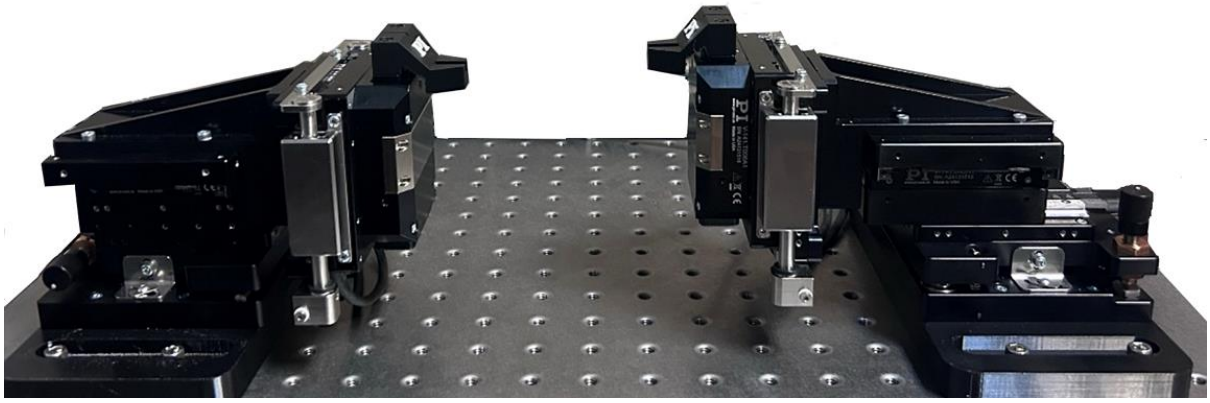
F-141 Compact 2 … 6 DOF Fast Photonics Alignment System

Cost-Optimized Multi-Axis System with Fast Alignment Algorithms—Ideal for PIC Test & Assembly



F-141, dual-sided 4+2 axis system for array alignment shown.

- 4 and 6 axis configurations ideal for array alignment. 2 and 3 axis configurations also available
- Compact integrated photonics scan & alignment system for high dynamics and duty cycle
- Optimized moving platform provides convenient mounting with minimal lever arm for direct optical probe
- Embedded PI proprietary alignment algorithms provide industry-leading alignment speed – up to 100X faster
- Advanced EtherCAT® control system with computationally optimized master processor providing rapid signal analysis for onboard machine learning
- 40mm XYZ travel range, 12° Theta-Y rotation range
- Optional motorized Theta-X/Z rotation, ±4° travel, 0.02µrad MicroStep Resolution

Fast and high-precision motion for high-throughput alignment and scanning

The F-141 is a cost-optimized multi-axis precision alignment system designed for fast and accurate scanning, alignment and nanopositioning tasks. It consists of three V-141 three-phase motor-driven, crossed roller bearing stages stacked in a XY+Z arrangement with a custom voice-coil motor-driven, flexure-based rotary stage mounted to the front of the counterbalanced Z stage. The 6-DOF version features an integrated stepper motor driven module for Theta X and Theta Z. Other configurations are available for applications with different optical axis orientations.

The combination of ultra-precision crossed roller bearings and flexures plus compact size offers high performance motion with excellent stiffness and positioning stability. The compact geometry minimizes angular errors for highly repeatable positioning at the probe tip. Direct drive motors and optical encoders enable this system to perform fast scanning motion for alignment over short and long travel ranges.

High-performance controller with integrated scan and alignment routines

The system is controlled by an advanced multi-axis ACS EtherCAT® control system with a computationally optimized master processor providing rapid signal analysis for onboard machine learning. Sophisticated scan and alignment routines are embedded in the controller, offering improved performance and simple integration compared to software-based alignment algorithms running on the host computer.

PI proprietary alignment algorithms provide unparalleled performance with the shortest first-light detection and signal optimization times in the industry. The system can manage all tasks in the field of photonics array and fiber optics alignment including simultaneous alignment in several degrees of freedom. The use of ultra-low noise electronics, PWM amplifiers, and onboard integrated analog inputs for the high-bandwidth optical power meter enable repeatable and stable optical signal coupling in a variety of environments.

Application fields

Alignment of PICs, optical components; automatic photonic wafer tests, assembling technology in silicon photonics

Specifications

Motion and Positioning	V-141.040A1	Unit	Tolerance
Active axes	*X, Y, Z, Θx Θy Θz*		
Travel range in X, Y, Z	*40*	*mm*	*Max.*
X, Y, Z Flatness	*1.5*	*µm*	*Max.*
X, Y, Z Straightness	*2.5*	*µm*	*Max.*
X, Y, Z Accuracy, calibrated (1)	*±2*	*µm*	*Max.*
X, Y, Z Bi-directional Repeatability	*±0.06*	*µm*	*Max.*
X, Y, Z Minimum incremental motion(2)	*30*	*nm*	*Max.*
X, Y, Z Speed	*1100*	*mm/s*	*Max*
X, Y, Z Acceleration	*20*	*m/s²*	*Max*
X, Y, Z Sensor Type	*Optical linear encoder*		
X, Y, Z Guide Type	*Precision crossed roller bearing*		
X, Y, Z Drive Type	*Brushless linear motor*		
Travel range in Theta (Θy)	*12*	*°*	*Max.*
Θy Accuracy, calibrated (1)	*±20*	*µrad*	*Max.*
Θy Bi-directional repeatability	*±2*	*µrad*	*Max.*
Θy Minimum incremental motion(2)	*1*	*µrad*	*Typ.*
Θy Speed	*20*	*°/s*	*Typ*
Θy Acceleration	*1000*	*°/s²*	*Typ*
Θy Sensor Type	*Optical linear encoder*		
Θy Guide Type	*Rotary flexure*		
Θy Drive Type	*Voice coil motor*		
6-DOF Variant, Optional Theta-X (Θx), Theta-Z (Θz)	*Stepper Motor Driven*		
Travel range in Theta-X (Θx), Theta-Z (Θz)	*±4*	*°*	*Max.*
Resolution	*0.02 (x2046 microstep resolution)*	*µrad*	*Max.*
Drive Type	*Stepper motor*		
Alignment performance			
Scanning time of spiraled area scan of 500 µm(3)	*<3*	*s*	
Scanning time of spiraled area scan of 100 µm(3)	*<0.3*	*s*	
Scanning time of spiraled area scan of 10 µm(3)	*<0.2*	*s*	
Signal optimization with gradient search, randomized with ±5µm (repeatability <0.01 dB)(4)	*<0.3*	*s*	

(1) Calibrated accuracy can only be obtained with controller-based error compensation. The stage must be ordered with a controller from PI to reach these values. Accuracy values assume short-term duration and do not consider the long-term effects of thermal drift on the stage.

(2) Minimum incremental performance is directly related to system stability (jitter) performance. This performance is dependent on the servo drive used. Performance may be improved by using ServoBoost+ on an ACS SPiiPlus controller.

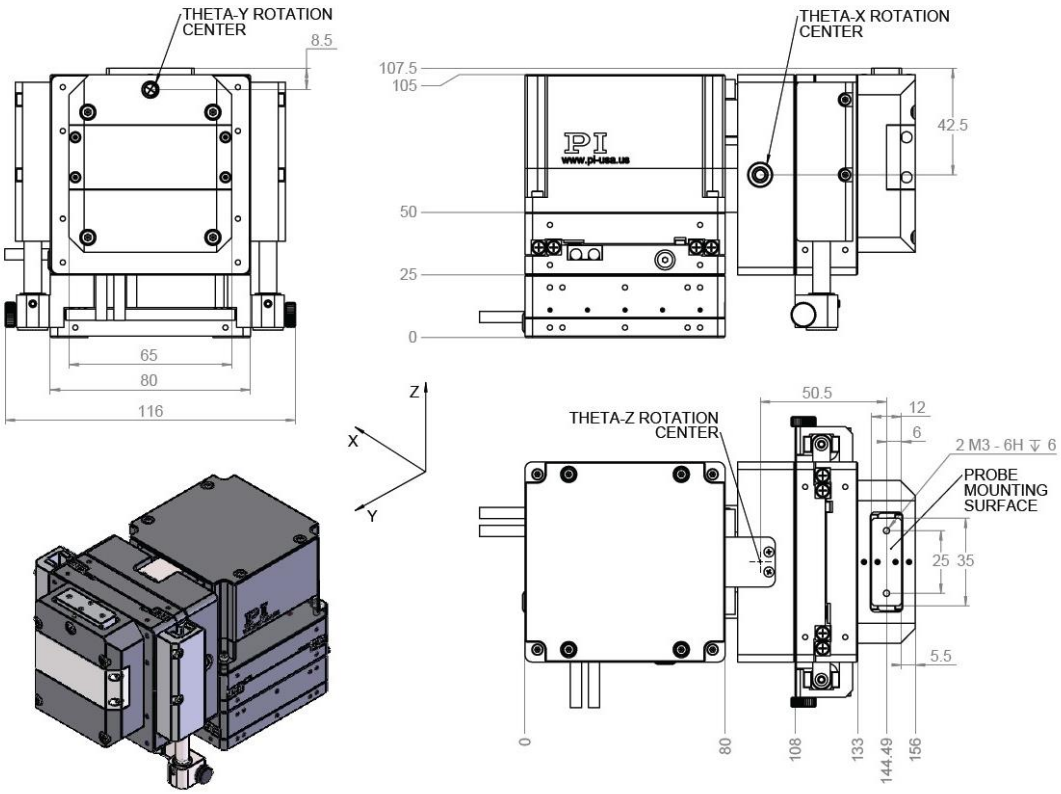
(3) Typical time span for scanning the entire area and moving to the highest intensity

(4) Reaching the global maximum after first light has been found

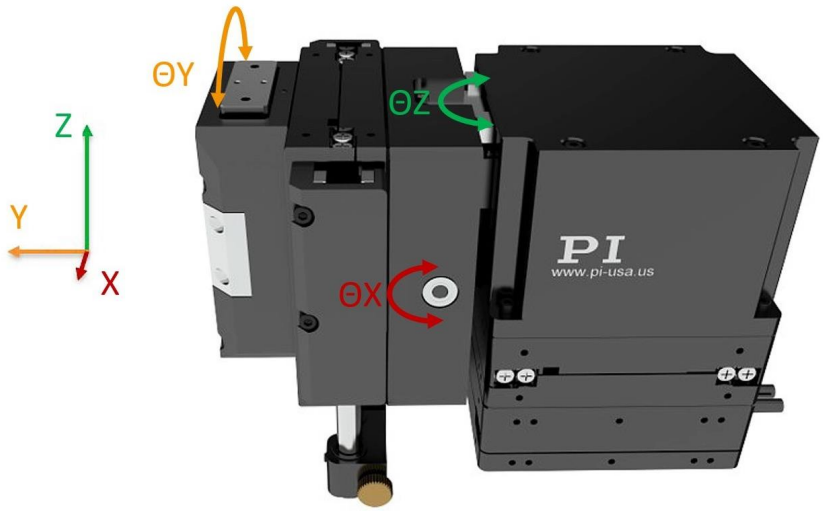
Ask about customized versions

7-Aug-2024

Drawings / Images

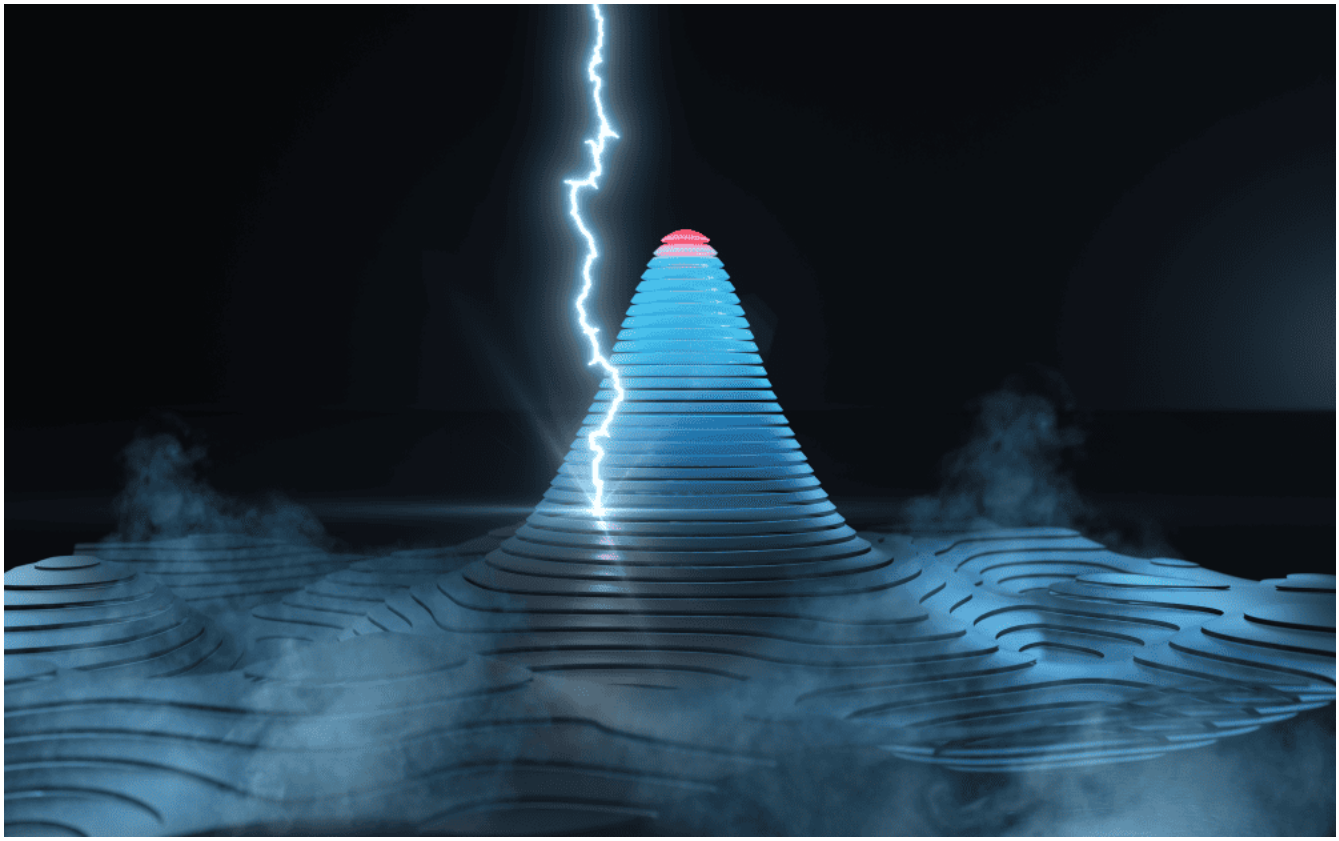


F-141, 6-axis variant, dimensions



F-141, 6-axis variant, rotary axes

ACS-based motion and alignment controller with embedded, industry-leading scan and alignment routines



The groundbreaking PILightning algorithm is embedded in the F-141 alignment system controller. PILightning solves the first light capture problem and reduces time to first light by one or more orders of magnitude, compared to legacy algorithms.