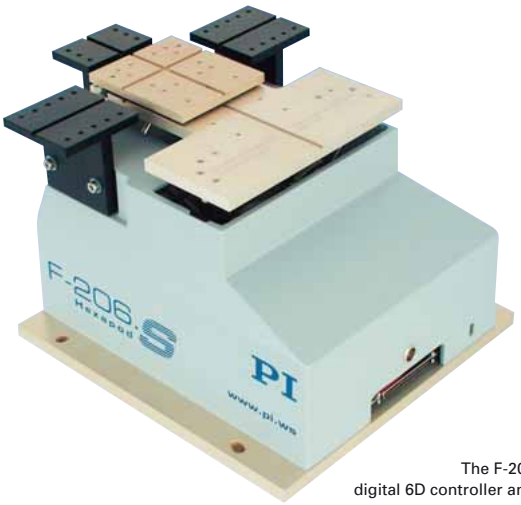
F-206.S HexAlign™ 6 Axis-Hexapod Alignment System

Parallel-Kinematics Precision Alignment System / Manipulator, with Controller



The F-206.S Hexapod comes with a digital 6D controller and comprehensive software

- **Parallel Kinematics with 6 Degrees of Freedom**
- **0.033 µm Actuator Resolution**
- **Repeatability 0.3 µm in Space**
- **No Moving Cables for Improved Reliability, Reduced Friction**
- **Better Dynamics, More Compact than Serial Kinematics Systems**
- **For Scanning and Alignment**
- **Cartesian Coordinate Control with Virtualized Pivot Point**
- **Powerful Digital Controller with Open Source LabVIEW Drivers, DLL Libraries...**
- **Integrated Fiber Alignment Routines**

The F-206.S HexAlign™ Hexapod is a highly accurate micropositioning system for complex multi-axis alignment tasks. It is based on PI's long experience with ultra-high-resolution, parallel kinematics stages. Unlike hexapods with variable-length struts ("legs") the F-206 features constant-length struts and friction-free flexure guides. This gives the F-206 even higher precision than other hexapod designs.

Application Examples

- Micromachining
- Photonics packaging
- Fiber alignment
- Semiconductor handling / test systems
- Micromanipulation (life science)
- Optical device testing
- Collimator and fiber bundle alignment
- MEMS positioning/alignment

Compact, Plug & Play

The F-206.S Hexapod is considerably smaller and more accurate than comparable serial kinematics six-axis systems (stacks of single-axis units).

The parallel kinematics of the F-206 is immune to the cumulative bending and guiding errors of the various axes which, together with the inertia and friction of the moving cables, can limit accuracy in stacked systems. In addition, rotations are not set in hardware, but about a pivot point freely definable in software. A high-performance controller does all necessary coordinate transformation for coordinating the six drives. Because all the actuators are attached directly to the same moving platform, there are none of the servo-tuning problems associated with the loading and inertia differences of the different axes, as are inherent in stacked systems.

Virtualized Pivot Point

It is important to have a fixed pivot point for alignment tasks, especially in photonics packaging. Because the parallel kinematics motion of the F-206 is calculated with complex algorithms in the digital controller, it was easy to allow programming any point in space as center of rotation. Furthermore, the cartesian coordinates of any position and any orientation can be entered directly and the specified target will be reached after travel along a smooth path.

Six Degrees of Freedom, No Moving Cables

In the F-206 parallel kinematics design, all cable terminations are on the stationary base, eliminating unpredictable friction and inertia, improving resolution and repeatability. Further advantages of the system are:

- No cable guides required
- Reduced Size and Inertia
- Improved Dynamic and Settling Behavior
- Identical Modular Actuators for Simplified Servicing

Open Command Set, Simplified Programming

Integration of the F-206 in complex applications is facilitated by the system's open command set and comprehensive tool libraries. The controller can be operated either through a host PC, or directly through a keyboard and monitor. It can also run programs stored in a user-friendly, fully documented macro language.

Automatic Optical Alignment

Optional internal and external photometers are available. Both types are fully integrated with the controller hardware and with routines designed for automatic alignment of collimators, optical fibers and arrays. For more information on the photometers see www.pi.ws.

Ordering Information

F-206.S0
Hexapod 6-Axis Precision Alignment System / Manipulator with 6 DOF Hexapod Controller

F-206.SD
Hexapod 6-Axis Precision Alignment System / Manipulator with 6 DOF Hexapod Controller, Built-in Display and Keypad

Options and Accessories

F-206.AC8
Upgrade for 2 Additional Servo-Motor Control Channels on F-206 Controller

F-206.MHU
Force-Limiting Mounting Platform, (included with F-206.SD)

F-206.NCU
Upgrades: Rapid Nanopositioning Upgrade for F-206.S. Consists of P-611.3SF NanoCube and E-760 Controller Card

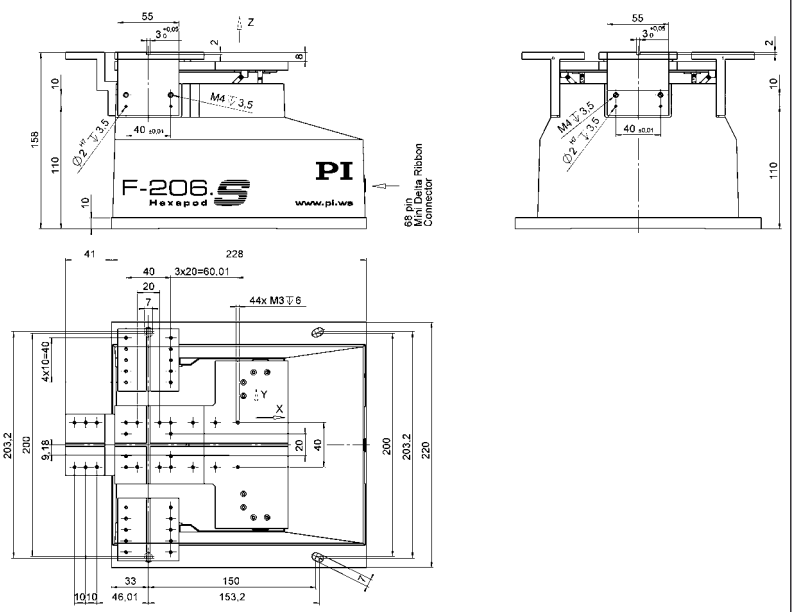
F-206.MC6
6D Interactive Manual Control Pad

F-206.VVU
2-Channel Photometer Card, (Visual Range)

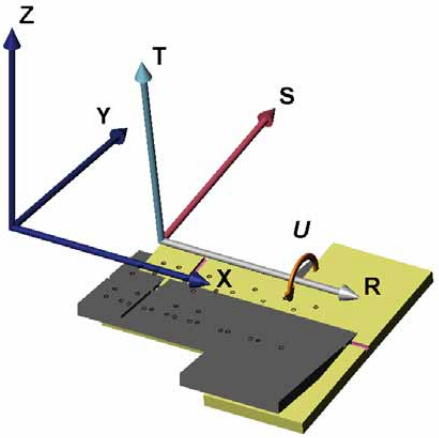
F-206.iiU
2-Channel Photometer Card (IR Range)

F-361.10
Absolute-Measuring Optical Power Meter, 1000-1600 nm Wavelength

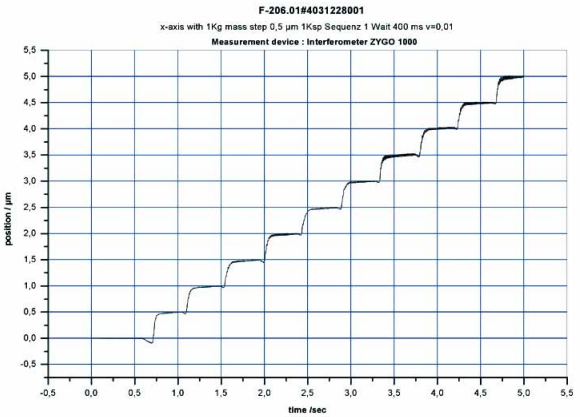
Additional Accessories, see www.pi.ws.



F-206.S. Dimensions in mm



F-206 provides ultra-precise motion in all six degrees of freedom with rotation about any point in space. The pivot point is set by the user with a simple software command



Interferometer test of an F-206.S system shows the excellent repeatability of small steps, here 0.5 µm spaced at 100 ms

Technical Data

Model	F-206.S0 / F-206.SD
Travel range X*	-8 to +5.7 mm
Travel range Y*	±5.7 mm
Travel range Z*	±6.7 mm
Travel range θ_X *	±5.7°
Travel range θ_Y *	±6.6°
Travel range θ_Z *	±5.5°
Actuator resolution	33 nm
Minimum incremental motion X, Y, Z**	0.1 µm (6-axis move!)
Minimum incremental motion θ_X, θ_Y, θ_Z**	2 µrad (0.4") (6-axis move!)
Bidirectional repeatability X, Y, Z	0.3 µm
Bidirectional repeatability θ_X, θ_Y, θ_Z	3.6 µrad
Speed X, Y, Z	0.01 to 10 mm/s
Maximum load in Z	2 kg (centered on platform)
Mass	5.8 kg
Controller	Digital Hexapod controller with optional photometer card and integrated scan and align routines
Operating voltage	100–240 VAC, 50/60 Hz
Software	LabVIEW drivers, software for alignment of arrays, DLL libraries, scan and align software, terminal software

*Travel ranges in the coordinate directions (X, Y, Z θ_X, θ_Y, θ_Z) are interdependent. The data given shows maximum travel range of the axis in question (i. e. its travel when all other axes are at their zero positions). If this is not the case, 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.

The Ebu^m l a comes with a powerful 6D controller and sophisticated, user-friendly positioning and alignment sofware. Keypad and display are optional

M-810.0A Miniature 6-Axis 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

Application Examples

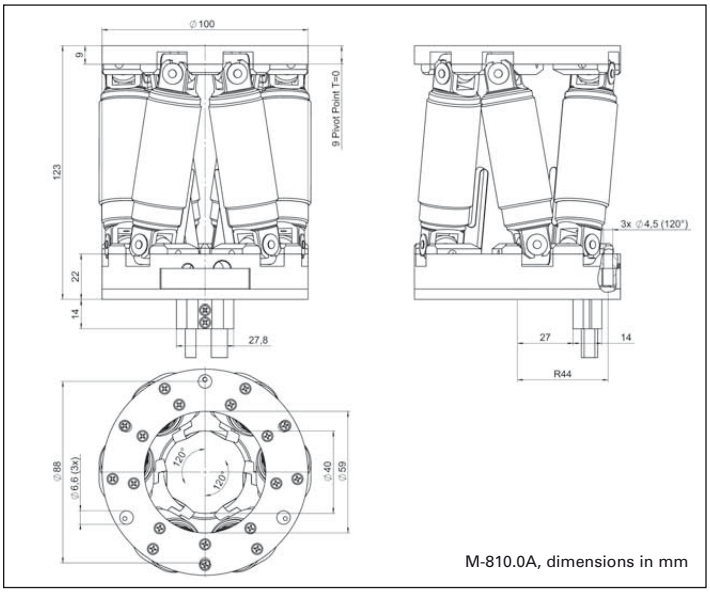
- Biotechnology
- Semiconductor technology
- Micromachining
- Micromanipulation
- X-ray diffraction measurements
- Tool control

Ordering Information

M-810.0A
Miniature Hexapod Microrobot with Controller, Direct Drive, Modified Cable Outlet

Ask about custom designs

- **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**



M-810.0A, dimensions in mm

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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