

M-810 Small Hexapod Paralell 6-Axis Positioner

6 Degrees of Freedom & High Precision in a Small Package

Ordering Information

M-810.00
Miniature-Hexapod Microrobot
with Controller, Direct Drive

Ask about custom designs



The miniature Hexapod M-810 provides long travel ranges despite its compact design

- **Most-Compact Hexapod in the PI Portfolio**
- **Travel Ranges 40 x 40 x 13 mm, Rotation to 60 Degrees**
- **Load Capacity to 5 kg**
- **Resolution of a Single Strut 40 nm**
- **Min. Incremental Motion to 200 nm**
- **Repeatability up to ±0.5 µm**
- **Velocity to 10 mm/s**

With a platform diameter of only 10 cm the M-810 Hexapod is the most compact parallel-kinematics micropositioning system to date. In addition to positioning all six axes with high speed and accuracy, it allows the user to define the center of rotation (pivot point) anywhere inside or outside the system envelope by one simple software command. This makes it ideal for all complex positioning tasks with restricted space.

Application Examples

- **Biotechnology**
- **Semiconductor technology**
- **Micromachining**
- **Micromanipulation**
- **X-ray diffraction measurements**
- **Tool control**

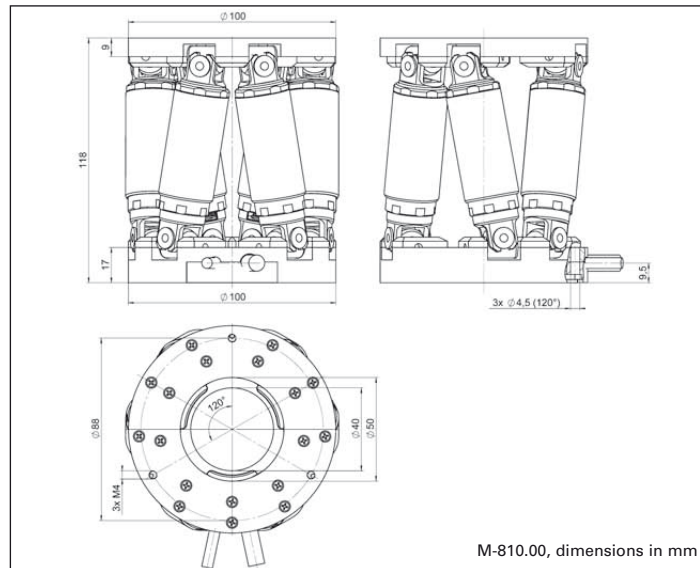
Extremely Compact, Great Freedom of Motion

The M-810.00 with its direct-drive torque motors and ActiveDrive™ system with integrated servo amplifiers provides an increased velocity of up to 10 mm/s for loads up to 5 kg. Small and compact, the Hexapod allows a large stroke of up to 40 mm (linear) and 60° (angular).

Hexapod vs. Serial Kinematics Systems

The Hexapod is driven by six high-resolution actuators all connected directly to the same moving platform. This design provides a high system stiffness and a large clear aperture.

Because of the low mass of the moving platform, positioning operations can be performed with far lower settling times than with conventional,



The Hexapod comes with a powerful 6D controller and sophisticated, user-friendly positioning and alignment software. Keypad and display are optional

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stacked multi-axis systems. In such systems, runout, guiding errors, and the friction and inertia of moving cables all accumulate to limit accuracy and repeatability-problems which do not affect parallel kinematic systems like the Hexapod.

User-Defined Pivot Point

For optics and other alignment tasks, it is important to be able

to define a fixed pivot point. The sophisticated Hexapod-controller allows choosing any point in space as the pivot point for the rotation axes with a simple software command. The pivot point remains fixed relative to the platform.

Target positions in 6-space are entered in user-friendly coordinates and reached by smooth vectorized motion.

Open Architecture

Control of the hexapod is facilitated by the controller's open interface architecture, which provides a variety of high-level commands and includes a macro language for programming and storing command sequences.



Custom miniature piezo hexapod

Technical Data

	M-810.00	Unit
Active axes	X, Y, Z, ΘX , ΘY , ΘZ	
Motion and positioning		
*Travel range X, Y	± 20	mm
*Travel range Z	± 6.5	mm
*Travel range ΘX , ΘY	± 11	°
*Travel range ΘZ	± 30	°
Actuator drive	Brushless DC Motor, ActiveDrive™	
Actuator stroke	± 7.5	mm
Single-actuator design resolution	0.04	μm
Integrated sensor	Rotary encoder	
Sensor resolution	12800	Cts./rev.
**Min. incremental motion X, Y	1	μm
**Min. incremental motion Z	0.2	μm
**Min. incremental motion ΘX , ΘY , ΘZ	3.5	μrad
Repeatability X, Y	± 2	μm
Repeatability Z	± 0.5	μm
Repeatability ΘX , ΘY , ΘZ	± 5	μrad
Backlash X, Y	2	μm
Backlash Z	0.5	μm
Max. velocity X, Y, Z	10	mm/s
Max. velocity ΘX , ΘY , ΘZ	250	mrad/s
Typ. velocity X, Y, Z	5	mm/s
Typ. velocity ΘX , ΘY , ΘZ	120	mrad/s
Mechanical properties		
Stiffness X, Y	0.1	N/ μm
Stiffness Z	4	N/ μm
Max. load (baseplate horizontal / any orientation)	5 / 2.5	kg
Miscellaneous		
Operating temperature range	0 to +50	°C
Material	Stainless steel, aluminum	
Mass	1.7	kg
Controller		
Operating Voltage	100–240 VAC, 50/60 Hz	

* The travel ranges of the individual coordinates (X, Y, Z, ΘX , ΘY , ΘZ) 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.

** Six-axis move. No moving cables (unlike serial-kinematic stacked systems). Eliminates bending, inertia and friction, improving accuracy.

Technical data are specified at 20 \pm 3°C. Data for vacuum versions may differ.

M-811 Vacuum-Compatible Miniature Hexapod 6-Axis Positioner

High Precision and Very Versatile



The M-811.STV vacuum-compatible Hexapod comes complete with software and a highly specialized Hexapod controller. It combines small size with high-load capacity and high accuracy.

- Vacuum-Compatible Miniature Hexapod
- Complete with Specialized Hexapod Controller and Software
- Travel Ranges 34 x 32 x 13 mm, Rotation to 42 Degrees
- Load Capacity to 5 kg
- Actuator Resolution 40 nm
- Min. Incremental Motion to 200 nm
- Repeatability up to $\pm 0.2 \mu\text{m}$
- Velocity to 10 mm/s

The M-811.STV is PI's smallest standard vacuum-compatible Hexapod. Despite its size it can handle loads up to 5 kg (2.5 kg in any orientation) and achieves velocities up to 10 mm/sec. With a diameter of only 130 mm and a height of 115 mm it provides travel ranges up to 35 mm in the

XY-plane and up to 13 mm in the Z-direction. In combination with the large tilting angles of 20° around the X and Y axis and up to 40° around the vertical axis it allows for complex motion profiles with particularly flexible placement of the load – a great advantage in restricted areas (such as beam lines) and small vacuum chambers.

Each individual strut has a positioning resolution of 40 nm; multi-axis motion can be accomplished with sub-micron repeatability. In addition to controlling all axes in Cartesian coordinates, a software command allows the user to select the center of rotation (pivot point) freely anywhere inside or outside the system envelope.

Hexapod vs. Serial Kinematics Systems

The Hexapod is driven by six high-resolution actuators all connected directly to the same moving platform. This design provides a high system stiffness and a large clear aperture. Because of the low mass of the moving platform, positioning operations can be performed with far lower settling times than with conventional, stacked multi-axis systems. In such systems, runout, guiding errors, and the friction and inertia of moving cables all accumulate to limit accuracy and repeatability—problems which do not affect parallel kinematic systems like the Hexapod.

Fixed Virtual Pivot Point

For optics and other alignment tasks, it is important to be able to define a fixed pivot point. The sophisticated Hexapod controller allows choosing any point in space as the pivot point for the rotation axes by software command. The pivot point remains fixed relative to the platform.

Ordering Information

M-811.STV
Miniature Hexapod Microrobot with Controller, Direct Drive, 5 kg Load, Vacuum Compatible to 10^{-6} hPa

Ask about custom designs!

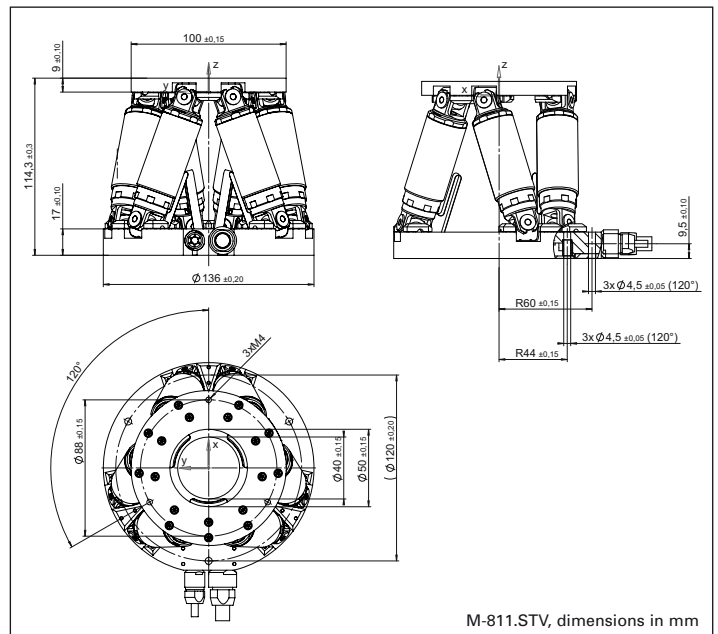
Target positions in 6-space are entered in user-friendly coordinates and reached by smooth vectorized motion.

Open Architecture

Control of the Hexapod is facilitated by the controller's open interface architecture, which provides a variety of high-level commands and includes a macro language for programming and storing command sequences.



The Hexapod comes with a powerful 6D controller and sophisticated, user-friendly positioning and alignment software. Keypad and display are optional



M-811.STV, dimensions in mm

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Application Examples

- Biotechnology
- Semiconductor technology
- Micromachining
- Micromanipulation
- X-ray diffraction measurements
- Tool control

Technical Data

Model	M-811.STV
Active axes	X, Y, Z, θX , θY , θZ
Motion and positioning	
*Travel range X, Y, Z	± 17 , ± 16 , ± 6.5 mm
*Travel range θX , θY , θZ	$\pm 10^\circ$, $\pm 10^\circ$, $\pm 21^\circ$
Actuator drive	Brushless DC motor, ActiveDrive
Single-actuator design resolution	0.04 μm
Integrated sensor	Rotary encoder
Sensor resolution	12800 cts./rev.
**Min. incremental motion X, Y	0.5 μm
**Min. incremental motion Z	0.2 μm
**Min. incremental motion θX , θY , θZ	10 μrad
Repeatability X, Y	± 0.5 μm
Repeatability Z	± 0.2 μm
Repeatability θX , θY , θZ	± 2 μrad
Backlash X, Y	1 μm
Backlash Z	0.2 μm
Max. velocity X, Y, Z	10 mm/s
Max. velocity θX , θY , θZ	250 mrad/s
Typ. velocity X, Y, Z	5 mm/s
Typ. velocity θX , θY , θZ	120 mrad/s
Mechanical properties	
Stiffness X, Y	0.2 N/ μm
Stiffness Z	3.6 N/ μm
Load (baseplate horizontal / any orientation)	5 / 2.5 kg
Miscellaneous	
Operating temperature range	0 to +50 °C
Material	Stainless steel, aluminum
Mass	2.2 kg
Controller	
Operating voltage	100-240 VAC, 50/60 Hz

* The travel ranges of the individual coordinates (X, Y, Z, θX , θY , θZ) 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.

** Six-axis move. No moving cables (unlike serial-kinematic stacked systems). Eliminates bending, inertia and friction, improving accuracy.

Technical data are specified at 20 ± 3 °C. Data for vacuum versions may differ.

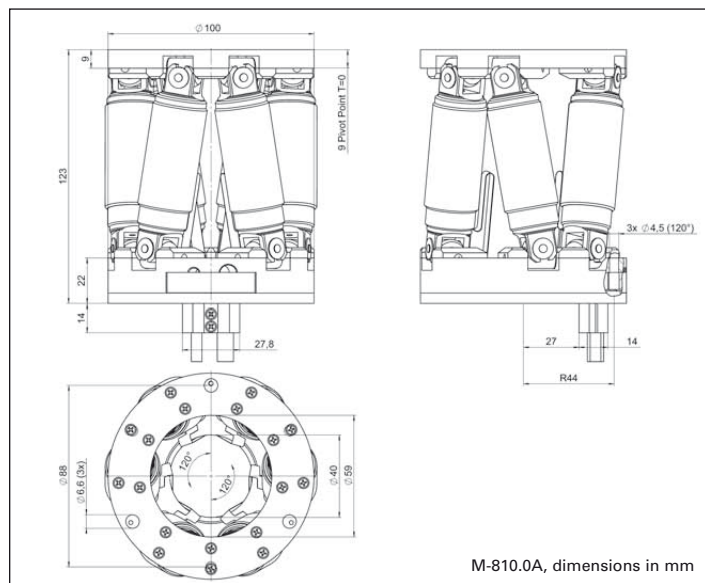
M-810.0A Miniature Hexapod

6 Degrees of Freedom & High Precision in a Small Package



The M-810 miniature Hexapod is now available with a modified cable exit. This makes for even more compact integration

- **Most-Compact Hexapod in the PI Portfolio**
- **Travel Ranges 40 x 40 x 13 mm, Rotation to 60 Degrees**
- **Clear Aperture Ø 59 mm**
- **Load Capacity to 5 kg**
- **Resolution of a Single Strut 40 Nm**
- **Min. Incremental Motion to 200 Nm**
- **Repeatability up to ±0.5 µm**
- **Velocity to 10 mm/s**



Application Examples

- Biotechnology
- Semiconductor technology
- Micromachining
- Micromanipulation
- X-ray diffraction measurements
- Tool control

Ordering Information

M-810.0A
Miniature Hexapod Microrobot with Controller, Direct Drive, Modified Cable Outlet
Ask about custom designs

Technical Data

Model	M-810.0A
Active axes	X, Y, Z, θX , θY , θZ
Motion and positioning	
*Travel range X, Y	±20 mm
*Travel range Z	±6.5 mm
*Travel range θX , θY	±11°
*Travel range θZ	±30°
Actor drive	Brushless DC motor, ActiveDrive
Actuator stroke	±7.5 mm
Single-actuator design resolution	0.04 µm
Integrated sensor	Rotary encoder
Sensor resolution	12800 cts. / rev.
**Min. incremental motion X, Y	1 µm
**Min. incremental motion Z	0.2 µm
**Min. incremental motion θX , θY , θZ	3.5 µrad
Repeatability X, Y	±2 µm
Repeatability Z	±0.5 µm
Repeatability θX , θY , θZ	±5 µrad
Backlash X, Y	2 µm
Backlash Z	0.5 µm
Max. velocity X, Y, Z	10 mm/s
Max. velocity θX , θY , θZ	250 mrad/s
Typ. velocity X, Y, Z	5 mm/s
Typ. velocity θX , θY , θZ	120 mrad/s
Mechanical properties	
Stiffness X, Y	0.1 N/µm
Stiffness Z	4 N/µm
Max. load (baseplate horizontal / any orientation)	5 / 2.5 kg
Miscellaneous	
Operating temperature range	0 to +50 °C
Material	Stainless steel, aluminum
Mass	1.7 kg
Controller	
Operating voltage	100–240 VAC, 50 / 60 Hz

* The travel ranges of the individual coordinates (X, Y, Z, θX , θY , θZ) 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.

** Six-axis move. No moving cables (unlike serial-kinematic stacked systems) to introduce bending forces, torque and friction which degrade positioning accuracy.

Technical data are specified at 20 ±3 °C. Data for vacuum versions may differ.

More Hexapods: <http://www.hexapods.net>



Program Overview

- Piezo Ceramic Actuators & Motors
- Piezo Nanopositioning Systems and Scanners
- Active Optics / Tip-Tilt Platforms
- Capacitive Nanometrology Sensors
- Piezo Electronics: Amplifiers and Controllers
- Hexapod 6-Axis Positioners / Robots
- Micropositioning Stages & Actuators
- Photonics Alignment Systems, Solutions for Telecommunications
- Motor Controllers
- Ultrasonic Linear Motors

Request or download the complete PI Nanopositioning & Piezo Actuator Catalog



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