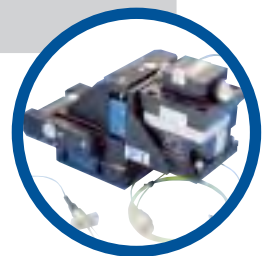


Systems for Fiber Optic Applications Photonics Alignment Solutions

09/2005





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Systems for Fiber Optic Applications

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For more information on PI products, visit <http://www.pi.ws/news>

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Systems for Fiber Optic Applications

Examples / Experience

PI offers a great variety of innovative solutions for testing and fabrication of MEMS and photonics devices. Products range from automated 6D alignment systems for industrial automation to simple devices for laboratory test setups. Piezo drives make possible rapid scanning with sub-millisecond response.

Applications include automated alignment of collimated fibers or arrays, and test systems for MEMS and multi-channel waveguides. The following pages show but a few examples of the system solutions that PI has developed for the photonics market.

Applications

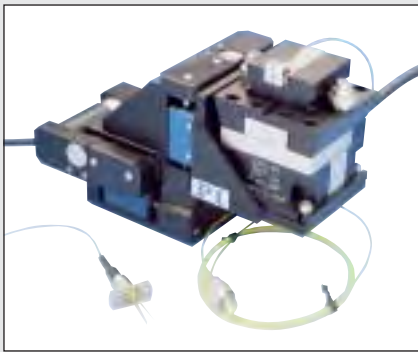
- High-Precision Photonics Device Alignment
- Collimator Alignment
- Fiber-Array Alignment
- Optical Device Testing
- MEMS High-Precision Positioning/Alignment
- Fiber Alignment
- Laser Tuning
- FBG Writing
- Fiber Stretching
- Optical Switches
- Beam Stabilization
- Micromachining and Assembly

Photometers



PI offers a variety of internal and external photometers with bandwidths up to 5 kHz. High bandwidth means that data is synchronized with the motion, speeding the alignment process.

Rapid XYZ Photometer Nano-Aligners



The F-130 XYZ fiber alignment system allows a full scan of a fiber optic device in just a few seconds; the system features 1 nm piezoelectric resolution and 15 mm travel range.

6D Microrobots

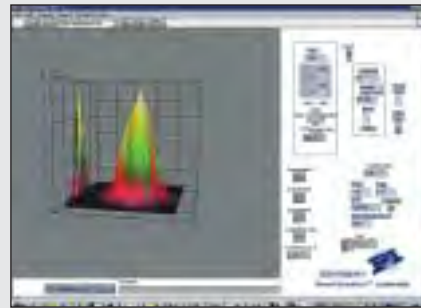


Variety of hexapod 6D alignment systems, for tasks like industrial micro-assembly of fiber optic devices PI has over 15 years development experience with 6D Hexapod designs.

Automation



Microrobot meets its industrial cousin: here at the OFC 2002 in the USA. PI's F-206 Hexapod, foreground, uses built-in, high-speed, fiber-array alignment routines to optimize photonic device coupling for manufacturing. Pick-and-place of the parts to align is handled by a FANUC industrial robot (background). The entire process is controlled by sequencing software from L-3 Communications Analytics.



Fast response of closed-loop piezoscanners like the NanoCube® allows rapid mapping of the entire coupling cross-section of optical components for fast localization of features like the point of maximum transmissivity. Full scanning eliminates spurious lock-on to local maxima.

High-Resolution Actuators



Variety of closed-loop linear actuators with travel ranges to 50 mm and resolutions better than 50 nm, for automation of photonics packaging and testing operations.

Piezo Actuators

Nanopositioning & Scanning Systems

Active Optics / Steering Mirrors

Tutorial: Piezo-electrics in Positioning

Capacitive Position Sensors

Piezo Drivers & Nanopositioning Controllers

Hexapods / Micropositioning

Photonics Alignment Solutions

Motion Controllers

Ceramic Linear Motors & Stages

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Systems for Fiber Optic Applications

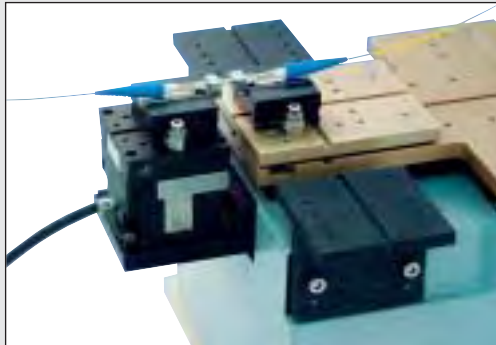
Examples / Experience

Sophisticated Controllers



An automation platform like the C-880 features built-in fiber alignment routines and can control up to 18 axes. The systems are easy to program and are supplied with a variety of comprehensive software drivers and tools.

Hybrid Systems



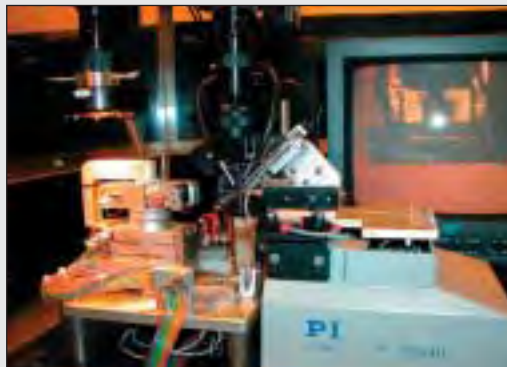
The F-206 HexAlign™ alignment system features 6 degrees of freedom and 0.1 μm minimal incremental motion. An optional high-speed, piezo-driven scanning module with 1 nm resolution is also available.

Image Processing



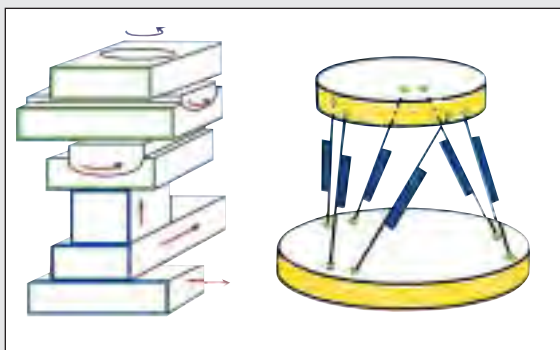
The PIMotion&Vision™ system includes a comprehensive collection of LabView™ drivers for continuous, real-time image processing; it includes basic functions ranging from autofocus, edge adjustment, distance measurement, to complex alignment algorithms in 6 degrees of freedom. Up to 80 axes, switching functions and photometer signals can be included in the processing algorithms.

Integration



F-206 HexAlign™ alignment system at a workstation for automated pigtailed fiber optic devices. Printed with permission from Aries Innovations.

Serial and Parallel Kinematics



Stacked, serial kinematics, 6D alignment system vs. Hexapod parallel kinematics system designs: advantages of the Hexapod, such as minimized inertia (all axes acting on a single moving platform) are clearly shown. The reduced moved mass in turn makes for significantly faster response than with serial kinematics. Because there are no moving cables to stacked stages to cause friction, better repeatability can also be achieved.

Reasons for Choosing PI:

- Broad range of architectures for high-precision positioning and automated alignment in industrial environments.
- Modular hybrid systems with fast piezo scanners and motorized drives for coarse repositioning
- Software and hardware solutions for throughput enhancement
- PIMotion&Vision™ system with image processing
- 35 years experience developing precision positioners and controllers
- 20 years experience with fiber alignment solutions
- Easy-to-use / easy-to-integrate software
- ISO-9001 certified since 1994

Alignment of NxN Fiber Arrays



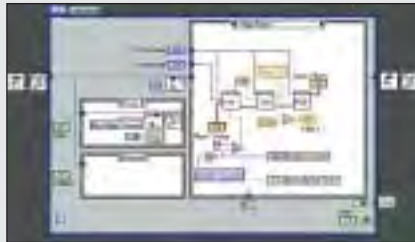
Software for automated alignment of fiber arrays with the F-206 system.

Virtual Pivot Point—Ideal for Collimator Alignment



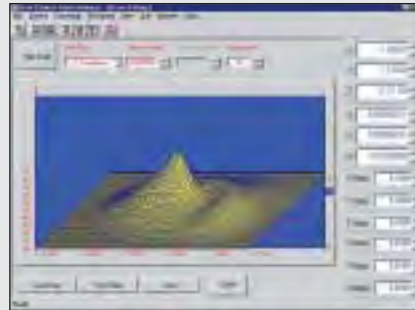
The Hexapod controller permits placing the center of rotation anywhere in space, for example, at the beam waist of a laser diode, the tip of an optical fiber or on the optical axis of a fiber array, thus greatly simplifying alignment algorithms.

LabView™ Support



LabView™ drivers, including complete routines for scanning and aligning photonic devices, are available to support your automation processes.

Specialized Software



Scan of an optical device made with the PI HexControl™ software showing the optical signal intensity distribution. PI offers a variety of automatic alignment routines designed to determine the point of maximum optical intensity as quickly as possible.

Piezo Actuators

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Hexapods / Micropositioning

Photonics Alignment Solutions

Motion Controllers

Ceramic Linear Motors & Stages

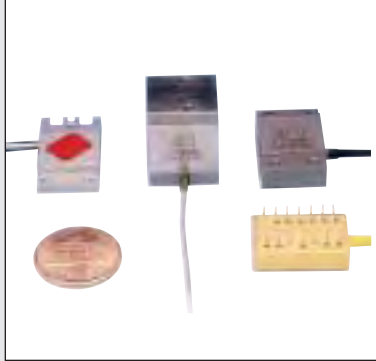
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Systems for Fiber Optic Applications

Examples / Experience

Laser Tuning



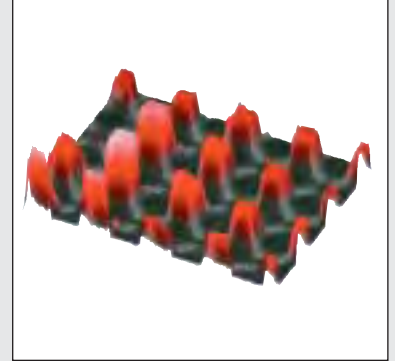
Sub-nanometer-resolution, miniature, piezo translation stages with ultra-precise trajectory control are ideal for telecommunications-laser tuning applications.

Fiber Stretchers



Piezoelectric tubes can be used to stretch optical fibers in applications such as laser tuning.

MEMS



PI alignment systems are ideal for testing and production of MEMS. The "animation" was made with a Polytec scanning laser vibrometer. MEMS from Computer Optics, Inc.

FBG Fabrication



PI provides a variety of nanoscanning stages used for writing FBGs that achieve considerably better channel separation. Techniques like InputShaping® can greatly improve the dynamics and precision of scanning operations.

Beam Steering



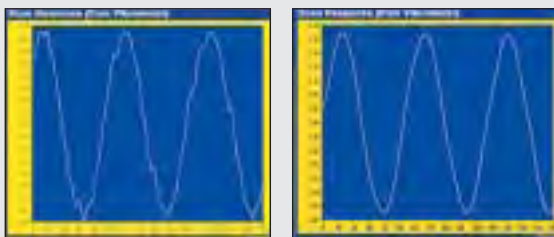
Piezo tip/tilt mirrors are used for beam steering and stabilization, for example in free-space optical data transmission.

Fabry-Perot Filters



Piezo-driven optics positioners achieve sub-nanometer accuracy and can be used, for example, in Fabry-Perot filters.

InputShaping® for Faster FBG Writing



Left: resonances occurring in and around the nano-scanner can degrade the quality and speed of the dithering process. Right: the same piezo scanning stage at the same frequency and the same load with InputShaping®. InputShaping® control technology allows fabrication of gratings with higher resolutions, finer spectral lines and better cross-talk suppression.

In the 80s



PI's first fiber alignment system with subnanometer resolution was developed in the 1980s.

Selection Guide

Photonics Alignment Solutions

Photometers, Vision System

Models*	Description	Axes	Page
F-311	PIMotion&Vision™ System for micro- / nanopositioning.	up to 80 Channels	8-16
F-361	Absolute-measuring integrating sphere optical power meter for F-206, C-880, M-840, M-850.	–	8-14

Hexapod 6D-Alignment Systems / Multi-Axis Automation Controllers

Models*	Description	Axes	Page
F-206	HexAlign™ 6-axis precision alignment system / manipulator (hexapod).	6 + 2	8-8
M-824	Compact Hexapod	6 + 2	7-24
M-840	HexaLight™: hexapod with 10 kg load capacity.	6 + 2	7-22
M-850	Hexapod with 200 kg load capacity.	6 + 2	7-20
C-880	Automation platform, integration of up to 18 axes: Piezo actuators, servo-motors, voice coil drives.	2 to 18	9-18

Compact Motorized / Piezoelectric Hybrid Photonics Alignment Solutions

Models*	Description	Axes	Page
F-130, F-131	Compact XYZ hybrid-fiber alignment system with motor drives and piezo actuators.	3 / 3 (Hybrid)	8-20
P-611	NanoCube®, fast XYZ nanopositioning system, 100 µm Z-travel.	3	8-18
P-615	NanoCube®, 350C: fast XYZ nanopositioning system 350 µm Z-Axis, capacitive sensors.	3	2-76

Compact Manual / Piezoelectric Hybrid Photonics Alignment Solutions

Models*	Description	Axes	Page
F-111	Manual/piezoelectric hybrid photonics alignment system.	3 / 3 (Hybrid)	8-22
F-110	Manual/piezoelectric hybrid photonics alignment system.	3 / 3 (Hybrid)	8-24

Accessories

Models*	Description	Axes	Page
F-603	Fiber, objective and waveguide holders.	–	8-26

* Ask about custom designs.

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F-206.S

HexAlign™ 6-Axis Precision Alignment System / Manipulator (Hexapod)



F-206.SD HexAlign™ System with Digital Controller. PI Hexapod controllers automatically perform vector-based motion and 6D coordinate transformation. The systems are easy to program and are supplied with comprehensive software tools.

- **Integrated Alignment Routines for Optical Fibers, Collimators and I/O Chips**
- **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...**
- **Choice of Optional Photometers**
- **Optional PIMotion&Vision with Integrated Real-Time Image Processing**

Application Examples

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

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 better resolution and repeatability than other hexapod designs.

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 individual 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 around 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, inherent in stacked systems.

Virtualized Pivot Point

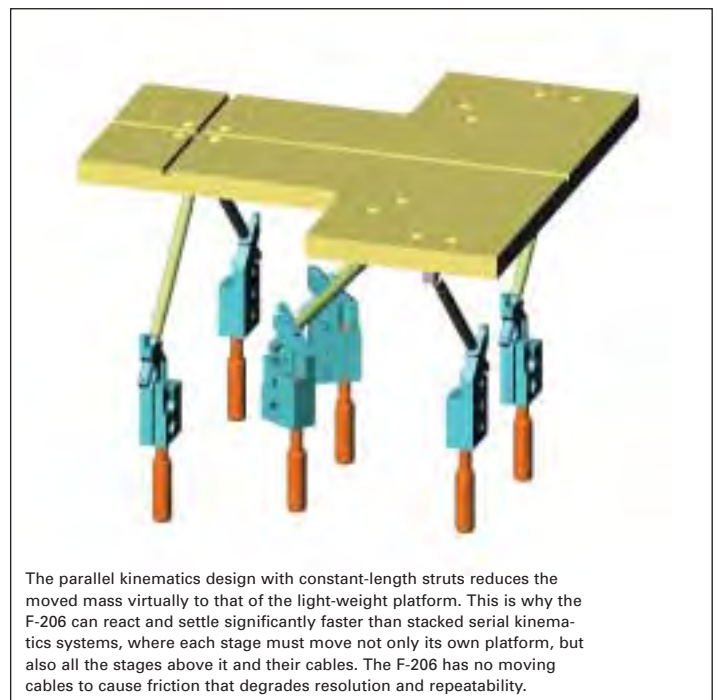
It is important to have a fixed pivot point for alignment tasks, especially in photonics packag-

ing. 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. 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, direct trajectory.

Six Degrees of Freedom, Zero Moving Cables

In the F-206 Parallel kinematics design, all cable terminations are on the stationary base eliminating unpredictable friction and inertia, increasing 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



The parallel kinematics design with constant-length struts reduces the moved mass virtually to that of the light-weight platform. This is why the F-206 can react and settle significantly faster than stacked serial kinematics systems, where each stage must move not only its own platform, but also all the stages above it and their cables. The F-206 has no moving cables to cause friction that degrades resolution and repeatability.

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 userfriendly, 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 F-206.IRU and F-206.00U, p. 8-12 and F-361, p. 8-14.

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-311

PIMotion&Vision Imaging Processing for Intelligent Automation (see p. 8-16)

F-206.AC8

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

F-206.i3E

GPIB/IEEE 488 Interface for F-206 controllers

F-206.MHU

Force-Limiting Mounting Platform (included with F-206.Sx)

F-206.MFU

Mounting Platform with Force Sensors

Upgrades / Options

F-206.NCU

Rapid Nanopositioning Upgrade for F-206. Consists of P-611.3SF NanoCube® and E-760 Controller Card

F-206.MC6

6D Interactive Manual Control Pad

C-815.MC6

3 m Extension Cable for Manual Control Pad

F-206.00U

2-Channel Photometer Card, (Visual Range)

F-206.iRU

2-Channel Photometer Card (IR Range)

F-361.10

Absolute-Measuring Optical Power Meter, 1000-1600 nm Wavelength (see p. 8-14)

F-206.iiU

2-Channel Photometer Card (IR Range)

F-206.VVU

2-Channel Photometer Card, (Visual Range)

M-500.206

Adapter Plate for Mounting F-206 on M-511, M-521 and M-531 Translation Stages

Ask about custom designs!

Piezo Actuators

Nanopositioning & Scanning Systems

Active Optics / Steering Mirrors

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Capacitive Position Sensors

Piezo Drivers & Nanopositioning Controllers

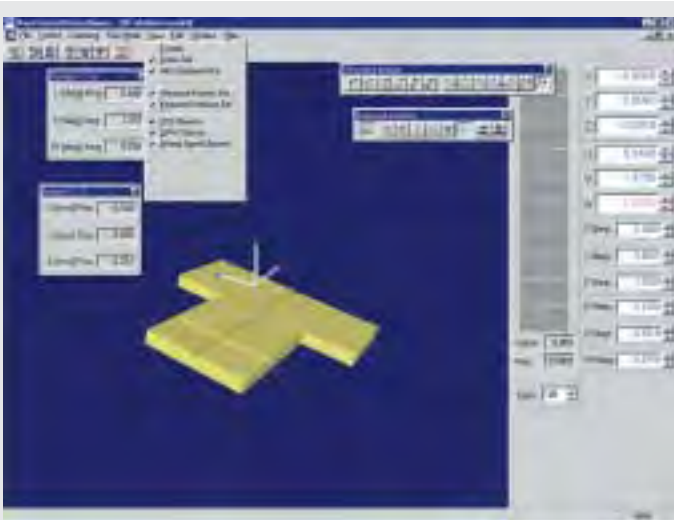
Hexapods / Micropositioning

Photonics Alignment Solutions

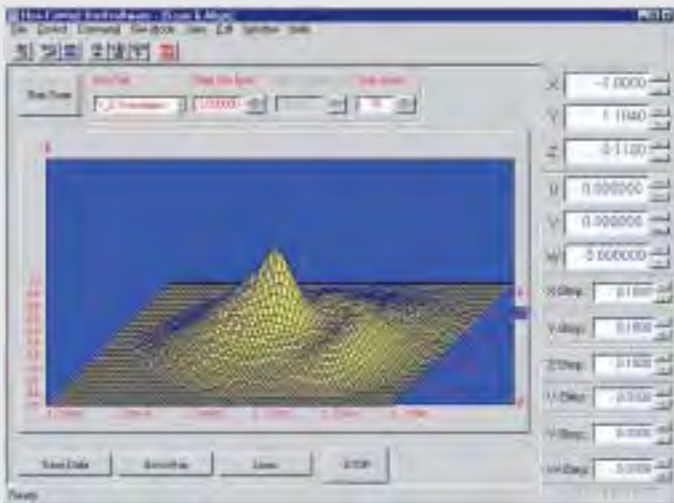
Motion Controllers

Ceramic Linear Motors & Stages

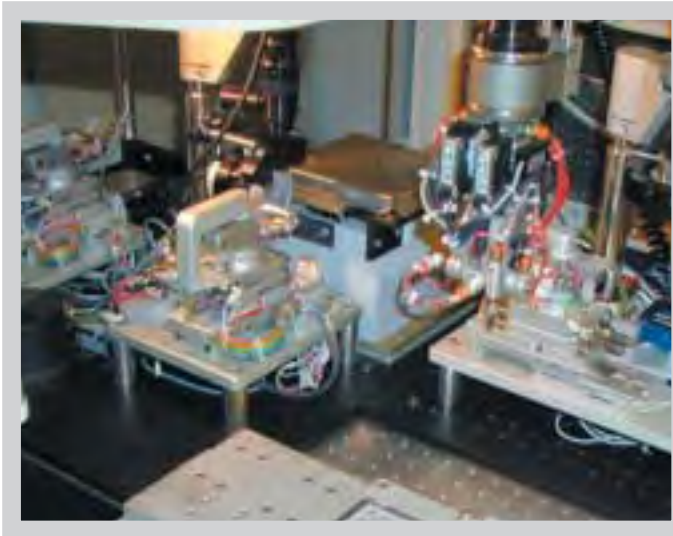
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HexControl™ Software, manual mode. 3D view of the F-206 platform in space, with coordinate vectors and pivot point.



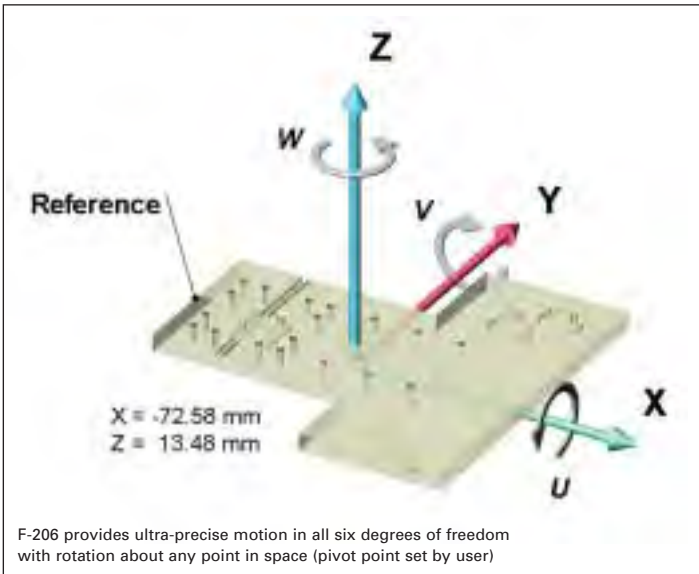
HexControl™ Software displaying scan of photonic component.



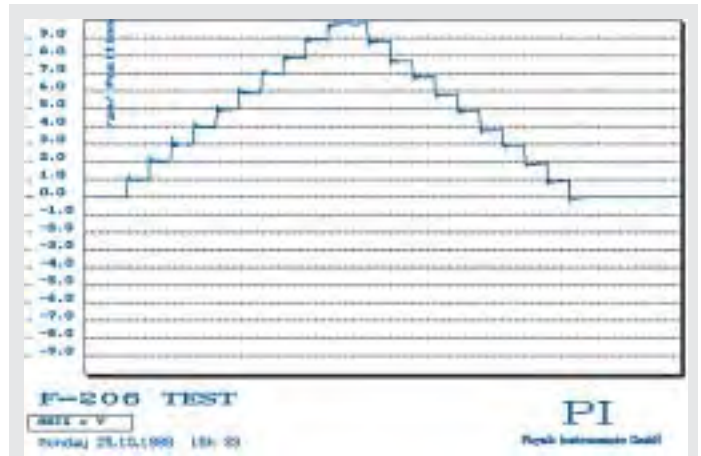
F-206 HexAlign™ Alignment System deployed as a photonics alignment subsystem for automated assembly of fiber pigtailed devices, courtesy of Aries Innovation



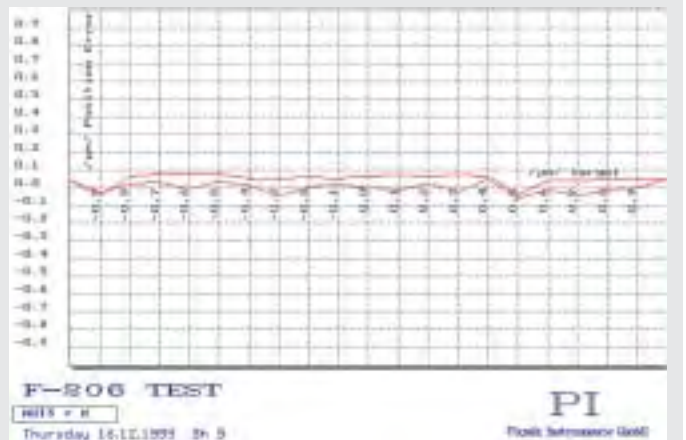
LabView™ drivers for automated fiber bundle alignment are part of the F-206 software package.



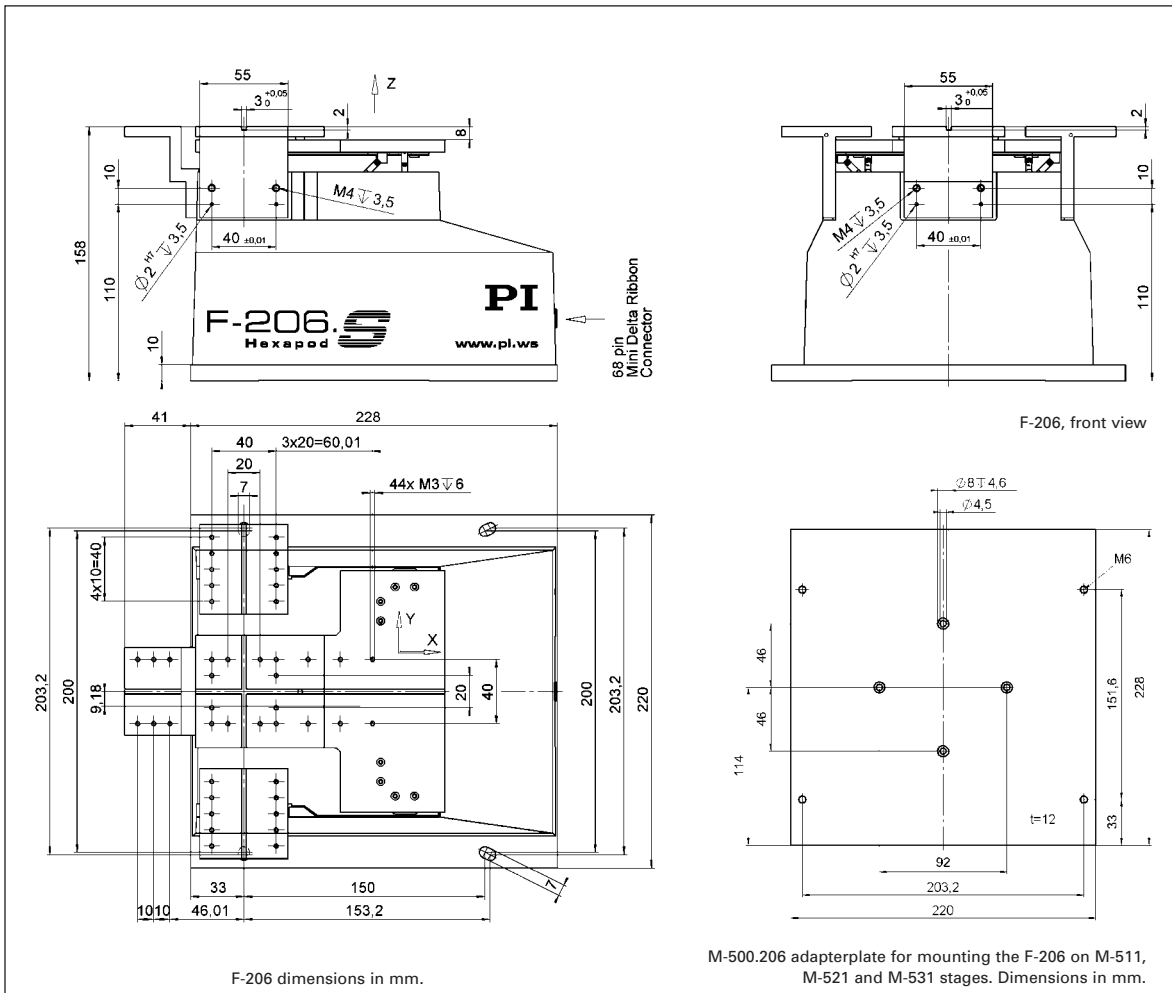
F-206 provides ultra-precise motion in all six degrees of freedom with rotation about any point in space (pivot point set by user)



F-206 Interferometer test: Y-axis settling behavior



F-206 Interferometer test: Accuracy and repeatability of 20 sequential 0.1 μm steps in both directions.



- Piezo Actuators
- Nanopositioning & Scanning Systems
- Active Optics / Steering Mirrors
- Tutorial: Piezo-electrics in Positioning
- Capacitive Position Sensors
- Piezo Drivers & Nanopositioning Controllers
- Hexapods / Micropositioning
- Photonics Alignment Solutions**
- Motion Controllers
- Ceramic Linear Motors & Stages
- Index

Technical Data

Models	F-206.S0 / F-206.SD
* Travel range X	-8 to +5.7 mm
* Travel range Y	-5.7 to +5.7 mm
* Travel range Z	-6.7 to +6.7 mm
* Travel range θ_x	-5.7 to +5.7°
* Travel range θ_y	-6.6 to +6.6°
* Travel range θ_z	-5.5 to +5.5°
Actuator resolution	33 nm
** Minimum incremental motion X, Y, Z	0.1 μ m (6-axis move!)
** Minimum incremental motion $\theta_x, \theta_y, \theta_z$	2 μ rad (0.4 arc seconds) (6-axis move!)
Bidirectional repeatability X, Y, Z	0.3 μ m
Bidirectional repeatability $\theta_x, \theta_y, \theta_z$	3.6 μ rad
Speed X, Y, Z	0.01 to 10 mm/s
Maximum load in Z	2 kg (centered on platform)
Weight	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, HexControl™, scan and align software, terminal software

* Travel ranges in the coordinate directions (X, Y, Z $\theta_x, \theta_y, \theta_z$) 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.

** Move involving all 6 actuators. No moving cables, unlike serial kinematics (stacked) systems. Eliminates bending, inertia and friction, improving accuracy.

F-206

Options



Photometer card for the F-206

Optical Metrology Boards

The controllers for the F-206, M-840 and M-850 Hexapod systems can be equipped/retrofitted with the following photometer cards: F-206.00U (visual range), F-206.iRU (IR range), F-206.VVU (2-channel, visual), F-206.iiU (2-channel, IR). Up to 2 cards per controller are supported.

Force-Limiting, Force-Sensing Platforms

In some applications it may be useful to limit the forces on or from the F-206 platform to protect the mechanics or components mounted on the F-206 from damage. Two platform options are available:

F-206.MHU

F-206.MHU is a magnetic kinematically clamped, add-on platform which consists of two parts. The upper part, also available separately under order number F-206.TMU, releases itself automatically when a certain force or torque is exceeded. With multiple F-206.TMUs, complete setups mounted on different top plates can be interchanged quickly and easily.

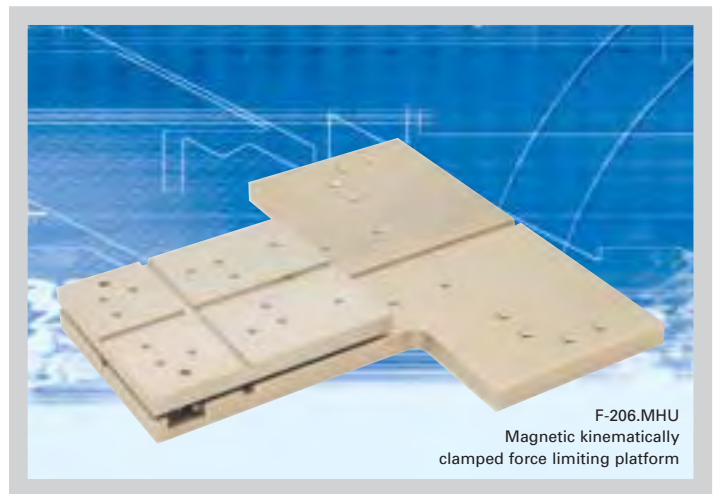
F-206.MHU is included as standard with F-206.S.



The F-206 HexAlign™ 6D alignment system combines high resolution and high accuracy with rapid response, and allows fully automatic alignment of fiber optic components. The optional NanoCube® module (front left) achieves nanometer resolution and, with its rapid-response piezo drive, can scan and characterize the entire cross-section of an optical component in a few seconds (see P-611, p. 8-16)

F-206.MFU

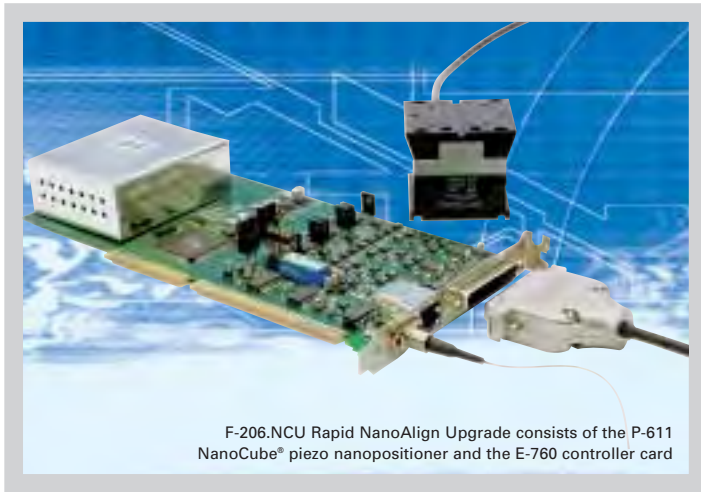
The F-206.MFU is similar to F-206.MHU platform, but is equipped with force sensors. The sensor output voltage can be monitored by external software which could, for example, shut off the system if a certain value is exceeded.



F-206.MHU
Magnetic kinematically clamped force limiting platform

Technical Data

Optical Metrology Boards for F-206, M-840, M-850 and C-880 Controllers	
Optical power range	5 nW – 10 mW
Analog input voltage range	0 – 10 V
A/D resolution	12-bit
Sample rate	10 kHz
Bandwidth	300 Hz (optical input), 10 kHz (electrical input)
Max. sensitivity at:	880 nm (visible); 1550 nm (IR range)
40% sensitivity at:	480/1040 nm (visible); 850/1680 nm (IR range)



F-206.NCU Rapid NanoAlign Upgrade consists of the P-611 NanoCube® piezo nanopositioner and the E-760 controller card

F-206.NCU Rapid NanoAlign Upgrade

For applications where alignment with nanometer-range resolution is required, or where rapid mapping of the entire cross-section of a component in as short a time as possible is desired, the F-206.NCU Rapid NanoAlign upgrade is recommended. It consists of the P-611.3SF XYZ piezo-drive NanoCube® (p. 8-18) and the E-760 controller board (p. 6-33), which is installed in the F-206 controller.



The F-206.MC6 manual control pad facilitates system setup and testing procedures. It permits independent motion in all degrees of freedom with programmable step size

F-206.MC6 6D Interactive Control Pad Upgrade

The F-206.MC6 manual control pad facilitates system setup and testing procedures. It consists of a board that plugs into the F-206 controller and a control pad with six digital “potentiometer” knobs (one for each degree of freedom).

The manual pad works seamlessly with the F-206 software, and allows programmable step

sizes from 0.1 μm to 1 mm per step. External positioning commands (via the computer interface) can be intermixed with manual positioning input without loss of the true position, because both inputs operate on the same position registers of the F-206 controller. The control pad comes with a 3 m cable. A 3 m extension cable is available as part number C-815.MC6.

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F-361

High-Speed Integrating Sphere Optical Power Meter



F-361 integrating sphere and optical power meter.

- **Ultra Fast: 5 ksamples/s**
- **Power Range 1 nW to 10 mW**
- **Absolute Power Measurement, NIST Traceable**
- **Display for Instantaneous and Test Measurements**
- **Spectral Range 1000 nm to 1600 nm**
- **Compatible to PI F-206, M-840 & M-850 Hexapod Systems**
- **Compatible to PI C-880 Multiaxis Alignment**

Absolute Power Measurement, NIST Traceable

F-361 is a very sensitive, absolute measuring power meter. All incoming light is detected by three InGaAs detectors in its integrating sphere. All F-361 are calibrated and NIST traceable.

10⁷ Power Range

The F-361 is extremely sensitive, the minimum signal resolution already starts at 1 nW. It covers a range of 7 orders of

magnitude to 10 mW. For higher optical power, an attenuator can be used.

High Speed

The F-361 provides a high bandwidth of 5 kHz, a prerequisite for automatic alignment. Its high-throughput RS-232 interface provides up to 5,000 samples/s.

Compatibility to PI Alignment Systems

PI offers various photonics alignment systems consisting of precision mechanics up to 1 nm resolution, advanced motion controllers, high level software and open-source alignment routines.

The F-361 is compatible to all PI alignment systems such as M-840/M-850, F-206 and C-880 and existing systems with rela-

tive power meters can be upgraded (firmware update required). Up to two F-361 can be used with the above alignment systems.

F-361 comes with an RS-232 interface board for the PI motion controllers, interface cables, power supply, installation and operation manual and software.

Compatible to

- M-840 Fast Six-Axis Parallel Kinematics Hexapod
- M-850 Hexapod Parallel Kinematics MicroMotion Robot
- F-206 HexAlign Six-Axis MicroMotion Robot and Alignment System
- M-824 Vacuum-Compatible Hexapod
- C-880 Multi-Axis Automation Platform

Ordering Information

F-361.10
High-Speed Optical Power Meter, NIST Traceable, 1000-1600 nm wavelength

Technical Data

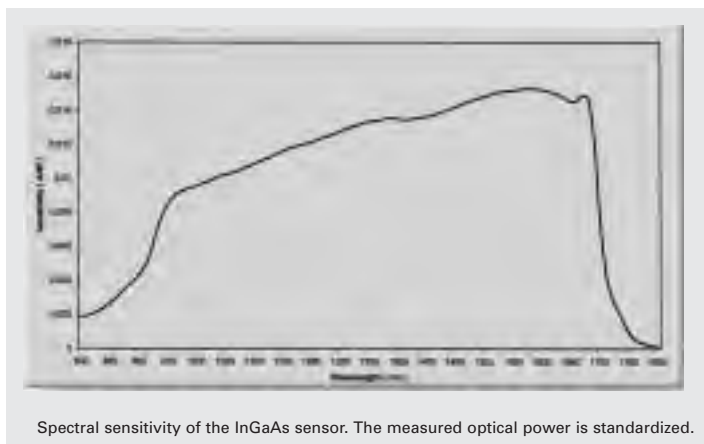
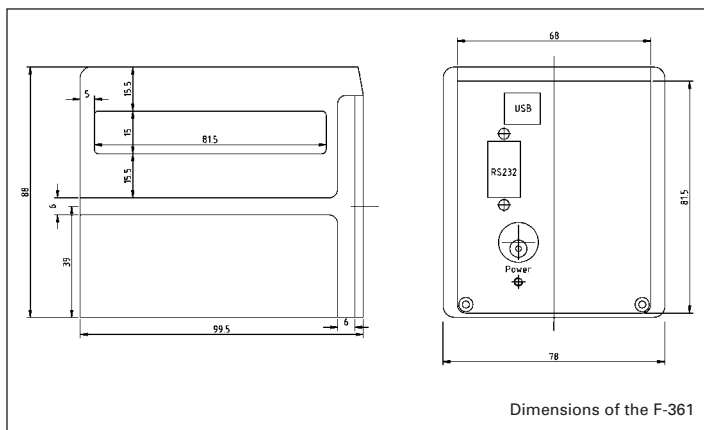
Models	F-361.10
Function	High-speed optical power meter for absolute power measurement
Channels	1
Spectral Range	1000 nm to 1600 nm
Calibration	NIST traceable
Power Range	1 nW to 10 mW
Absolute accuracy	8.5 %
Autoranging time	140 μs
Interface	USB, RS-232
RS-232 throughput	5 ksamples/s, max. 7 ksamples/s
Fiber Connector	FC
Detector	3 x InGaAs
Dimensions	99.5 x 88 x 78 mm
Weight	865 g

Application Examples

- Fiber alignment
- Optical measurement
- Characterization of optical parts or MEMS
- Quality assurance of optical parts or MEMS

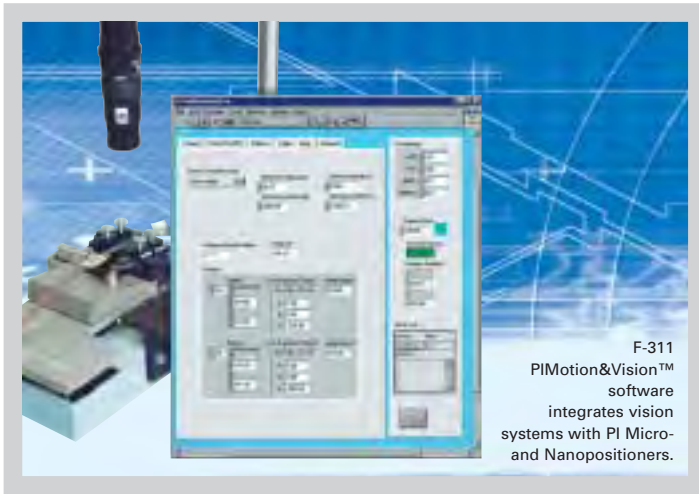


- Piezo Actuators
- Nanopositioning & Scanning Systems
- Active Optics / Steering Mirrors
- Tutorial: Piezo-electrics in Positioning
- Capacitive Position Sensors
- Piezo Drivers & Nanopositioning Controllers
- Hexapods / Micropositioning
- Photonics Alignment Solutions**
- Motion Controllers
- Ceramic Linear Motors & Stages
- Index



F-311

PIMotion&Vision™—Integration of Vision System and Micro-/Nanopositioning



F-311
PIMotion&Vision™
software
integrates vision
systems with PI Micro-
and Nanopositioners.

- Vision System for Integration with PI Micro- and Nanopositioning Systems
- Controls up to Six DOF Motion with Sub- μm or Sub-nm (Sub- μrad) Resolution
- National Instruments Compatible Vision System
- Multi-Channel Vision for a Mix of Resolutions and/or 3D Observation
- Powerful LabView VIs for PIMotion&Vision

PIMotion&Vision™ offers an integrated solution for difficult tasks such as automated positioning of optics, semi-conductor wafers, microsystems technology MEMS fabrication or alignment and scanning of samples under a microscope:

- Basic functions such as autofocus, edge and pattern recognition, and gap measurement.

Application Examples

- Optical 6D alignments
- Autofocussing
- Gap measurements
- Pattern recognition in
 - Semiconductor industry
 - Biotechnology
 - Life science
 - MEMS Manufacturing/MST
 - Photonics

- Intelligent automated procedures.
- Motion systems capable of carrying out the positioning or scanning required.

NI Framegrabber

The hardware for the F-311 PIMotion&Vision™ system consists of a National Instruments PCI bus framegrabber card. This fact guarantees a high degree of compatibility for further system integration. The framegrabber card supports a number of camera systems and is available with one or four channels.

Software Interface to Micro- and Nanopositioners

PIMotion&Vision™ offers a large number of LabView™ drivers for continuous monitoring and processing of the image information, including standard procedures for gap measurement, autofocus, align-

ing edges all the way to complex alignment routines in six degrees of freedom with up to 80 axes of motion, switching functions and read-in of analog signals (e.g. photometer signals for optical fiber alignment).

Motion is commanded using the PI General Command Set, which is supported by all PI multi-axis micropositioning and nanopositioning controllers.

The basic version contains all the drivers provided by PI; the Pro Version includes the full IMAQ development environment from National Instruments, making possible an even wider range of system integration and function development.

Notes

Optimal performance in transmitted-light applications can be obtained with the F-311.L10

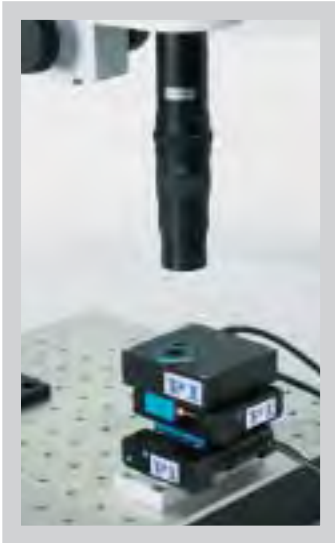
Ordering Information

- F-311.V01**
PIMotion&Vision™ Basic Module, 1CH
- F-311.V04**
PIMotion&Vision™ Basic Module, 4CH
- F-311.V11**
PIMotion&Vision™ Pro Module, 1CH
- F-311.V14**
PIMotion&Vision™ Pro Module, 4CH
- F-311.V1U**
PIMotion&Vision™ Upgrade to Pro Module
- F-311.L10**
PIMotion&Vision™ Illumination System

illumination system, developed by PI. The light intensity is adjustable and the use of LEDs assure long lifetime. The unit can be powered directly from the PI controller, a feature which helps reduce the number of components.



Optical fiber-alignment with F-206 6-axis-alignment system and P-611 NanoCube® 3D piezo nanopositioning / scanning system. Two cameras allow a 3-dimensional visual automated coarse alignment.



NI

Compatible

Simple setup with a single camera, two M-111 stages in an XY configuration and an M-116 rotary platform (all controlled from a C-843 PCI card). This sample setup can be used for pattern recognition, as can be seen in the next graphics.

Piezo Actuators

Nanopositioning & Scanning Systems

Active Optics / Steering Mirrors

Tutorial: Piezo-electrics in Positioning

Capacitive Position Sensors

Piezo Drivers & Nanopositioning Controllers

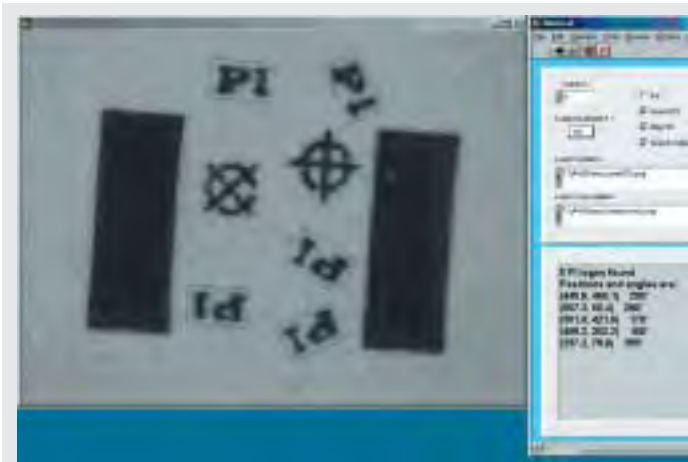
Hexapods / Micropositioning

Photonics Alignment Solutions

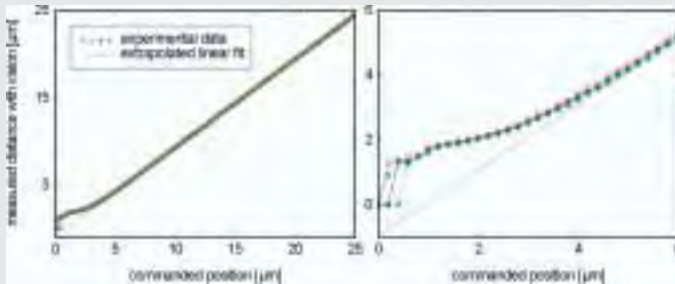
Motion Controllers

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PIMotion&Vision™ sample pattern recognition task. The sample program searches for PI logos, counts and aligns them. The logos are 1 x 0.5 mm in size.



Gap measurement with PIMotion&Vision™ is linear down to 5 µm, and at separations down to 1 µm the values provided can be used with correction. Optical gap measurement then begins to be limited by refraction and optical imperfections. The reference measurements were made with a P-611 NanoCube® Piezo-NanoPositioning system.

P-611.30F · P-611.3SF

NanoCube® Rapid Photonics NanoAlignment Add-on System



- **Ideal for Fiber Alignment and Photonics Packaging Applications**
- **100 µm Travel Range, Ultra-Compact Package!**
- **1 nm Resolution**
- **Closed- and Open-Loop Versions, X, Z, XZ, XY, XYZ**
- **Precision Trajectory Control w/ Frictionless Flexures**
- **Fast Scanning and Settling**
- **Large Variety of Controllers**

The P-611.30F and P-611.3SF NanoCube® NanoAlignment systems are based on PI's vast experience with ultra-high-precision piezo scanning systems (see the "Nanopositioning &

Scanning Systems" section) and photonics packaging applications. They combine a 100 x 100 x 100 µm XYZ positioning and scanning range with a zero stiction/friction wire-EDM-cut guiding system in an extremely compact package. NanoCube® systems provide motion with nanometer-scale resolution and settling times of only a few milliseconds.

Open- & Closed-Loop Models

Open- and closed-loop versions are offered to suit your application. Several fiber, waveguide and optics adapters are available for mounting on the NanoCube® (e.g. model F-603.60, see "Fiber, Objective and Waveguide Holders" see page 8-26).

NanoCubes® are also available in a slightly different package without the fiber adapter interface, see the P-611 article on page 2-74 in the "Nanopositioning & Scanning Systems" section.

Automatic Alignment

NanoCubes® can be operated with the E-664 bench-top controller. A special controller card (model E-760, see page 6-33) featuring built-in optical metrology can be installed in the F-206 hexapod controller or the C-880 automation controller. A variety of other rackmount and bench-top controllers is also available.

NanoCubes® can be easily combined with a number of automated or manual PI micropositioning systems, from single axis stages to 6-degree-of-freedom micromanipulators.

Working Principle / Lifetime

P-611 nanopositioners are equipped with the award-winning PICMA® long-life piezoelectric drives integrated into a sophisticated flexure guiding system. The force exerted by the piezo drive pushes a multi-flexure parallelogram via an integrated motion amplifier. The wire-EDM-cut flexures are FEA modeled (finite element analysis) for zero stiction and friction, ultra-high resolution and exceptional guiding precision. All components are frictionless and maintenance-free.

Notes

For versions without the fiber adapter interface see p. 2-36, p. 2-38 and p. 2-74 in the "Nanopositioning & Scanning Systems" section.

Ordering Information

P-611.3SF
NanoCube® XYZ NanoAlignment Stage, 100 x 100 x 100 µm, Closed Loop, Fiber Adapter Interface

P-611.30F
NanoCube® XYZ NanoAlignment Stage, 100 x 100 x 100 µm, Open-Loop, Fiber Adapter Interface

Recommended Controllers
E-760, E-664 (see pp. 6-32 ff.)

X, Z, XZ, XY, XYZ Versions

P-611.ZS
Z Nanopositioning System
100 µm, SGS Sensor

P-611.Z0
Z Nanopositioning System
100 µm, Open-Loop

P-611.XZS
XZ Nanopositioning System
100 x 100 µm, SGS Sensor

P-611.XZ0
XZ Nanopositioning System
100 x 100 µm, Open-Loop

P-611.10
Nanopositioning System 100 µm,
Open-Loop

P-611.1S
Nanopositioning System 100 µm,
SGS Sensor

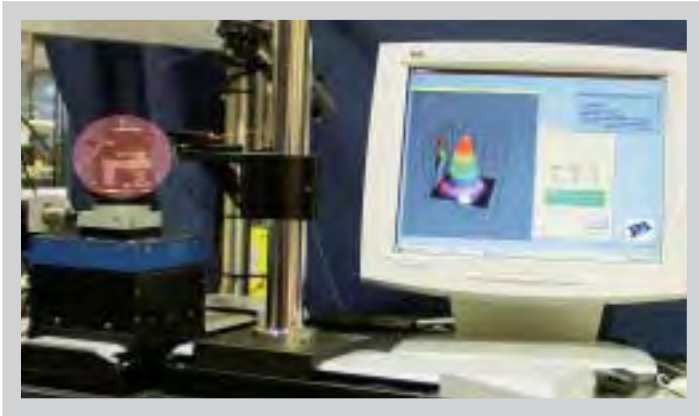
P-611.20
XY Nanopositioning System
100 x 100 µm, Open-Loop

P-611.2S
XY Nanopositioning System
100 x 100 µm, SGS Sensor

Ask about custom designs!

Application Examples

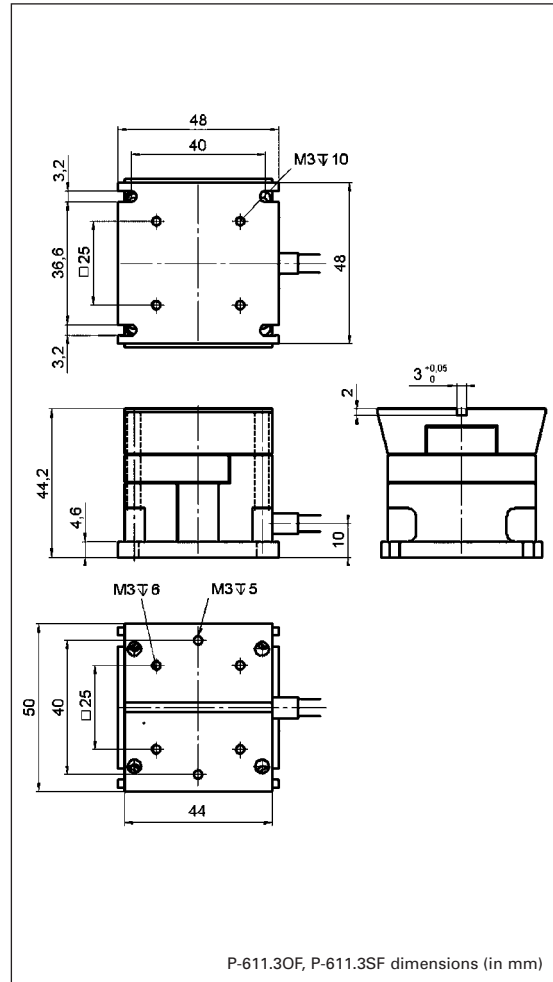
- Photonics packaging
- Optical device testing
- MEMS positioning/alignment
- Fiber alignment
- Micromachining
- Micromanipulation (life sciences)
- Semiconductor test systems



P-611 NanoCube® in a coarse/fine travel alignment application with M-511, M-501 and M-037 stages. CyberAligner™ software takes data of the complete cross-coupling section, aligns the platform and displays the profile on screen (this process only takes a few seconds).



Combination of NanoCube® and F-206 Six-Axis Parallel-Kinematics MicroMotion-Robot



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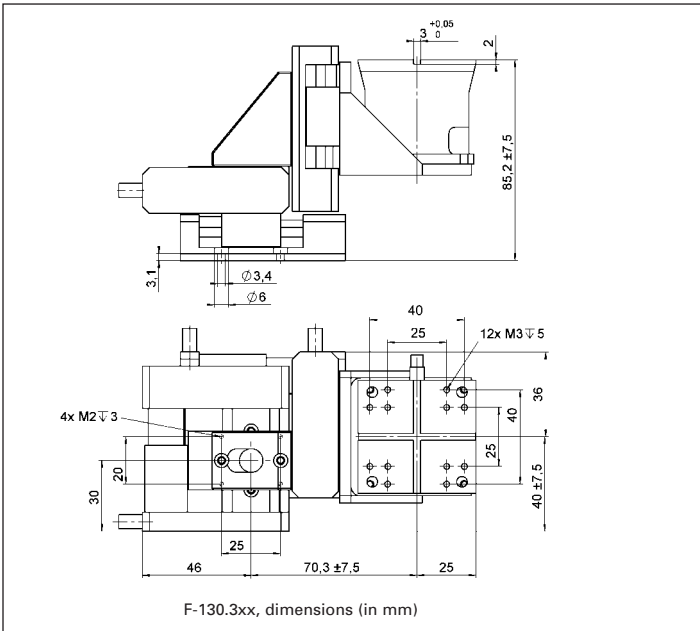
Technical Data

Models	P-611.3SF	P-611.3OF	Units	Notes see page 2-44
Active axes	X,Y,Z	X,Y,Z		
Open-loop travel @ 0 to 100 V	100 / axis	100 / axis	$\mu\text{m} \pm 20 \%$	A2
Closed-loop travel	100 / axis	-	μm	A5
Integrated feedback sensor	SGS	-		B
** Closed-loop / open-loop resolution	2 / 1	- / 1	nm	C1
Stiffness	0.3	0.3	N / $\mu\text{m} \pm 20 \%$	D1
Max. (+/-) normal load	1.5	1.5	kg	D4
Electrical capacitance	1.5 / axis	1.5 / axis	$\mu\text{F} \pm 20 \%$	F1
* Dynamic operating current coefficient (DOCC)	1.7 / axis	1.7 / axis	$\mu\text{A}/(\text{Hz} \times \mu\text{m})$	F2
Unloaded resonant frequency (X/Y/Z)	350/220/250	350/220/250	Hz $\pm 20 \%$	G2
Operating temperature range	- 20 to 80	- 20 to 80	$^{\circ}\text{C}$	H2
*** Voltage connection	Sub-D-Special	Sub-D-Special		J1
*** Sensor connection	Sub-D-Special	-		J2
Weight (w/o cables)	250	250	g $\pm 5 \%$	
Body material	S/Al	S/Al		L
Recommended Amplifier/Controller (codes explained see page 6-46)	N, C, D ,G , H	N, G, C		

* Dynamic Operating Current Coefficient in μA per hertz and μm . Example: Sinusoidal scan of $50 \mu\text{m}$ at 10 Hz requires approximately 0.8 mA drive current.

** Resolution of PZT NanoPositioners is not limited by stiction or friction. Noise equivalent motion with E-503 amplifier.

*** Adapter cable with LEMO connectors for sensor and operating voltage available.



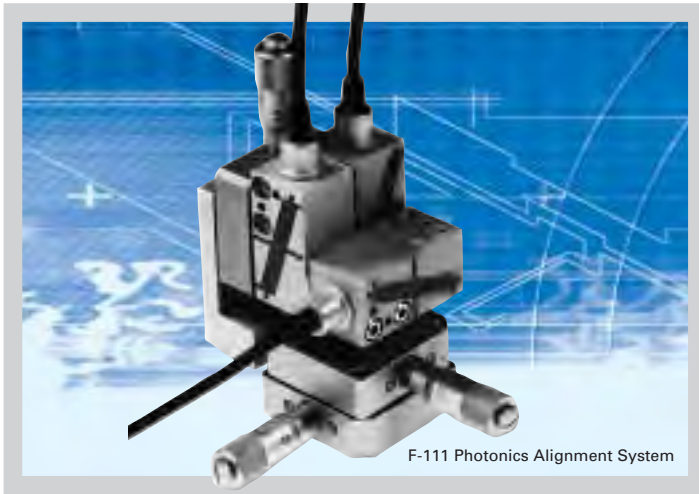
- Piezo Actuators
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Technical Data

Models	F-130.3SD	F-130.3SS	F-130.3OD	F-130.3OS	F-131.3SD	F-131.3SS	F-131.3OD	F-131.3OS	Units	Notes see page 7-96
Key features	Closed-loop DC motors, closed-loop PZT drives	Stepper motors, closed-loop PZT drives	Closed-loop DC motors, open-loop PZT drives	Stepper motors, open-loop PZT drives	Closed-loop DC motors, closed-loop PZT drives	Stepper motors, closed-loop PZT drives	Closed-loop DC motors, open-loop PZT drives	Stepper motors, open-loop PZT drives		
Active axes	X,Y,Z	X,Y,Z	X,Y,Z	X,Y,Z	X,Y,Z	X,Y,Z	X,Y,Z	X,Y,Z		
Motorized travel range (XYZ)	5	5	5	5	15	15	15	15	mm	
Piezo travel range (XYZ)	100	100	100	100	100	100	100	100	µm	
Design resolution (motor)	0.007	0.006	0.007	0.006	0.007	0.006	0.007	0.006	µm	A3
Min. incremental motion (motor)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	µm	A4
Closed-loop / open-loop resolution (PZT)	2/1	2/1	- / 1	- / 1	2/1	2/1	- / 1	- / 1	nm	
Motorized stage	M-110.3DG	M-110.32S	M-110.3DG	M-110.32S	M-111.3DG	M-111.32S	M-111.3DG	M-111.32S		see page 7-30
Piezo drive	P-611.3SF	P-611.3SF	P-611.3OF	P-611.3OF	P-611.3SF	P-611.3SF	P-611.3OF	P-611.3OF		see page 8-16
Material	Al / S	Al / S	Al / S	Al / S	Al / S	Al / S	Al / S	Al / S		L
Recommended controller (see page 9-6)	C-880	-	C-880	-	C-880	-	C-880	-		

F-111

Compact Hybrid Manual/Piezoelectric Photonics Alignment System



F-111 Photonics Alignment System

- PZT Drives with Sub-Nanometer Resolution
- Precision Mechanics with Crossed Roller Bearings
- 6 x 6 x 6 mm Travel Range
- 30 x 30 x 30 μm PZT Fine Travel Range

The F-111 photonics alignment system is an ideal solution for applications where a coarse "operating" position can be set manually and an ultra-high-resolution alignment process (tracking, scanning etc. with sub-nm resolution) is started from that position.

High-Resolution Piezo Drives

The F-111 is based on the M-313.00 XYZ translation stage (see page 7-20) and the P-282.10 XYZ piezo Nano-Positioner (see page 2-25). The advantage of the piezoelectric fine adjustment is based on its extremely high resolution, responsiveness and electrical controllability. If used with an external optical power meter

and control software, the F-111 can be used as semi-automatic aligner or scanner with a range of 30 x 30 x 30 μm.

The E-463 piezo amplifier (see page 6-40) is recommended as driving system. It comes with an analog high-speed interface (0 to 10 V). For digital control with a computer, the E-500 modular PZT control system with E-507 amplifier modules (see page 6-23) and optional E-516.i3 computer interface (see page 6-27) is available.

For motorized alignment, please refer to the new F-130, integrated motorized/piezoelectric alignment system featuring closed-loop piezo drives (see page 8-20).

Application Examples

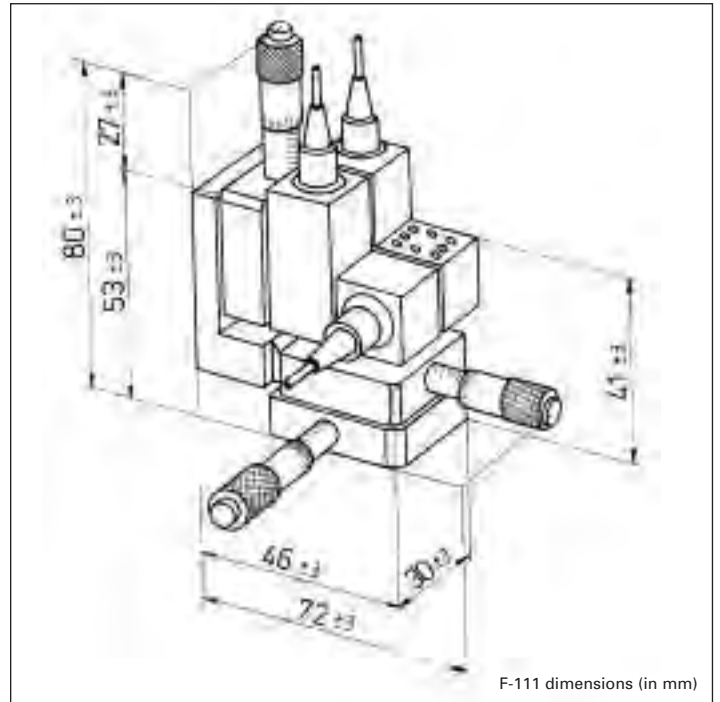
- Photonics packaging
- Optical device testing
- Fiber alignment
- Micro-manipulation (life sciences)

Related Products

The M-313.80 XYZ stage (see page 7-20) with PiezoMike drives (replaces the manual micrometers). It is modular and can also be configured with only one or two PiezoMike high-resolution drives.

Ordering Information

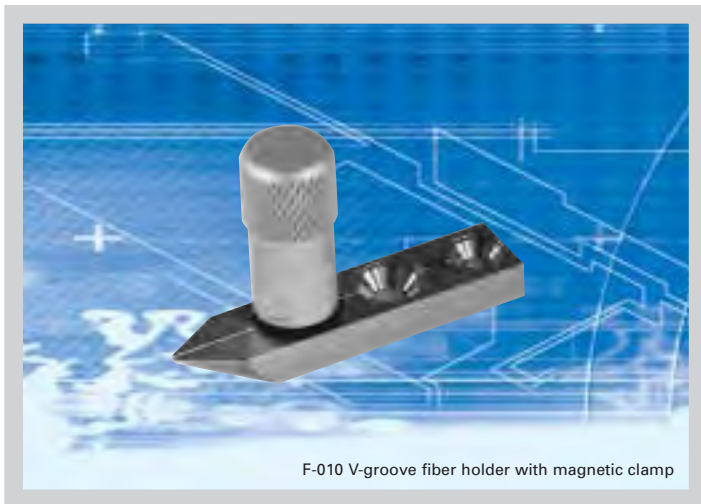
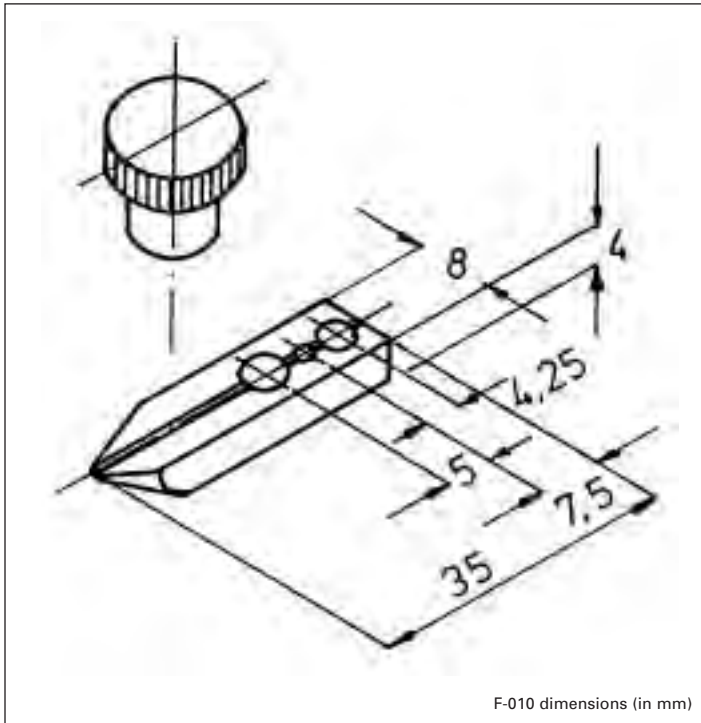
- F-111.00**
XYZ Piezoelectric Photonics Alignment System, 6 mm, 30 μm
- F-010.00**
Fiber Holder with Magnet
- Ask about custom designs!



F-111 dimensions (in mm)



Example of an F-111-related photonics alignment system. M-313.80 XYZ stage with PiezoMike drives, 30 μm fine motion range, M-318.20 mounting bracket and F-010 V-groove fiber holder.



Technical Data

Models	F-111.00	Units
Axes	X, Y, Z	
Travel range (manual)	6	mm
Piezo fine travel range	30	μm
Resolution (piezoelectric)	0.3	nm
Resolution (micrometer drive)	1	μm
Max. load (Z-axis)	20	N
Mechanical positioning system	M-313.00, see page 7-20	
Piezoelectric positioning system	P-282.10, see page 2-25	
Weight	0.4	kg
Recommended amplifier/controller	E-463, E-500 w/ 3 x E-507	

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Hexapods / Micropositioning

Photonics Alignment Solutions

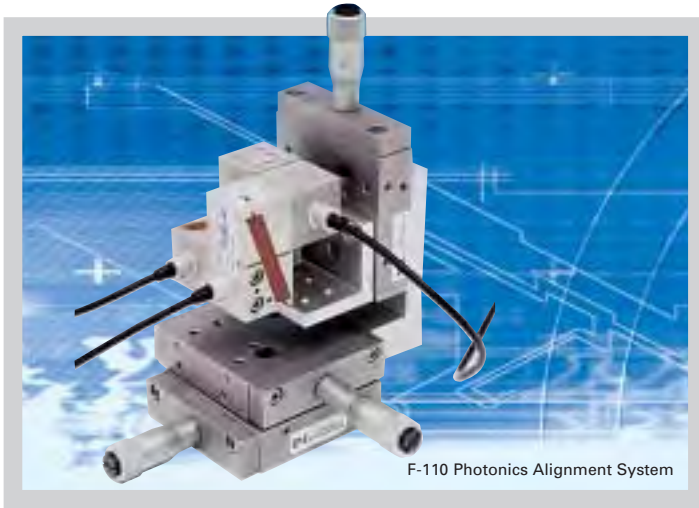
Motion Controllers

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F-110

XYZ Hybrid Manual/Piezoelectric Photonics Alignment System



F-110 Photonics Alignment System

- PZT Drives with Sub-Nanometer Resolution
- Precision Mechanics with Crossed Roller Bearings
- 18 x 18 x 18 mm Travel Range
- 50 x 50 x 50 μm PZT Fine-Travel Range
- Optional Motor Drives

The F-110 photonics alignment system is an ideal solution for applications where a coarse operating position can be set manually and an ultra-high-resolution alignment process (tracking, scanning etc. with sub-nm resolution) is started from that position.

High-Resolution Piezo Drives

The F-110 is based on the M-105.30 XYZ translation stage, (see page 7-24) and the P-282.20 XYZ piezo Nano-Positioner (see page 2-25). The advantage of the piezoelectric fine adjustment is based on its extremely high resolution, responsiveness and electrical

controllability. If used with an external optical power meter and control software, the F-110 can be used as automatic aligner or scanner with a range of 50 x 50 x 50 μm.

The E-463 piezo amplifier (see page 6-40) is recommended as driving system. It comes with an analog high-speed interface (0 to 10 V). For digital control with a computer, the E-500 modular PZT control system with E-507 amplifier modules (see page 6-23) and optional E-516.i3 computer interface (see page 6-27) is available.

Optional Motor Drives

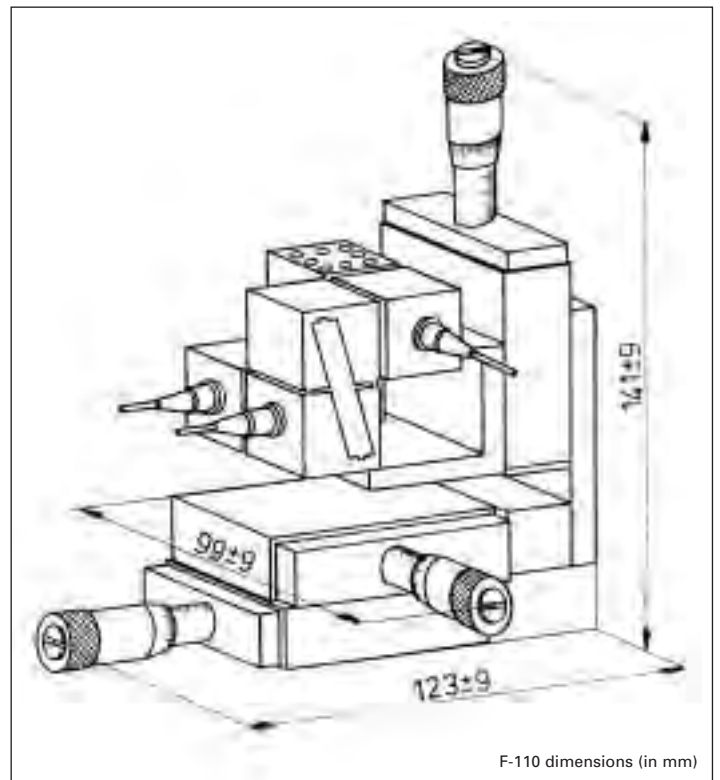
Motordrive upgrades for the F-110 are also available, (M-231 and M-232 Mike drives, see page 7-80 ff.). For fully automated alignment tasks, the new F-130, integrated motorized/piezoelectric alignment system featuring closed-loop piezo drives is recommended (see page 8-20).

Related Products

The M-105.3P XYZ stage with PiezoMike drives (replacing the manual micrometers). It is modular and can also be configured with only one or two PiezoMike high-resolution drives. The M-105.3BA translation stage, basic unit without drives (see page 7-24).

Ordering Information

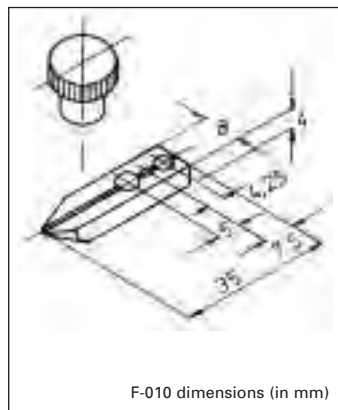
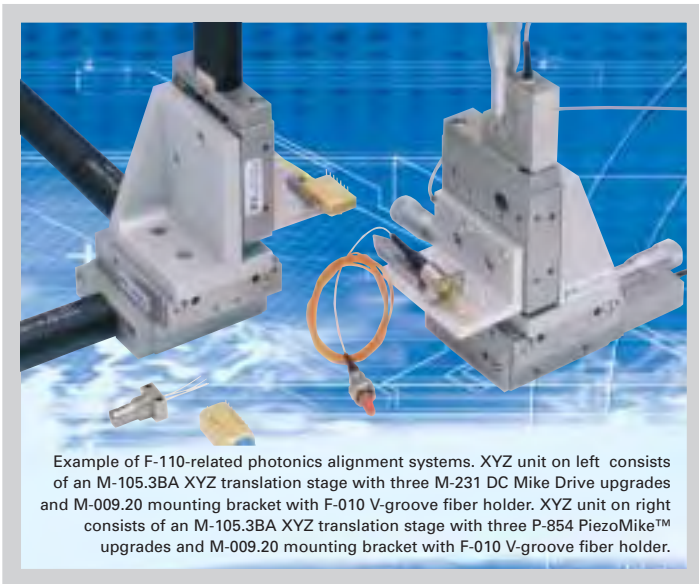
- F-110.00**
XYZ Piezoelectric Photonics Alignment System, 18 mm, 50 μm
- F-010.00**
Fiber Holder with Magnet
- Ask about custom designs!**



F-110 dimensions (in mm)

Application Examples

- Photonics packaging
- Optical device testing
- Fiber alignment
- Micro-manipulation (life sciences)



Technical Data

Models	F-110.00	Units
Axes	X, Y, Z	
Travel range (manual)	18	mm
Piezo fine-travel range	50	µm
Resolution (piezoelectric)	0.5	nm
Resolution (micrometer drive)	1	µm
Max. load (Z-axis)	20	N
Mechanical positioning system	M-105.30, see page 7-24	
Piezoelectric positioning system	P-282.20, see page 2-25	
Weight	1.1	kg
Recommended amplifier/controller	E-463, E-500 w/ 3 x E-507	

Piezo Actuators

Nanopositioning & Scanning Systems

Active Optics / Steering Mirrors

Tutorial: Piezo-electrics in Positioning

Capacitive Position Sensors

Piezo Drivers & Nanopositioning Controllers

Hexapods / Micropositioning

Photronics Alignment Solutions

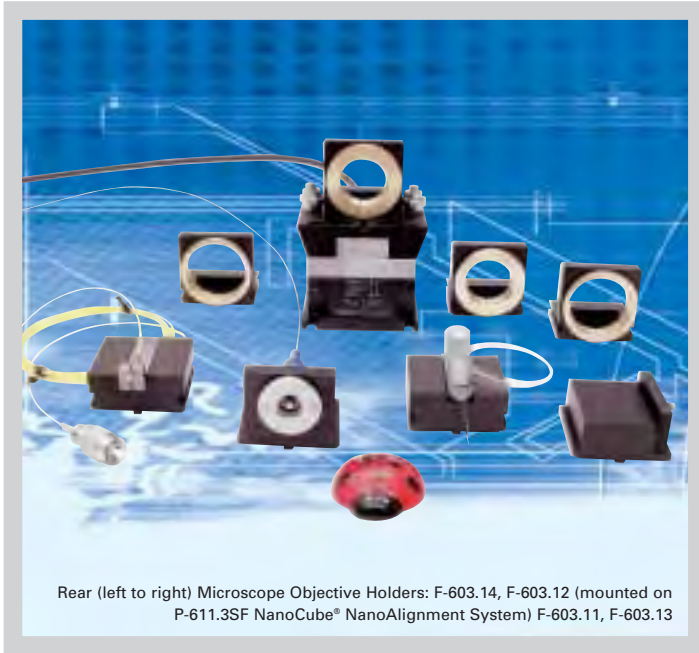
Motion Controllers

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F-603

Fiber, Objective and Waveguide Holders



Rear (left to right) Microscope Objective Holders: F-603.14, F-603.12 (mounted on P-611.3SF NanoCube® NanoAlignment System) F-603.11, F-603.13

- Mount on a Variety of PI Alignment Systems
- Precision Machined from High-Strength Aluminum/Brass

The F-603 series component holders for fiber optic applications can be combined with the following Micro- & Nano-Positioning systems from PI:

- F-206 6D-Hexapod-Alignment System
- F-130 and F-131 Alignment Systems
- P-611.30F and P-611.3SF NanoCube® NanoAligners
- A Variety of Combinations of NanoCubes® with Other MicroPositioning Systems

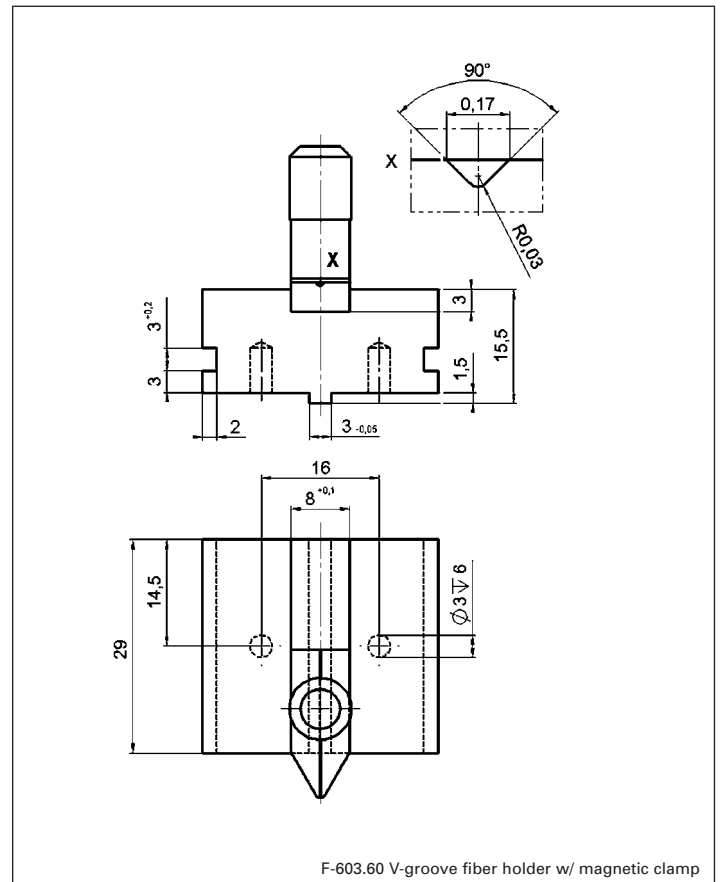
All adapters are equipped with a 3-mm-wide tongue that fits in a slot machined into the platform of the positioning system.

M3 capscrews and miniature cleats supplied with each F-603 adapter are used to fasten these accessories quickly.

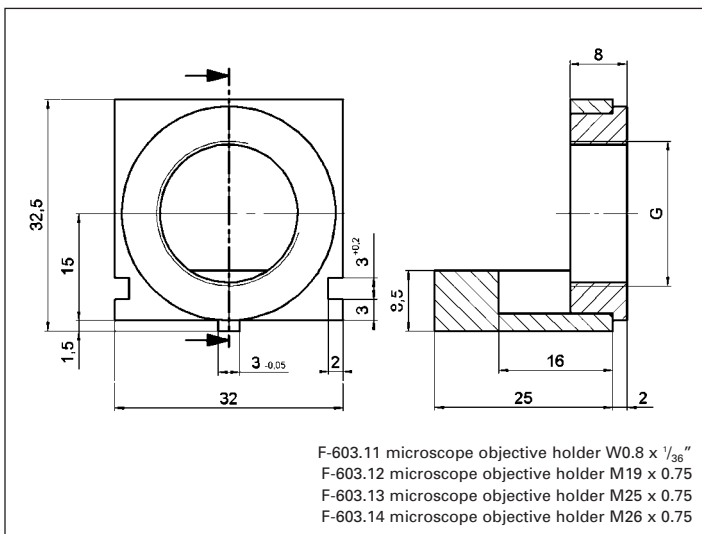
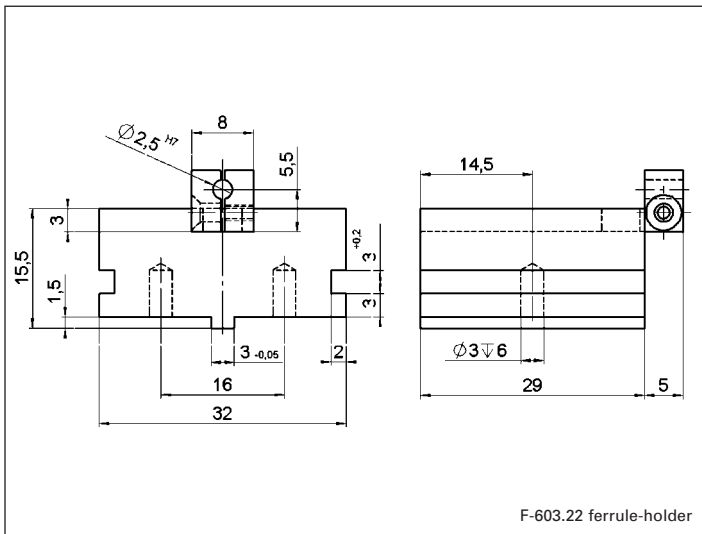
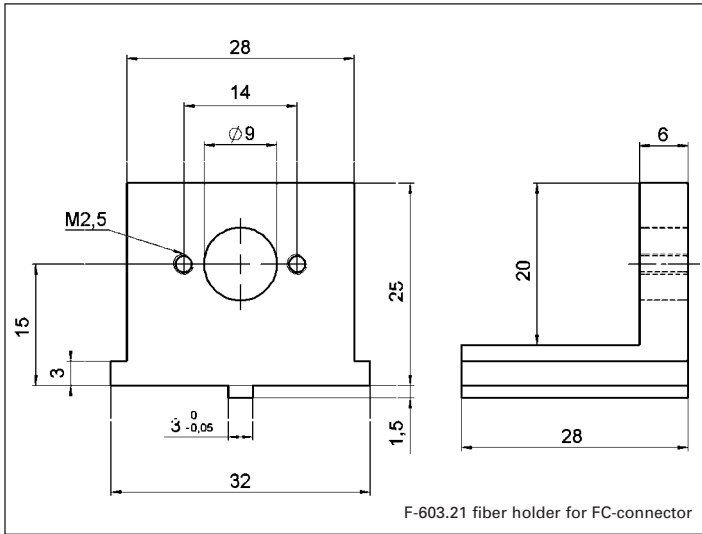
Ordering Information

- F-603.11**
Microscope Objective Holder
W0.8 x 1/36"
- F-603.12**
Microscope Objective Holder
M19 x 0.75
- F-603.13**
Microscope Objective Holder
M25 x 0.75
- F-603.14**
Microscope Objective Holder
M26 x 0.75
- F-603.20**
Vacuum Waveguide Mount
- F-603.21**
Fiber Holder for FC-Connector
- F-603.22**
Ferrule Holder
- F-603.60**
V-Groove Fiber Holder with
Magnetic Clamp

Ask about custom designs!



F-603.60 V-groove fiber holder w/ magnetic clamp



Piezo Actuators

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Hexapods / Micropositioning

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C-880

Automation Platform



Fiber alignment configuration example. Top: C-880.00D equipped with F-206.IRU IR-photometer card, 2 x C-842.40 servo-motor control cards and E-760.3S0 piezo controller card. Bottom left: M-511.DD precision translation stage with 0.1 µm linear encoder for rapid loading/unloading; F-131.3SD hybrid fiber alignment system with 15 mm travel range in XYZ and 1 nm resolution. Bottom right: M-501.1PD precision vertical stage with 0.008 µm encoder resolution; M-061.PD rotation stage and the discontinued F-210 fiber rotator.

- Seamless Control of up to 18 Axes with Piezo Actuators, Servo-Motors, Voice Coil Drives
- Integrated High-Level Command Set Performs Scans, Alignments, etc.
- Plug-and-Play Configuration
- Integrated Amplifiers
- Large Variety of Accessories: I/O Cards, Photometers, Manual Control Pad
- Optional IEEE 488 Interface
- Software Libraries and High-Level Drivers
- Powerful Macro Command Language

Flexibility from the Ground up

The C-880 Automation Platform is a modular and highly versatile system for complex multi-axis positioning and automation tasks. It was conceived for applications ranging from photonics alignment and packaging to biotechnology.

Based on a rugged, industrial PC, it offers the flexibility expected in today's demanding prototyping and high-precision production environment.

Several basic versions and upgrades are available to coordinate combinations of up to 18 micro- and nanopositioning channels. Servo-motors, voice coil-drives and piezo actuators/stages can be controlled in almost any combination. Available options include photometer cards for fully automated fiber alignment, a relay board for flexible automation, an integrated screen and keyboard for stand-alone operation, and a manual control pad.

Up to 273 Channels

A special version of the C-880 Controller was developed for

the SALT telescope in South Africa (www.salt.ac.za). This telescope, the largest in the southern hemisphere, is controlled by 9 modified and networked C-880 controllers which in turn control 273 precision linear actuators based on the M-235 DC-Mike (see p. 7-82).

Ease of Operation, System Integration and Upgrade

All C-880s are delivered fully configured to your requirements and with all installed options tested and ready to run your positioning equipment. The sophisticated configuration engine allows you to upgrade the system at any time, change the assignment of the individual axes and replace or add controller cards easily.

Operating the system, alone or as part of a larger complex, is

Ordering Information

C-880.00
Automation Platform, Chassis with Power Supply, RS-232 Interface

C-880.00D
Automation Platform, Chassis with Power Supply, RS-232 Interface, Front-Panel Keypad and LCD Monitor

Options

C-842.20
DC-Motor Controller Card, 2 Channels

C-842.40
DC-Motor Controller Card, 4 Channels

V-820.20
Voice Coil Controller, 2 Channels

E-760.3S0
Piezo Controller for NanoCube®

Options and Accessories

F-206.iRU
Photometer Card, IR Range

F-206.00U
Photometer Card, Visible Range

F-206.i3E
GPIB/IEEE 488 Interface Card

F-206.MC6
Manual Control Pad

C-880.R8
Relay Board with 8 Relays

Additional Options:
See Description!

facilitated by the C-880's open software architecture. A powerful and comprehensive high-level-language command set, including complete scan and alignment routines, reduces both the programming effort and the communications bandwidth usage.

Application Examples

- Photonics
- Fiber alignment
- Micro-assembly
- Flexible automation
- Quality control
- Semiconductor test equipment
- Biotechnology

Technical Data

Models	C-880.00, C-880.00D
Axes	Up to 18 axes with (servo-motors, voice coil drives), or piezo actuators (max. 6 piezo axes)
Processor	32-bit AMD
Interfaces	RS-232, IEEE 488/GPIB, optional
Command set	PI General Command Set, ASCII communications
Dimensions	19-inch case, 450 mm x 460 mm x 180 mm
Operating voltage	100 to 250 VAC, 50 / 60 Hz

Integration of Nano- and Micropositioning Drives



The F-130.3SD Hybrid Fiber Alignment System permits rapid XYZ alignment of optical fibers and other optical components with nanometer precision. Two F-130 systems can be controlled in parallel with other devices by a single C-880 controller.

The C-880 controller can be equipped with servo-controllers and power amplifiers for the following drive types:

Fast Piezo Nanopositioning Stages

Frictionless, stictionless piezo-nanopositioning systems provide sub-nanometer accuracy combined with very short settling times. The high acceleration of piezo drives makes possible precision scans like those

used in scanning microscopy or for characterizing fiber optic devices in significantly shorter times than with motor-driven stages.

The C-880 can accommodate up to two P-611 NanoCube® XYZ piezo nanopositioners.

Micropositioning Stages and Actuators

The C-880 can control all DC-motor-drive translation, rotation, tip/tilt stages and linear

actuators offered by PI, without the need for external amplifiers. Examples are the highly compact M-110 / M-111 / M-112 translation stages with 50 nanometer minimum incremental motion, the high-load M-235 series and the high-precision M-605 translation stages with integrated linear encoder.

Voice Coil Drives: Fast Linear Drives for Scanning Applications

Voice coil drives offer high scanning rates with travel ranges in the centimeter range in a very small package. Standard systems like the V-106 can be controlled directly from the C-880.

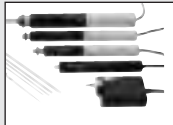
Photonics Applications

The C-880 has its roots in the F-206 HexAlign Hexapod photonics alignment systems (see p. 8-8) and has integrated routines like fast scans conceived for aligning or scanning fiber optic components.

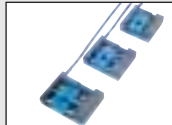
C-880 Drive Examples



P-611 NanoCube PZT NanoPositioning System. High-speed scanning, nanometer-level precision



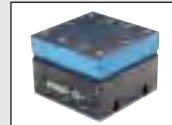
M-230 through M-235 Linear actuators. 50 nm min. incremental motion



M-110 series miniature translation stages. 60 x 62 mm foot print, 50 nm min. incremental motion



F-130 low-inertia hybrid photonics alignment system. PZT drives / servo motors



M-501 elevator stage. 12.5 mm vertical travel, < 0.1 µm min. inc. motion



V-106 Voice-Coil-driven XY scanner. 6 mm travel, up to 5 Hz scanning rate. Direct output metrology



M-500 series translation stages, 100 to 300 mm travel. High load, high resolution



M-605 compact translation stage. 50 mm travel, direct output metrology



M-060 to M-062 series rotation stages. Compact, high resolution



Pneumatic grabber

The high flexibility of the C-880 makes it the solution of choice for many automation and precision-positioning tasks. Here only a few examples can be given. Contact a PI Applications Engineer about your application.

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C-880

Options and Accessories



Pneumatic grabber gripper on an XZ micro-positioning combination for high precision pick-and-place applications. The C-880 controls both the stages (M-505.4PD, 100 mm horizontal travel and M-605.2DD, 50 mm vertical travel) and the gripper with the C-880.R8 power-switch card.

Accessories for Flexible Automation

To live up to its name of "Automation Controller," a variety of options and high-level drivers are available for the C-880.

■ F-206.I3E

IEEE 488 interface card for operation of one or more C-880s from a single PC.

■ C-880.R8

Relay Board which can switch power on up to 8 channels. The high-power capacity (24 V, 1 A) can be used to directly drive loads like pneumatic valves, magnets, relays, etc.

■ F-206.MC6

Interactive manual control pad. This option allows easy manual control of any 6 motorized axes in the system using control knobs with programmable step-sizes.

■ F-206.iRU / F-206.00U

Photometer and A/D Cards. These cards are equipped with fiber-optic connectors, infrared or visible-light photodiodes and amplifiers. Both have integrated 12-bit A/D converters with inputs accessible via a BNC socket on the card bracket.

Technical Data C-880.R8 Power- Switch Card

Models	C-880.R8
Function	Power-switch card
Channels	8
Output power	60 W
Voltage per channel	24 V
Current per channel	1 A

Technical Data C-842 Servo Motion Controller Card

Models	C-842.20 / C-842.40
Function	DC servo-motor controller
Channels	2 / 4
Output power	Analog H-bridge +/-12 V, 5 W per channel, 12-bit PWM output, 10 bit, 24.5 kHz for external amplifiers (ActiveDrive™)
Encoder input	Quadrature encoder signals (single-ended or differential mode), max. 10° cts/s
I/O Ports	Limit and origin switches
Servo characteristics	32-bit programmable PID-ff filter
Connectors	2 x 15-pin D-sub on board 2 x 15-pin D-sub on bracket holder (C-842.40)
Dimensions	PC card (ISA)

Technical Data E-760 Piezo-Controller Card

Models	E-760
Function	Power amplifier & sensor/position servo-control of P-611 NanoCube® systems
Channels	3 LVPZT
Max. output power	9 W
Average output power	3 W
Peak output current	90 mA
Average output current	30 mA
Output voltage	-20 to +120 V
Sensor type	Strain gauge
Servo characteristics	P-I (analog), notch filter
Connector	25-pin sub-D
Dimensions	PC card (ISA)

C-880

Software Tools

PI General Command Set (GCS)

The C-880 comprehensive command structure is based on the PI General Command Set (GCS). The GCS was developed by PI to facilitate coordinated operation of a variety of devices with a minimum of programming effort. Most PI piezo controllers and servomotor controllers can be commanded with GCS.

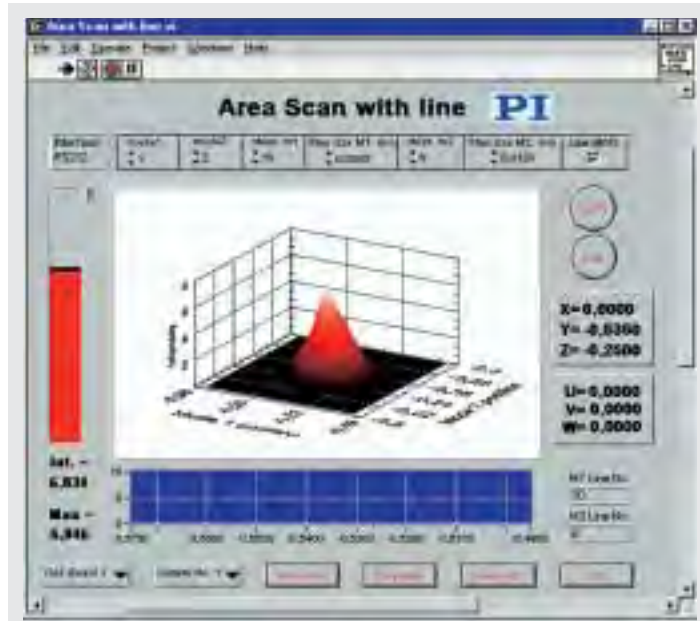
For more information on GCS, see p. 9-28.

Software

All C-880 controllers are delivered preconfigured for the intended application. All you need to do is connect the system components together and install and start the operating software. Later system changes or upgrades can be incorporated easily using the included configuration software.

DLL, COM and LabView™ Drivers for Custom Programming

A number of driver libraries are provided to make the full power of the C-880 available to the programmer. Custom programs have access to all features of the C-880, including internal routines like those designed for automated fiber alignment.

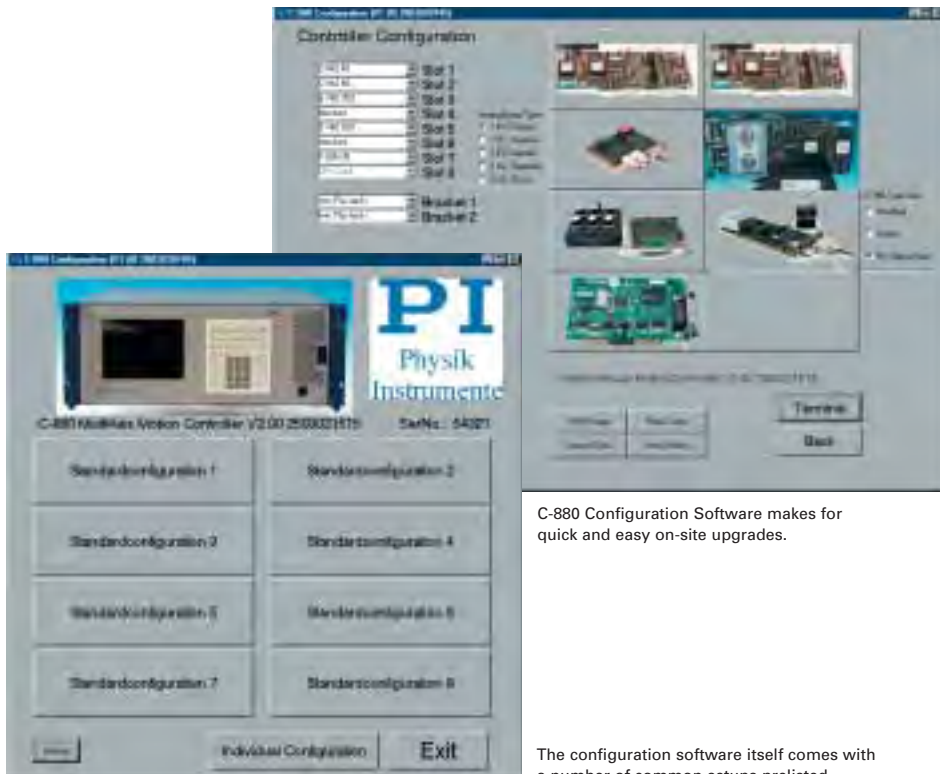


The versatile scan-and-align routines make the C-880 an ideal tool for photonics applications.

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- Photonics Alignment Solutions

Motion Controllers

- Ceramic Linear Motors & Stages
- Index



C-880 Configuration Software makes for quick and easy on-site upgrades.

The configuration software itself comes with a number of common setups prelisted.

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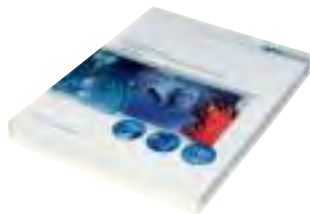
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Program Overview

- Piezoelectric Actuators
- Piezo Nanopositioning Systems and Scanners
- Active Optics / Tip-Tilt Platforms
- Capacitive Sensors
- Piezo Electronics: Amplifiers and Controllers
- Hexapods
- Micropositioners
- Positioning Systems for Fiber Optics, Photonics and Telecommunications
- Motor Controllers
- Piezo Ceramic Linear Motors