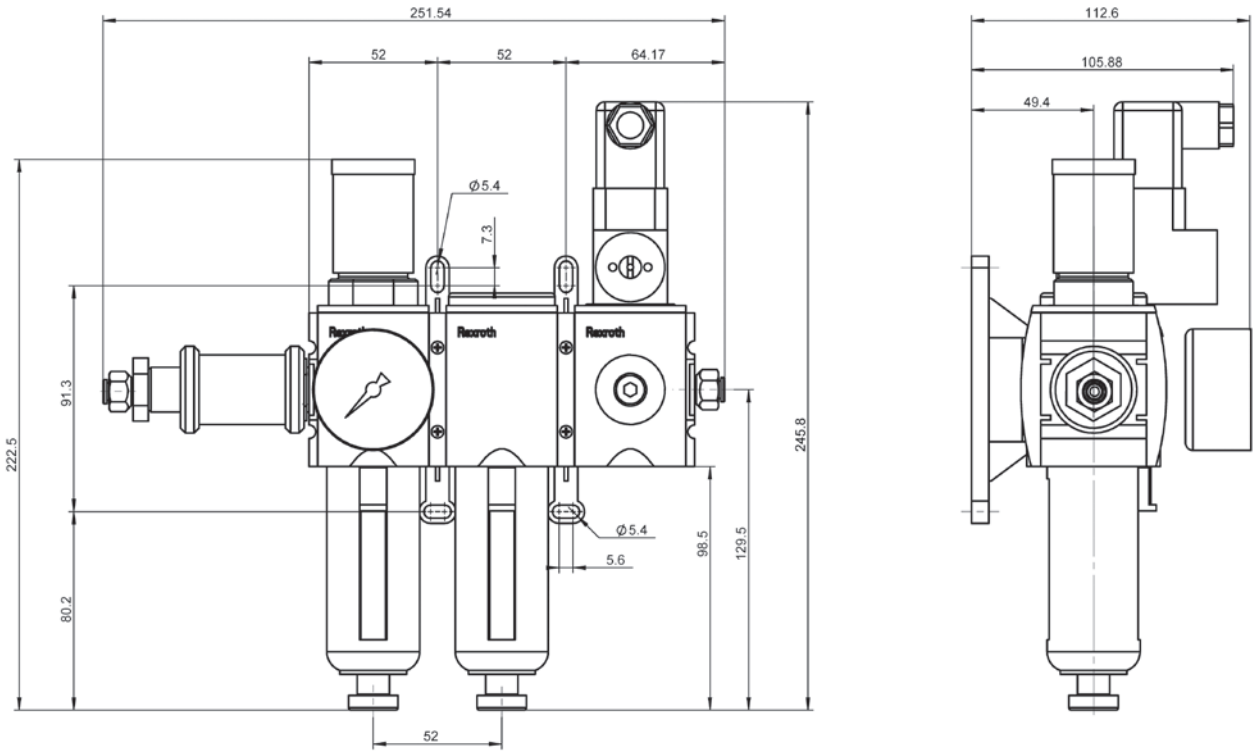
A-801.200, dimensions in mm



A-802.100, dimensions in mm



A-802.200, dimensions in mm



Air pressure below the threshold value, pressure switch opened (left).
Air pressure above the threshold value, pressure switch closed (right).

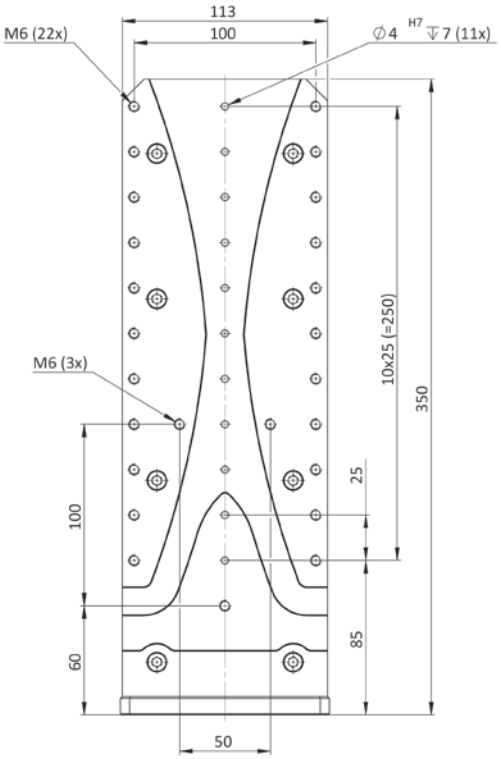
L-500 Adapter Bracket

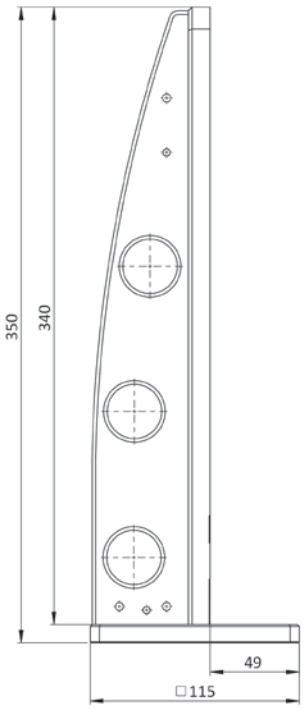
For Vertical Mounting of Linear and Rotation Stages

	L-500.AV1 (Angle to axis)	L-500.AV1 (Axis to angle)	L-500.AV3 (Angle to axis)	L-500.AV3 (Axis to angle)
Linear stages				
HPS-170	X	X*	X	–
L-406	–	–	X	X
L-408	–	–	–	X
L-412	X	X	X	–
L-417	X	–	–	–
V-412	X	X	X	
V-417	X	–	–	–
L-509	–	–	X	X
L-511	X	X*	X	–
LS-180	X	–	X	–
UPL-120	–	–	–	X
Rotation stages				
DT-80	–	–	–	X
L-611	–	X	X	–
UPR-100	–	–	–	–
UPR-120	–	X	X	–
UPR-120 AIR	–	X	X	–
Goniometers				
WT-85	–	–	X	X
WT-90	–	–	X	–
WT-100	–	–	–	X
WT-120	–	–	X	–
Z stage				
L-306	–	–	X	–
L-310	–	–	X	–
XY stage				
L-731	X	–	X	–
V-731	X	–	X	–
L-741	X	–	X	–
V-741	X	–	X	–

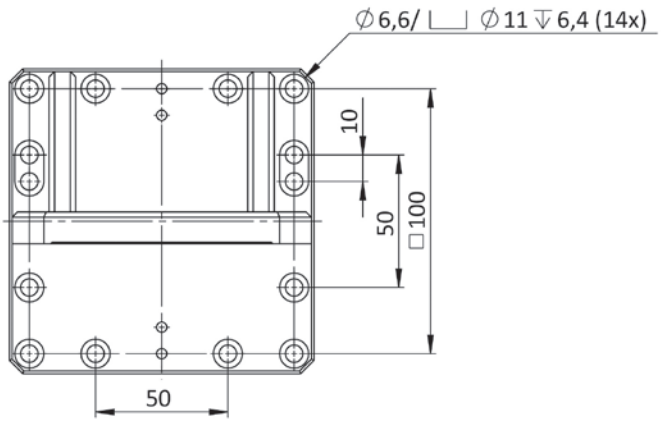
* to 155 mm stroke
Ask about custom designs!

L-500.AV1, dimensions in mm

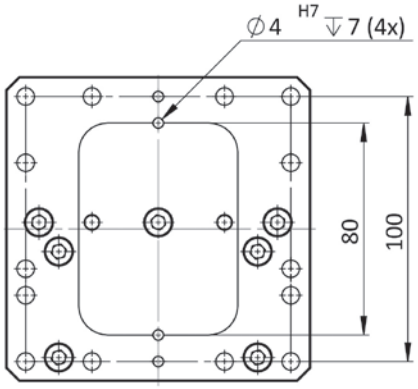




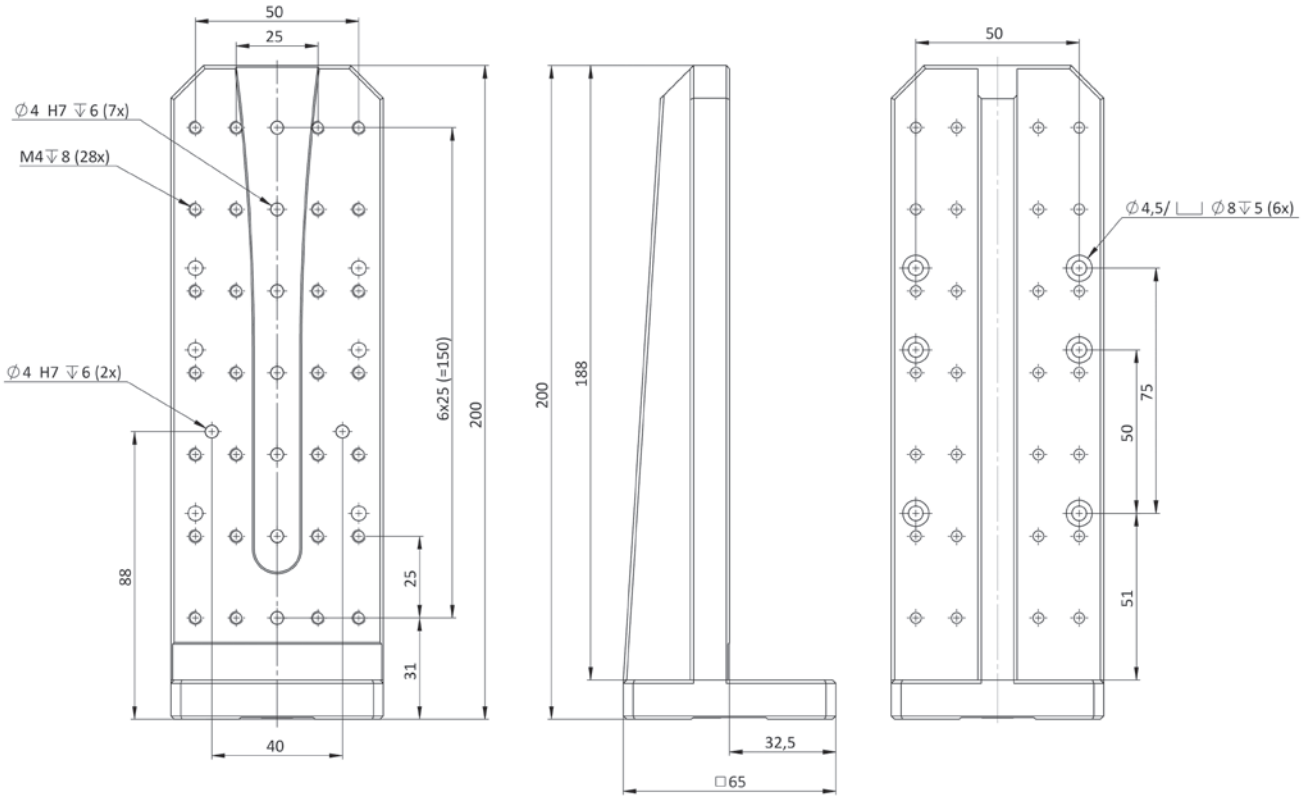
Top view of the L-500.AV1 adapter bracket, dimensions in mm



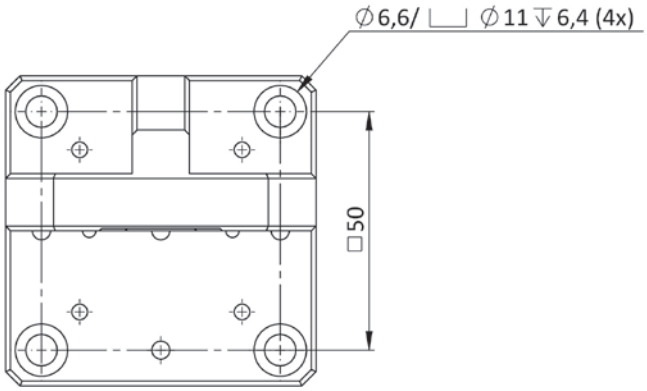
Bottom view of the L-500.AV1 adapter bracket, dimensions in mm



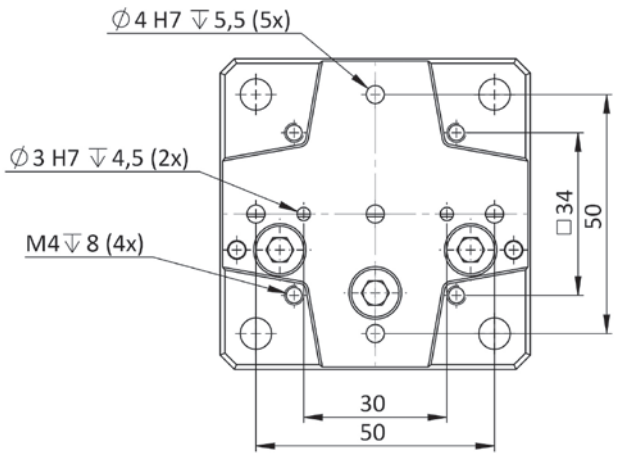
L-500.AV3, dimensions in mm



Top view of the L-500.AV3 adapter bracket, dimensions in mm



Bottom view of the L-500.AV3 adapter bracket, dimensions in mm



Terms and Technology Glossary

A

Absolute encoder

Absolute encoders are used for detecting the position and provide information on the absolute position of a motion platform. For example, this can be realized optically by using an additional Pseudo Random Code (PRC) scale.

ActiveDrive motor

The ActiveDrive Motor also integrates a servo amplifier into the motor housing, which is driven in PWM mode (Pulse Width Modulation). The operating voltage, which is mostly 24 V for ActiveDrive motors, is supplied by a separate power supply. Advantage: Lower costs, more compact design and higher reliability compared to an externally cabled amplifier; a higher degree of efficiency due to elimination of power loss between the amplifier and motor; avoidance of radiation interference because the amplifier and motor are built into the same shielded housing.

Air bearing

An air film of a few micrometers is used as bearing. Therefore, air bearings are free of friction and, compared to mechanical bearings, allow a considerably higher guiding accuracy. See “PIglide Air Bearing Technology”.

Average current

Current that is available reliably over a longer period. Given as measured value. For multi-axis controllers, it is specified per channel.

B

Ball screw

In the case of ball screws, only rolling friction occurs, which allows higher speeds, drive performance, and longer lifetime than leadscrews. They are however, not self-locking. The backlash can be minimized adjusting the ball diameter and the thread profile.

Brushless DC Motor (BLDC)

Compared to conventional DC motors, BLDC motors manage without wear-prone brushes meaning that a considerably longer lifetime is possible. Commutation is fully electronic and is generated completely by a rotating magnetic field in the stator that drags the rotor; the motor is based more on the concept of a synchronous machine. If sine commutation and a servo amplifier are used for position control instead of block commutation, the term synchronous servo motor (SSVM) is often encountered. Compared to DC motors, it is possible to realize a smaller and lighter design and provide the same performance, which results in a high ratio between the torque and the motor size. At the same time, the drivetrain can be shorter for the same travel range because the drive shaft is located inside the motor.

C

Capacitive sensor

Capacitive sensors allow contactless measuring, do not introduce much energy into the drive system and have a flat design. Their direct position measurement eliminates drift effects for travel ranges of up to 1.5 mm. The overall system, which consists of the stage, sensor technology, and electronics, gains on performance and precision. Due to noncontact measuring in the 10 µm up to approx. 2 mm range, it is possible to mount the capacitive sensor in the stage at the point where the motion actually takes place. The design consists of two conductive surfaces: A high-frequency alternating current generates a homogenous electric field between the two surfaces. Customers from the semiconductor industry also appreciate the small and versatile design as well as the lack of thermal build-up in the system. See “Sensor linearization”.

Closed-loop operation

Additional position feedback makes it possible to operate motors in a closed servo loop. Feedback of the corresponding encoder signals is necessary for this purpose. Basically, this concept makes it possible to control the rotational speed, the position, and the torque, which allows realization of a high position resolution, a uniform feed rate, and a large dynamic range for velocity and acceleration at a constant torque.

Creep

An unwanted change in the displacement over time.

Crossed roller guide

Crossed roller guides are comparatively stiff and manage with low preload. This results in reduced friction with high load capacity, high guiding accuracy, and smooth running. An additional forced cage control helps to prevent the roller bearing from creeping. Nevertheless, this shortens the possible travel range over the same axis length.

Crosstalk

Deviation from the ideal motion in axes perpendicular to the direction of motion.
Angular errors are xrx = roll, xry = pitch, xrz = yaw. Linear errors are lateral runout such as xty = straightness, xtz = flatness. See "Linearity error".

Current consumption

Current consumption of the system on supply end. It is specified for controller without load. Alternatively, power consumption.

Current limitation

Short-circuit protection.

D

DC motor

A DC motor exploits the force effect of the electrical current via a pivoted conductor loop in a magnetic field. In conjunction with servo controllers (see "servo motor") , these types of motors allow high torques at lower motor speeds, good dynamics over a large speed range, faster response, lower heat generation as well as smooth and vibration-free operation. The disadvantage is the wear-prone brushes used for commutation that does result in a comparatively shorter lifetime. However, due to their low holding force, DC motors (without gearhead) are generally not suited for vertically oriented axes.

Design resolution

The theoretical minimum movement that can be made. Design resolution must not be confused with minimum incremental motion. In indirect position measurement methods, values for spindle pitch, gear ratio, motor or sensor / encoder resolution, for example, are included in the calculation of the resolution; normally it is considerably below the minimum incremental motion of a mechanical system. Indirect measurement methods, the resolution of the sensor is specified.

Direct metrology

Position measuring is performed with the highest accuracy directly at the motion platform so that nonlinearity, mechanical play or elastic deformation have no influence on position measuring. This is achieved by noncontact optical linear encoders. Precision positioning systems use different encoder types as position sensor: Incremental encoders with different accuracy levels, absolute-measuring encoders that additionally make referencing unnecessary when a machine is switched on again, and for travel ranges under 2 mm, capacitive sensors.

Drift

See "Creep".

Drive type

Defines the types of drive supported by the controller / driver, such as voice coils, linear motors, DC/BLDC motors, stepper motors and others.

E

Encoder

An encoder is used for determining the position. Basically, a difference is made between linear and rotary encoders, which, depending on the configuration, operate either incrementally or absolutely.

Encoder input

Maximum bandwidth (-3 dB) of the input signals for the encoder input.

Extensive software package

To make systems more user friendly, software plays an important role in positioning systems. Customers expect a plug-and-play solution even if several positioning systems are combined or different drive systems need to interact, and that is why PI (Physik Instrumente) provides PIMikroMove® host software. You only need to enter your parameters into the application to avoid programming altogether. Also supports a number of text-based languages, has its own LabVIEW, Python and Matlab drivers, and the software is compatible with Windows, Linux, and OSX. However, not all software tools may be available for all controller versions.

F

Flatness

See "Crosstalk".

Flexures

The motion of a flexure is based on elastic deformation of a solid. This avoids any static, rolling or sliding friction. Flexure elements have high stiffness and load capacity and are very insensitive to shocks and vibrations. They do not wear, require no maintenance, are completely vacuum compatible, function in a wide temperature range, and do not require any lubricants.

Terms and Technology Glossary

G

Gearhead

Gearheads allow adjustment of the speed and the torque. However, the transmission ratio, which is the proportion between the speed and the gear input, is decisive and the speed is defined at the gear output. In the case of transmission reduction, this ratio is greater than one, which results in a lower speed with a higher torque. The opposite applies in the case of higher speeds. Typical types of gears include for example, worm gears, spur gears, planetary gears, bevel gears, and belt gears.

I

ID chip

An ID chip is located in the connector of many stages. When the stage is calibrated at the factory with a digital controller, the calibration data is saved together with specific product information on the ID chip. When switched on, digital electronics read the data from the ID chip of the connected stage. Stages, whose ID chip contains the calibration data, can therefore be connected to any suitable digital electronics without renewed calibration.

Incremental encoder

When incremental encoders are in motion, they generate impulses that are counted by the controller. However, in contrast to absolute encoders, it is a question of determining a relative position. To determine an absolute position, a limit switch or reference point switch signal must also be referenced.

Input level

Permissible input level for digital interfaces.

Integrated feedback sensor

Absolute measuring capacitive, piezo resistive (PRS) or strain gauge (SGS) and optical (absolute and relative) sensors are used to provide position information to the controller.

L

Lateral force, max.

Maximum lateral force perpendicular to the operating direction. For XY stages the push/pull force capacity of the other module (in its operating direction) limits the lateral force that can be tolerated.

Leadscrew

Leadscrews can achieve very high resolutions with smooth running and are often preloaded by springs to minimize backlash. This results in sliding friction and therefore a self-locking effect. However, this reduces the speed, performance, and the lifetime.

Limit switch

Function: Optical, magnetic.

Linear ball guiding

Linear ball guides require exact tolerances between the guide and bearing in order to keep the play and friction as low as possible. This limits the load capacity. Due to the simple design, they are only suitable for inexpensive applications with comparatively low requirements.

Linear encoder

Linear encoders measure the position directly at the motion platform. As a rule, this means that a higher accuracy is achieved compared to rotary encoders, because nonlinearity, mechanical play, and elastic deformation have no influence.

Linear motor

A linear motor is an electromagnetic direct drive that generates straight linear motion. The range of a linear motor is practically unlimited. A linear measuring system is always required for motion and positioning; open loop operation of a linear motor is not possible. The linear motor does not require mechanical coupling elements to convert the rotation of the motor into linear motion as is the case with servo motors. Typically, 3-phase motors are used.
Typical applications are found in the electronics and semiconductor industry, medicine and biotechnology, in tool machines with a strong focus on laser cutting but also in other fields where precision, dynamics, and productivity are important.

Linearity error

Deviation in motion direction, of measured position from commanded position (positioning accuracy). Measured with an external, traceable device. The value is given as a percentage of the entire measuring range.
Measurement of the linearity error: The target and measured actual values of the positions are plotted against each other, a line is drawn through the first and last data point, and the maximum absolute deviation is determined. A linearity error of 0.1 % corresponds to an area of ±0.1 % around the ideal line. Example: A linearity error of 0.1 % over a measuring range of 100 µm produces a possible maximum error of 0.1 µm.

Load capacity

Maximum vertical load, when the stage is mounted horizontally.

M

Magnetic bearing

Magnetic levitation allows excellent linear and rotational guiding accuracy on a plane. The passive runner hovers of a magnetic field and is then actively guided by it. Flatness errors are measured and compensated by very accurate noncontact sensors. Contrary to air bearings, which are also very accurate, magnetic bearings can also be used in vacuum.

Measurement range extension factor

For capacitive sensors, used by PI.

N

Noise

For capacitive sensors. In extended measurement ranges, noise is considerably higher than in the nominal measurement range.

Nonlinearity

See “Linearity error”.

O

Open-loop operation

The actuator is used without a position sensor. Displacement roughly corresponds to the drive voltage. Creep, nonlinearity and hysteresis remain uncompensated. Open-loop operation is ideal for applications where fast response and very high resolution with maximum bandwidth are essential. Here, commanding and reading the target position in absolute values is either not important or carried out by external position sensors. Open-loop operation is not possible for electro-magnetic direct drives, such as linear motors and voice-coil drives.

Operating temperature range

In any case, the device can be operated safely in the maximum permissible temperature range. To avoid internal overheating however, full load is no longer available above a certain temperature (maximum operating temperature under full load). Nevertheless, recalibration or zero-point-adjustment may be required if the system is operated at different temperatures. Performance specifications are valid for room temperature range. Please refer to individual datasheets and contact PI for more details.

Operating voltage

Allowed control input voltage range (also input frequency) for the supply of the device.

Overtemperature protection

Switch-off temperature for voltage output. No automatic restart.

P

Patents

PI owns a large variety of patents on piezo and motor technology.

Parallel kinematics, hexapods

Hexapods are parallel-kinematic systems with six drives that are connected directly to a single platform. This makes it possible for users to position objects automatically in all degrees of freedom, X, Y, Z, and rotatory and, depending on the drive, with an accuracy in the micrometer range or lower. The parallelkinematic system is very stiff, with only a low passive weight to move and, with the corresponding design, can carry loads of up to several tons. Users are able to arbitrarily choose the reference coordinate system and, today, workers are now working together with hexapods on the production line. The user integrates the system into the automation environment via EtherCAT.

Parallel metrology

Each sensor measures the position of the same moving platform in the respective degree of freedom. This keeps the off-axis runout, or crosstalk, of all actuators inside the servo-control loop and allows it to be corrected automatically.

Peak current

Only available for very short times, typically under a few milliseconds. It is used to estimate the possible dynamics with a certain capacitive load. Note: In this case, the controller / driver does not necessarily work linearly.

Piezoresistive sensor (PRS)

Strain gauge sensors that consist of a semiconductor foil. See “Strain gauge sensors”.

PIglide Air Bearing Technology

The PIglide air bearing technology allows friction-free positioning with a high guiding accuracy of up to 5 µrad over 100 mm. The technology improves the position resolution and it is possible to realize constant-velocity scanning. The repeatability is only a few encoder impulses. A similar precision in the nanometer range is also possible with flexure-guided piezo nanopositioners, however, only over considerably shorter travel ranges. The developers at PI (Physik Instrumente) adapt high-precision, air bearing positioning stages and motion control systems according to customer requirements.

Terms and Technology Glossary

PIMag® Magnetic Linear Motors

Magnetic direct drives from PI (Physik Instrumente) provide a direct and stiff connection between the load to be moved and the drive. The industry demand is particularly high when objects need to be positioned with high dynamics and precision. Thanks to the smooth-running precision linear guides with crossed roller bearings, these types of linear motor stages are particularly suitable for applications that require constant-velocity scanning. The drives operate without contact and therefore very reliable. Users can integrate the magnetic direct drives into existing machines and systems quickly and easily via standardized fieldbus systems. See “Linear motor”, “Torque motor”

PIMag® Voice Coil

Thanks to their low weight and friction-free drive principle, voice coil drives are small and particularly suitable for applications that require high dynamics and high velocities over limited travel ranges – for example, in medical technology. Voice coil drives have a greater advantage for the customer when compared to traditional drive screw-based solutions, particularly with respect to wear and dynamics. High scan frequencies and precision positioning are possible with these drives, because they are free of hysteresis effects. See “Voice Coil Drive”.

Pitch

See “Crosstalk”.

Power consumption

Maximum power consumption under full load.

Profile generator

Functionality of motor controllers that allows motion profiles such as linear interpolation, point-to-point, trapezoid, double bends. For several axes: Electronic gearing.

Pulse width modulation (PWM)

PWM-controlled motors allow control of the (motor) performance with a high-frequency-signal. This means that the power signal can be separated from the digital control signal.
PWM control is used for example for controlling electric motors such linear motors or voice coil drives. The “ActiveDrive Motor” is a special feature from PI, see there.

Push/pull force capacity (in operating direction)

Specifies the maximum forces that can be applied to the system along the active axis. If larger forces are applied, damage to the actuator can occur. The force limit must also be considered in dynamic applications.
Example: the dynamic forces generated by sinusoidal operation at 500 Hz, 20 µm peak-to-peak, 1 kg moved mass, are approximately ±100 N.

R

Recirculating Ball Bearing

Due to their design, recirculating ball bearings are already insensitive to creeping. For example, they are suitable for high-precision axes, which are often used for scanning smaller areas. When assembled correctly, they offer a high load capacity and at the same time, long lifetime, no maintenance, and high guiding accuracy.

Reference point switch

Function: Optical, magnetic.

Repeatability

Typical values in closed-loop operation mode (RMS, 1 σ). Repeatability is a percentage of the total distance or angle traveled. For small ranges, repeatability may be significantly better.

Resolution

Position resolution relates to the smallest change in displacement that can still be detected by the measuring devices. Values are typical results (RMS, 1 σ).

Roll

See “Crosstalk”.

Rotational runout

See “Crosstalk”.

Rotary encoder

Rotary encoders measure the position indirectly because for example, they are mounted directly on the motor shaft. That means that they are attached to a rotating part of the drivetrain. Easy installation of the sensors is an advantage but backlash and mechanical play affect the resulting measurement.

S

Stepper motor

Stepper motors only take discrete positions within one revolution. A position can be commanded with a constant step size without an additional encoder. The achievable step size is specified by the motor control. Intelligent wiring of the individual poles allows a so-called microstep mode, which, depending on the type, is able to realize several hundreds of thousands of microsteps between the full steps by electrical interpolation. However, step losses and the associated positioning errors can be the result in the case of excessively high loads and accelerations as well as resonance effects if an additional encoder is

not used. High speeds are only possible with high numbers of steps, which however, prevents reaching the achievable torque. A mechanical damper on the motor shaft, which also works as handwheel, supports smooth running. To hold position without a self-locking gearhead, stepper motors must be supplied with current, which can then lead to jittering. Nevertheless, stepper motors offer a very long lifetime and, compared to DC motors, are especially suited to applications with reduced dynamics and in a vacuum.

Sensor bandwidth

Measured value that specifies the frequency, with which the amplitude decreased by -3 dB.

Sensor linearization

For capacitive sensors, the signal conditioning electronics demonstrates a notably low noise level. The integrated linearization system (ILS) compensates for the influences of parallelism errors between the capacitor plates.

Sensor resolution

The smallest calculable increment that can be detected by the measuring system used. Rotary encoder: Number of counts per screw rotation. Linear encoder: Smallest increment still detected by the sensor system used. The sensor can be the critical element in position resolution, for this reason the sensor resolution is specified separately if necessary. See “Design resolution”.

Serial kinematics

Each actuator acts on its own platform. There is a clear relationship between actuators and motion axes. The advantages are the relatively simple assembly and multi-axis control. The dynamic characteristics depend on the individual axis. Guiding errors cumulate and the overall guiding accuracy is poorer if compared to “Parallel kinematics”, see there.

Serial metrology

One sensor is assigned to each moving axis to be servo-controlled. Undesired off-axis motion, guiding error or crosstalk, go unnoticed and uncorrected. See “Parallel metrology”.

Servo motor

A motor with position detection and control is called a servo motor. The motor itself is often a DC motor. Servo motors offer high torques at a low speed, good dynamics over a large speed range, fast response, low heat generation as well as smooth and vibration-free operation. Either rotary or absolute encoders are used for detecting the position. A servo amplifier takes care of amplifying the signal and controlling the motor parameters. This is normally a PID controller (Proportional, Integral, Derivative) with additional filters in order to exploit the above-mentioned characteristics as best as possible.

Specification

Performance specifications are valid for room temperature (22 ±3 °C) and closed-loop systems are calibrated at this temperature (specifications for different operating temperatures on request). Recalibration is recommended for operation at significantly higher or lower temperature. Custom designs for ultralow or ultrahigh temperatures on request.

Straightness

See “Crosstalk“.

Synchronous servo motor (SSVM)

A servo motor that is designed as a synchronous machine. This type of motor for example, can be realized from a brushless DC servo motor with sine commutation (see brushless “DC motor” and “servo motor”).

T

Threaded roller drive screw

In the case of threaded roller drive screws, the contact surface between the drive screw, roller, and nut is considerably larger than with ball screw drives. This results in a very high stiffness and higher loads are possible. There are various versions, for example, guided planetary rollers without roller recirculation or rotating rollers, i.e., with roller recirculation, which allow even smaller pitches.

Torque motor

Torque motors are mainly brushless DC motors that are optimized for high torques or classical servo drives with a high number of poles. On the other side, it is possible to envisage torque motors as rolled-up linear motors. In contrast to conventional servo drives, torque motors achieve lower speeds but are able to achieve very high torques at medium to low speeds. The torque generated by a torque motor increases squared to the rotor diameter. As a rule, the rotor is a hollow shaft. When compared to the usual servo drives, the length of the installation space is not used and this allows low-profile dimensions. Torque motors represent a zero-play and stiff direct drive and can reach high positioning and repeatability with a high load. The high drive torque also allows higher accelerations and the associated high dynamics.

Trajectory control

Provisions to prevent deviation from the specified trajectory. Can be passive (e.g., flexure guidance) or active (e.g., using additional active axes and sensors).

Translator

A linear actuator.

Terms and Technology Glossary

U

User software and functions

PIMikroMove®, PI General Command Set (GCS). Drivers for LabVIEW, shared libraries for Windows and Linux. Compatible with µManager, MetaMorph, MATLAB. Wave Generator. Linearization. Data recorder. Auto zero. Trigger I/O. Software configurable servo parameters. See “Extensive software package”.

V

Vacuum-compatible versions

In a large number of industry sectors, production in a vacuum is becoming increasingly more important. Therefore, PI (Physik Instrumente) offers various different drive technologies to its customers that can be operated in a vacuum of 10^{-7} or even 10^{-10} hPa. This applies to specially designed motors and actuators.

Voice coil drives

These friction-free electromagnetic linear drives are characterized by their good dynamics, albeit with relatively low holding force.
Voice coil motors are direct drives. The drive principle is the technical implementation of the Lorentz force: The force that a live conductor exerts in a permanent magnetic field is proportional to the magnetic field strength and the current. The motion controller controls the force via PWM control. The drive is combined with a measuring system for precision positioning and operated in a closed loop. The travel ranges of voice coil drives are therefore limited by the technology and are between 0.5 mm and 25 mm.
Typical applications include short-range motion with fast settling times, applications with low noise generation, or sensitive programmable force controls.

Y

Yaw

See “Crosstalk”.

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