

M-840

HexaLight™ 6-Axis-Parallel Kinematics Microrobot

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M-840 HexaLight™ 6-axis micropositioning system

- Six Degrees of Freedom
- Rapid Response
- No Moving Cables for Improved Reliability and Precision
- 10 kg Load Capacity
- Repeatability to $\pm 2 \mu\text{m}$
- Actuator Resolution to $0.016 \mu\text{m}$
- Significantly Smaller and Stiffer than Serial-Kinematics Systems, Better Dynamics
- Vacuum-Compatible Versions
- Virtualized Pivot Point
- Sophisticated Controller Using Vector Algorithms
- 20,000 h MTBF

The M-840, M-824 and M-850 (see. p. 7-20 ff.) Hexapod systems are the results of PI's many years of experience with high-resolution parallel kinematics (PKM).

The M-840 is the ideal micro-positioning system for all com-

plex positioning tasks which depend upon high speed and accuracy in six independent axes. In addition to positioning all axes, it allows the user to define the center of rotation (pivot point) anywhere inside or outside the system envelope by one simple software command.

Two models are available: The M-840.5PD featuring higher speed and direct-drive actuators, and the M-840.5DG with a gear ratio that makes it self-locking.

Hexapod Working Principle and Advantages

The M-840 HexaLight™ is driven by six high-resolution actuators (for the M-840.5DG, $0.016 \mu\text{m}$ resolution) all connected

directly to the same moving platform. The principle is similar to that seen in flight simulators, but considerably more precise. In place of the hydraulic actuators used there, the M-840 uses highly accurate micrometer screws and servomotors.

Laser metrology techniques and finite element method (FEM) simulations were used to design and optimize the system.

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, friction and the inertia of moving cables all accumulate to limit accuracy and repeatability—problems which do not affect parallel kinematic systems like the Hexapod. Furthermore, the pivot point is freely definable, independent of the positions of the linear axes.

Faster Positioning in All Six Axes

In comparison with the M-850 Hexapod (p. 7-20) the M-840 is designed for higher speeds and lighter loads. Loads of up to 10 kg can be positioned at up to 50 mm/s and 600 mrad/s with micron accuracy.

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

Ordering Information

M-840.5PD
Hexapod 6-Axis Parallel Kinematics Microrobot with Controller, Direct Drive

M-840.5DG
Hexapod 6-Axis Parallel Kinematics Microrobot with Controller, Gearhead Drive

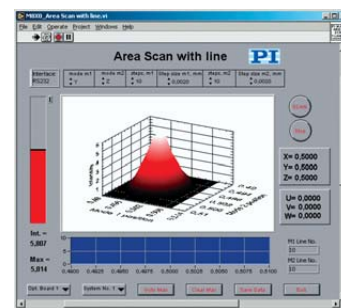
Optional Photometer

F-206.00U
Photometer Card (Visible Range)

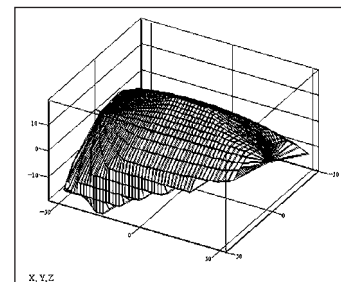
F-206.iRU
Photometer Card (IR Range)

F-361.10
NIST Traceable Optical Power Meter, 1000 to 1600 nm

Ask about custom designs!



HexControl™ software showing scan of a fiber optics component.



x, y, z

The X, Y, Z working space of the M-840 with $\theta_x = \theta_y = \theta_z = 5^\circ$.

Open Architecture

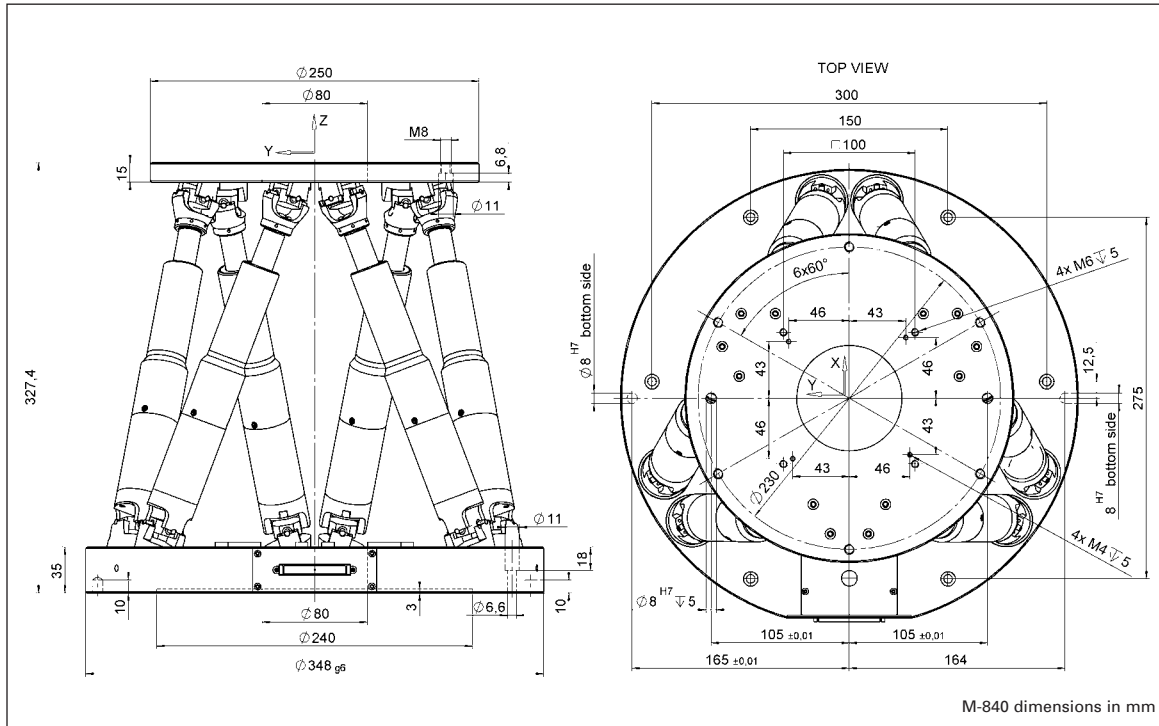
Control of the M-840 is facilitated by the controller's open interface architecture, which provides a variety of high-level commands and includes a macro language for programming and storing command sequences.

Automatic Optics Alignment

With the internal or external photometer option and the integrated scanning routines, just a few commands are needed to perform an automated alignment of optical components. For more information on photometers / optical power

meters, see the F-206.IRU and F-206.00U, p. 8-12 and the F-361, p. 8-14.

A smaller, even-more-precise hexapod, specially developed for alignment of collimators, fiber bundles and I/O chips, is available as the F-206 (see p. 7-18 and p. 8-8).



Technical Data

| Models | M-840.5PD | M-840.5DG | Units |
|--|-----------|-----------|--------|
| * Travel range X, Y | ±50 | ±50 | mm |
| * Travel range Z | ±25 | ±25 | mm |
| * Travel range θ_x, θ_y | ±15 | ±15 | ° |
| * Travel range θ_z | ±30 | ±30 | ° |
| Actuator stroke | ±25 | ±25 | mm |
| Actuator design resolution | 0.5 | 0.016 | µm |
| ** Minimum incremental motion, X, Y | 3 | 1 | µm |
| ** Minimum incremental motion, Z | 1 | 0.5 | µm |
| ** Minimum incremental motion $\theta_x, \theta_y, \theta_z$ | 5 | 5 | µrad |
| Repeatability X, Y | ±2 | ±2 | µm |
| Repeatability Z | ±1 | ±1 | µm |
| Repeatability $\theta_x, \theta_y, \theta_z$ | ±20 | ±20 | µrad |
| Typical Speed X, Y, Z | 30 | 2 | mm/s |
| Max. Speed X, Y, Z | 50 | 2.5 | mm/s |
| Typical Speed $\theta_x, \theta_y, \theta_z$ | 300 | 20 | mrad/s |
| Max. Speed $\theta_x, \theta_y, \theta_z$ | 600 | 30 | mrad/s |
| Load capacity (mounted vertically) | 10 | 10*** | kg |
| Weight | 12 | 12 | kg |

* The maximum travel ranges in the different coordinate directions (X, Y, Z, $\theta_x, \theta_y, \theta_z$) 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

*** self-locking

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Index