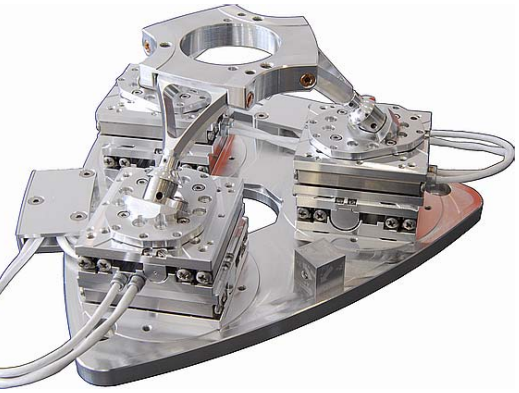
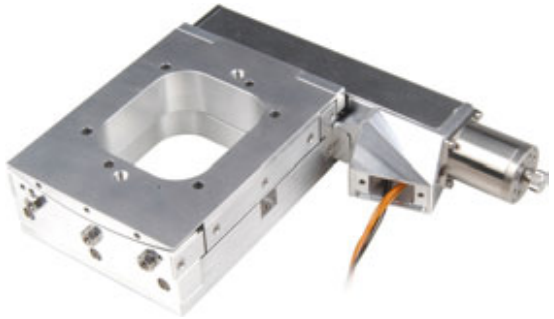
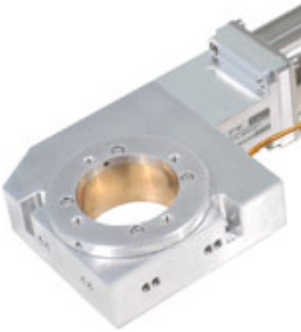
MOTION CONTROL | VACUUM

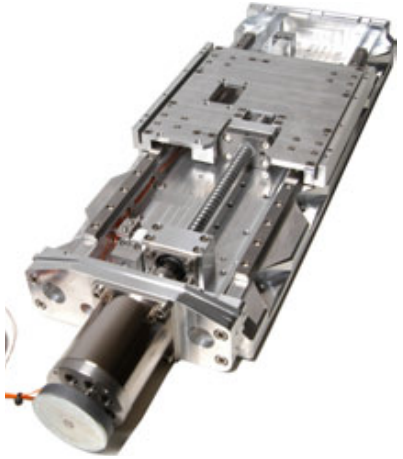
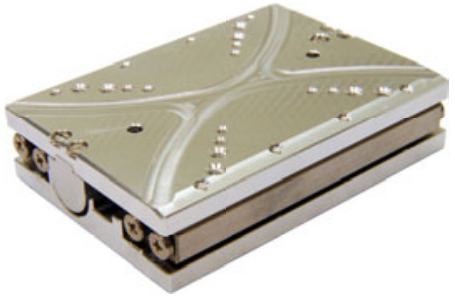
PI | micos




PIMICOS
ES-100




WELCOME

PI micos

PI miCos GmbH, founded in 1990 and located in Eschbach, south west Germany operates in the high technology field with a staff of approximately 70 people.

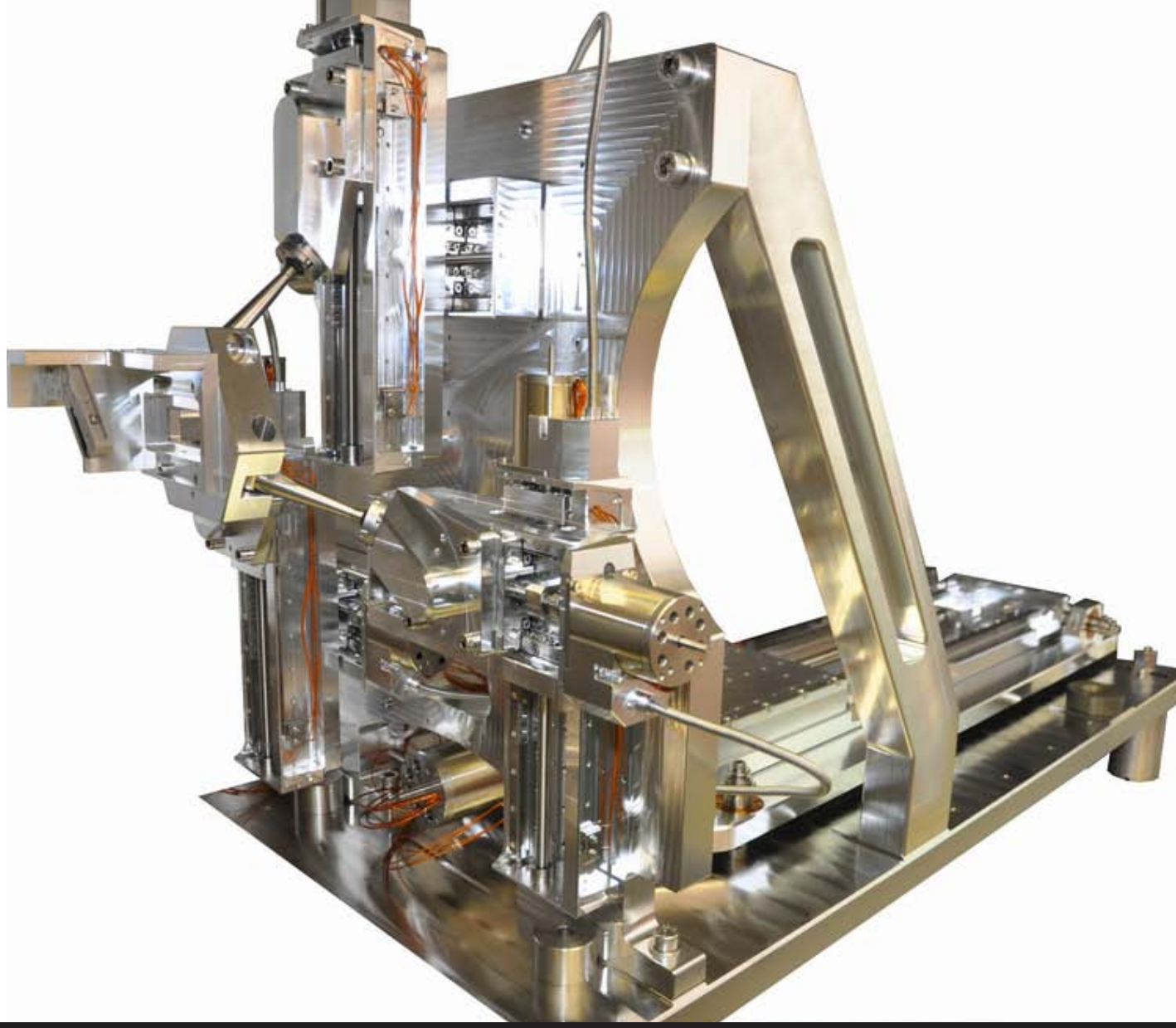
PI miCos specialises in developing, manufacturing and marketing of innovative components and systems in the arena of ultra precise positioning, photonics and laser technology. A high quality range of positioning systems for both research and industry are offered to our customers. Distinguished companies such as Carl Zeiss, Siemens, University research institutes as well as the Fraunhofer Gesellschaft and Max-Planck-Institute are among our established customers.

Our international network of sales partners and subsidiaries support an extensive worldwide customer base. Functionality together with excellent quality down to the last detail matched with world class design and a competitive price-quality ratio can be found in all PI miCos products. Market-oriented customised solutions and a wide product range are documented in two product catalogues with around 180 pages.
Know-how, customer service and reliability are the convincing attributes of PI miCos as well as the ability to offer everything under one roof. Equally important to our company's philosophy is close customer contact. Individual requirements and challenging customised solutions require an effective and efficient support service. Therefore, expert advice always precedes the sale of components and systems alike. We are not only a high technology manufacturer but also importantly a service provider, this is what makes PI miCos stand out from the crowd.
Flexible and open-minded, PI miCos is facing the technical challenges with it's staff members working in an owner-managed company.

Lucius Amelung Managing Director

ABOUT US

Engineering | Vacuum



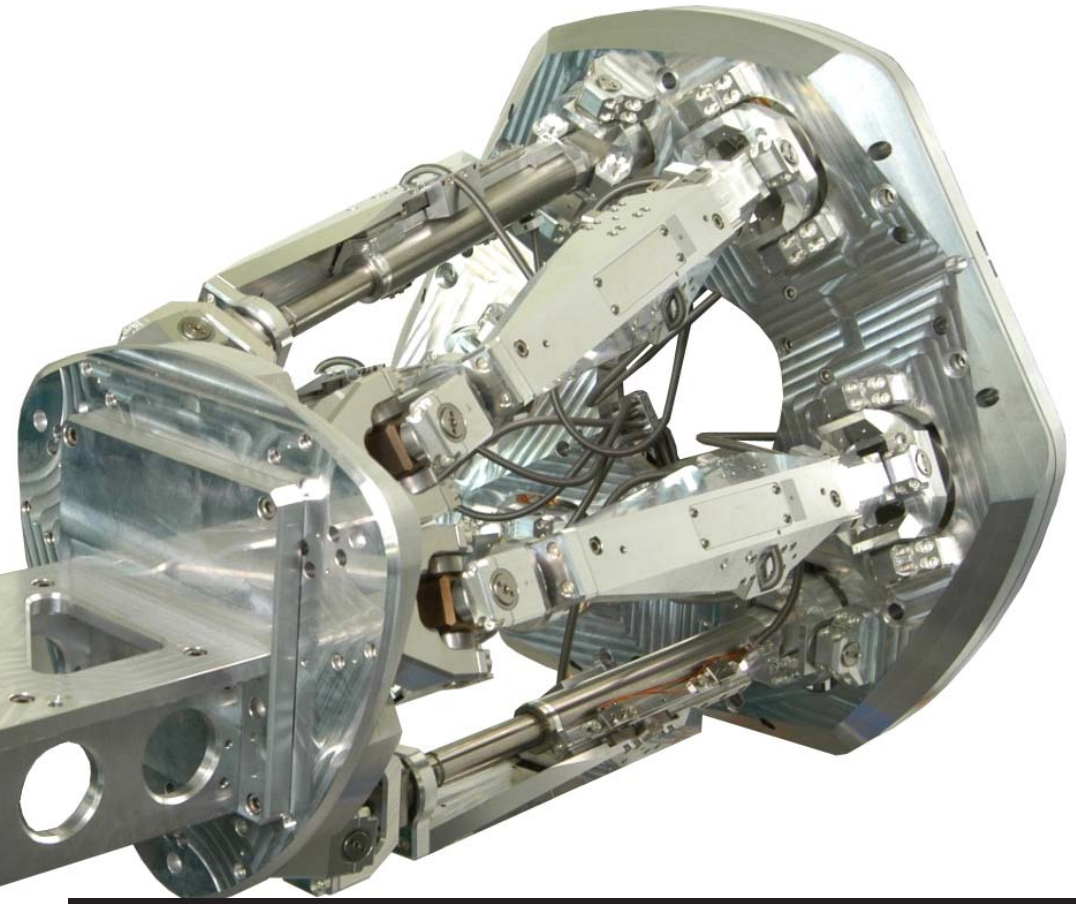
VACUUM

PI | micos

Engineering is of major relevance for PI miCos to be competitive in the global market.
The essential qualifications are a constant advance through innovation and extensive know-how, customer and solution related product development, as well as optimum efficiency in production.
Technical solutions of tomorrow can be found in the engineering of today at PI miCos, where the understanding of structures, relations and functions of technical systems are among our strengths.
The design team develops new products, starting with the analysis, design scheme and simulation to the subsequent realisation of the finished product.
The fundamental basis of our innovative creativity is the synergy of different disciplines such as precision engineering, optics, electronics and software development.

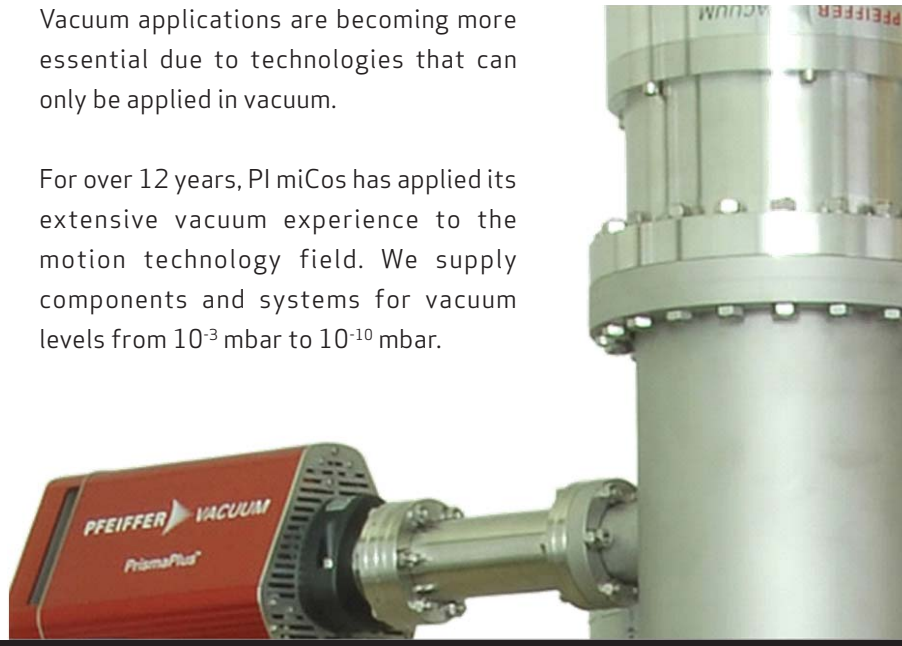
Numerous customers from different markets and disciplines, such as biotechnology, life science, medical, nanotechnology, photonics, telecommunications, semi conductors, astronomy, microscopy and educational laser systems, access these abilities.
They all have a partner in PI miCos, which provides high competency in technical trouble-shooting, considers complex system solutions as a constant challenge and offers the knowledge accumulated from this experience, from the process of product development through to large project handling.

ENGINEERING



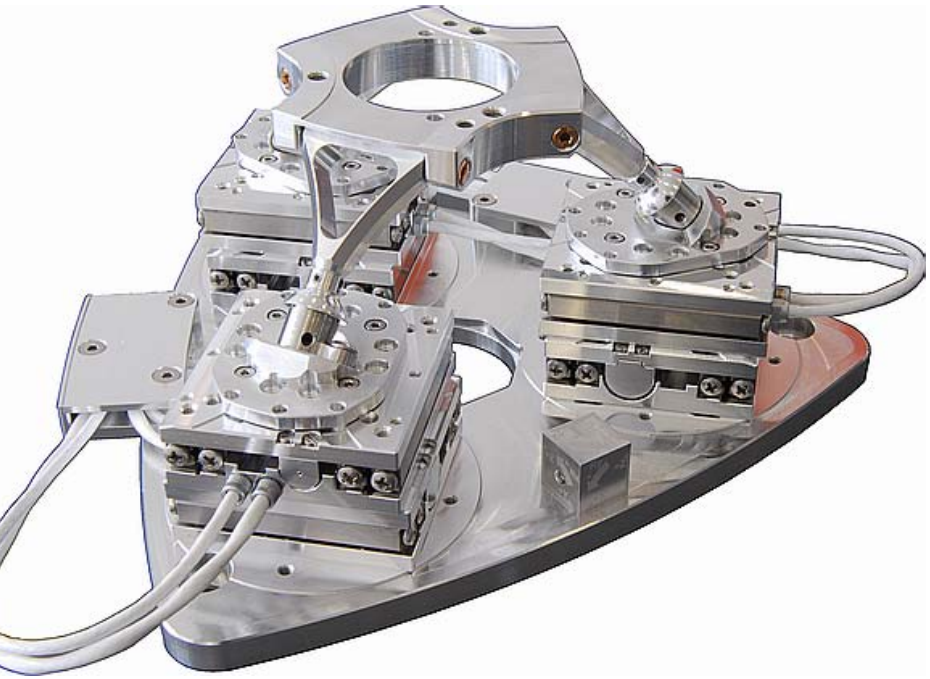
Vacuum applications are becoming more essential due to technologies that can only be applied in vacuum.

For over 12 years, PI miCos has applied its extensive vacuum experience to the motion technology field. We supply components and systems for vacuum levels from 10^{-3} mbar to 10^{-10} mbar.



PIONEER OF SPECIAL CHALLENGES

PI miCos



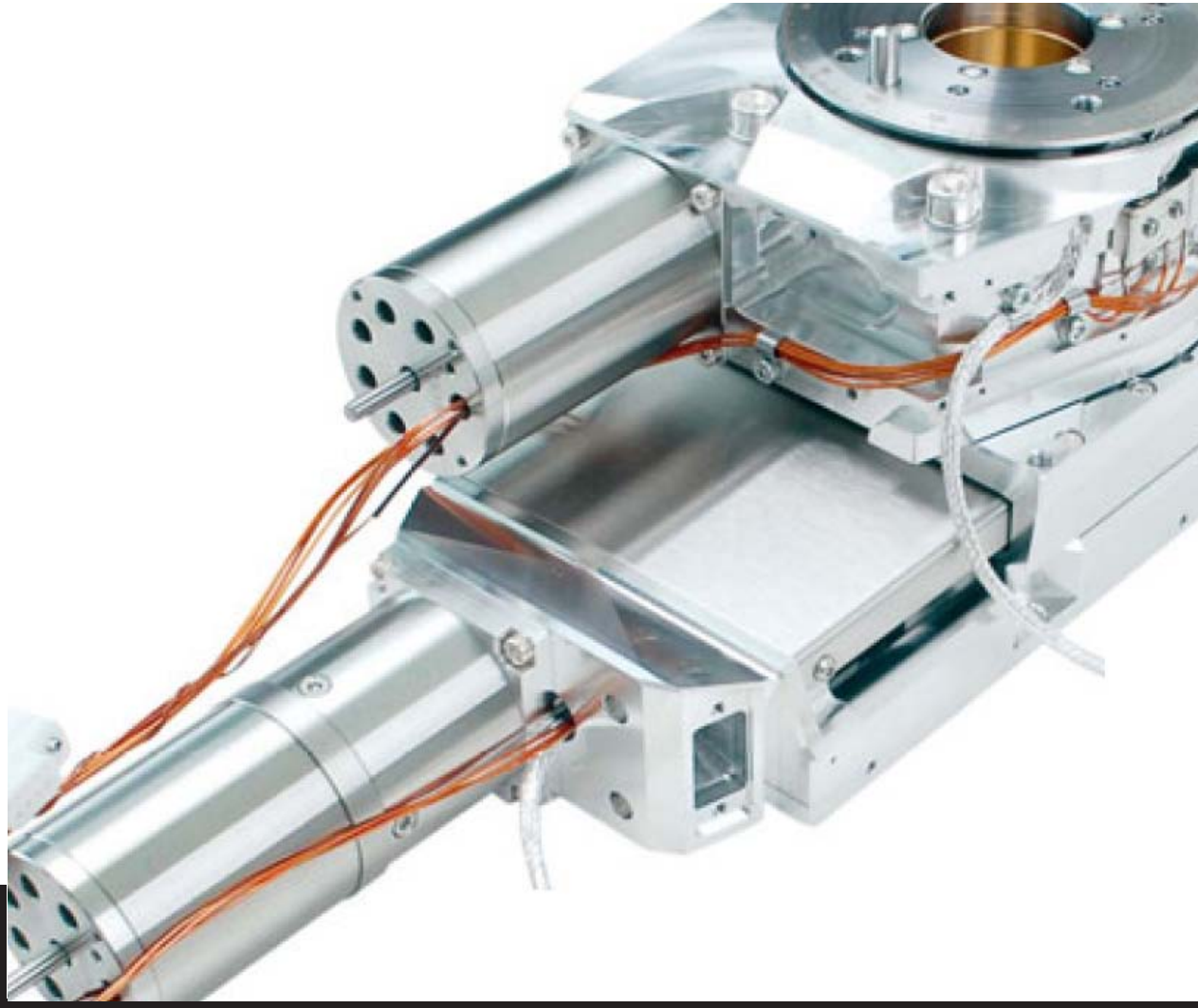
With one SpaceFAB 450 PS Vaccum all six degress of freedom can be moved without additional positioning elements. The none preloaded design is carry up to 1 kg center mounted. SpaceFAB 450 PS Vacuumis operating in closed loop mode. The SpaceFAB 450 PS Vacuum is driven by piezo stick slip motor. The SpaceFAB is controlled with 6 axes E-871 closed loop piezo controller. Optical linear encoder provides, highest repeatability and resolution. SpaceFAB 450 PS Vacuum are especially developped for vacuum and non magnetic applications.

PIEZO SpaceFAB

Vacuum Engineering

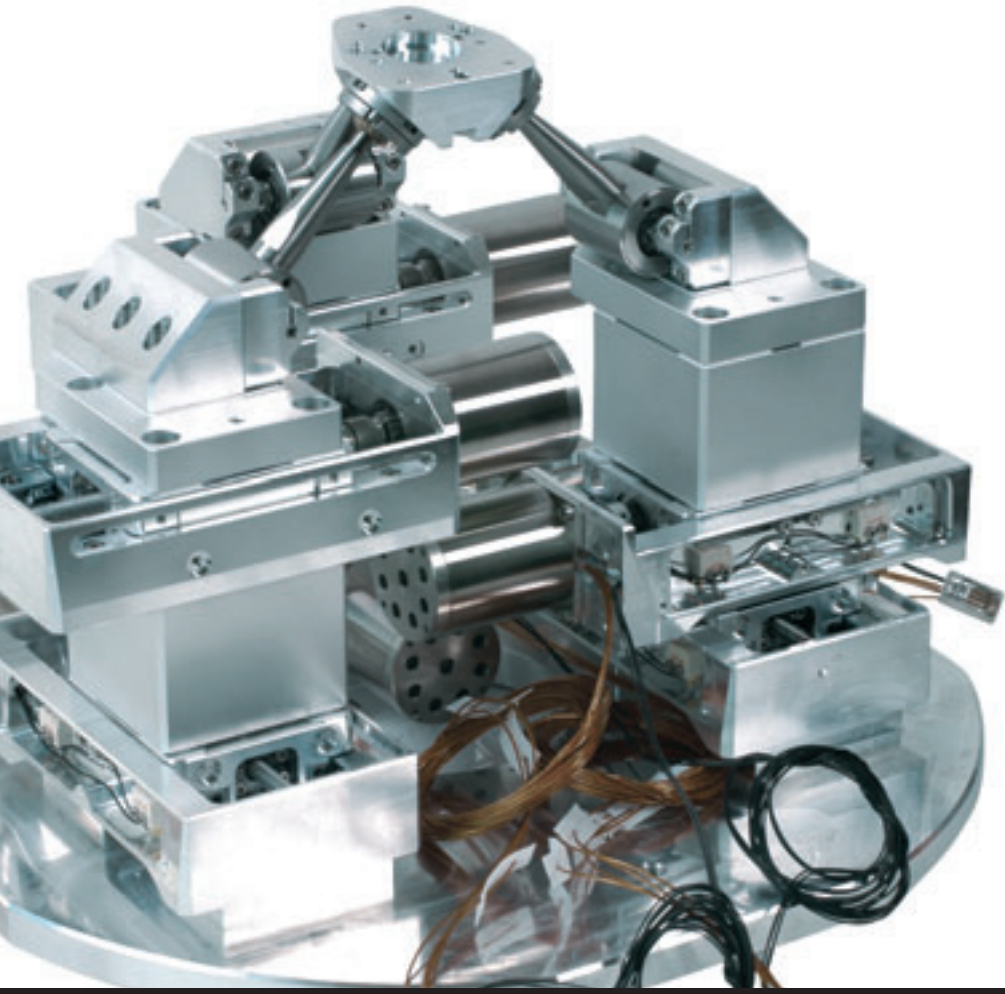
PI miCos stages can be designed for UHV and cryo applications. To reach a vacuum level of 10^{-9} mbar the material of the stages have to be selected carefully. Special end switches for a wide temperature range and special 2 phase stepper motors with stainless steel housing, actively heated up to 120°C for outgasing can be adapted.

Using our own chamber with a connected mass spectrometer we are able to verify the suitability of possible materials. A level of 10^{-7} mbar or less can be reached by a longer pump time and outbaking. If needed we can also design stages without any grease by using coatings and other materials.



STAGES FOR UHV

PI micos



Customized SpaceFAB for vacuum 10^{-7} mbar and temperature range of -40°C to +80°C. 6 degrees of freedom.

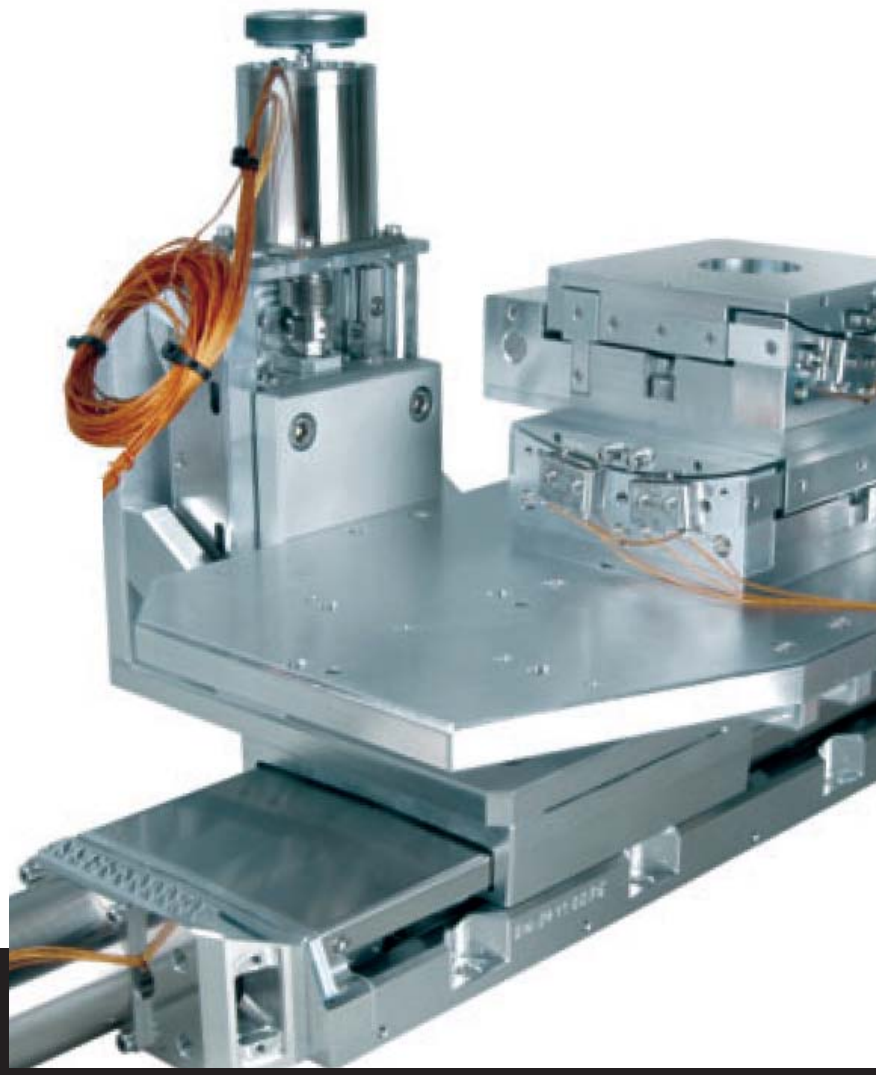
With the SpaceFAB SF-3000 BS (vacuum) all six degrees of freedom can be moved without additional positioning elements. The low weight of the moving platform allows highly dynamic positioning. Using no pre-load, the design can easily carry up to 5 kg (center mounted). The pivotpoint can be set by software.

SpaceFAB HV

Vacuum Engineering

A 5 m long spectrometer for soft x-rays used in a synchrotron radiation beamline for resonant x-ray emission spectroscopy and resonant inelastic x-ray scattering in the 400–1600 eV energy range. 5 axes advanced x-ray emission spectrometer is mounted on a rotating platform allowing the scattering angle to be varied from 25° to 130°. The spectrometer is operational at the ADRESS ADvanced REsonant SpectroScopy beam-line of the Swiss Light Source.

This positioning system was designed for a custom application. The system uses the linear stages LS-110 and the PLS-85 in addition to two goniometers (WT-100 and WT-85) at a vacuum level of 10^{-7} mbar.



Beamline Instrumentation

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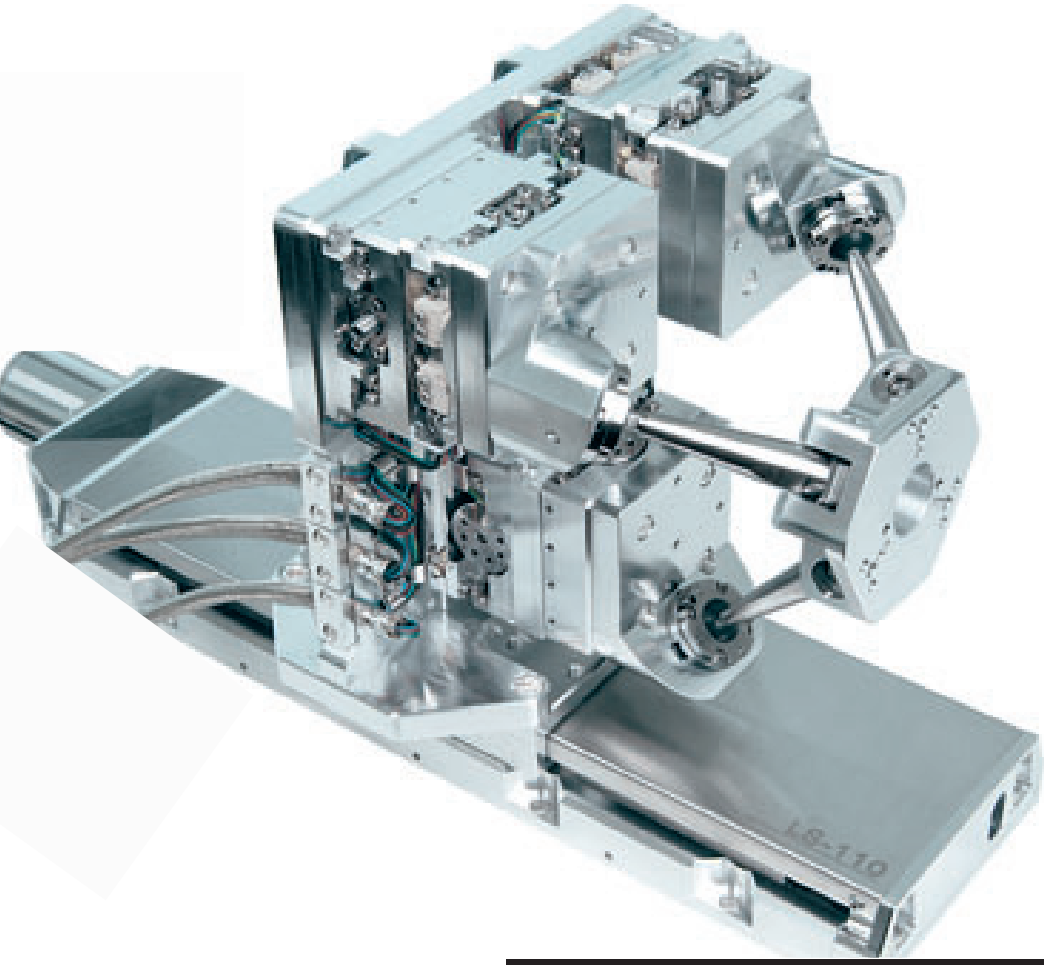
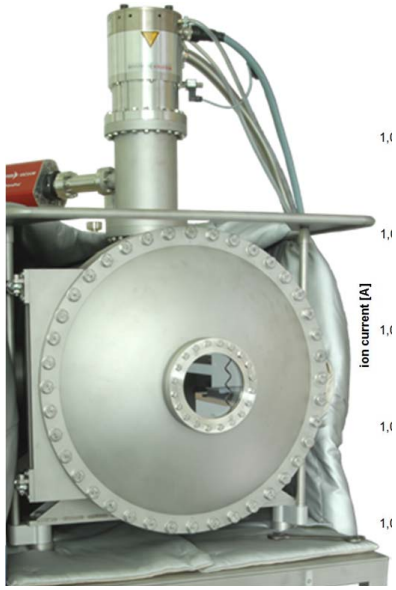


This 7 axes positioning system consists of a LS-110 and a custom designed SpaceFAB which is used for dynamic measurements. To achieve the required precision, highstiffness and repeatability was required. The pivot point can be set by software in this case important for adjusting an X-Ray single reflection lens at BESSY II in Berlin.

SpaceFAB HV FOR SYNCHROTRON



VACUUM

For specifying the necessary vacuum level it is important to analyze the application. The requirement of coating optics, epitaxy or crystallography is different in the necessary vacuum level as well as mass spectroscopy or others. Not the general vacuum level of 10^{-7} or 10^{-9} hPa is often important but e.g. the partial pressure of hydrocarbons. As a result of using wrong grease with higher vapor pressure or use of plastics these hydrocarbons can be a source of contamination of surfaces. Especially laser applications e.g. in the UV range are critical because the hydrocarbons can be split into fragments and these fragments can be deposed on optics. The choice of materials and handling processes are at the end the most important points to get the right vacuum stage.

DEFINITION VACUUM

Vacuum is defined as pressure lower than normal air pressure. A system is in vacuum if the pressure is lower than the atmospherical pressure. The PI miCos catalog uses hPa as a unit of air pressure. Other physical units commonly used are Millibar (mbar) and Torr (Torr).

DEFINITION ACCORDING TO DIN 28400

Vacuum is defined as pressure lower than the air pressure of the atmosphere.

CLASSIFICATION OF THE VACUUM CLASSES

Vacuum class	Abbr.	Pressure range
Low vacuum	FV	<1 - 1-10^{-3} hPa
High vacuum	HV	<1x10^{-3} - 10^{-7} hPa
Ultra-high vacuum	UHV	<1x10^{-7}-1x10^{-9} hPa
Ultra-high vacuum Grease	UHV-G	<1x10^{-7}-1x10^{-9} hPa
Ultra-high vacuum Cryo	UHV-C	up to 1x10^{-9} hPa
Extreme-ultra-high vacuum	EUHV	<1x10^{-9} - 1x10^{-11} hPa

According to DIN28400-1:1900-5

Almost all miCos stages can be prepared for FV, HV and UHV. For UHV vacuum class all components are made for 1x10^{-9} hPa. Special UHV motors, cables, controllers, greases and coatings are used.

PI MICOS STANDARD VACUUM PREPARATION CATEGORIES:

FV UP TO <1X10^{-3} hPa

- Standard motor
- Standard measuring system, if measuring system required
- Standard wiring
- Standard connector for plug connection
- Standard limit switch
- All Al parts are anodized
- Stainless steel screws
- All guidance and driving elements are equipped with vacuum grease
- Outbaking temperature max. 80°C

Cryogenic Linear Stage / EADS project ‚James Webb Telescope'/ High End Measurement Heidenhain Glass scale

HV UP TO <1X10^{-3} TO 1X10^{-7} hPa

- Special vacuum motor
- Measuring system modified for the use in vacuum
- Motor and limit switches equipped with teflon or kapton insulated braids 2 m length wired to a test plug
- Standard limit switches, with plastic parts
- All Al parts un-anodized
- Stainless steel screws
- All guides and driving elements are equipped with vacuum grease
- No use of CuZn alloys
- All holes are vented (if possible)

WHEN STAGES ARE USED IN A HIGH-VACUUM AREA PLEASE CONSIDER THE FOLLOWING:

- Use low speed operation, max. motor speed 10 rev/s
- Shorter life time expectation
- Stages can only be run in vacuum
- Stages are delivered with test plugs, not designed for vacuum
- Outbaking temperature max. 120°C [150°C]

UHV <1X10^{-7} UP TO 1X10^{-9} hPa

- Special vacuum motor
- Measuring system modified for the use in vacuum
- Motor and limit switches equipped with kapton insulated braids 2 m length wired to a test plug
- No limit switch, but can be offered with special UHV limit switch
- All Al parts are un-anodized
- Stainless steel screws are Ag coated, with degass drilling (apart from M3 thread)
- Bearing and driving elements made of hardened stainless steel and equipped with vacuum grease
- No use of CuZn alloys
- No use of plastics, unless so desired after consultation with the customer
- All holes are vented (if possible)

Electronic devices such as controller, amplifier and other electronic devices supplied by PI miCos are not made for vacuum use. Therefore, they must be placed outside the vacuum chamber. PI miCos supplies vacuum-prepared stages with test plugs, which cannot be used in vacuum. The plug has to be disconnected and replaced by a vacuum plug by the customer. Vacuum feed-through and plugs can optionally be obtained from PI miCos.

For use in HV and UHV all guides and spindles are lubricated with vacuum lubricant. The specific lubricant for your application will be defined during the ordering process.

HANDLING / CLEAN ROOM

Our vacuum stages are assembled in clean room conditions. All components are cleaned in an ultrasonic bath. Afterwards they are packed in a particle free and antistatic bag. Our components and systems can be used in clean room, cryogenic applications and various other climatic environments.

PI miCos PREFERRED MATERIALS FOR STAGES ARE:

- Stainless steel
- Aluminum
- Titanium
- Brass
- Viton
- Ceramic
- Sapphire
- Teflon
- Peek
- Kapton
- Macor

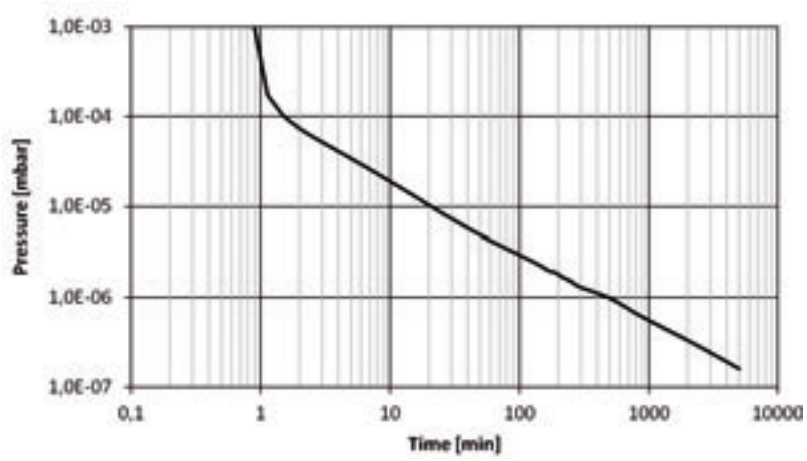
Vacuum handling

To achieve the goal of a high vacuum (HV) or an ultra high vacuum (UHV) stage, one has to take three main points into account.
Material selection: Electrical and electronic equipment like motors, scaling systems or limit switches have to be suitable for vacuum environment. But also the use of materials for the body of the product is limited. For example CuZn alloys are not used in vacuum systems, and standard plastic parts are exchanged by PEEK or metal components.
Careful design: the body of the stage is designed for avoiding closed compartments which can gas out very slowly causing virtual leaks. Holes as well as screws are vented, a reduction of the surface is desired.
Cleaning and assembling in clean room: The components undergo a three-stage cleaning process. Herein the key step is the ultrasonic cleaning. In a next step the components are dried in a climate cabinet under nitrogen atmosphere. Assembling of the stage is done in clean room or in a flow box. The system is packed in vacuum sealed bags protected against dirt, air and humidity.

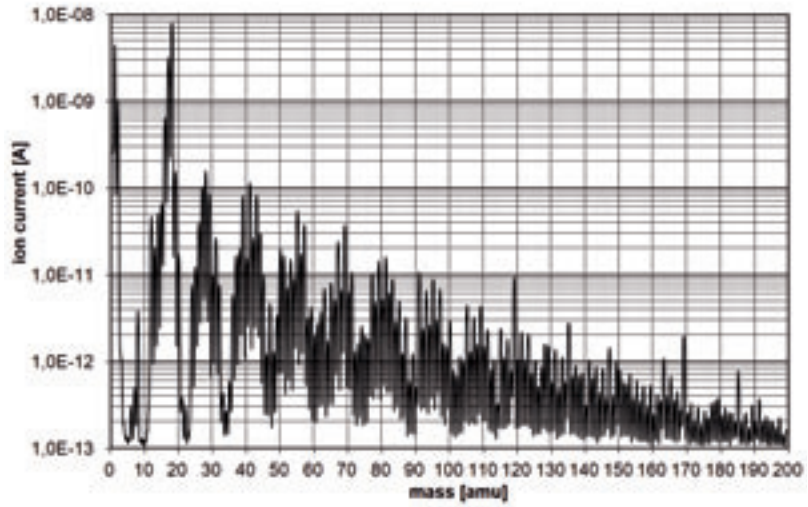
Mounted and handled in this way, the stages reach high vacuum level within a few hours or days by pumping down in the vacuum chamber at room temperature. As an example the vacuum test results of a high vacuum version of the hexapod HP 140 is n the following graphs.
A pump down pressure curve for the HP 140 hexapod (6 linear pushers) was taken in a vacuum chamber of 40l volume and about 0.3m2 surface area. The turbo pump was capable of pumping 400 l/s (nitrogen).

A residual gas analysis was taken after 48 hours pumping time, and shows a spectrum which is dominated by the water peaks (16-18 amu), followed by the hydrogen signal (1-2 amu). The next most dominant signal was caused by nitrogen (28 amu) with about 2% of the water peak intensity

Pump-down pressure curve of HP 140 (HV)



Pump-down pressure curve of HP 140 (HV)



UHV stage protocol

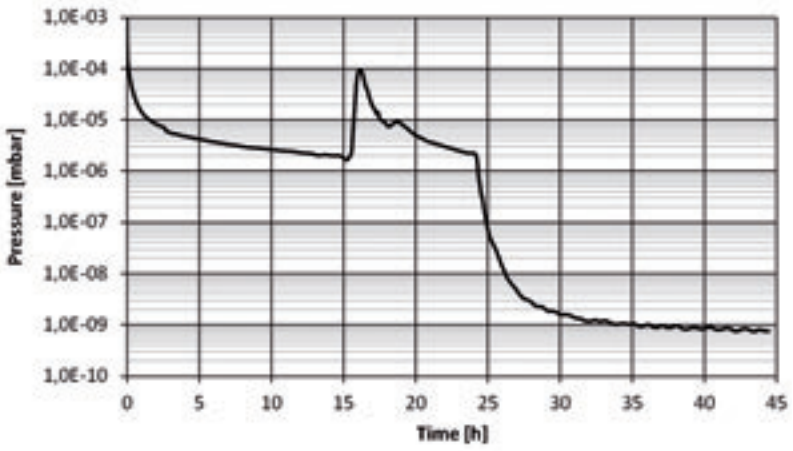
For ultra-high vacuum stages the pump down period in the vacuum chamber is followed by a heat out process of several hours or days, depending on the size of the vacuum stage. The stage is kept in thermal contact with the vacuum chamber which is heated. The heat out temperature depends on the components the stage is assembled from and lies between 80°C and 150°C. Additionally, the motor of the stage is heated by current feed of its coils.
As an example for an UHV product vacuum test results of a linear stage PLS 85 are shown below.

This measurement is performed in the same chamber as mentioned above (40l, 0.3m^2, pump 400l/s). After a pump down sequence of 15 hours, the stage was heated for 8 hours.

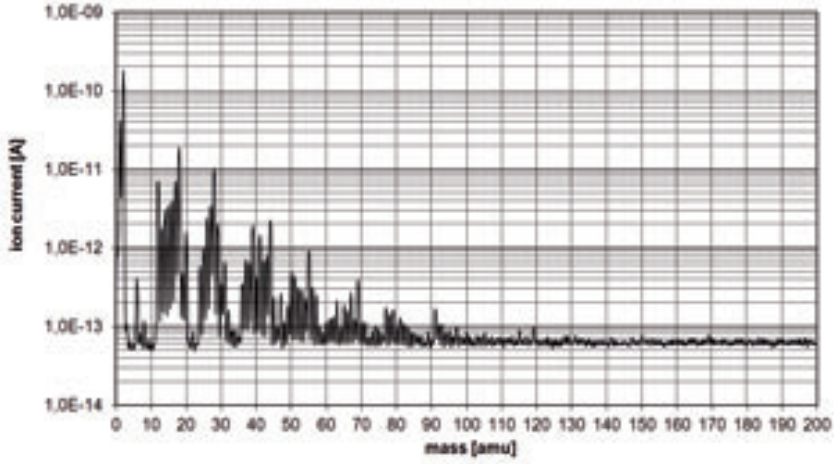
When switching the heater on, the pressure in the vacuum chamber increases by almost two orders of magnitude, and slowly decreases during the heat out period. After switching the heater off, the effect of heat out can be seen: the pressure in the vacuum chamber decreases by more than three orders of magnitude, reaching pressures below 10-9mbar at room temperature.

After the cool down period a residual gas analysis spectrum was taken. In the spectrum hydrogen (1-2 amu) is dominating which is hard to get rid of with a turbo pump. All other signals are at least 10 times smaller. Above 91 amu there are practically no significant contributions to the spectrum.

Pump-down pressure curve of PLS 85 (UHV)



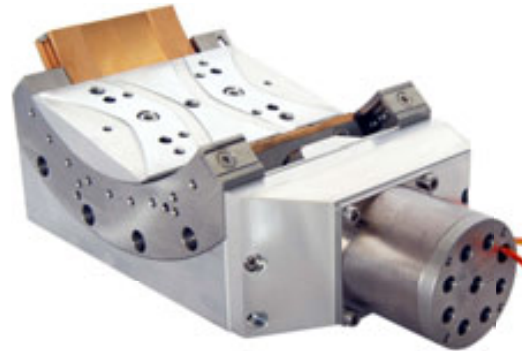
RGA scan of PLS 85 (UHV)



Definitions Vacuum

Icon	Definitions
NEW	New Product
	Serial / GPIB / USB / Ethernet
	Extended Warranty
	Point to Point Motion
	PC-card
V	Vacuum Option
	Linear & Circular Interpolation
	Linear Or Rotation Feedback
	Motion Server
	Torque Motor
	Linear Motor
	Voice Coil
	Flexure
	LabVIEW™
	Gearbox
	Microstep
	Piezomotor
	Cryonic Option
	Motion & Control

Icon	Definitions
	Travel Range
	Depth
	Countersink 90°
	Counterbore
	Input For Power and Signals
	Control
	Dimension in Millimeters
	Projection Method
Ø4H7	Hole Basis Fit Ø4 Tolerance Zone H7
M6	Metric Thread
	Square
	Brake



ROBOTICS

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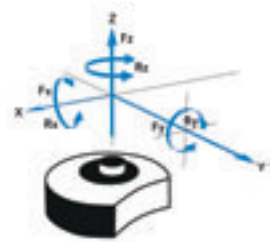
3.054 SpaceFAB SF-300 BS Vacuum

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$
FV	5	5	30	0.2	0.2	0.2
HV	5	5	30	0.2	0.2	0.2
UHVG	5	5	30	0.2	0.2	0.2



KEY FEATURES

- Vacuum up to 10-9 hPa
- Six axes micro positioning system
- Compact, low profile system
- Travel ranges linear (X,Y,Z) 50x100x12.7 mm
- Travel ranges rotation Rx, Ry, Rz 10°x10°x10°
- Maximum speed 10 mm/sec
- Load capacity up to 3 kg center mounted
- Pivot Point can be set by the user
- User friendly software
- Can be used by any modern programming language
- Including software, controller and amplifiers

The SpaceFAB SF-300 BS Vacuum system can perform motions in all six degree of freedom. The low weight of the moving plattform allows highger dynamic positioning processes.The non-preload version can easily carry up to 3 kg center mounted load. The SpaceFAB SF-300 BS Vacuum is operarting in open or in closed loop and it can generate any arbitrary trajectory.

The SpaceFAB SF-300 BS Vacuum is equipped with a special 2-phase vacuum stepper motor.

TECHNICAL DATA

Travel range	
X, Y, Z (mm)	50 x 100 x 12.7 *
Rx, Ry, Rz (°)	10, 10, 10 *

Vacuum type	FV	HV	UHVG
Speed max. X, Y, Z (mm/sec)	10	2.5	2.5
Speed max. Rx, Ry, Rz (°/sec)	3	1.25	1.25
Velocity Range (mm/sec)	0.01...10	0.1...2.5	0.1...2.5
Velocity Range (°/sec)	0.01...1.25	0.01...1.25	0.01...1.25
Weight (kg)	23	23	23
Bi-directional Repeatability X, Y, Z (µm)	± 0.5, ± 0.5, ± 0.5	± 0.5, ± 0.5, ± 0.5	± 0.5, ± 0.5, ± 0.5
Bi-directional Repeatability Rx, Ry, Rz (°)	± 0.0011	± 0.001	± 0.001
Resolution, calc. without load X, Y, Z (µm)	0.2	0.2	0.2
Resolution, calc. without load (height platf.) Rx, Ry, Rz (°)	ppp.	ppp.	ppp.
Resolution typical without load X, Y, Z (µm)	0.0005	0.005	0.005
Resolution typical without load Rx, Ry, Rz (°)			
Current (A)			
Voltage Range (V)			

Stiffness, theoretical Kx, Ky, Kz (N/µm)	
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: * = The maximum travel ranges in the different coordinate directions (X, Y, Z, RX, RY, RZ) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.
** = leg speed.
ppp. = depending on the pivot point position.
ppp. = depending on the pivot point position.
Please see "GLOSSARY Vacuum Specification" for all vacuum specification.

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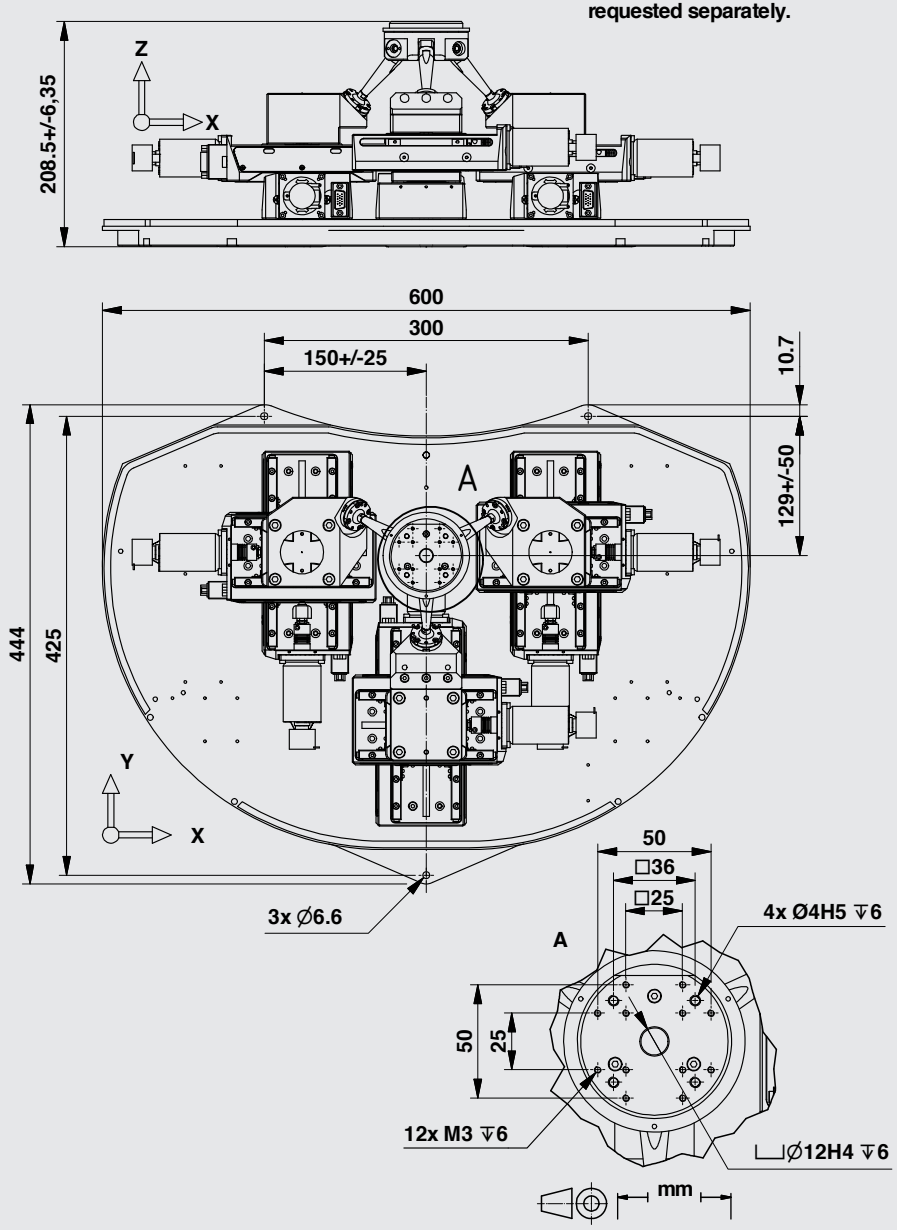
drawings for the corresponding vacuum class must be requested separately.

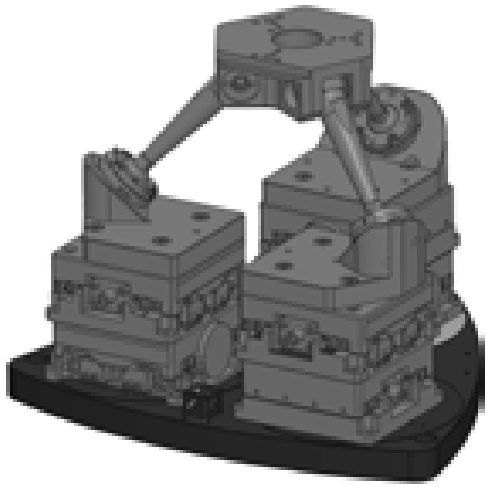


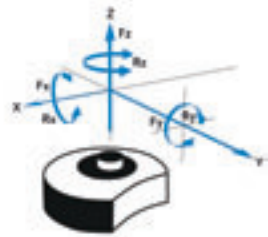
Order No.	6901-V-		1		0	0
FV	1					
HV	2					
UHVG	3					
open loop	0					
closed loop	1					

3.056 SpaceFAB SF-307 BS Vacuum

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$
FV	10	3	10	0.4	0.6	0.4
HV	10	3	10	0.4	0.6	0.4
UHVG	10	3	10	0.4	0.6	0.4





The SpaceFAB SF-307 BS Vacuum system can perform motions in all six degree of freedom. The low weight of the moving plattform allows highger dynamic positioning processes.The non-preload version can easily carry up to 2 kg center mounted load. The SpaceFAB SF-307 BS Vacuum is operarting in open or in closed loop and it can generate any arbitrary trajectory.

The SpaceFAB SF-307 BS Vacuum is equipped with a special 2-phase vacuum stepper motor.

KEY FEATURES

- Vacuum up to 10-9 hPa
- Six axes micro positioning system
- Compact, low profile system
- Travel ranges linear (X,Y,Z) 10x10x10 mm
- Travel ranges rotation Rx, Ry, Rz 12°x8°x7°
- Maximum speed 5 mm/sec
- Load capacity up to 2 kg center mounted
- Pivot Point can be set by the user
- User friendly software
- Can be used by any modern programming language
- Including software, controller and amplifiers

TECHNICAL DATA

Travel range	
X, Y, Z (mm)	10 x 10 x 10 *
Rx, Ry, Rz (°)	12, 8, 7 *

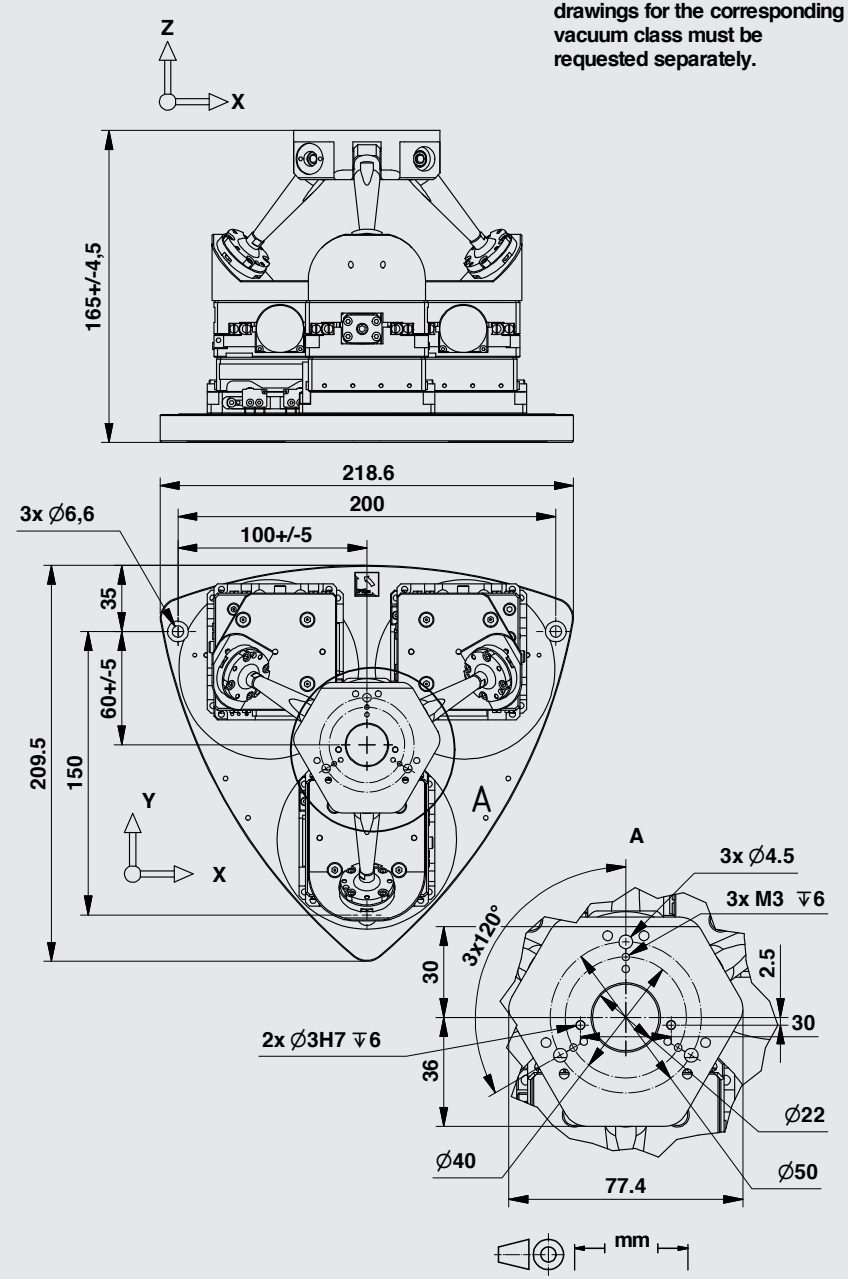
Vacuum type	FV	HV	UHVG
Speed max. X, Y, Z (mm/sec)	5	1	1
Speed max. Rx, Ry, Rz (°/sec)	3	0.6	0.6
Velocity Range (mm/sec)	0.01...5	0.01...1	0.01...1
Velocity Range (°/sec)	0.01...3	0.01...0.6	0.01...0.6
Weight (kg)	12	12	12
Bi-directional Repeatability X, Y, Z (µm)	± 0.5, ± 0.5, ± 0.5	± 0.5, ± 0.5, ± 0.5	± 0.5, ± 0.5, ± 0.5
Bi-directional Repeatability Rx, Ry, Rz (°)	± 0.0011	± 0.0011	± 0.001
Resolution, calc. without load X, Y, Z (µm)	0.2	0.2	0.2
Resolution, calc. without load (height platf.) Rx, Ry, Rz (°)	ppp.	ppp.	ppp.
Resolution typical without load X, Y, Z (µm)	0.2	0.2	0.2
Resolution typical without load Rx, Ry, Rz (°)			
Current (A)			
Voltage Range (V)			

Stiffness, theoretical Kx, Ky, Kz (N/µm)	
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: * = The maximum travel ranges in the different coordinate directions (X, Y, Z, RX, RY, RZ) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.
** = leg speed.
ppp. = depending on the pivot point position.
Please see "GLOSSARY Vacuum Specification" for all vacuum specification.

PI micos

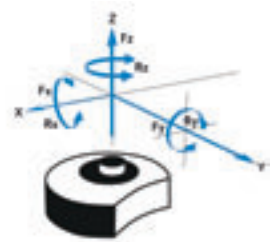
drawings for the corresponding vacuum class must be requested separately.



Order No.	6903-V-		1	0	0	0
FV	1					
HV	2					
UHVG	3					

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$
FV	2	2	5	0.1	0.1	0.1
HV	2	2	5	0.1	0.1	0.1
UHVG	2	2	5	0.1	0.1	0.1



KEY FEATURES

- Vacuum up to 10-9 hPa
- Non magnetic applications.
- Six axes micro robot system
- Compact, low profile system
- Travel ranges linear (X,Y,Z) 13x13x10 mm
- Travel ranges rotation Rx, Ry, Rz 9°x9°x9°
- Maximum speed 10 mm/sec
- Load capacity up to 2 kg center mounted
- Pivot Point can be set by the user
- User friendly software
- Can be used by any modern programming language
- Including software, controller and amplifiers

With one SpaceFAB 650 PS Vaccum all six degress of freedom can be moved without additional positioning elements. The none preloaded design is carry up to 2 kg center mounted. SpaceFAB 650 PS Vacuumis operating in closed loop mode. The SpaceFAB 650 PS Vacuum is driven by piezo stick slip motor. The SpaceFAB is controlled with 6 axes E-864 closed loop piezo controller. Optical linear encoder provides, highest repeatability and resolution. SpaceFAB 650 PS Vacuum are especially developped for vacuum and non magnetic applications.

TECHNICAL DATA

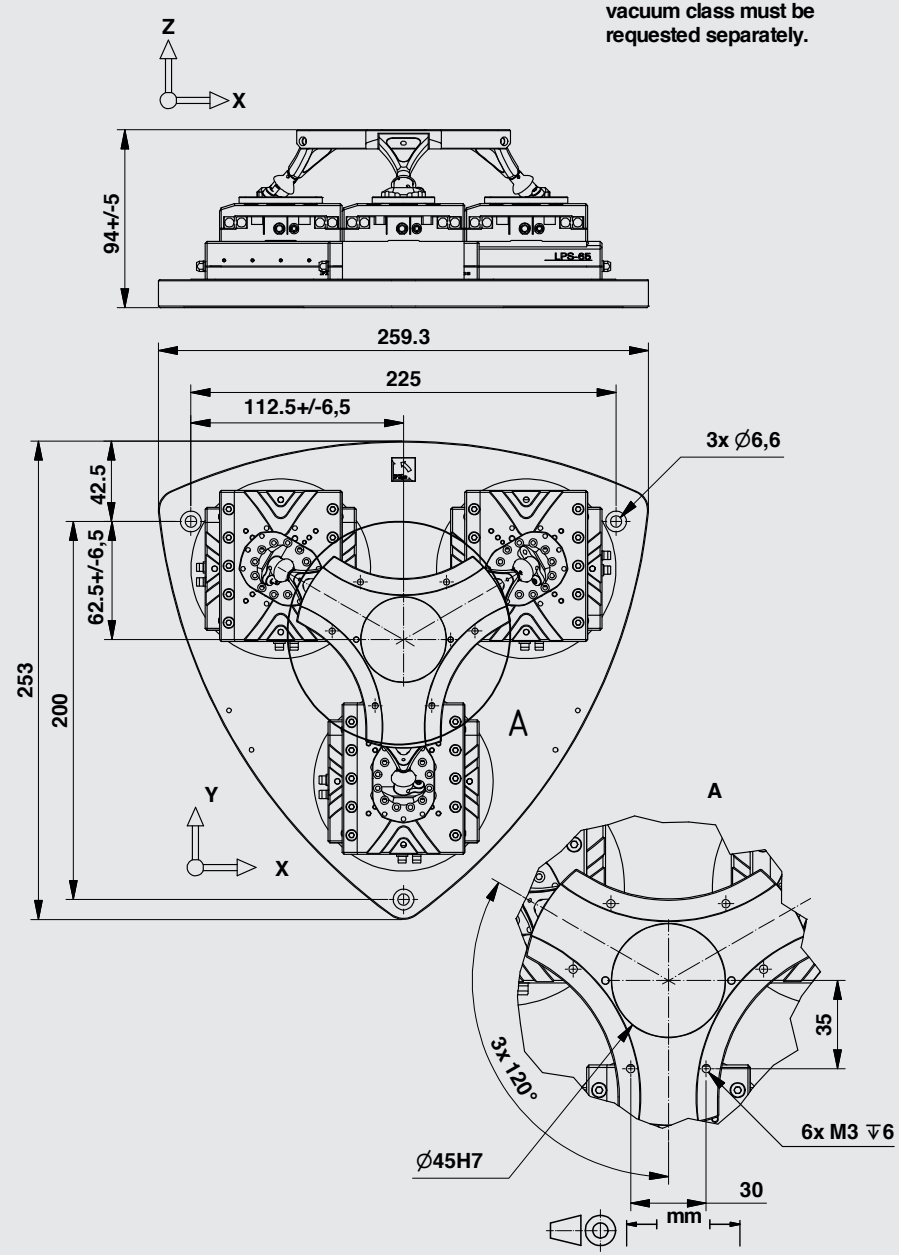
Travel range	
X, Y, Z (mm)	13 x 13 x 10 *
Rx, Ry, Rz (°)	9, 9, 9 *

Vacuum type	FV	HV	UHVG
Speed max. X, Y, Z (mm/sec)	10	10	10
Speed max. Rx, Ry, Rz (°/sec)	5	5	5
Velocity Range (mm/sec)	0.02...10	0.002...10	0.002...10
Velocity Range (°/sec)	0.02...5	0.002...5	0.002...5
Weight (kg)	0	0	0
Bi-directional Repeatability X, Y, Z (µm)	± 0.008, ± 0.008, ± 0.008		
Bi-directional Repeatability Rx, Ry, Rz (°)	± 0.0005	± 0.0005	± 0.0005
Resolution, calc. without load X, Y, Z (µm)	0.005	0.005	0.005
Resolution, calc. without load (height platf.) Rx, Ry, Rz (°)	ppp.	ppp.	ppp.
Resolution typical without load X, Y, Z (µm)	0.005	0.005	0.005
Resolution typical without load Rx, Ry, Rz (°)			
Current (A)			
Voltage Range (V)			

Stiffness, theoretical Kx, Ky, Kz (N/µm)	
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: * = The maximum travel ranges in the different coordinate directions (X, Y, Z, RX, RY, RZ) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.
** = leg speed.
ppp. = depending on the pivot point position.
Please see "GLOSSARY Vacuum Specification" for all vacuum specification.

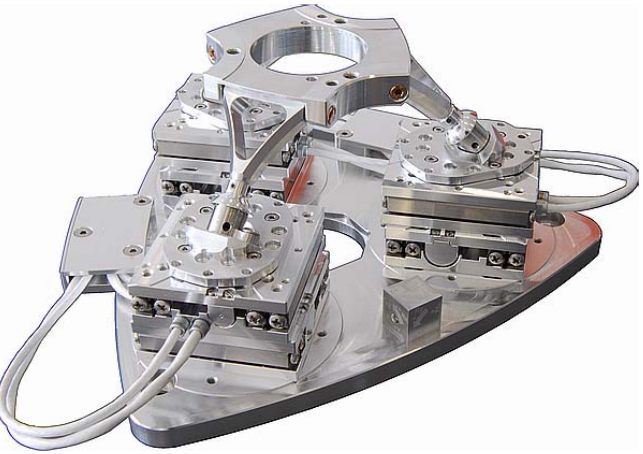
drawings for the corresponding vacuum class must be requested separately.

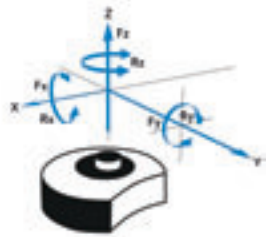


Order No.	6907-V-			1	1	0
FV	1					
HV	2					
UHVG	3					
1/2"x1/2"	1					

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$
FV	2	2	3	0.1	0.1	0.1
HV	2	2	3	0.1	0.1	0.1
UHVG	2	2	3	0.1	0.1	0.1





With one SpaceFAB 450 PS Vaccum all six degress of freedom can be moved without additional positioning elements. The none preloaded design is carry up to 1 kg center mounted. SpaceFAB 450 PS Vacuumis operating in closed loop mode. The SpaceFAB 450 PS Vacuum is driven by piezo stick slip motor. The SpaceFAB is controlled with 6 axes E-871 closed loop piezo controller. Optical linear encoder provides, highest repeatability and resolution. SpaceFAB 450 PS Vacuum are especially developped for vacuum and non magnetic applications.

KEY FEATURES

- Vacuum up to 10-9 hPa
- Non magnetic applications.
- Six axes micro robot system
- Compact, low profile system
- Travel ranges linear (X,Y,Z) 13x13x10 mm
- Travel ranges rotation Rx, Ry, Rz 14°x14°x14°
- Maximum speed up to 10 mm/sec
- Load capacity up to 1 kg center mounted
- Pivot Point can be set by the user
- User friendly software
- Can be used by any modern programming language
- Including software, controller and amplifiers

TECHNICAL DATA

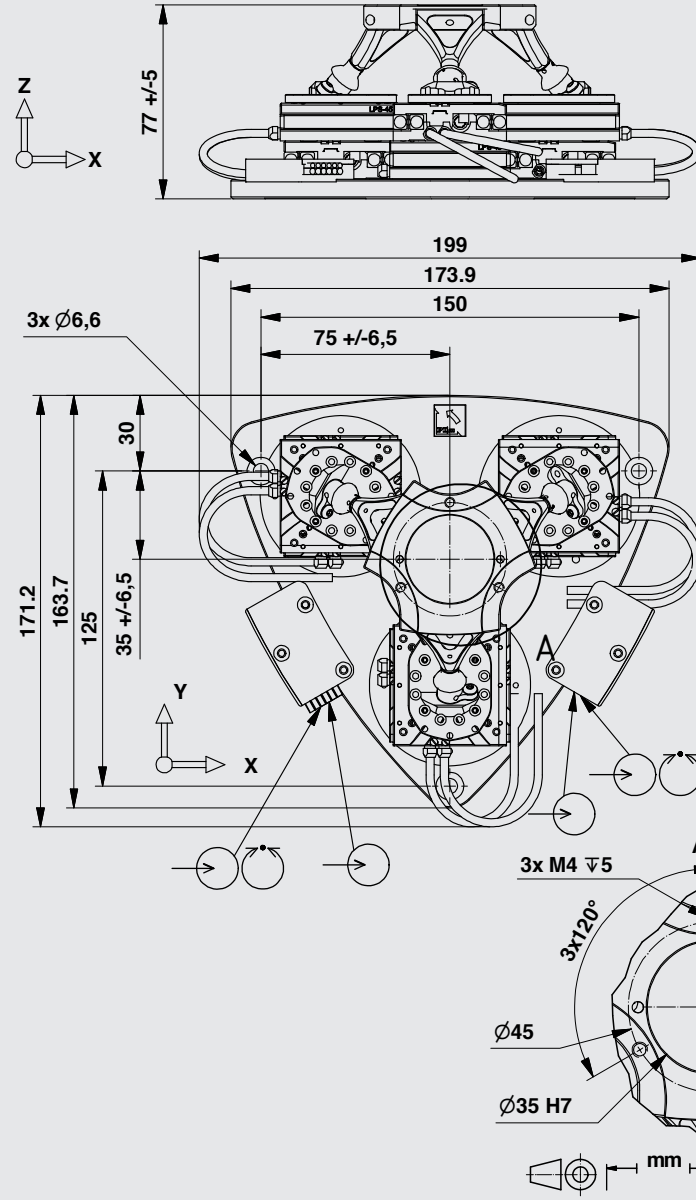
Travel range	
X, Y, Z (mm)	13 x 13 x 13 *
Rx, Ry, Rz (°)	14, 14, 14 *

Vacuum type	FV	HV	UHVG
Speed max. X, Y, Z (mm/sec)	10	10	10
Speed max. Rx, Ry, Rz (°/sec)	5	5	5
Velocity Range (mm/sec)	0.5...10	0.5...10	0.5...10
Velocity Range (°/sec)	0.5...5	0.5...5	0.5...5
Weight (kg)	2.1	2.1	2.1
Bi-directional Repeatability X, Y, Z (µm)	± 0.25, ± 0.25, ± 0.25	± 0.25, ± 0.25, ± 0.25	± 0.25, ± 0.25, ± 0.25
Bi-directional Repeatability Rx, Ry, Rz (°)	± 0.001	± 0.001	± 0.001
Resolution, calc. without load X, Y, Z (µm)	0.002	0.002	0.002
Resolution, calc. without load (height platf.) Rx, Ry, Rz (°)	ppp.	ppp.	ppp.
Resolution typical without load X, Y, Z (µm)	0.025	0.025	0.025
Resolution typical without load Rx, Ry, Rz (°)			
Current (A)			
Voltage Range (V)			

Stiffness, theoretical Kx, Ky, Kz (N/µm)	
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: * = The maximum travel ranges in the different coordinate directions (X, Y, Z, RX, RY, RZ) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.
** = leg speed.
ppp. = depending on the pivot point position.
Please see "GLOSSARY Vacuum Specification" for all vacuum specification.

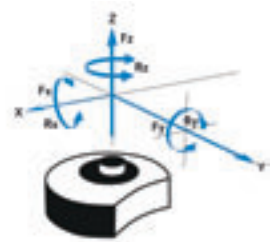
drawings for the corresponding vacuum class must be requested separately.



Order No.	6911-V-		1	1		0
FV		1				
HV		2				
UHVG		3				
A0°					1	
A45°					2	

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$
FV	0.1	0.1	0.1	0.1	0.1	0.1
HV	0.1	0.1	0.1	0.1	0.1	0.1
UHVG	0.1	0.1	0.1	0.1	0.1	0.1



KEY FEATURES

- Vacuum up to 10-9 hPa
- Non magnetic applications.
- Six axes micro robot system
- Compact, low profile system
- Travel ranges linear (X,Y,Z) 12x12x6 mm
- Travel ranges rotation Rx, Ry, Rz 13°x13°x13°
- Maximum speed up to 10 mm/sec
- Load capacity up to 0,2 kg center mounted
- Pivot Point can be set by the user
- User friendly software
- Can be used by any modern programming language
- Including software, controller and amplifiers

With one SpaceFAB 230 PS Vaccum all six degress of freedom can be moved without additional positioning elements. The none preloaded design is carry up to 0.2 kg center mounted. SpaceFAB 230 PS Vacuumis operating in closed loop mode. The SpaceFAB 230 PS Vacuum is driven by piezo stick slip motor. The SpaceFAB is controlled with 6 axes E-871 closed loop piezo controller. Optical linear encoder provides, highest repeatability and resolution. SpaceFAB 230 PS Vacuum are especially developped for vacuum and non magnetic applications.

TECHNICAL DATA

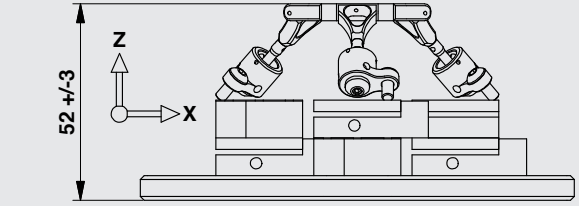
Travel range	
X, Y, Z (mm)	12 x 12 x 6.5 *
Rx, Ry, Rz (°)	13, 13, 13 *

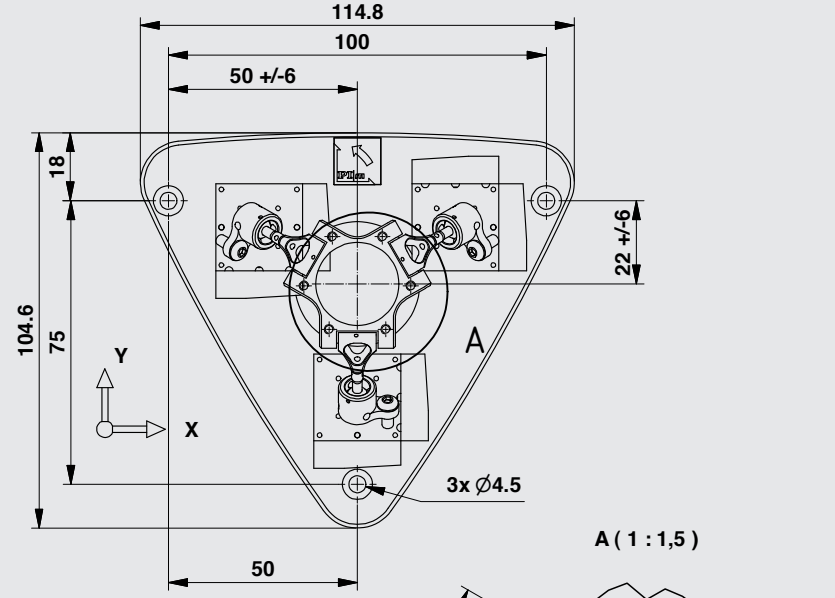
Vacuum type	FV	HV	UHVG
Speed max. X, Y, Z (mm/sec)	10	10	10
Speed max. Rx, Ry, Rz (°/sec)	5	5	5
Velocity Range (mm/sec)	0.5...10	0.5...10	0.5...10
Velocity Range (°/sec)	0.5...5	0.5...5	0.5...5
Weight (kg)	1.8	1.8	1.8
Bi-directional Repeatability X, Y, Z (µm)	± 0.5, ± 0.5, ± 0.5	± 0.5, ± 0.5, ± 0.5	± 0.5, ± 0.5, ± 0.5
Bi-directional Repeatability Rx, Ry, Rz (°)	± 0.002	± 0.002	± 0.002
Resolution, calc. without load X, Y, Z (µm)	0.002	0.002	0.002
Resolution, calc. without load (height platf.) Rx, Ry, Rz (°)	ppp.	ppp.	ppp.
Resolution typical without load X, Y, Z (µm)	0.05	0.05	0.05
Resolution typical without load Rx, Ry, Rz (°)			
Current (A)			
Voltage Range (V)			

Stiffness, theoretical Kx, Ky, Kz (N/µm)	
Material	Aluminum or Stainless steel, suitable for vacuum

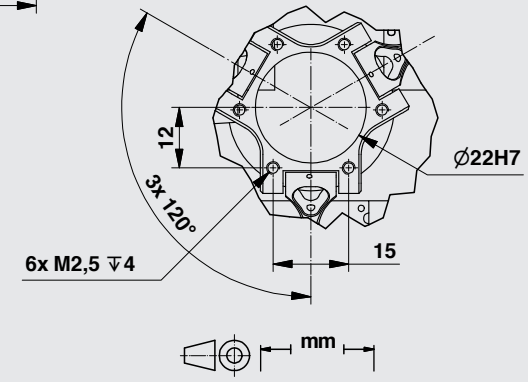
Vacuum Note: * = The maximum travel ranges in the different coordinate directions (X, Y, Z, RX, RY, RZ) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.
** = leg speed.
ppp. = depending on the pivot point position.
Please see "GLOSSARY Vacuum Specification" for all vacuum specification.

drawings for the corresponding vacuum class must be requested separately.





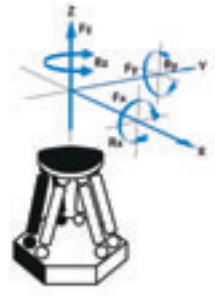
A (1 : 1,5)



mm

Order No.	6913-V-		1	1		0
FV		1				
HV		2				
UHVG		3				
A0°					1	
A45°					2	

3.064 Hexapod HP-550 Vacuum



FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$
FV	300	300	500
HV	300	300	500

Non-vacuum model shown

KEY FEATURES

- Vacuum up to 10-9 hPa
- Six axes Parallel Kinematic System
- Travel ranges linear (X,Y,Z) 100x100x100 mm
- Travel ranges rotation Rx, Ry 40°, Rz 60°
- Maximum speed 2 mm/sec
- Pivot Point can be set by the customer
- User friendly software
- Load capacity central (Fx; Fy) 30 kg / (Fz) 50 kg

The HP-550 Hexapod system can perform motions in all six degrees of freedom. Due to the parallel kinematic design architecture, the system can achieve a much higher stiffness than a conventional stages stack. Typical Hexapod applications include antenna positioning, medical research, laser technology, semiconductor technology and optical systems. An optimized design ensures maximum system stiffness and spatial resolutions up to 0.5 µm. Vacuum versions are available on request. The system use a Delta-Tau controller includes advanced algorithms for inverse kinematic transformations within a user-friendly software package.

TECHNICAL DATA

Travel range	
X, Y, Z (mm)	100 x 100 x 100 *
Rx, Ry, Rz (°)	40, 40, 60 *

Vacuum type	FV	HV
Speed max. X, Y, Z (mm/sec)	2	0.25
Speed max. Rx, Ry, Rz (°/sec)	1	0.125
Velocity Range (mm/sec)	0.001...2 **	0.001...0.25 **
Velocity Range (°/sec)	0.01...1 **	0.01...0.125 **
Weight (kg)	33	33
Bi-directional Repeatability X, Y, Z (µm)	± 4, ± 4, ± 3	± 4, ± 4, ± 3
Bi-directional Repeatability Rx, Ry, Rz (°)	± 0.002	± 0.002
Resolution, calc. without load X, Y, Z (µm)	0.016	0.016
Resolution, calc. without load (height platf.) Rx, Ry, Rz (°)	ppp.	ppp.
Resolution typical without load X, Y, Z (µm)	0.05	0.05
Resolution typical without load Rx, Ry, Rz (°)	0.00057	0.00057
Current (A)		
Voltage Range (V)		

Stiffness, theoretical Kx, Ky, Kz (N/µm)	
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: * = The maximum travel ranges in the different coordinate directions (X, Y, Z, RX, RY, RZ) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.
** = leg speed.
ppp. = depending on the pivot point position.
Please see "GLOSSARY Vacuum Specification" for all vacuum specification.

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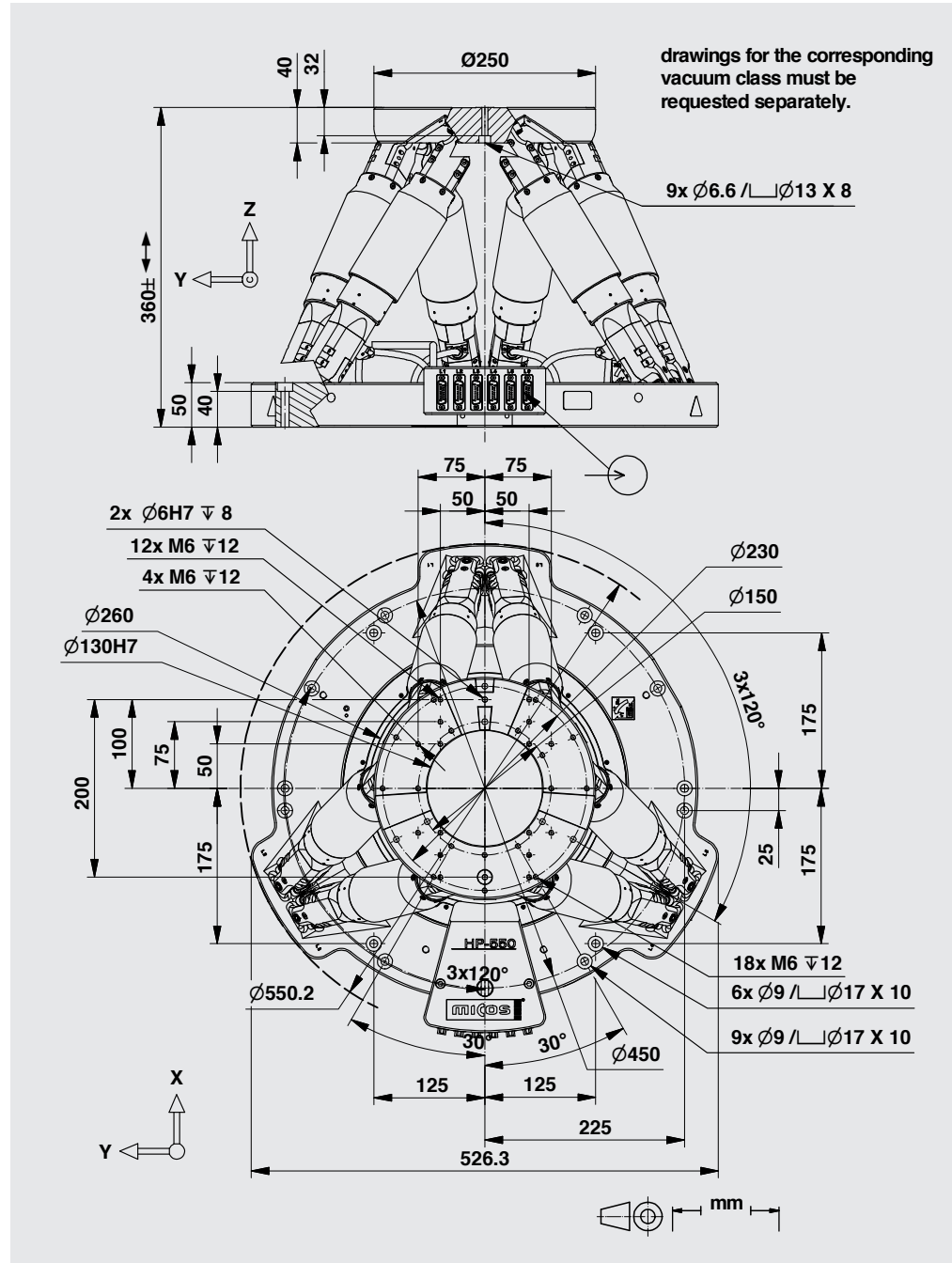
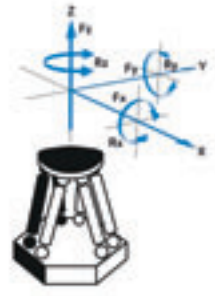


Order No.	6005-V-		1	0	0	0
FV	1					
HV	2					
UHVG (on request)	3					

3.066 Hexapod HP-430 Vacuum



FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$
FV	300	300	500
HV	300	300	500

Non-vacuum model shown

KEY FEATURES

- Vacuum up to 10-9 hPa
- Six axes Parallel Kinematic System
- Travel ranges linear (X,Y,Z) 50x50x30 mm
- Travel ranges rotation Rx, Ry 20°, Rz 40°
- Maximum speed 1 mm/sec
- Pivot Point can be set by the customer
- Load capacity central (Fx; Fy) 30 kg / (Fz) 50 kg

The HP-430 Hexapod system can perform motions in all six degrees of freedom. Due to the parallel kinematic design architecture, the system can achieve a much higher stiffness than a conventional stages stack. Typical Hexapod applications includen antenna positioning, medical research, optical systems and synchrotron setups. An optimized design ensures maximum system stiffness and spatial resolutions up to 0.5 µm. Vacuum versions are available on request. The system use a Delta-Tau controller includes advanced algorithms for inverse kinematic transformations within a user-friendly software package.

TECHNICAL DATA

Travel range	
X, Y, Z (mm)	50 x 50 x 30 *
Rx, Ry, Rz (°)	20, 20, 40 *

Vacuum type	FV	HV
Speed max. X, Y, Z (mm/sec)	1	0.125
Speed max. Rx, Ry, Rz (°/sec)	0.5	0.06
Velocity Range (mm/sec)	0.01...1 **	0.01...0.125 **
Velocity Range (°/sec)	0.001...0.5 **	0.001...0.06 **
Weight (kg)	24	24
Bi-directional Repeatability X, Y, Z (µm)	± 3, ± 3, ± 2	± 3, ± 3, ± 2
Bi-directional Repeatability Rx, Ry, Rz (°)	± 0.002	± 0.002
Resolution, calc. without load X, Y, Z (µm)	0.01	0.01
Resolution, calc. without load (height platf.) Rx, Ry, Rz (°)	ppp.	ppp.
Resolution typical without load X, Y, Z (µm)	0.5	0.5
Resolution typical without load Rx, Ry, Rz (°)	0.00057	0.00057
Current (A)		
Voltage Range (V)		

Stiffness, theoretical Kx, Ky, Kz (N/µm)	on request
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: * = The maximum travel ranges in the different coordinate directions (X, Y, Z, RX, RY, RZ) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.
** = leg speed.
ppp. = depending on the pivot point position.
Please see "GLOSSARY Vacuum Specification" for all vacuum specification.

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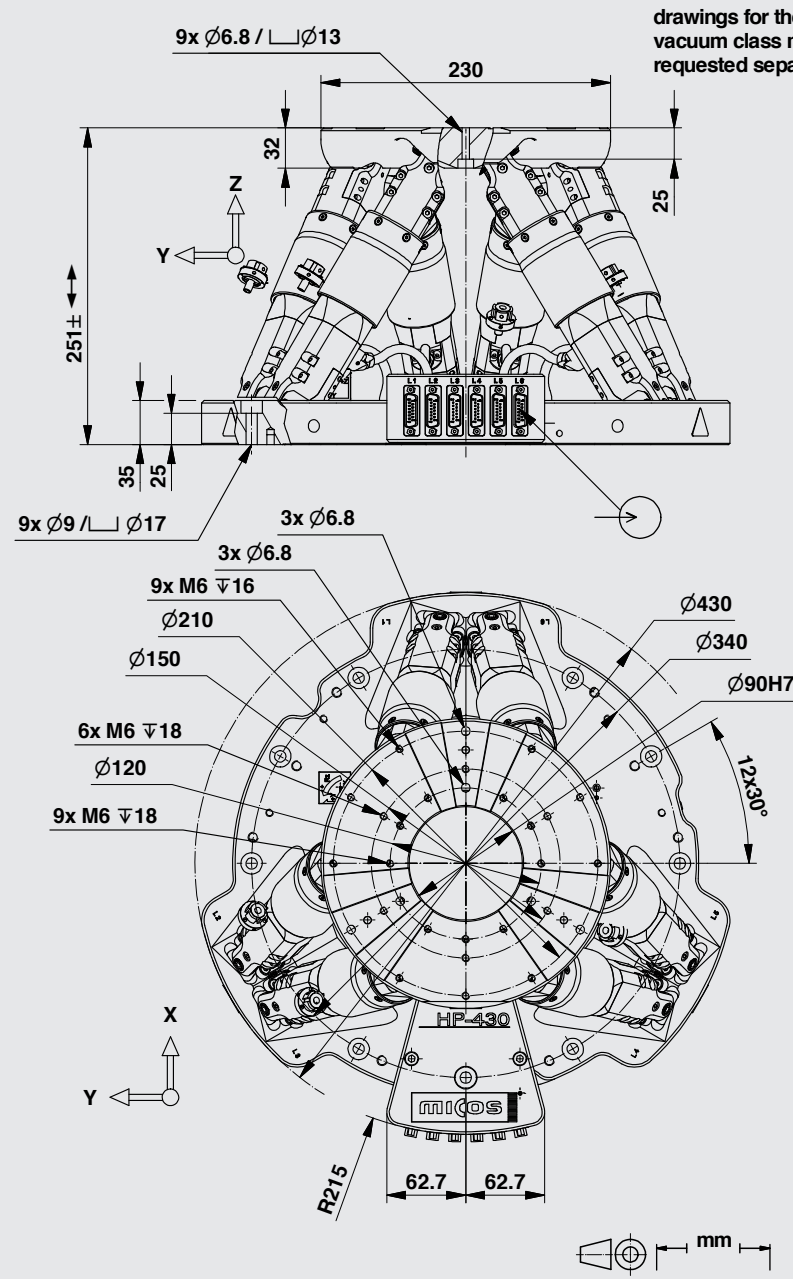
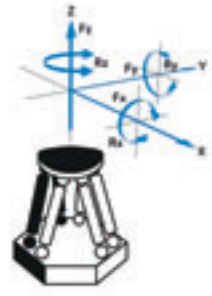


Order No.	6010-V-		1	0	0	0
FV	1					
HV	2					
UHVG (on request)	3					

3.068 Hexapod HP-300 Vacuum



FACTS

Load characteristics	$F_{x(N)}$	$F_{y(N)}$	$F_{z(N)}$
FV	40	40	100
10-6	40	40	100

Non-vacuum model shown

KEY FEATURES

- Vacuum up to 10-6 hPa
- Six axes Parallel Kinematic System
- Travel ranges linear (X,Y,Z) 44x44x30 mm
- Travel ranges rotation Rx, Ry 18°, Rz 25°
- Maximum speed 3 mm/sec
- Pivot Point can be set by the customer
- User friendly software
- Load capacity central (Fx; Fy) 4 kg / (Fz) 10 kg

With a Hexapod HP-300 system motions in all six degrees of freedom can be achieved. Due to the parallel kinematic design principle of Hexapods, a much higher system stiffness is achieved than with conventional stacked stages. The low weight of the moving platform allows highly dynamic positioning processes. Hexapods are especially suited for applications of precision positioning. The HP-300 is especially designed for applications with limited space conditions. An optimized general concept allows maximum stiffness and accuracy. The system use a Delta-Tau controller includes advance algorithms for inverse kinematic transformations within a user-friendly software packaging.

TECHNICAL DATA

Travel range	
X, Y, Z (mm)	44 x 44 x 30 *
Rx, Ry, Rz (°)	18, 18, 25 *

Vacuum type	FV	10-6
Speed max. X, Y, Z (mm/sec)	3	3
Speed max. Rx, Ry, Rz (°/sec)	2	2
Velocity Range (mm/sec)	0.01...3 **	0.01...3 **
Velocity Range (°/sec)	0.001...2 **	0.001...2 **
Weight (kg)	12	12
Bi-directional Repeatability X, Y, Z (µm)	± 3, ± 3, ± 1	± 3, ± 3, ± 1
Bi-directional Repeatability Rx, Ry, Rz (°)	± 0.0028	± 0.0028
Resolution, calc. without load X, Y, Z (µm)	0.022	0.022
Resolution, calc. without load (height platf.) Rx, Ry, Rz (°)	ppp.	ppp.
Resolution typical without load X, Y, Z (µm)	0.5	0.5
Resolution typical without load Rx, Ry, Rz (°)	0.001	0.001
Current (A)		
Voltage Range (V)		

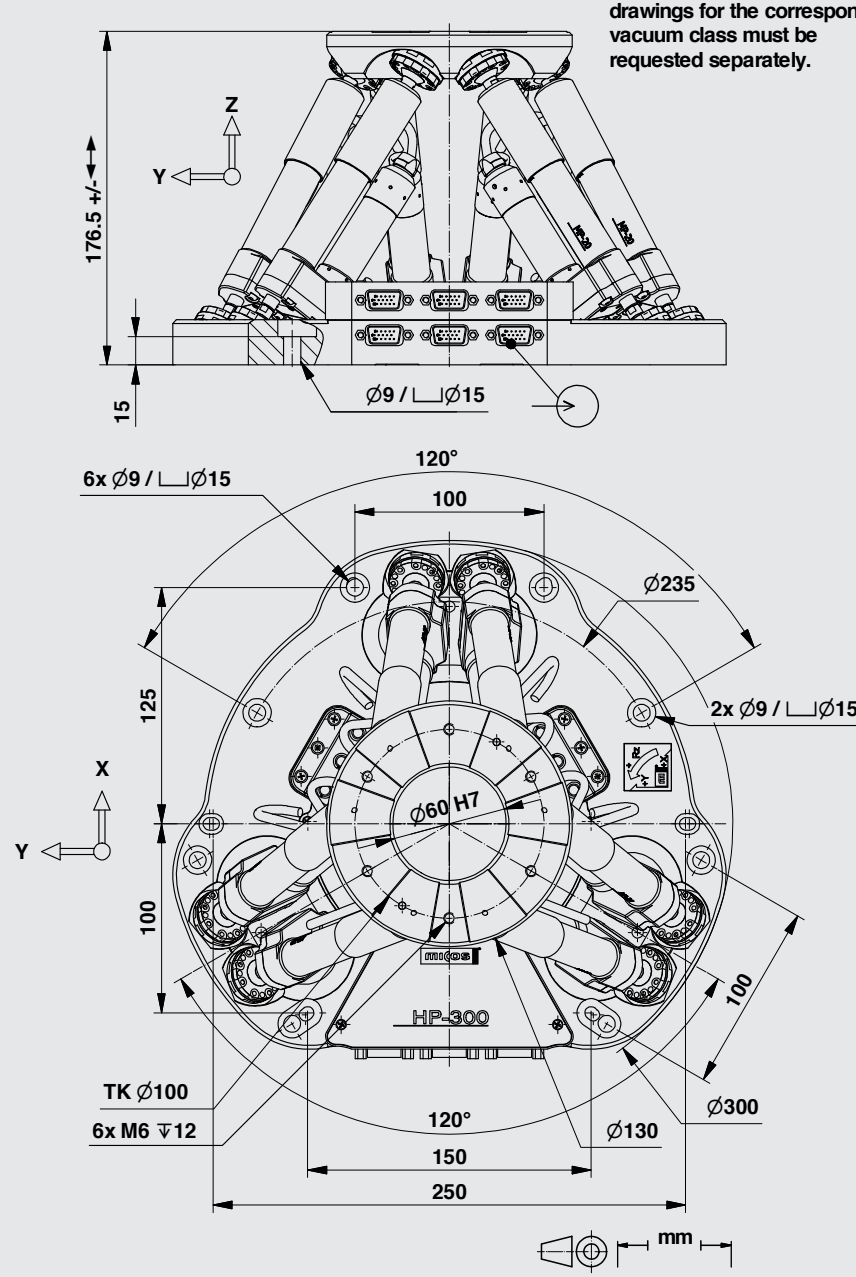
Stiffness, theoretical Kx, Ky, Kz (N/µm)	
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: * = The maximum travel ranges in the different coordinate directions (X, Y, Z, RX, RY, RZ) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.
** = leg speed.
ppp. = depending on the pivot point position.

Please see "GLOSSARY Vacuum Specification" for all vacuum specification.

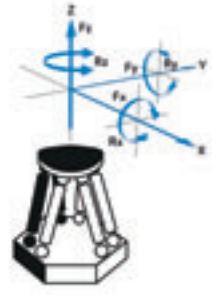
PI micos

drawings for the corresponding vacuum class must be requested separately.



Order No.	6020-V-		1	0	0	0
FV		1				
10-6		6				

3.070 Hexapod HP-140 Vacuum



FACTS

Load characteristics	$F_{x(N)}$	$F_{y(N)}$	$F_{z(N)}$
FV	20	20	50
HV	20	20	50

KEY FEATURES

- Vacuum up to 10-7 hPa
- Six axes Parallel Kinematic System
- Travel ranges linear (X,Y,Z) 32 x 32 x 12 mm
- Travel ranges rotation Rx, Ry 12°, Rz 20 °
- Maximum speed 1 mm/sec
- Pivot Point can be set by the customer
- User friendly software
- Load capacity central (Fx; Fy) 2kg / (Fz) 5 kg

With a Hexapod HP-140 system motions in all six degrees of freedom can be achieved. Due to the parallel kinematic design principle of Hexapods, a much higher system stiffness is achieved than with conventional stacked stages. The low weight of the moving platform allows highly dynamic positioning processes. Hexapods are especially suited for applications of precision positioning. Hexapods are suitable for antenna positioning, medical technology, laser technology, semiconductor technology and for optical systems. The HP-140 is especially designed for applications with limited space conditions. An optimized general concept allows maximum stiffness and accuracy. The system use a Delta-Tau controller includes advanced algorithms for inverse kinematic transformations within a user-friendly software package.

TECHNICAL DATA

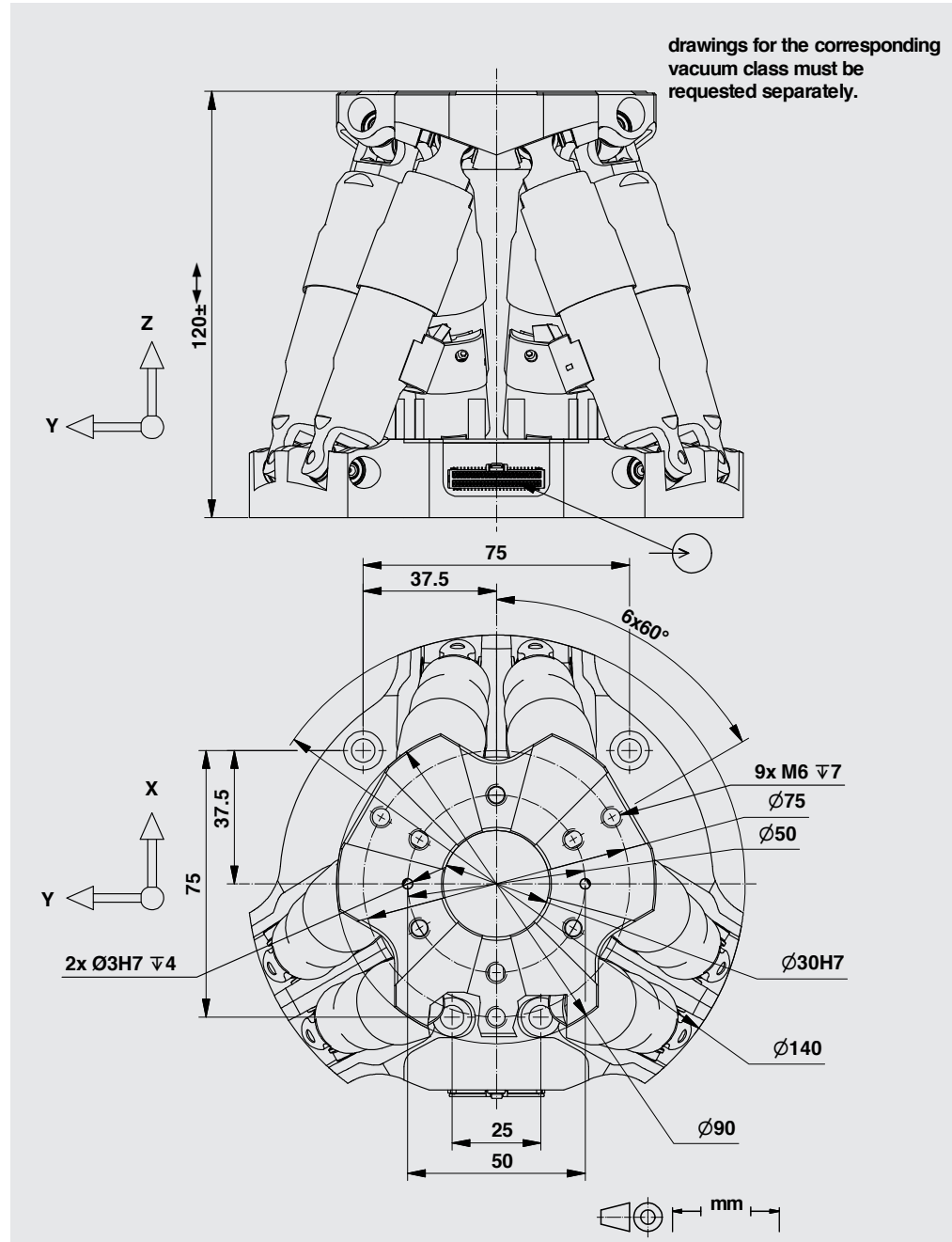
Travel range	
X, Y, Z (mm)	32 x 32 x 12 *
Rx, Ry, Rz (°)	12, 12, 20 *

Vacuum type	FV	HV
Speed max. X, Y, Z (mm/sec)	1	1
Speed max. Rx, Ry, Rz (°/sec)	0.5	0.5
Velocity Range (mm/sec)	0.01...1 **	0.01...1 **
Velocity Range (°/sec)	0.001...0.5 **	0.001...0.5 **
Weight (kg)	12	12
Bi-directional Repeatability X, Y, Z (µm)	± 3, ± 3, ± 1	± 3, ± 3, ± 1
Bi-directional Repeatability Rx, Ry, Rz (°)	± 0.003	± 0.003
Resolution, calc. without load X, Y, Z (µm)	0.0064	0.0064
Resolution, calc. without load (height platf.) Rx, Ry, Rz (°)	ppp.	ppp.
Resolution typical without load X, Y, Z (µm)	0.5	0.5
Resolution typical without load Rx, Ry, Rz (°)	0.001	0.001
Current (A)		
Voltage Range (V)		

Stiffness, theoretical Kx, Ky, Kz (N/µm)	on request
Material	Aluminum or Stainless steel, suitable for vacuum

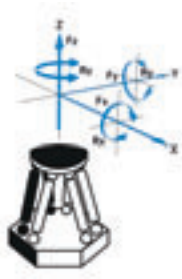
Vacuum Note: * = The maximum travel ranges in the different coordinate directions (X, Y, Z, RX, RY, RZ) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.
** = leg speed.
ppp. = depending on the pivot point position.
Please see "GLOSSARY Vacuum Specification" for all vacuum specification.

PI micos



Order No.	6030-V-		1	0	0	0
FV	1					
HV	2					
UHVG (on request)	3					

3.072 Hexapod H-811 Vacuum



FACTS

Load characteristics	$F_{x(N)}$	$F_{y(N)}$	$F_{z(N)}$
10-6	25	25	25

KEY FEATURES

- Vacuum up to 10-6 hPa
- Six axes Parallel Kinematic System
- Travel ranges linear (X,Y,Z) 34 x 32x 13 mm
- Travel ranges rotation Rx, Ry 40°, Rz 42°
- Maximum speed 10 mm/sec
- Includes integrated scan algorithms for fiber optic alignment
- Sophisticated controller using vector algorithms, virtual pivot point
- Extensive software support
- More information www.pi.ws

With a Hexapod H-811 Vacuum system motions in all six degrees of freedom can be achieved. Due to the parallel kinematic design principle of Hexapods, a much higher system stiffness is achieved than with conventional stacked stages. The low weight of the moving platform allows highly dynamic positioning processes. Hexapods are especially suited for applications of precision positioning. Hexapods are suitable for antenna positioning, medical technology, laser technology, semiconductor technology and for optical systems. The H-811 is especially designed for applications with limited space conditions. An optimized general concept allows maximum stiffness and accuracy.The system use a digital controller with an open software architecture.The system is equipped with open source LabVIEW driver set and macro programming.

TECHNICAL DATA

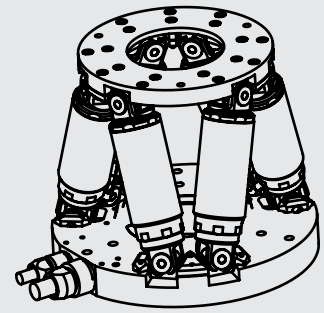
Travel range	
X, Y, Z (mm)	34 x 32 x 13 *
Rx, Ry, Rz (°)	20, 20, 42 *

Vacuum type	10-6
Speed max. X, Y, Z (mm/sec)	10
Speed max. Rx, Ry, Rz (°/sec)	15
Velocity Range (mm/sec)	0.05...10 **
Velocity Range (°/sec)	0.08...15 **
Weight (kg)	2.2
Bi-directional Repeatability X, Y, Z (µm)	± 0.6, ± 0.6, ± 0.2
Bi-directional Repeatability Rx, Ry, Rz (°)	± 0.00045
Resolution, calc. without load X, Y, Z (µm)	0.04
Resolution, calc. without load (height platf.) Rx, Ry, Rz (°)	ppp.
Resolution typical without load X, Y, Z (µm)	0.2
Resolution typical without load Rx, Ry, Rz (°)	0.0002
Current (A)	
Voltage Range (V)	

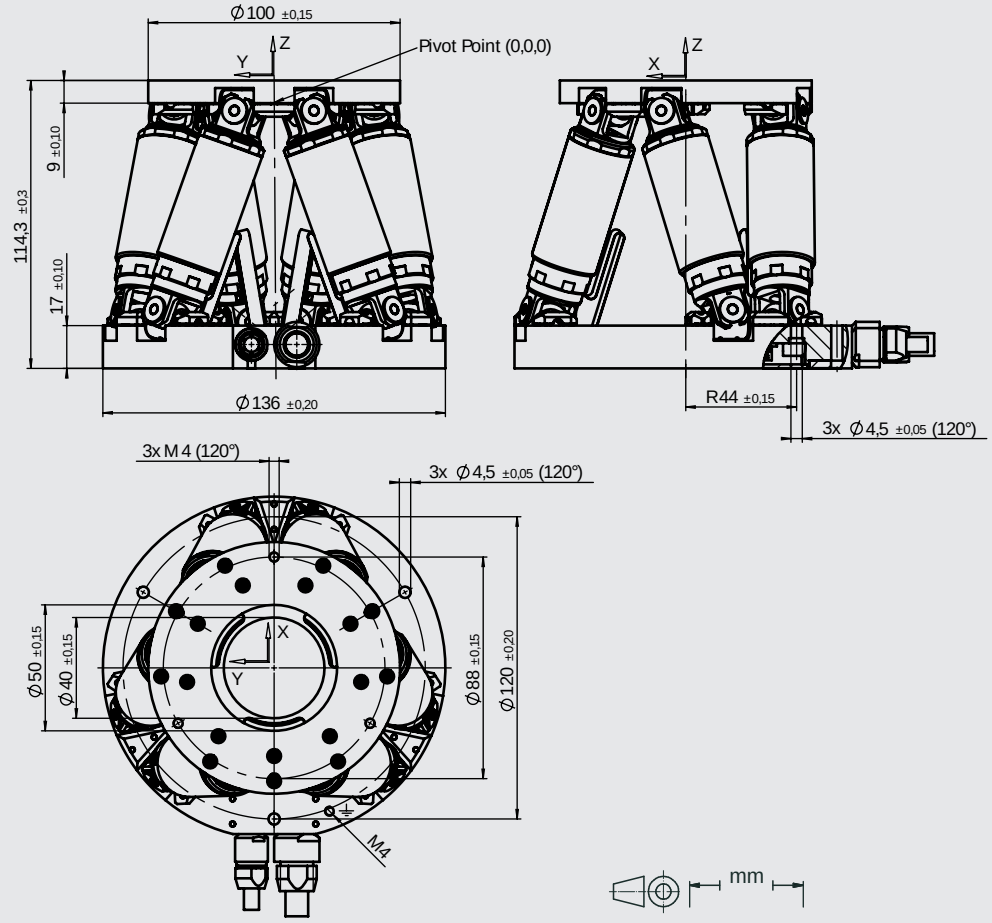
Stiffness, theoretical Kx, Ky, Kz (N/µm)	
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: ppp. = The maximum travel ranges in the different coordinate directions (X, Y, Z, RX, RY, RZ) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.
ppp. = depending on the pivot point position.
** = leg speed
Please see more information at www.pi.ws

PI micos

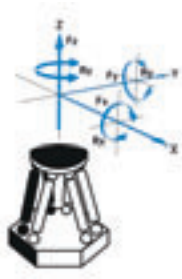


drawings for the corresponding
vacuum class must be requested separately.



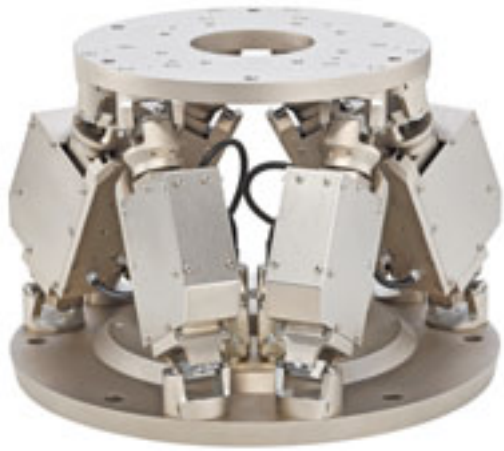
Order No. H-811

3.074 Hexapod H-824 Vacuum



FACTS

Load characteristics	$F_{x(N)}$	$F_{y(N)}$	$F_{z(N)}$
10-6	25	25	25



KEY FEATURES

- Vacuum up to 10-6 hPa
- Six axes Parallel Kinematic System
- Travel ranges linear (X,Y,Z) 45 x 45x 25 mm
- Travel ranges rotation Rx, Ry 15°, Rz 25°
- Maximum speed 0.5 mm/sec
- Load capacity to 2.5 kg
- Includes integrated scan algorithms for fiber optic alignment
- Sophisticated controller using vector algorithms, virtual pivot point
- Extensive software support
- More information www.pi.ws

With a Hexapod H-824 Vacuum system motions in all six degrees of freedom can be achieved. Due to the parallel kinematic design principle of Hexapods, a much higher system stiffness is achieved than with conventional stacked stages. The low weight of the moving platform allows highly dynamic positioning processes. Hexapods are especially suited for applications of precision positioning. Hexapods are suitable for antenna positioning, medical technology, laser technology, semiconductor technology and for optical systems. The H-824 is especially designed for applications with limited space conditions. An optimized general concept allows maximum stiffness and accuracy.The system use a digital controller with an open software architecture.The system is equipped with open source LabVIEW driver set and macro programming.

TECHNICAL DATA

Travel range	
X, Y, Z (mm)	45 x 45 x 25 *
Rx, Ry, Rz (°)	15, 15, 25 *

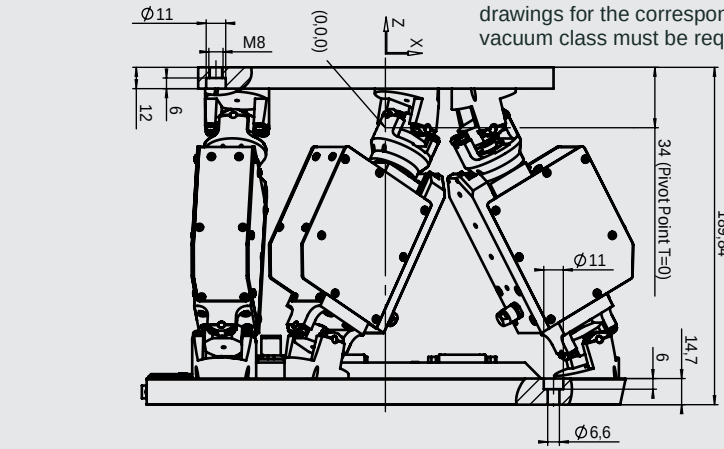
Vacuum type	10-6
Speed max. X, Y, Z (mm/sec)	0.5
Speed max. Rx, Ry, Rz (°/sec)	0.3
Velocity Range (mm/sec)	0.01...0.5 **
Velocity Range (°/sec)	0.05...0.3 **
Weight (kg)	8
Bi-directional Repeatability X, Y, Z (µm)	± 1, ± 1, ± 0.2
Bi-directional Repeatability Rx, Ry, Rz (°)	± 0.0022
Resolution, calc. without load X, Y, Z (µm)	0.007
Resolution, calc. without load (height platf.) Rx, Ry, Rz (°)	ppp.
Resolution typical without load X, Y, Z (µm)	0.3
Resolution typical without load Rx, Ry, Rz (°)	0.0002
Current (A)	
Voltage Range (V)	

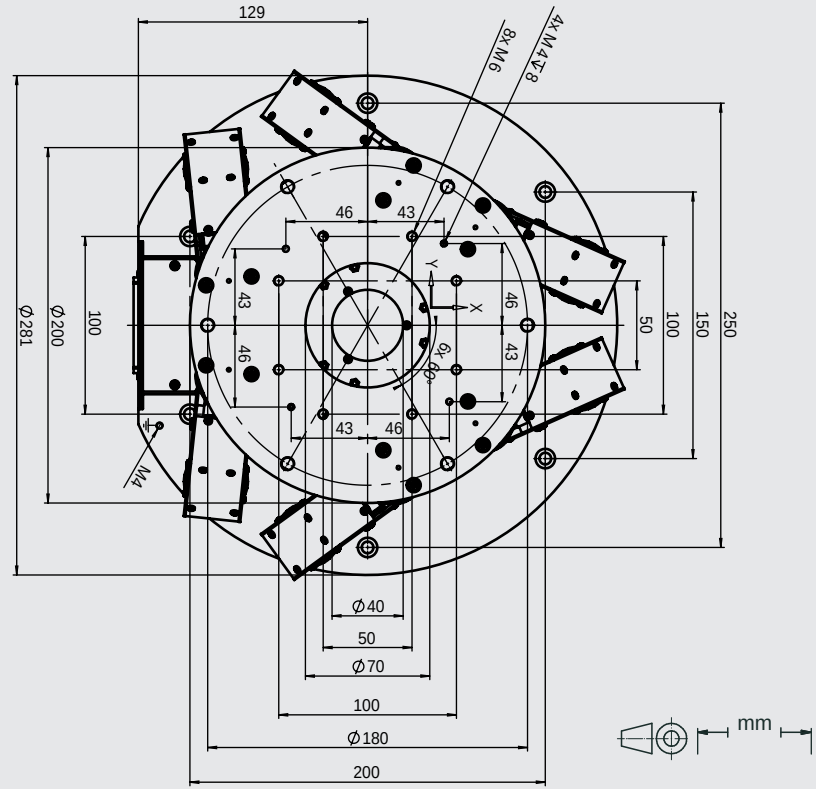
Stiffness, theoretical Kx, Ky, Kz (N/µm)	
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: ppp. = The maximum travel ranges in the different coordinate directions (X, Y, Z, RX, RY, RZ) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.
ppp. = depending on the pivot point position.
** = leg speed
Please see more information at www.pi.ws

PI micos

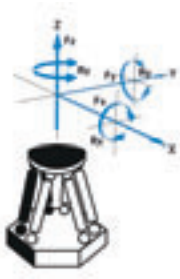
drawings for the corresponding vacuum class must be requested separately.





Order No. H-824

3.076 Hexapod H-850 Vacuum



FACTS

Load characteristics	$F_{x(N)}$	$F_{y(N)}$	$F_{z(N)}$
10-6	400	400	400

KEY FEATURES

- Vacuum up to 10-6 hPa
- Six axes Parallel Kinematic System
- Travel ranges linear (X,Y,Z)100 x 100x 50 mm
- Travel ranges rotation Rx, Ry 30°, Rz 60°
- Maximum speed 0,15 mm/sec
- Load capacity up to 40 kg
- Includes integrated scan algorithms for fiber optic alignment
- Sophisticated controller using vector algorithms, virtual pivot point
- Extensive software support
- More information www.pi.ws

With a Hexapod H-850 Vacuum system motions in all six degrees of freedom can be achieved. Due to the parallel kinematic design principle of Hexapods, a much higher system stiffness is achieved than with conventional stacked stages. The low weight of the moving platform allows highly dynamic positioning processes. Hexapods are especially suited for applications of precision positioning.

Hexapods are suitable for antenna positioning, medical technology, laser technology, semiconductor technology and for optical systems. The H-850 is especially designed for applications with limited space conditions. An optimized general concept allows maximum stiffness and accuracy.The system use a digital controller with an open software architecture.The system is equipped with open source LabVIEW driver set and macro programming.

TECHNICAL DATA

Travel range	
X, Y, Z (mm)	100 x 100 x 50 *
Rx, Ry, Rz (°)	30, 30, 60 *

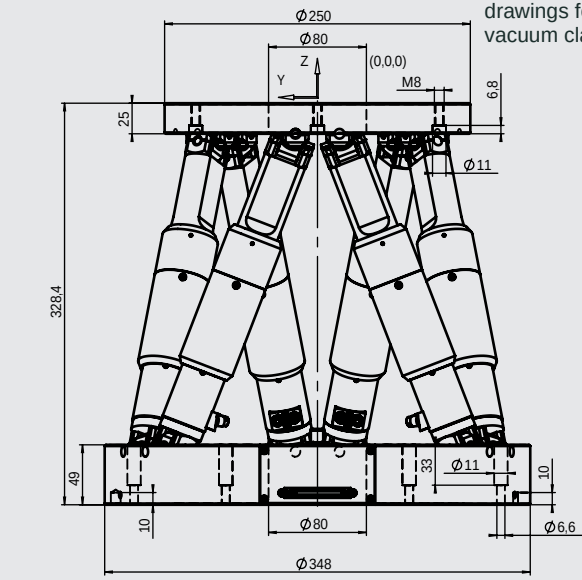
Vacuum type	10-6
Speed max. X, Y, Z (mm/sec)	0.15
Speed max. Rx, Ry, Rz (°/sec)	0.1
Velocity Range (mm/sec)	0.005...0.15 **
Velocity Range (°/sec)	0.02...0.1 **
Weight (kg)	17
Bi-directional Repeatability X, Y, Z (µm)	± 2, ± 2, ± 4
Bi-directional Repeatability Rx, Ry, Rz (°)	± 0.0023
Resolution, calc. without load X, Y, Z (µm)	0.005
Resolution, calc. without load (height platf.) Rx, Ry, Rz (°)	ppp.
Resolution typical without load X, Y, Z (µm)	2
Resolution typical without load Rx, Ry, Rz (°)	0.0005
Current (A)	
Voltage Range (V)	

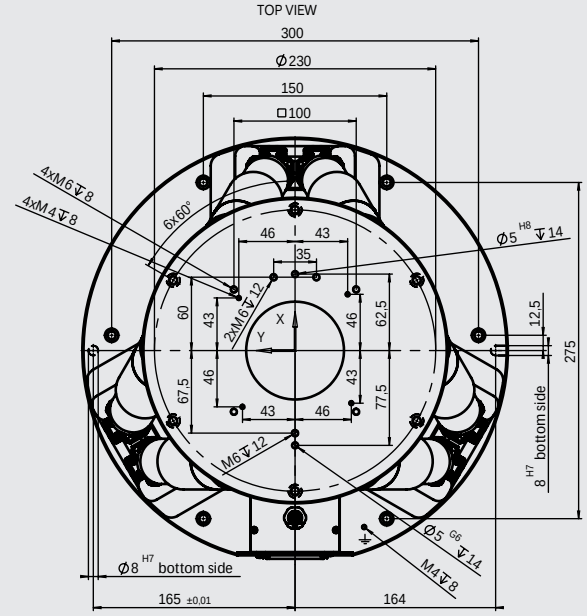
Stiffness, theoretical Kx, Ky, Kz (N/µm)	
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: ppp. = The maximum travel ranges in the different coordinate directions (X, Y, Z, RX, RY, RZ) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.
ppp. = depending on the pivot point position.
** = leg speed
Please see more information at www.pi.ws

PI micos

drawings for the corresponding vacuum class must be requested separately.





mm

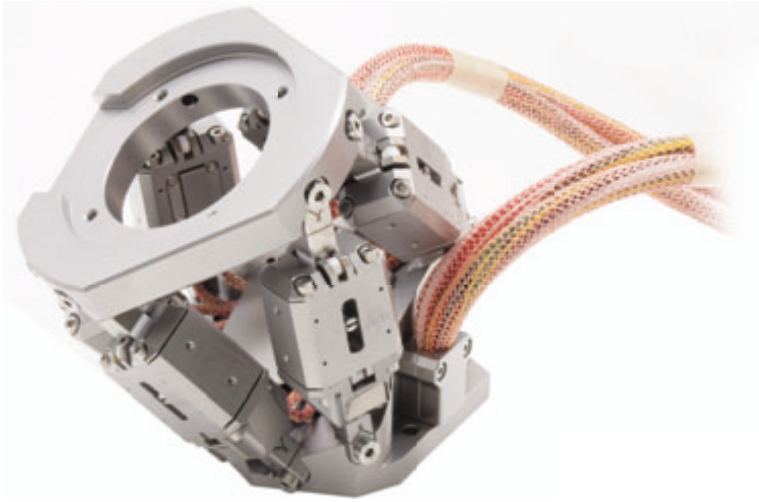
Order No. H-850

3.078 Hexapod P-911KNMV Vacuum

V

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$
UHV	15	15	15	1	1	1



The space-saving parallel-kinematic design allows for the low overall height of less than 90 mm and a diameter of only 100 mm. NEXLINE® piezo stepping motor drives and integrated incremental sensors ensure a position resolution down to 0.1 µm in the linear axes.The system includes a dedicated digital controller with integrated drive electronics for NEXLINE® piezo motors.

KEY FEATURES

- UHV-compatible to 10-9 hPa
- Nonmagnetic
- Customized model
- Ultra-compact
- Ultra-high precision flexure joints
- Load capacity to 1.5 kg
- Travel ranges (X,Y,Z) up to 1.5 mm Rx, Ry 2° Rz 0°
- With NEXLINE® piezo stepping drives
- All product details, see www.pi.ws

TECHNICAL DATA

Travel range	
X, Y, Z (mm)	1.5 x 1.5 x 1.5 *
Rx, Ry, Rz (°)	2, 2, 0 *

Vacuum type	UHV
Speed max. X, Y, Z (mm/sec)	
Speed max. Rx, Ry, Rz (°/sec)	
Velocity Range (mm/sec)	
Velocity Range (°/sec)	
Weight (kg)	
Bi-directional Repeatability X, Y, Z (µm)	
Bi-directional Repeatability Rx, Ry, Rz (°)	
Resolution, calc. without load X, Y, Z (µm)	
Resolution, calc. without load (height platf.) Rx, Ry, Rz (°)	
Resolution typical without load X, Y, Z (µm)	
Resolution typical without load Rx, Ry, Rz (°)	
Current (A)	
Voltage Range (V)	

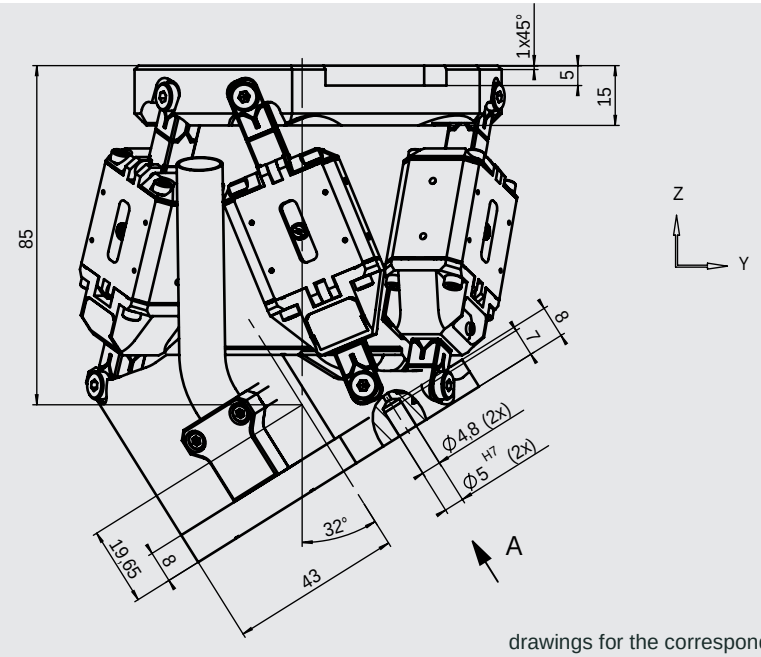
on request

Stiffness, theoretical Kx, Ky, Kz (N/µm)	
Material	Aluminum or Stainless steel, suitable for vacuum

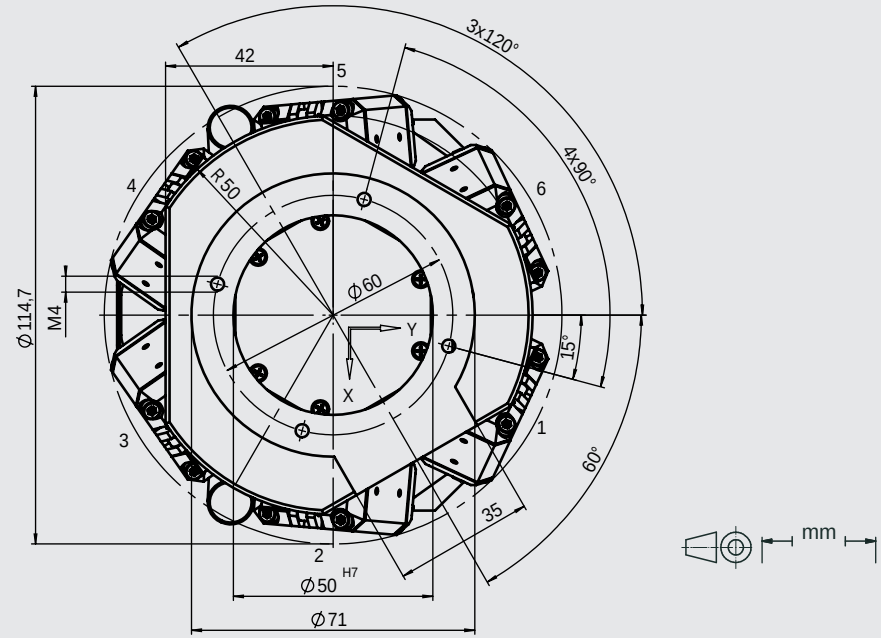
Vacuum Note: * The maximum travel ranges in the different coordinate directions (X, Y, Z, RX, RY, RZ) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.

Please see more information at www.pi.ws

PI micos



drawings for the corresponding
vacuum class must be requested separately.



Order No. P-911KNMV

LINEAR STAGES

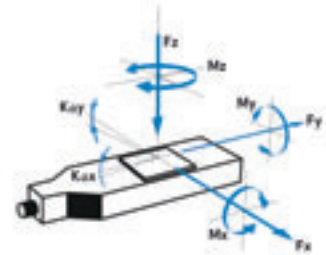
4.082 Ultra Precision Elevation Stage UPM-160 Vacuum

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	150	100	350	100	200	100	5	3
HV	150	100	350	100	200	100	5	3
UHVG	150	100	350	100	200	100	5	3

KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range up to 205 mm (8")
- Uni-directional repeatability down to 0.035 µm
- Maximum speed 6 mm/sec
- Load capacity up to 35 kg
- Integrated limit switches
- Integrated linear scale (center mounted)



The UPM-160 Vacuum ultra-precision linear stage was specifically designed for wafer inspection, fiber alignment or for any other tasks where the highest positioning accuracy and reliability are absolutely mandatory. All UPM-160 Vacuum stages are equipped with an integrated linear scale that is center mounted between the guides. High-quality cross-roller bearings mounted on a stress-relieved tempered aluminum-alloy body guarantee maximum load capacity and smooth motion. The UPM-160 Vacuum stage is offered with a special 2-phase stepper vacuum motor and is equipped with two limit switches. All ultra precision linear stages are supplied with a certificate of performance (flatness, straightness & accuracy).

TECHNICAL DATA

Travel range (mm)	52	105	155	205
Straightness / Flatness (µm)	± 0.5	± 0.75	± 1	± 1.25
Pitch (µrad)	± 15	± 20	± 25	± 30
Yaw (µrad)	± 20	± 20	± 20	± 20
Weight (kg)	5	6	7	8

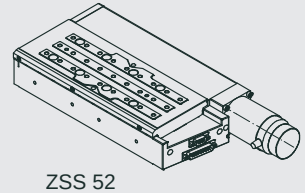
Vacuum type	FV	HV	UHVG	
Linear scale				FV
Speed max. (mm/sec)	6	2	2	
Resolution calculated (µm)	5 (FS)	12.5 (FS)	12.5 (FS)	0.05
Resolution typical (µm)				0.04
Bi-directional Repeatability (µm)				± 0.05
Uni-directional Repeatability (µm)				0.05
Nominal Current (A)	2.5	2.5	2.5	

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 6
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

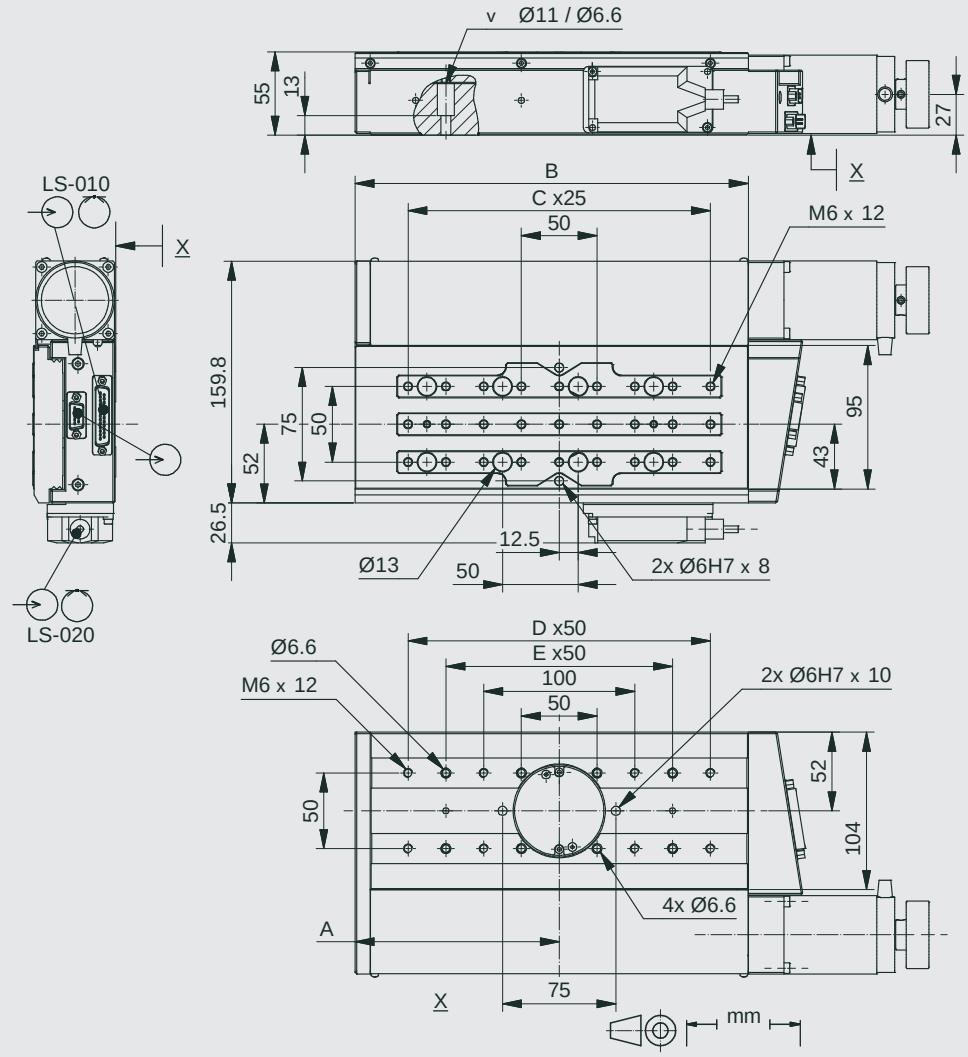
PI micos

Travel (mm)	52	105	155	205
A	110	135	160	185
B	210	260	310	360
C	6	8	10	12
D	-	4	4	6
E	3	3	5	5



ZSS 52

drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
ZSS 52.200.1.2-E for FV
VSS 52.200.1.2-E for HV & UHVG



Order No.	6270-V-				0	0
FV	1					
HV	2					
UHVG	3					
55 mm (2")		1				
105 mm (4")		2				
155 mm (6")		3				
205 mm (8")		4				
open loop			0			
closed loop			1			

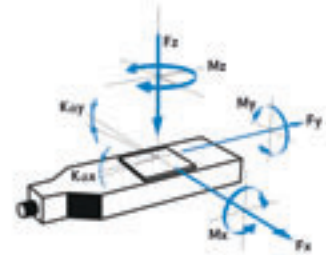
4.084 High Precision Stage HPS-170 Vacuum

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	150	150	350	300	400	300	12	8
HV	150	150	350	300	400	300	12	8
UHVG	150	150	350	300	400	300	12	8

KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range up to 305 mm (12")
- Uni-directional repeatability down to 0.05 µm
- Maximum speed 10 mm/sec
- Load capacity up to 35 kg
- Integrated limit switches
- Option: linear scale (center mounted)



The HPS-170 Vacuum precision stage was developed to meet the demands of high precision positioning. Due to its precise and smooth operation this linear stage is perfectly suited for measuring and inspection equipment. High-quality cross-roller bearings mounted on a stress-relieved, tempered aluminum alloy body guarantee maximum load capacity and long-time stability. The HPS-170 Vacuum stage is equipped with a special 2-phase stepper vacuum motor and with limit switches. A linear scale with a resolution of less than 0.05 µm is optional. Optical and inductive limit switches as well as a certificate of performance can be supplied on request.

TECHNICAL DATA

Travel range (mm)	52	102	155	205	305
Straightness / Flatness (µm)	± 0.75	± 1	± 2	± 3	± 4
Pitch (µrad)	± 20	± 25	± 30	± 35	± 40
Yaw (µrad)	± 40	± 40	± 40	± 40	± 40
Weight (kg)	5	5.5	6	6.5	7

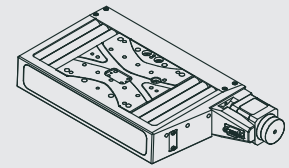
Vacuum type	FV	HV	UHVG		
Linear scale				FV	UHV
Speed max. (mm/sec)	10	4	4		
Resolution calculated (µm)	10 (FS)	10 (FS)	10 (FS)	0.05	0.05
Resolution typical (µm)	0.1	0.1	0.1	0.05	0.05
Bi-directional Repeatability (µm)	± 1	± 1	± 1	± 0.05	± 0.05
Uni-directional Repeatability (µm)	0.2	0.2	0.2	0.05	0.05
Nominal Current (A)	1.5	1.2	1.2		

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 10
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

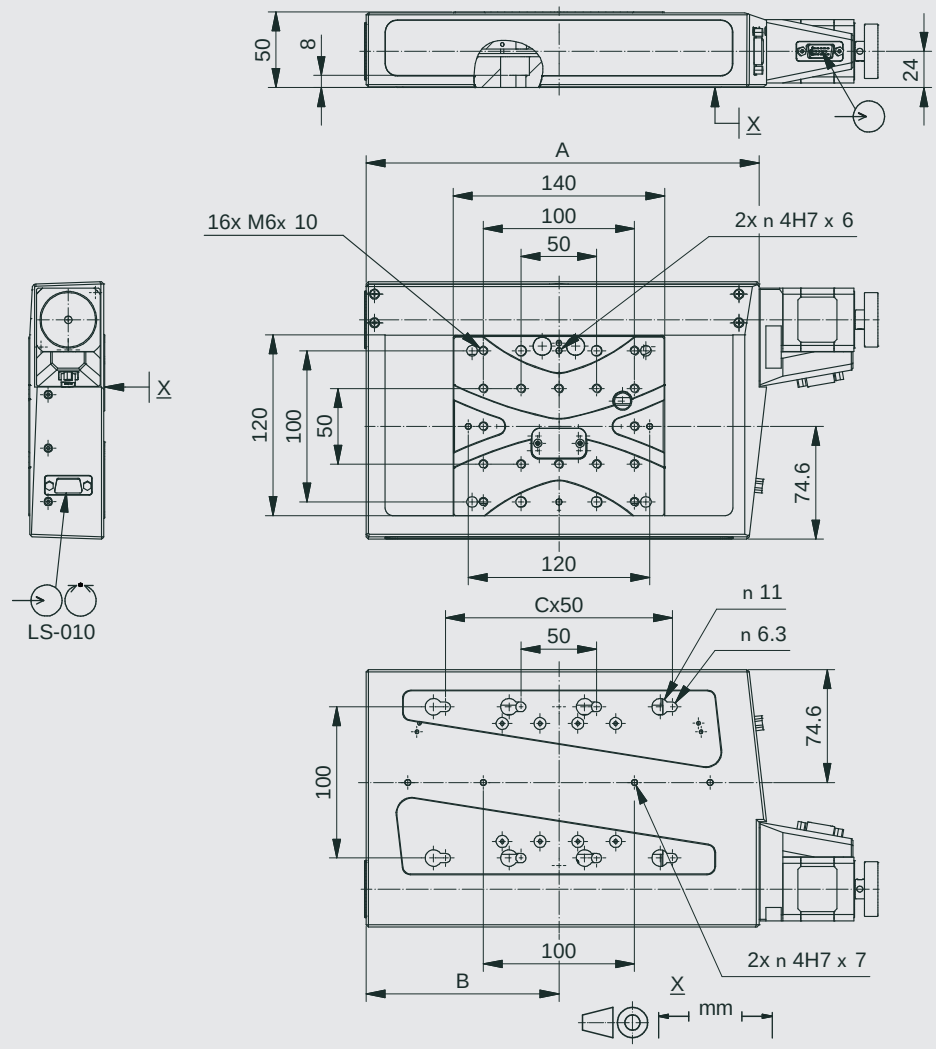
PI micos

Travel (mm)	52	102	155	205	305
A	261	311	381	456	556
B	127,5	152,5	187,5	225	275
C	3	3	5	6	7



PK246

drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
PK246 for FV
VSS 43.200.1.2-E for HV & UHVG

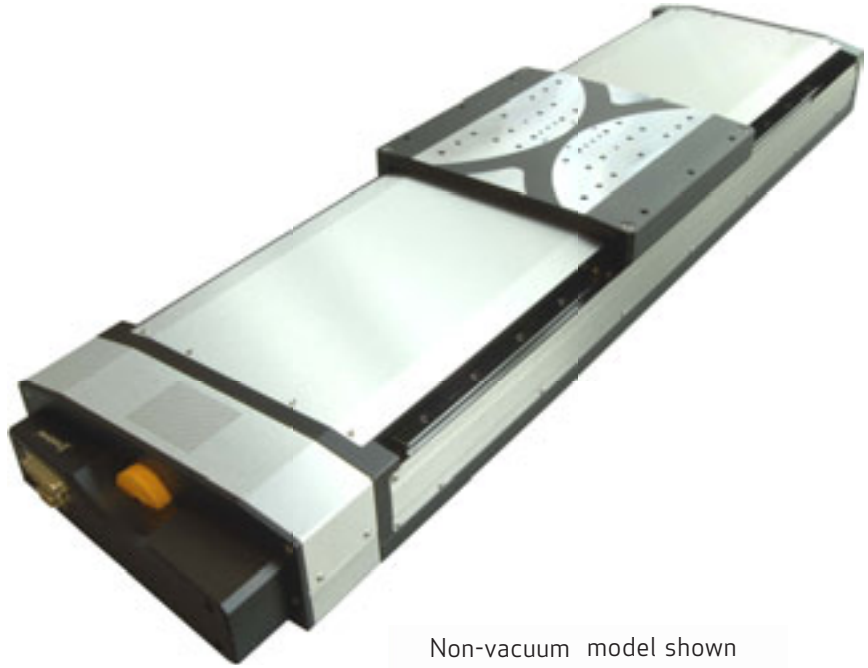


Order No.	6262-V-				0	0
FV	1					
HV	2					
UHVG	3					
52 mm (2")		1				
102 mm (4")		2				
155 mm (6")		3				
205 mm (8")		4				
305 mm (12")		5				
open loop					0	
closed loop					1	

4.086 Linear Stage LS-270 Vacuum

FACTS

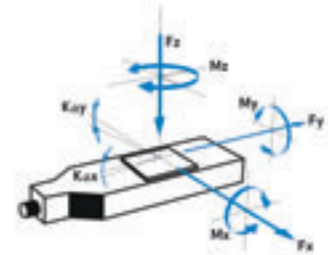
Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	1200	260	1500	250	280	250	3.2	1.6
HV	1200	260	1500	250	280	250	3.2	1.6
UHVG	1200	260	2500	250	280	250	3.2	1.6



Non-vacuum model shown

KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range up to 1016 mm (40")
- Uni-directional repeatability down to 0.05 µm
- Maximum speed 15 mm/sec
- Load capacity up to 150 kg
- Integrated limit switches
- Option: linear scale (center mounted)



The LS-270 Vacuum linear stage was developed for positioning high loads. Cross-roller bearings mounted on a rigid tempered aluminum-alloy body guarantee very high guiding stiffness and long operating life. The ball screw with 5 mm pitch allows velocities up to 15 mm/s. For demanding positioning tasks the LS-270 Vacuum linear stages can be supplied with a linear scale which is centrally installed between the guides. The LS-270 Vacuum linear stages is equipped with a special 2-phase vacuum stepper motor and have two limit switches.

TECHNICAL DATA

Travel range (mm)	155	305	508	815	1015
Straightness / Flatness (µm)	± 1.5	± 3	± 4	± 7	± 10
Pitch (µrad)	± 20	± 40	± 80	± 100	± 120
Yaw (µrad)	± 20	± 20	± 30	± 40	± 50
Weight (kg)	25	29	35	43	50

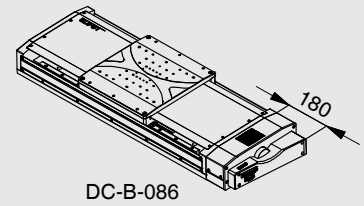
Vacuum type	FV	HV	UHVG		
Linear scale				FV	UHV
Speed max. (mm/sec)	15	6	6		
Resolution calculated (µm)	12.5 (FS)	25 (FS)	25 (FS)	0.05	0.05
Resolution typical (µm)	0.4	0.4	0.4	0.05	0.05
Bi-directional Repeatability (µm)	± 2.5	± 2.5	± 2.5	± 0.04	± 0.04
Uni-directional Repeatability (µm)	0.4	0.4	0.4	0.05	0.05
Nominal Current (A)	2	5	5		

Accuracy	on request
Velocity range (mm/sec)	0.01 ... 15
Material	Aluminum or Stainless steel, suitable for vacuum

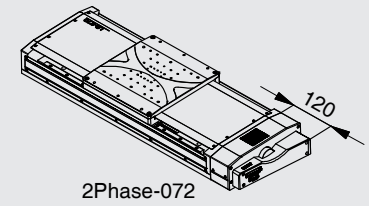
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos

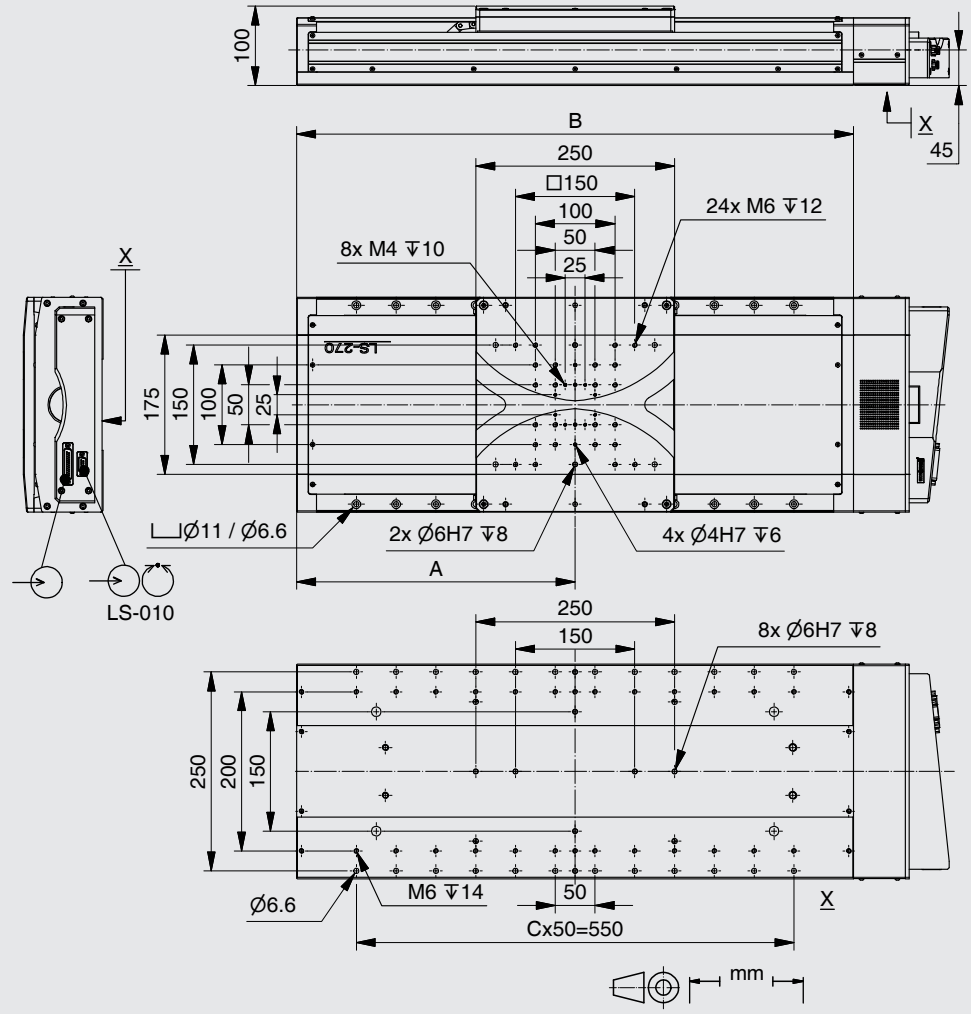
Travel (mm)	155	305	508	815	1015
A	275	350	450	600	700
B	550	700	900	1200	1400
C	9	11	15	21	25



DC-B-086



2Phase-072

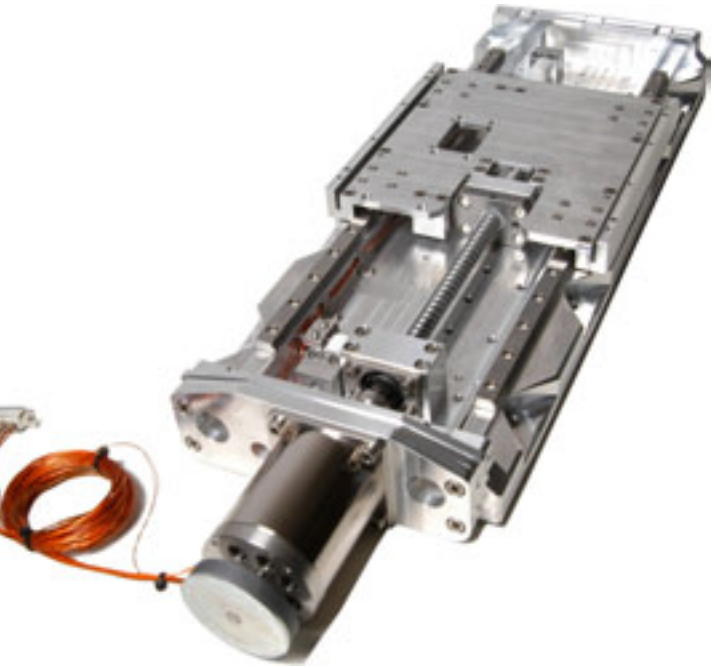


Order No.	6239-V-				0	0
FV	1					
HV	2					
UHVG	3					
155 mm (6")		1				
305 mm (12")		2				
508 mm (20")		3				
815 mm (32")		4				
1016 mm (40")		5				
open loop					0	
closed loop					1	

4.088 Linear Stage LS-180 Vacuum

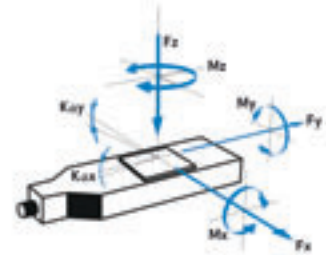
FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	500	250	1000	132	400	125	60	50
HV	300	150	100	132	400	125	60	50
UHVG	300	150	100	132	400	125	60	50



KEY FEATURES

- Vacuum up 10-9 hPa
- Travel range up to 610 mm (24")
- Uni-directional repeatability down to 0.05 µm
- Maximum speed 25 mm/sec
- Load capacity up to 100 kg
- Integrated inductive limit switches
- Option: linear scale (center mounted)



The LS-180 Vacuum linear stage was developed for industrial applications. Re-circulating ball guides mounted on a rigid tempered aluminum-alloy body guarantee a very high guiding stiffness and long operating life. The ball screw with 5 mm pitch allows velocities up to 25 mm/s. For demanding positioning tasks the linear stages LS-180 Vacuum can be supplied with a linear scale which is centrally installed between the guides. The LS-180 Vacuum linear stages is equipped with a special 2-phase vacuum stepper motor and are supplied with two limit switches.

TECHNICAL DATA

Travel range (mm)	155	205	305	408	508
Straightness / Flatness (µm)	± 2	± 3	± 4	± 5	± 6
Pitch (µrad)	± 40	± 50	± 60	± 70	± 80
Yaw (µrad)	± 50	± 50	± 50	± 50	± 50
Weight (kg)	8.4	8.8	9.6	10.2	10.8

Vacuum type	FV	HV	UHVG		
Linear scale				FV	UHV
Speed max. (mm/sec)	25	9	9		
Resolution calculated (µm)	25 (FS)	25 (FS)	25 (FS)	0.05	0.05
Resolution typical (µm)	0.5	0.5	0.5	0.05	0.05
Bi-directional Repeatability (µm)	± 2.5	± 2.5	± 2.5	± 0.1	± 0.1
Uni-directional Repeatability (µm)	0.5	0.5	0.5	0.05	0.05
Nominal Current (A)	2	2.5	2.5		

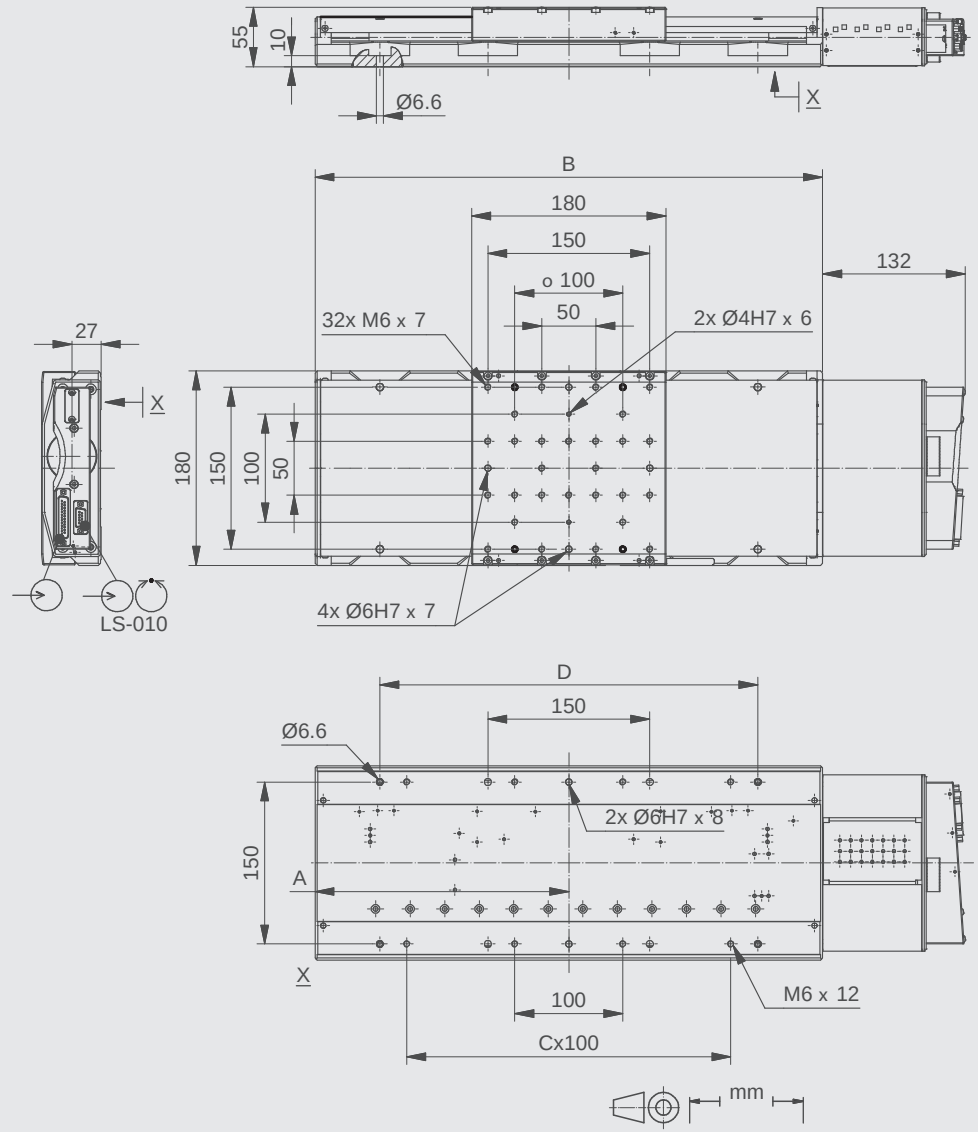
Accuracy	on request
Velocity range (mm/sec)	0.001 ... 25
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos

Travel (mm)	155	205	305	408	508
A	235	260	310	360	410
B	470	520	620	720	820
C	3	3	5	5	5
D	350	350	450	550	650

drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
PK258 for FV
VSS 57 for HV & UHVG

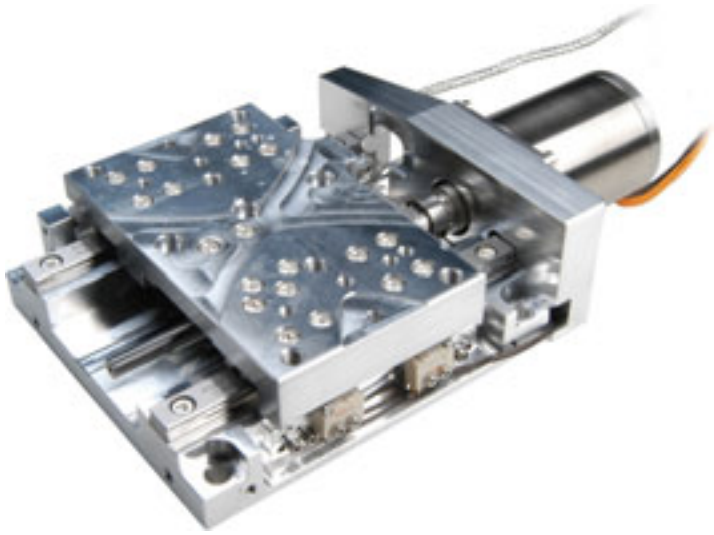


Order No.	6240-V-				0	0
FV	1					
HV	2					
UHVG	3					
155 mm (6")		1				
205 mm (8")		2				
305 mm (12")		3				
408 mm (16")		4				
508 mm (20")		5				
open loop					0	
closed loop					1	

4.090 Linear Stage LS-120 Vacuum

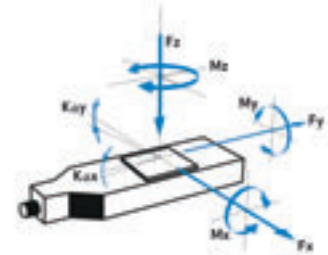
FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	50	80	100	30	60	33	40	30
HV	50	80	100	30	60	33	40	30
UHVG	50	80	100	30	60	33	40	30



KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range up to 40 mm (xy setup by PI miCos)
- Maximum speed 15 mm/sec
- Load capacity up to 10 kg
- Integrated limit switches
- Option: linear scale (center mounted)



The LS-120 Vacuum linear stage is suited for high precision applications with limited space conditions. High rigidity within a compact package is achieved by using re-circulating linear ball bearings mounted within a highly rigid, tempered aluminum-alloy stage body. The linear stage is driven by a re-circulating ball screw h and can be supplied with a linear scale which is centrally installed between the guides. The LS-120 Vacuum linear stages is equipped with a special 2-phase vacuum stepper motor.

TECHNICAL DATA

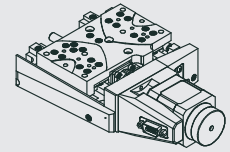
Travel range (mm)	40
Straightness / Flatness (µm)	± 1.5
Pitch (µrad)	± 40
Yaw (µrad)	± 40
Weight (kg)	1.8

Vacuum type	FV	HV	UHVG		
Linear scale				FV	UHV
Speed max. (mm/sec)	15	5	5		
Resolution calculated (µm)	10 (FS)	10 (FS)	10 (FS)	0.05	0.05
Resolution typical (µm)	0.2	0.2	0.2		
Bi-directional Repeatability (µm)	± 1	± 1	± 1		
Uni-directional Repeatability (µm)	0.2	0.2	0.2		
Nominal Current (A)	1.2	1.2	1.2		

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 15
Material	Aluminum or Stainless steel, suitable for vacuum

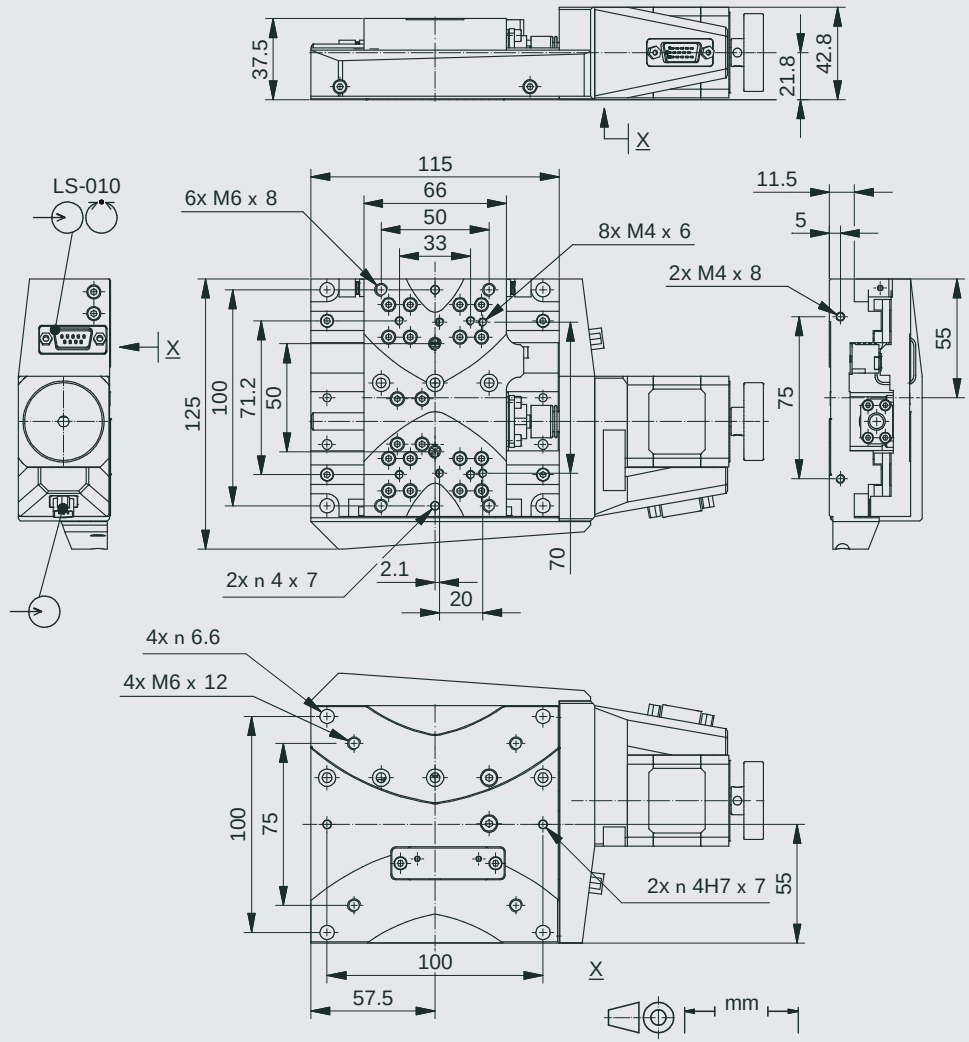
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI miCos



PK245

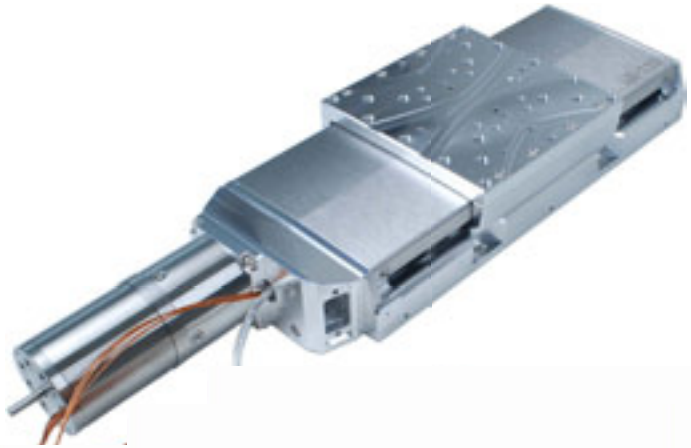
drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
PK245 for FV
VSS 42.200.1.2-E for HV & UHVG

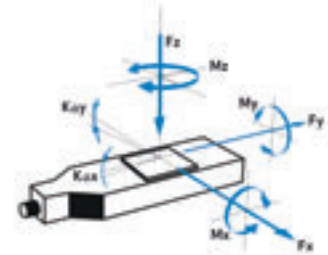


Order No.	6237-V-				0	0
FV	1					
HV	2					
UHVG	3					
40 mm (1.5")		1				
open loop				0		
closed loop				1		

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	50	80	100	30	60	33	50	40
HV	50	80	100	30	60	33	50	40
UHVG	50	80	100	30	60	33	50	40





The LS-110 Vacuum linear stage series is especially suited for industrial laser treatment. Linear guides with re-circulating linear ball bearings guarantee very high guiding stiffness. Driven by a re-circulating ball screw with 2 mm pitch, the LS-110 Vacuum can be mounted in any orientation. For demanding positioning tasks, the LS-110 Vacuum linear stages can be supplied with a linear scale which is centrally installed between the guides. The LS-110 Vacuum is equipped with a special 2-phase vacuum stepper motor and is equipped with limit switches.

KEY FEATURES

- Vacuum upt 10-9 hPa
- Travel range up to 508 mm (20")
- Uni-directional repeatability down to 0.05 µm
- Maximum speed15 mm/sec
- Load capacity up to 10 kg
- Integrated mechanical limit switches
- Option: linear scale (center mounted)

TECHNICAL DATA

Travel range (mm)	26	52	77	102	155	190	255	305	508
Straightness / Flatness (µm)	± 1	± 1.5	± 2	± 2.5	± 3	± 3.5	± 4	± 5	± 6
Pitch (µrad)	± 30	± 40	± 50	± 60	± 70	± 80	± 90	± 100	± 110
Yaw (µrad)	± 40	± 40	± 40	± 40	± 40	± 40	± 40	± 40	± 40
Weight (kg)	2.6	2.7	2.8	2.9	3.1	3.1	3.5	3.7	4

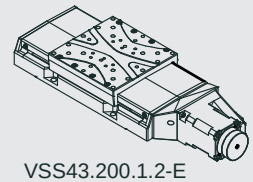
Vacuum type	FV	HV	UHVG		
Linear scale				FV	UHV
Speed max. (mm/sec)	15	5	5		
Resolution calculated (µm)	10 (FS)	10 (FS)	10 (FS)	0.05	0.05
Resolution typical (µm)	0.2	0.2	0.2	0.05	0.05
Bi-directional Repeatability (µm)	± 1	± 1	± 1	± 0.1	± 0.1
Uni-directional Repeatability (µm)	0.2	0.2	0.2		0.05
Nominal Current (A)	1.5	1.2	1.2		

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 15
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

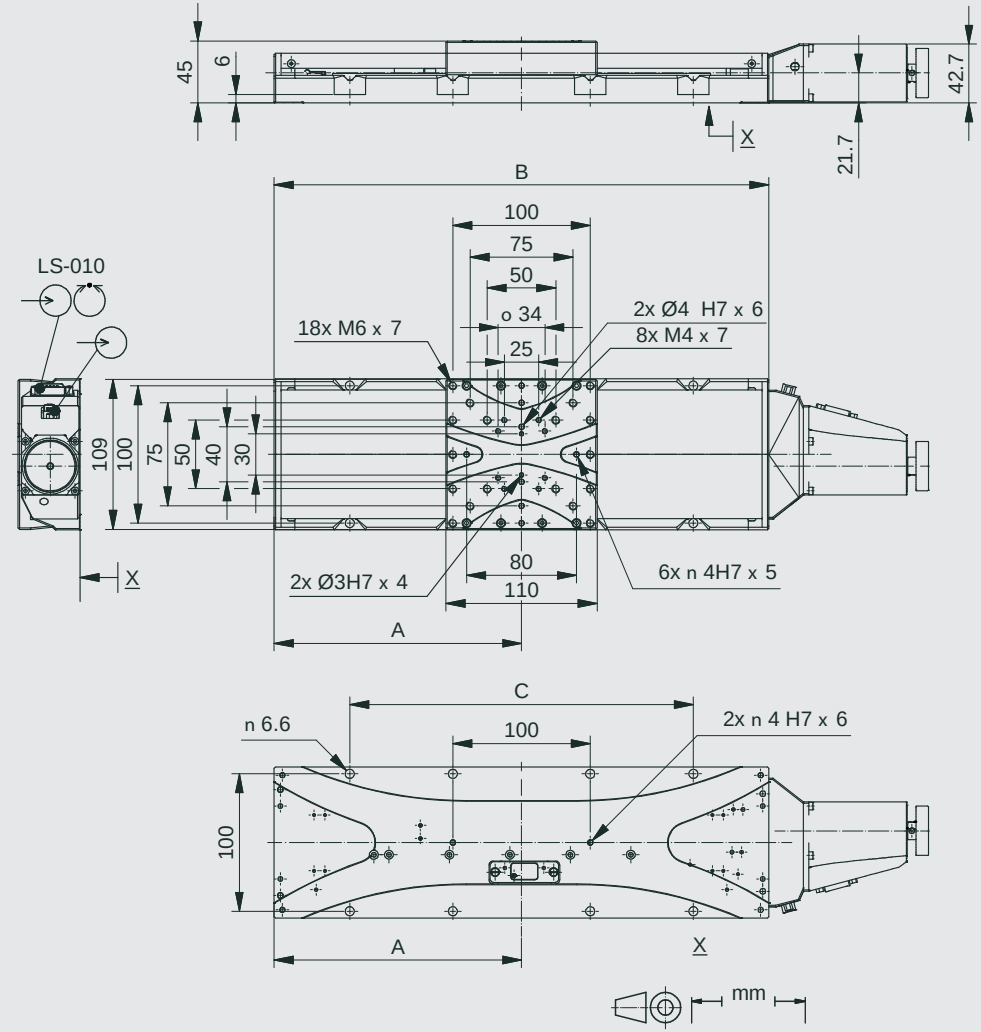
PI micos

Travel (mm)	26	52	77	102	155	190	255	305	508
A	112,5	125	137,5	150	180	180	215	240	340
B	225	250	275	300	360	360	430	480	680
C	-	-	-	-	250	250	300	350	500



VSS43.200.1.2-E

drawings for the corresponding
vaccum class must be requested separately.
The installed motor types are:
PK245 für FV
VSS 42.200.1.2-E für HV & UHVG

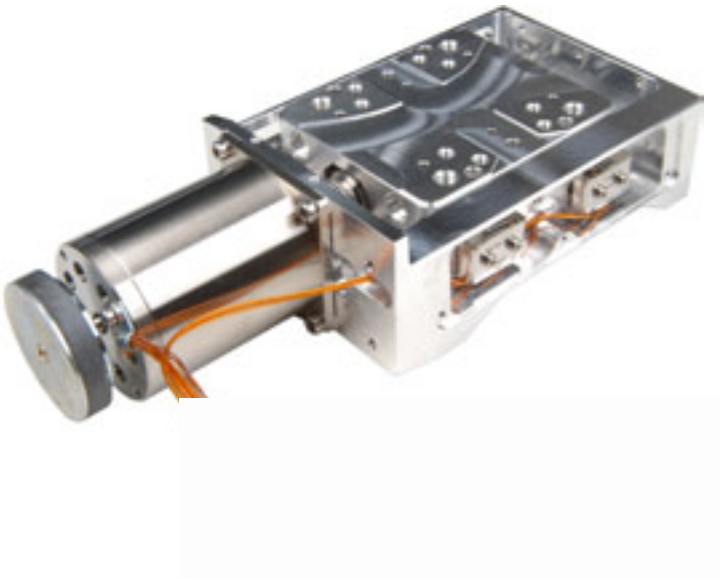


Order No.	6236-V-				0	0
FV	1					
HV	2					
UHVG	3					
26 mm (1")		1				
52 mm (2")		2				
77 mm (3")		3				
102 mm (4")		4				
155 mm (6")		5				
190 mm		6				
255 mm (10")		7				
305 mm (12")		8				
508 mm (20")		9				
open loop			0			
closed loop (max 155 mm)			1			

4.094 Precision Linear Stage PLS-85 Vacuum

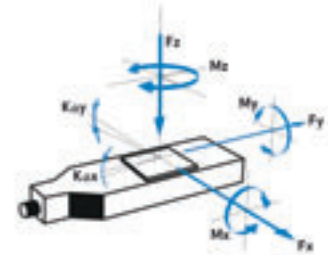
FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	60	50	100	25	30	20	70	40
HV	60	50	100	25	30	20	70	40
UHVG	60	50	100	25	30	20	70	40



KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range up to 155 mm (6")
- Uni-directional repeatability down to 0.05 µm
- Maximum speed 6 mm/sec
- Load capacity up to 8 kg
- Integrated switches
- Option: linear scale



The PLS-85 Vacuum linear stages are especially suited for high precision applications with limited space conditions while allowing loads of up to 10 kg. Cross-roller bearings guarantee very high guiding stiffness. Driven by a re-circulating ball screw with 1 mm pitch.The PLS-85 Vacuum can be mounted in any orientation. For demanding positioning tasks, the PLS-85 Vacuum linear stages can be supplied with a side-mounted linear scale. The PLS-85 Vacuum is equipped with a 2-phase steppervacuum motor and has two limit switches.

Please see"GLOSSARY Vacuum Specification" for all vacuum specification.

TECHNICAL DATA

Travel range (mm)	26	52	102	155
Straightness / Flatness (µm)	± 1	± 2	± 4	± 6
Pitch (µrad)	± 60	± 90	± 120	± 150
Yaw (µrad)	± 60	± 80	± 100	± 130
Weight (kg)	0.9	1.2	1.5	1.8

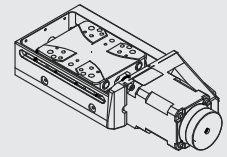
Vacuum type	FV	HV	UHVG		
Linear scale				FV	UHV
Speed max. (mm/sec)	6	2.5	2.5		
Resolution calculated (µm)	5 (FS)	5 (FS)	5 (FS)	0.05	0.05
Resolution typical (µm)	0.05	0.05	0.05	0.05	0.05
Bi-directional Repeatability (µm)	± 1	± 1	± 1	± 0.1	± 1
Uni-directional Repeatability (µm)	0.1	0.1	0.1	0.05	0.05
Nominal Current (A)	1.2	1.2	1.2		

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 6
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

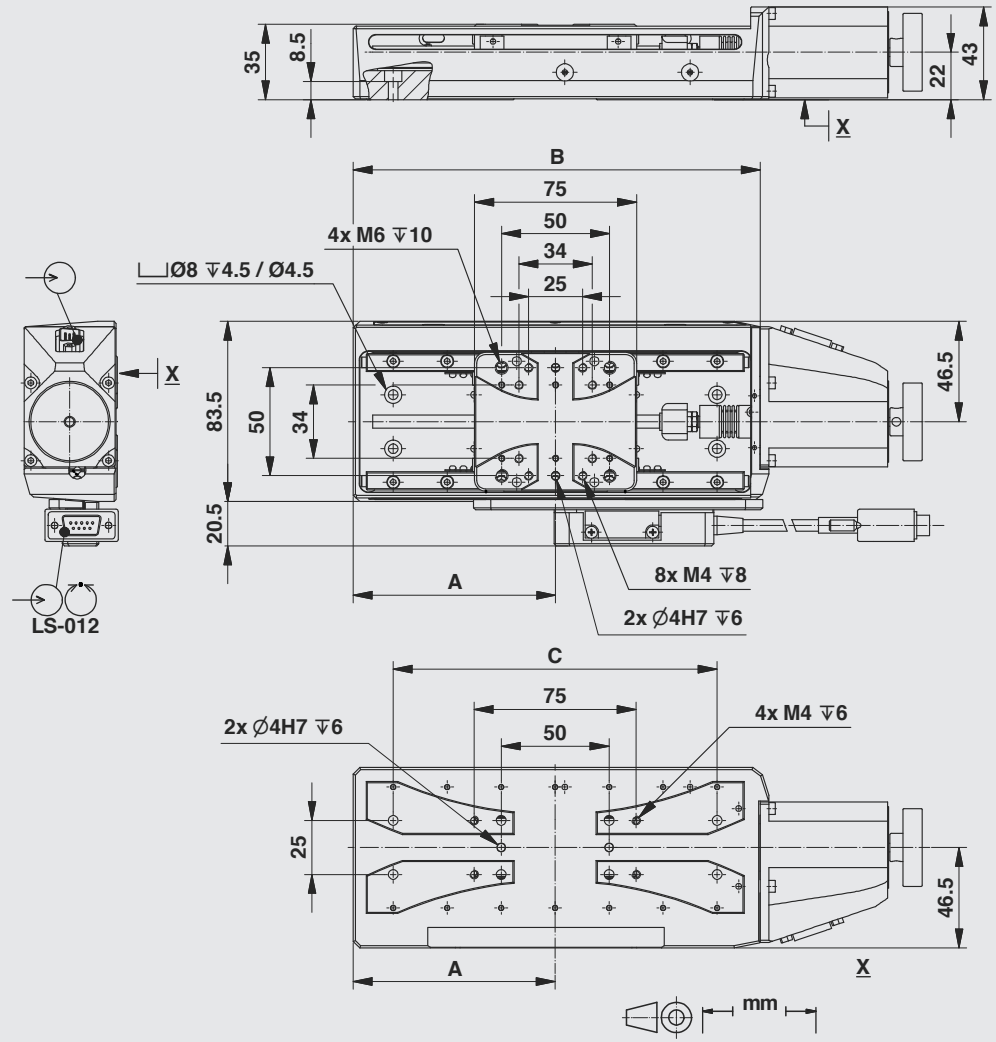
PI micos

Travel (mm)	26	52	102	155
A	59	68,5	93,5	128
B	119,5	138,5	188,5	257,5
C	-	100	150	200



drawings for the corresponding vacuum class must be requested separately.
The installed motor types are:
PK245 for FV
VSS 42.200.1.2-E for HV, UHVG

PK245

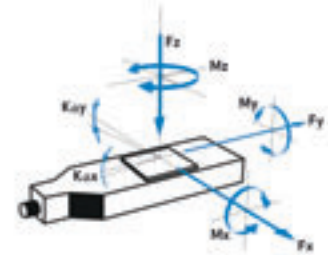


Order No.	6234-V-				0	0
FV	1					
HV	2					
UHVG	3					
26 mm (1")		1				
52 mm (2")		2				
102 mm (4")		3				
155 mm (6")		4				
open loop			0			
closed loop			1			

4.096 Linear Stage LS-65 Vacuum

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	50	25	60	7.5	7.5	7.5	140	80
10-6	50	25	60	7.5	7.5	7.5	140	80
HV	50	25	60	7.5	7.5	7.5	140	80
UHVG	50	25	60	7.5	7.5	7.5	140	80



The LS-65 Vacuum linear stage features a compact, low profile construction for high strength in a lightweight package. Typical applications for this measuring stage are inspection stations and micro-manipulators for laser diodes and other highly sensitive components. A precision ground lead-screw with 1 mm pitch guarantees smooth and quiet motion. The LS-65 Vacuum linear stages are equipped with a re-circulating ball guiding system and are motorized with a special 2-phase vacuum stepper motor.

KEY FEATURES

- Vacuum upt 10-9 hPa
- Travel range up to 102 mm (4")
- Uni-directional repeatability down to 0.3 µm
- Maximum speed 4 mm/sec
- Load capacity up to 6 kg
- Integrated limit switches
- Optionally higher resolution / 0.4 mm pitch
- Optionally higher repeatability and speed with ballscrew

TECHNICAL DATA

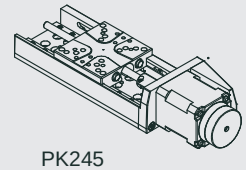
Travel range (mm)	26	52	77	102
Straightness / Flatness (µm)	± 2	± 4	± 6	± 8
Pitch (µrad)	± 70	± 90	± 110	± 130
Yaw (µrad)	± 70	± 80	± 90	± 100
Weight (kg)	0.6	0.7	0.8	0.9

Vacuum type	FV	10-6	HV	UHVG	
Linear scale					UHV
Speed max. (mm/sec)	4	1.5	1.5	1.5	
Resolution calculated (µm)	5 (FS)	5 (FS)	5 (FS)	5 (FS)	0.05
Resolution typical (µm)	0.2	0.2	0.2	0.2	0.05
Bi-directional Repeatability (µm)	± 5	± 5	± 5	± 5	± 0.1
Uni-directional Repeatability (µm)	0.3	0.3	0.3	0.3	0.05
Nominal Current (A)	1.2	1.2	1.2	1.2	

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 3
Material	Aluminum or Stainless steel, suitable for vacuum

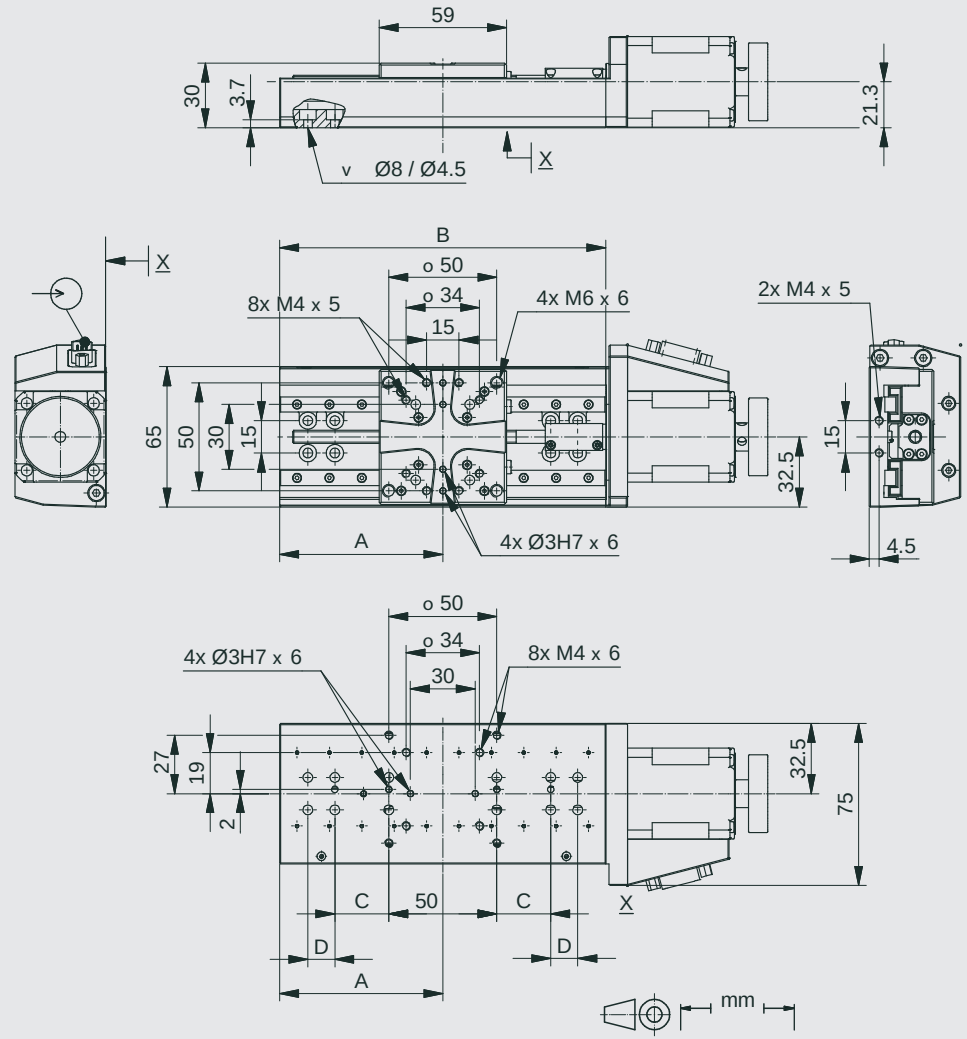
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

Travel (mm)	26	52	77	102
A	46,5	60,5	75,5	85,5
B	93	121	151	171
C	9	25	25	37,5
D	-	-	12,5	12,5



PK245

drawings for the corresponding vacuum class must be requested separately.
The installed motor types are:
PK245 for FV
VSS 42.200.1.2-E for HV & UHVG



Order No.	6233-V-				0	0
FV	1					
HV	2					
UHVG	3					
10-6	6					
26 mm (1")		1				
52 mm (2")		2				
77 mm (3")		3				
102 mm (4")		4				
open loop					0	
closed loop					1	

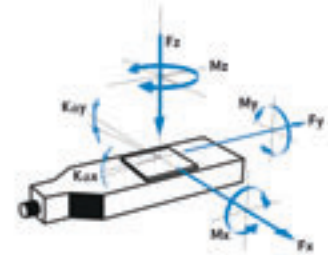
4.098 Micro Stage MTS-65 Vacuum

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	10	3	10	0.4	0.6	0.4	80	30
HV	10	3	10	0.4	0.6	0.4	80	30
UHVG	10	3	10	0.4	0.6	0.4	80	30

KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range up to 52 mm (2")
- Uni-directional repeatability down to 0.1 µm
- Maximum speed 2.5 mm/sec
- Load capacity up to 1 kg
- Integrated limit switches
- Option: linear scale



The MTS-65 Vacuum micro stage was developed for industrial application with limited space conditions and is typically used for the positioning of laser diodes and optical components. Driven by a 2-phase stepper vacuum motor using high resolution micro-stepping, the gearless stage utilizes re-circulating ball bearings and a ground re-circulating ball screw. As a result, a high stiffness, accuracy and smoothness of motion is achieved. The micro stage is equipped with two limit switches. For higher positioning accuracy and repeatability of 0.1 µm, the MTS-65 Vacuum micro stage is offered with a linear scale. Using a special mounting kit, the MTS-65 Vacuum stages can be assembled as XY or XYZ- modules.

TECHNICAL DATA

Travel range (mm)	13	26	52
Straightness / Flatness (µm)	± 1	± 2	± 3
Pitch (µrad)	± 40	± 60	± 80
Yaw (µrad)	± 40	± 40	± 40
Weight (kg)	0.4	0.6	0.8

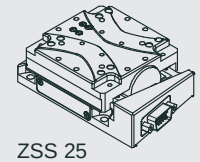
Vacuum type	FV	HV	UHVG	
Linear scale				UHV
Speed max. (mm/sec)	2.5	1	1	
Resolution calculated (µm)	5 (FS)	5 (FS)	5 (FS)	0.05
Resolution typical (µm)	0.1	0.1	0.1	0.05
Bi-directional Repeatability (µm)	± 5	± 5	± 5	± 0.2
Uni-directional Repeatability (µm)	0.2	0.2	0.2	0.1
Nominal Current (A)	1.2	1.2	1.2	

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 3
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

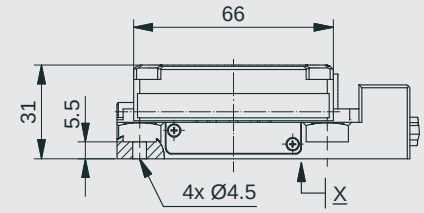
PI micos

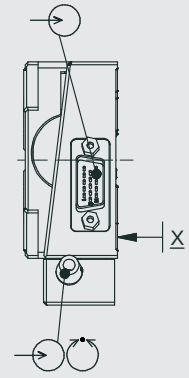
Travel (mm)	13	26	52
A	38,5	45	62
B	62	75	105
C	99,5	112,5	147,5



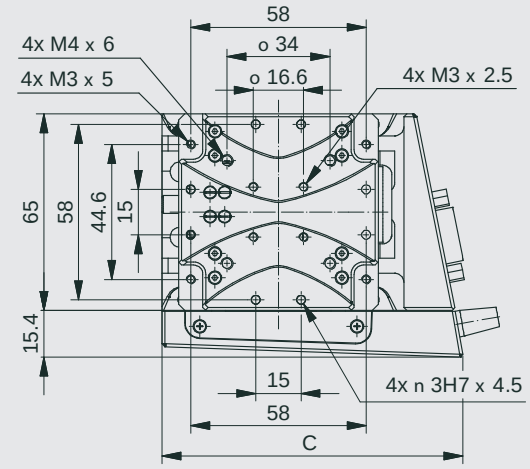
ZSS 25

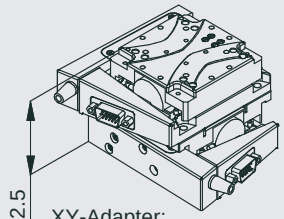
drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
ZSS 25.200.1.2-E for FV
VSS 25.200.1.2-E for HV & UHVG



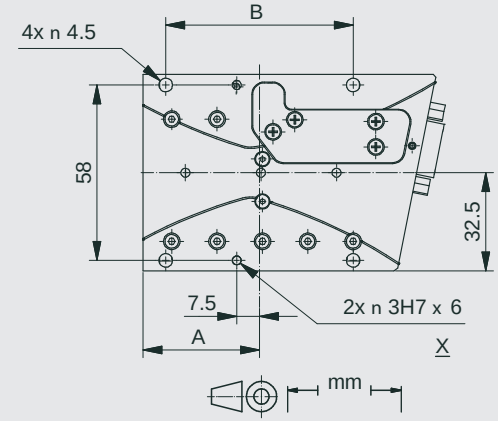


LS-050





XY-Adapter:
6217-9-0001 Var. 1"
6217-9-0002 Var. 1/2"
6217-9-0003 Var. 2"



Order No.	6217-V-				0	0
FV	1					
HV	2					
UHVG	3					
13 mm (1/2")		1				
26 mm (1")		2				
52 mm (2")		3				
open loop				0		
closed loop				1		

4.100 Micro Stage MTS-70 Vacuum

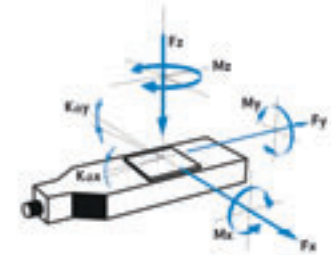
FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	10	3	10	0.4	0.6	0.4	80	30
HV	10	3	10	0.4	0.6	0.4	80	30
UHVG	10	3	10	0.4	0.6	0.4	80	30

xy axes (setup by PI miCos)

KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range 10 mm
- Uni-directional repeatability down to 0.1 µm
- Maximum speed 3 mm/sec
- Load capacity up to 1 kg
- Integrated limit switches
- Option: linear scale



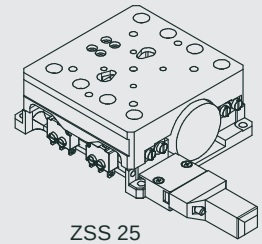
The MTS-70 Vacuum micro stage was developed for precision industrial applications with limited space conditions. The stage is driven by a 2-phase gearless vacuum stepper motor.The MTS-70 Vacuum micro stages series is provided with cross-roller bearings and a ground re-circulating ball screw guaranteeing maximum stiffness, accuracy and smoothness of motion. The MTS-70 Vacuum stages are equipped with two limit switches. For high positioning accuracy and repeatability, the MTS-70 micro stages are offered with a linear scale. The stages are offered as a single axis or as an integrated XY system.

TECHNICAL DATA

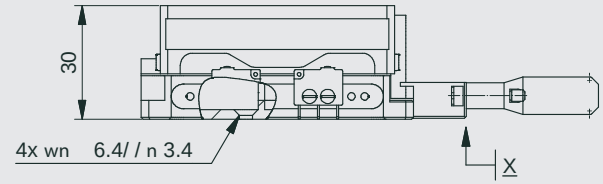
Travel range (mm)	10				
Straightness / Flatness (µm)	± 1				
Pitch (µrad)	± 50				
Yaw (µrad)	± 50				
Weight (kg)	0.4				
Vacuum type	FV	HV	UHVG		
Linear scale				FV	UHV
Speed max. (mm/sec)	2.5	1	1		
Resolution calculated (µm)	5 (FS)	5 (FS)	5 (FS)	0.05	0.05
Resolution typical (µm)	0.1	0.1	0.1	0.05	0.05
Bi-directional Repeatability (µm)	± 5	± 5	± 5	± 0.2	± 0.2
Uni-directional Repeatability (µm)	0.2	0.2	0.2	0.1	0.1
Nominal Current (A)	1.2	1.2	1.2		
Accuracy	on request				
Velocity range (mm/sec)	0.001 ... 3				
Material	Aluminum or Stainless steel, suitable for vacuum				

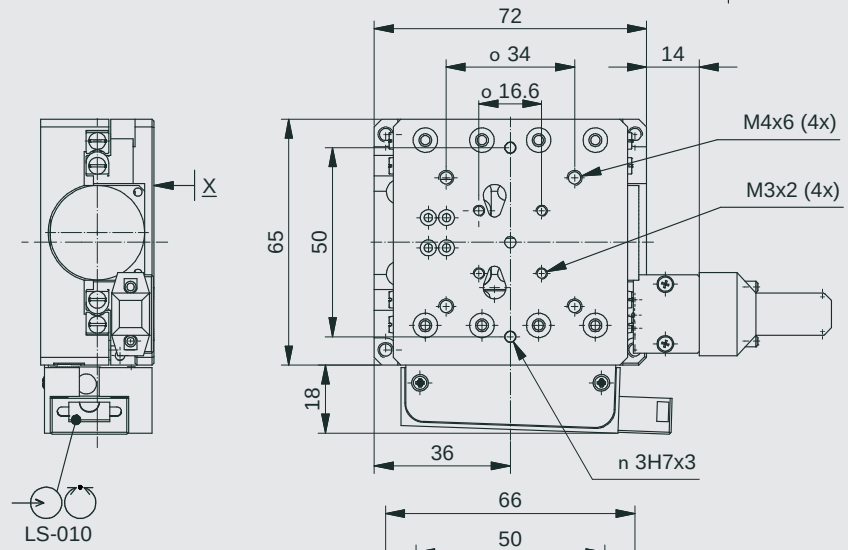
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

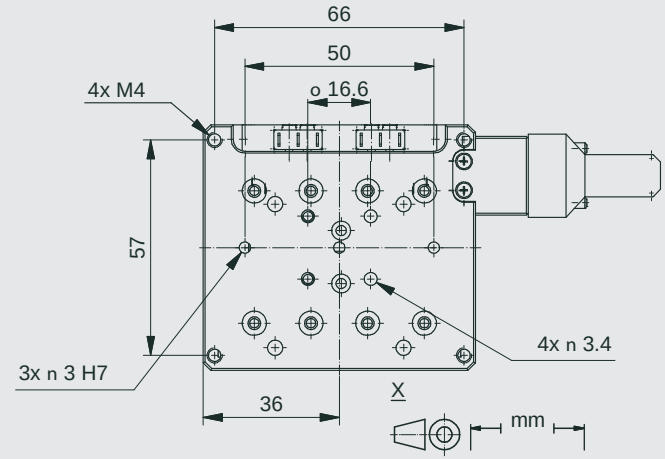
PI miCos



drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
ZSS 25.200.1.2-E for FV
VSS 25.200.1.2-E for HV & UHVG



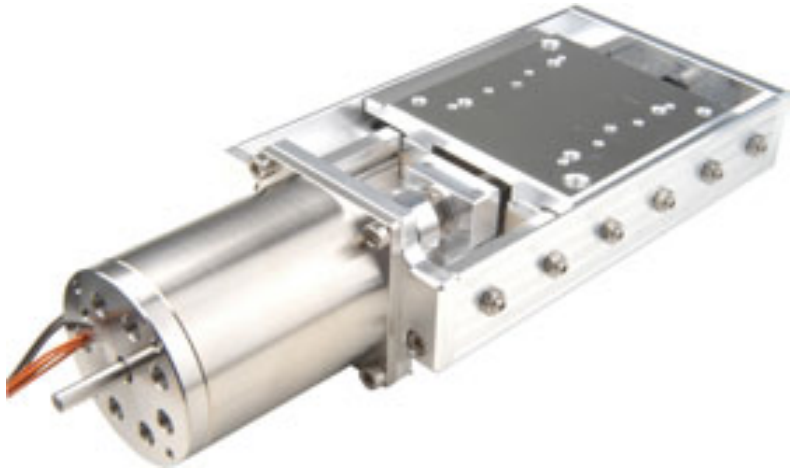




Order No.	6218-V-				0	0
FV	1					
HV	2					
UHVG	3					
10 mm		0				
open loop			0			
closed loop			1			

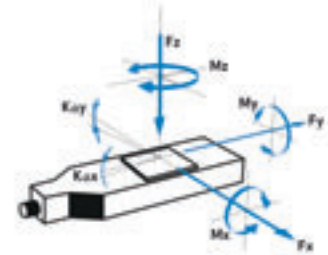
FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	40	30	50	2.5	5	2.5	220	150
10-6	40	30	50	2.5	5	2.5	220	150
HV	40	30	50	2.5	5	2.5	220	150
UHVG	40	30	50	2.5	5	2.5	220	150



KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range up to 300 mm
- Uni-directional repeatability down to 0.4 µm
- Maximum speed 4 mm/sec
- Load capacity up to 5 kg
- Integrated limit switches



The VT-80 Vacuum translation stage is a popular laboratory stage that offers a wide range of travel lengths. A backlash-free re-circulating ball bearing along with a backlash compensated lead screw guarantee a quiet and smooth motion. The VT-80 Vacuum translation stages are equipped with integrated limit switches and is motorized with a special 2-phase stepper vacuum motor. All VT-80 Vacuum translation stages can be directly assembled in XY configurations. The XY systems with a travel of 25 mm must be assembled at the factory and must be specified when ordering.

TECHNICAL DATA

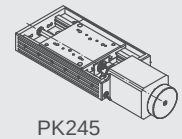
Travel range (mm)	25	50	75	100	150	200	250	300
Straightness / Flatness (µm)	± 8	± 10	± 11	± 12	± 14	± 20	± 25	± 35
Pitch (µrad)	± 100	± 110	± 120	± 130	± 150	± 170	± 190	± 21
Yaw (µrad)	± 150	± 150	± 150	± 150	± 150	± 150	± 150	± 150
Weight (kg)	0.55	0.65	0.7	0.75	0.85	0.95	1.1	1.25

Vacuum type	FV	10-6	HV	UHVG
Speed max. (mm/sec)	4	1.6	1.6	1.6
Resolution calculated (µm)	5 (FS)	5 (FS)	5 (FS)	5 (FS)
Resolution typical (µm)	0.2	0.2	0.2	0.2
Bi-directional Repeatability (µm)	± 10	± 10	± 10	± 10
Uni-directional Repeatability (µm)	0.4	0.4	0.4	0.4
Nominal Current (A)	1.2	1.2	1.2	1.2

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 6
Material	Aluminum or Stainless steel, suitable for vacuum

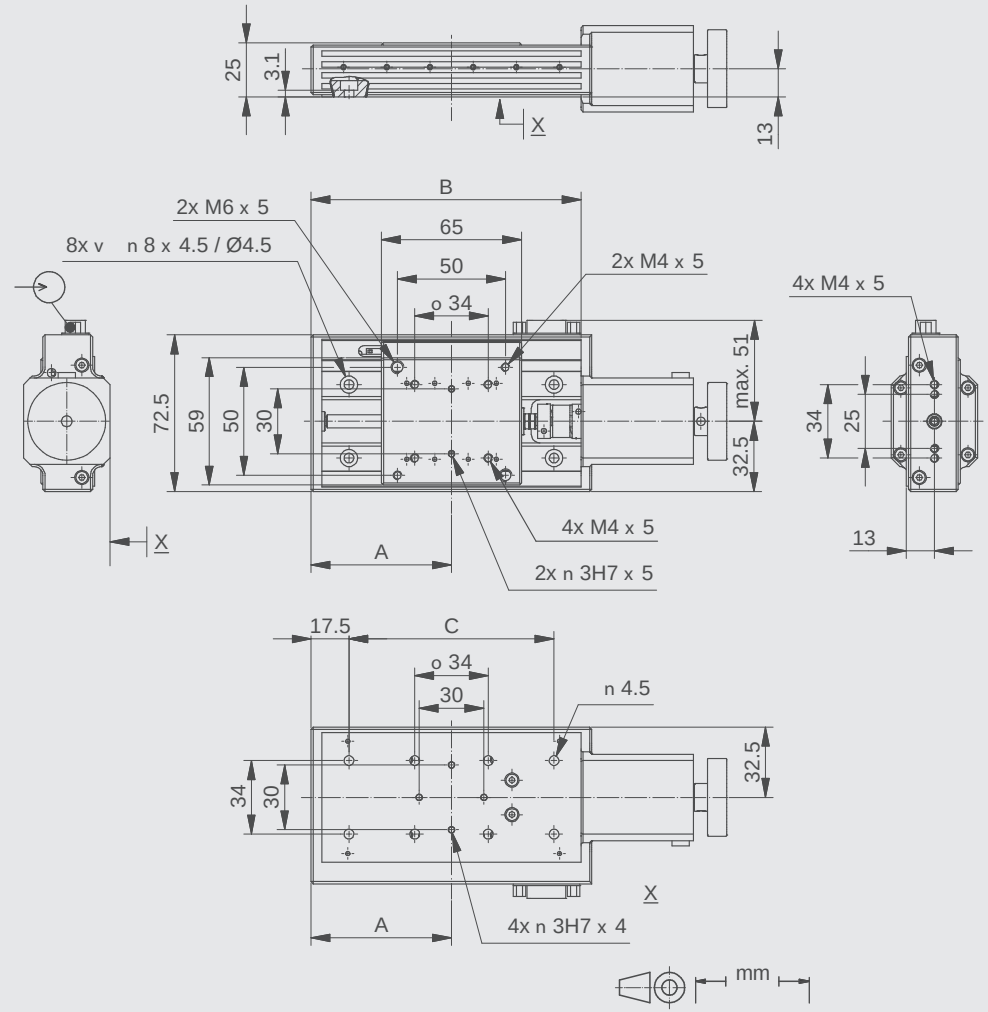
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

Travel (mm)	25	50	75	100	150	200	250	300
A	52,5	65	77,5	90	115	140	165	190
B	100	125	150	175	225	275	325	375
C	70	95	120	145	195	245	295	345



PK245

drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
PK245 for FV
VSS 42.200.1.2-E for HV & UHVG



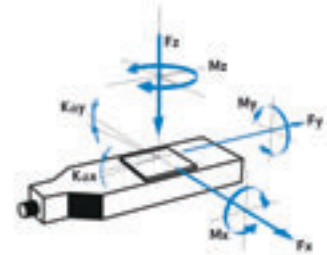
Order No.	6230-V-			0	0	0
FV	1					
HV	2					
UHVG	3					
10-6	6					
25 mm (xy set up by PI miCos)		1				
50 mm		2				
75 mm		3				
100 mm		4				
150 mm		5				
200 mm		6				
250 mm		7				
300 mm		8				

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$
FV	20	10	30	0.4	0.6	0.4
10-6	20	10	30	0.4	0.6	0.4
HV	20	10	30	0.4	0.6	0.4
UHVG	20	10	30	0.4	0.6	0.4

KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range up to 52 mm
- Uni-directional repeatability down to 0.1 µm
- Maximum speed 0.13 mm/sec
- Load capacity up to 2 kg
- Integrated limit switches
- Optionally higher quality with ballscrew



Micro stages LS-40 Vacuum are suited for the precise positioning of small parts such as fibers, optical components, laser diodes and inspection equipment. The space saving modules can be assembled into XYZ-systems. The micro stage LS-40Vacuum is equipped with re-circulating ball guides and a finepitch screw with 0,5 mm pitch (optionally a ball screw with 1 mm pitch can be delivered). It is driven with a 2-phase gearless or geared vacuum motor. The LS-40 series excels with very smooth, high resolution motion. For restricted space conditions.

Travel ranges of 13, 26 or 52 mm are available and two standard limit switches prevent damage from accidental over-travel. XY-assembly is possible at the factory and must be indicated when ordering.

TECHNICAL DATA

Travel range (mm)	13	26	52
Straightness / Flatness (µm)	± 1.5	± 3	± 5
Pitch (µrad)	± 150	± 170	± 190
Yaw (µrad)	± 150	± 150	± 150
Weight (kg)	0.18	0.2	0.25

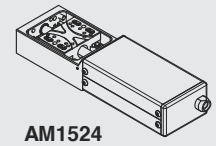
Vacuum type	FV	10-6	HV	UHVG
Speed max. (mm/sec)	0.13	0.05	0.05	0.05
Resolution calculated (µm)	0.2745086 (FS)	0.2745086 (FS)	2.5 (FS)	2.5 (FS)
Resolution typical (µm)	0.1	0.1	0.1	0.1
Bi-directional Repeatability (µm)	± 3	± 3	± 3	± 3
Uni-directional Repeatability (µm)	0.1	0.1	0.1	0.1
Nominal Current (A)	0.25	0.25	1.2	1.2

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 1.5
Material	Aluminum or Stainless steel, suitable for vacuum

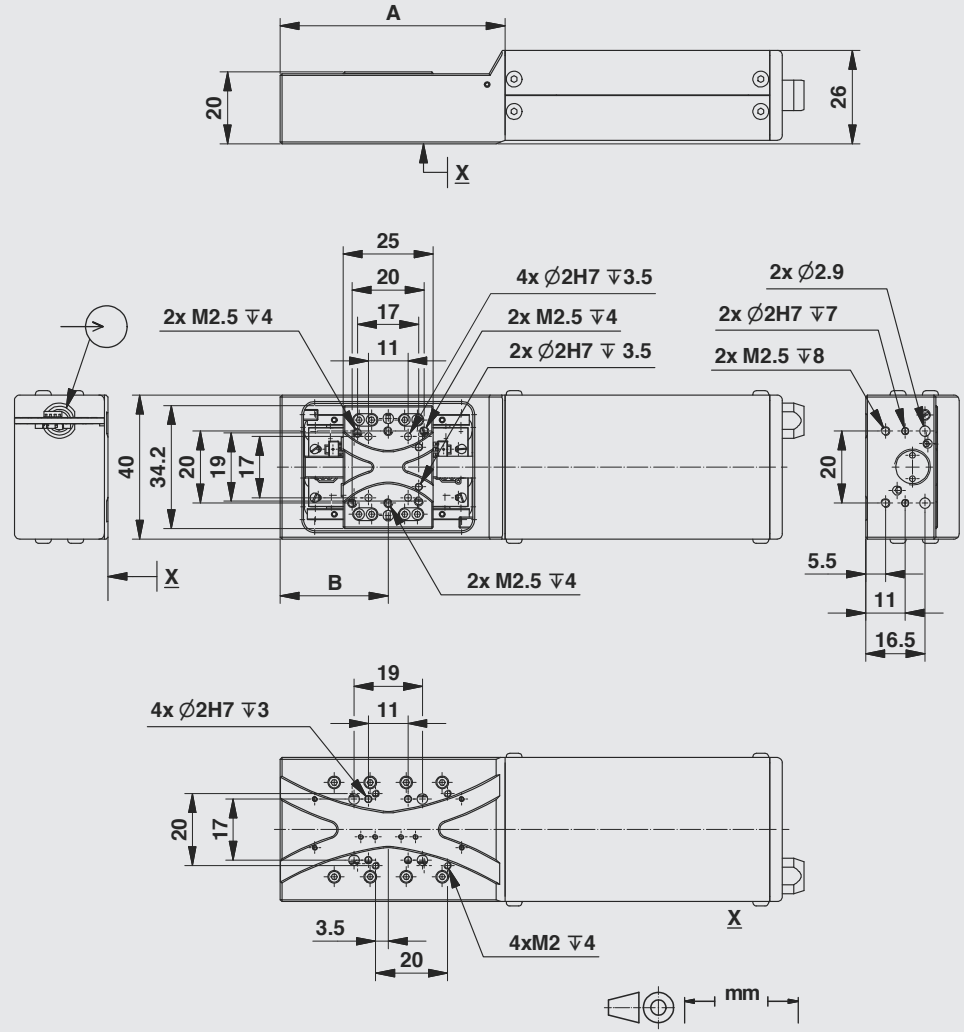
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos

Travel (mm)	13	26	52
A	62,5	75,5	101,5
B	30	36,5	49,5



drawings for the corresponding vacuum class must be requested separately.
The installed motor types are:
AM1524 for FV
VSS 32.200.1.2-E for HV, UHVG



Order No.	6213-V-			0	0	0
FV	1					
HV	2					
UHVG	3					
10-6	6					
13 mm		1				
26 mm		2				
52 mm		3				

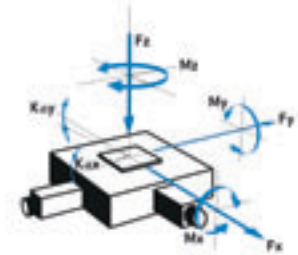
FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fy\ Peak_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	80	80	200	200	130	130	90	80	60
HV	80	80	200	200	130	130	90	80	60
UHVG	80	80	200	200	130	130	90	80	60

Non-vacuum model shown

KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range up to 206 mm x 206mm (8")
- Uni-directional repeatability down to 0,1 µm
- Maximum speed 11 mm/sec
- Load capacity up to 20 kg
- Integrated optical limit switches
- Option: Linear scale



The MCS XY Vacuum Stage was developed for inspection and microscopy applications. The travel range will be produced in two sizes, namely 102 x 102mm (4"), 206 x 206 mm (8") . The MCS XY Vacuum stage is equipped with re-circulating ball guides on a rigid aluminium-alloy body and two limit switches on each axis. MCS Vacuum stages are motorized with special 2-phase stepper vacuum motors. For higher positioning accuracy and repeatability the MCS stage can be optionally equipped with linear scales.

TECHNICAL DATA

Travel range (mm)	102
Straightness / Flatness (µm)	± 2
Pitch (µrad)	± 40
Yaw (µrad)	± 20
Weight (kg)	22

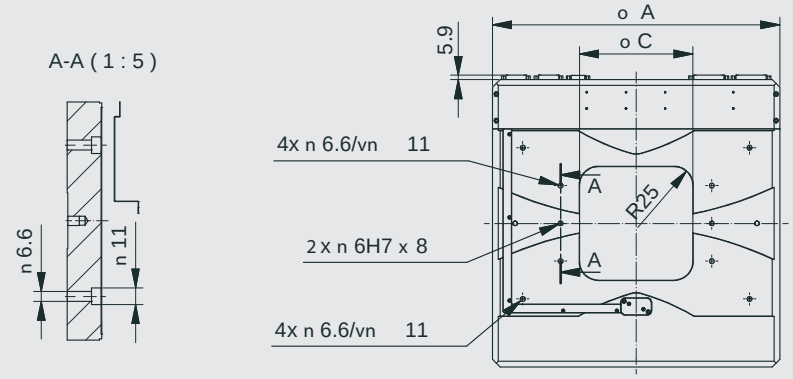
Vacuum type	FV	HV	UHVG	
Linear scale				HV
Speed max. (mm/sec)	11	4	4	
Resolution calculated (µm)	10 (FS)	10 (FS)	10 (FS)	0.00012
Resolution typical (µm)	0.2	0.2	0.2	0.05
Bi-directional Repeatability (µm)	± 1	± 1	± 1	± 0.1
Uni-directional Repeatability (µm)	0.2	0.2	0.2	0.05
Nominal Current (A)	1.2	1.2	1.2	

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 6
Material	Aluminum or Stainless steel, suitable for vacuum

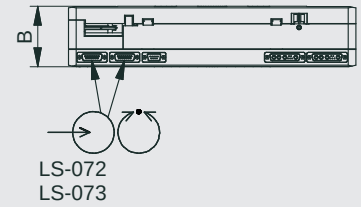
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

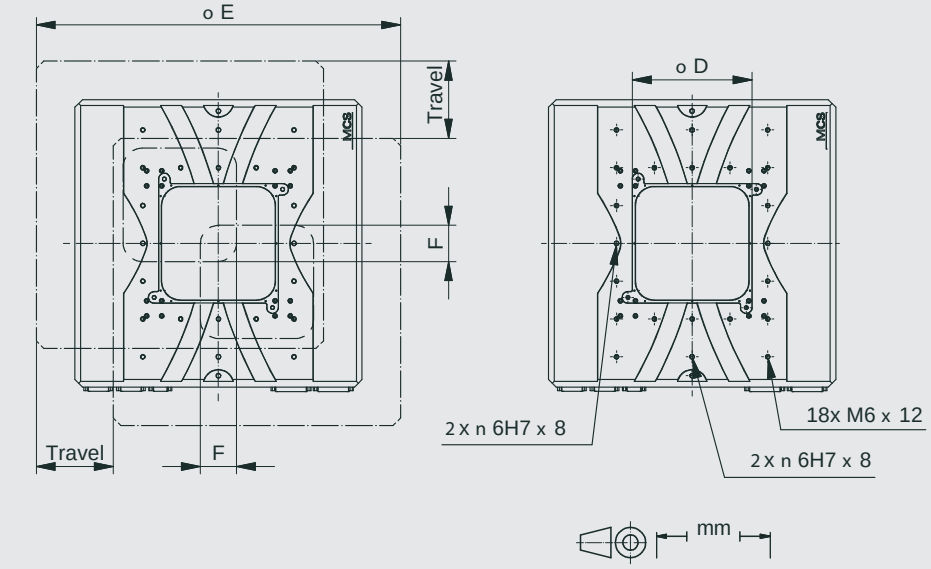
PI micos

Travel (mm)	102
A	380
B	80
C	150
D	158,2
E	482
F	48



drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
PK245 for FV
VSS 42.200.1.2-E for HV & UHVG





Order No.	6304-V-				0	0
FV	1					
HV	2					
UHVG	3					
102 mm (4") x 102 mm (4")		2				
open loop				0		
closed loop (only up to HV)				1		

4.108 Nano Precision Elevation Stage NPE-200 Vacuum

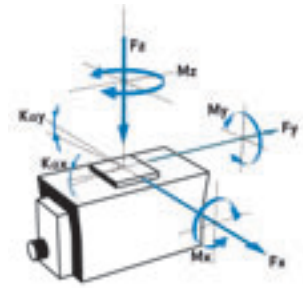
FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	100	80	300	100	50	100	3	1
HV	100	80	300	100	50	100	3	1
UHVG	100	80	100	100	50	100	3	1

Non-vacuum model shown

KEY FEATURES

- Vacuum up tp 10-9 hPa
- Travel range 13 mm (1/2")
- Uni-directional repeatability down to 0.04 µm
- Maximum speed 0.06 mm/sec / higher on request
- Load capacity up to 30 kg
- Integrated limit switches
- Integrated linear scale (center mounted)



The NPE-200 Vacuum nano-precision elevation stage offers the highest precision in our elevation stage series. Maximum positioning accuracy and high stiffness makes this stage especially suitable for lithography, fiber alignment and wafer inspection. High-quality ball bearings mounted on a stress-relieved, tempered aluminum-alloy body guarantee a non-warping stage structure, high stiffness and smooth motion. Position stability of less than 5 nm over a period of 1 minute can be achieved. The NPE-200 Vacuum is equipped with a 2-phase stepper vacuum motor using a backlash-free gear-head (ratio=50:1), two mechanical limit switches and a linear scale which is center mounted for highest accuracy. All nano-precision elevation stages are supplied with a certificate of performance (flatness, pitch, yaw, straightness & accuracy).

TECHNICAL DATA

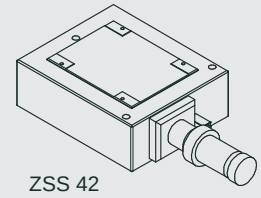
Travel range (mm)	13
Straightness / Flatness (µm)	± 0.7
Pitch (µrad)	± 20
Yaw (µrad)	± 20
Weight (kg)	9.2

Vacuum type	FV	HV	UHVG		
Linear scale				FV	UHV
Speed max. (mm/sec)	0.06	0.025	0.025		
Resolution calculated (µm)	0.2 (FS)	10 (FS)	10 (FS)	0.001	1
Resolution typical (µm)				0.005	
Bi-directional Repeatability (µm)				± 0.004	
Uni-directional Repeatability (µm)				0.04	
Nominal Current (A)	1.2	1.2	1.2		

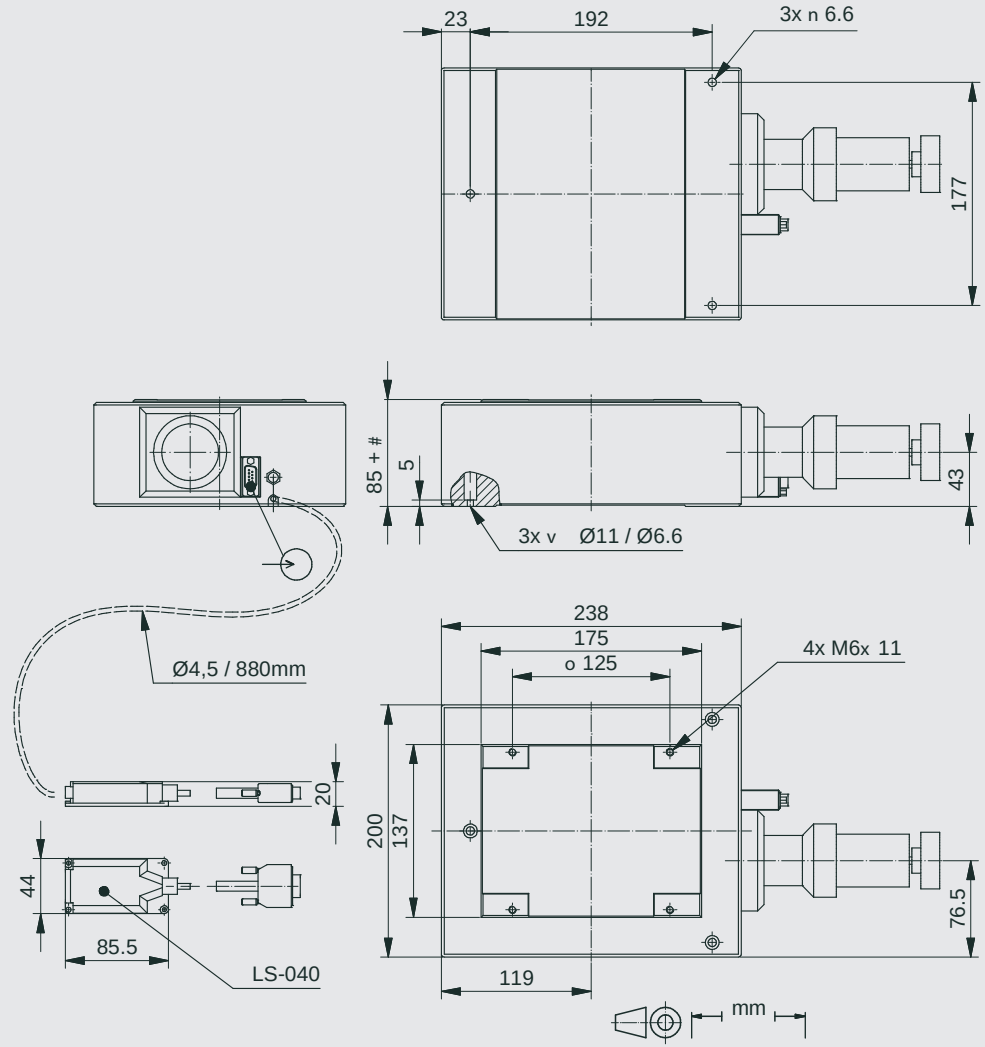
Accuracy	on request
Velocity range (mm/sec)	0.00001 ... 0.2
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos



drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
ZSS 42.200.1.2-E for FV
VSS 42.200.1.2-E for HV & UHVG



Order No.	6283-V-				0	0
FV	1					
HV	2					
UHVG	3					
13 mm (1/2")		1				
open loop				0		
closed loop				1		

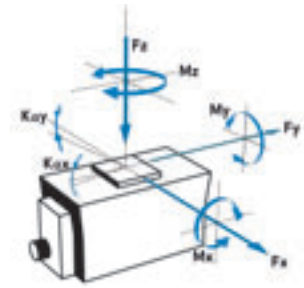
4.110 Ultra Precision Elevation Stage UPL-120 Vacuum

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	200	150	150	130	38	130	35	65
HV	200	150	150	130	38	130	35	65
UHVG	200	150	150	130	38	130	32	65

KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range 13 mm (1/2")
- Uni-directional repeatability down to 0.05 µm
- Maximum speed 2 mm/sec
- Load capacity up to 15 kg
- Integrated limit switches
- Option: linear scale (center mounted)



The UPL-120 Vacuum ultra-precision elevation stage replaces our older UPL-160 Vacuum stage. It was specifically designed for wafer inspection, fiber alignment and any other task where maximum positioning accuracy and reliability are absolutely mandatory. The UPL-120 Vacuum stage can be equipped with an integrated linear scale. High-quality cross roller bearings mounted on a stress-relieved tempered aluminum alloy body guarantee a maximum load capacity and smooth motion.

The UPL-120 Vacuum stage is offered with a special 2-phase stepper vacuum motor and is equipped with two limit switches.

Please see"GLOSSARY Vacuum Specification" for all vacuum specification.

TECHNICAL DATA

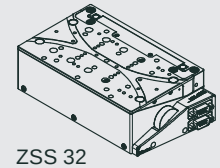
Travel range (mm)	13
Straightness / Flatness (µm)	± 3
Pitch (µrad)	± 100
Yaw (µrad)	± 100
Weight (kg)	2.1

Vacuum type	FV	HV	UHVG	
Linear scale				HV
Speed max. (mm/sec)	2	0.75	0.75	
Resolution calculated (µm)	1.34 (FS)	1.34 (FS)	1.34 (FS)	0.05
Resolution typical (µm)	0.5	0.5	0.5	0.1
Bi-directional Repeatability (µm)	± 1.5	± 1.5	± 1.5	± 0.05
Uni-directional Repeatability (µm)	0.5	0.5	0.5	0.05
Nominal Current (A)	1.2	1.2	1.2	

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 2
Material	Aluminum or Stainless steel, suitable for vacuum

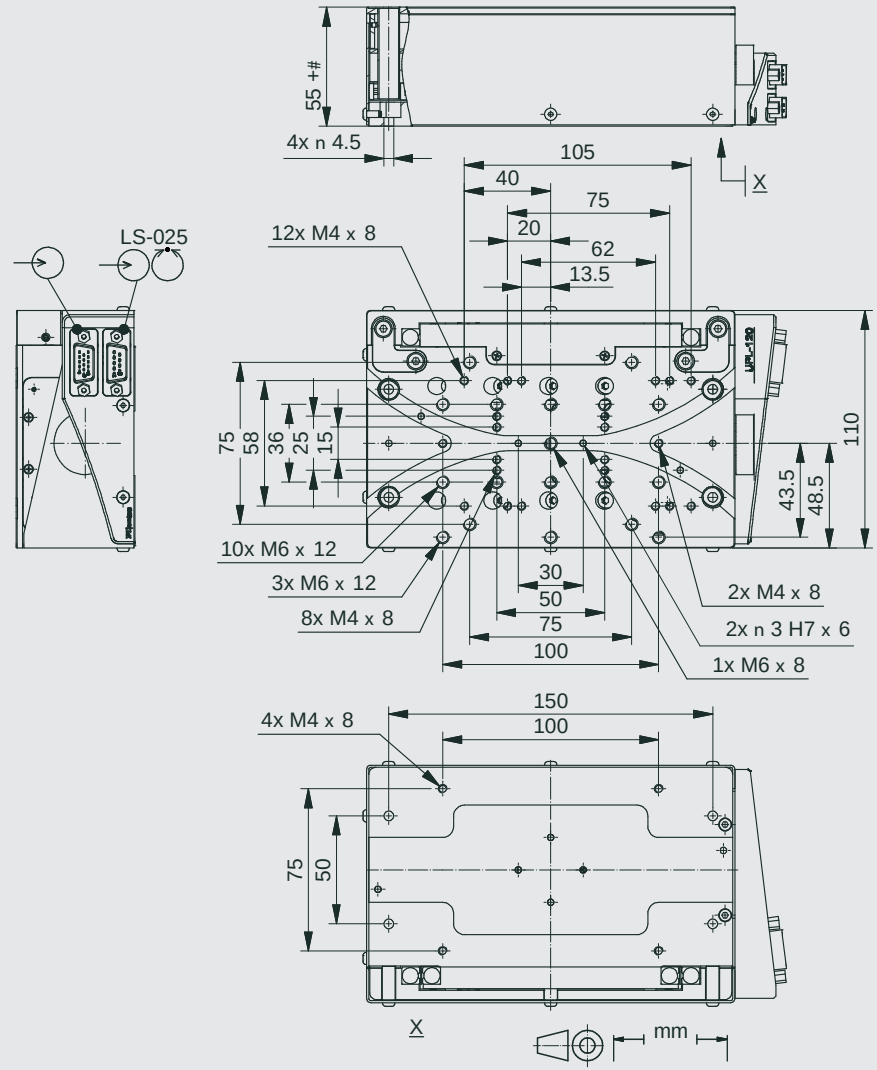
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos



ZSS 32

drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
ZSS 32.200.1.2-E for FV
VSS 32.200.1.2-E for HV & UHVG



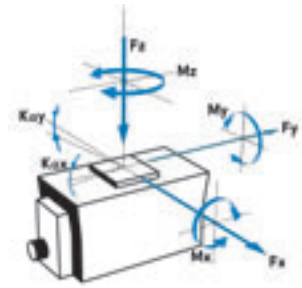
Order No.	6635-V-				0	0
FV	1					
HV	2					
UHVG	3					
13 mm (1/2")		1				
open loop				0		
closed loop (only up to HV)				1		

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	100	50	30	40	80	80	60	60
10-6	100	50	30	40	80	80	60	60

KEY FEATURES

- Vacuum up to 10-6 hPa
- Travel range up to 26 mm (1")
- Uni-directional repeatability down to 0.05 µm
- Maximum speed 6 mm/sec
- Load capacity up to 5.5 kg
- Integrated limit switches
- Option: linear scale (center mounted)



The ES-100 Vacuum elevation stage matches the LS-110 and PRS-110 stage families. The elevation stage is driven by a precision ground re-circulating ball screw with a 1 mm pitch.

Cross-roller bearings guarantee a maximum rigidity and guiding quality. The ES-100 Vacuum is motorized with a 2-phase stepper vacuum motor and is equipped with two limit switches. The travel ranges are 13 mm or 26 mm.

For demanding positioning tasks, the ES-100 Vacuum elevation stages can be supplied with a cost-effective linear scale.

TECHNICAL DATA

Travel range (mm)	13	26
Straightness / Flatness (µm)	± 2	± 3
Pitch (µrad)	± 100	± 150
Yaw (µrad)	± 100	± 150
Weight (kg)	2.4	2.5

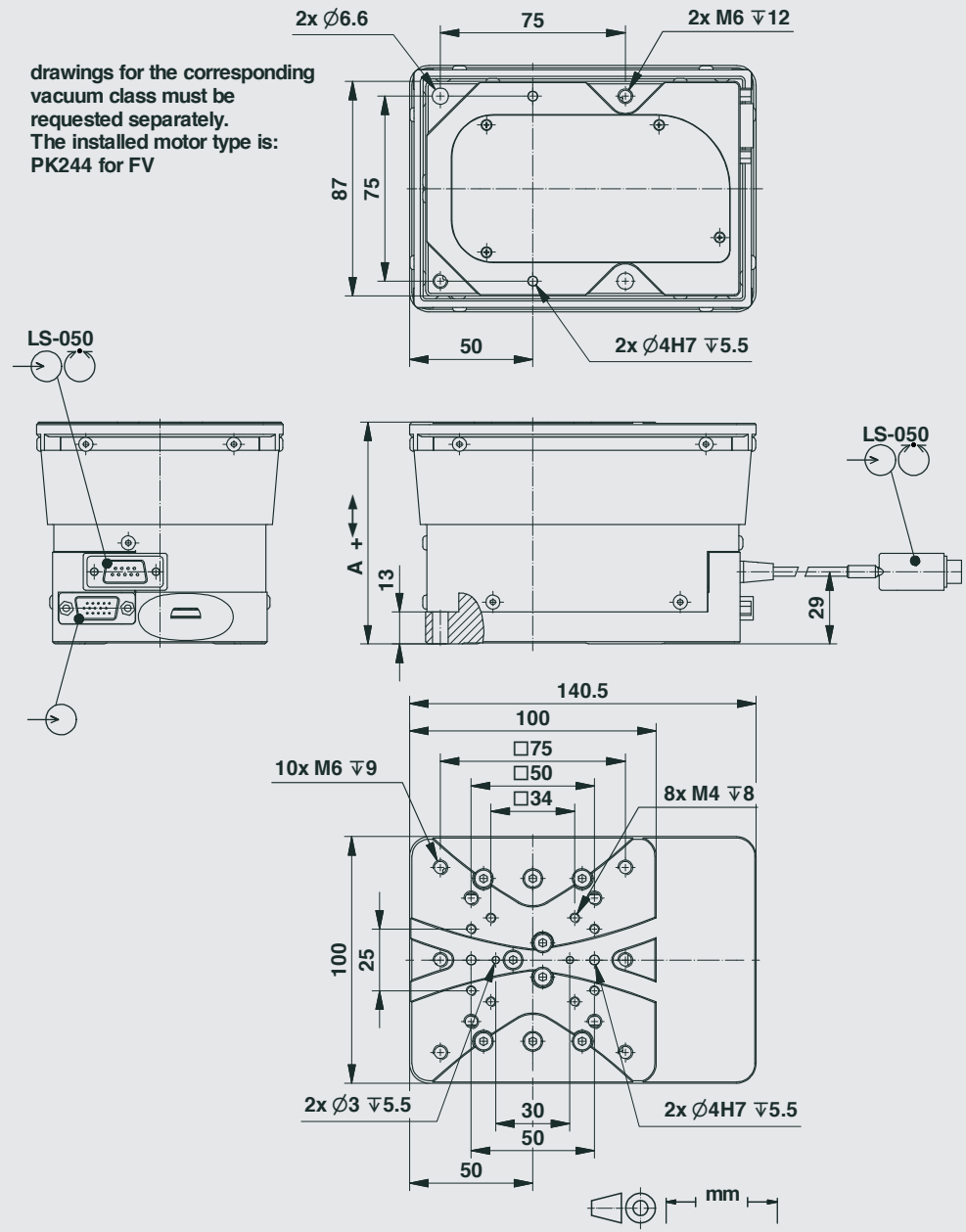
Vacuum type	FV	10-6	
Linear scale			UHV
Speed max. (mm/sec)	5	1.8	
Resolution calculated (µm)	5 (FS)	5 (FS)	0.05
Resolution typical (µm)	0.2	0.2	0.05
Bi-directional Repeatability (µm)	± 1.5	± 1.5	± 0.1
Uni-directional Repeatability (µm)	0.2	0.2	0.05
Nominal Current (A)	1.2	1.2	

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 6
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

Travel (mm)	13	26
A	90	105

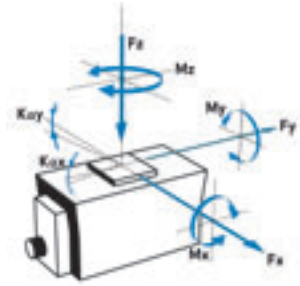
drawings for the corresponding vacuum class must be requested separately.
The installed motor type is:
PK244 for FV



Order No.	6611-V-				0	0
FV	1					
10-6	6					
13 mm (1/2")		1				
26 mm (1")		2				
open loop				0		
closed loop				1		

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fy\ Peak_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$
FV	5	5	99	20	0.25	0.25	0.25
HV	5	5	99	20	0.25	0.25	0.25
UHVG	5	5	99	20	0.25	0.25	0.25



The ES-82 Vacuum elevation stage excels due to its minimum height and can be combined with the series of PLS-85, LS-65 or MTS-65 stages. The ES-82 Vacuum is equipped with a 2-phase geared stepper motor and with limit switches.

KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range 13 mm (1/2")
- Uni-directional repeatability down to 0.1 µm
- Maximum speed 0.02 mm/sec
- Load capacity up to 2 kg
- Integrated limit switches
- Option: linear scale

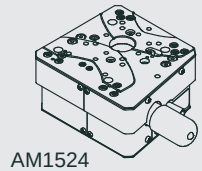
TECHNICAL DATA

Travel range (mm)	13
Straightness / Flatness (µm)	± 3
Pitch (µrad)	± 75
Yaw (µrad)	± 75
Weight (kg)	0.8

Vacuum type	FV	HV	UHVG	
Linear scale				HV
Speed max. (mm/sec)	0.02	0.01	0.01	
Resolution calculated (µm)	0.0427009 (FS)	0.055555 (FS)	0.055555 (FS)	0.05
Resolution typical (µm)	0.3	0.3	0.3	0.1
Bi-directional Repeatability (µm)	± 2	± 2	± 2	± 0.2
Uni-directional Repeatability (µm)	0.3	0.3	0.3	0.1
Nominal Current (A)	0.25	1.2	1.2	

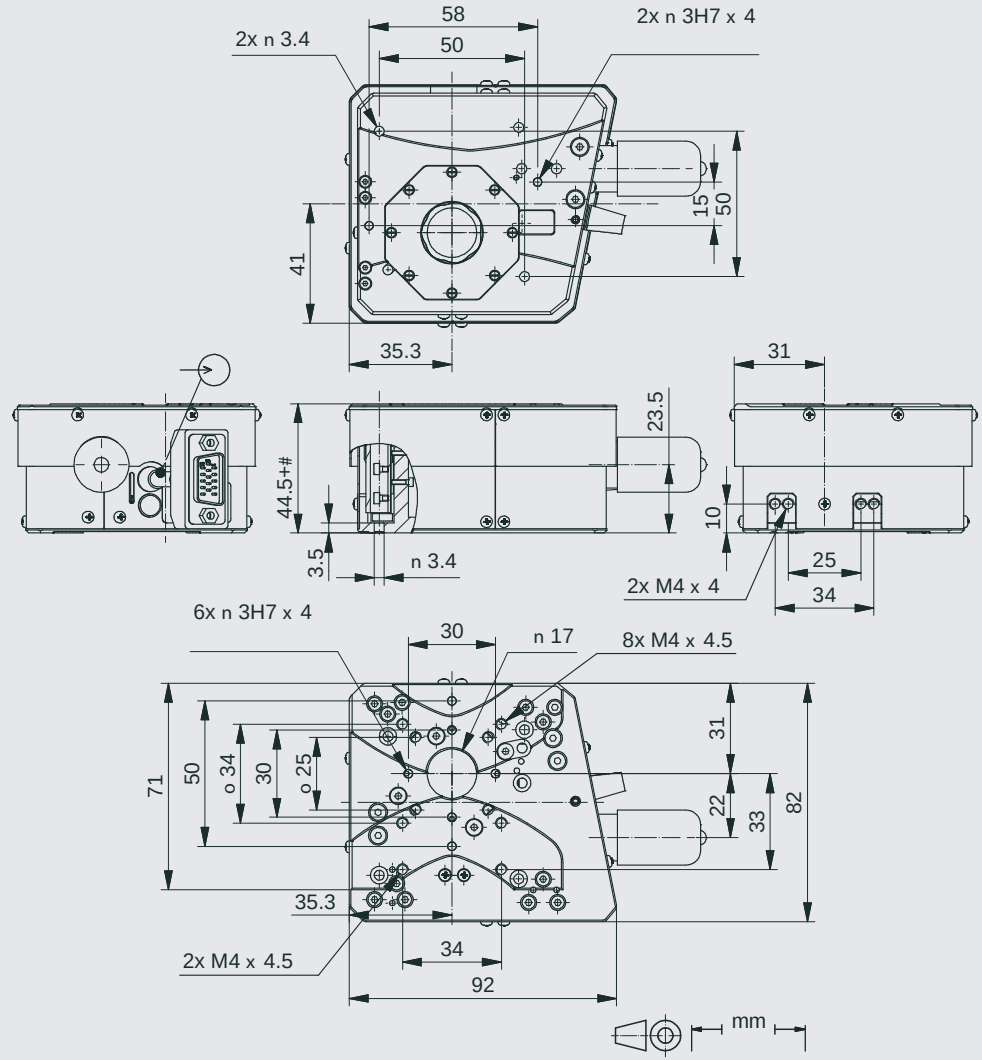
Accuracy	on request
Velocity range (mm/sec)	0.001 ... 0.1
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.



AM1524

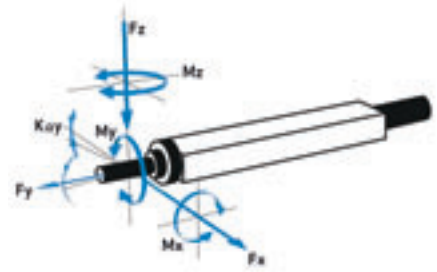
drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
AM1524 for FV
VSS 32.200.1.2-E for HV & UHVG



Order No.	6613-V-				0	0
FV	1					
HV	2					
UHVG	3					
13 mm (1/2")		1				
open loop				0		
closed loop (only up to HV)				1		

FACTS

Load characteristics	$F_{x(N)}$	$F_{y(N)}$	$F_{z(N)}$
FV	10	200	10
HV	10	200	10
UHVG	10	200	10



The MA-35 Vacuum micro actuator was designed for applications with limited space conditions or where high precision actuators must be positioned decoupled from the drive. Compared to other pushers, the standard force is very high and can be increased. The MA-35 Vacuum actuators are motorized with a special 2-phase gear-motor vacuum combination or as direct drive 2-phase stepper vacuum motor. The motorized drives can be combined with a ground preloaded re-circulating ball screw with 1 mm pitch. Depending on the requirement, the actuator can be configured for high pushing forces, high resolution or higher speed. The travel range is 52 mm (2"). Two integrated limit switches prevent damage from accidental over-travel. All critical elements are made of stainless steel.
Please see"GLOSSARY Vacuum Specification" for all vacuum specification.

KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range 52 mm (2")
- Uni-directional repeatability down to 0.2 µm
- Maximum speed 8 mm/sec
- Force max. 300 N
- Integrated limit switches
- High resolution

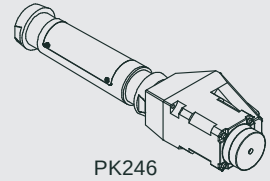
TECHNICAL DATA

Travel range (mm)	52
Weight (kg)	2

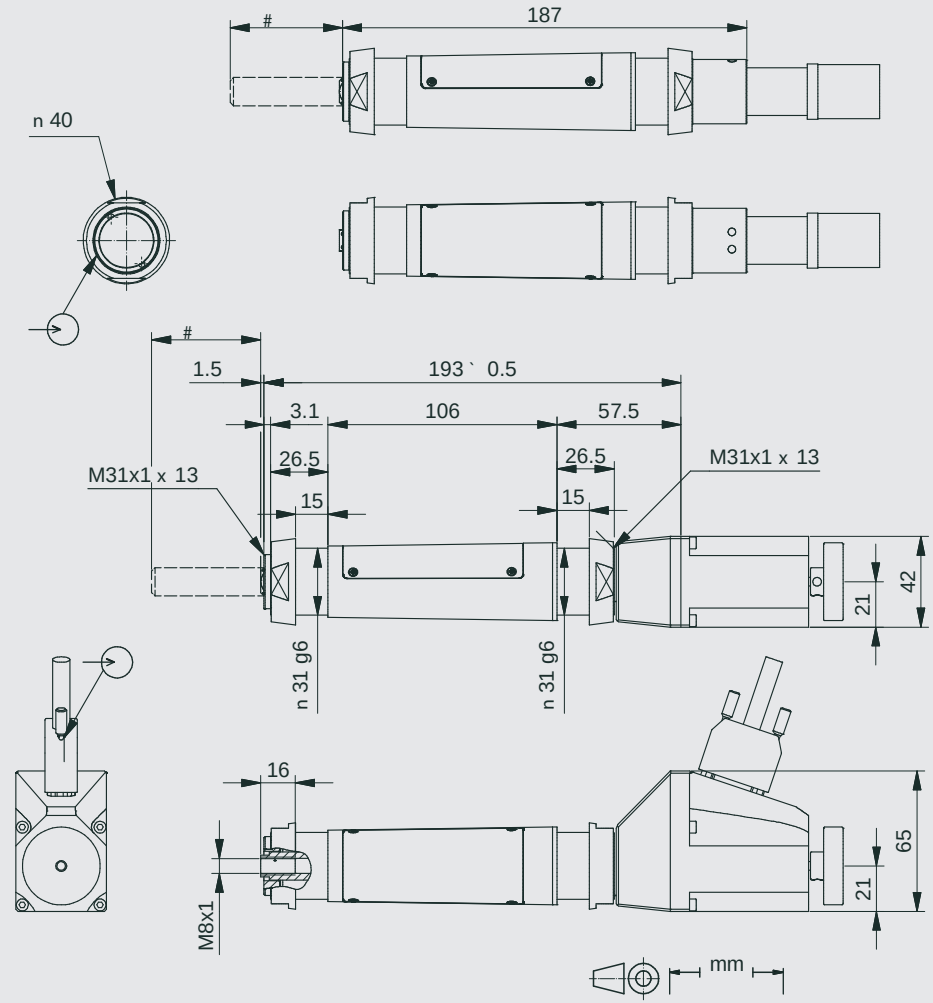
Vacuum type	FV	HV	UHVG
Speed max. (mm/sec)	8	3	3
Resolution calculated (µm)	5 (FS)	5 (FS)	5 (FS)
Resolution typical (µm)	0.1	0.1	0.1
Bi-directional Repeatability (µm)	± 1	± 1	± 1
Uni-directional Repeatability (µm)	0.2	0.2	0.2
Nominal Current (A)	1.2	1.2	1.2

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 6
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.



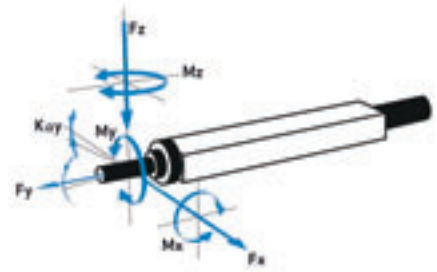
drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
PK246 for FV
VSS 43.200.1.2-E for HV & UHVG



Order No.	5702-V-			0	0	0
FV	1					
HV	2					
UHVG	3					
52 mm (2")		1				

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$
FV	1	125	1
10-6	1	125	1
HV	1	125	1
UHVG	1	125	1



The new MP-20 Vacuum micro pusher is designed to motorize manual drives or mirror mounts and it is an ideal component for limited space conditions. Small light components such as mirrors and diodes can be directly mounted to the tip. The MP-20 Vacuum micro pusher is equipped with a re-circulating ball screw for a quiet, precise and homogeneous smooth motion and has a non-rotating tip. The MP-20 Vacuum micro pushers are offered with 2-phase geared stepper vacuum motor combination or with a gearless 2-phase stepper vacuum motor. Round or flat ground inserts can be attached to the tip. The side-mounted design of model MP-20 B Vacuum results in much shorter length.

KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range up to 72 mm (3")
- Uni-directional repeatability 0.5 µm
- Maximum speed 0.2 mm/sec
- Force max. 125 N
- Integrated limit switches

TECHNICAL DATA

Travel range (mm)	13	26	52	77
Weight (kg)	0.22	0.26	0.28	0.29

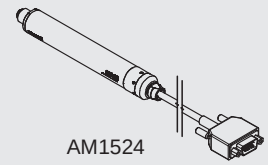
Vacuum type	FV	10-6	HV	UHVG
Speed max. (mm/sec)	0.2	0.1	0.1	0.1
Resolution calculated (µm)	0.5490171 (FS)	0.5490171 (FS)	5 (FS)	5 (FS)
Resolution typical (µm)	0.1	0.1	0.1	0.1
Bi-directional Repeatability (µm)	± 1	± 1	± 1	± 1
Uni-directional Repeatability (µm)	0.3	0.3	0.3	0.3
Nominal Current (A)	0.25	0.25	1.2	1.2

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 4
Material	Aluminum or Stainless steel, suitable for vacuum

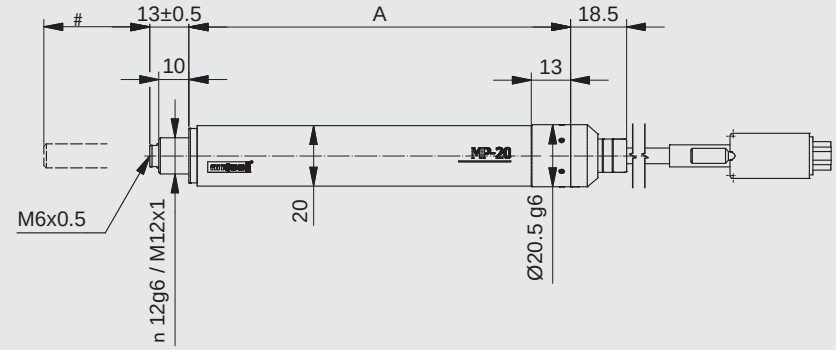
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

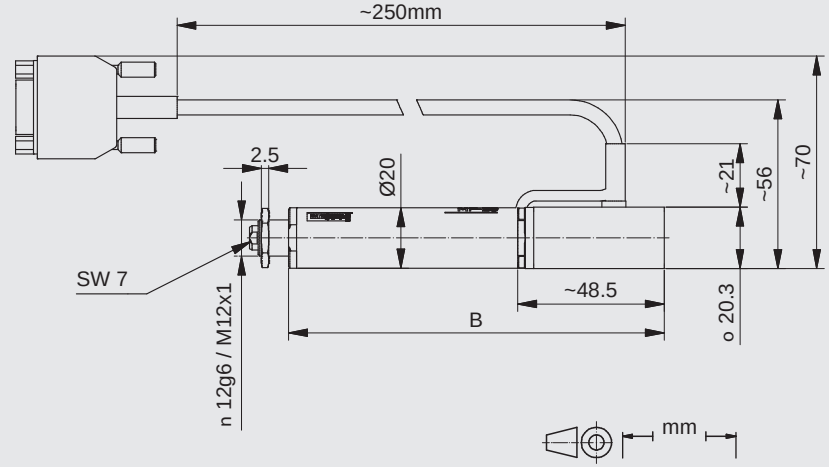
PI micos

Travel (mm)	13	26	52	77
A	126	139,5	164,5	189,5
B	124,5	137,7	162,7	187,7



drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
AM1524 for FV
VSS 32.200.1.2-E for HV & UHVG



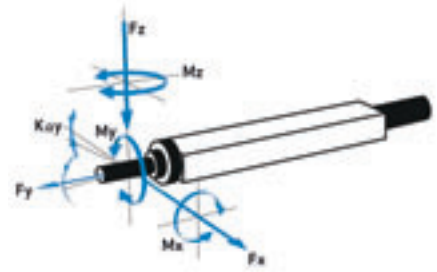


Order No.	5701-V-			0		0
FV	1					
HV	2					
UHVG	3					
10-6	6					
13 mm (1/2")		1				
26 mm (1")		2				
52 mm (2")		3				
77 mm (3")		4				
12g6			1			
M12x1			2			

4.120 Micro Pusher MP-20 B Vacuum

FACTS

Load characteristics	$F_{x(N)}$	$F_{y(N)}$	$F_{z(N)}$
FV	1	125	1
10-6	1	125	1



The new MP-20 B Vacuum micro pusher is designed to motorize manual drives or mirror mounts and it is an ideal component for limited space conditions. Small light components such as mirrors and diodes can be directly mounted to the tip. The MP-20 B Vacuum micro pusher is equipped with a re-circulating ball screw for a quiet, precise and homogeneous smooth motion and has a non-rotating tip. The MP-20 B Vacuum micro pushers are offered with a 2-phase geared stepper vacuum motor combination or with a gearless 2-phase stepper vacuum motor. Round or flat ground inserts can be attached to the tip. The side-mounted design of model MP-20 B results in much shorter length.

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KEY FEATURES

- Vacuum up to 10-6 hPa
- Travel range up to 76 mm (3")
- Uni directional repeatability 0.5 µm
- Max. speed 0.2 mm/sec
- Force 125 N
- Integrated limit switches

TECHNICAL DATA

Travel range (mm)	13	26	52	77
Weight (kg)	0.24	0.26	0.28	0.29

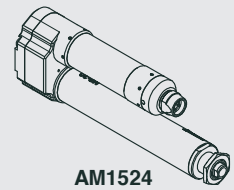
Vacuum type	FV	10-6
Speed max. (mm/sec)	0.2	0.07
Resolution calculated (µm)	0.5490171 (FS)	0.5490171 (FS)
Resolution typical (µm)	0.2	0.2
Bi-directional Repeatability (µm)	± 1.5	± 1.5
Uni-directional Repeatability (µm)	0.5	0.5
Nominal Current (A)	0.25	0.25

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 0.6
Material	Aluminum or Stainless steel, suitable for vacuum

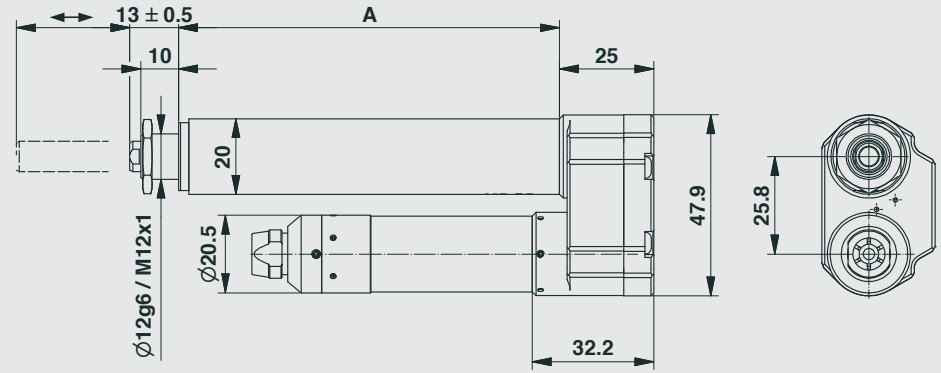
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

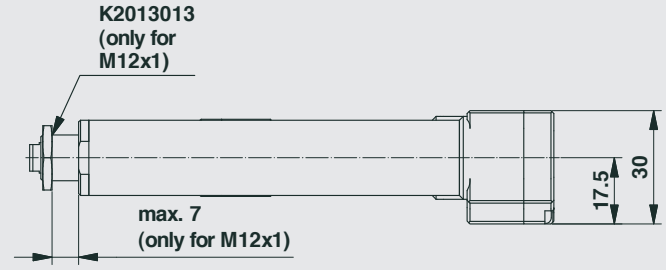
PI micos

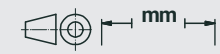
Travel (mm)	13	26	52	77
A	63	76	101	125,5



drawings for the corresponding vacuum class must be requested separately. The installed motor type is: AM1524 for FV



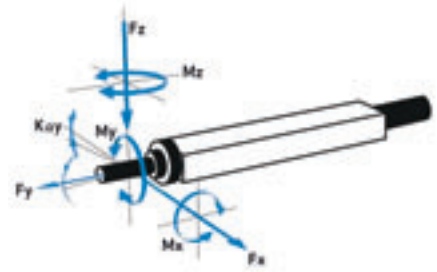




Order No.	5696-V-			0		0
FV	1					
10-6	6					
13 mm (1/2")		1				
26 mm (1")		2				
52 mm (2")		3				
77 mm (3")		4				
12g6			1			
M12x1			2			

FACTS

Load characteristics	$F_{x(N)}$	$F_{y(N)}$	$F_{z(N)}$
FV	0	10	0
10-6	0	10	0



The MP-15 Vacuum micro pusher was specifically designed to motorize manual drives or mirror mounts. It is an ideal component for limited space conditions. The MP-15 Vacuum micro pusher is equipped with a 0.5 mm fine-pitch screw thread resulting in a quiet and homogeneous smooth motion. The MP-15 is offered with 2-phase geared stepper motor and is delivered with two integrated limit switches.

KEY FEATURES

- Vacuum up to 10-6 hPa
- Travel range up to 12.7 mm
- Uni-directional repeatability down to 0.5 µm
- Maximum speed 0.03 mm/sec
- Force max. 10 N
- Integrated limit switches

TECHNICAL DATA

Travel range (mm)	6	12.7
Weight (kg)	0.1	0.17

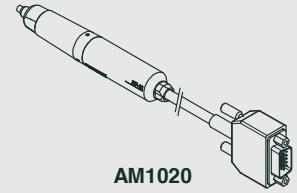
Vacuum type	FV	10-6
Speed max. (mm/sec)	0.03	0.01
Resolution calculated (µm)	0.0976563 (FS)	0.0976563 (FS)
Resolution typical (µm)	0.2	0.2
Bi-directional Repeatability (µm)	± 10	± 10
Uni-directional Repeatability (µm)	0.5	0.5
Nominal Current (A)	0.25	0.25

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 0.1
Material	Aluminum or Stainless steel, suitable for vacuum

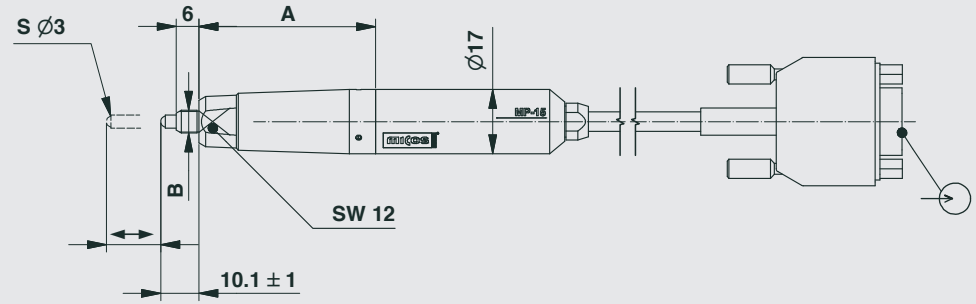
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos

Travel (mm)	6	12.7
A	33,5	47

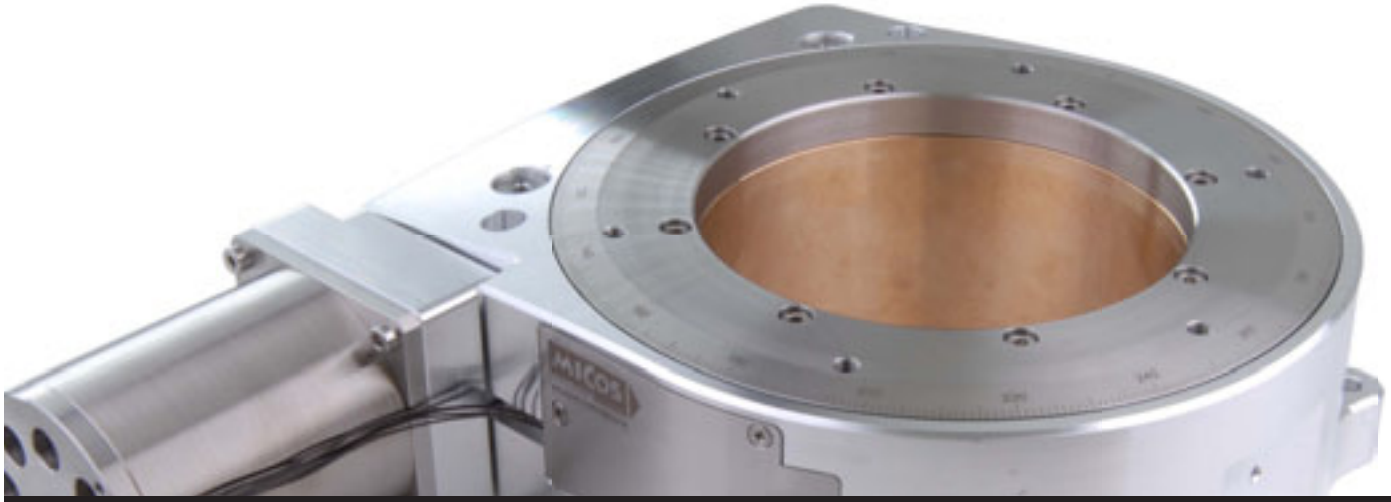


drawings for the corresponding vacuum class must be requested separately. The installed motor type is: AM1020 for FV



mm

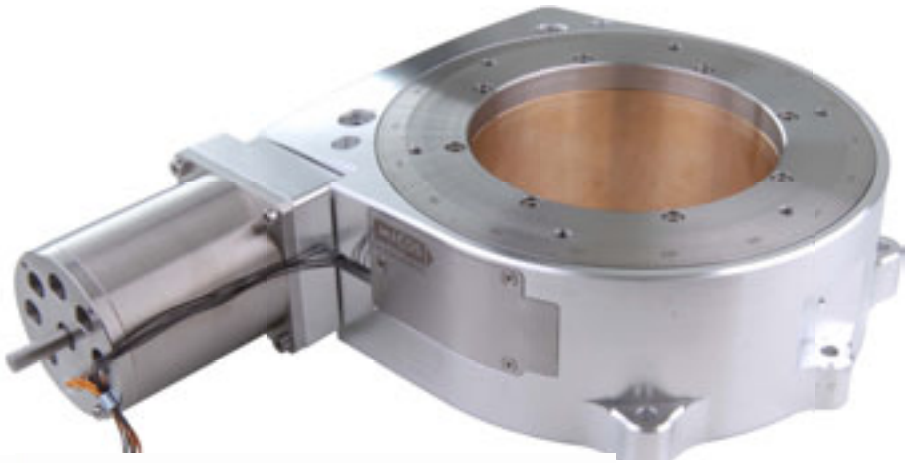
Order No.	5663-V-			0		0
FV	1					
10-6	6					
6 mm		1				
12.7 mm		2				
Mounting surface B=Ø6 mm			1			
Mounting surface B=Ø9.5 mm			2			
Mounting surface B=M8x0.35 mm			3			
Mounting surface B=M6x0.5 mm			4			

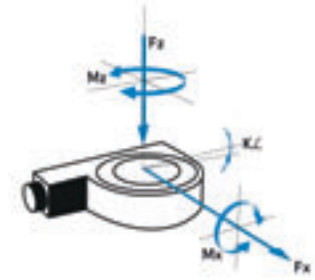


ROTATION STAGES

FACTS

Load characteristics	$Fx_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$
FV	200	500	60	4	10
HV	200	500	60	4	10
UHVG	200	500	60	4	10





The large 120 mm diameter clear aperture is particularly significant for the PRS-200 Vacuum rotation stages. The body is fabricated from a special, high-rigidity, tempered aluminum alloy. Two calibrated preloaded zero backlash precision roller bearings guarantee an excellent flatness and smooth motion. A hardened and ground screw worm combined with a calibrated worm gear guarantee a quiet and smooth motion. As an option, the PRS-200 Vacuum stages can be delivered with an integrated optical angular scale. The PRS-200 Vacuum rotation stages are equipped with two reference switches which can be easily adjusted by the user. Drive variations is driven with a special 2-phase stepper vacuum motor.

KEY FEATURES

- Vacuum up to 10-9 hPa
- Uni-directional repeatability down to 0.0003 °
- Maximum speed 10 °/sec
- Load capacity up to 50 kg
- Integrated reference limit switches
- Limit switch adjustable
- Option: angular scale
- Clear aperture 120 mm

TECHNICAL DATA

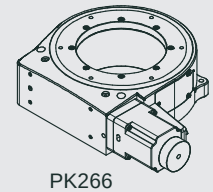
Travel range (°)	360
Flatness (Bearings) (µm)	± 1
Eccentricity (Bearings) (µm)	± 2.5
Wobble (Bearings) (µrad)	± 17.5
Weight (kg)	8

Vacuum type	FV	HV	UHVG	
Linear scale				HV
Speed max. (°/sec)	10	4	2	
Resolution calculated (°)	0.01 (FS)	0.01 (FS)	0.01 (FS)	0.00002
Resolution typical (°)	0.001	0.001	0.001	0.0003
Bi-directional Repeatability (°)	± 0.001	± 0.001	± 0.001	± 0.0005
Uni-directional Repeatability (°)	0.002	0.002	0.002	0.0003
Nominal Current (A)	2	2.5	2.5	

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 10
Material	Aluminum, stainless steel, red brass

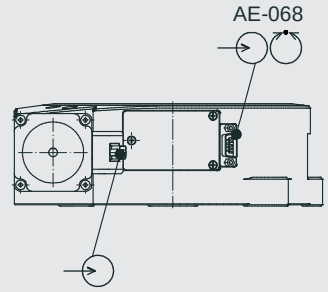
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

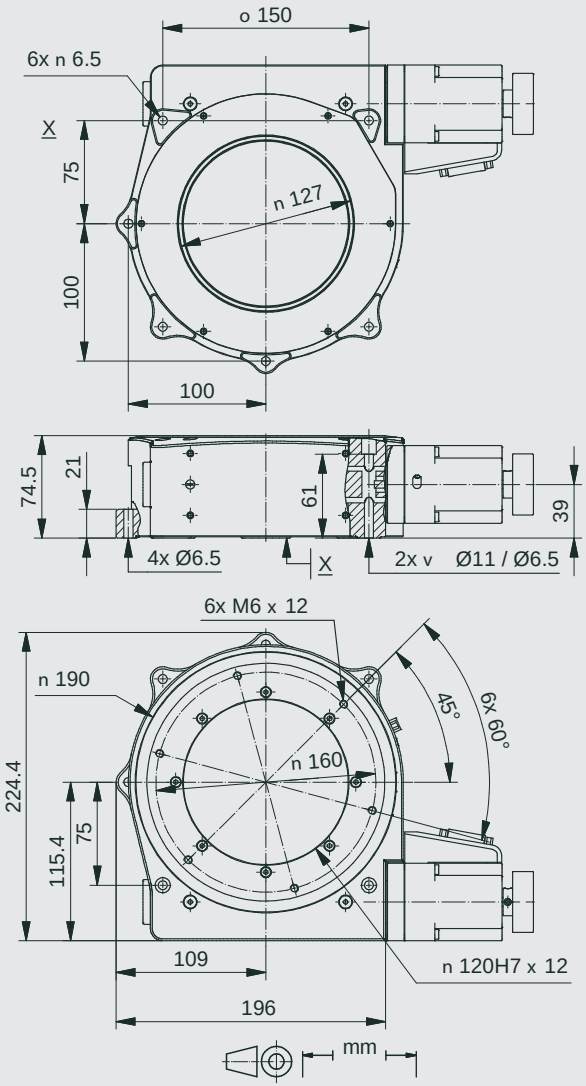
PI micos



PK266

drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
PK266 for FV
VSS 65.200.1.2-E for HV & UHVG



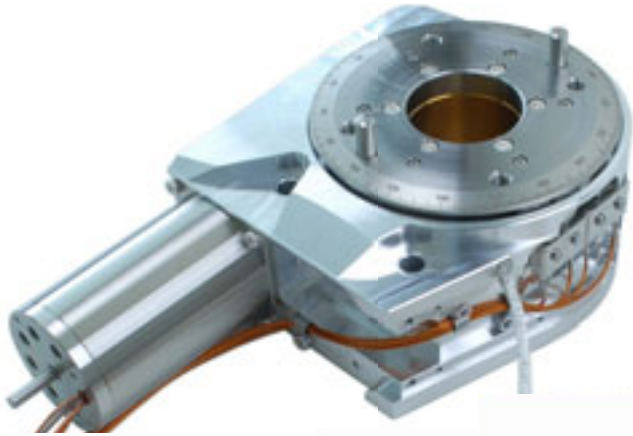


Order No.	6449-V-		1		0	0
FV		1				
HV		2				
UHVG		3				
open loop					0	
closed loop					1	

5.128 Precision Rotation Stage PRS-110 Vacuum

FACTS

Load characteristics	$Fx_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	50	100	40	3	30	30
HV	50	100	40	3	30	30
UHVG	50	100	40	3	30	30



KEY FEATURES

- Vacuum up to 10-9 hPa
- Uni-directional repeatability down to 0.0002 °
- Maximum speed 15 °/sec
- Load capacity up to 10 kg
- Integrated limit switches
- Limit switch adjustable
- Option: angular scale
- Clear aperture 35 mm

The PRS-110 Vacuum precision rotation stages can be used in a wide range of industrial and scientific applications. They are a good fit with the LS-110 Vacuum linear stages and ES-100 Vacuum elevation stages. The body is fabricated from a special, high-rigidity tempered aluminum alloy. Two calibrated and preloaded four-point contact bearings guarantee excellent wobble, flatness and eccentricity specifications. A hardened and ground worm screw combined with a calibrated worm gear insure a smooth and accurate motion. The PRS-110Vacuum precision rotation stages can be equipped with optical angular scales. Resolutions up to 0.0002° are standard. The PRS-110 Vacuum precision rotation stages are equipped with reference switches and is motorized with a special 2-phase vacuum stepper motor.

TECHNICAL DATA

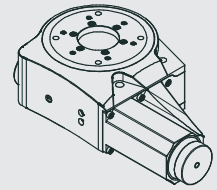
Travel range (°)	360
Flatness (Bearings) (µm)	± 1
Eccentricity (Bearings) (µm)	± 2.5
Wobble (Bearings) (µrad)	± 15
Weight (kg)	2.6

Vacuum type	FV	HV	UHVG	
Linear scale				HV
Speed max. (°/sec)	15	6	2.7	
Resolution calculated (°)	0.02 (FS)	0.02 (FS)	0.02 (FS)	0.0001
Resolution typical (°)	0.002	0.002	0.002	0.0002
Bi-directional Repeatability (°)	± 0.01	± 0.01	± 0.01	± 0.0002
Uni-directional Repeatability (°)	0.002	0.002	0.002	0.0002
Nominal Current (A)	1.5	1.2	1.2	

Worm gear reduction	90:1
Accuracy	on request
Velocity range (mm/sec)	0.002 ... 15
Material	Aluminum, stainless steel, red brass

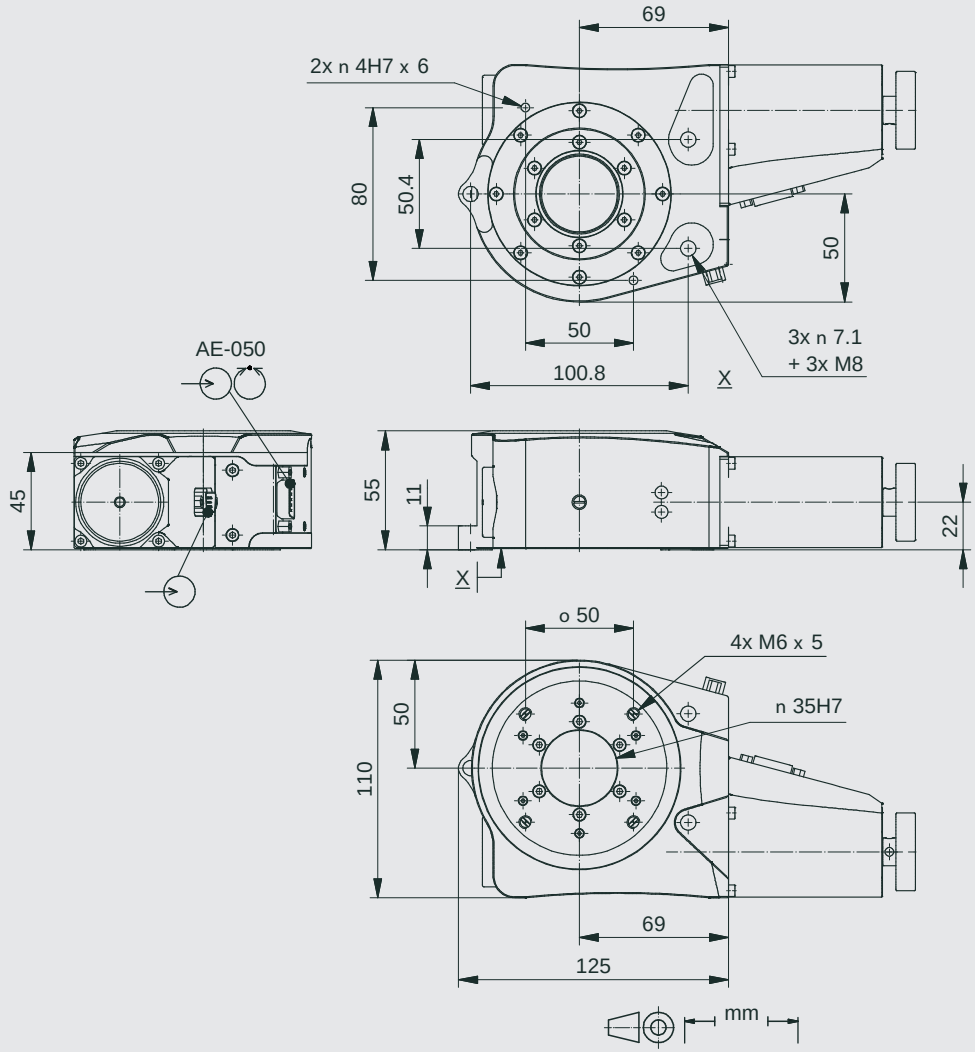
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos



VSS43.200.1.2-E

drawings for the corresponding
vaccum class must be requested separately.
The installed motor types are:
PK245 für FV
VSS 42.200.1.2-E für HV & UHVG

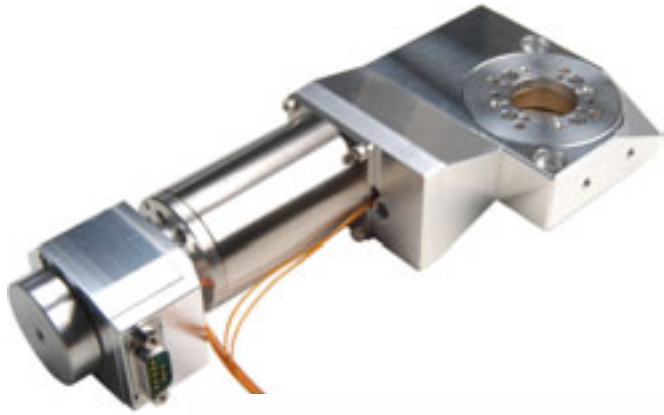


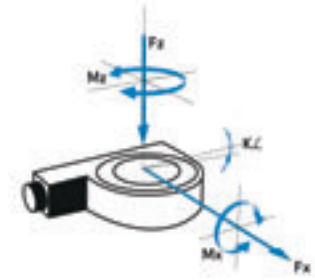
Order No.	6447-V-		1		0	0
FV		1				
HV		2				
UHVG		3				
open loop					0	
closed loop					1	

5.130 Rotation Stage DT-65 N Vacuum

FACTS

Load characteristics	$Fx_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$
FV	15	30	10	0.8	180
10-6	15	30	10	0.8	180
HV	15	30	10	0.8	180
UHVG	15	30	10	0.8	180





The rotation stages DT-65N Vacuum are fabricated from a special high-rigidity tempered aluminum alloy. A pre-loaded four-point double row ball bearing guarantees good wobble and flatness specifications. A hardened and ground worm screw combined with a calibrated worm gear guarantees minimum backlash. All motorized rotation DT-65 N Vacuum stages are equipped with a reference switch. Stages are driven wit a special 2-phase stepper vacuum motor.

KEY FEATURES

- Vacuum up to 10-9 hPa
- Uni-directional repeatability down to 0.002°
- Maximum speed 15 °/sec
- Load capacity up to 3 kg
- Integrated mechanical reference switch
- Clear aperture 25 mm
- Optionally rotary encoder on the rotation axis

TECHNICAL DATA

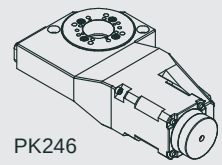
Travel range (°)	360
Flatness (Bearings) (µm)	± 6
Eccentricity (Bearings) (µm)	± 6
Wobble (Bearings) (µrad)	± 30
Weight (kg)	1.3

Vacuum type	FV	10-6	HV	UHVG
Speed max. (°/sec)	15	5	5	2.5
Resolution calculated (°)	0.01 (FS)	0.01 (FS)	0.01 (FS)	0.01 (FS)
Resolution typical (°)	0.002	0.002	0.002	0.002
Bi-directional Repeatability (°)	± 0.01	± 0.01	± 0.01	± 0.01
Uni-directional Repeatability (°)	0.002	0.002	0.002	0.002
Nominal Current (A)	1.5	1.5	1.2	1.2

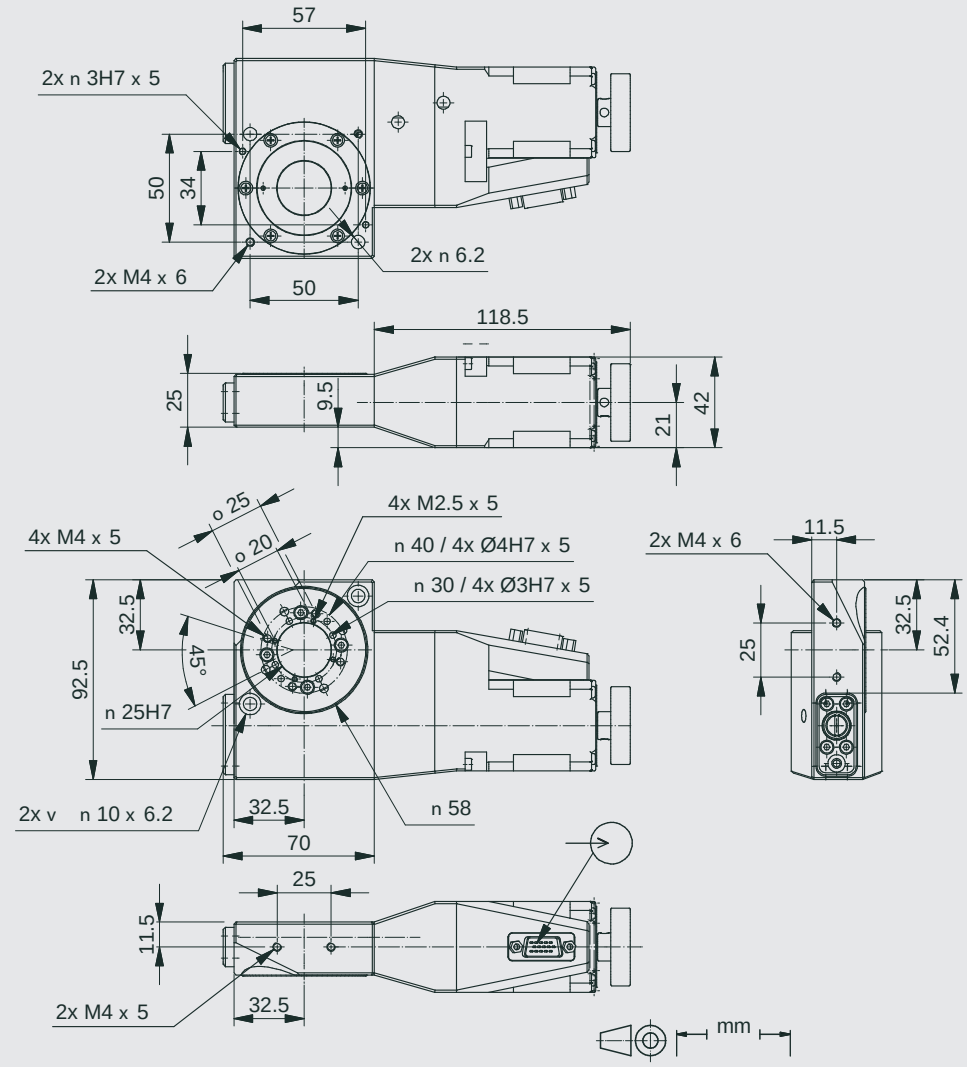
Accuracy	on request
Velocity range (mm/sec)	0.001 ... 10
Material	Aluminum, stainless steel, red brass

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos


PK246

drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
PK246 for FV
VSS 43.200.1.2-E for HV & UHVG

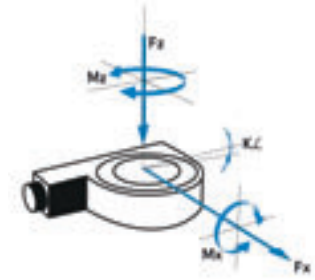


Order No.	6440-V-		1	0	0	0
FV		1				
HV		2				
UHVG		3				
10-6		6				

5.132 Rotation Stage RS-40 Vacuum

FACTS

Load characteristics	$Fx_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$
FV	5	10	1	0.2	270
10-6	5	10	1	0.2	270
HV	5	10	1	0.2	270
UHVG	5	10	1	0.2	270



The RS-40 Vacuum rotation stage is very compact but offers a big 20 mm (25 mm holding diameter) aperture. A precision bearing guarantees a perfectly smooth move. The RS-40 Vacuum rotation stages have nearly zero backlash worm gear reduction. All RS-40Vacuum motorized rotation stages are equipped with a reference switch and are offered with a special 2-phase geared vauum stepper motor.

Please see"GLOSSARY Vacuum Specification" for all vacuum specification.

KEY FEATURES

- Vacuum up to 10-9 hPa
- Clear aperture 20 mm
- Uni-directional repeatability down to 0.005 °
- Maximum speed 1.5 °/sec
- Load capacity up to 1 kg
- Integrated hall reference switch
- Optionally rotary encoder on the rotation axis

TECHNICAL DATA

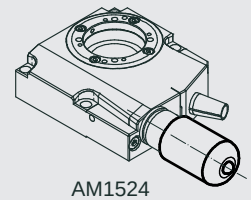
Travel range (°)	360
Flatness (Bearings) (µm)	± 5
Eccentricity (Bearings) (µm)	± 5
Wobble (Bearings) (µrad)	± 35
Weight (kg)	0.4

Vacuum type	FV	10-6	HV	UHVG
Speed max. (°/sec)	1.5	0.6	0.6	0.27
Resolution calculated (°)	0.0021961 (FS)	0.0021961 (FS)	0.02 (FS)	0.02 (FS)
Resolution typical (°)	0.005	0.005	0.002	0.002
Bi-directional Repeatability (°)	± 0.04	± 0.04	± 0.03	± 0.03
Uni-directional Repeatability (°)	0.005	0.005	0.015	0.015
Nominal Current (A)	0.25	0.25	1.2	1.2

Accuracy	on request
Velocity range (mm/sec)	0.002 ... 1.5
Material	Aluminum, stainless steel, red brass

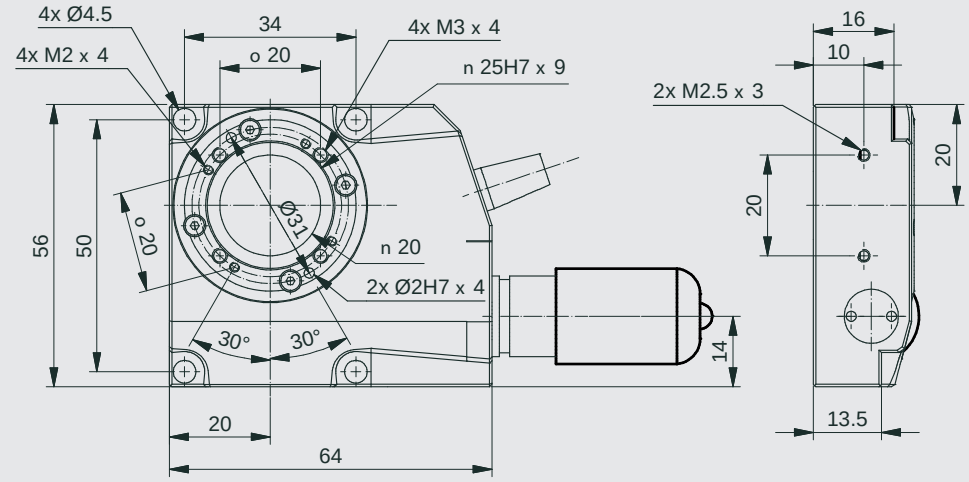
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

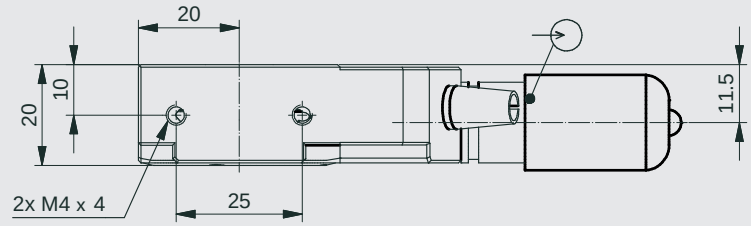
PI micos



AM1524

drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
AM1524 for FV
VSS 25.200.1.2-E for HV & UHVG





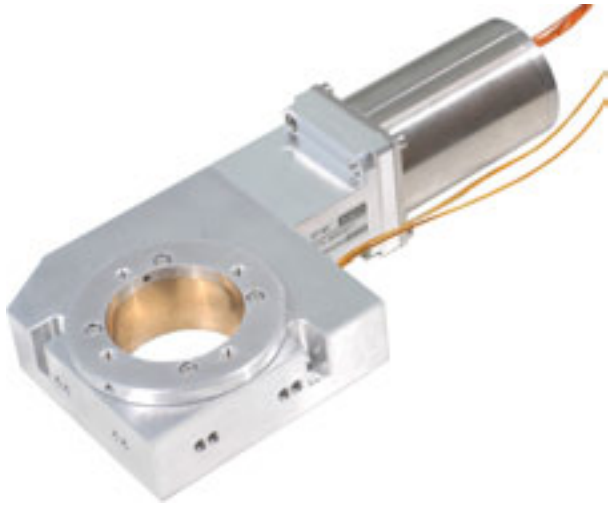
mm

Order No.	3216-V-		1	0	0	0
FV		1				
HV		2				
UHVG		3				
10-6		5				

5.134 Rotation Stage DT-80 Vacuum

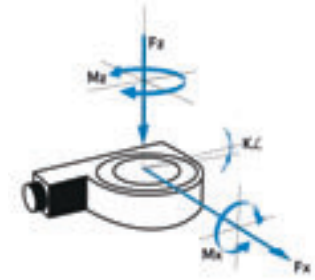
FACTS

Load characteristics	$Fx_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$
FV	10	20	5	0.1	150
10-6	10	20	5	0.1	150
HV	10	20	5	0.1	150
UHVG	10	20	5	0.1	150



KEY FEATURES

- Vacuum up to 10-9 hPa
- Uni-directional repeatability down to 0.01 °
- Maximum speed 10 °/sec
- Load capacity up to 2 kg
- Integrated mechanical reference switch
- Clear aperture 40 mm



The DT-80 Vacuum rotation stages are a low cost alternative to the PI miCos DT-65 N Vacuum and PRS-110 Vacuum high precision rotation stages. They are mainly developed for simple positioning in the laboratory. The large aperture of 40 mm diameter is suitable for many applications in the microscopy area. The worm screw and worm gear combination is preloaded to produce a near "zero-backlash" and smooth motion. Rotation stages of the DT-80 Vacuum series is driven by a special 2-phase stepper vacuum motor and are equipped with a reference switch.

TECHNICAL DATA

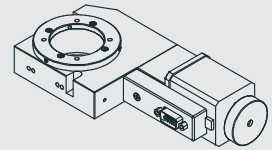
Travel range (°)	360
Flatness (Bearings) (µm)	± 30
Eccentricity (Bearings) (µm)	± 30
Wobble (Bearings) (µrad)	± 100
Weight (kg)	0.8

Vacuum type	FV	10-6	HV	UHVG
Speed max. (°/sec)	10	3.7	3.7	1.6
Resolution calculated (°)	0.01 (FS)	0.01 (FS)	0.01 (FS)	0.01 (FS)
Resolution typical (°)	0.004	0.004	0.004	0.004
Bi-directional Repeatability (°)	± 0.2	± 0.2	± 0.2	± 0.2
Uni-directional Repeatability (°)	0.01	0.01	0.01	0.01
Nominal Current (A)	1.2	1.2	1.2	1.2

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 10
Material	Aluminum, stainless steel, red brass

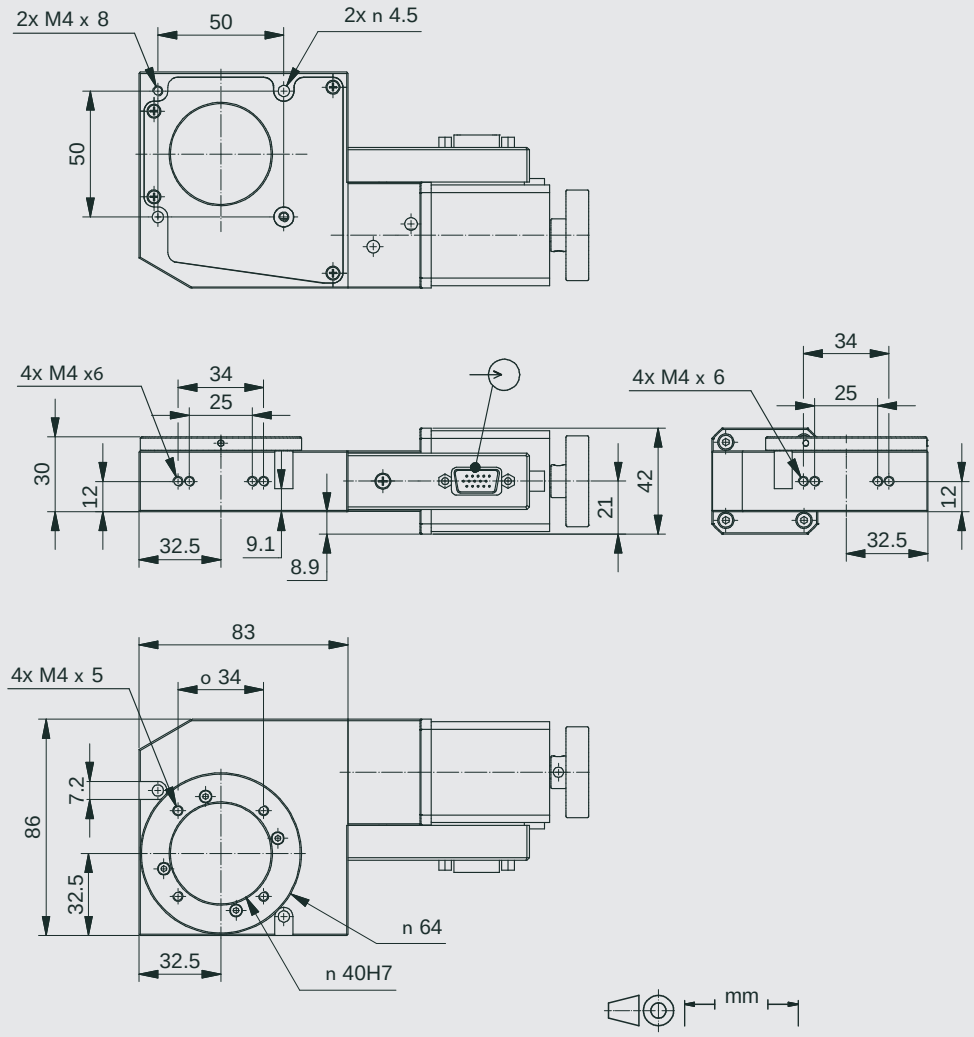
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI miCos



PK245

drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
PK245 for FV
VSS 42.200.1.2-E for HV & UHVG

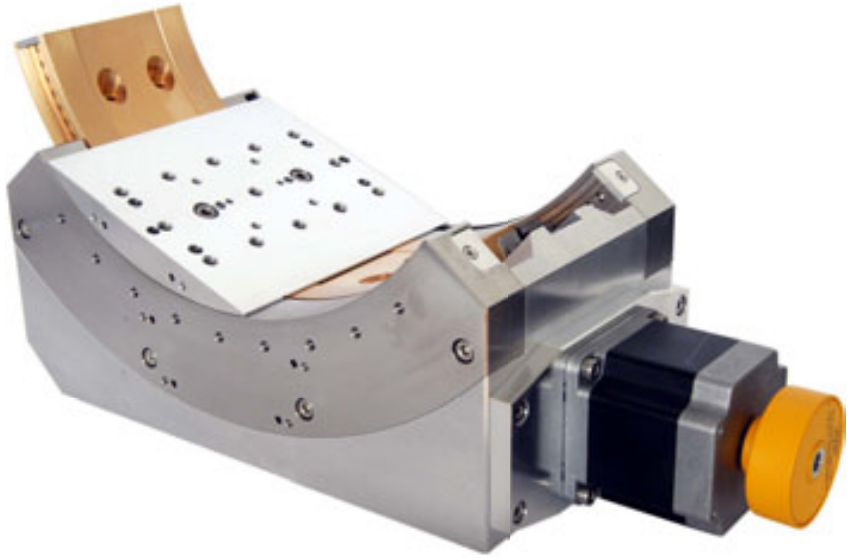


Order No.	6443-V-		1	0	0	0
FV		1				
HV		2				
UHVG		3				

5.136 Goniometer WT-120 Vacuum

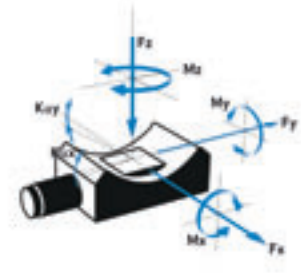
FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	90	90	200	8	25	25	15	15
HV	90	90	200	8	25	25	15	15
UHVG	90	90	250	8	25	25	15	15



KEY FEATURES

- Vacuum up to 10-9 hPa
- Uni-directional repeatability down to 0.001°
- Max. speed 8°/sec
- Load capacity up to 20 kg
- Integrated Mechanical Limit Switches
- Limit switch adjustable
- Option: angular scale
- Together with W T-90 one centre of rotation



The WT-120 Vacuum goniometer stage is designed for all tasks where conventional rotation stages cannot be used due to limited space conditions. Typical uses are applications in the area of laser positioning and radiology. The WT-120 Vacuum and WT-90 Vacuum goniometer stages are matched to work together. When mounted orthogonally to each other they have a common center of rotation. The WT-120 Vacuum stage is equipped with a ground bearing guide. The ground and hardened worm screw and worm gear combination produces a very quiet and smooth motion. The stages are directly driven by a special 2-phase vacuum stepper motor and can achieve a relatively high speed. The WT-120 stages can be equipped with an optical angular scale system and have two limit switches.

Please see"GLOSSARY Vacuum Specification" for all vacuum specification.

TECHNICAL DATA

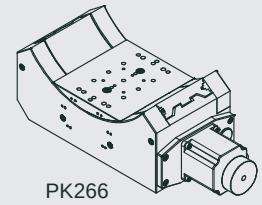
Travel range (°)	90
Wobble (Bearings) (µrad)	± 125
Weight (kg)	11.5

Vacuum type	FV	HV	UHVG	
Linear scale				HV
Speed max. (°/sec)	8	3	1.3	
Resolution calculated (°)	0.01 (FS)	0.01 (FS)	0.01 (FS)	0.00009
Resolution typical (°)	0.004	0.004	0.004	0.001
Bi-directional Repeatability (°)	± 0.02	± 0.02	± 0.02	± 0.001
Uni-directional Repeatability (°)	0.005	0.005	0.005	0.001
Nominal Current (A)	2	2.5	2.5	

Accuracy	on request
Velocity range (mm/sec)	0.001 ... 6
Material	Aluminum, stainless steel, red brass

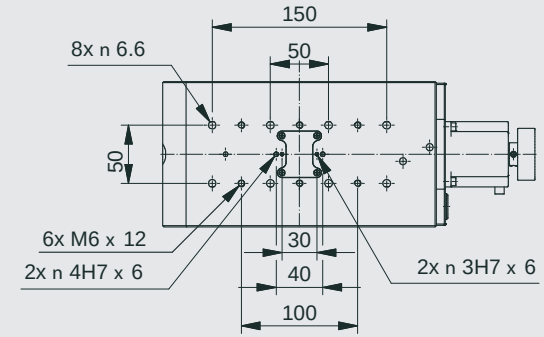
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

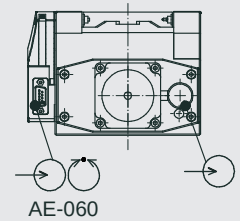
PI micos



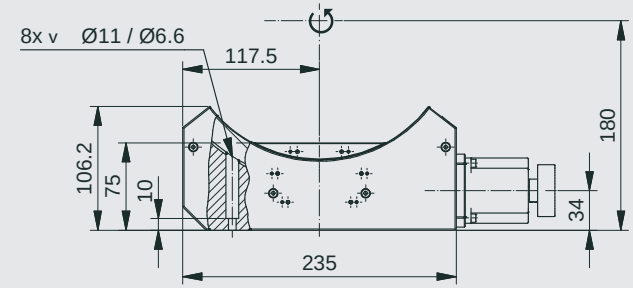
PK266

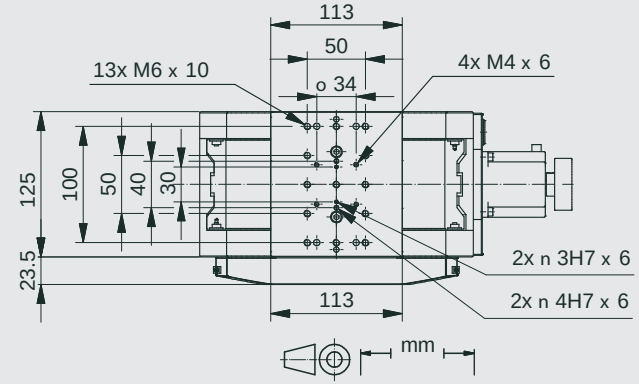
drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
PK266 for FV
VSS 65.200.1.2-E for HV & UHVG





AE-060



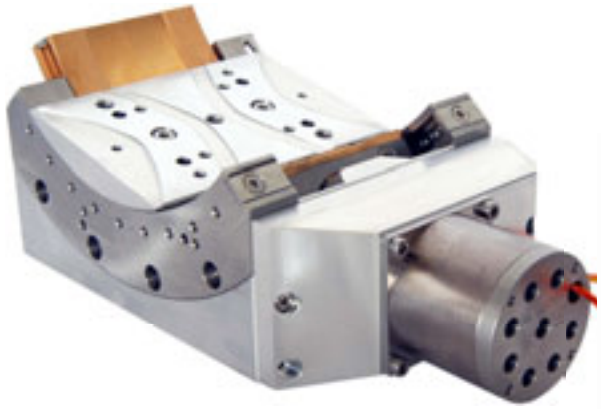


Order No.	6560-V-		1		0	0
FV	1					
HV	2					
UHVG	3					
open loop	0					
closed loop	1					

5.138 Goniometer WT-90 Vacuum

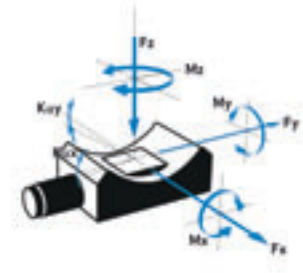
FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	50	50	80	2.5	12	12	25	25
HV	50	50	80	2.5	12	12	25	25
UHVG	50	50	80	2.5	12	12	25	25



KEY FEATURES

- Vacuum up to 10-9 hPa
- Uni-directional repeatability down to 0.001 °
- Maximum speed 4 °/sec
- Load capacity up to 8 kg
- Integrated mechanical limit switches
- Together with W T-120 one centre of rotation
- Option: Integrated angular scale



The WT-90 Vacuum goniometer stage is designed for all tasks where conventional rotation stages cannot be used due to limited space conditions. Typical uses are applications in the area of laser positioning and radiology. The WT-120 Vacuum and WT-90 Vacuum goniometer stages are matched to work together. When mounted orthogonally to each other they have a common center of rotation. The WT-90 Vacuum is equipped with a ground bearing guide. The ground and hardened worm screw and worm gear combination produces a very quiet and smooth motion. The stages are directly driven by a special 2-phase stepper vacuum motor and can achieve a relatively high speed. The WT-90 stages can be equipped with an optical angular scale system and have two limit switches.

Please see"GLOSSARY Vacuum Specification" for all vacuum specification.

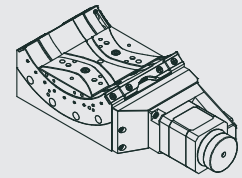
TECHNICAL DATA

Travel range (°)	90
Wobble (Bearings) (µrad)	± 125
Weight (kg)	2.8

Vacuum type	FV	HV	UHVG	
Linear scale				HV
Speed max. (°/sec)	4	1.5	0.6	
Resolution calculated (°)	0.005 (FS)	0.005 (FS)	0.005 (FS)	0.0001542
Resolution typical (°)	0.004	0.004	0.004	0.001
Bi-directional Repeatability (°)	± 0.002	± 0.002	± 0.002	± 0.001
Uni-directional Repeatability (°)	0.005	0.005	0.005	0.001
Nominal Current (A)	1.2	1.2	1.2	

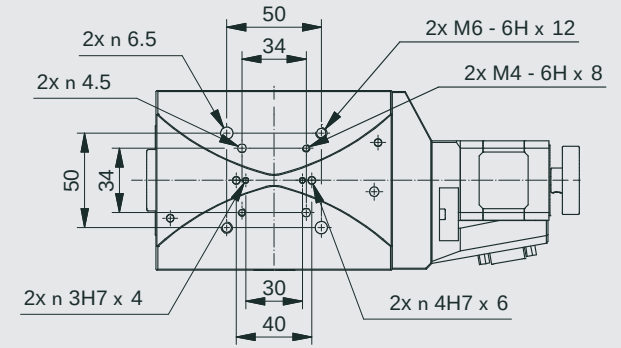
Accuracy	on request
Velocity range (mm/sec)	0.001 ... 4
Material	Aluminum, stainless steel

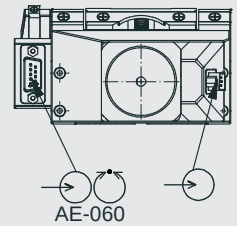
Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

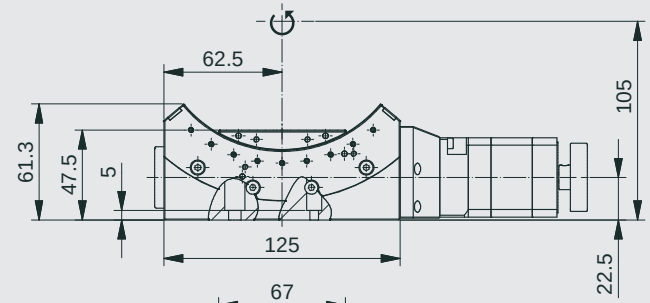


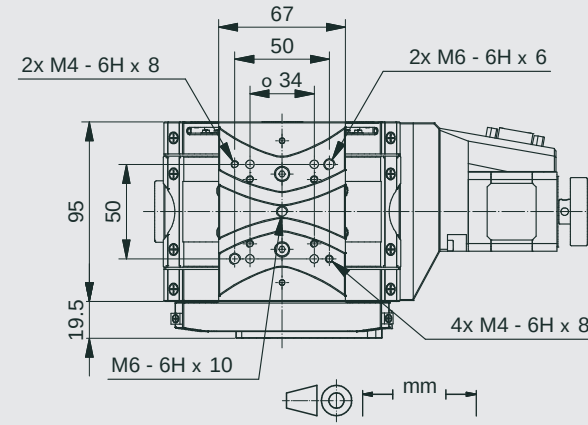
ZSS 43

drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
ZSS 43.200.1.2-E for FV
VSS 43.200.1.2-E for HV & UHVG









Order No.	6550-V-		1		0	0
FV		1				
HV		2				
UHVG		3				
open loop					0	
closed loop					1	

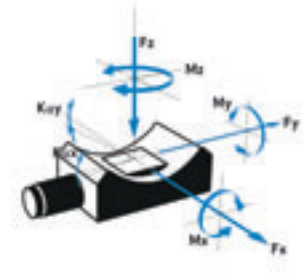
5.140 Goniometer WT-100 Vacuum

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	15	15	20	0.75	4	4	80	80
HV	15	15	20	0.75	4	4	80	80
UHVG	15	15	20	0.75	4	4	80	80

KEY FEATURES

- Vacuum upt 10-9 hPa
- Uni-directional repeatability down to 0.0005 °
- Maximum speed 2 °/sec
- Load capacity up to 2 kg
- Integrated mechanical limit switches
- Clear aperture 60 x 25 mm
- Precise, smooth continuous 10° motion
- Together with W T-85 one centre of rotation
- Option: Integrated angular scale



The WT-100 Vacuum goniometer stage is designed for all tasks where conventional rotation stages cannot be used due to limited space conditions or where a clear aperture is needed. Typical applications are metrology tasks in the area of laser technology and radiology. The WT-100 Vacuum and WT-85 Vacuum goniometer stages are designed to work together. When mounted orthogonally to each other they have a common center of rotation. The WT-100 Vacuum has a 60 x 25 mm clear aperture. A unique driving mechanism insures a very quiet and smooth motion. The stages are driven directly by a special 2-phase stepper vacuum motor and can achieve a relatively high speed. The WT-100 Vacuum stage is available with optional optical angular scales and is equipped with two limit switches.

Please see"GLOSSARY Vacuum Specification" for all vacuum specification.

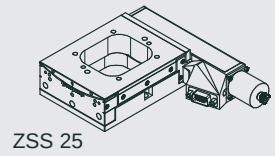
TECHNICAL DATA

Travel range (°)	10
Wobble (Bearings) (µrad)	± 125
Weight (kg)	0.9

Vacuum type	FV	HV	UHVG	
Linear scale				HV
Speed max. (°/sec)	2	0.8	0.4	
Resolution calculated (°)	0.002 (FS)	0.002 (FS)	0.002 (FS)	0.00009
Resolution typical (°)	0.001	0.001	0.001	0.0005
Bi-directional Repeatability (°)	± 0.004	± 0.004	± 0.004	± 0.0005
Uni-directional Repeatability (°)	0.004	0.004	0.004	0.0005
Nominal Current (A)	1.2	1.2	1.2	

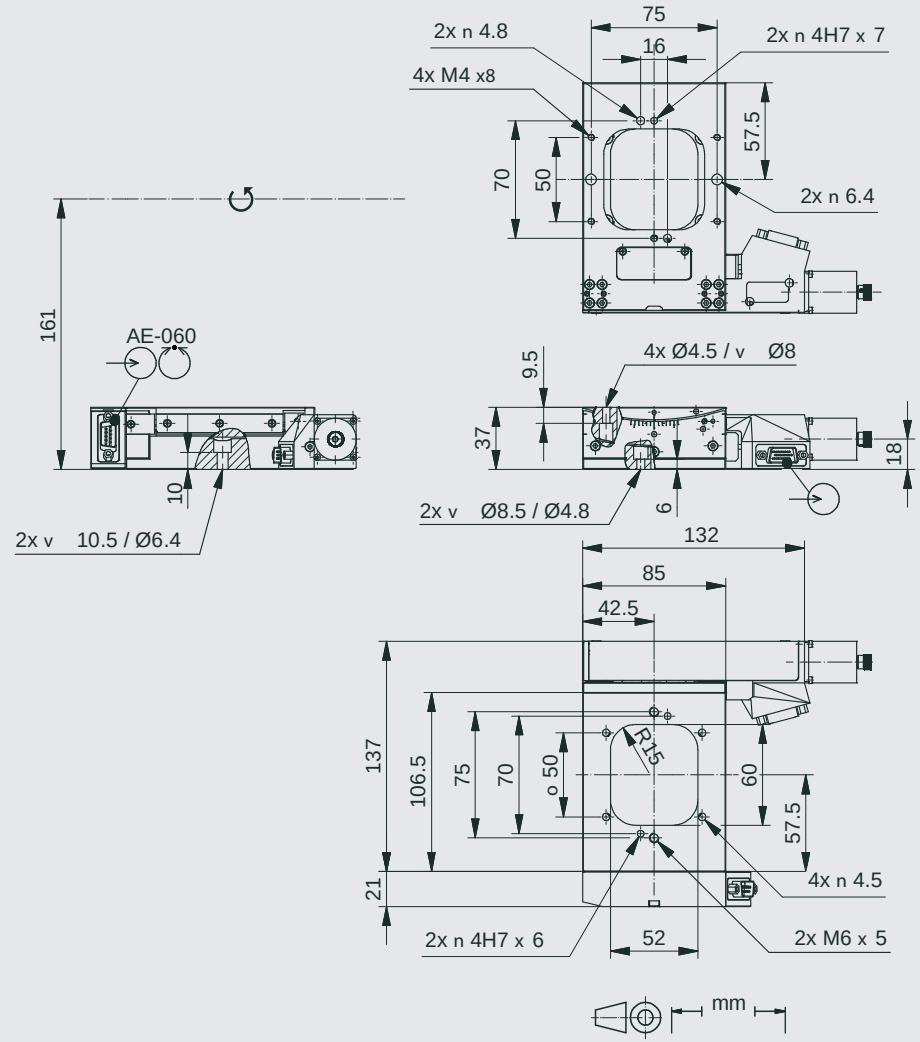
Accuracy	on request
Velocity range (mm/sec)	0.001 ... 2
Material	Aluminum, stainless steel

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.



ZSS 25

drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
ZSS 25.200.1.2-E for FV
VSS 25.200.1.2-E for HV & UHVG



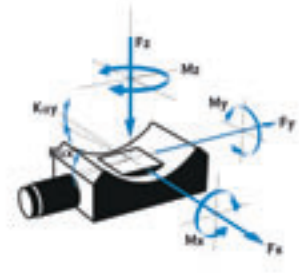
Order No.	6541-V-		1		0	0
FV		1				
HV		2				
UHVG		3				
open loop		0				
closed loop		1				

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	15	15	20	0.75	4	4	80	80
HV	15	15	20	0.75	4	4	80	80
UHVG	15	15	20	0.75	4	4	80	80

KEY FEATURES

- Vacuum up to 10-9 hPa
- Uni-directional repeatability down to 0.0005 °
- Maximum speed 2°/sec
- Load capacity up to 2 kg
- Integrated mechanical limit switches
- Clear aperture 30 mm
- Precise, smooth continuous 10° motion
- Option: Integrated angular scale
- Together with W T-100 one centre of rotation



The WT-85 Vacuum goniometer stage is designed for all tasks where conventional rotation stages cannot be used due to limited space conditions or where a clear aperture is needed. Typical applications are metrology tasks in the area of laser technology and radiology. The WT-85Vacuum and WT-100 Vacuum goniometer stages are designed to work together. When mounted orthogonally to each other they have a common center of rotation. The WT-85 Vacuum has a 30 mm clear aperture. A unique driving mechanism insures a very quiet and smooth motion. The stage is driven directly by a special 2-phase stepper vacuum motor and can achieve a relatively high speed. The WT-85 Vacuum stages are available with an optional optical angular scale and are equipped with two limit switches.

Please see"GLOSSARY Vacuum Specification" for all vacuum specification.

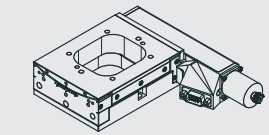
TECHNICAL DATA

Travel range (°)	10
Wobble (Bearings) (µrad)	± 125
Weight (kg)	0.9

Vacuum type	FV	HV	UHVG	
Linear scale				HV
Speed max. (°/sec)	2	0.8	0.4	
Resolution calculated (°)	0.00265 (FS)	0.00265 (FS)	0.00265 (FS)	0.0001208
Resolution typical (°)	0.001	0.001	0.001	0.0005
Bi-directional Repeatability (°)	± 0.004	± 0.004	± 0.004	± 0.0005
Uni-directional Repeatability (°)	0.004	0.004	0.004	0.0005
Nominal Current (A)	1.2	1.2	1.2	

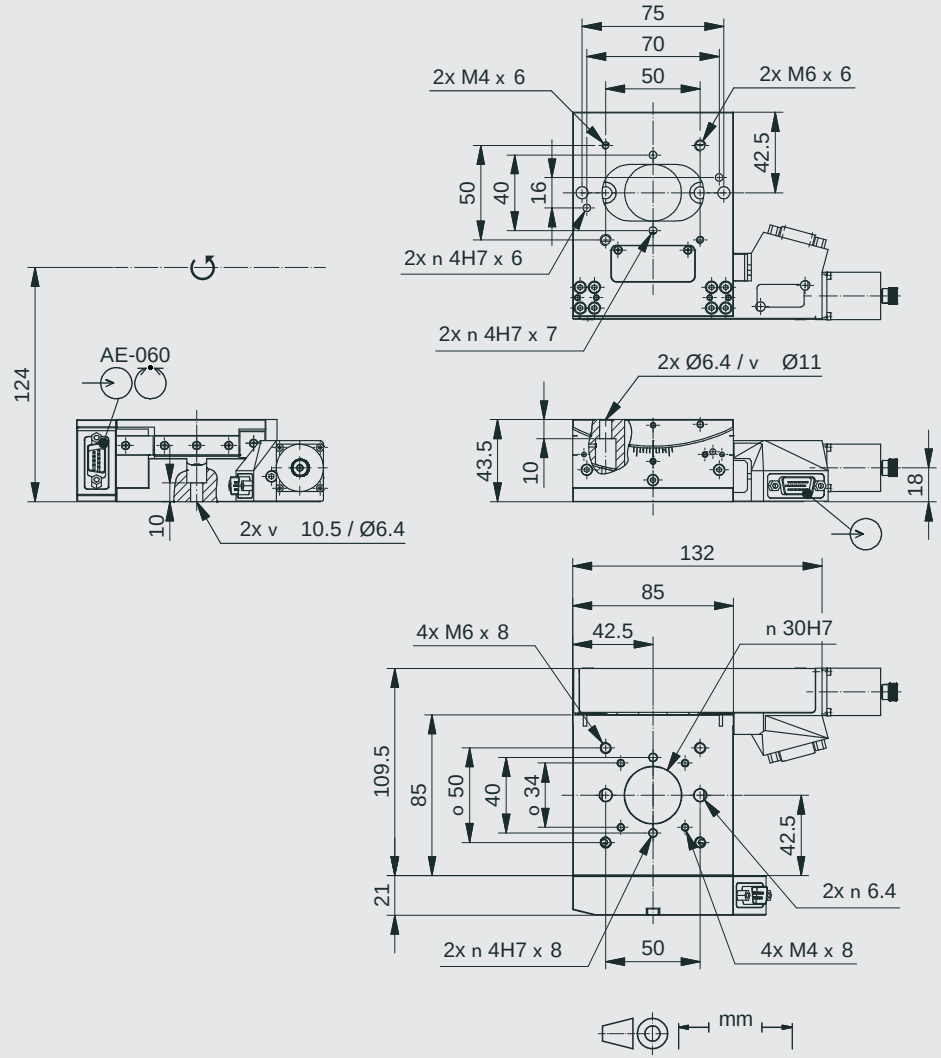
Accuracy	on request
Velocity range (mm/sec)	0.001 ... 2
Material	Aluminum, stainless steel

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

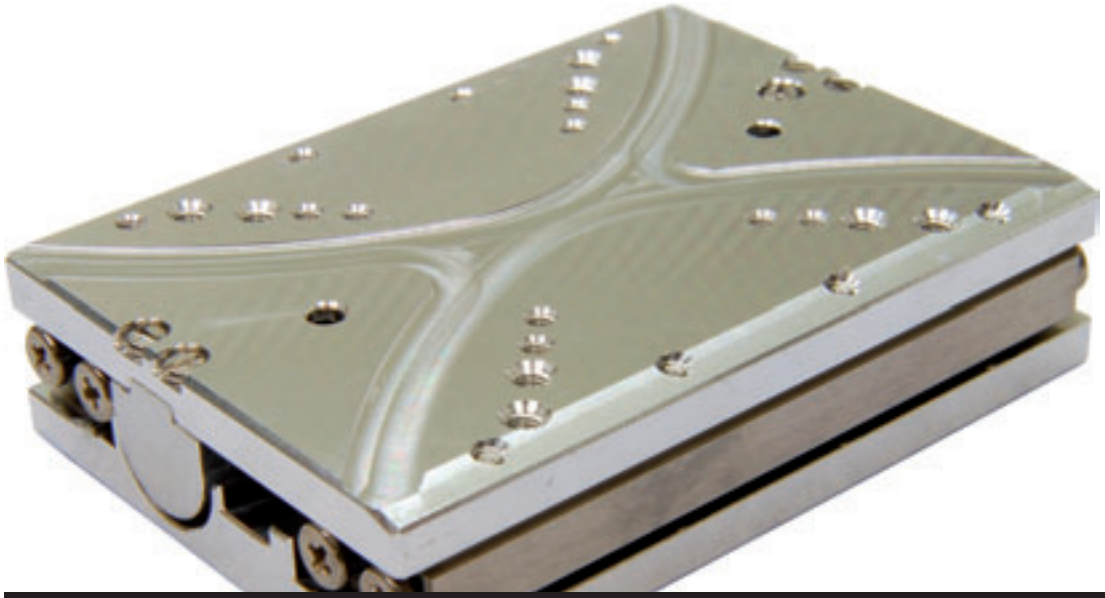


ZSS 25

drawings for the corresponding
vacuum class must be requested separately.
The installed motor types are:
ZSS 25.200.1.2-E for FV
VSS 25.200.1.2-E for HV & UHVG



Order No.	6540-V-		1		0	0
FV		1				
HV		2				
UHVG		3				
open loop					0	
closed loop					1	

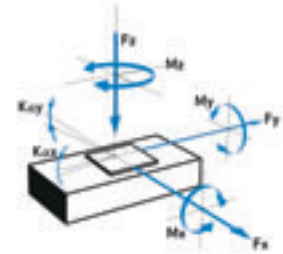


PIEZO STAGES

6.146 Linear Piezo Stage LPS-65 Vacuum

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$	$kax_{(\mu rad/Nm)}$	$kay_{(\mu rad/Nm)}$
FV	50	10	20	2	1.5	2	100	80
HV	50	10	20	2	1.5	2	100	80
UHVG	50	10	20	2	1.5	2	100	80



The LPS-65 Vacuum is a low profile linear stage utilizing synchronized piezo stepping motor for increased precision and load capacity. The big platform and the cross roller bearing are guaranteeing a smooth and high accurate movement in the range of sub nanometer. LPS-65 Vacuum stages can be controlled with our E-861 piezo controller and the linear encoder provides nanometer repeatability. None magnetic versions are available.

KEY FEATURES

- Vacuum up to 10-9 hPa
- Piezo driven stepping motor with subnanometer resolution
- Travel range up to 52 mm (2")
- Uni-directional repeatability down to 0.005 µm
- Maximum speed 10 mm/sec
- Load capacity up to 2 kg
- Encoder Resolution 0.005 µm
- Inegrated linear scale

TECHNICAL DATA

Travel range (mm)	13	26	52
Straightness / Flatness (µm)	± 1	± 1.5	± 2
Pitch (µrad)	± 40	± 50	± 60
Yaw (µrad)	± 40	± 50	± 60
Weight (kg)	0.3	0.4	0.6

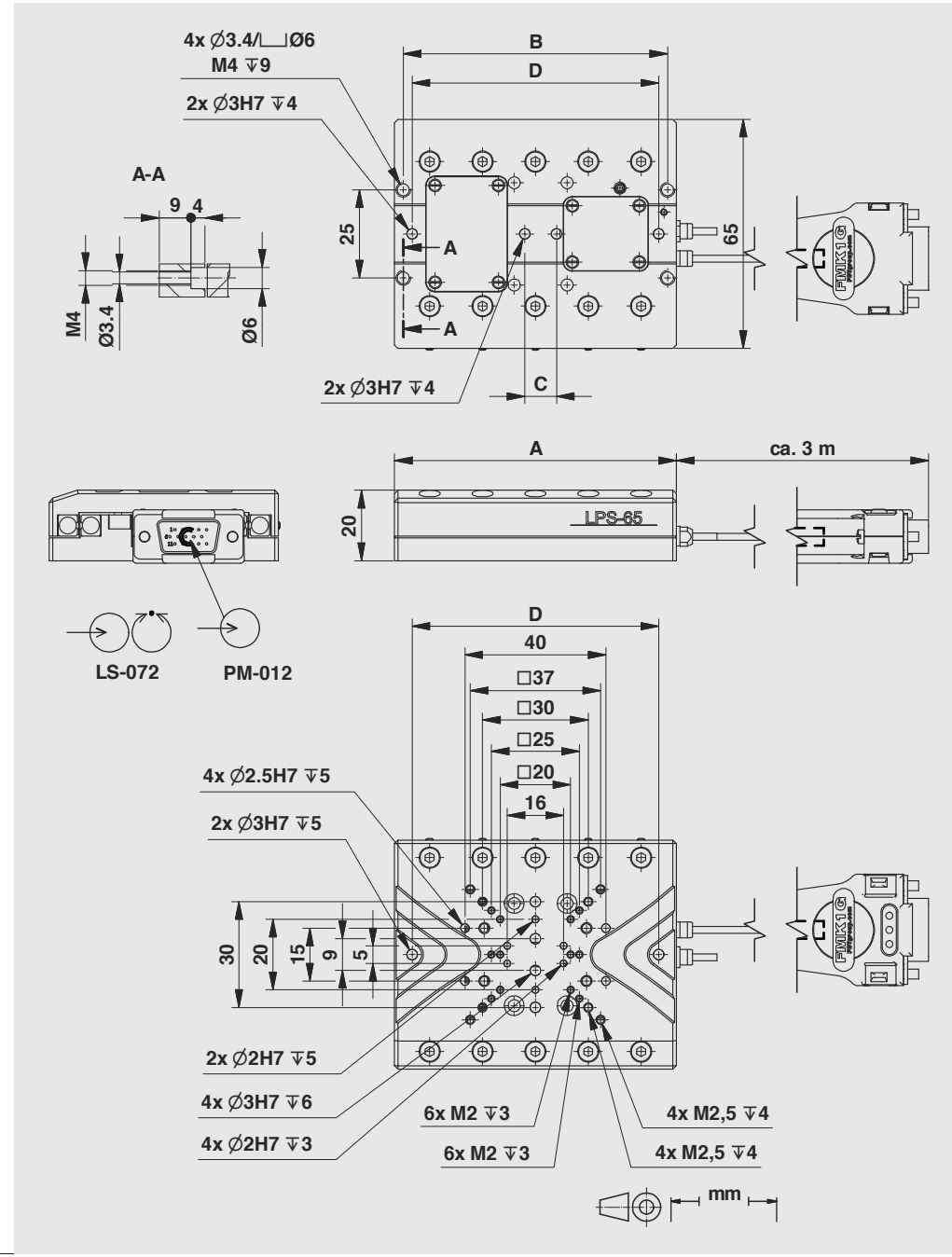
Vacuum type	FV	HV	UHVG	
Linear scale				UHV
Speed max. (mm/sec)	10	10	10	
Resolution calculated (µm)				0.0005
Resolution typical (µm)	0.4	0.4	0.4	0.001
Bi-directional Repeatability (µm)				± 0.001
Uni-directional Repeatability (µm)				0.001
Nominal Current (A)				

Accuracy	on request
Velocity range (mm/sec)	0.005 ... 10
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos

Travel (mm)	13	26	52
A	80	110	160
B	75	100	150
C	9	9	30
D	70	100	150

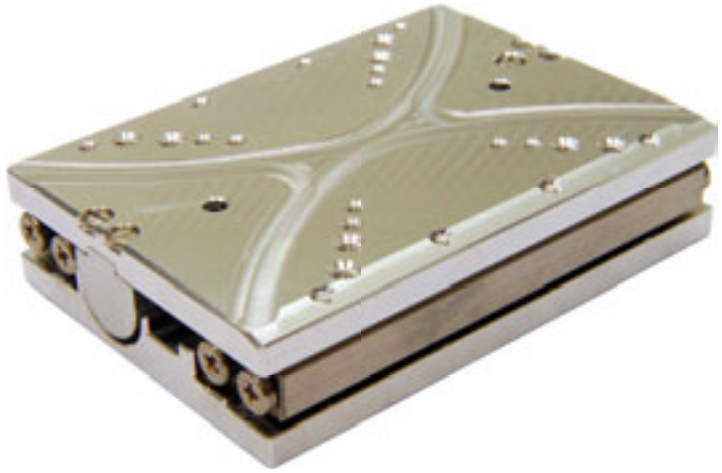


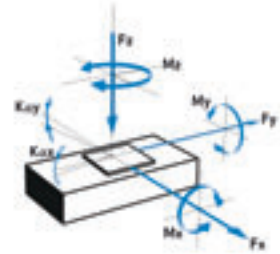
Order No.	5860-V-				0	0
FV	1					
HV	2					
UHVG	3					
13 mm (1/2")		1				
26 mm (1")		2				
52 mm (2")		3				
LS-072, Linear glass scale			1			

6.148 Linear Piezo Stage LPS-45 Vacuum

FACTS

Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$
FV	10	8	10	1	0.8	1
HV	10	8	10	1	0.8	1
UHVG	10	8	10	1	0.8	1





The LPS-45 Vacuum is a low profile linear stage utilizing piezo stick slip motor for increased precision and load capacity. The big platform and the cross roller bearing are guaranteeing a smooth and high accurate movement in the range of sub nanometer. LPS-45 Vacuum stages can be controlled with our E-871 closed loop piezo controller. The optional linear encoder provides nanometer repeatability. Non magnetic versions are available.

KEY FEATURES

- Vacuum up to 10-9 hPa
- Piezo stick slip motor with subnanometer resolution
- Travel range up to 26 mm (1")
- Uni-directional repeatability down to 0.018 µm
- Maximum speed 10 mm/sec
- Load capacity up to 1 kg
- Encoder Resolution 0.006 µm
- Optional integrated linear scale

TECHNICAL DATA

Travel range (mm)	13	26
Straightness / Flatness (µm)	± 1	± 2
Pitch (µrad)	± 50	± 80
Yaw (µrad)	± 50	± 80
Weight (kg)	0.13	0.145

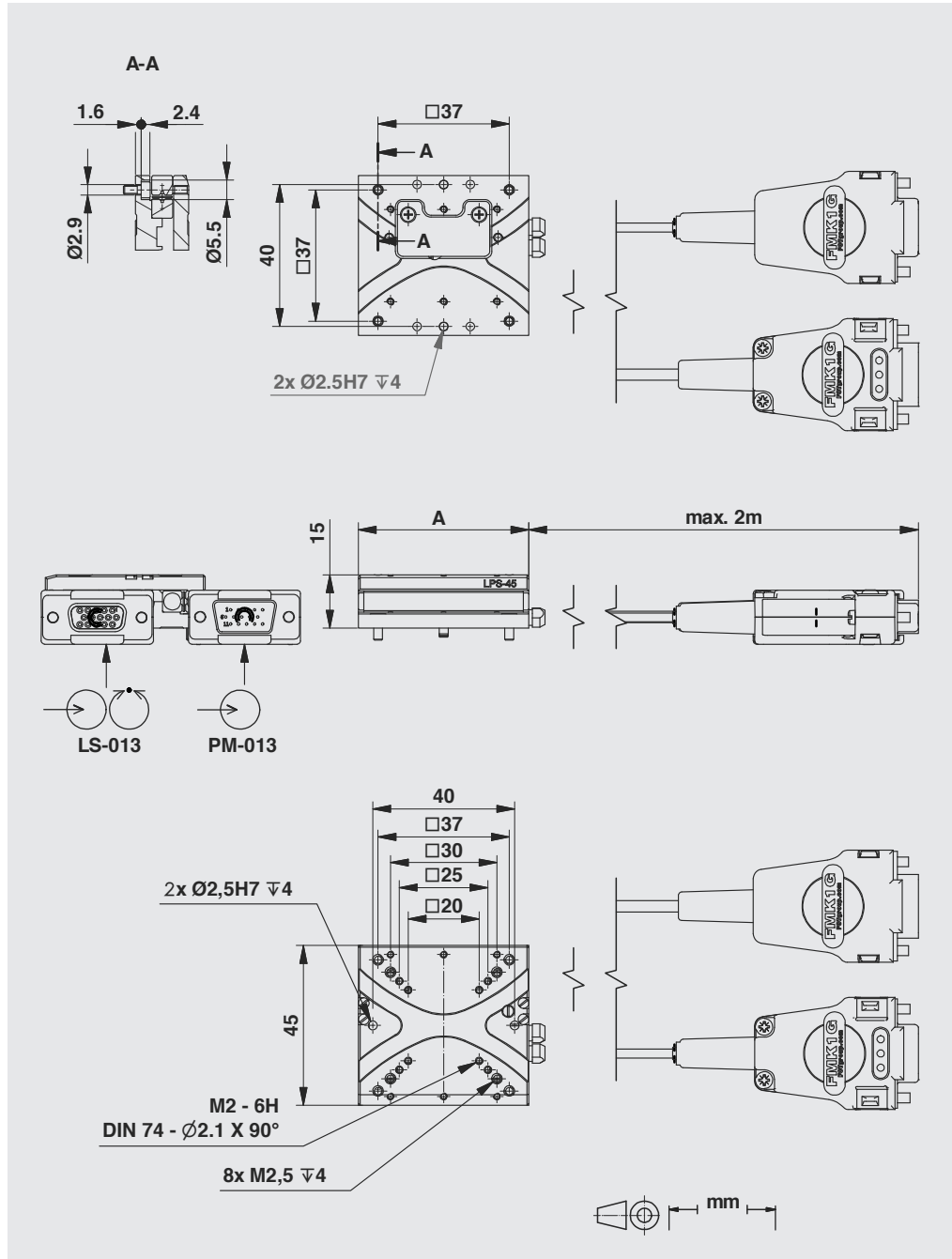
Vacuum type	FV	HV	UHVG	
Linear scale				UHV
Speed max. (mm/sec)	10	10	10	
Resolution calculated (µm)				0.001
Resolution typical (µm)	0.5	0.5	0.5	0.006
Bi-directional Repeatability (µm)				± 0.018
Uni-directional Repeatability (µm)				0.018
Nominal Current (A)				

Accuracy	on request
Velocity range (mm/sec)	0.05 ... 10
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos

Travel (mm)	13	26
A	48	63

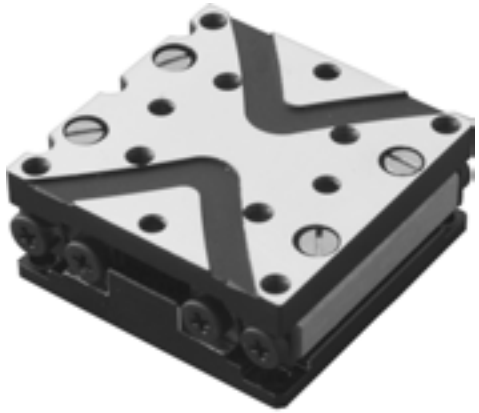


Order No.	5861-V-				0	0
FV	1					
HV	2					
UHVG	3					
13 mm (1/2")		1				
26 mm (1")		2				
open loop					0	
LS-013, Linear glass scale					1	

6.150 Linear Piezo Stage LPS-23 Vacuum

FACTS

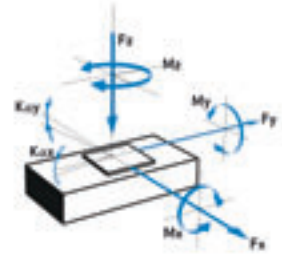
Load characteristics	$Fx_{(N)}$	$Fy_{(N)}$	$Fz_{(N)}$	$Mx_{(Nm)}$	$My_{(Nm)}$	$Mz_{(Nm)}$
FV	2	2	2	0.2	0.4	0.2
HV	2	2	2	0.2	0.4	0.2
UHVG	2	2	2	0.2	0.4	0.2



Non-vacuum model shown

KEY FEATURES

- Vacuum up to 10-9 hPa
- Piezo stick slip motor with subnanometer resolution
- Travel range up to 26 mm (1")
- Uni-directional repeatability down to 0.020 µm
- Maximum speed 10 mm/sec
- Load capacity up to 0.2 kg
- Encoder Resolution up to 0,005 µm
- Optional integrated linear scale



The LPS-23 Vacuum is a low profile linear stage utilizing piezo stick slip motor for increased precision and load capacity. The big platform and the cross roller bearing are guaranteeing a smooth and high accurate movement in the range of sub nanometer. LPS-23 Vacuum stages can be controlled with E-871 closed loop piezo controller. The optional linear encoder provides nanometer repeatability. Non magnetic versions are available.

Please see "GLOSSARY Vacuum Specification" for all vacuum specification.

TECHNICAL DATA

Travel range (mm)	13	26
Straightness / Flatness (µm)	± 2	± 4
Pitch (µrad)	± 80	± 110
Yaw (µrad)	± 80	± 80
Weight (kg)	0.1	0.12

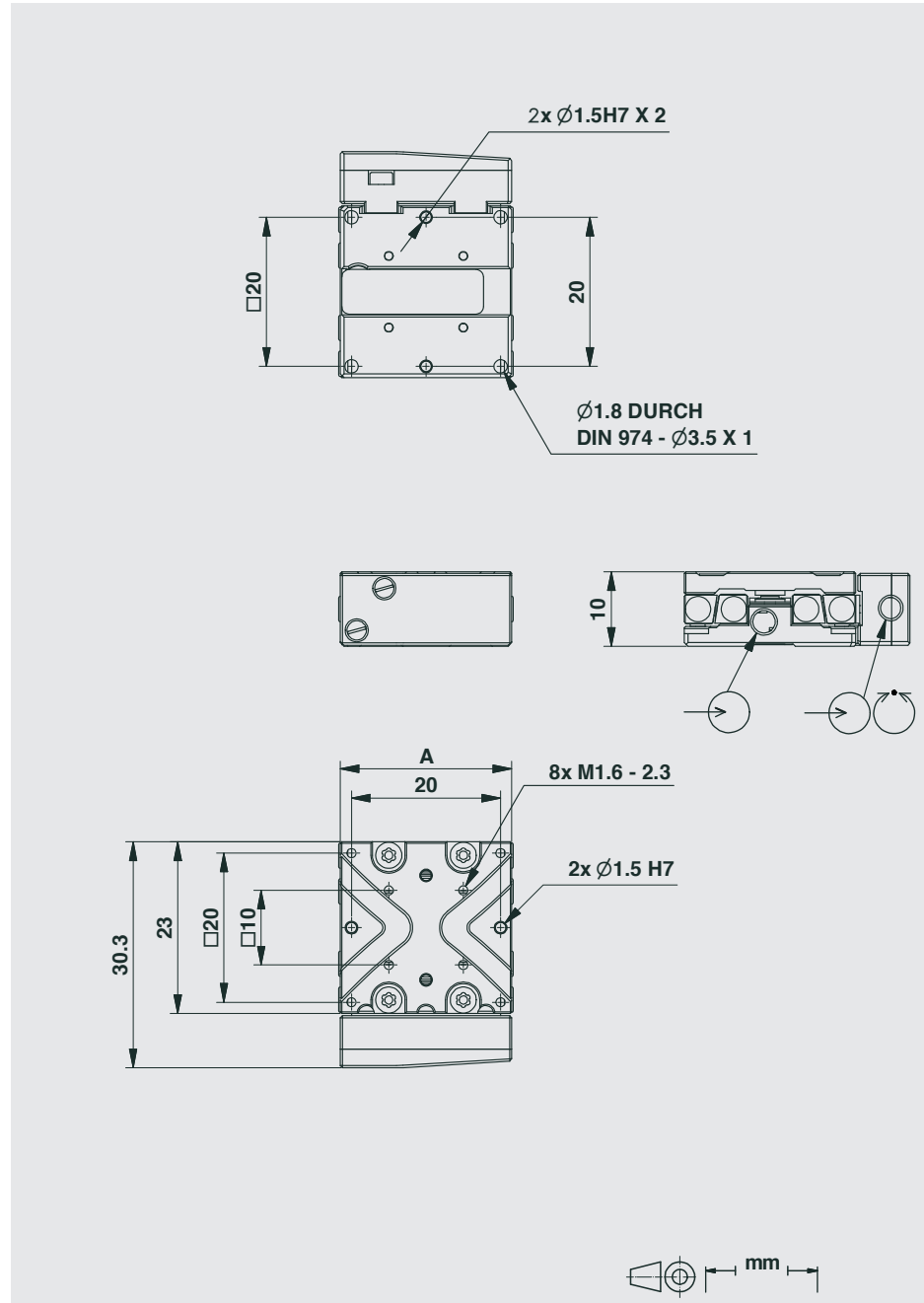
Vacuum type	FV	HV	UHVG	
Linear scale				UHV
Speed max. (mm/sec)	10	10	10	
Resolution calculated (µm)				0.001
Resolution typical (µm)	0.5	0.5	0.5	0.01
Bi-directional Repeatability (µm)				± 0.02
Uni-directional Repeatability (µm)				0.02
Nominal Current (A)				

Accuracy	on request
Velocity range (mm/sec)	0.5 ... 10
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos

Travel (mm)	13	26
A	23	35

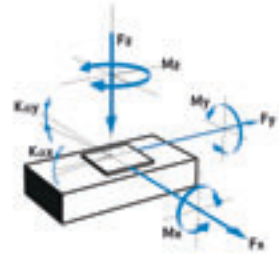


Order No.	5863-V-				0	0
FV	1					
HV	2					
UHVG	3					
13 mm (1/2")		1				
26 mm (1")		2				
open loop			0			
LS-013, Linear glass scale			1			

6.152 High-Precision Nanopositioner P-561 Vacuum

FACTS

Load characteristics	$F_{x(N)}$	$F_{y(N)}$	$F_{z(N)}$
UHV	30	30	30



KEY FEATURES

- Vacuum up to 10-9 hPa
- Enhanced responsiveness & multi-axis precision: parallel kinematics and metrology
- Travel ranges to 340 x 340 x 340 µm
- Highest linearity and stability with capacitive sensors
- Frictionless, high-precision flexure guiding system
- Excellent scanning flatness
- Clear aperture 66 x 66 mm
- Outstanding lifetime due to PICMA® piezo actuators
- Non-vacuum: High-dynamics XYZ version available; custom versions to 6-DOF
- More information www.pi.ws

The P-561.3DD versions have resonant frequencies to 1.0 kHz, enabling millisecond scanning rates with sub-nanometer resolution. Capacitive Sensors for Highest Accuracy and Position Stability

PI"s proprietary capacitive sensors measure position directly and without physical contact. They are free of friction and hysteresis, a fact which, in combination with the positioning resolution of well under 1 nm, makes it possible to achieve very high levels of linearity. A further advantage of direct metrology with capacitive sensors is the high phase fidelity and the high bandwidth of up to 10 kHz.

TECHNICAL DATA

Travel range (mm)	0.1 x 0.1
Straightness / Flatness (µm)	± 0.015
Pitch (µrad)	± 1
Yaw (µrad)	± 6
Weight (kg)	1.45

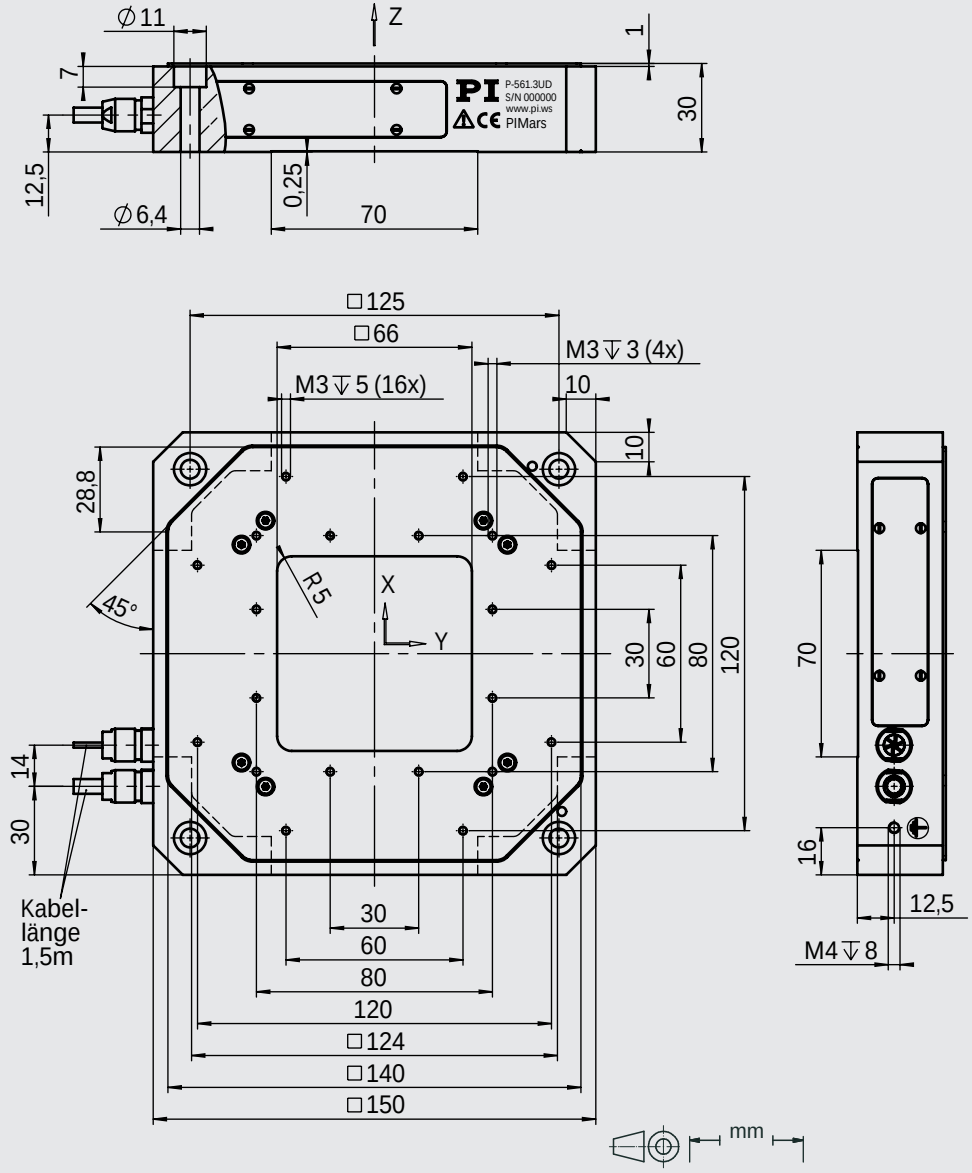
Vacuum type	UHV
Speed max. (mm/sec)	
Resolution calculated (µm)	
Resolution typical (µm)	0.00002
Bi-directional Repeatability (µm)	± 0.002
Uni-directional Repeatability (µm)	
Nominal Current (A)	

Accuracy	on request
Velocity range (mm/sec)	...
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos

drawings for the corresponding
vacuum class must be requested separately.

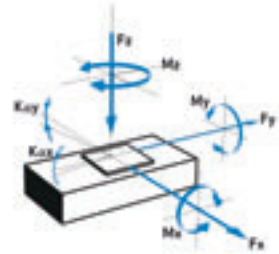


Order No. P-561

6.154 High-Precision Nanopositioner P-621 Vacuum

FACTS

Load characteristics	$F_{x(N)}$	$F_{y(N)}$	$F_{z(N)}$
UHV	10	10	10



PIHera® piezo stages offer the longest travel ranges in the industry at a very affordable price. Lately an additional extra-small 50 µm version as well as a variety of Z and XY stages have been added to the successful PIHera® Piezoelectric Nanopositioning system family. These stages feature integrated capacitive sensors providing high accuracy with less than 0.01% linearity errors and resolution in the sub-nanometer range.

KEY FEATURES

- Vacuum up to 10-9 hPa
- Horizontal Travel Range 100 to 250 µm
- Non-vacuum versions: travel to 1800 µm
- High-Precision, Cost-Efficient
- Resolution to 0.1 nm
- Direct Metrology with Capacitive Sensors
- Positioning Accuracy
- Frictionless, High-Precision Flexure Guiding System
- Outstanding Lifetime Due to PICMA® Piezo Actuators
- X-, XY-, Z- XYZ-Versionen
- Vacuum-Compatible Versions Available
- More information www.pi.ws

TECHNICAL DATA

Travel range (mm)	0.1
Pitch (µrad)	± 3
Yaw (µrad)	± 3
Weight (kg)	0.16

Vacuum type	UHV
Speed max. (mm/sec)	
Resolution calculated (µm)	
Resolution typical (µm)	0.0002
Bi-directional Repeatability (µm)	± 0.001
Uni-directional Repeatability (µm)	
Nominal Current (A)	

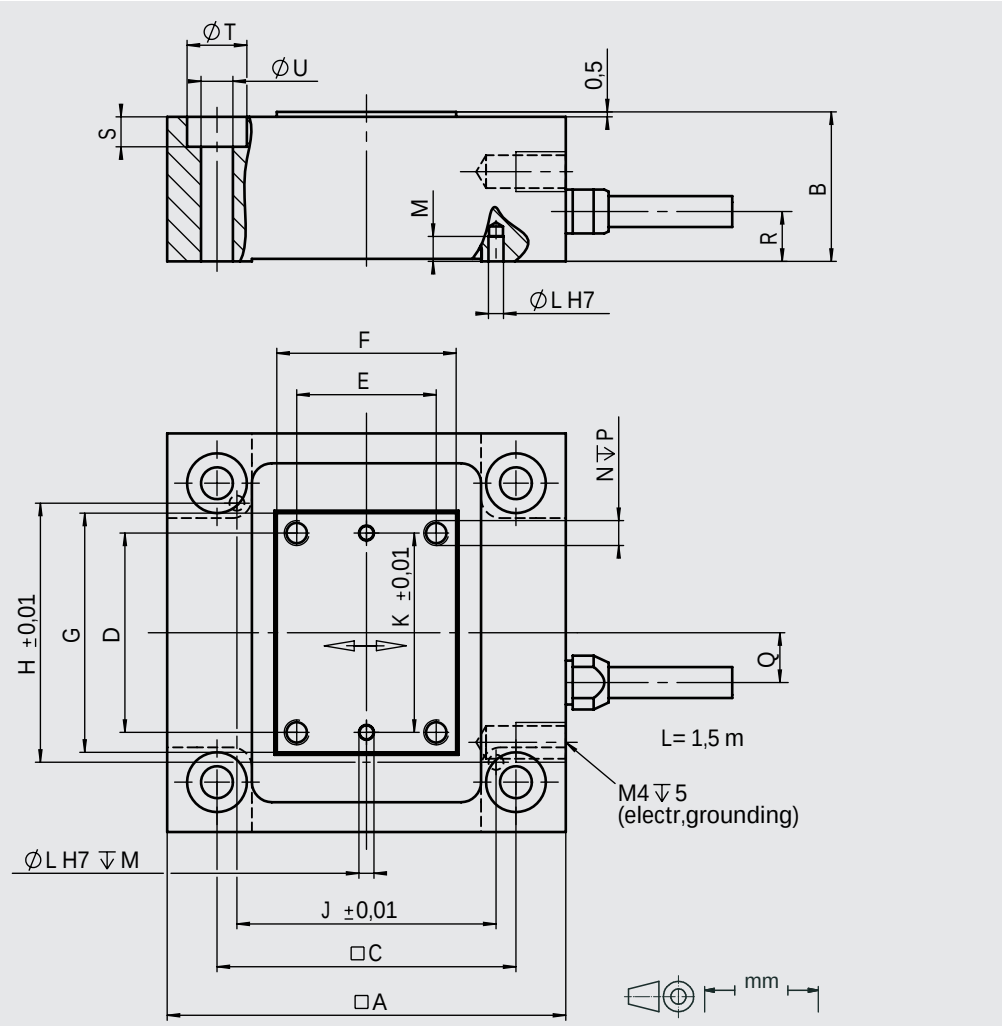
Accuracy	on request
Velocity range (mm/sec)	...
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos

drawings for the corresponding
vacuum class must be requested separately.

	A	B	C	D	E	F	G	H	J	K	∅L	M	N	P	Q	R	S	∅T	∅U
P-620.1CD / 10L	30	12	24	15	12	15	18	19	24	15	1,01	1,5	M2	4	4,5	6	2	4,4	2,2
P-621.1CD / 10L	40	15	30	20	14	18	24	26	26	20	1,51	2,5	M2,5	5	5	5	3	6	3,2
P-622.1CD / 10L	50	15	40	24	20	25	30	35	35	24	1,51	2,5	M2,5	5	5,5	5	3	6	3,2
P-625.1CD / 10L	60	15	50	40	27	32	44,5	46	46	40	1,51	2,5	M2,5	5	5,5	5	3	6	3,2
P-628.1CD / 10L	80	17	70	58	41	45	63	66	66	58	1,51	2,5	M2,5	5	5,5	5	3	6	3,2
P-629.1CD / 10L	100	22,5	90	60	40	60	84	82	82	60	2,01	3,5	M2,5	5	10	7,5	4	8	4,3

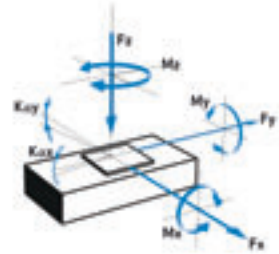


Order No. P-621

6.156 XY Piezo Scanning Stage P-733 Vacuum

FACTS

Load characteristics	$F_{x(N)}$	$F_{y(N)}$	$F_{z(N)}$
UHV	20	20	20



P-733 XY and XYZ piezo driven stages are fast and highly accurate nanopositioning and scanning systems. They provide a positioning and scanning range of 100 x 100 µm, 10 µm in Z together with sub-nanometer resolution and are equipped with parallel-metrology capacitive position feedback for superior multi-axis linearity and repeatability. The guiding accuracy minimizes runout to under 10 nm over the whole travel range. In addition, the high-speed Z-axis of the P-733.3CD can actively compensate any out-of-plane Z-axis deviation during XY motion. .

KEY FEATURES

- Vacuum up to 10-9 hPa
- Travel range to 100 x 100 µm in X,Y 10 µm in Z
- Resolution to 0.1 nm with capacitive sensors
- Non-magnetic versions
- Parallel kinematics for enhanced dynamics and better multi-axis accuracy
- Parallel Metrology for Active Trajectory Control
- Frictionless, high-precision flexure guiding system
- Clear aperture 50 x 50 mm
- More information www.pi.ws

TECHNICAL DATA

Travel range (mm)	0.1 x 0.1
Pitch (µrad)	± 3
Yaw (µrad)	± 10
Weight (kg)	0.58

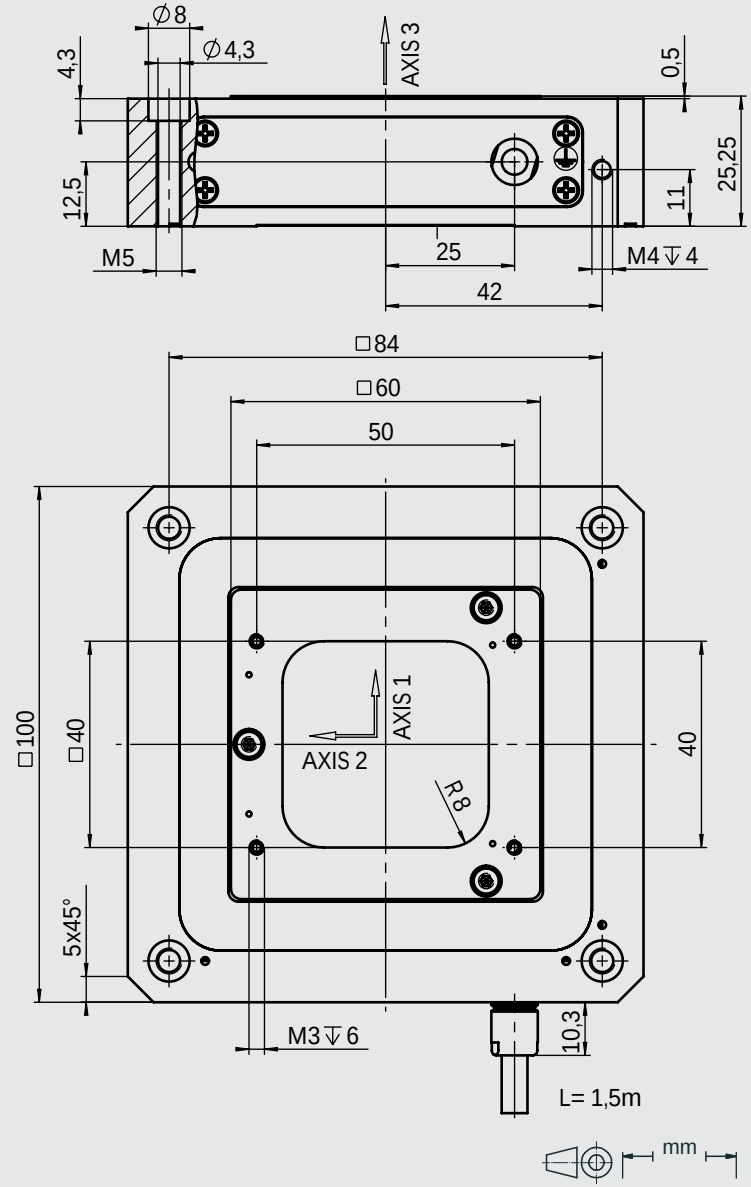
Vacuum type	UHV
Speed max. (mm/sec)	
Resolution calculated (µm)	
Resolution typical (µm)	0.0002
Bi-directional Repeatability (µm)	
Uni-directional Repeatability (µm)	
Nominal Current (A)	

Accuracy	on request
Velocity range (mm/sec)	...
Material	Aluminum or Stainless steel, suitable for vacuum

Vacuum Note: FS = full step, RE = rotary encoder
More info: Detailed information concerning motors and encoders, see appendix.

PI micos

drawings for the corresponding
vacuum class must be requested separately.



Order No. P-733

PI miCos

CONTROLLERS

SMC-series

	Version	Form-Factor	Stepper Motor	DC-brushed Motor	DC-brushless Motor	Piezo-Motor	2-Phase Linear/Torque	3-Phase Linear/Torque	Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	SMC corvus	desktop 19" rack	■						yes / optional	RS-232 Ethernet TCP / IP GPIB	linear interpolation	2 or 3 (n x 3)	2.010
	SMC corvus eco	desktop	■						yes / optional	RS-232 USB	linear interpolation	2 or 3 (n x 3)	2.012
	SMC corvus pci	PCI-board	■						yes / optional	PCI-COM RS-232	Linear interpolation	2 or 3	2.014
	SMC pollux	desktop 19" chassis intelligent motor	■						yes / optional	RS 232 Ethernet TCP/IP USB-cable	point to point	1, daisy chain up to 16	2.016
	SMC hydra	desktop CM / TT 19" RM	■	■	■	■	■	■	yes / optional absolute encoder optional: 1Vpp and RS-422	RS-232 Ethernet TCP/IP	point to point linear interpolation	2	2.018

PI-series

	Version	Form-Factor							Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	C-887	desktop 19" RM		■	■	■			Yes	TCP/IP, RS-232 VGA (monitor), USB (keyboard, mouse, manual control unit)	point to point vector motion	6 axes, 2 additional axes	2.020
	E-709	desktop				■			Yes, SGS, piezoresistive and capacitive sensors	USB, RS-232, SPI		1	2.021
	E-725	desktop				■			Yes, capacitive sensor 18bit	Ethernet, USB, RS-232		3	2.022
	E-861	desktop				■			yes, linear encoder 1Vpp	RS-232 USB	point to point	1	2.023
	E-871	desktop				■			yes, linear encoder 1Vpp	RS-232 USB	point to point	1	2.024

DMC-series

	Version	Form-Factor							Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	DMC Controller	PC based PCI-Slot external 19"-chassis	■*	■*	■*	■*	■*	■*	yes	PCI-Bus Ethernet RS-232	Linear interpolation Circular interpolation Contouring independant	1..8	2.025

* in combination with MPA

Delta-Tau-series

	Version	Form-Factor	Stepper Motor	DC-brushed Motor	DC-brushless Motor	Piezo-Motor	2-Phase Linear/Torque	3-Phase Linear/Torque	Closed-Loop	Communication	Modes of Motion	Number of Axes	Index
	Geobrick / Clipper	19" rackmount	■	■	■	■	■	■	yes RS-422 1Vpp	Ethernet USB RS-232	Linear interpolation Circular interpolation Contouring independant	4 / 8	2.027

Our SMC family of motion controllers is based on modern 32 bit technology which enables performances of stepper motor driven systems which haven´t been possible before. A so-called sin² acceleration offers very smooth acceleration and deceleration of the motors which allows highest performance positioning in the nanometer range. One of the big advantages of our SMC controllers is the possibility to drive the stages with extremly high resolution.

In Figure 1 you can see the measurement results of 100 nm steps driven with a PLS-85 stage with 2 phase stepper motor in open loop (without feedback of an encoder system). The stage is moving these steps with high precision. Driving the stage with 25 nm steps (Figure 2) it is obvious that the step width shows more variations, but in average the value is about 25 ± 5 nm. Positioning in the nm range is normally done with piezo drivers. But even with a standard linear stage like PLS-85 and our SMC-controllers it is possible to push the stage in the nm range. In Figure 3 you can see the result of programmed 10 nm steps measured by an interferometer. The stage is not moving in equal 10 nm steps, but the average motion is in this range. The measurement is limited by the 5 nm resolution of the interferometer. This amazing resolution is not possible with any other typical stage.

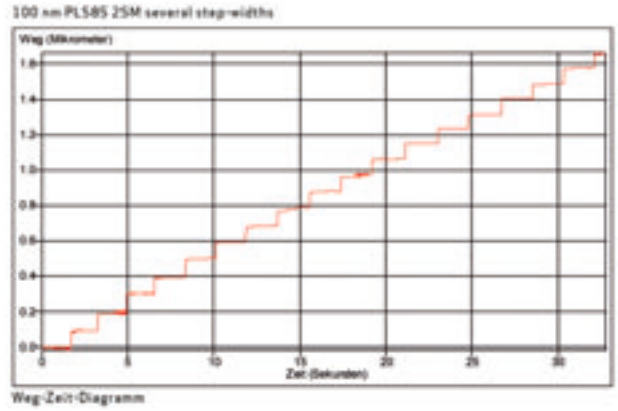


Figure 1: PLS-85, 2 SM open loop, resolution with 100 nm steps

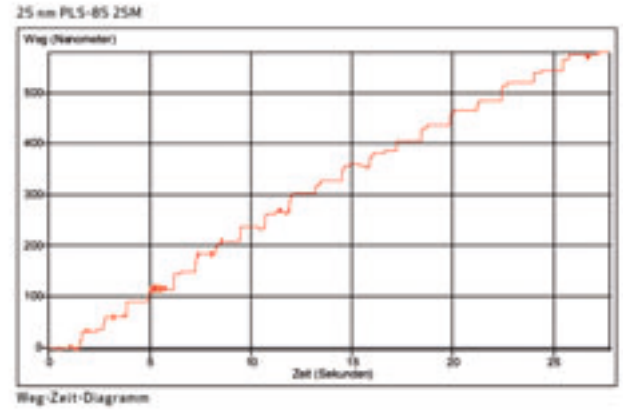


Figure 2: PLS-85, 2 SM open loop, resolution with 25 nm steps

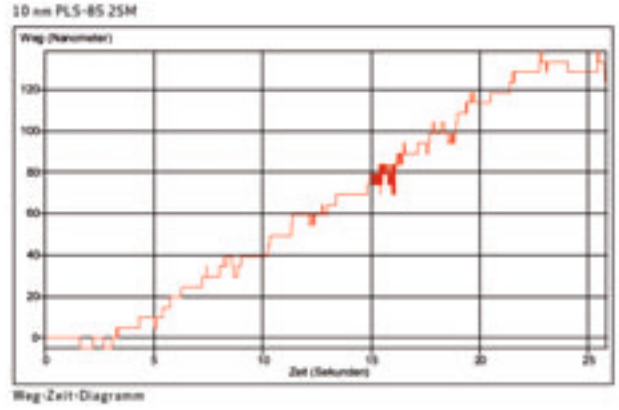


Figure 3: PLS-85, 2 SM open loop, resolution with 10 nm steps

For example, our VT-80 stage can be “positioned” with 100 nm steps (figure 4) but the result is not visible in defined levels and constant step width which is mainly due to the fine pitch leadscrew.

On the other hand the results of a PLS-85 stage shown in Figure 1-3 can be improved by driving the stage in closed loop. One of the advantages of our SMC-controllers is the intelligent control of the stage by using the 1 Vpp interface of a high resolution scale. Figure 5 shows the measurement of a LS-110 stage with a linear scale. The resolution of 50 nm is visible in well defined moving steps. Even changing the load does not disturb the stage positioning. The resolution is limited by the scale system, so using a 2 nm scale enables resolutions of 2 nm which can be influenced by environmental disturbances like temperature drift (for example, a change of 0.01 degree in the temperature is resulting in a stage expansion of about 10 nm).

For these type of applications we designed our ultra-precision stages UPM-160 and NPE-200 or customized granite based setups using Heidenhain Zerodur scales.

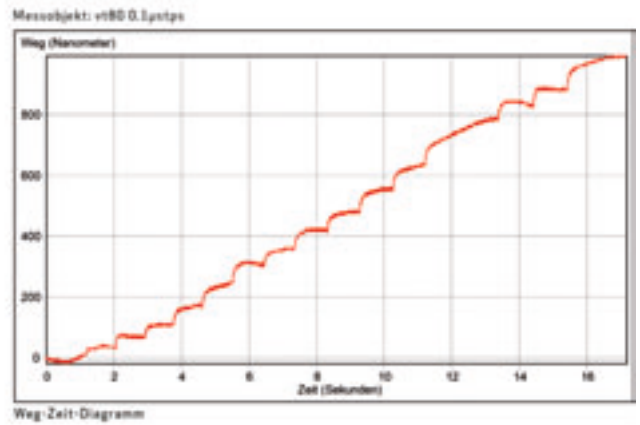


Figure 4: VT-80, 2 SM open loop, resolution with 100 nm steps

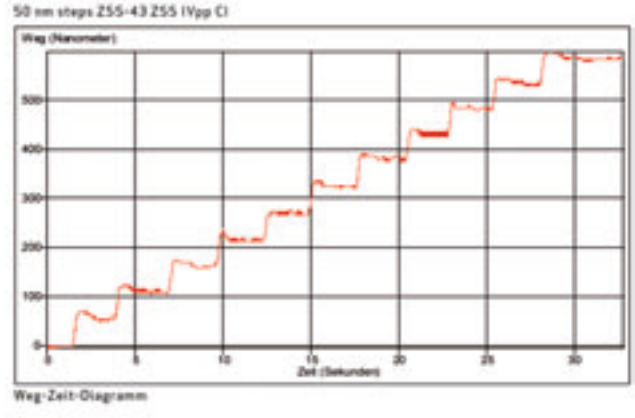


Figure 5: LS-110, 2 SM closed loop 1 Vpp, resolution with 50 nm steps

Speed is one important parameter for setting up a system. Often the maximum speed is required but for other applications it is very important to drive very slow and smooth. Standard stepper motor controllers cannot drive smooth. Even DC servo motors are not able to drive in the low velocity range in a linear and smooth way.

Figure 6 shows the measurement of a PLS-85 stage with linear scale (with a 10 nm encoder resolution).
The speed was set to 100 nm/s, so the stage traveled 360 µm within one hour, or about 10 mm per day. The movement is very smooth. Here it is important to realize that the interferometer resolution is 5 nm which results in the step-wise diagram. These steps are not coming from the stage. The movement is much smoother. It is very important to understand that the speed is linear and variations are in the 1 nm/s range which is exceptional for a loaded stage with several mm travel range. The results can be also improved by using a better encoder resolution.
Figure 7 shows an open loop result of a UPM-160 stage controlled with a speed of 45 nm/s.
The smaller time window is shown in Figure 8. The 450 nm move within 10 seconds is very linear. The interferometer resolution is limiting the interpretation of the picometer-per-second scale.

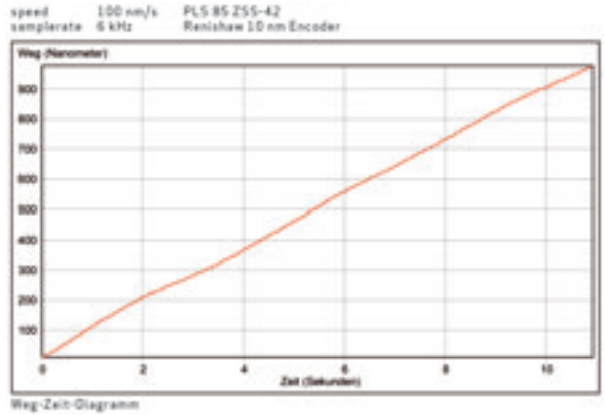


Figure 6: PLS-85, 2 SM closed loop, speed with 100 nm/s

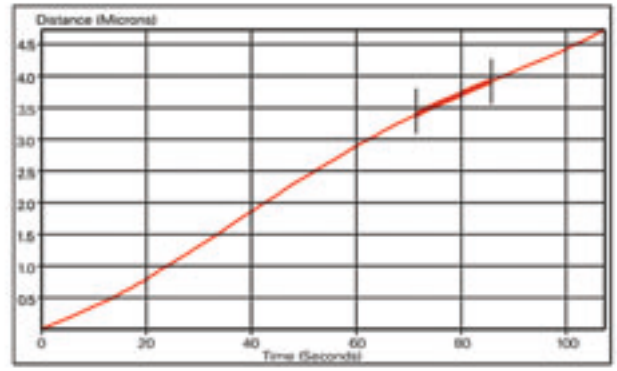


Figure 7: UPM-160, 2 SM open loop, speed with 45 nm/s

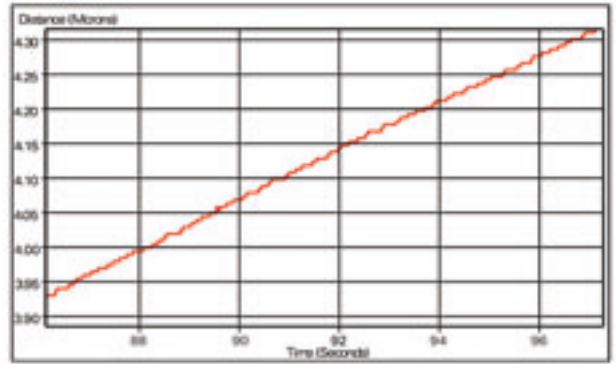


Figure 8: UPM-160, 2 SM open loop, speed with 45 nm/s (zoomed)

Positioning accuracy is normally limited by the quality of the bearings and drive mechanism, so for example errors in the leadscrew pitch are resulting in a positioning error. Figure 9 shows the deviation of the position between desired and measured position. Within a travel range of 100 mm the LS-180 stage has a positioning error of about 32 µm. The measurement shows both travel directions, so that the bidirectional repeatability, which depends on the backlash, can be seen with a value of 1.78 µm.

For some applications it is important to improve the absolute positioning, whereas the bidirectional repeatability is not important. The problem can be solved by using the deviation measurement for a position correction inside the SMC controller (see position correction option in SMC Corvus). The result is presented in Figure 10 which looks crowded at a deviation scale of 3 µm. The deviation is minimized by a factor of 10, eliminating the slope grading. This is a cost effective method to minimize system positioning errors.
By using a linear scale system, the repeatability and accuracy can be further improved.

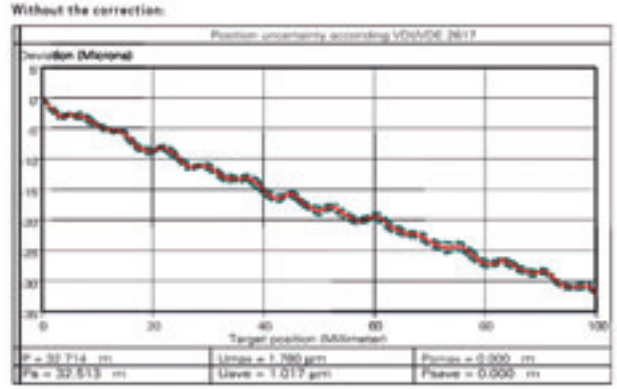


Figure 9: LS-180, 2 SM open loop, positioning error

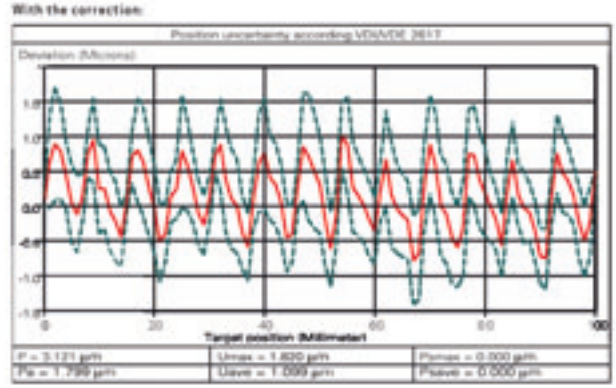


Figure 10: LS-180, 2 SM open loop, position corrected

Rack 19" 2HE

Joystick (optional)

KEY FEATURES

- 2 or 3 axes microstep controller system
- High resolution microstep
- 48 V bus-voltage
- 133 MHz RISC processor, with flash memory
- Velocity range < 0.1 µm/s... 45 rev/s (200 step motor)
- Closed-loop for quadrature encoders (RS-422) and sin-cos encoders (1Vpp)
- Linear interpolation of all axes
- Linear & $\sin^2$ acceleration
- Position compare output <= 2 kHz
- Position capture (up to 1000 x 3 axes coordinates)
- Joystick input
- Serial interface RS-232 upto 115.6 KBaud
- Ethernet interface 10Base TCP/IP
- GPIB (IEEE-488) interface
- Venus-1 compatible string based command language

TECHNICAL DATA

Axes	2 or 3 axes 2 phase stepper motors
Computer interface	RS-232 up to 115.2 kBaud, optional: Ethernet 10Mbit
Commands	Venus-1 ASCII
Supply voltage	90-250 VAC 50-60 Hz
Cooler	Integrated
Power configuration	Desktop 50W standard, max. 100W 2/3 axes 19´´ 2 HE rackmount, max. 240W 2/3 axes 19´´ 2 HE rackmount, max. 500W 2/3 axes
Limit switches	2 per axis software configurable
Trajectory mode	Linear interpolation
Velocity range	<0.1 µm/s.. 45 rev/s (200 step motor)
Program and parameter	Flash memory
Diagnostics	LED at the front with 2 user LEDs, acoustic messages with integrated buzzer
Amplifier	48V bipolar 2 Phase, with short-circuit & temperature protection
Phase-current	max. 2.5 - 3 A
Housing	Desktop HxBxT 70x240x305 mm
Software interface	Windows demo program WINPOS-light DLLs, demo applications (C/Delphi/VB) LabVIEW™ VIs and Demoapplication

PI micos

SMC corvus

2 axes SMC corvus microstep controller 48 V 50 W with RS-232	001
2 axes SMC corvus NET microstep controller 48 V 50 W with RS-232 and Ethernet TCP/IP	003
3 axes SMC corvus microstep controller 48 V 50 W with RS-232	002
3 axes SMC corvus NET microstep controller 48 V 50 W with RS-232 and Ethernet TCP/IP	004

SMC corvus options

Power amplifier	Power amplifier 100 W (desktop/2HE/3HE)	101
	Power amplifier 150 W (2HE/3HE)	102
	Power amplifier 240 W (2HE/3HE)	103
	Power amplifier 500 W (3HE)	104
19" 84TE Rackmount	19" 84TE rackmount 19" 2HE	121
	19" 84TE rackmount 19" 3HE	122
Closed-loop	For quadrature encoders RS422 per axis	115
	For sin/cos encoders 1Vpp, 12-bit interpolation per axis	116
Joystick	2 axes	106
	3 axes	107
	2 axes with 10-key touch display	108
	3 axes with 10-key touch display	109
Hand wheel	Hand wheel with 3 axes selector	110
Digital I/O	Digital I/O 3 x inputs (5- 24V) 3 x outputs (5- 24V) with position compare trigger output and position capture functionality	112
StPCor	static position correction (incl. stage measurement) per axis	118
SMC corvus GPIB	GPIB (IEEE-488) interface	123
Winpos	Full version software	124
Brake logic	Brake logic for one axis and power output (24V 0.4A)	125
Emergency stop	Emergency stop button with interface and cable l=3 m	128

7170-9-			

Front Panel

Back Panel

Front Panel

KEY FEATURES

- 2 or 3 axes microstep controller system
- High resolution microstep
- 24 V bus-voltage
- 133 MHz RISC processor, with flash memory
- Velocity range < 0.1 µm/s... 15 rev/s (standard) 25 rev/s (with speed upgrade) (200 step motor)
- Closed-loop for quadrature encoders (RS-422) and sin-cos encoders (1Vpp)
- Linear interpolation of all axes
- Linear & $\sin^2$ acceleration
- Position compare output = 2 kHz
- Position capture (up to 1000 x 3 axes coordinates)
- Joystick input or integrated 2/3 axes joystick
- Serial interface RS-232 115 KBaud
- USB interface
- Venus-1 compatible string based command language

TECHNICAL DATA

Axes	2 or 3 axes 2 phase stepper motors
Computer Interface	RS-232 up to 115.2 kBaud USB interface
Commands	
Supply voltage	90-250 VAC 50-60 Hz
Power supply	24 VDC 40 W
Limit switches	2 per axis software configurable
Trajectory mode	Linear interpolation
Velocity range standard	<0.1 µm/s .. 15 rev/s (200 step motor) <0.1 µm/s .. 25 rev/s (200 step motor) speed upgrade
Program and parameter	Flash memory
Amplifier	24 V bipolar 2 phase, with short-circuit & temperature protection
Phase current	Max. 1.5 A
Housing	Desktop 65x225x216 mm [HxWxD]
Software interface	Windows demo program WINPOS DLLs, demo applications (C/Delphi/VB) LabVIEW™ VIs and demo application

Back Panel with joystick

SMC corvus eco

2 axes SMC corvus eco microstep controller	006
3 axes SMC corvus eco microstep controller	007
2 axes SMC corvus eco microstep controller & joystick	008
3 axes SMC corvus eco microstep controller & joystick	009

SMC corvus eco options

Speed upgrade	Max speed 25 rev/s (200 step motor)	204
Closed-loop	For quadrature encoders RS422 per axis	201
	For sin/cos encoders 1Vpp, 12-bit interpolation per axis	202
Joystick	External 2 axes	106
	External 3 axes	107
	2 axes with 10-key touch display	108
	3 axes with 10-key touch display	109
Hand wheel	Hand wheel with 3 axes selector	110
Digital I/O	3 x inputs (5- 24 V) 3 x outputs (5- 24 V) with position compare trigger output and position capture functionality	203
StPCor	static position correction (incl. stage measurement) per axis	118
Winpos	Full version software	124
Emergency stop	Emergency stop button with interface and cable l=3	128

7170-9-			

Joystick

KEY FEATURES

- 2 or 3 axes microstep controller system
- High resolution microstep
- 24 V bus-voltage
- 133 MHz RISC processor, with flash memory
- Velocity range < 0.1 µm/s... 15 rev/s (standard) 25 rev/s (with speed upgrade) (200 step motor)
- Closed-loop for quadrature encoders (RS-422) and sin-cos encoders (1Vpp)
- Linear interpolation of all axes
- Linear & $\sin^2$ acceleration
- Position compare output = 2 kHz
- Position capture (up to 1000 x 3 axes coordinates)
- Joystick input or integrated 2/3 axes Joystick
- Serial interface RS-232 115 KBaud
- USB interface
- Venus-1 compatible string based command language
- 12 V PC
- PCI plug-in board with onboard microstepping power amplifiers
- Motor power 12 V (PC power supply), or optional external 24 V power supply
- Communication via PCI-Com-bridge, assures software compatibility to SMC corvus and SMC corvus eco

TECHNICAL DATA

Axes	3 axes 2 phase stepper motors
Computer interface	pci-COM bridge 115.2 KBaud
Commands	Venus-1 ASCII
Supply voltage	12 V PC or external up to 24 V DC
Power configuration	12 V PC, max. 30 W 2/3 axes 24 V external, max. 30 W 2/3 axes
Limit switches	2 per axis software configurable
Trajectory mode	Linear interpolation
Velocity range	<0.1 µm/s .. 15 rev/s (200 step motor) <0.1 µm/s .. 25 rev/s (200 step motor) speed upgrade
Program and parameter	Flash memory
Amplifier	12 V..24 V bipolar 2 Phase, with short-circuit & temperature protection
Phase current	Max. 1.5 A
Housing	Pci slot HxB 99x184 mm
Software interface	Windows demo program WINPOS DLLs, demo applications (C/Delphi/VB) LabVIEW™ VIs and demo application

SMC corvus pci

2 axes SMC corvus pci microstep controller	002
3 axes SMC corvus pci microstep controller	001

SMC corvus pci options

Speed upgrade	Max speed 25 rev/s (200 step motor)	113
Closed-loop	For quadrature encoders RS422 per axis	115
	For sin/cos encoders 1Vpp, 12-bit interpolation per axis	116
Joystick	2 axes	106
	3 axes	107
	2 axes with 10-key touch display	108
	3 axes with 10-key touch display	109
Hand wheel	Hand wheel with 3 axes selector	110
Digital I/O	3 x inputs (5- 24V) 3 x outputs (5- 24V) with position compare and position capture functionality	112
StPCor	static position correction (incl. stage measurement) per axis	118
Winpos	Full version software	124
Emergency stop	Emergency stop button with interface and cable l = 3 m	128
ext. power supply	24V DC/60 W	126
Joystick	Interface SMCpci	105

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Pocket Box Controller / Motor & Controller System

KEY FEATURES

- Single axis microstep controller system
- Stand alone system, or with integrated 2-phase stepper motor
- High resolution microstep
- Up to 16 SMC pollux can be combined with only one RS-232 interface
- DSP controller type
- Velocity range <0.1 µm/s... 40 rev/s (200 step motor)
- Serial interface RS-232 19200 Baud
- Venus 2 compatible string based command language
- Windows™ user interface
- 24 VDC power supply (external)
- Synchron motion start commands
- Speed mode
- Closed-loop 1 Vpp interface, optional for NT series
- Mixed configurations (open-loop / closed-loop) possible with NT series
- LabVIEW™ VIs
- Windows DLL and open source project available
- 3 types with different torques / velocities available

TECHNICAL DATA

Axes	1 axis, 2 phase stepper motors
Computer interface	RS-232 19.2 kBaud
Commands	Venus-2 ASCII
Supply voltage	24 VDC
Phase currents	<= 1.2 A/phase
Limit switches	2 per axis software configurable
Velocity range	For 200 step motor <0.1 µm/s .. 13 rev/s TYPE I <0.1 µm/s .. 25 rev/s TYPE II <0.1 µm/s .. 50 rev/s TYPE III
Max. resolution	300 000 positions/rev.
Max linear resolution	1 nm
Program and parameter	Flash memory
Amplifier	24 V bipolar 2 phase, with short-circuit & temperature protection
Version with integrated 2-Phase stepper motor	
Motor torque	160 mNm (Type I) 160 mNm (Type II) 320 mNm (Type III) 900 mNm (Type II HT)
Housing	Pocket desktop (without motor), or motor/controller HxWxD 48x56x97 mm (additional motor shaft 20 mm)
	19" chassis SMC-pollux integration box: 3HE 84TE chassis with 90..230 VAC power
Software Interface	Windows demo program SMC_Pollux DLLs, demo applications (C/Delphi/VB) LabVIEW™ VIs and demo application

Pollux box controller

Pollux motor & controller

Pollux multiaxis desktop

Pollux accessories

The Pollux-Chassis 19 includes power-supply (90-230VAC), RS-232 interface, interlock input, power-mains, netfilter/fuse

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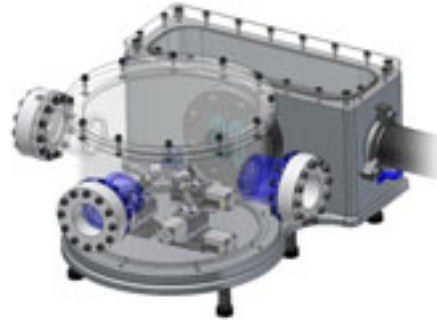
Pocket Box Controller Closed Loop

SMC pollux 16 Axes 19" 4H 84T



SpaceFAB & Controller System in 10-7 hPa

SMC pollux network (2-axes), DIN rail

SMC hydra CM

SMC hydra CM

KEY FEATURES

- 2 axes motion controller
- High resolution microstep amplifier for DC brush, 2-phase stepper, 2- and 3-phase linear / torque motors (BLDC), 4-phase piezo motor
- Motor type software configurable (except piezo motor)
- 24 V / 48 V bus-voltage up to 500 W
- Motorola power PC with 760 Mips
- Closed-loop with absolute encoder (multiturn)
- Closed-loop with incremental encoder 1Vpp or RS-422
- Encoder based trigger output
- Position capture input
- Linear interpolation
- Ethernet 10/100 MBit
- RS-232 up to 115.2 kbaud
- VENUS-3 compatible string based command language
- Handwheel (Can-Bus)
- Joystick (Can-Bus)
- Linear 4 Phase Piezo Amplifier (no PWM, for electrical noise sensitive applications)

Available soon:

- Digital IO expansion (Can-Bus)

TECHNICAL DATA

Axes	2
Computer interface	Ethernet 10/100 MBit ; RS-232 interface 115.2 kBaud
Commands	Venus-3 ASCII
Motortypes	Stepper, linear and torque motors 1, 2 and 3 phase motors and 4 Phase Piezo motors
Input / output	6x inputs, optically isolated, 5-24 V 1x input for emergency (optically isolated) 4x 10 bit analog outputs 1x open drain output (100mA) fast trigger output 400 kHz / trigger input (10 kHz)
Memory	Parameter & program 8 MByte
Operating system	Realtime
Encoder Interface	1Vpp 12 bit sin-cos interpolator 150 kHz RS-422 quadrature 16 MHz
Trigger-out / capture-in	Position compare output max. 400 kHz Position capture input max 10 kHz 4M captures (only available with Delta-Star interface)
Operation	Open loop and closed-loop PID standard or PID adaptive
Amplifier principle	Digital MOS-FET, galvanically isolated, 24V/10 A or 48V/5A Piezo: Analog , galvanically isolated, 48V/10A
Power supply	Hydra CM : 24 VDC 48 V 360 Watt (optional) Hydra TT : 90-260 VAC 300 Watt Hydra RM: 90-260 VAC 1000 Watt

SMC hydra

2 Axes SMC hydra CM Motion Controller 24 V	600
2 Axes SMC hydra TT Motion Controller 24 V	601
2 Axes SMC hydra TT Motion Controller 48 V	602
2 Axes SMC hydra CM Motion Controller 48 V	603
4 Axes SMC Hydra RM 19" Motion Controller 24V	604
4 Axes SMC Hydra RM 19" Motion Controller 48V	605
2 Axes SMC hydra CM piezo	606
2 Axes SMC hydra TT piezo	607

SMC hydra options

Motors	2SM with absolute encoder & gearbox 5 Nm	610
	2SM with absolute encoder & gearbox 12 Nm	611
	Motor cable for motor with absolute encoder	620
Power supply	CM power supply 24 V 60 W	627
	CM Power supply 24 V 120 W	626
	CM Power supply 48 V 120 W	625
Closed-loop	Encoder interface Delta-Star 1Vpp & RS-422 (with trigger out and capture in)	631
	Encoder interface Delta-Star Eco 1Vpp & RS-422 (without trigger)	632
Manual device	CAN-joystick 2 axes	633
	CAN-handwheel 2 axes	636
Trigger out capture in	Trigger cable Mini-HDMI-DB9	634
	Trigger cable Mini-HDMI-BNC	635

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CAN-Joystick

SMC hydra TT rear

Special motor with absolute encoder

CAN-handwheel

Controller for Hexapod Positioning Systems

KEY FEATURES

- Controller for Parallel Kinematic Systems
- 6-D Vector Motion Control, Comprehensive Functionality
- Sophisticated controller using vector algorithms
- Freely programmable, virtual pivot point
- Data recorder
- Macro program functionality
- Stand-alone operation possible and control through TCP/IP and RS-232 interfaces
- Extensive software support
- Simulation software for working space and single strut analysis
- Optional: Collision avoidance software
- Digital controller for 6-axis-parallel kinematics
- Included in the delivery of all PI standard Hexapod systems
- All product details, see www.pi.ws

TECHNICAL DATA

Axes	6 Axes Hexapod (6 DOF) + 2 additional axes	
Computer Interface	Ethernet TCP/IP, RS-232	Monitor, mouse & keyboard interface
Commands	PI General Command Set (GCS)	
Supply Voltage	100 to 240 VAC, 50/60 Hz	
Processor	CPU 1.8 GHz, motion control chip with 2.5 kHz servo update rate	
Servo	32-bit PID filter	
Trajectory profile mode	Trapezoid, linear interpolation	
Encoder Input	AB (quadrature) differential TTL signal, 5 MHz	
Interface to Amplifier	10-bit output for PWM drivers, 24kHz TTL Sign Magnitude mode	
Software drivers	LabView driver, shared libraries for Windows and Linux	
User software	PIMikroMove	

KEY FEATURES

- Single-channel piezo nanopositioning controller
- For SGS, Piezoresistive and Capacitive Sensors
- Linearity error to 0.02%
- Fast 25 Mbit/s serial interface
- Comprehensive I/O functions
- Low-cost OEM versions available
- Extensive software support
- All product details, see www.pi.ws

TECHNICAL DATA

Axes	1
Computer Interface	USB, RS-232, SPI
Commands	PI General Command Set (GCS)
Supply Voltage	24 VDC
Output Voltage	-30 V to 130 V
Servo Characteristics	P-I, 2 notch filter, sensor linearization
Sampling rate, servo-control	10 kHz
Motor	Piezo
Sensor	SGS Piezoresistive
Linearization	5th order polynomials
Sensor bandwidth	5 kHz
Sensor resolution	16 bit
Digital IO	1 analog input 0 to 10 V 1 sensor monitor 0 to 10 V 1 digital input (LVTTL, programmable) 1 analog output 5 digital outputs (LVTTL, 3× predefined, 2× programmable
User software	PIMikroMove
Software Drivers	LabVIEW drivers,shared libraries for Windows and Linux
Supported functionality	Wave generator, data recorder, auto zero, trigger I/O, MATLAB, MetaMorph, µ Manager

2.044 PI-series E-725 Vacuum

KEY FEATURES

- High Speed Precision Positioning System
- For Nanopositioning Systems with Capacitive Sensors
- 3-Channel Version
- Powerful Digital Controller: DSP 32-bit Floating Point, 225 MHz; 20 kHz Sampling Rate; 24-bit DAC
- Communication via Ethernet, USB, RS-232
- 4th Order Polynomial Linearization for Mechanics & Electronics
- Dynamic Digital Linearization (DDL) Option for Improved Path Accuracy
- Auto-Loading of Calibration Data from Stage ID-Chip for Interchangeability of Controller and Mechanics
- Additional High-Bandwidth Analog Control Input / Sensor Input
- Optional High-Speed Parallel I/O Interface
- Flexible Wave generators
- Digital I/O Lines for Task Triggering
- Extensive software support
- All product details, see www.pi.ws

TECHNICAL DATA

Axes	3	
Computer Interface	Ethernet TCP/IP	
Commands	PI General Command Set (GCS)	
Supply Voltage	24 VDC from external power supply	(included)
Output Voltage	-30 to 135V	
Peak Output Power	25 W	
Average Output Power	10 W	
Sampling rate, servo control	20 kHz	P-I, two notch filters
Sensor-Interface	analog for capactive sensors, 18 bit resolution, 24 bit DAC resolution	Bandwidth (-3dB) 5.6 kHz
Digital IO	MDR20; 2 x IN, 8 x OUT	
Software Drivers	LabView driver, DLL's	
User Software	Nano Capture, PIMikroMove	

PI micos

KEY FEATURES

- For NEXACT® Drives and Positioning Systems
- Complete System with Controller, Integrated Power Amplifiers and Software
- Open-Loop Operation, or Closed-Loop with Linear Encoder
- Versatile and Cost-Effective
- Daisy-Chain Networking for Multi-Axis Operation
- Non-Volatile Macro Storage for Stand-alone operation with Autostart Macro
- I/O for Automation, Joystick for Manual Operation
- Parameter Changes On-the-Fly
- All product details, see www.pi.ws

TECHNICAL DATA

Axes	1
Computer Interface	USB 1.0, RS-232
Commands	PI General Command Set (GCS)
Motortype	PI NEXACT
Supply Voltage	24 VDC from external power supply (included)
Servo Characteristics	P-I-D servo control, parameter change on-the-fly
Trajectory profile mode	Trapezoidal
Encoder Input	Analog encoder input sine-cosine, interpolation circuit for differential 1Vpp signals
Controller Network	Up to 16 units on single interface
Digital IO	4 analog/digital IN, 4 digital Out (TTL)
Software Drivers	LabVIEW driver, shared libraries for Windows and Linux
User Software	PIMikroMove. PI Terminal
Supported functionality	Point-to-point motion, start-up macro, data recorder for recording parameters as motor input voltage, position or position error;

KEY FEATURES

- For PIShift® Drives and Positioning Systems
- Complete System with Controller, Integrated Power Amplifiers and Software
- Open-Loop Operation, or Closed-Loop with Linear Encoder
- Versatile and Cost-Effective
- Daisy-Chain Networking for Multi-Axis Operation
- Non-Volatile Macro Storage for Stand-alone operation with Autostart Macro
- I/O for Automation, Joystick for Manual Operation
- Parameter Changes On-the-Fly
- All product details, see www.pi.ws

TECHNICAL DATA

Axes	1
Computer Interface	USB 1.0, RS-232
Commands	PI General Command Set (GCS)
Motortype	PI SHIFT
Supply Voltage	24 VDC from external power supply (included)
Servo Characteristics	P-I-D servo control, parameter change on-the-fly
Trajectory profile mode	
Encoder Input	Analog encoder input sine-cosine, interpolation circuit for differential 1Vpp signals
Controller Network	Up to 16 units on single interface
Digital IO	4 analog/digital IN, 4 digital Out (TTL)
Software Drivers	LabVIEW driver, shared libraries for Windows and Linux
User Software	PIMikroMove. PI Terminal
Supported functionality	Point-to-point motion, start-up macro, data recorder for recording parameters as motor input voltage, position or position error;

DMC Ethernet / RS-232

KEY FEATURES

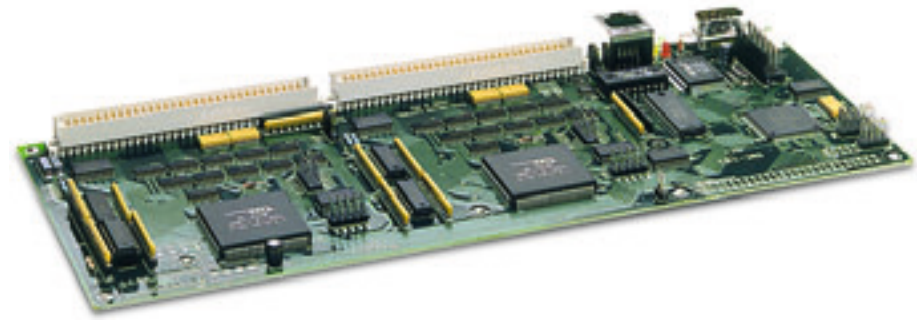
- 62.5 µs (250 µs) microsecond per axes servo update rate
- Up to 8 axes of motion control
- Controls servo motors, step motors, and hydraulics
- Maximum encoder input rate up to 22 MHz (Accelera)
- Non-volatile program memory
- Multitasking of four independent programs
- Modes of motion: jogging, point to point positioning, linear and circular interpolation, electronic gearing and cam, and contouring
- Optoisolated inputs for home, abort, limits (ecxept pci low cost)
- Digital I/O and analog inputs
- High speed position capture
- High speed encoder compare output
- Programmable event triggers (trip points)
- I/O functions and timers for executing PLC tasks
- Easy programming language plus software tools for quick start-up and tuning
- Contour mode for profiling along computer generated paths such as parabolic or spherical profiles
- Error handling including programmable software limits, automatic error shut-off, amplifier enable, user-defined error subroutines, and watchdog timer

Possible configurations

	DMC pci-eco	DMC pci-accelera	DMC Ethernet / RS-232
Form factor	PCI card	PCI card	19" card
Communication interface	PCI bus	PCI bus	Ethernet & RS-232
Number of axes	1..4	1..4	1..8
Max encoder frequency	12 MHz	22 MHz	12 MHz
Servo update rate	1-2 axis 250 µs	1-2 axis 62 µs	1-2 axis 250 µs
	3-4 axis 374 µs	7-8 axis 187 µs	7-8 axis 625 µs
Digital inputs	8 TTL	8..16 optically isolated	8..16 optically isolated
Digital outpus	8..16 TTL	8..16 TTL	8 Highside driver 8 TTL (5..8 axes)
Analog inputs	no	8	no, optional
Dual encoder	no	yes	yes

TECHNICAL DATA

Axes	1-8 axes per card, pci-eco 1-4 axes
Computer interface	PCI-bus / Ethernet / RS-232
Commands	ASCII 2 letter mnemonic
Position range	±2.147,483,647 counts/move; automatic rollover;
Acceleration/deceleration	1,024 to 67,107, 840 counts/sec^2 mm
Motor command signal	+/-10 V 16-bits, Clock/Dir
Step motor control mode	Full, half, or microstep
Encoder Interface	RS-422
Analog inputs	8, ± 10 V; 12-bit resolution (16-bit optional)
Dedicated inputs per axes	Forward and reverse limits, high-speed position latch, home.
Dedicated outputs per axes	Analog motor command, pulse and direction, amplifier enable, encoder output compare.
Software Interface	Plug and Play: utilities for all Windows™ versions .net libraries and DLL, Linux, demo applications C and LabVIEW™ VIs



Order No.	7110-9-	0		
DMC pci-eco (1..4 axes)	2			
DMC pci-accelera (1..8 axes)	3			
DMC Ethernet/RS-232 (1..8 axes)	4			
DMC Ethernet/USB (1..8 axes)	5			
number axes	n			

PI miCos MPA Power Amplifier Systems, see page 2.060

MC geobrick lv 8 axes control & amp (front)

MC geobrick lv 8 axes control & amp (back)

KEY FEATURES

- 4 or 8 axes of simultaneous control (0.1 ms update time)
- 80 MHz CPU optional 240 MHz
- Ethernet TCP/IP, USB and RS-232 communication interface
- All axes independent or coordinated in any combination
- Multitasking of up to 256 motion and 64 asynchronous PLC programs
- Easy-to-use, high-level programming language
- Linear, circular, rapid, B-spline, Hermite-spline interpolation modes
- True S-curve accel/decel for jerk-limited profiles
- Dynamic multi-move lookahead for robust acceleration control
- Coordinate system translation and rotation, 2D and 3D
- Embedded forward and inverse kinematics routines for Non-Cartesian geometries (PI miCos Hexapod series and PI miCos SpaceFAB series)
- Hardware position capture and compare circuits for high precision
- Windows™ PEWin User-Interface

TECHNICAL DATA

	MC clipper LD DC	MC geobrick LV DC
Axes	4 / 8	
Computer interface	Ethernet TCP/IP 100Mbit, USB-2.0, RS-232	
Supply voltage	90-250 VAC 50-60 Hz	
Power configuration	100 W	240W (others available see options)
Limit switches	2 x npn normally closed	2 x npn/pnp normally closed
Encoder interface	RS-422	RS-422 & 1Vpp x 4096 interpolator
Trajectory mode	Linear, circular, rapid, B-spline, Hermite-spline interpolation modes	
Digital inputs		16 optocoupler npn/pnp 12-24 VDC
Digital outputs		8 highside/lowside 0.5A outputs
Position range	32 bit	
Amplifier	linear amplifier (no PWM)	direct digital PWM
Program and parameter	flash memory, 256 motion programs and 64 PLC's	
Motor current	0.5 A continues	5 A continues 15 A peak
CPU type	DSP 80 MHz / 240 MHz	
Housing	19" 2HE	19" 4HE

PI miCos

MC clipper ld 8 axes control board

MC-clipper LD:

- build-in linear servo brush amplifiers (no PWM) Icont. < 0.5A per axis
- 12 VDC power-supply 30 W

MC-geobrick LV:

- build-in direct digital PWM amplifiers for DC-brush, 2Phase stepper, 3Phase BLDC, 3 phase linear and torque motors
- I cont. 5A, I peak 15 A per axis
- 24 VDC power-supply 240 W, 16 digital inputs, 8 digital outputs

Optional:

- analog inputs 8 x 12 bit ± 10 VDC
- additional 16 digital inputs / 8 outputs
- 1Vpp sin-cos encoder interpolator x 4096
- Absolute encoder interface (Endat/ BISS)
- 24/48 VDC power supply 500 W or 1000 W

Delta-Tau controller

MC-Clipper LD 80MHz 8 axes DC-brush controller	001
MC-Clipper LD 80MHz 4 axes DC-brush controller	002
MC-Clipper LD 240MHz 8 axes DC-brush controller	011
MC-Geobrick LV 80MHz 8 axes DC-brush controller	101
MC-Geobrick LV 80MHz 4 axes DC-brush controller	102
MC-Geobrick LV 240MHz 8 axes DC-brush controller	111

MC-Geobrick offers many custom made version with mixed motor configurations, please consult PI miCos for a detailed offer.

Delta-Tau accessories

Geobrick LV 1Vpp x 4096 Interface 4 axes
Geobrick LV Absolute Encoder Interface 4 axes (EnDat 2.2 or BISS_C) to be defined at ordering time
Geobrick LV Analog Input 8 channel, 12 Bit +/-10V
Geobrick LV IO expansion 8 outputs 16 inputs
Geobrick LV bus voltage 24 VDC 500W
Geobrick LV bus voltage 48 VDC 500W
Geobrick LV bus voltage 48 VDC 1000W
Hexpod inverse and forward kinematics (model dependend)
Spacefab inverse and forward kinematics (model dependend)

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ACCESSORIES

Accessories. PI|miCos can supply typical range of feedthroughs, crimp pins, crimp tools and Kapton insulated wire. Internal vacuum compatible connectors are available in two versions: ceramic for UHV and Special Low Vapor Polymer for high vacuum. D-type Feedthroughs are recommended for electrical measurement, signals, heaters up to amps as well as thermocouple connections. Internal and external connections have locking screws which are important for safety and ease of demountability. Particularly suited for the manufacturing of CE compliant equipment. The sockets are industry standards and can be used with a wide range of connectors available from electronic components suppliers.

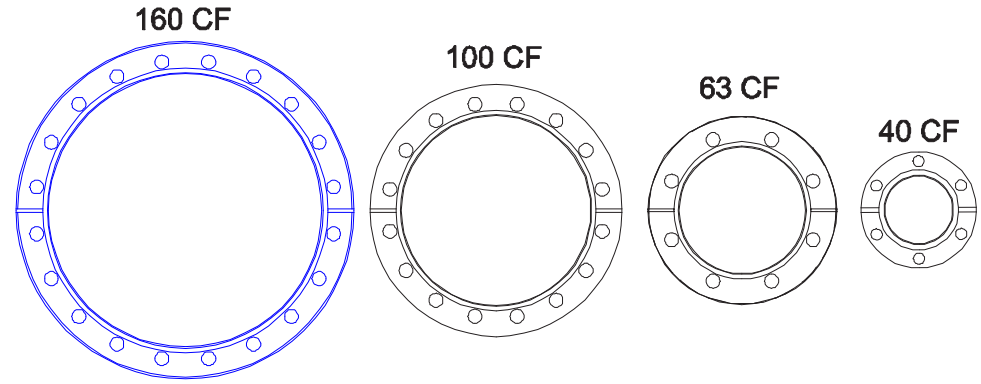
Please note: PI|miCos supplies vacuum-prepared stages with test plugs first, which cannot be used in vacuum. The plug has to be disconnected and replaced by a vacuum plug by the customer. Vacuum feedthrough, plugs and other vacuum accessories can optionally be obtained from PI miCos.

DN 40 CF with 1×15 pin D-type

Materials: SS, Glass-Ceramic
RoHS compliant: YES
Gender: Male - Male
Max. Bake Temperature: 250° C
Max. Operating Temperature: 230° C
Min. Operating Temperature: -200° C
Max. Vacuum Level 1× 10-12 hPa
Max. Current Rating 1 Amp. per pin
Leakage <5×10-10 hPa-l/sHe

Order Information - standard type

D-type Feedthrough 1× 9-pin on DN 40 CF Flange
D-type Feedthrough 1× 15-pin on DN 40 CF Flange
D-type Feedthrough 4× 9-pin on DN 63 CF Flange
D-type Feedthrough 3× 15-pin on DN 63 CF Flange
D-type Feedthrough 8× 9-pin on DN 100 CF Flange
D-type Feedthrough 6× 15-pin on DN 100 CF Flange



D-type Connectors PI|miCos can supply D-Type connectors which are compatible to our typical range of feedthroughs. Our vacuum compatible connectors are available in two versions: ceramic for UHV and Special Low Vapor Polymer for high vacuum. D-type Feedthroughs are recommended for electrical measurement, signals, heaters up to amps as well as thermocouple connections. Internal and external connections have locking screws which are important for safety and ease of demountability. Particularly suited for the manufacturing of CE compliant equipment. The connectors are industry standards and can be used with a wide range of feedthroughs available from electronic components suppliers.

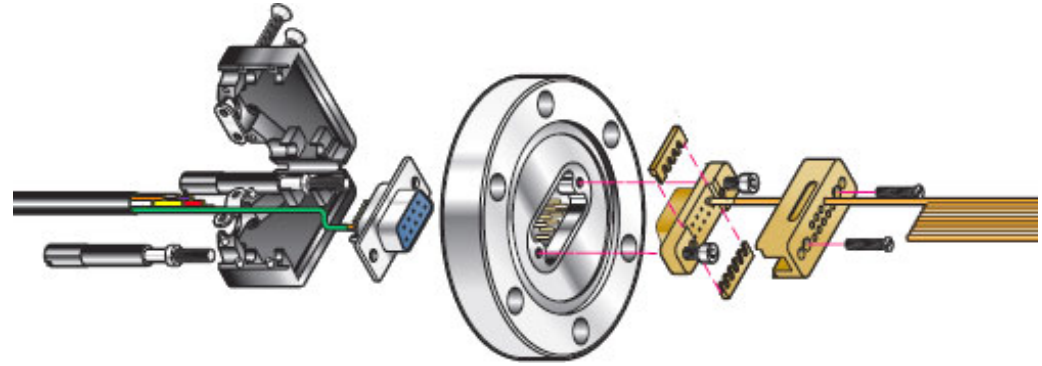
Ceramic Version for UHV

Materials UHV: Glass-Ceramic
Temperature range 4k – 300°C
Materials UHV: Peak
Temperature range -50°C – 230°C
Materials HV: Glass filled polymer
Temperature range -50°C – 140°C
RoHS compliant: YES
Gender: Female - Crimp
Max. Vacuum Level 1× 10-12 hPa
Max. Current Rating 1 Amp. per Pin

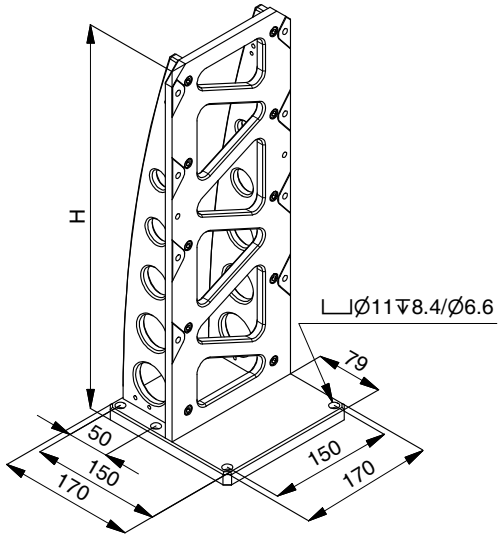
PEEK Version for HV/UHV

Order Information - standard type

D-type Connector HV 9-pins female incl. 9× Steel crimp pin
D-type Connector UHV 9-pins female incl. 9× Gold crimp pin
D-type Connector HV 15-pins female incl. 15× Steel crimp pin
D-type Connector UHV 15-pins female incl. 15× Gold crimp pin
Option1: D-type Connector HV with Gold pin
Option2: D-type Housing HV 9/15-pins Nickel Plated Zinc



AB-180 L (6" & 8") H=465
AB-180 XL (12"&16") H=665

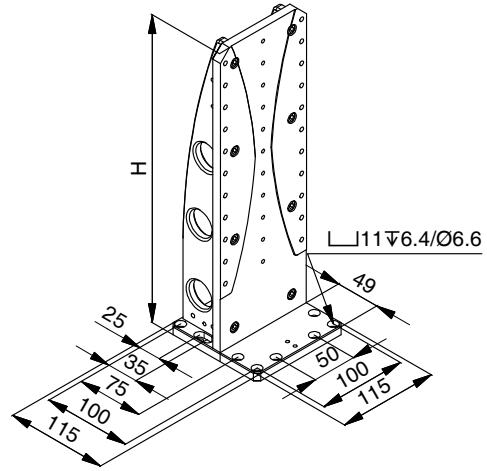


MOUNTING

LMS-180	LMS-180
LS-180	LS-180
UPL-160	
UPR-270 AIR	

6100-V-	0	6	1	AB-180 L (6" & 8")
6100-V-	0	6	2	AB-180 XL (12"&16")

AB-150 L H=350
AB-150 XL H=550

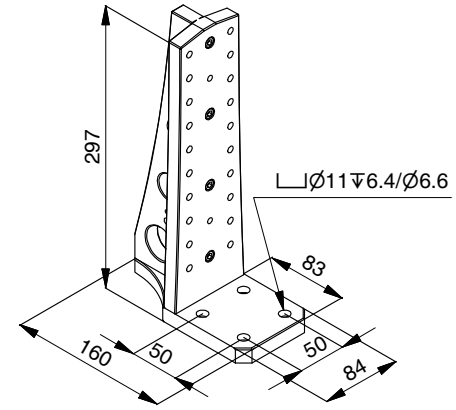


MOUNTING

UPS-150	HPS-170
HPS-170	LS-120
LS-180	LS-110
LS-110	UPR-160 AIR
UPL-160	
UPR-270 AIR	

6100-V-	0	7	1	AB-150 L
6100-V-	0	7	2	AB-150 XL

AB-160

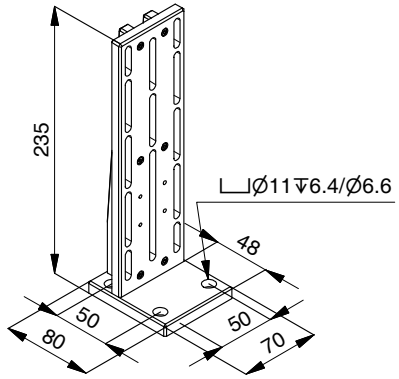


MOUNTING

UPS-150	LS-180	ES-100	UPM-160
UPM-160	LMS-120	UPR-270 AIR	WT-120
HPS-170	LS-120	UPR-160 AIR	WT-90
LMS-300	LS-110	WT-120	
LMS-180	UPL-160		

6270-V-	5	1	0	AB-160

AB-XL

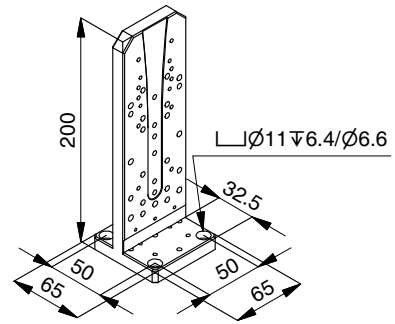


MOUNTING

UPS-150	LS-110	UPR-160 AIR	WT-90
UPM-160	PLS-85	PRS-110	WT-100
HPS-170	LS-65	WT-120	WT-85
LMS-300	UPL-160	WT-90	
LMS-180	ES-100		
LS-180	UPR-270 AIR		

6244-V-	5	1	5	AB-XL

AB-65 XL
AB-65 LS65

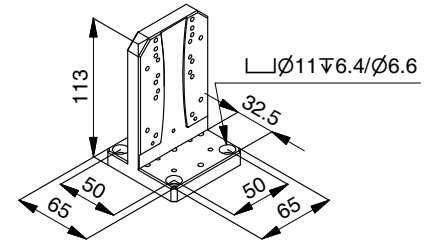


MOUNTING

UPS-150	PLS-85	RSP-200	PLS-85
UPM-160	VT-80	WT-120	VT-80
HPS-170	UPL-160	WT-90	DT-65 N
LMS-300	ES-100	WT-85	WT-90
LMS-180	UPR-270 AIR	APT-65	WT-100
LS-180	UPR-160 AIR	AMT-65 C	WT-85
LS-110	PRS-110	AMT-65 S	

6100-V-	0	7	6	AB-65 XL
6100-V-	0	7	9	AB-65 LS65

AB-65 L

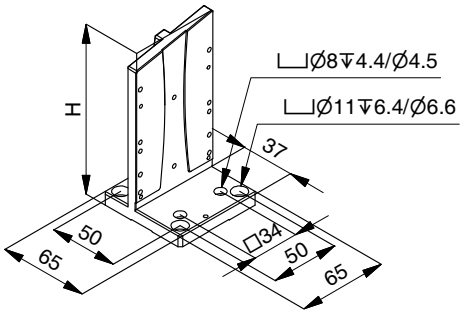


MOUNTING

UPS-150	PLS-85	RSP-200	VT-80
UPM-160	VT-80	WT-120	RS-40
HPS-170	UPL-160	WT-90	DT-80
LMS-300	ES-100	WT-85	DT-80 R
LMS-180	UPR-270 AIR	APT-65	WT-90
LS-180	UPR-160 AIR	AMT-65 C	ADT-80
LS-110	PRS-110	AMT-65 S	

6100-V-	0	7	5	AB-65 L

AB-65 M H=123
AB-65 ML H=155

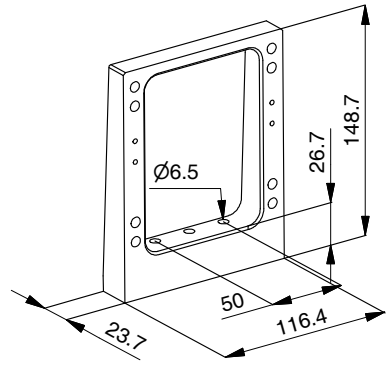


MOUNTING

UPS-150	MTS-70	DT-80 R	MTS-65
UPM-160	VT-80	RSP-200	
HPS-170	UPL-160	WT-120	
LMS-300	ES-100	WT-90	
LMS-180	LPS-65	WT-85	
LS-180	UPR-270 AIR	APT-65	
LS-110	UPR-160 AIR	AMT-65 C	
PLS-85	PRS-110	AMT-65 S	
MTS-65	DT-80	ADT-80	

6100-V-	0	7	4	AB-65 M
6100-V-	0	7	8	AB-65 ML

BF-1202

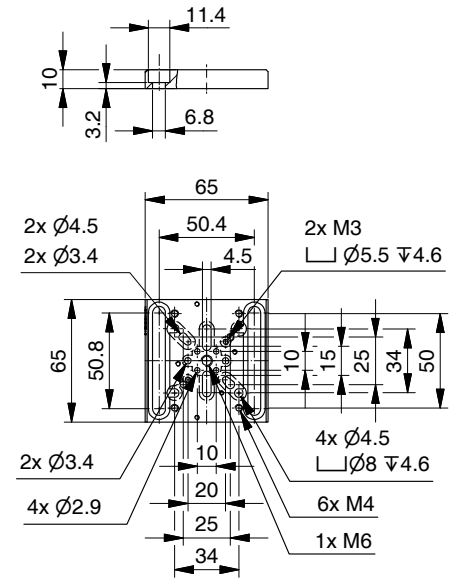


MOUNTING

AMT-120	AMT-120

6227-V-	1	4	0	BF-1202

FP-65N Fußplatte

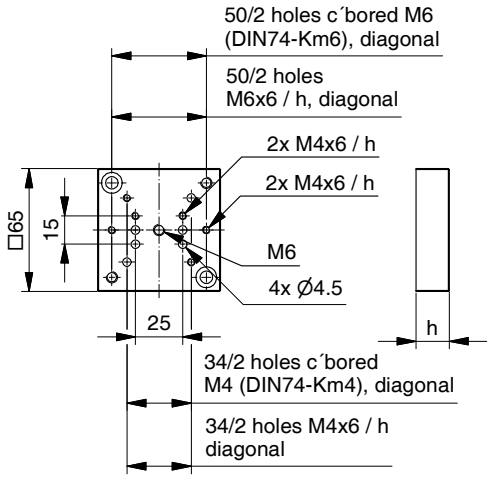


MOUNTING

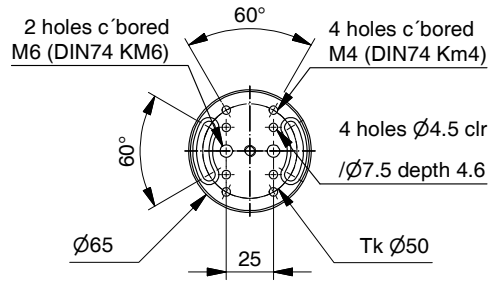
LS-40	LS-65
PP-30	ASS 5E
RS-40	RS-40
APT-38	DT-80
AVT-54	DT-80 R
MT-40	DT-50
	AFW-65
	APT-65
	APT-38
	AVT-54
	MT-40

2541-V-	0	2	1	FP-65N Fußplatte

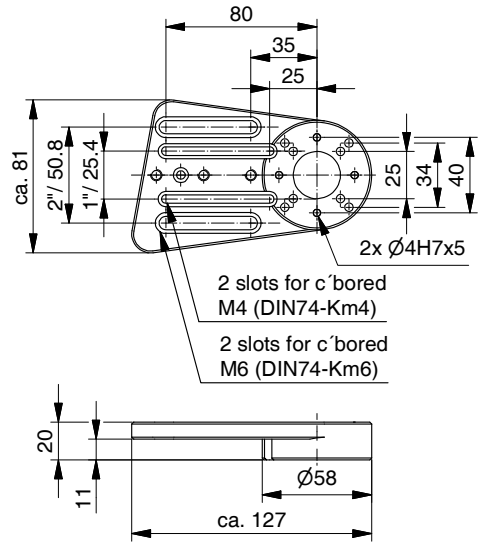
BFP-65 L=17.5 H=17.5
BFP-65 L=25.0 H=25
BFP-65 L=32.5 H=32.5



FP-65R



MP-rot



MOUNTING

DT-65 N	DT-65 N
DT-80	RS-40
	DT-80

2710-V-	1	0	5	BFP-65 L=17.5
2710-V-	1	1	5	BFP-65 L=25.0
2710-V-	1	2	0	BFP-65 L=32.5

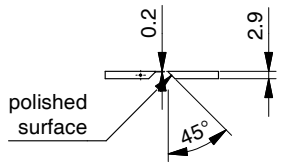
2541-V-	0	1	2	FP-65R

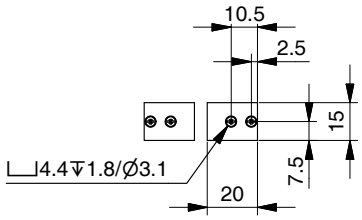
6100-V-	0	5	0	MP-rot

S-45 aluminium

S-45 stainless steel

S-45 wolfram





6710-V-	9	1	0	S-45 aluminium
6710-V-	9	2	0	S-45 stainless steel
6710-V-	9	3	0	S-45 wolfram

PI micos

ABSOLUTE ACCURACY

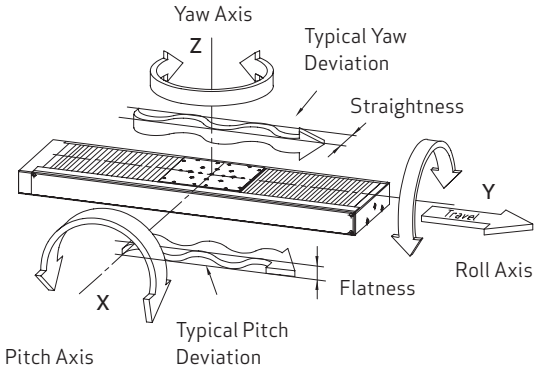
Absolute accuracy is defined as the difference between the required position and the achieved position for each possible position within the full travel range. Absolute accuracy should not be confused with resolution. Resolution is defined as the smallest measurable increment of motion in a system. For most systems, the positioning resolution is considerably higher than its absolute accuracy.

There are several sources of error in a positioning system. Linear errors can be caused by an imperfect screw pitch, thermal expansion or angular deviations at the point of measurement.

For absolute accuracies below 1 µm for longer travel ranges, a closed loop linearmeasuring systemis required. Some examples of linear measuring systems are laser interferometer, optical linear encoders using glass scales or magnetic encoders. Most sources of mechanical positioning inaccuracies, such as pitch error and thermal expansion, can be corrected using such measurement devices. Stepper motors in open loop or DC-motors with rotary, shaft mounted encoders are usually not capable of achieving sub-micron accuracies.

DEFINITION OF LINEAR STAGES

X: Linear movement orthogonal to the moving direction
Y: Linear movement to the moving direction
Z: Vertical movement

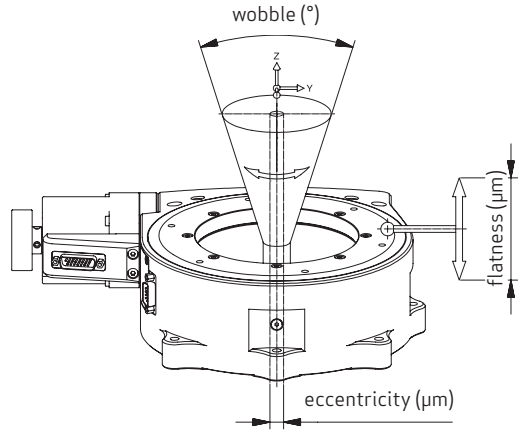


RUN-OUT

Run-out is defined as the discrepancy from a perfectly straight line and describes any undesired movement in the remaining 5 degrees of freedom of motion other than the desired axis. For example, for a desired translation in y axis, there will also be small but undesired motion in x and z direction as well as rotation around y (Θy = roll), x (Θx = pitch) and z (Θz = yaw). Errors in guidance (run-out) appear because of bearing imperfection in addition to mounting base imperfections.

DEFINITION OF ROTATION STAGES

Θx: Rotation around Y (roll)
Θy: Rotation around X (pitch)
Θz: Rotation around Z (yaw)

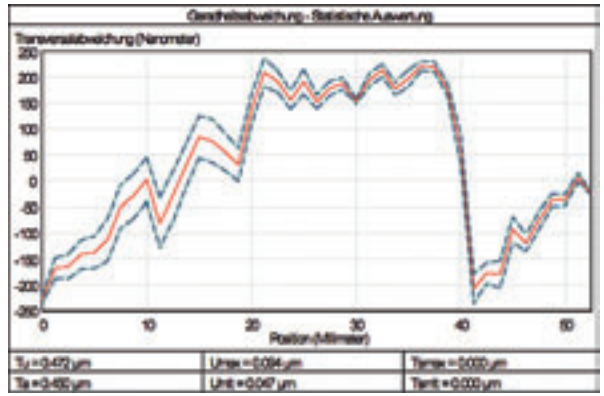


EXAMPLE FOR LINEAR MEASUREMENT

Stage		HPS-170 52 mm 2SM-LIE5 encoder 15 nm resolution
Serial Number		07090035
Customer		
Date		18.09.07
Measurement Device		Laser-interferometer ZLM 500 Zeiss
Measurement Base		Granit-base 800x600 mm, Quality LAB, Max error= 0.0014 mm
Environment	Temperature	20.6 °C
	Humidity	58%
	Pressure	992 hPa
Hint		HPS-170 mounted with 8 x M6 (5Nm)

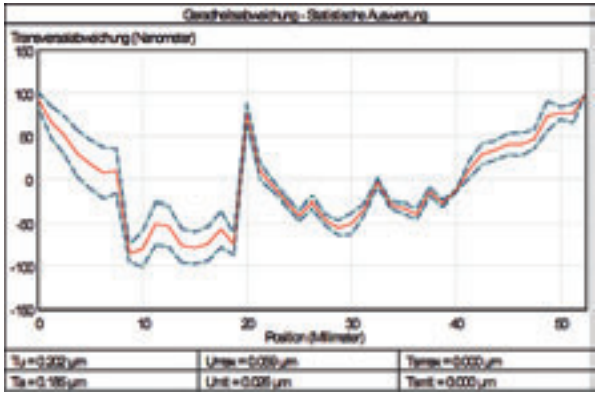
STRAIGHTNESS

measured in a height 40 mm above the slider. The straightness referring to the travel range of 52 mm will be measured. The straightness is Tu = 0.472 µm absolute. The repeatability of the guidance accuracy referring to the straightness is Umax = 0.094 µm.



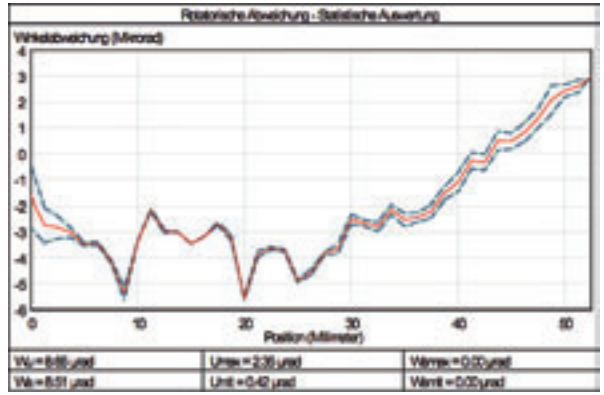
FLATNESS

The flatness referring to the travel range of 52 mm will be measured. The flatness is Tu = 0.0202 µm absolute. The repeatability of the guidance accuracy referring to the flatness is Umax = 0.059 µm.



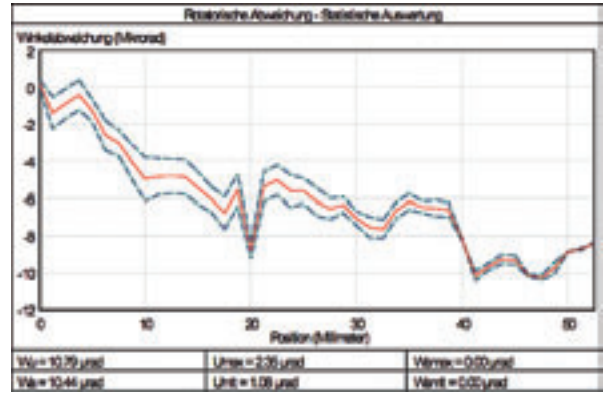
PITCH

measured in a height 40 mm above the slider. The pitch angle referring to the travel range of 52 mm, will be measured. The pitch angle is Wu = 8.65 µrad absolute. The repeatablility of the guidance accuracy referring to the pitch angle is Umax = 2.35 µrad.



YAW

measured in a height 40 mm above the slider. The yaw angle referring to the travel range of 52 mm, will be measured. The yaw angle is Wu = 10.79 µrad absolute. The repeatablility of the guidance accuracy referring to the yaw angle is Umax = 2.35 µrad.



Next 3 measuring protocols are illustrating the positioning accuracy of stages with a travel range of 100 mm, respectively 52 mm.
The first stage will operate in open loop. The second stage will be controlled using a linear encoder (closed loop). The third stage is equipped with a linear encoder in closed loop. The stage was calibrated with additional positioning correction in software. In this case, interferometrically measured stage data is mapped in the controller and used to electronically compensate mechanical errors.

POSITION, OPEN LOOP

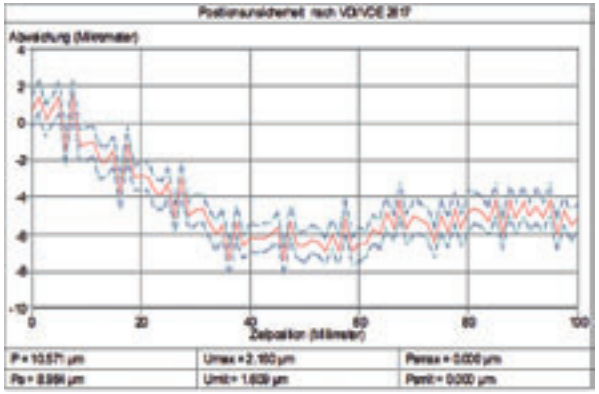
measured in a height 40 mm above the slider.
The stage is operated in open loop.
With a total travel range of 100 mm the absolute position accuracy is P = 10.571 µm.
The stage has a backlash of Umax = 2.16 µm.

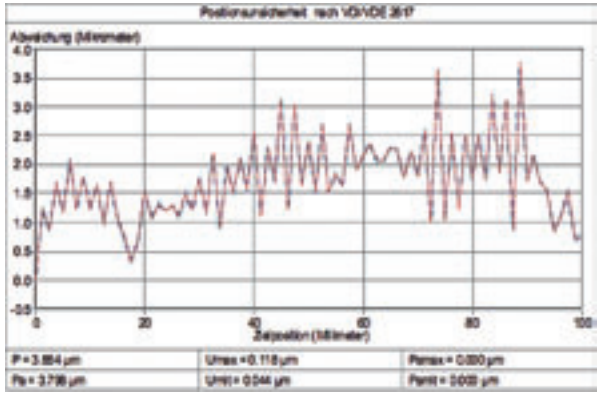
POSITION, CLOSED LOOP

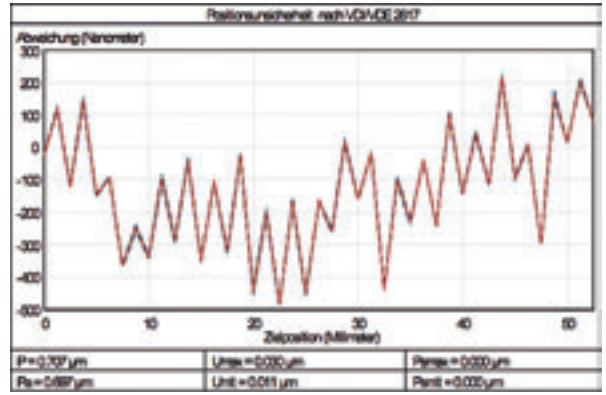
measured in a height 40 mm above the slider.
The linear stage, equipped with a linear scale with a resolution of 50 nm and a total accuracy of +/- 3 µm, operates in closed loop.
Absolute positioning accuracy improved from Pmax = 10.571µm to P = 3.854 µm. The backlash (hysteresis) of the stage was reduced from Umax = 2.16 µm to Umax = 0.118 µm. (Please compare with the measuring protocol).

POSITION CLOSED - LOOP WITH POSITION CORRECTION

measured in a height 40 mm above the slider.
The absolute position accuracy with a travel range of 52 mm is P = 0.707 µm. The backlash of the absolute position accuracy (bidirectional) Umax = 0.030 µm.



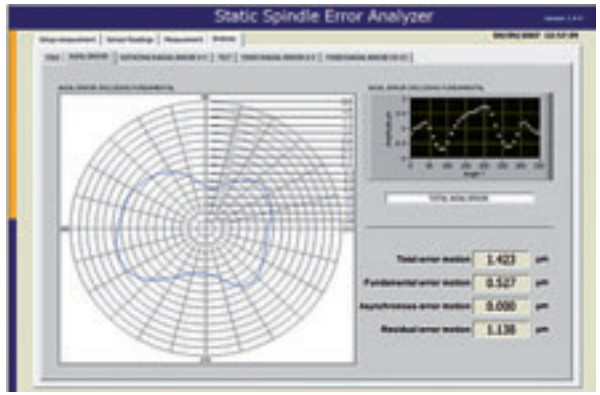




EXAMPLE FOR ROTATION MEASUREMENT

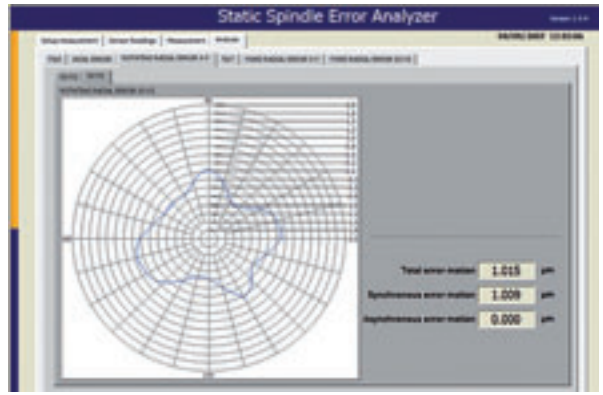
AXIAL ERROR

This measurements shows the flatness of a rotation stage. The flatness measured at a 360° rotation is 1.423 µm.



ROTATING RADIAL ERROR X2-Y2

The eccentricity error in the Y coordinate at a rotation of 360° is 1.015 µm.



TILT-Y

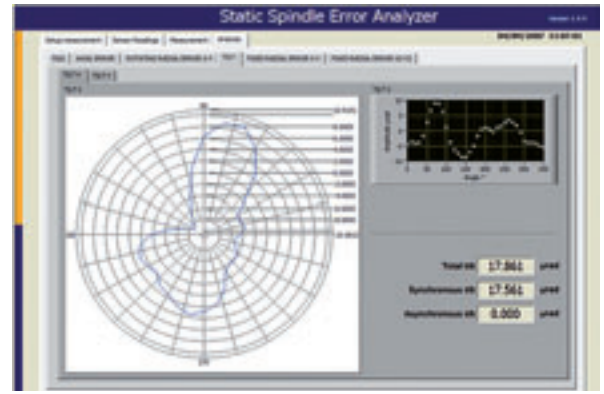
The angle error (wobble) in the Y coordinate at a rotation of 360° is 22,531µrad.

ROTATING RADIAL ERROR X1-Y1 (WOBBLE IN X-COORDINATE)

The eccentricity error in the X coordinate at a 360° rotation is 2.324 µm.

TILT-X

The angle error (wobble) in the X coordinate at a rotation of 360° is 12.861 µrad.

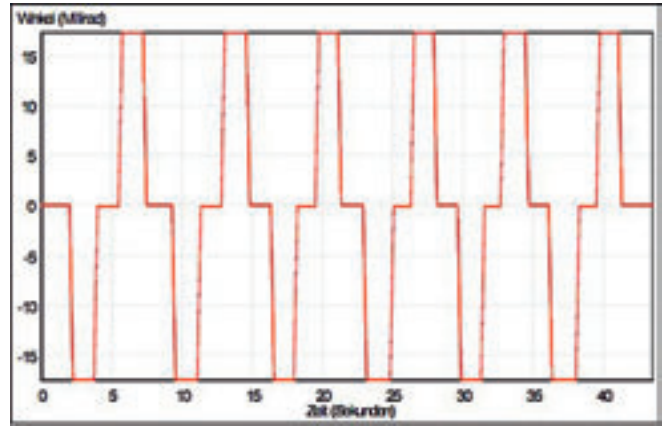


EXAMPLE REPEATABILITY OF PRS-200 STAGE OPEN LOOP

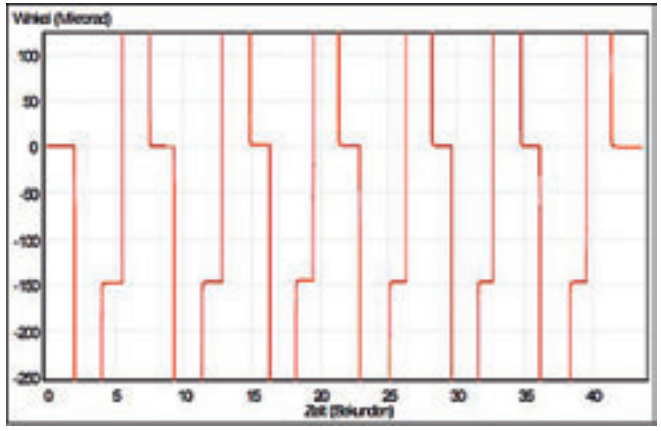
Stage		PRS-200 2SM
Serial Number		07090203
Customer		TSA
Date		04.10.07
Measurement Device		Laser-interferometer ZLM 500 Zeiss
Measurement Base		Granit-base 800x600 mm Quality LAB Max error= 0.0014 mm
Environment	Temperature	21.8 °C
	Humidity	54%
	Pressure	994 hPa
Hint		PRS-200 mounted with 4 x M6 (5Nm)

Shown is the repeatability of a rotation stage PRS-200 in open loop.

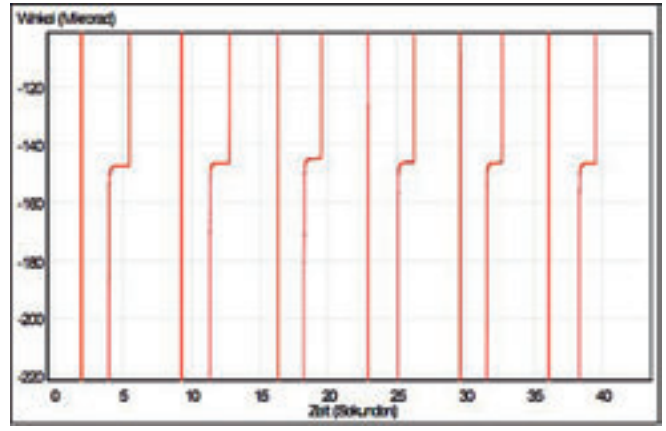
MILLIRAD SCALE



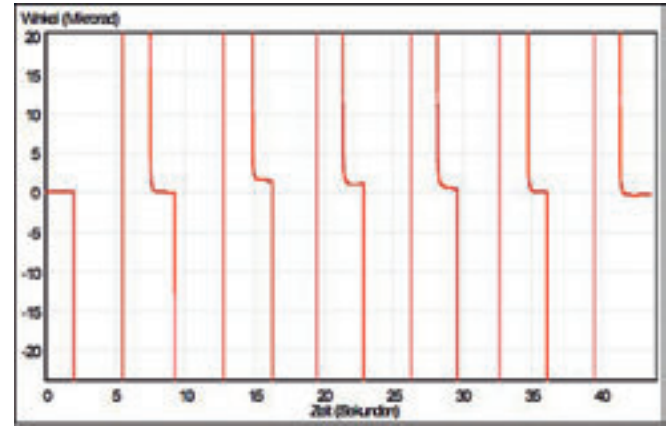
MICRORAD SCALE



REPEATABILITY BI-DIRECTIONAL ZOOM



REPEATABILITY UNI-DIRECTIONAL ZOOM



RESOLUTION, RESPECTIVELY SMALLEST STEP SIZE

This is the smallest movement, which can be performed repeatably.

PI miCos distinguishes between calculated and actual resolution. Actual resolution is often worse than the calculated value due to stiction, friction, elastic deformations in the drive train and elasticities in the guides.

CALCULATED RESOLUTION

Is defined as the theoretically smallest movement, which can be achieved by the positioning system based on the ideal values for drive components (pitch, gear ratio, angular resolution of the motor or encoder, etc). The theoretical resolution almost always is many times better than the actual resolution (smallest step size). In real systems, the minimally achievable motion increment is almost always bigger than the calculated resolution.

STICK-SLIP EFFECT (STICTION)

This effect appears at the junction of static friction to sliding friction and leads to a sudden motion jump. This effect limits the smallest repeatable step size. Only frictionless actuators such as flexure-based piezo stages, are able to overcome such effects and are therefore ideal in the nanometer and sub-nanometer range.

BACKLASH

Reverse backlash is defined as a systems dead zone that occurs if an adjustment component is moved from one direction to the opposite direction. Preload as well as closed loop control by using a linear scale can avoid this effect.

UNI-DIRECTIONAL REPEATABILITY

This specification means the ability to repeat a motion in one direction only. Backlash and hysteresis are compensated.

BI-DIRECTIONAL REPEATABILITY

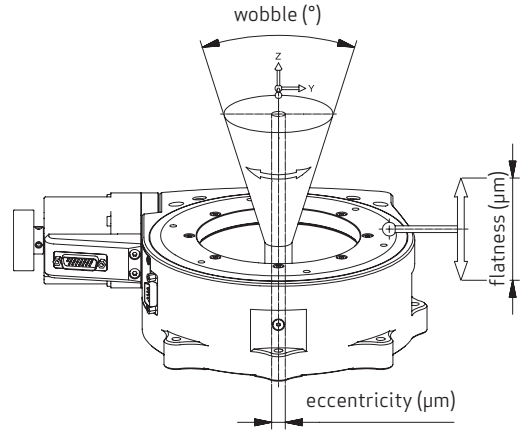
The ability to achieve a commanded position over many attempts independent of the direction where positioning occurs.

ECCENTRICITY

Also called concentricity, occurs in a rotation stage and defines the deviation of the center of rotation from its mean position.

WOBBLE

Is defined as the angular deviation of the axis of rotation over one revolution.



OVERALL CONTROL

The overall control is a static and frictionless slide element, which is based on the deformation (curving) of a solid object (e.g. steel) and operates completely without rolling or gliding parts.

Further advantages are the high stiffness, capacity and little wastage.

ORTHOGONALITY

For example, in the case of XY stages, orthogonality is the deviation of the ideal 90° angle of two axes.

LOAD CAPACITY

The permissible force due to load vertically applied at the center of the stage.

NORMAL LOAD CAPACITY

The maximum centered load that can be placed directly on the stage.

TRANSVERSE LOAD CAPACITY

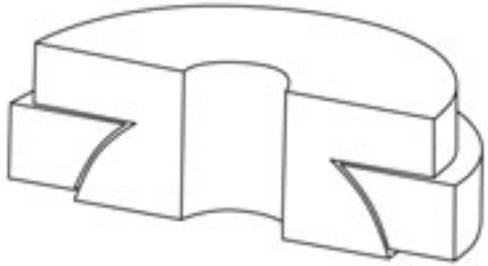
The maximum load that can be applied vertically to the stage and along the surface of the stage. This so-called 'side load' capacity is limited by the load capacity of the bearings.

STIFFNESS

Refers to the amount of force that is necessary to produce a given amount of deflection.

AIR BEARINGS

Air bearings are elements that separate two moving surfaces with a thin air film in the µm range. Air-bearings are nearly frictionless and allow guiding accuracy up to factor 10 better than mechanical bearings. PI miCos air bearings are equipped with air pressure connectors as well as vacuum connectors to pre-load the bearings, which optimizes guiding accuracy. Air bearings are used for ultra precision machines (measuring systems and machines) and high-speed machines (high-speed spindles).

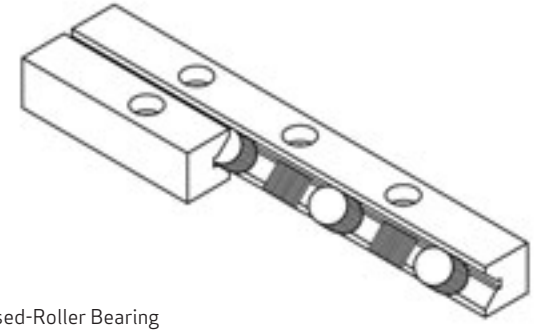


Air-Bearing

CROSSED-ROLLER BEARINGS

As with ball bearing slides rolls roll between two precisely ground and hardened sides.

The individual balls are lead through a ball cage in order to prevent obstruction. The rollers are arranged reciprocally in the cage. Roller bearings are as the ball bearing slides terminate guiding mechanism where the rollers cover 0.5-times of the way of the translating object. Due to good rolling features (they lack static and sliding friction) crossed roller bearings are perfectly suited for precision adjustment units. In contrast to ball bearing slides they provide a significant higher stiffness and load capacity.

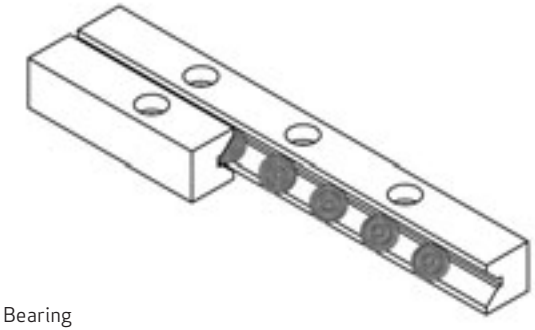


Crossed-Roller Bearing

BALL BEARINGS

Balls roll between two precisely ground and hardened sides. This corresponds to the principle of a ball bearing. The individual balls are led through a ball cage in order to prevent obstruction. Ball bearing slides are finite guiding mechanisms where the balls cover 0.5-times the way of the translating object.

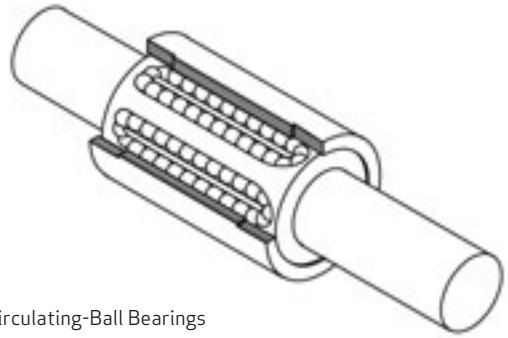
Owing to good rolling features (they are lacking static and sliding friction) they are preferable to conventional guidings such as dovetail slides. Backlash free linear translation is achieved by precise adjustment. However, the load capacity is not as high as with classical gliding guides.



Ball Bearing

RECIRCULATING-BALL BEARINGS

On a hardened and ground surface balls roll in guiding grooves. Arriving at the end of the guide body the balls are carried back by an integrated recirculation to the beginning of the guide body. Therefore the guidance system achieves travel ranges that are a multiple of the guidance bodys dimensions. The travel range is only limited by the terminate length of the guide surface. Adjustment and zero backlash respectively are achieved by adjusting screws. No static or sliding friction occurs with correct adjustment.

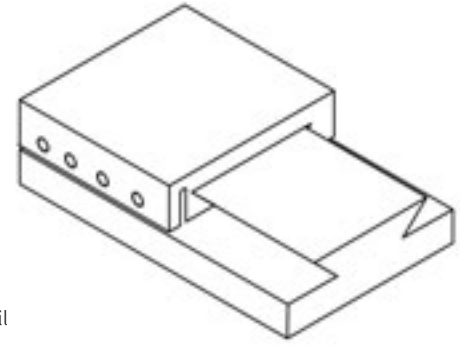


Recirculating-Ball Bearings

DOVETAIL

Dovetail slide prevents the carriage from elevation off by slanting the side faces. Adjustment is made possible by a screw adjusted gib strip. Advantages of dovetail slides are high load capacity and precise guiding (if well adjusted).

Sliding and static friction that do not appear with bearings such as ball bearing slides or crossed roller bearing slides are disadvantageous.

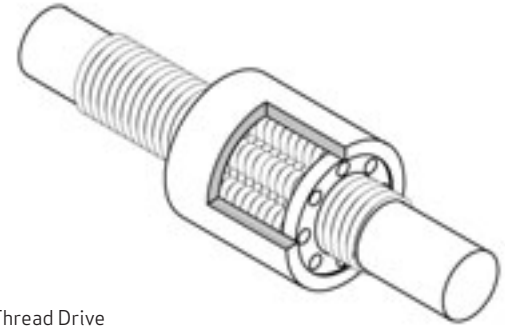


Dovetail

DRIVE SYSTEMS

ROLLER THREAD DRIVE

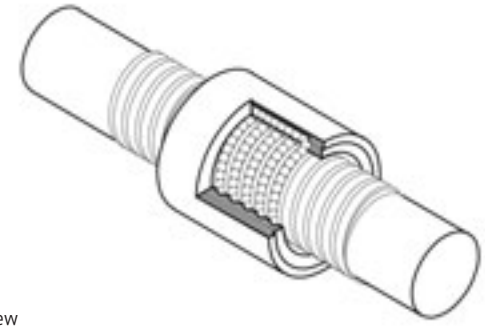
Roller thread drives consist mainly of a threaded screw and a threaded nut. Between threaded screw and threaded nut several thread rolls are arranged parallel to the axis. Roller thread drives stand out for their high load capacity and stiffness. Likewise very small pitches can be realized. As with ballscrews, rotational speed depends on length and diameter of the threaded screw. With appropriate greasing and assembly an approximately three-fold rotational speed and lifetime of ball screw is achieved.



Roller Thread Drive

BALL SCREW

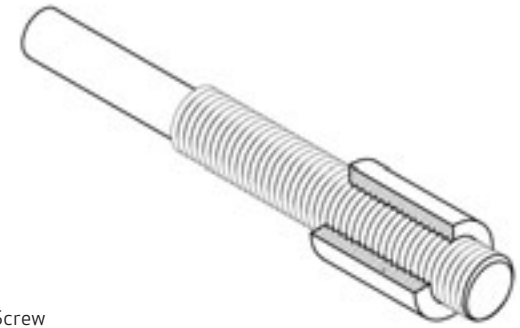
Balls roll on a ground or rolled shaft, having a helical groove. The balls support themselves in a helical groove with same pitch which is incorporated in the nut. Due to the revolving shaft the balls roll in the groove andmove the nut (if not revolving) one screw pitch per rotation (further).
The nut incorporates a recirculation system returning the balls that arrived at the end to the beginning of the nut. This model allows execution of linear motions by rotary movements. This ball screw shows high efficiency. Stick-slip effect does not occur. Due to selected balls a thread-nut combination with zero backlash can be achieved.



Ball Screw

LEAD SCREW

The lead screw corresponds to the principle of screw-nut combination. However the screw and the nut respectively are highly precise manufactured. In combination with particular thread pitch and corresponding choice of material static and sliding friction can be reduced to minimum. In spite of high quality of manufacture the lead screw shows some axial backlash. This can be eliminated with help of preload. A limited lifetime is due to friction of the sides of threaded nut and threaded screw. The lead screw is not suited for highly static and dynamic loads.



Lead Screw

DRIVE OPTIONS

MOTORS

With the conception of a positioning system the basic question of a necessary drive system occurs. Different parameters are relevant to the choice. They differ depending on type of problem.

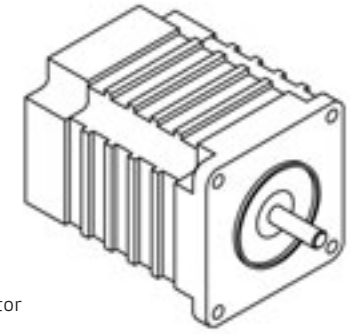
Deciding factors are:

- Speed of translation
- Smoothness of running
- Resolution
- Occurring load moments
- Range of capacity
- Heat of the motor

STEPPER MOTORS

A stepper motor is an electromagnetic driving system that moves around a particular reproduceable step angle due to defined wiring and triggering of windings (phases).

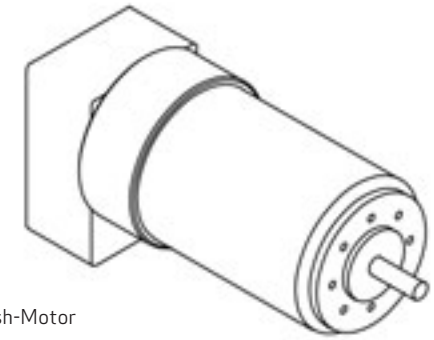
A quasi-continuous rotation is achieved owing to the stepper motor control that triggers the phases. Rotation speed depends directly on frequency of triggering/drive. The smallest possible resolution of positioning depends on the motor as well as on the type of drive. Commercial stepper motors allow resolutions from 200 up to 1000 steps per revolution. However resolution can be considerably increased by electronic micro-stepping. The advantage of a stepper motor compared with other electric drives is that expensive encoders or glass scales are not required. For reproduceable positioning, however, a loss of steps must be excluded because a feedback of the stepper motors' position does not follow. The reason for loss of steps is often an incorrectly designed drive unit where frequencies of triggering/drive, accelerations or irregular ranges of capacities occur that are too high.



Stepper Motor

BRUSH-MOTORS

In contrast to a stepper motor a DC-motor (direct current motor/servo motor) requires no external commutation. By feeding with an appropriate direct current, the DC-motor starts to move. The rotational speed of the unloaded DC-motor is direct proportional to the applied voltage, the torque of a motor is directly proportion the motorcurrent. Since a direct current motor does not have defined grid steps, an additional hodometry is required to determine the actual position. Usually incremental encoders, glass scales or interferometers are utilized.



Brush-Motor

LINEAR / TORQUE MOTORS

DIRECT-DRIVES

Unlimited Travel motors do not have limitations on travel displacements. Since the stationary magnet assemblies can be easily joined together to form any length of motor, travel can be made as long as necessary. Since the same moving coil assembly could be used for any travel, there is no trade-off in performance as a function of travel.

Screw-driven systems, on the other hand, have critical speed limitations and higher inertia with added length. Speed limitations, high inertia, and low stiffness are major performance trade-offs with larger travels with other drive techniques.

SMOOTHNESS OF MOTION

Brushless linear servo motors can provide extremely smooth motion, since they have no contacting surfaces to cause jitter.

Ultimate smooth motion is achieved with sinusoidal-commutated non-ferrous motors. By contrast, ball screws are not as smooth due to the vibrating nature of the balls entering and exiting the ball nut raceways, which is easily observed in sub-micron systems. Belt and rack-and-pinion drives also have contacting mechanisms which are susceptible to friction and backlash caused vibrations.

With linear motors, the only limit to total system accuracy and repeatability is the sensing device and the bearings of the positioning system.

In rotary driven systems there are additional factors which effect these performance variables, including backlash, hysteresis, lost motion and jitter.

PIEZO MOTOR

Piezo drives achieve resolutions of 1 nm or better. They are offered as an alternative option to our numerous linear, elevation or rotation stages.

Piezo stages are able to operate with high velocities, low friction and low backlash.

OPEN LOOP

Driving signals are not controlled using postion feedback and error correction.

CLOSED LOOP

The actual position of the stage is measured and compared to the ideal (commanded) postion.

In order to achieve the ideal position, a control algorithm is used. As a result, the positioning accuracy will be increased.

ROTARY ENCODER

For indirect position measurements of linear and rotation stages, as well as actuators we use rotary encoders mounted on the motor.

However, this method is not able to correct for spindle errors, hysteresis and backlash.

LINEAR ENCODER

Linear encoders are used for direct position feedback. Linear encoders have a positive effect on overall positioning accuracy, resolution and repeatability. They also improve speed regulation of the stage. Mechanical inaccuracies of stages, such as backlash, hysteresis, and spindle errors can be improved.

ABSOLUTE ENCODER

Absolute encoders always give an absolute positioning data, unlike incremental encoders, even after a potential loss of power to the stage.

Absolute encoders most often use several readtracks to generate binary codes such as gray codes which contain the absolute position.

TACHOMETERS

Utilized for applications requiring velocity regulation. Speed can be measured directly or from the encoder supplied position information.

GEAR HEAD

Gears are most often used to increase the torque and/or resolution of the motor.

ACCELERATION

Is defined as the change in velocity per unit time.

VELOCITY

Is defined as change in distance per unit time.

Specifications for maximum speed are stated at the normal load capacity of the stage.

Linear servo motors can be used in both very low and very high velocity applications, all with very high precision. They can precisely operate at velocities ranging from less than

0.1 µm/s to more than 5 m/s. Ball screws and lead screws have critical speed limitations. Belt drives exhibit lower stiffness. Rack-and-pinion drives typically have backlash and poor low velocity performance.

SPEED STABILITY

Refers to the ability to keep a constant speed over time.

POSITION STABILITY

Refers to the ability to keep a constant position over time.

INERTIA

Describes the measure of a loads resistance to change in velocity. The larger the inertia, the greater the torque that is necessary to accelerate or decelerate the load. Therefore loads such as sliding or static friction and fitting positions (horizontally or vertically) must be taken into account.

COSINE ERROR

Misalignment between the measurement axis and the axis of motion produces cosine error. This error is a function of the angle between the measurement axis and the axis of motion. It is eliminated when the axis of motion and the measurement axis are parallel.

HYSTERESIS

Hysteresis is a component of the reversal error and is dependent on the recent history of the system. It is observed when the forces acting on a system reverse direction and is the result of elastic forces in the various components. It affects both bi-directional repeatability and accuracy.

RUNOUT

Runout error is the divergence of an imaginary point, on the moving part of the positioning element, to a stationary coordination system. Due to work tolerance in guiding systems the translators carriage does not move in an ideal straight line. The divergence of this straight line is referred to as runout error.

Two types of runout errors are to be defined:

- In translation direction (plane motion)
- In crosswise translation direction (out of plane motion)

Additionally these divergences can be defined as relative or absolute runout error.

MTBF

Stands for Mean Time Between Failure and means reliability and lifetime of the stage.

PI miCos SPECIFICATIONS

CALCULATED RESOLUTION

Calculated resolution is the theoretical resolution of the stage. The main factors depend on the lead screw, the motor, gear and the measuring system such as the encoder or interpolation unit.

TYPICAL RESOLUTION

The typical resolution specifies the statistical resolution based on real-world measurement data.

VACUUM

For specifying the necessary vacuum level it is important to analyze the application. The requirement of coating optics, epitaxy or crystallography is different in the necessary vacuum level as well as mass spectroscopy or others. Not the general vacuum level of 10^{-7} or 10^{-9} hPa is often important but e.g. the partial pressure of hydrocarbons. As a result of using wrong grease with higher vapor pressure or use of plastics these hydrocarbons can be a source of contamination of surfaces. Especially laser applications e.g. in the UV range are critical because the hydrocarbons can be split into fragments and these fragments can be deposed on optics. The choice of materials and handling processes are at the end the most important points to get the right vacuum stage.

DEFINITION VACUUM

Vacuum is defined as pressure lower than normal air pressure. A system is in vacuum if the pressure is lower than the atmospherical pressure. The PI miCos catalog uses hPa as a unit of air pressure. Other physical units commonly used are Millibar (mbar) and Torr (Torr).

DEFINITION ACCORDING TO DIN 28400

Vacuum is defined as pressure lower than the air pressure of the atmosphere.

CLASSIFICATION OF THE VACUUM CLASSES

Vacuum class	Abbr.	Pressure range
Low vacuum	FV	<1 - 1-10^{-3} hPa
High vacuum	HV	<1x10^{-3} - 10^{-7} hPa
Ultra-high vacuum	UHV	<1x10^{-7}-1x10^{-9} hPa
Ultra-high vacuum Grease	UHV-G	<1x10^{-7}-1x10^{-9} hPa
Ultra-high vacuum Cryo	UHV-C	up to 1x10^{-9} hPa
Extreme-ultra-high vacuum	EUHV	<1x10^{-9} - 1x10^{-11} hPa

According to DIN28400-1:1900-5

Almost all miCos stages can be prepared for FV, HV and UHV. For UHV vacuum class all components are made for 1x10^{-9} hPa. Special UHV motors, cables, controllers, greases and coatings are used.

PI MICOS STANDARD VACUUM PREPARATION CATEGORIES:

FV UP TO <1X10^{-3} hPa

- Standard motor
- Standard measuring system, if measuring system required
- Standard wiring
- Standard connector for plug connection
- Standard limit switch
- All Al parts are anodized
- Stainless steel screws
- All guidance and driving elements are equipped with vacuum grease
- Outbaking temperature max. 80°C

Cryogenic Linear Stage / EADS project ‚James Webb Telescope'/ High End Measurement Heidenhain Glass scale

HV UP TO <1X10^{-3} TO 1X10^{-7} hPa

- Special vacuum motor
- Measuring system modified for the use in vacuum
- Motor and limit switches equipped with teflon or kapton insulated braids 2 m length wired to a test plug
- Standard limit switches, with plastic parts
- All Al parts un-anodized
- Stainless steel screws
- All guides and driving elements are equipped with vacuum grease
- No use of CuZn alloys
- All holes are vented (if possible)

WHEN STAGES ARE USED IN A HIGH-VACUUM AREA PLEASE CONSIDER THE FOLLOWING:

- Use low speed operation, max. motor speed 10 rev/s
- Shorter life time expectation
- Stages can only be run in vacuum
- Stages are delivered with test plugs, not designed for vacuum
- Outbaking temperature max. 120°C [150°C]

UHV <1X10^{-7} UP TO 1X10^{-9} hPa

- Special vacuum motor
- Measuring system modified for the use in vacuum
- Motor and limit switches equipped with kapton insulated braids 2 m length wired to a test plug
- No limit switch, but can be offered with special UHV limit switch
- All Al parts are un-anodized
- Stainless steel screws are Ag coated, with degass drilling (apart from M3 thread)
- Bearing and driving elements made of hardened stainless steel and equipped with vacuum grease
- No use of CuZn alloys
- No use of plastics, unless so desired after consultation with the customer
- All holes are vented (if possible)

Electronic devices such as controller, amplifier and other electronic devices supplied by PI miCos are not made for vacuum use. Therefore, they must be placed outside the vacuum chamber. PI miCos supplies vacuum-prepared stages with test plugs, which cannot be used in vacuum. The plug has to be disconnected and replaced by a vacuum plug by the customer. Vacuum feed-through and plugs can optionally be obtained from PI miCos.

For use in HV and UHV all guides and spindles are lubricated with vacuum lubricant. The specific lubricant for your application will be defined during the ordering process.

HANDLING / CLEAN ROOM

Our vacuum stages are assembled in clean room conditions. All components are cleaned in an ultrasonic bath. Afterwards they are packed in a particle free and antistatic bag. Our components and systems can be used in clean room, cryogenic applications and various other climatic environments.

PI miCos PREFERRED MATERIALS FOR STAGES ARE:

- Stainless steel
- Aluminum
- Titanium
- Brass
- Viton
- Ceramic
- Sapphire
- Teflon
- Peek
- Kapton
- Macor

PRICE LIST

All prices are valid for sales in Germany. For international prices contact PI miCos or our representatives. Offers and invoices are quoted in EURO. Our offers are valid for 60 days. Inside Germany transport is included, outside Germany ex works. Transport insurance is included.

INTERNATIONAL PRICE LIST

Prices outside of Europe include insurance plus packing and customs duty. Offers and invoices are quoted in EURO.

Our offers are valid for 60 days. Customers from countries where PI miCos is not represented are directly supplied by PI miCos Germany.

TERMS OF PAYMENT

Inside Germany 10 days with 2% cash discount, 30 days net after receipt of delivery.
Outside Germany 30 days net after receipt of the goods.

In case of larger orders or custom-made systems delivery is only made after receipt of a bank surety, prepayment or 30% deposit when placing your order.

We will reserve the right to deliver part of the goods and to make out partial invoices.
The supplied goods are our own until complete payment has been made.

VAT: DE 142213462
INAN: DE 14 6805 0101 0012 5837 97
SWIFT/BIC: FRSPDE66

CANCELLATION

Orders can only be written cancelled by mutual agreement with PI miCos GmbH Germany.

PRODUCT MODIFICATIONS

Because we endeavour to offer our customers modernst technical developments we will always improve our products. For this reason our products are subject to change.

WARRANTIES

All PI miCos products are guaranteed for a period of two years. In case of repaired products, all replaced structural parts are guaranteed for a period of 36 months.
If you do need to return a product for check up without exchange of any parts we grant a 12 months warranty. Please take into account that all PI miCos products can only be returned with the original packing. Furthermore, the customers pay insurance for the goods.

RETURN OF PRODUCTS

Standard products can only be returned/exchanged within 30 days. They are subject to a restocking fee of up to 15% net.
In case of damage we reserve the right to repair the defective products.

GENERAL

Measuring certificates are not included in delivery, only on request and for an extra charge!

SHIPMENT

All PI miCos products are carefully dispatched with the original packing.
Please verify product specifications immediately after receipt of the goods.
In case of damage please inform at once the shipping carrier or PI miCos Germany.
PI miCos products can only be returned via the shipping carrier that delivered the goods.

If these instructions are not observed you are not entitled to damages.

REPRESENTATIVES

We have learned that our customers appreciate the direct contact with a local distributor. Therefore PI miCos has selected qualified representatives in different countries. We continuously provide training and updated product information to them so that they are able to offer an excellent customer service concerning technical questions, customs paperwork, insurance and delivery. If you find no representative in your region, please contact us directly.

When ordering a product or a service you accept the PI miCos AGB's.

I. General, Coverage

(1) These General Terms and Conditions of Sale are valid exclusively. Contrary conditions of the ordering party or conditions differing from these General Terms and Conditions of Sale shall not be effective, except in cases where there has been an explicit consent as to their validity. These General Terms and Conditions of Sale are also valid even if despite knowledge of conditions of the ordering party contrary to or differing from these General Terms and Conditions of Sale the delivery is executed without prejudice.

(2) The entirety of all agreements, conditions, and considerations between PI miCos and the Customer relating to execution of this agreement is contained herein.

(3) These General Terms and Conditions of Sale are only valid in relation to companies and legal entities as set forth in § 14 BGB and § 310 BGB.

II. Offer, Documentation, Order Contracts

(1) PI miCos 's offers are non-binding unless the order confirmation contains clauses stipulating otherwise. Based on these General Terms and Conditions of Sale orders placed with PI miCos shall only be deemed contractual after they have been confirmed in writing by PI miCos or after PI miCos has commenced with the fulfillment of the contractual work or deliveries. Ancillary agreements and amendments must be confirmed in writing by PI miCos.

(2) PI is freed of its performance obligation even in case of confirmed orders under circumstances where the delivery or partial delivery is made impossible by unpredictable obstacles outside PI miCos responsibility. Such reasons may be regulatory orders, higher power or supplies delivered late or faulty.

(3) Documentation relating to offers such as pictures, drawings, as well as weight and measure specifications are only approximations unless they are expressly specified as binding. Quotes, drawings, and other documentation remain physical and intellectual property of PI miCos; they must not be made available to third parties. If plans marked as confidential are provided by the Customer, PI agrees to make them available to third parties only with the Customer's express consent.

III. Pricing, Payment Conditions

(1) Unless otherwise provided in the order confirmation the prices are FOB factory prices, not including shipping from Eschbach or – at the discretion of PI miCos – from the nearest airport. Orders which do not explicitly specify prices are calculated based on the list prices valid on the day of delivery. Prices not including customs fees („ohne Zoll") are subject to timely presentation of a customs waiver and to approval by the customs agency.

(2) Prices do not include the legally required Value-Added Tax (VAT or „MwSt"). The VAT shall be itemized separately on the bill at the rate in effect on the billing date.

(3) The Customer shall be deemed in default if it fails to remit payments due the latest 30 days after receipt of the invoice or any payment-due notice equivalent. It remains within [PI miCos 's] discretion to effect such default at an earlier time by issuing a reminder, to be served after the due date. Contrary to paragraphs 1 and 2 of this Article, the Customer shall be in default also in such cases where it is agreed that the sales price is to be paid on a specified date and the Customer fails to remit its payment by that date. Invoices are due without discounts. Delivery may be made against pre-payment or COD, especially for first-time orders or after occurence of late payments.

(4) Payments shall be considered made only at such time when PI miCos has actual access to the monies involved.

(5) The Customer may deduct counter claims [from its payments] only after they have been determined undisputed and legally binding. In such a case the Customer is additionally entitled to exercise its right to withhold payment to the extent that its counter claim relates to the same contract.

(6) Without prejudice against further claims by PI miCos the Customer in case of payment default shall pay interest to PI miCos of 5% above the current base rate of the European Central Bank.

(7) Delivery of open orders may be made contingent upon timely payment of monies due. If after entering into a contract PI miCos learns of circumstances mitigating against the credit worthiness of the Customer PI miCos is entitled to withdraw from the contract and/or without regard for any due dates demand payment for or immediate release of merchandize already delivered.

IV. Delivery Times

(1) The delivery time commences with the date of mailing the order confirmation but not before supplying the documentation to be provided by the Customer such as permits, releases, and not before receipt of any agreed down payment.

(2) The delivery time shall be considered met if the merchandize ordered has left the factory or the Customer has been notified of the merchandize being ready for shipment by the delivery due date.

(3) The delivery time shall be extended appropriately in case of labor disputes especially such as strikes and lockouts, as well as in case of unexpected events outside the influence of PI miCos, provided such hindrances are proven to have a significant influence on the completion or delivery of the merchandize ordered. The same also applies if such circumstances arise at PI miCos suppliers. P|miCos I shall further not be held liable for the above circumstances if they occur during an already existing delivery delay. In important cases PI miCos will notify the Customer of the beginning and end of such hindrances as soon as possible.

(4) In case of a delay on the part of PI miCos and after setting a fulfillment period of another 4 weeks, the Customer may rescind the contract or in such cases where the Customer has suffered damages due to a delay caused by PI miCos may claim delay damages excluding any further claims. Such delay damages amount to one half of one percent per week of the delay but may total no more than five percent of the value of that part of the total order which due to the delay could not be used in time or not in the manner contracted for. These limitations apply only in case of simple negligence. PI miCos is not liable for damages if they would have also occured in case of a timely delivery.

(5) If the shipment is delayed upon request of the Customer the costs arising in connection with the storage at the PI miCos factory but at least one half of one percent of the invoiced amount per month is charged starting one month after notification of readiness for shipment. If after notifying the Customer of an appropriate waiting period such time has passed without action PI miCos is entitled to dispose of the merchandize ordered as it sees fit and to deliver to the Customer at an appropriately extended delivery time.

(6) Prerequisite for PI miCos keeping the delivery time is the Customer's fulfillment of its obligations under the respective contract.

V. Risk Assignment, Insurance, Packing

(1) The risk is assigned to the Customer at the time of shipment of the merchandize; this applies also in case of partial delivery and if PI miCos has agreed to undertake additional items such as shipping costs, delivery, and erection. PI can upon Customer's request and at its expense insure the shipment against theft, breakage, freight, fire, and water damage and various other coverable risks.

(2) If the shipment is delayed due to circumstances within the Customer's responsibility the risk is assigned to the Customer beginning with the date the order is ready for shipment, but PI miCos must if requested by the Customer at Customer's cost procure such insurance coverage as it demands.

(3) Delivery must be taken of merchandize delivered even if it has minor flaws. This does not preempt the Customer's rights as set out in Article VII.

(4) Partial deliveries shall be permitted unless the Customer can prove that the partial delivery represents an unreasonable imposition.

(5) With the exception of pallets, no transport or any other packaging meeting the packaging regulation will be taken back [by PI miCos]. The Customer is obligated to effect the disposal of any such packaging at its own expense.

VI. Title

(1) Up to such time as all monies due have been received PI miCos reserves the right of ownership on the merchandize ordered. This title also remains with PI miCos in case of receivables of PI miCos arising from any other ongoing business relationship with the Customer and up to such an amount as PI is entitled to based on the current purchase.

(2) PI miCos is entitled to insure the merchandize ordered at Customer's expense against theft, breakage, fire, water, and other damage provided the Customer itself cannot provide proof of itself having purchased appropriate insurance.

(3) The Customer may not mortgage the merchandize to be delivered, nor pass any rights thereto to third parties as a security, nor make any dispositions to the detriment of any merchandize still property of PI except for actions taken in the context of regular business dealings.

(4) If maintenance and inspection work needs to be performed these must be undertaken in a timely manner by the Customer at its own expense.

(5) In case of liens against the merchandize ordered or any actions brought by third parties the Customer must immediately inform PI miCos in writing in order to enable PI miCos to file suit pursuant § 771 ZPO. Inasmuch as such third party is unable to reimburse PI miCos for the court or out-of-court costs of said suit filed pursuant § 771 ZPO the Customer shall be liable for any damages incurred by PI miCos.

(6) Any processing or use of any such merchandize whose title is still with PI miCos shall be performed by the Customer for and in the name of PI miCos without any obligations arising for PI miCos. In case of any processing, use, or merging of such merchandize with other items not property of PI miCos, the partial property of the newly created item shall be assigned to PI miCos to the extent corresponding to the value of PI miCos part at the time of said processing, use, or merging. If the Customer gains sole proprietorship of the newly created item Customer shall without the requirement for a separate agreement assign property rights to PI miCos to the extent corresponding to the value of PI miCos s part at the time of said processing, use, or merging and maintain its safekeeping it safely without any costs incurring for PI miCos

(7) The Customer is entitled to sell such reserved merchandize or the product newly created using it in the course of its regular business dealings. In such case Customer at the present time and without the requirement for a separate agreement for each individual occurrence assigns to PI miCos the title to the gross amount (including VAT) of the receivables arising against its customers or third parties from such sale up to the amount owed to PI miCos, regardless whether the merchandize was sold with or without any processing. The Customer shall retain the right to collect such receivables even after the assignment. This shall not preclude the right of PI miCos itself to collect them. PI miCos, however, agrees not to collect the receivables as long as Customer meets its payment obligations arising from the income collected and does not incur any delays and especially does not file for bankruptcy or insolvency. If this be the case PI miCos can demand that the Customer discloses to PI miCos the assigned receivables and the corresponding debtors, providing all data necessary for collecting them, turning over all related documents, and notifying the debtors (third parties) of that assignment.

(8) In case of any violation of the contract through the Customer, especially payment default, PI miCos after issuing a reminder with a fulfillment period is entitled to repossession and the Customer is obligated to release the merchandize. The Customer shall carry any and all costs incurred in the course of such a repossession or release. The enforcement of a property title by PI miCos or a repossession of any delivered merchandize by PI miCos do not constitute a withdrawal from the contract.

VII. Warranty for Faulty Merchandize

In case of faults of merchandize delivered PI miCos shall notwithstanding Article VIII and barring any additional claims be liable as follows:

(1) Any parts or components whose usability for the intended purpose turns out within 24 months after risk assignment to be severely impaired due to a circumstance originating before the risk assignment, especially faulty construction, defective material, or deficient manufacture, shall at reasonable discretion by PI be repaired or replaced. PI miCos must immediately be notified of the determination of any such faults. To maintain its entitlement to replacement, the Customer must notify PI miCos within 10 days after delivery in writing of obvious faults and such faults apparent by inspecting the merchandize after delivery.

(2) If two attempts at correction by PI miCos fail the Customer is, at its discretion, entitled to either demand a price reduction or to withdraw from the contract.

(3) Parts replaced become property of PI miCos.

(4) There will be no warranty for damages occurring due to the following reasons: Unsuitable or improper use, faulty installation or startup by the Customer or a third party, regular wear, faulty or negligent handling, unsuitable operating materials or consumables, deficient building provisions, unsuitable site properties, chemical, electro-chemical or electrical influences, provided they are not caused by PI miCos.

(5) The Customer must after communicating with PI miCos allow PI miCos the required time and opportunity for performance of all repair and replacement deemed necessary in PI miCos 's reasonable discretion, otherwise PI miCos shall not be liable for any deficiencies. Only in urgent case of the endangerment of operational safety and to prevent unreasonably extensive damage - whereby PI miCos must be notified immediately - or if PI miCos defaults on remedying the fault the Customer is entitled to remedy the fault itself or have it remedied by third parties and to demand the necessary costs be reimbursed by PI miCos.

(6) The expenses necessarily incurred for repair and/or replacement such as transport, travel, labor, and material are carried by PI miCos, whereby it remains within PI miCos discretion in each case to determine the most cost effective solution. This obligation does not cover excessive costs caused by the merchandize after its delivery having been moved to a location other than the residence or the business site of the customer unless such transport corresponds to the intended purpose of the item.

(7) The warranty period for the replacement part or the repair extends from the shipment of the replacement part or the completion of the repair to the end of the original warranty of the merchandize. This period, however, shall be extended for the amount of down time caused by the repair or replacement work.

(8) Any modifications or maintenance work performed by the Customer or a third party which is unsuitable or done without prior permission by PI miCos invalidates any warranty for its consequences.

VIII. Liability

(1) If based on legal requirements or the conditions herein PI miCos is liable for damages caused by simple negligence, PI miCos liability shall be limited as follows: The liability applies only in case of a violation of essential contractual obligations and is limited to typical damages as could be foreseen at the time of entering into the contract. This limitation does not apply in case of loss of life, bodily injuries, and health damage. Inasmuch as the damages are covered by an insurance purchased by PI miCos for that specific incident (except for blanket insurance), PI miCos is only liable for disadvantages suffered by the Customer in connection with the damages such as, for example, increased insurance premiums or interest losses up to the payment of damages by the insurance. No liability shall apply for damages caused by faulty merchandize due to minor negligence.

(2) Any liabilities of PI miCos in case of malicious concealment of a fault, in cases arising from the assignment of warranty or a procurement risk are not affected by any culpability of PI miCos.

(3) Liabilities relating to delivery delays are dealt with in their entirety in Para, 4 of Article IV.

(4) Excluded is the personal liability of legal representatives, agents, and employees of PI miCos for damages they caused due to minor negligence.

IX. Electrical and Electronic Equipment

European Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE-Reg.-Nr.: DE142213462) were delivered after 13 August 2005, wherever PI miCos is legally recognized as the producer. The time of delivery can be determined by the 2nd and 3rd places of the PI serial number on the nameplate. If the positions contain "05" or higher, then the wider provisions of the law apply, and the device can be returned to PI miCos for disposal.

X. Export and Customs

Certain goods are subject to German and/or US-American export regulations. It is the Customer's responsibility to abide by such regulations in case of a sale to a foreign country.

XI. Other

(1) Special conditions apply for assembly and service.

(2) If any one or more of the conditions set out in these General Terms and Conditions of Sale should be or become invalid it shall be replaced by a valid clause or interpretation which most closely resembles the invalid one in its economic result. The validity of the remaining General Terms and Conditions of Sale shall not be affected.

XII. Place of Performance, Venue, Applicable Law

(1) Place of performance for any and all obligations arising from this agreement for both parties is D-76228 Karlsruhe, Germany.

(2) For both parties the venue for any disputes directly or indirectly arising from this contract is Karlsruhe; this also applies to suits filed in conjunction receivables from bills of exchange and checks. We also reserve the right to file suit at any other venue as reasonably explained to the Customer.

(3) This contract is subject to the laws of the Federal Republic of Germany. UN Commercial Laws (CISG) shall not apply.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Due to the various operating conditions and applications of the products in this catalog, the user is solely responsible for making the final selection of the products and assuring that all performance, safety and warning requirements are met.

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Call Us Today

508.832.3456 (East)

949.679.9191 (West)

PI (Physik Instrumente) L.P.
Irvine, CA
USA (West) & MEXICO

Phone: +1 (949) 679 9191
Fax: +1 (949) 679 9292
e-mail: info@pi-usa.us
home: www.pi-usa.us

PI (Physik Instrumente) L.P.
Auburn, MA
USA (East) & CANADA

Phone: +1 (508) 832 3456
Fax: +1 (508) 832 0506
e-mail: info@pi-usa.us
home: www.pi-usa.us

VACUUM FAB GmbH
Bareggio (MI)
ITALY

Phone: +39 02 90 36 33 18
Fax: +39 02 90 36 61 86
e-mail: info@vacuumfab.it
home: www.vacuumfab.it

miCos IBERIA
Vilanova i la Geltrú
SPAIN & PORTUGAL

Phone: +34 93 816 03 80
Fax: +34 93 816 03 79
e-mail: t.etzkorn@pimicos.com
home: www.pimicos.es

PI FRANCE S.A.S.
Montrouge
FRANCE

Phone: +33 1 55 22 60 00
Fax: +33 1 41 48 56 62
e-mail: info.france@pi.ws
home: www.pifrance.fr

PI (Physik Instrumente) Ltd.
Bedford
UK & IRELAND

Phone: +44 (1234) 756 360
Fax: +44 (1234) 756 369
e-mail: uk@pi.ws
home: www.physikinstrumente.co.uk

PI Japan Co., Ltd.
Tokyo
JAPAN

Phone: +81 42 526 7300
Fax: +81 42 526 7301
e-mail: info@pi-japan.jp
home: www.pi-japan.jp

PI Japan Co., Ltd.
Osaka
JAPAN

Phone: +81 6 6304 5605
Fax: +81 6 6304 5606
e-mail: info@pi-japan.jp
home: www.pi-japan.jp

PI Shanghai Co., Ltd.
Shanghai
CHINA

Phone: +86 21 518 792 98
Fax: +86 21 687 900 98
e-mail: info@pi-china.cn
home: www.pi-china.cn

PI Korea Ltd.
Seoul
KOREA

Phone: +82 2475 0060
Fax: +82 2475 3663
e-mail: info-kr@pi.ws
home: www.pi-korea.ws

PI Singapore LLP
Singapore
SINGAPORE

Phone: +65 665 98400
Fax: +65 665 98404
e-mail: info-sg@pi.ws
home: www.pi-singapore.sg

ООО „МИКОС“
Moscow
RUSSIA

Phone: +7 495 6478389
Fax: +7 495 6478389
e-mail: v.nikitina@pimicos.ru
home: www.pimicos.ru

Applied Laser Technology
Best
NETHERLANDS

Phone: +31 499 375 375
Fax: +31 499 375 373
e-mail: info@alt.nl
home: www.alt.nl

DYNEOS AG
Effretikon
SWITZERLAND

Phone: +41 52 355 12 40
Fax: +41 52 355 12 44
e-mail: info@dyneos.ch
home: www.dyneos.ch

Parameter AB
Stockholm
SWEDEN / NORWAY / POLAND

Phone: +46 (8) 555 110 00
Fax: +46 (8) 555 110 01
e-mail: mekanik@parameter.se
home: www.parameter.se

PI miCos

Headquarters:
PI miCos GmbH
Freiburger Strasse 30
D-79427 Eschbach
GERMANY

Phone: +49 7634 50 57 0
Fax: +49 7634 50 57 393
e-mail: info@pimicos.com
home: www.pimicos.com