

# Optics & Photonics Applications

MPS Microsystems

2019

## **INTRODUCTION TO MPS MICROSYSTEMS**

MPS Microsystems develops and manufactures high precision, high-performance and very low-friction electro-mechanical microsystems. Managing the miniaturisation and integration of functions in small spaces, MPS Microsystems provides solutions that meet specific customer requirements. MPS Microsystems also offers a standard range of products, such as linear bearings and ball screws under the "microlinea" trademark.

MPS belongs to the Faulhaber Group, the German manufacturer of micromotors ([www.faulhaber.com](http://www.faulhaber.com)).

## **APPLICATIONS FOR THE OPTIC INDUSTRY (selection)**

### **Laser machining**

The requirements in laser engraving and laser cutting machines in terms of speed, and reliability are getting more and more challenging: the accuracy of lens positioning with frequencies of 50-200 Hz must be well below 10 µm.

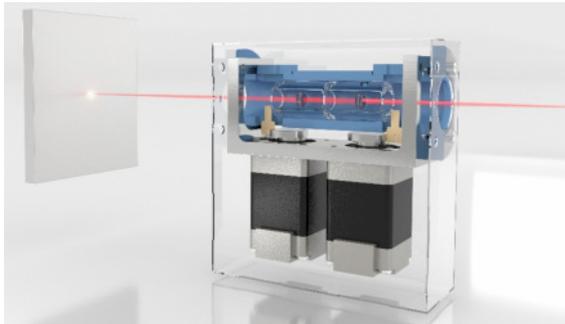


Located in Bienne, Switzerland, in a modern and well-equipped facility MPS Microsystems offers its 220 employees an exceptional working environment and provides customers with unique capabilities that are perfectly suited to the requirements of the optics&photonics and high-tech sectors.

Furthermore, the environment, where the engraving/cutting process takes place, must be free of particles. One of the main factor limiting the power of a laser cutting equipment today is the generation of particles by the system driving the lenses.

### **Highly Dynamic Laser Focusing Mechanism**

This technology platform is meant for optical applications needing high acceleration, high resolution, high frequencies and very long lifetime. The precise relative positioning between two mobile lens groups moving on the same axis and the perpendicularity of a few tenth of a degree with the machine interfaces is achieved with shortest stack-up and MPS specific assembly skills. In the proposed solution, the precision needed in term of concentricity and perpendicularity is performed in only one component, which geometries are machined during the same manufacturing process.



This technology can be easily customized to very different sizes and specifications. The geometry tested so far is reaching the following specifications (per lens):

- Stroke  $\pm 1.5\text{mm}$ ;
- Resolution:  $1\ \mu\text{m}$ ;
- Frequency : up to 50Hz;
- Acceleration: up to 15g;

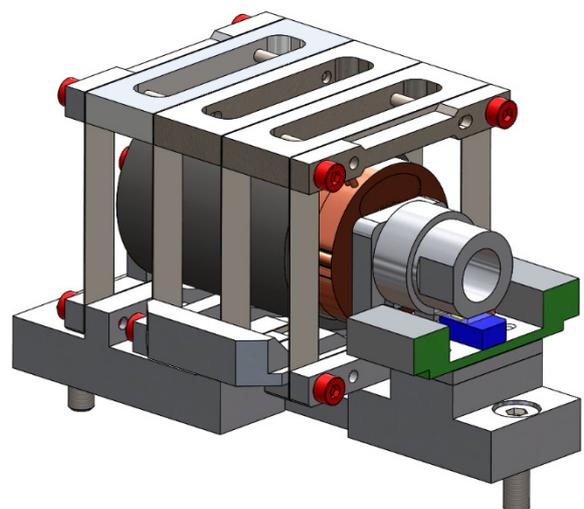
Possible technology customization:

- Motor selection related to frequency, speed and acceleration requirements
- Cam and linear ball bearing type regarding the needed stroke

- Cost vs resolution, proposing the system in open loop with a homing sensor
- Dimensions regarding the optical system, size and number of mobile lenses
- Flanges, to integrate fixed lenses
- Bellows, if a clean lens chamber is needed
- Overall size. Our product range of linear ball bearings covers from ID 1.5mm to 6mm for the L steel version, and up to 25mm with the cost effective DBL version.

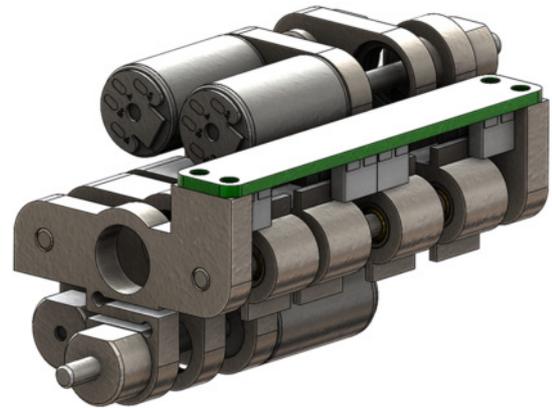
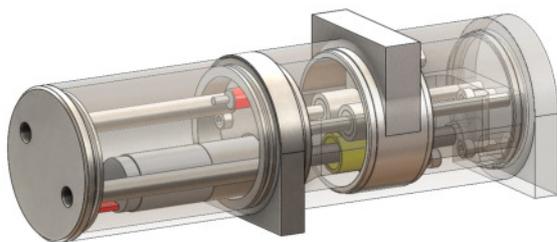
### **Short stroke, high frequency active optics based on flexure elements**

MPS has developed a friction free actuator technology based on flexure elements and voice coil drive. Driven in closed loop, this very dynamic technology (up to 200Hz) reaches positioning accuracy in the 1-5 micron range. This technology is very appropriate for strokes between 0.1 to 3mm. Above this limit, the system starts to get very bulky and solutions with micro-motors are more suitable.



**Particle free laser focus mechanisms**

For laser machining applications requiring longer strokes, for which the flexure elements are not appropriate, MPS has developed a hermetically sealed focus mechanism. Here the drive system is based on an 8mm gear motor coupled to a Ø4mm ball screw. MPS L-306 linear bearings insure smooth and play free movement of the lenses. In order to protect the optics from smallest particulates generated by the tiny wear of the system, the portion of the actuator inside the optical chamber is completely sealed.

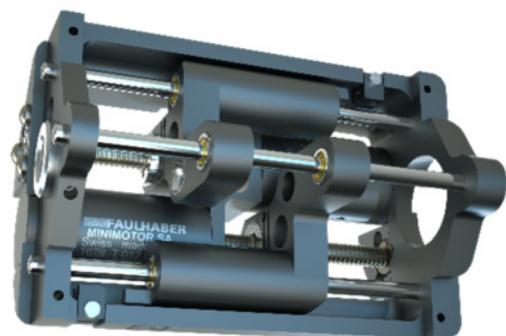


The system is driven by standard stepper or BLDC micromotors coupled with either ground lead screw or high precision MPS ball screws. MPS is using its own miniature L-Type linear ball bearing for smooth and play free guiding. High precision requirements are put on the frame, which has to ensure perfect perpendicularity between lense and z-axis axis during any movement. The linear positioning precision is 1 µm over the full stroke.

**Configurable multi-purpose zoom mechanism**

Focussing a laser over a distance of several kilometres or moving lenses very accurately in imaging based stereoscopic surgical glasses require the lenses to remain coaxial with no tilting over long strokes of 50mm or more.

MPS has developed a configurable zoom platform that can accommodate 1-3 movable groups of lenses depending on customer requirements. The stroke as well as the size of the lenses can be adjusted and though the size of the system optimised.



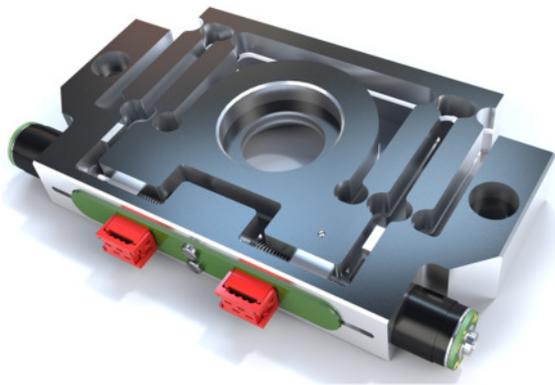
**Ophthalmology**

Eye tomography as well as cataract and refractive surgery require the focus of the laser beam to be very precise. MPS has developed high-precision miniature lens actuators for manufacturers of ophthalmic devices.

These actuators consist of a 6 mm micro motor, a pre-loaded screw-nut system and a linear guideway. The system is designed in such a way that it is able to compensate for the imperfection of axes alignment. The most stringent requirement is to find the 0 position with a precision of 1  $\mu\text{m}$  between each measurement.

### **Microscopy**

Microscopic observation of three-dimensional samples can be a challenge when moving the objective in the z-axis close to the sample: the risk of touching and destroying it is significant. MPS has developed a backlash-free, flexure elements based system, which moves 2 lenses laterally in order to make the fine focus and though eliminate the risk of contact with the sample.



The system with a full stroke of 2.5mm is driven in open loop by 2 stepper motors attached to a miniature lead screw. Light barriers set the home position at the beginning of each operation. The position repeatability is below 2 micron. The simplicity of the systems makes it very reliable, easy to connect and affordable.

### **Optical fibre positioner for Astronomical Observation**

Research in the field of dark matter is leading to the development of new equipment that enable the collection and analysis of light emitted by distant galaxies. In partnership with a research group, MPS has developed and is manufacturing a number of high precision, reliable systems for positioning optical fibre directed towards these galaxies. Thousands of these positioners are installed in the focal plate of telescopes. With a diameter of less than 10mm, the positioner must be able to accommodate two parallel axes that rotate independently, the optical fibre and two 4mm Faulhaber gearmotors.



MPS has already realised three projects, for which positioners are installed or will soon be installed on three telescopes around the world. An easily customizable positioner platform is available at MPS for any organisation needing such systems.

## MPS COMPETENCES

### Research & Development

The high level of training and experience of its **micro-mechanics engineers** allows MPS to quickly develop innovative solutions that meet the needs of its customers. Our developments and documentation meet the international standards of the medical market.

Fully equipped, the **prototyping workshop** guarantees the production and modification of rapid prototypes, free from the logistical constraints of mass production. The equipment includes lathes, milling machines, wire erosion machines and grinding machines.

The **test laboratory** equipment is used to carry out service life tests for systems developed by MPS, noise measurements, traction tests, torque measurements and simple measurement systems.

### Manufacturing (precision as a key value of MPS)

The **turning & milling** workshop has a series of CNC and EDM machines. Each work bench is equipped with measuring instruments for controlling, at any time, the quality of the products manufactured.

Acquired over many decades, MPS's **heat treatment** knowledge is essential to achieve the material properties needed for the performance of the systems manufactured. MPS also has expertise in deburring and washing components.

MPS sets itself apart thanks to its **grinding and polishing** expertise. In these workshops, components achieve dimensional precision of less than one micron, through centerless grinding, external / internal diameter grinding, and mirror surface finishes ( $Ra < 0.1 \mu m$ ). All MPS ball screws have threads that are grinded on latest-generation equipment.

MPS manufactures high quality (ISO grade 3) miniature stainless steel and ceramic (zirconium oxide) **balls** with diameters between 0.130 mm and 1.588 mm.



### Micro Assembly

MPS specialises in the micro-assembly of complex systems which require specialist knowledge and specific expertise.



The size of parts and the required precision necessitate a controlled atmosphere in the entire assembly workshop, with continual air change and filtration. A clean room ISO 7 is available for implantable medical applications.

Our main skills include the assembly of micro-components, laser welding, laser marking, gluing, precision lubrication, washing and pairing, enabling adjustments of less than 0.2 µm.

The workshop is organised according to "lean manufacturing" principles. Dedicated cells are set up when necessary.

### **Quality**

The MPS Quality department ensures the continuation of certification: ISO 9001 - ISO 1348 - ISO 14001

In order to guarantee the delivery of products that observe legal requirements, MPS prepares the files that are essential for certifications (European Directives 93/42/EC, 90/385/EEC, 21CFRpart820, etc.) and for medical devices to be placed on the market.

### **Project management**

In our project development process, customers are in close contact with a dedicated project manager who ensures close communication and coordination with the internal project team and external partners. The MPS management system integrates the project management process.

### **WHERE TO FIND US**

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