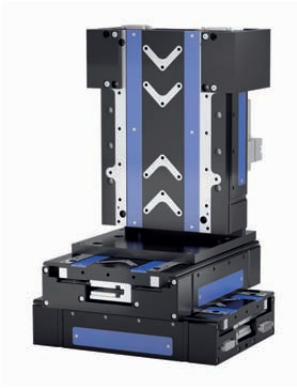
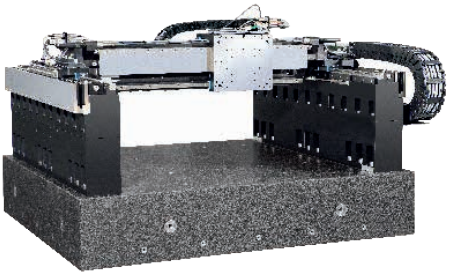
PI

HIGH PRECISION
XY & XYZ Stages

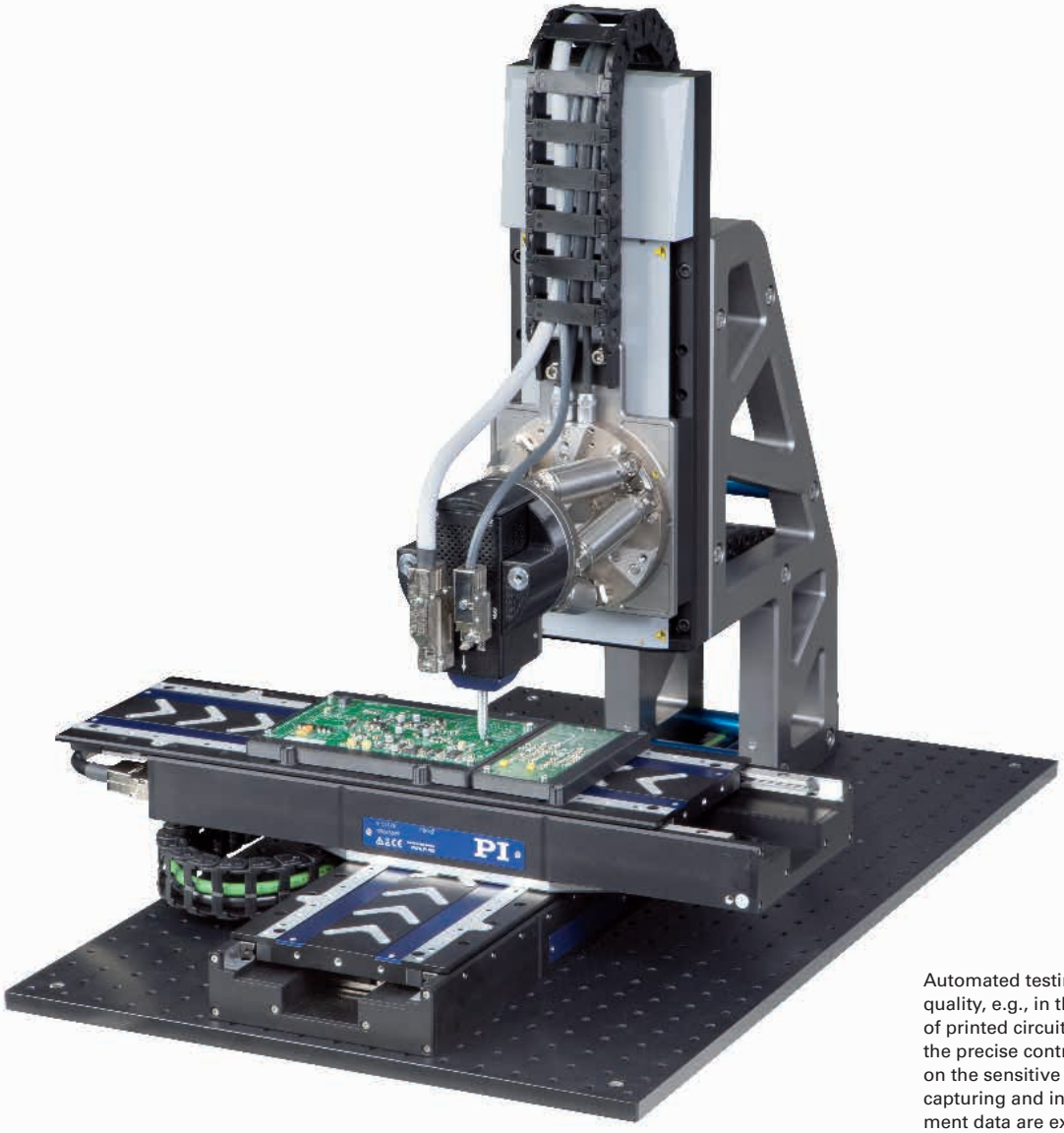




INDUSTRIAL AUTOMATION
AND MOTION CONTROL

Markets and Applications

INDUSTRIAL MANUFACTURING



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

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.

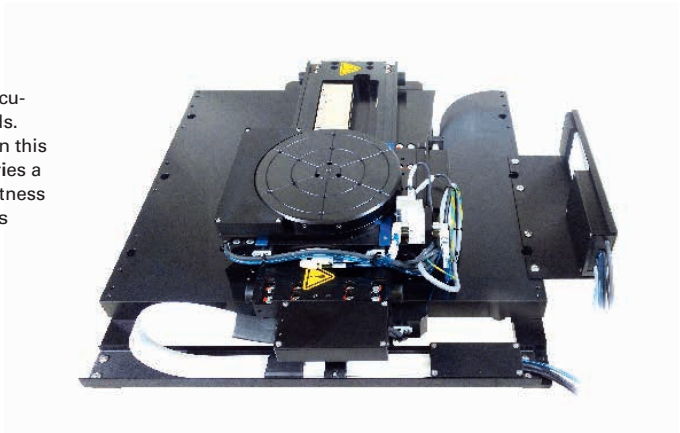
Another example is force-controlled testing of a touch screen, a keyboard or electronic car keys, as well as the control of force with which small parts are being assembled. Here, PI offers advanced solutions for those markets using its proprietary voice coil and force sensor technologies.

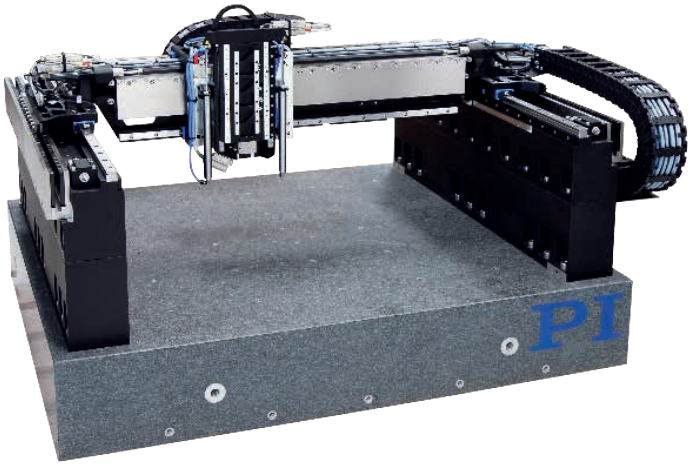
Markets and Applications

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





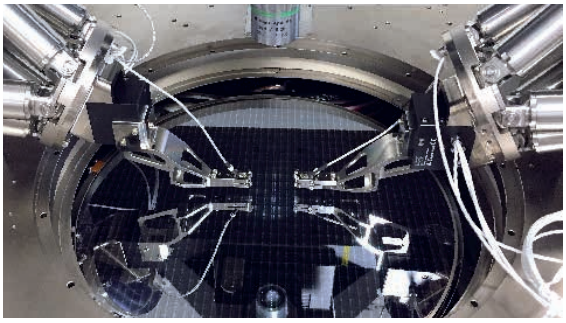
The semiconductor industry often requires very specific solutions, e.g., for wire or ball bonders. PI's Gantry systems are an ideal basis for customized adaptations. The strokes and the stacking height can be varied almost arbitrarily, the configuration of the motors provides extremely high accelerations 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

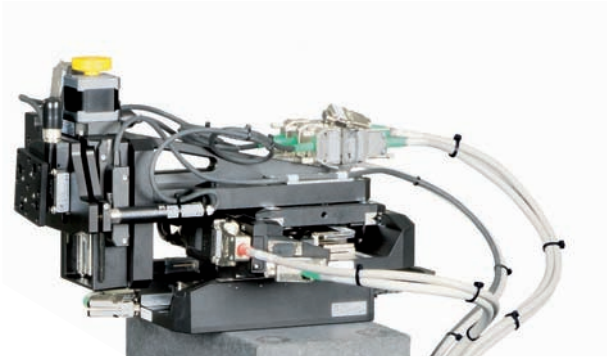
Markets and Applications

PHOTONICS PACKAGING AND OPTICAL ALIGNMENT

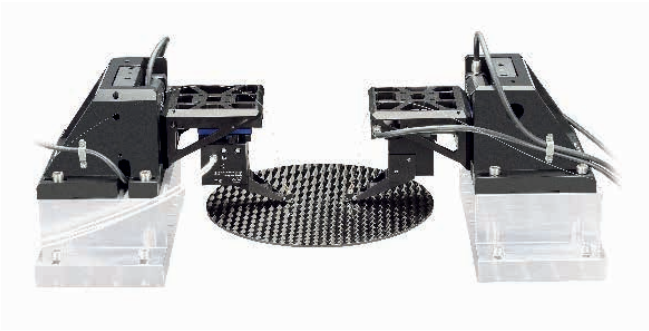
During production and inspection of components with optical data transmission, it is important to align fibers or fiber arrays for optimum connection with the highest possible accuracy. Position tolerances way under 50 nm are usual and multi-channel inputs and outputs require simultaneous alignment in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



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)



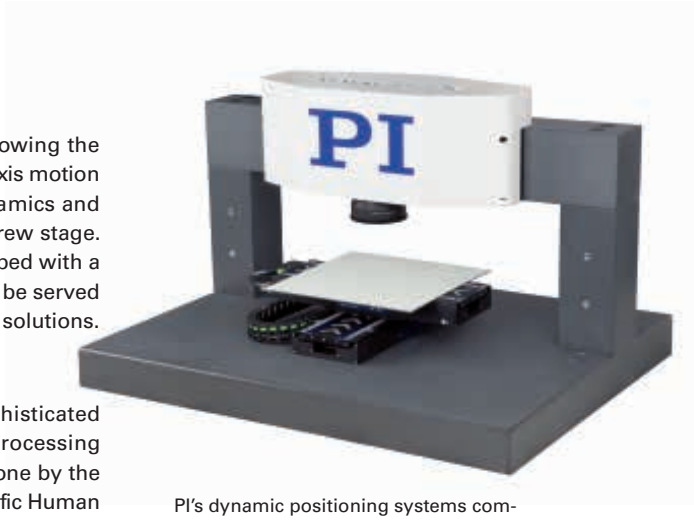
In this multi-axis system for wafer inspection and photonics alignment, high speed linear motor stages are used for the long xy stroke, while mechanical stages with stepper motors and screw drives are used for the other degrees of freedom that do not require too high dynamics



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

LASER MATERIAL PROCESSING

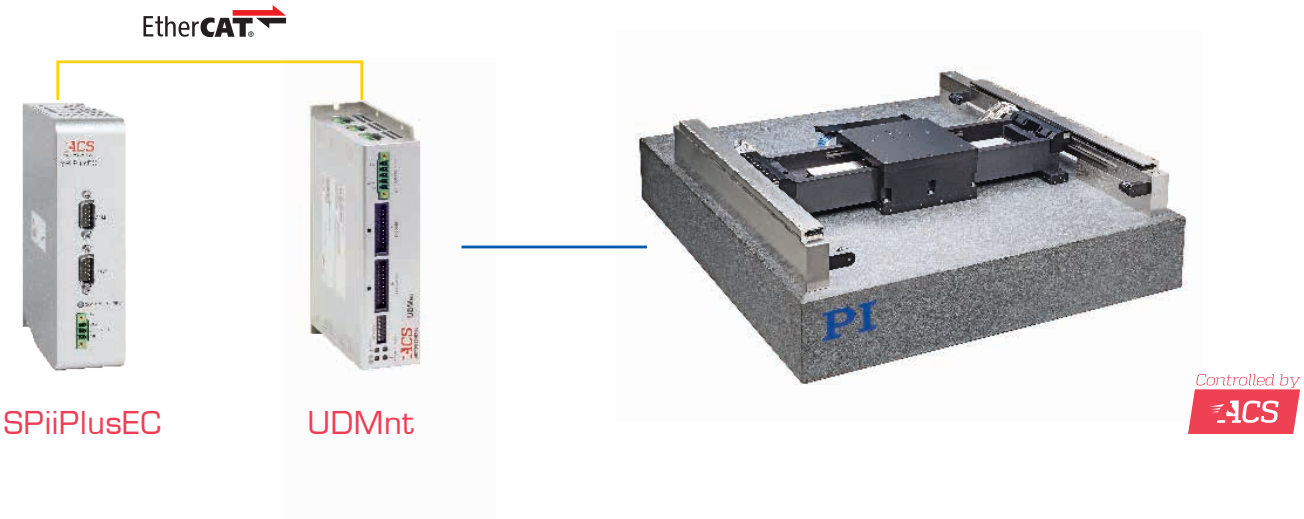


PI's dynamic positioning systems combined with ACS motion controllers become fast, productive systems which, with the help of lasers, can label, mark, rip, cut, or drill

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.

Building Highly Productive Laser Systems

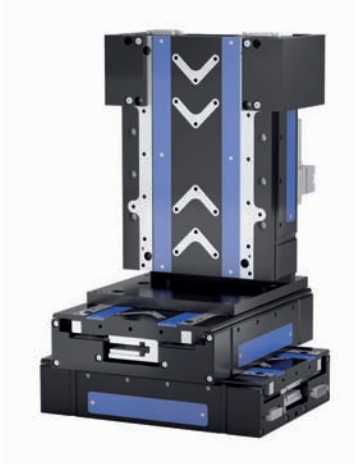
ACS Motion Control, as part of the PI group, allows to supply highly sophisticated Motion Controller and Universal Drive Modules for the control of laser processing applications. Control of the laser power and the triggering of the laser is done by the LCMV2 Laser Control Module. A dedicated software 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.



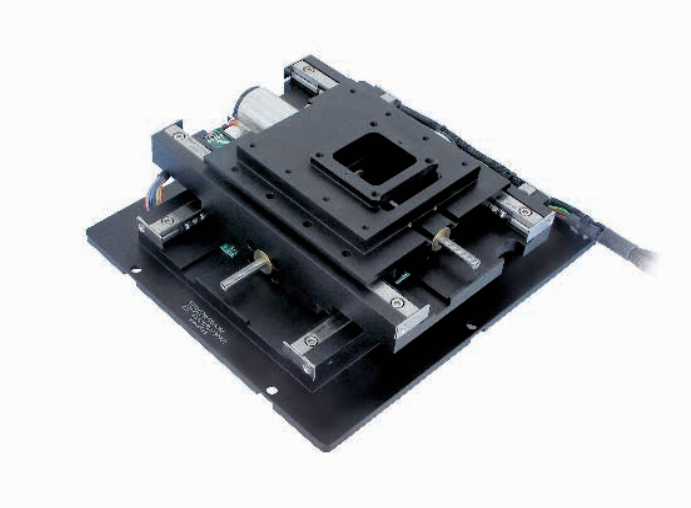
ACS Motion Control and PI motion systems are perfectly matched to each other. A solution from a single-source supplier does not just offer the customer sophisticated positioning technology and high-performance control solutions, but also faster start-up and high flexibility when implementing new requirements

Markets and Applications

AUTOMATED OPTICAL INSPECTION (AOI)



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



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

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.

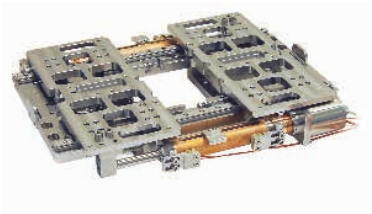
To increase productivity, it is very common to do a **meander scan**. While one axis generates a motion with constant speed, the perpendicular axis moves one step to the next line. Pictures are taken during the constant speed motion which leads to high requirements in straightness and flatness of those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

Markets and Applications

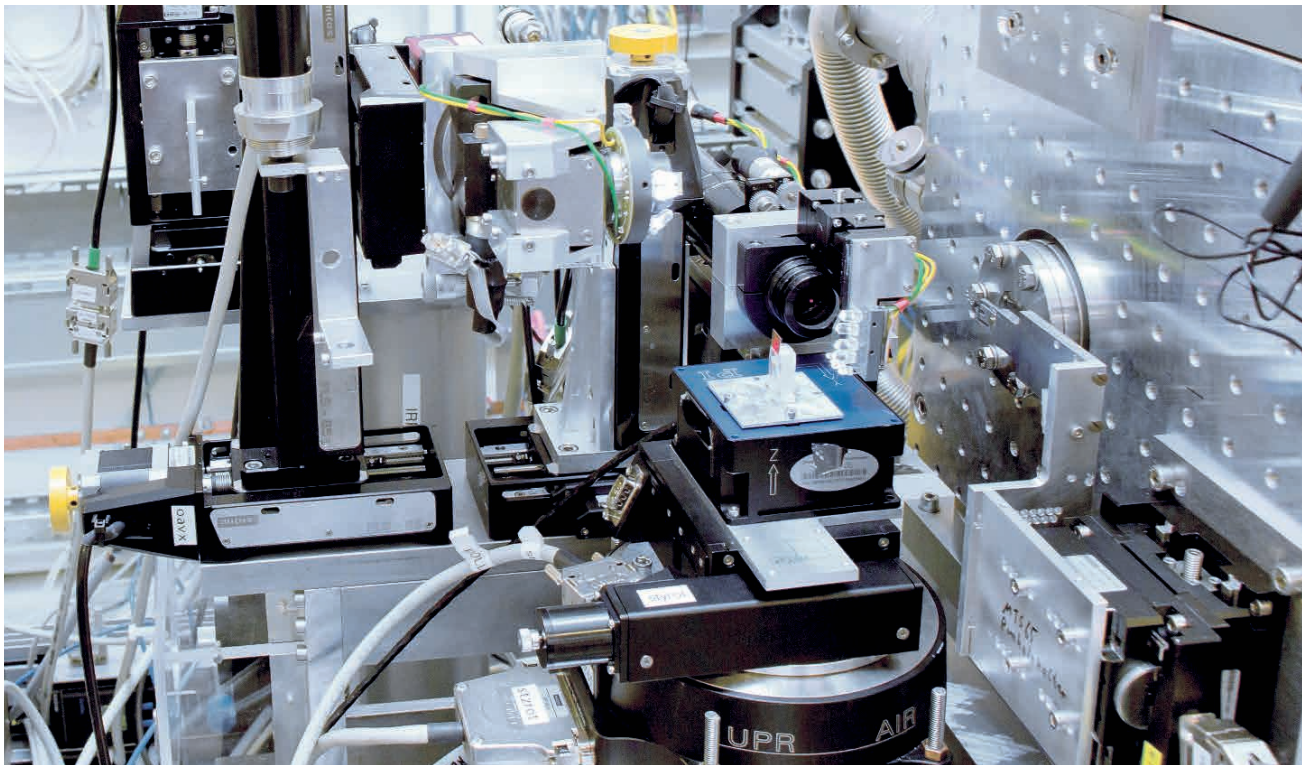
BASIC RESEARCH, SCIENTIFIC INSTRUMENTATION

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.



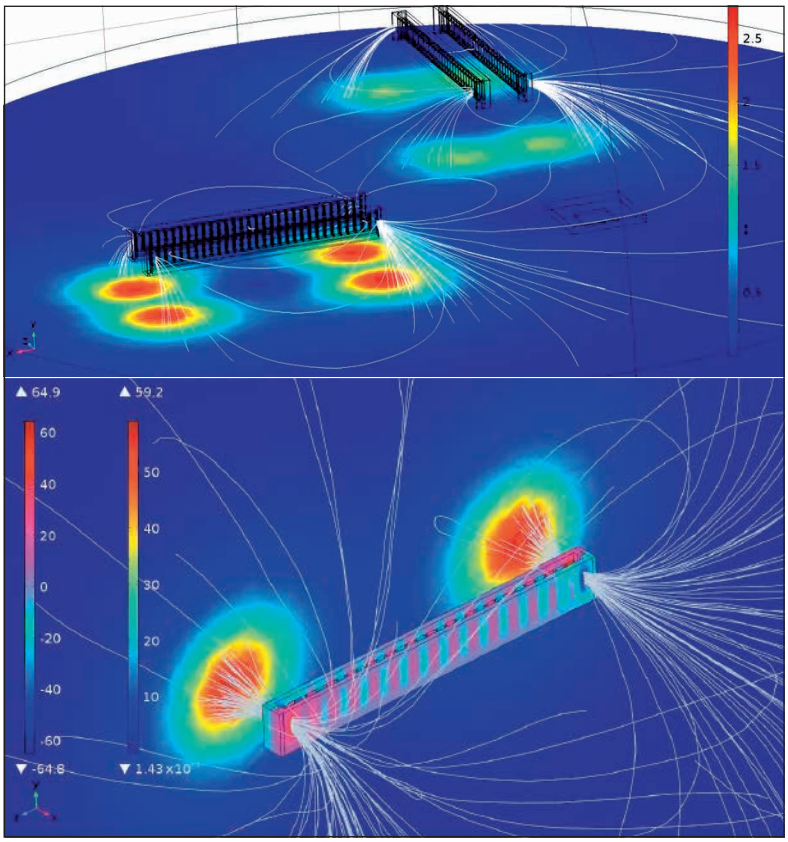
Compact linear translation stage that features two separate moving plates on one guiding

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



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)

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

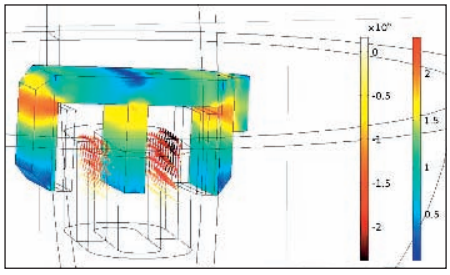
The development and customized design of electromagnetic direct drives that are used for high-resolution motion and positioning tasks require a scientific approach to the technology. The images show the analysis of magnetic fields down to a magnitude of 5 µT that were used to select the optimum position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



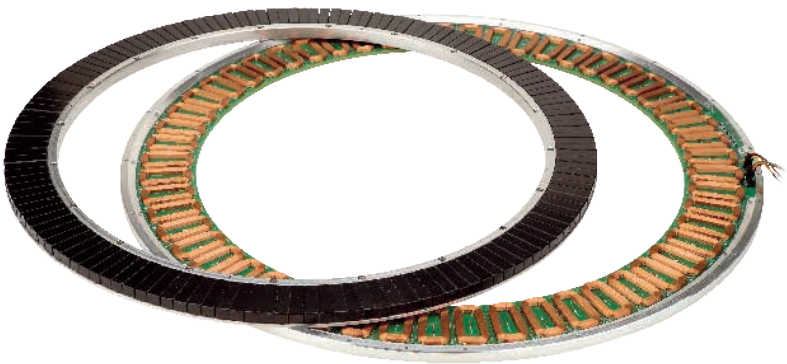
Calculation of the magnetic flux density and currents for a novel voice coil drive allowing multiple degrees of freedom

Technological Depth for Optimized Products

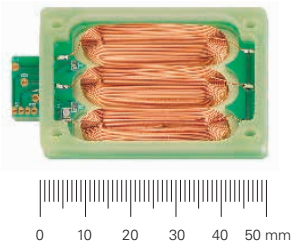
From Standard to Custom Products

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 PIglide 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

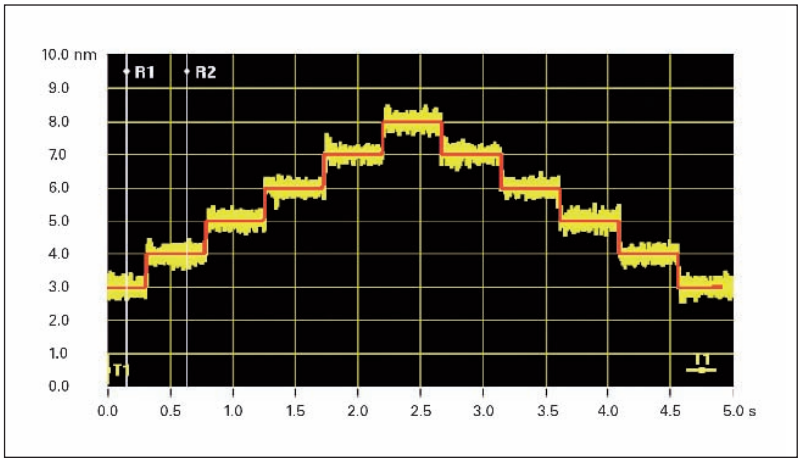
Technological Depth for Optimized Products

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



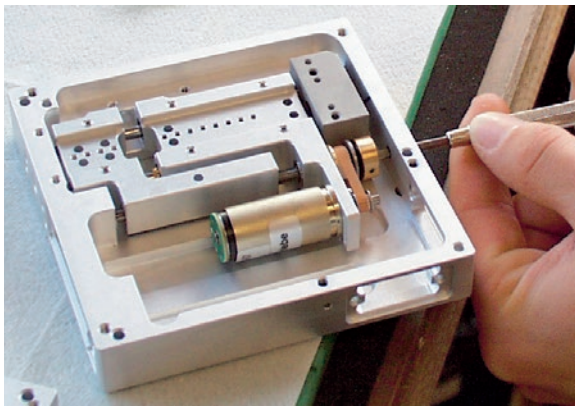
Positioning stages with PIMag® linear motor and with PIOne measuring system allow minimum incremental motion and the highest precision such as for example, the V-551.xD linear stage. The diagram shows steps from 1 nm and the idle noise of <±0.4 nm. In the linear motor axes, this precision can be combined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

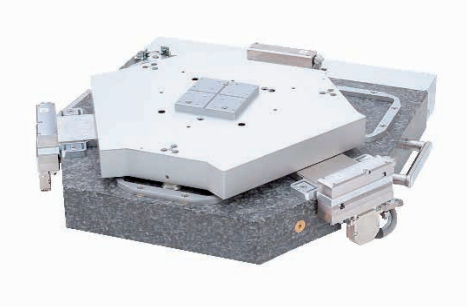
Customization on all levels of integration

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.

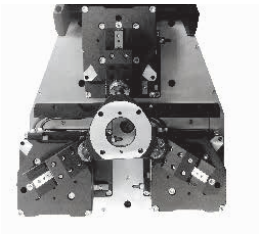


Individual assembly of a stage

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

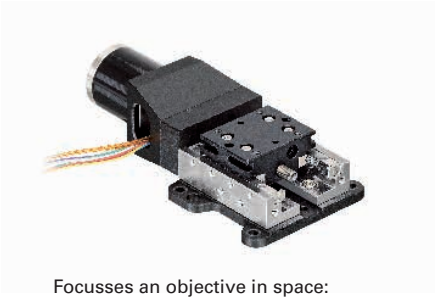


Customized parallel-kinematics stage with six degrees of freedom. The PIMag® linear motors ensure high dynamics and precision as required in optical alignment or fiber alignment. The solution is based on 3 XY stages which are driven by linear motors that allow high dynamics for the precision alignment. 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 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

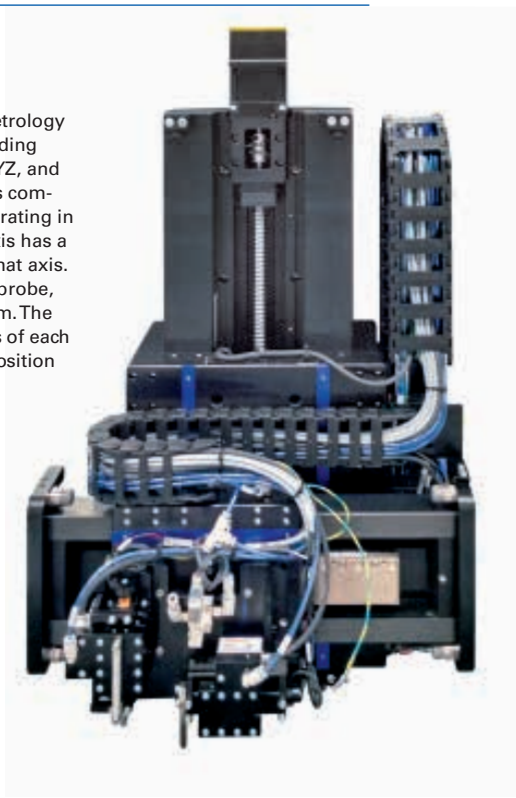
Technological Depth and Customization

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



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

Vacuum & Clean Room Manufacturing

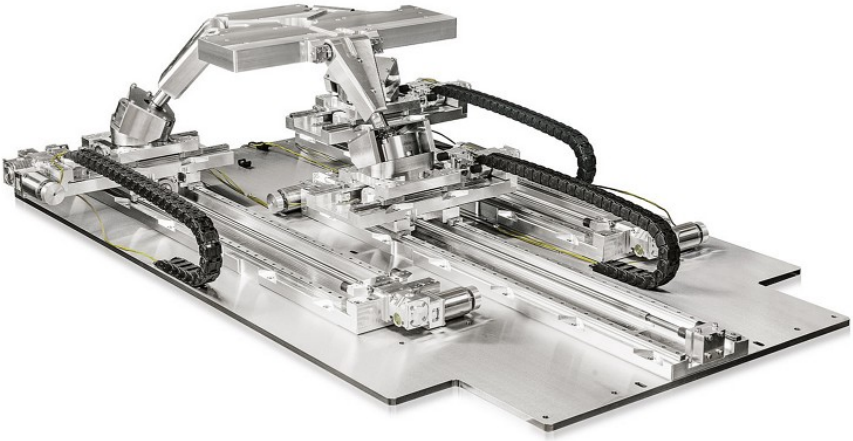
PI offers high-precision solutions for positioning in vacuum conditions to 10^{-10} hPa. Positioning solutions in a vacuum follow clearly defined constraints. This applies to the limited installation space, as well as prevention of contamination and excessive heat input.

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.

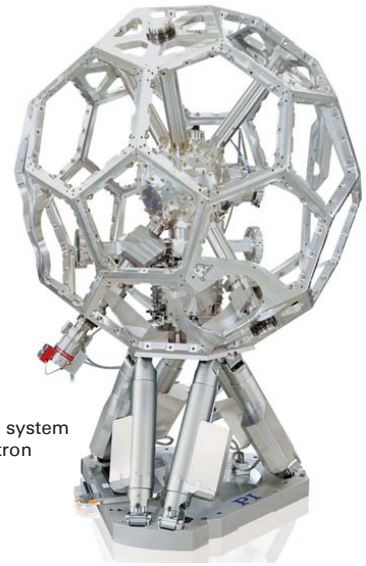
The handling regulations for vacuum positioning systems are just as important as the design principles. Cleanrooms are available for assembling larger parts. Suitable packaging and the corresponding instructions for the recipient are part of shipping.

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



This example of a customized parallel-kinematic design for 6 axes of motion (SpaceFAB) is used in a beamline application. The high load capacity of up to 250 kg and the asymmetric layout with a long travel range in one direction, allows for positioning a sample in the synchrotrom beam, and removing it. The stage is intended for use in radiation environment



Double hexapod PKM system designed for synchrotron X-ray spectroscopy

Minaturized piezo-motor driven 6-Axis and XYZ positioning solutions for vacuum applications

Production Capabilities

- 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

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.

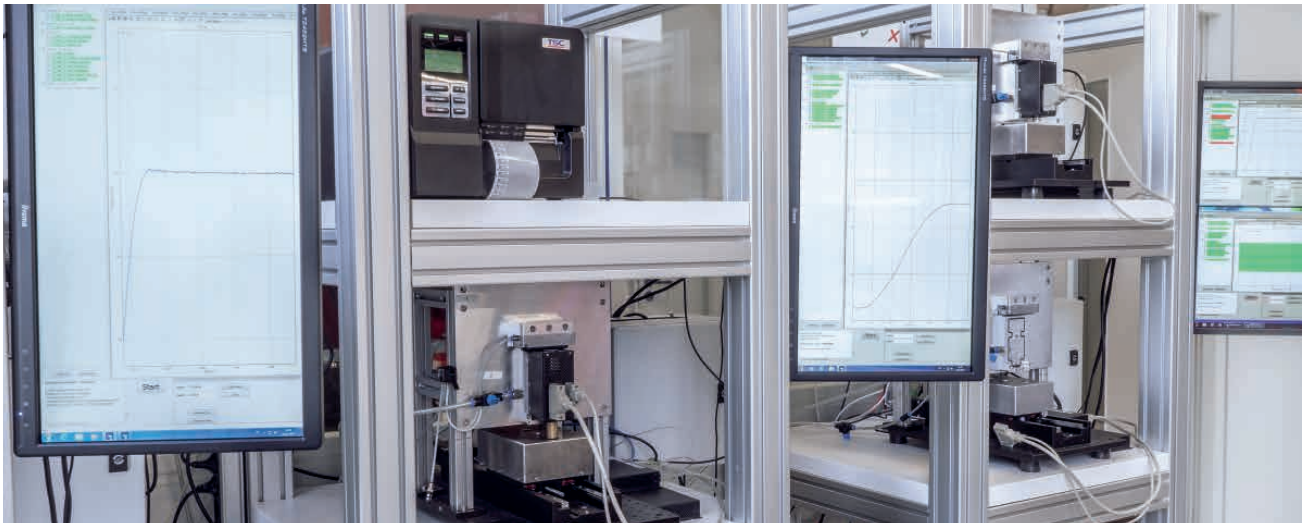
Vertical Production Range and Production Capacity

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.

OEMs Benefit From Maximum Flexibility

From 1-off to 100000

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.



Standardized performance control with full documentation of individual measurement charts

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

Expert Consulting and Global Service

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

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.

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.

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
- Support – Ongoing remote and on-site support to maximize system uptime and provide maintenance for the whole life of any system
- Training Program – User training on software and programming, through to optimization of system performance
- Maintenance Systems Health Check – Preventative maintenance

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

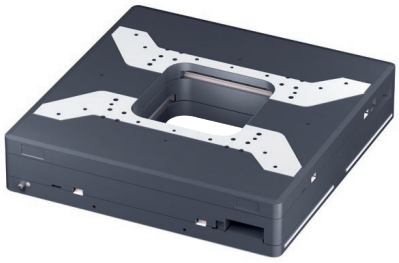
Most customer applications require PI's systems to be operational beyond the standard warranty period. Extending the warranty for additional year(s), is simply extending the customers peace of mind and PI's commitment that the product will not fail due to poor workmanship or faulty materials. Should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

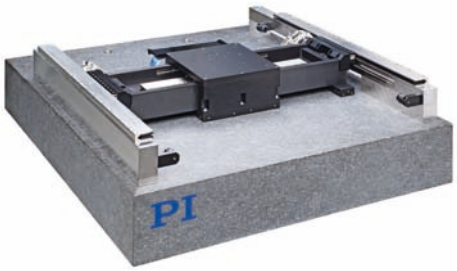
International Support

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.

Precision XY Stages

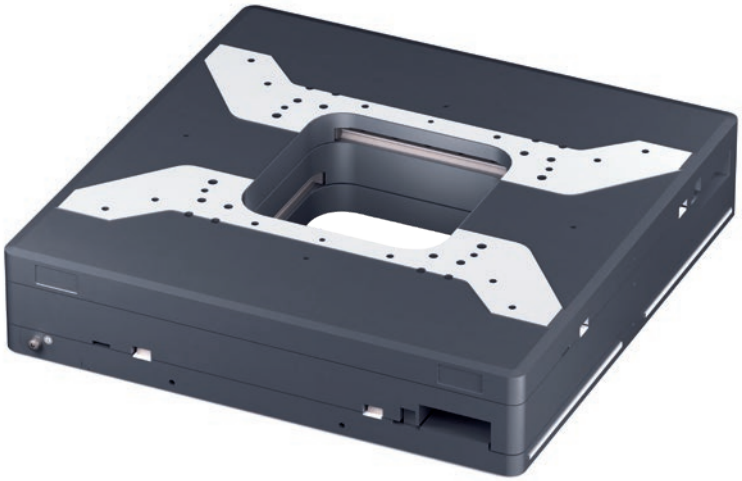
with Ball Screws/Servo & Stepper Motors,
Linear Motors, Air Bearings & Linear Motors

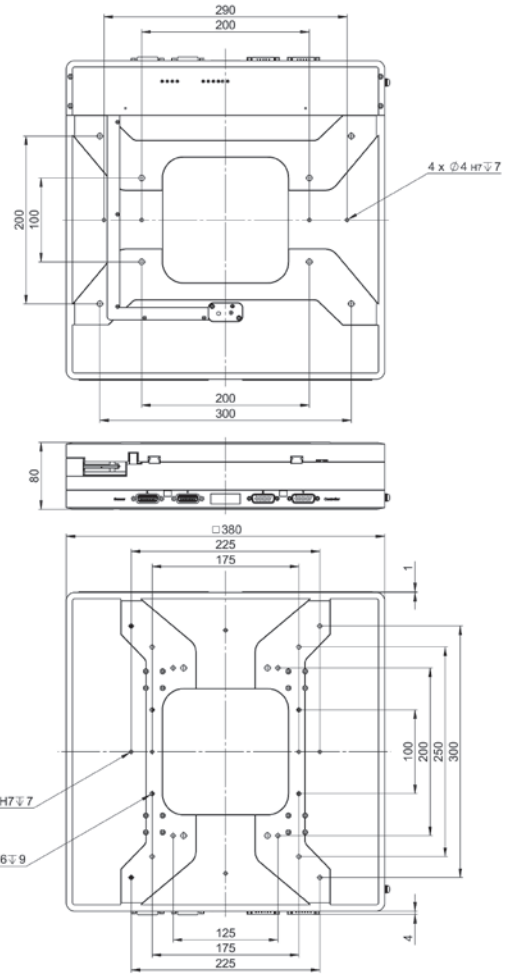




V-738 4" Linear Motor High-Precision XY Stage

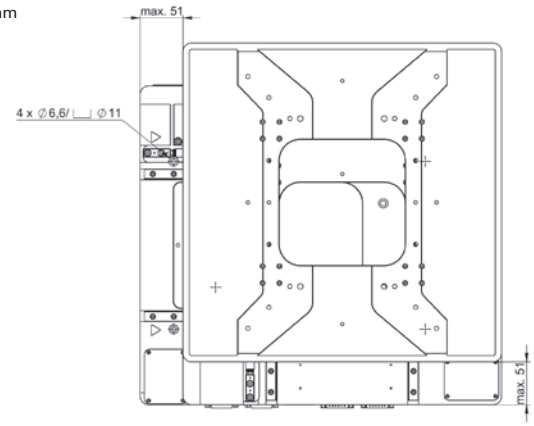
Clear Aperture, High Travel Accuracy and Stability, Magnetic Direct Drive





- 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

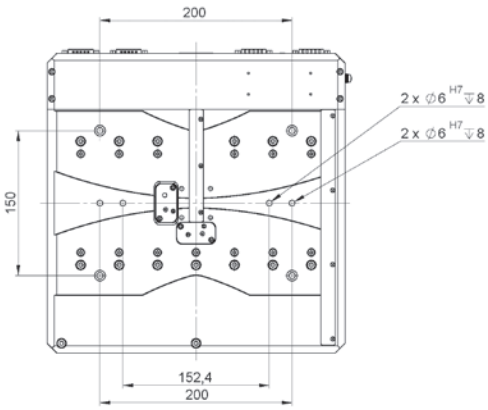
- Automated Optical Inspection (AOI)
- Biotechnology
- Laser Cutting
- Laser Marking
- Medical Industry
- Metrology / Testing
- Scanning

	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!

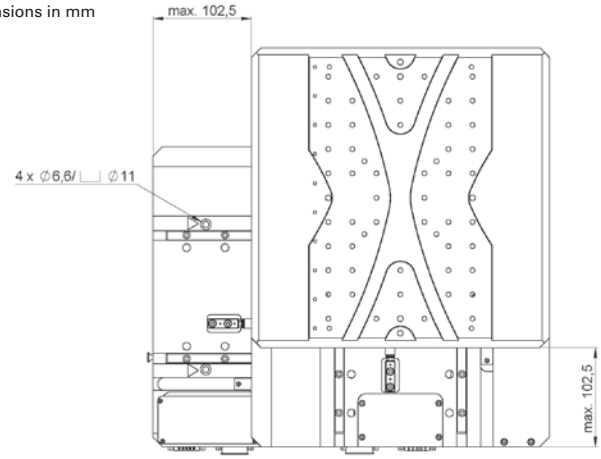
V-731 8" Linear Motor High-Precision XY Stage

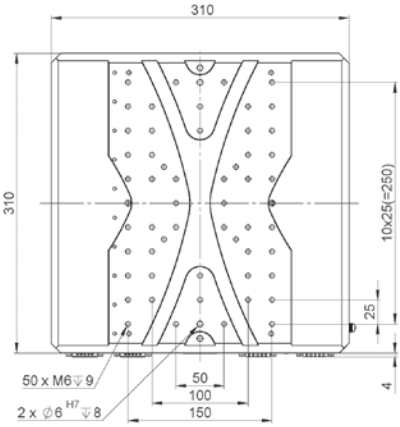
High Travel Accuracy and Stability, Magnetic Direct Drive



- 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

	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/s^2	max.
Acceleration in Y, without load	15	m/s^2	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		

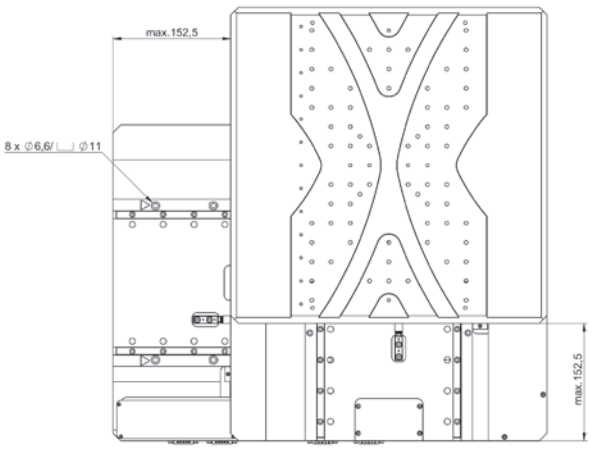
All cables required for operation with the ordered controller are included in the scope of delivery.
The cable length is 3 m. Cable for connecting to other controllers can be ordered as accessory.
Ask about custom designs!

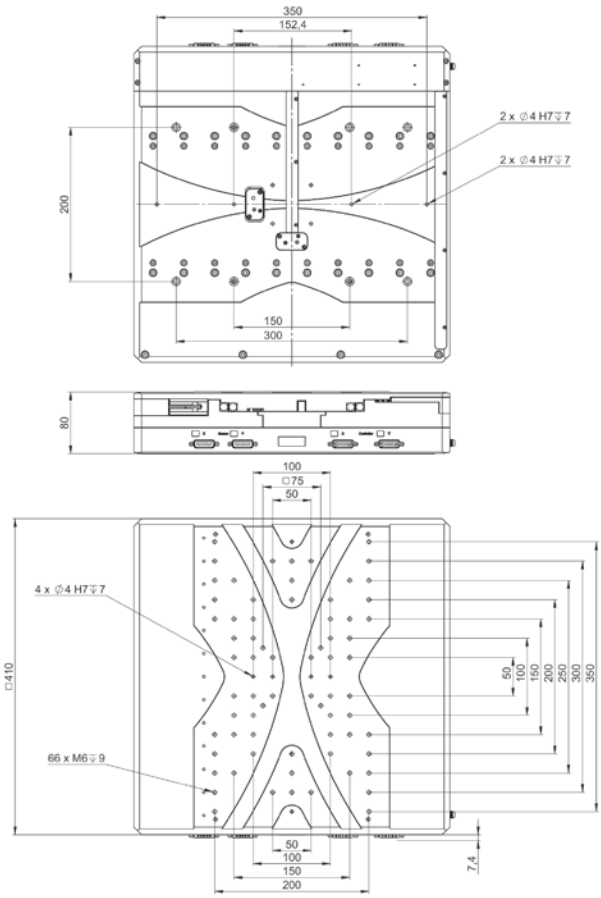
V-741 12" Linear Motor High-Precision XY Stage

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

	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/s^2	max.
Acceleration in Y, without load	9	m/s^2	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 4" Ball Screw-Driven 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

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.

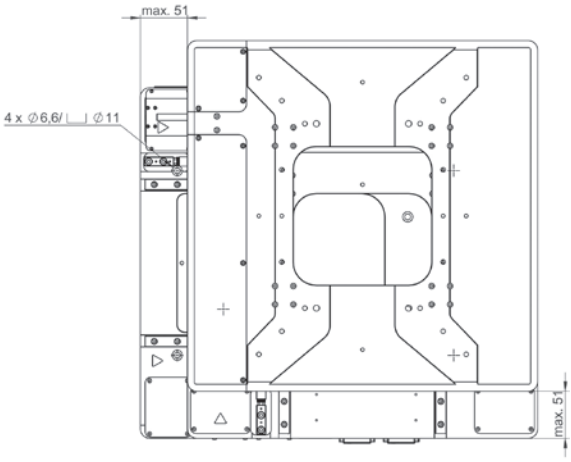
Stages with stepper motor	L-738.051100	L-738.051111	L-738.051112	Unit	Tolerance
Positioning					
Integrated sensor	–	Incremental linear encoder	Incremental linear encoder		
Sensor signal	–	Sin/cos, 1 V peak-peak, 20 µm signal period	A/B quadrature, TTL		
Design resolution	10.0	0.001	0.01	µm	
Minimum 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		

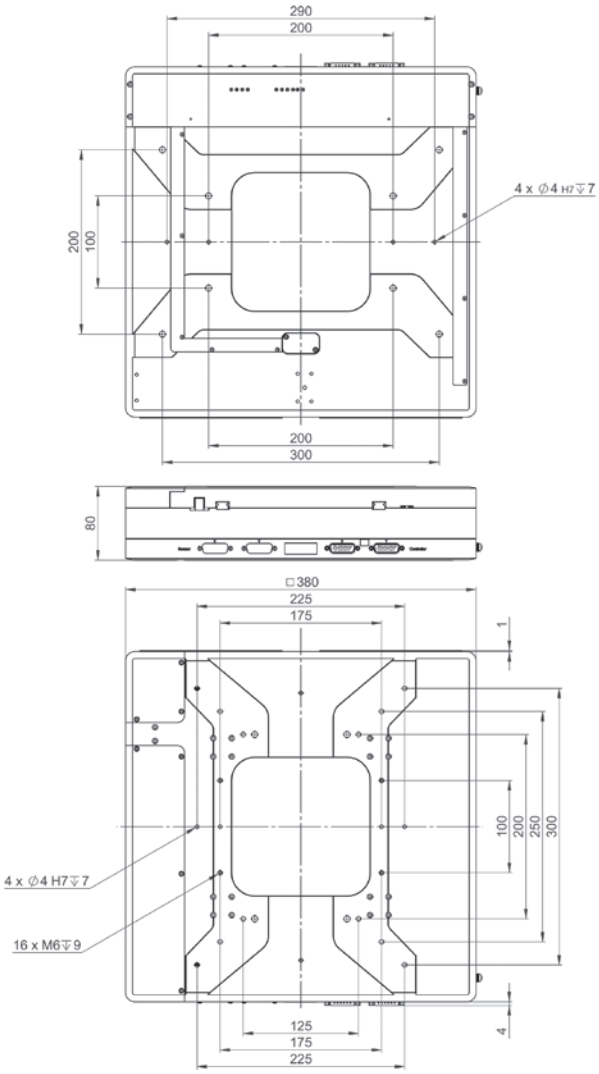
Stages with stepper motor	L-738.051xxx	Unit	Tolerance
Mechanical properties			
Drive screw type	Ball screw		
Drive screw pitch	2	mm	
Guide type	Recirculating ball bearing		
Holding force, power off	60	N	typ.
Push/pull force F_X, F_Y power on	100	N	max.
Load capacity	200	N	max.
Permissible torque M_x 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 in Y, 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





L-731 8" Ball Screw-Driven 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

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.

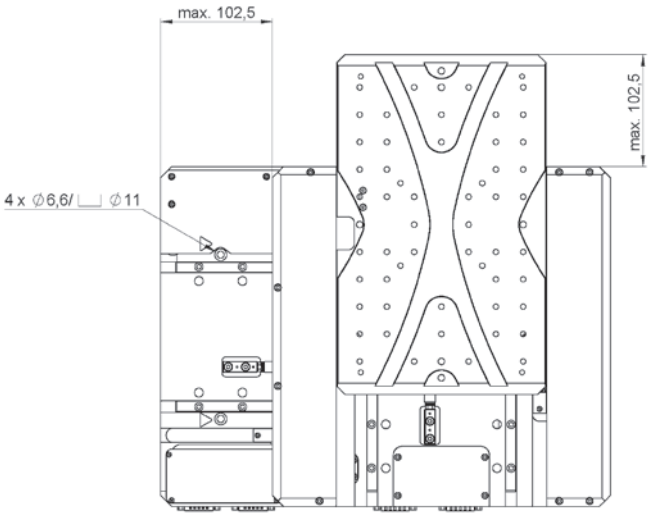
Stages with stepper motor	L-731.40SD	L-731.44SD	L-731.4ASD	Unit	Tolerance
Positioning					
Integrated sensor	–	Incremental linear encoder	Incremental linear encoder		
Sensor signal	–	A/B quadrature, TTL	Sin/cos, 1 V peak-peak, 20 µm signal period		
Design resolution	10.0	0.01	0.001	µm	
Minimum incremental 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		

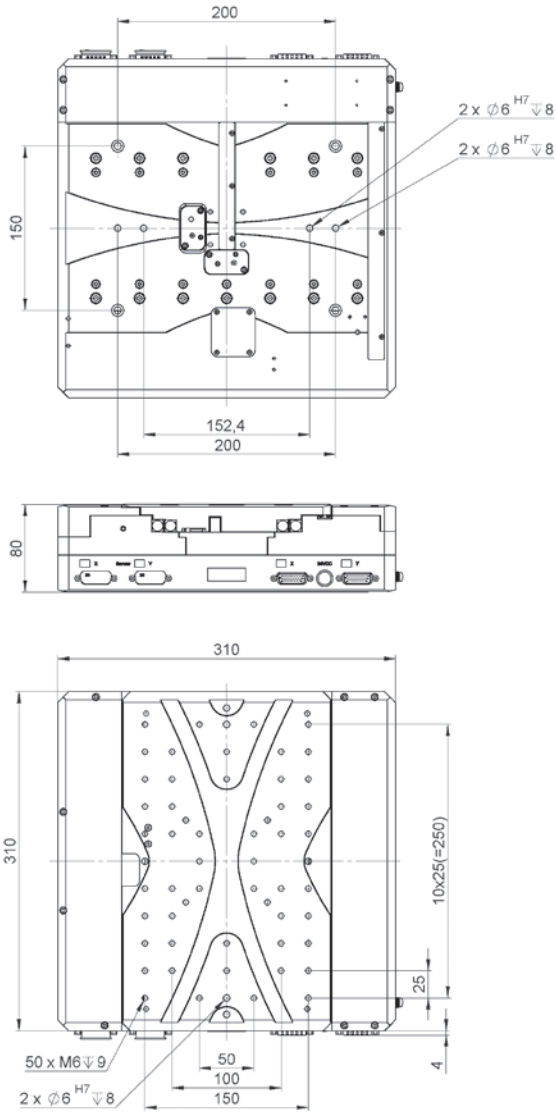
Stages with stepper motor	L-731.4xSD	Unit	Tolerance
Mechanical properties			
Drive screw type	Ball screw		
Drive screw pitch	2	mm	
Guide type	Crossed roller guide with anti-creep system		
Load capacity	200	N	max.
Permissible torque M_x in θ_X	125	N·m	max.
Permissible torque M_y in θ_Y	125	N·m	max.
Permissible 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





L-741 12" Ball Screw-Driven 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

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.

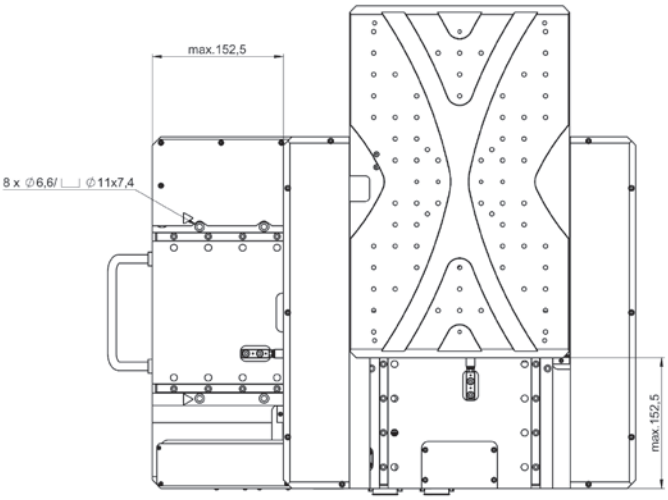
Stages with stepper motor	L-741.131100	L-741.131111	L-741.131112	Unit	Tolerance
Positioning					
Integrated sensor	–	Incremental linear encoder	Incremental linear encoder		
Sensor signal	–	Sin/cos, 1 V peak-peak, 20 µm signal period	A/B quadrature, TTL		
Design resolution	10.0	0.001	0.01	µm	
Sensor resolution 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		

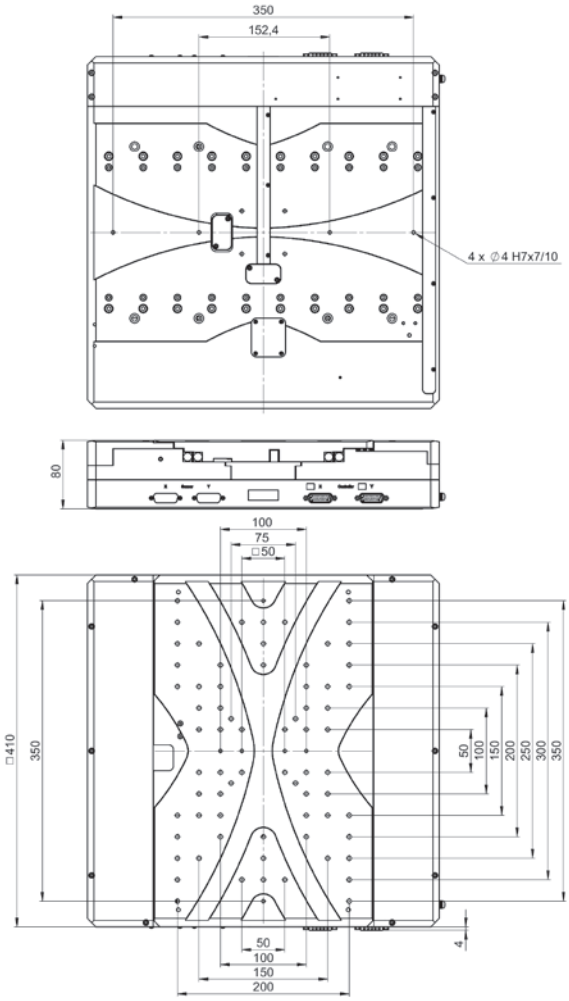
Stages with stepper motor	L-741.131xxx	Unit	Tolerance
Mechanical properties			
Drive screw type	Ball screw		
Drive screw pitch	2	mm	
Guide type	Crossed roller guide with anti-creep system		
Load capacity	200	N	max.
Permissible torque M_x in θ_X	125	N·m	max.
Permissible torque M_y in θ_Y	125	N·m	max.
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



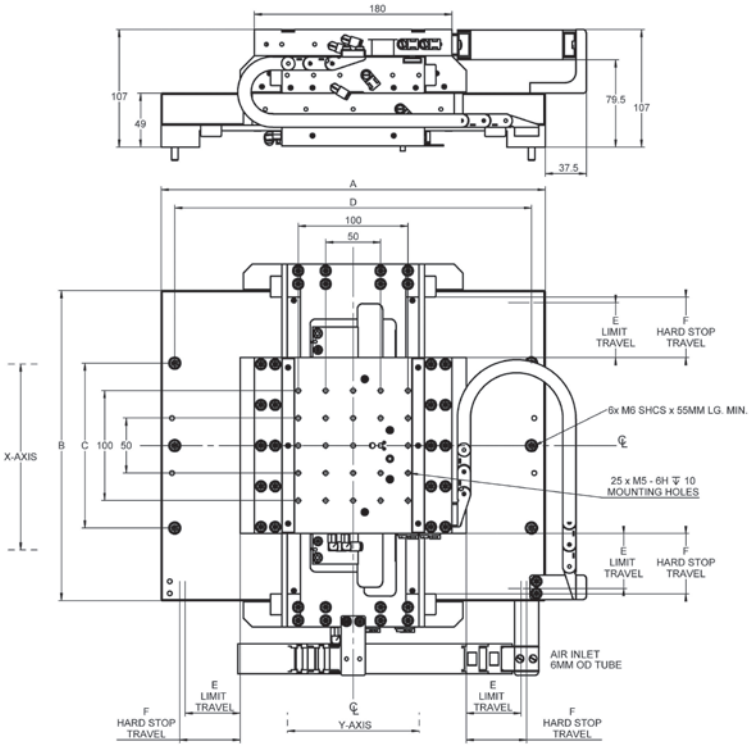


A-311 PIglide IS Planar Scanner with Air Bearing

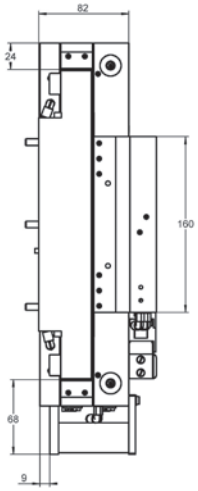
High-Performance, Compact XY Nanopositioning System

- 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

	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	

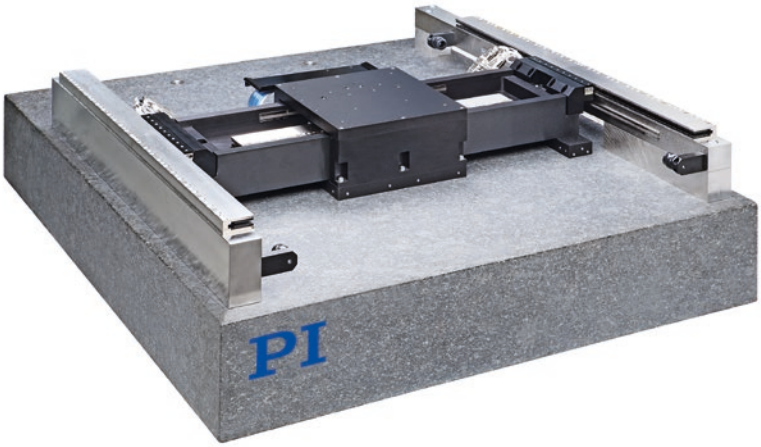
	A-311.xAx	A-311.xBx	A-311.xCx
Positioning			
Integrated sensor	Incremental linear encoder	Absolute encoder	Incremental linear encoder
Sensor signal	Sin/cos, 1 V peak-peak, 20 µm signal period	BiSS-C	A/B quadrature, TTL
Sensor resolution	1.2 nm [4]	1 nm	50 nm
Bidirectional repeatability	±0.05 µm [4]	±0.05 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.

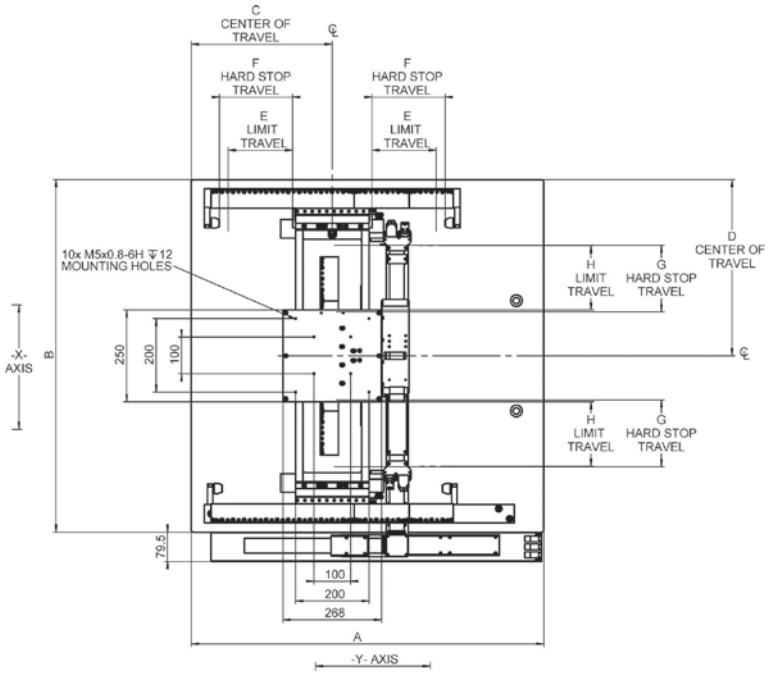
A-322 Plglide HS Planar Scanner with Air Bearing

XY Positioning System with 1 nm Resolution

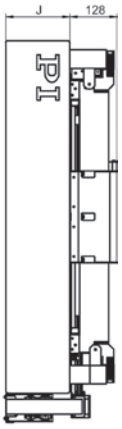


- Ideal for scanning applications or high-precision positioning
- Cleanroom compatible
- Travel ranges to 500 mm × 1000 mm
- Load capacity to 245 N
- Resolution to 1 nm
- Velocity up to 2 m/s

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

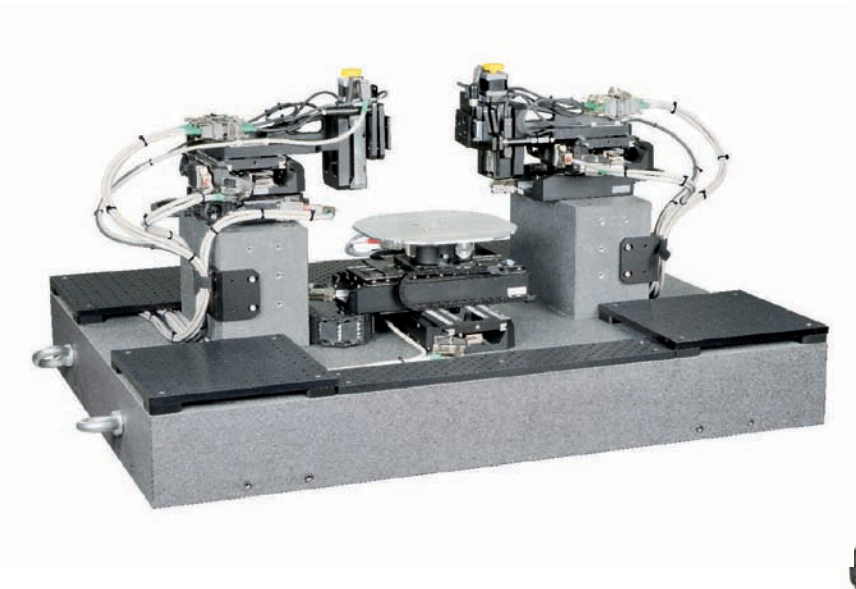
- Electronics Manufacturing
- Laser Cutting
- Scanning
- Scientific Instrumentation
- Semiconductor

	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		

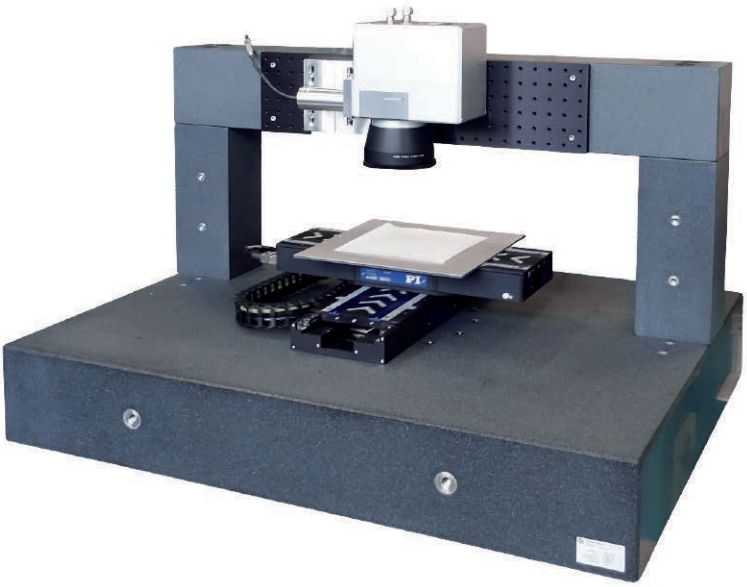
* Improved accuracy can be obtained with controller-based error compensation. Stage must be ordered with controller. Accuracy values assume short-term time duration and do not consider the long-term effects of thermal drift on the stage.
** Unloaded. Can be limited by the insulating system payload, controller 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.

Gantry Systems / Engineered Systems



From Concept to Commissioning

Working Closely Together for the Best Solution



PI designs and manufactures to a wide variety of precision motion technologies, including air bearings, linear motors, piezoelectric drives, flexure guides and mag-lev systems, to name a few.

PI's **Engineered Systems Division** integrates these components into custom motion systems. Complete solutions, fitting seamlessly into existing processes that advance automation in major industrial and research installations for applications such as

- Semiconductor inspection and production
- Photonics alignment, test and packaging
- Laser micromachining
- Additive nano-manufacturing
- Surface metrology
- Biotechnology

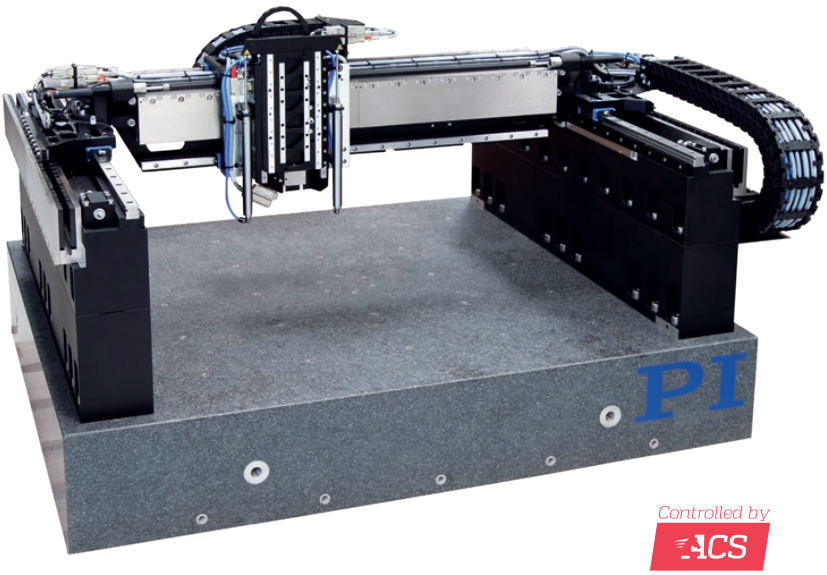
Post-delivery service is an essential part of PI's philosophy and includes commissioning and on-site installation as well as training and maintenance support.

How PI Engineered Systems Works:

1. Definition phase: Together, we identify current issues and the goal of your new motion system
2. Concept phase: Brainstorming about the best solution in close cooperation with your and our engineering teams
3. The resulting solution is converted into a Technical and Business Proposal
4. The design and detail phase begins after your approval
5. The system is then assembled and tested, and - after your approval - delivered
6. You end up with a fully functioning system, and avoid losing time trying to integrate components from different suppliers

Throughput, Precision and Reliability

Solutions for Motion-Centric Industrial Automation



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!

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.

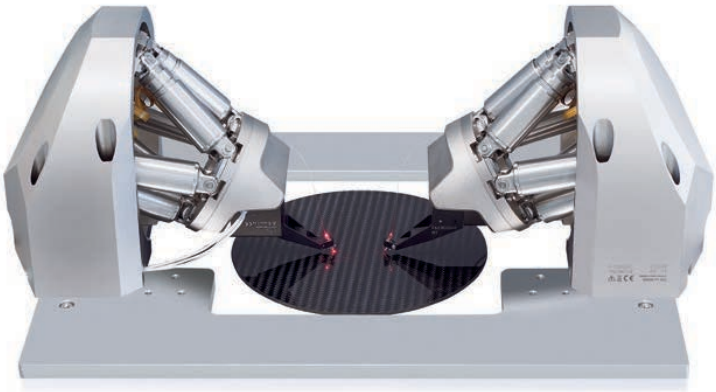
				Unit	Tolerance
Active axes	X	Y	Z		
Motion and positioning					
Travel range	508	508	155	mm	
Integrated sensor	Optical linear encoder, incremental	Optical linear encoder, incremental	Optical linear encoder, incremental		
Sensor resolution	0.002	0.002	0.002	µm	
Unidirectional repeatability	0.5	0.5	0.5	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.

Fast Multi-Channel Photonic Alignment System

System with 6 Degrees of Freedom for Aligning Fibers and Optical Components



F-712.HA1 / F-712.HA2

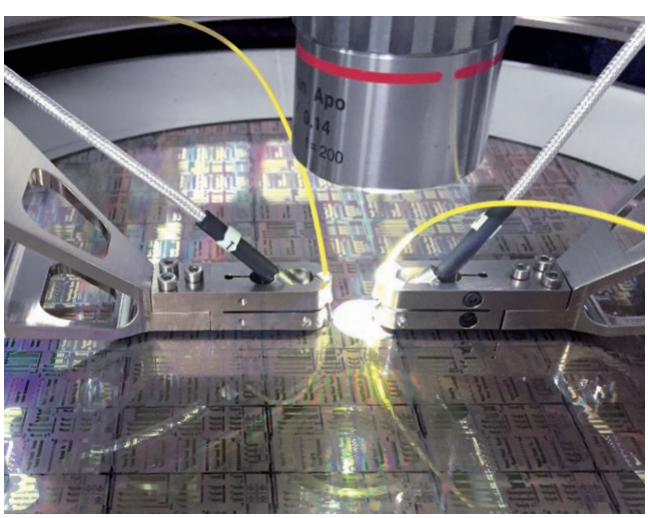
- Integrated scan routines for fiber optic alignment
- Ideal for applications in silicon photonics
- Extensive software package
- Direct detection of the optical signal
- Position sensors for high accuracy and operational reliability
- Automatic alignment of several fibers in <1 s

Fast and high-precision drives

The basis of the fiber alignment system is a very stiff set-up consisting of the H-811 hexapod and P-616 NanoCube® nanopositioner. The parallel-kinematic design for motion in six degrees of freedom ensures high system stiffness. 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.

High-performance scan routines

The sophisticated scan routines are integrated directly into the controller. The performance is improved considerably and integration simplified. The system can manage all tasks in the field of fiber alignment. For example, double-sided systems allow simultaneous alignment of the transmitter and receiver.



Extensive software package

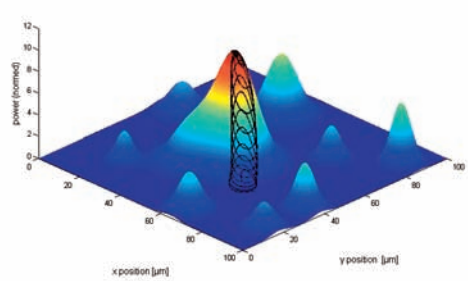
The software package supplied in the scope of delivery allows integration of the system into virtually any environment. All common operating systems such as Windows, Linux, and OS X as well as a large number of common programming languages including MATLAB and LabVIEW are supported. Thanks to sophisticated program examples and the use of software tools such as PIMikroMove, the time between starting integrating and productive operation is shortened considerably.

High-resolution analog input

The controller receives the optical intensity signal directly via a high-resolution analog input. Complex set-ups with cameras are not necessary. Various distribution functions are available for determining the maximum intensity.

Fields of application

Alignment of optical components, automatic wafer tests, assembling technology in silicon photonics.



Cascade Microtech's pioneering CM300 photonics-enabled engineering wafer prober integrates PI's Fast Multi-Channel Photonics Alignment systems for high throughput, wafer-safe, nano-precision optical probing of on-wafer Silicon Photonics devices. Photo courtesy Cascade Microtech div. of Formfactor, Inc.

Preliminary data	F-712.HA1 / F-712.HA2	Unit
Motion and positioning		
Rough positioning		
Active axes	X, Y, Z, θ_X, θ_Y, θ_Z	
Travel range in X, Y, Z	±6.5, ±16, ±8.5*	mm
Travel range in θ_X, θ_Y, θ_Z	±14.5, ±10, ±10*	°
Minimum incremental motion	0.1	µm
Max. velocity	10	mm/s
Sensor type	Rotary encoder	
Guiding	–	
Drive type	Brushless DC motor	
Fine positioning		
Active axes	X, Y, Z	
Closed-loop travel in X, Y, Z	100	µm
Min. incremental motion, open-loop	0.3	nm
Min. incremental motion, closed-loop	2.5	nm
Linearity error, for the entire travel range**	2	%
Repeatability (bidirectional) 10 % travel range	2	nm
Sensor type	Incremental	
Drive type	PICMA®	
Alignment		
Alignment time area scan 100 µm x 100 µm (max. deviation of peak intensity 0.02 dB)***	<0.5 / <1	s
Alignment time gradient search, randomized with ±5 µm (repeatability <0.01 dB)***	<0.5 / <1	s
Miscellaneous		
Operating temperature range, mechanics	0 to 50	°C
Operating temperature range, controller	5 to 40	°C
Cable length	2	m

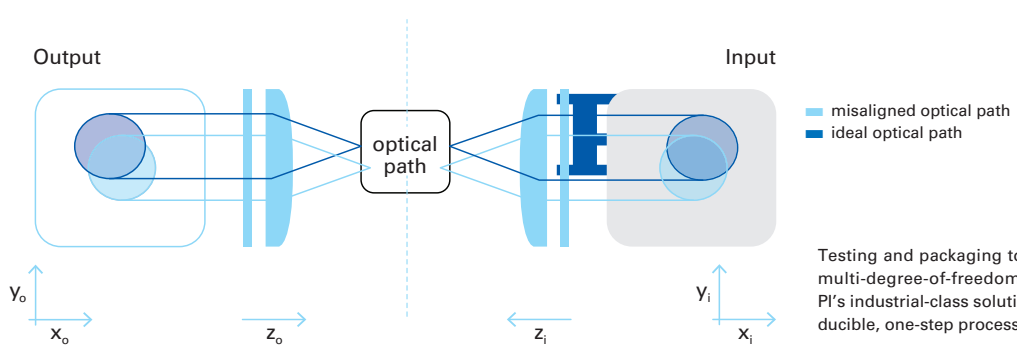
Technical data specified at 20±3 °C.

* The travel ranges of the individual coordinates (X, Y, Z, θ_X, θ_Y, θ_Z) are interdependent. The data for each axis in this table shows its maximum travel range, where all other axes and the pivot point are at the reference position. See the dimensional drawings for the default coordinate system and pivot point coordinates of the hexapod. Changing the pivot point will reduce the travel range in θ_X, θ_Y, θ_Z. Changing the orientation of the coordinate system (e.g., when the optical axis is to be the Z axis), will change the travel range in X, Y, and Z.

** Without polynomial linearization

*** Reaching the global maximum after first light has been found

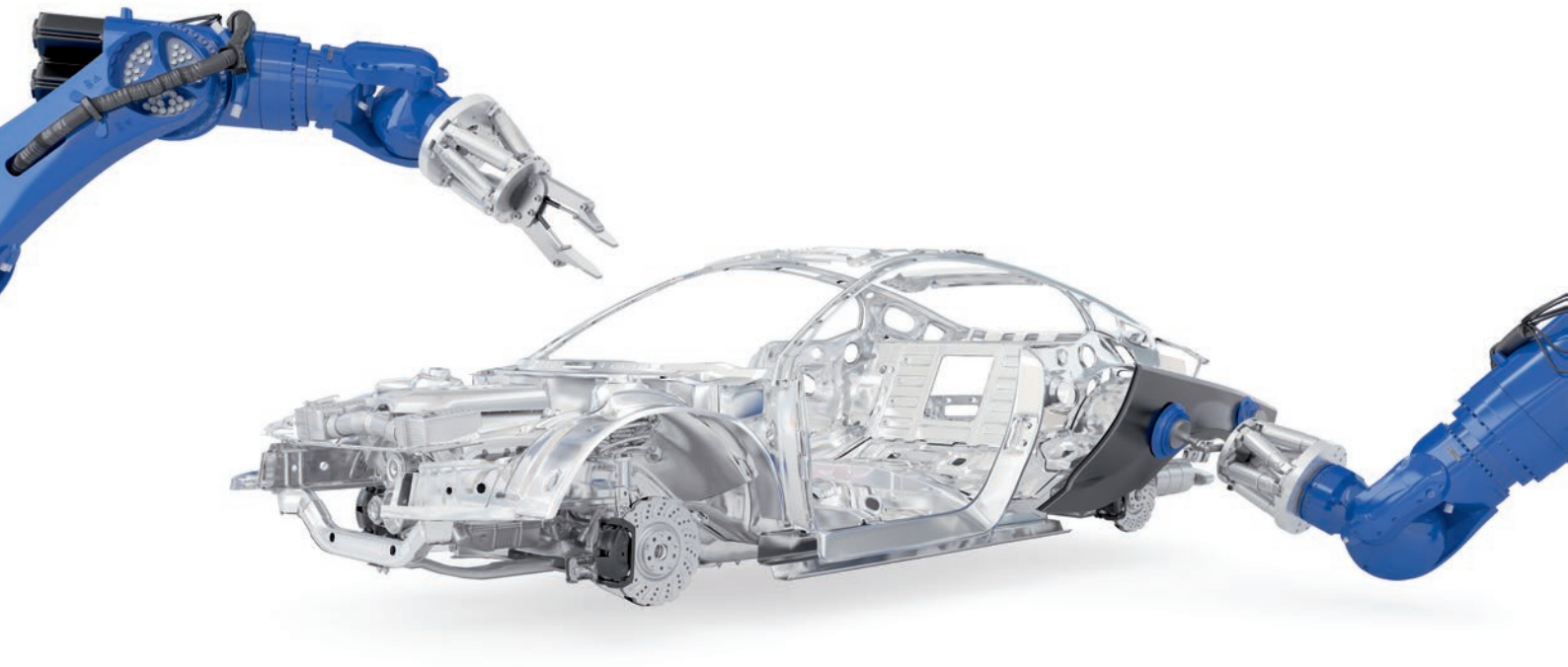
Ask about custom designs!



Testing and packaging today's photonic devices can be a multi-degree-of-freedom challenge and a moving target. PI's industrial-class solutions help you make it a fast, reproducible, one-step process.

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

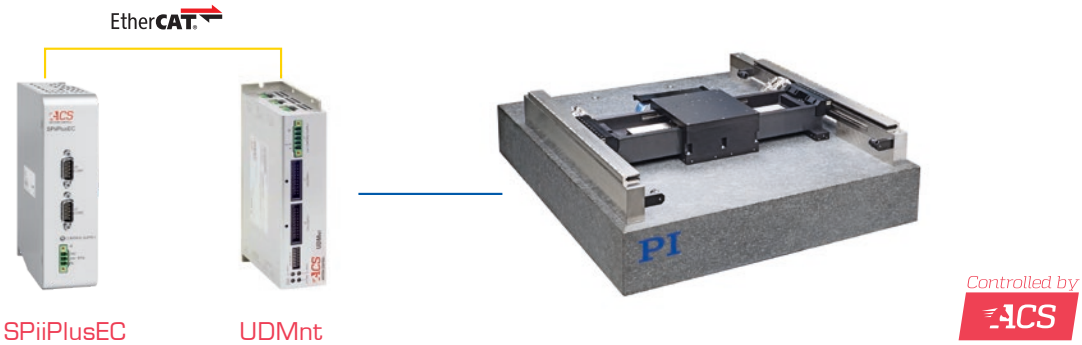
What makes a positioner and motion solution smart? What functions and features must a high-performance control solution offer to make smart motion and positioning possible? PI has identified the following list of basic requirements that make it possible to offer solutions for industrial applications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

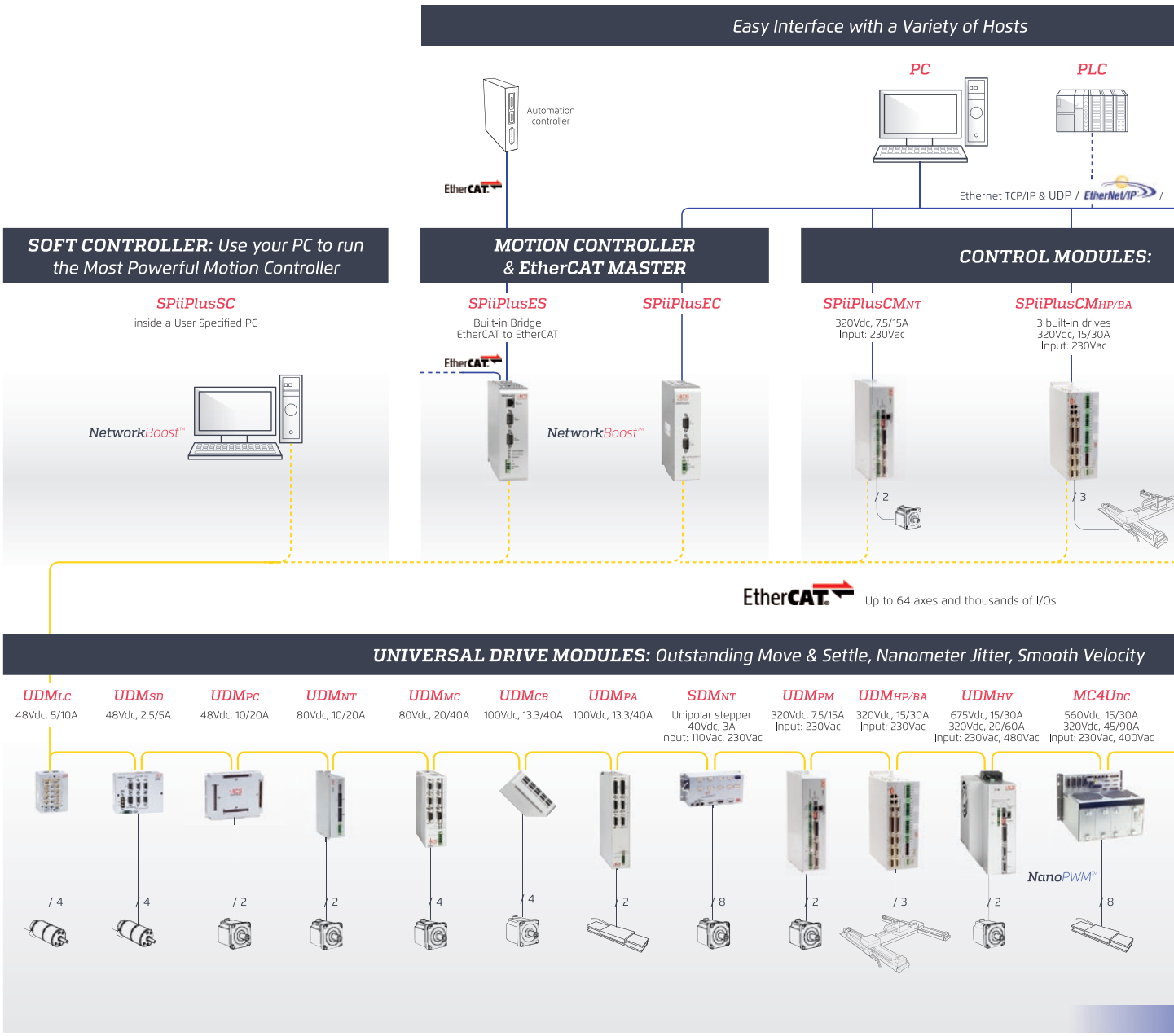
ACS Motion Control offers distributed-architecture motion control systems, completely modular, with components organized over three levels: The first level is the user interface. This is basically the host software and allows communication with the motion system.

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.

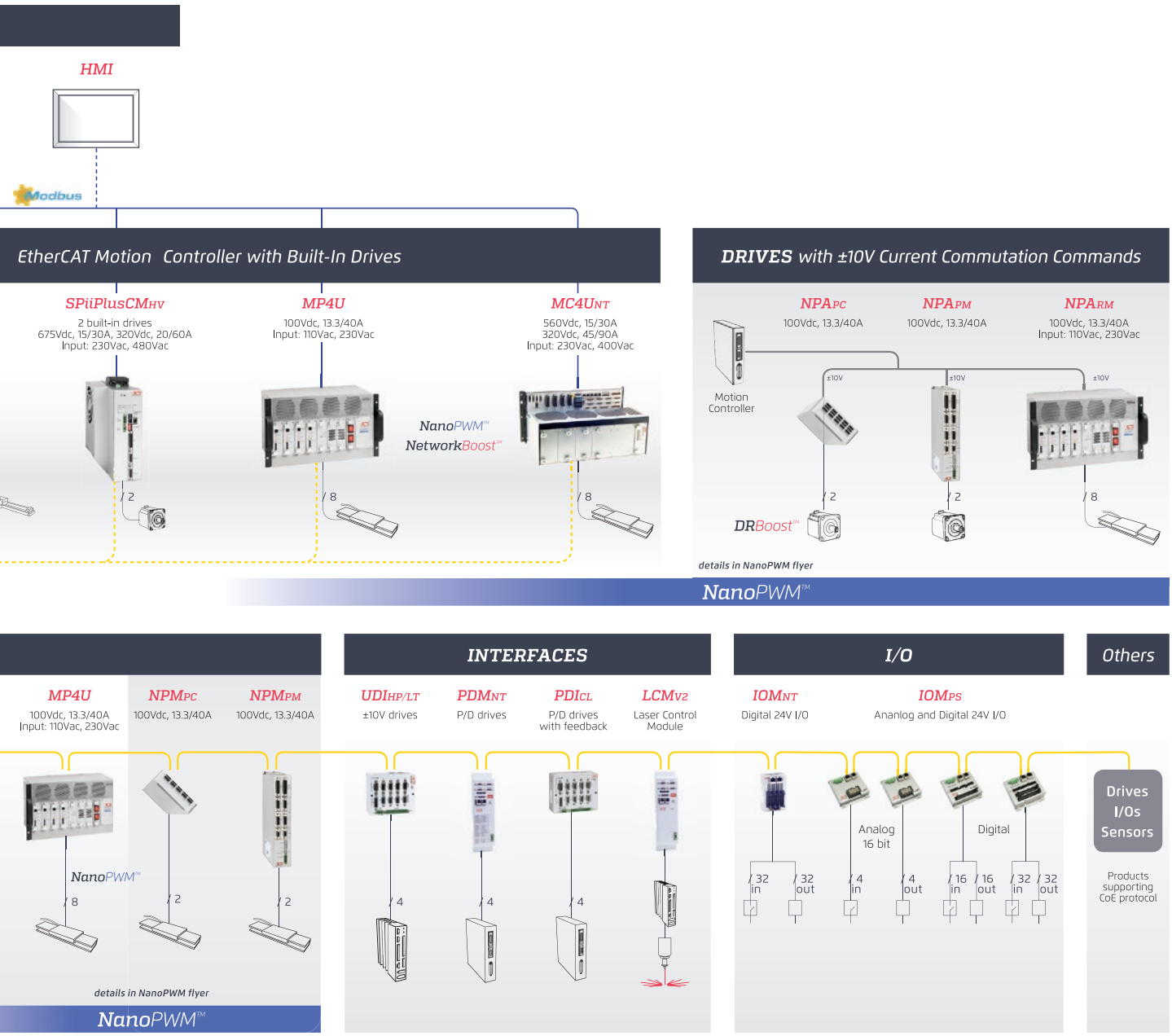
The universal drive modules on the third level include the digital servo processor (DSP). It performs the servo positioning of the axes. The drive modules power and actuate the motors, handle the feedback devices, manage the I/Os, and analyze the sensor signals for closed-loop positioning control.

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.



Motion Control

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

	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

	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)

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

	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-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

	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.

	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

	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!

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