

Laser Beam Stabilization

Compact

The company

MRC Systems celebrates its 30th anniversary in 2025. The company is based in the very inspiring area of Heidelberg/Germany with well-known universities and leading industry. Here we develop and produce innovative products for various fields in laser and medical technology.

With our innovative strength, precision and reliability we became a leading innovator in various segments. We always focus on the ideal solution for the end user.

Our beam stabilization systems are on the market since 20 years now. Starting from initial uses with selected research lasers they have become a quasi standard in many industrial and research applications.

We established long-term cooperations with many companies, universities, research institutes and manufacturing partners. Our products are designed for international markets and are in use all over the world, often in 24/7 operation.

We guarantee our customers highest quality and offer our service along the complete product life cycle. We introduced a total quality management system in 1998 and continuously refine it. All our processes are in accordance with ISO 13485.

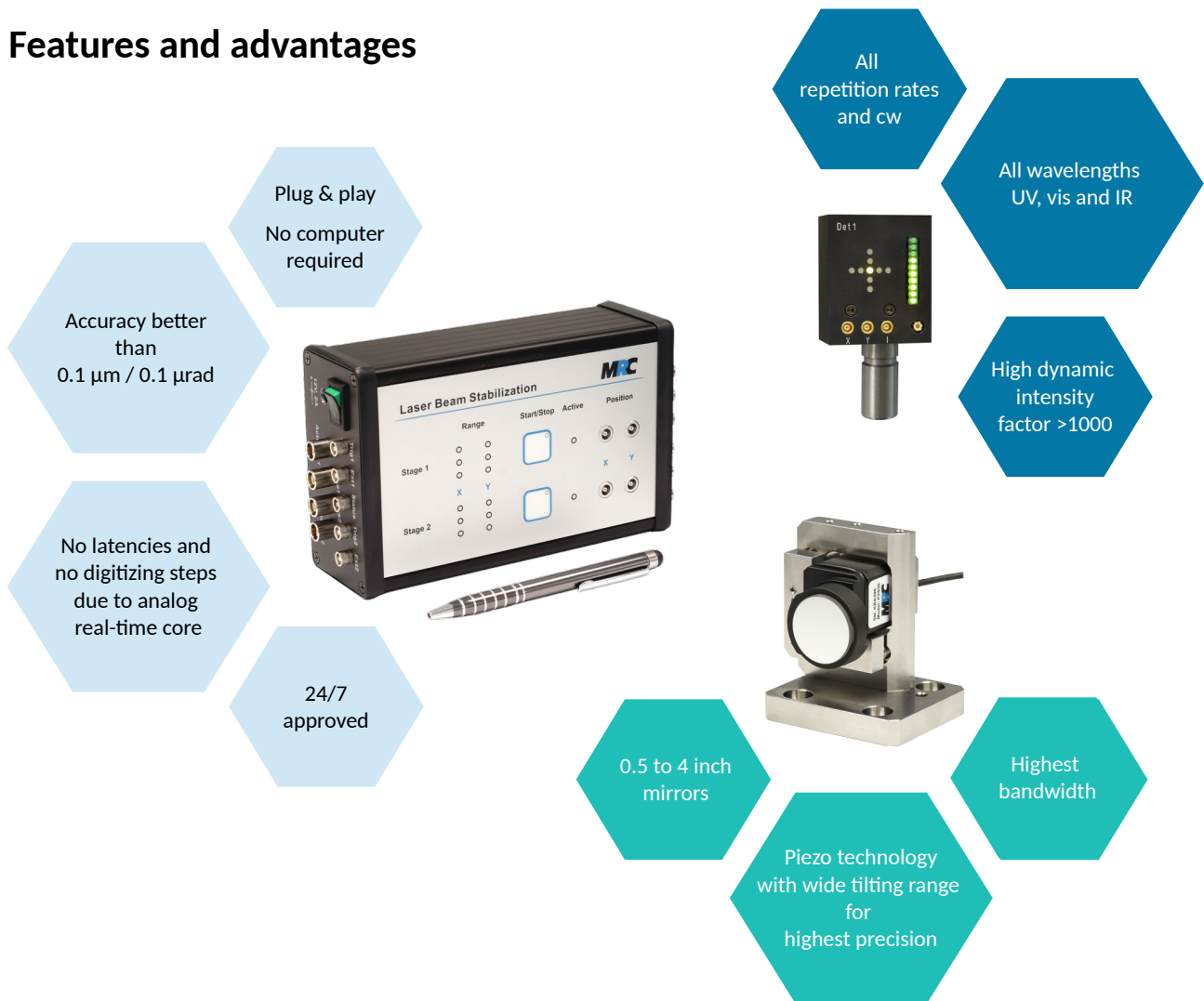
We are looking forward to hearing from you and your specific task and would be pleased to support you in your projects.

Our customers across the world



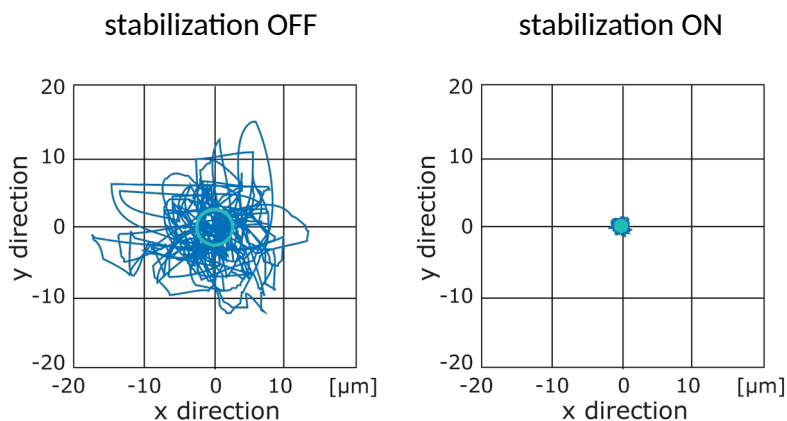
The Compact system

Features and advantages

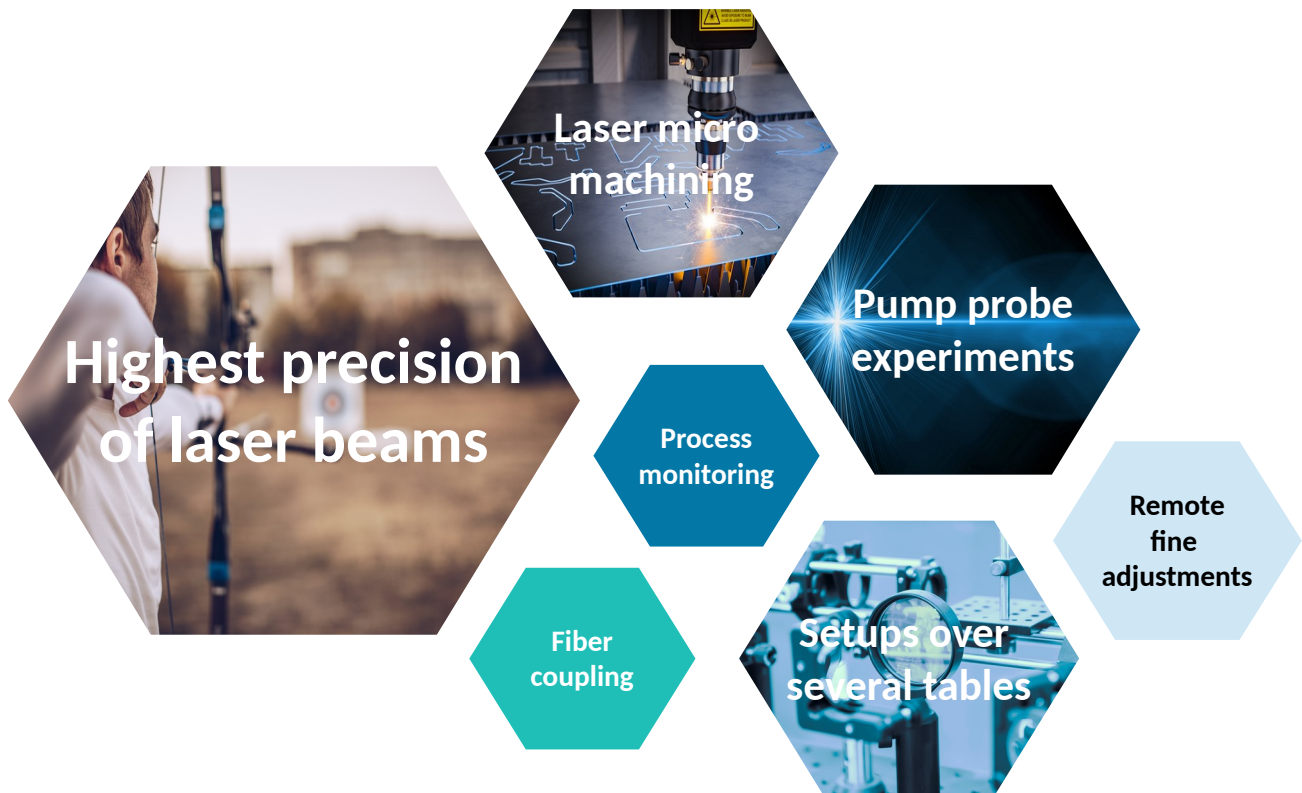


The *Compact* laser beam stabilization system is used in all applications which require a precise and reliable beam pointing. It ensures very stable beam positions and angles.

The real-time closed-loop control eliminates all kinds of deviations caused by thermal drifts, vibrations or other mechanical impacts. It can even compensate for effects with high frequencies like air fluctuations, shocks or moving optics.



Application examples



Principle of laser beam stabilization

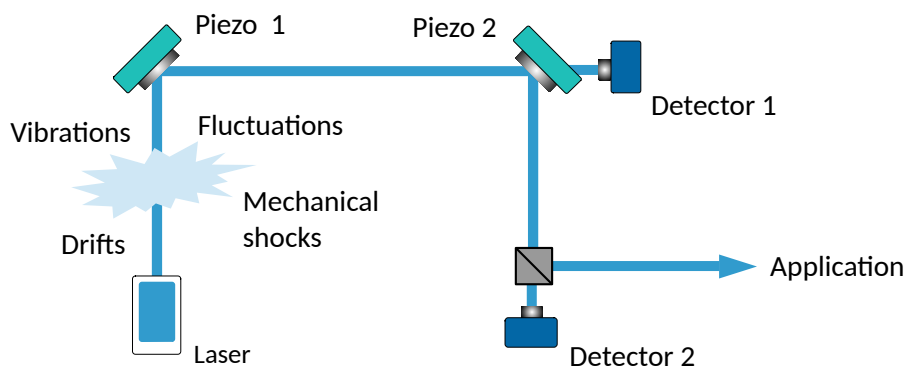
Optimized fast piezo-actuated mirror mounts are used to control the laser beam. The desired position and angle of the beam are defined by one or two detectors (4-quadrant diodes or PSDs). For the detection, a small portion of the laser power is sufficient. You can e.g. use the leakage through a high-reflective deflection mirror.

The closed-loop controller continuously determines the deviation of the laser beam from the target position.

A typical setup is shown in the figure below, where two piezo mirror mounts and two detectors are used to stabilize the beam in four dimensions (4D).

In this setup, the first stage of piezo 1 - detector 1 maintains a stable position on piezo 2. Then the second stage of piezo 2 - detector 2 guarantees the correct beam angle for the application.

Many more setups are possible. Feel free to ask us how to integrate the system into your setup.



System components and options

The standard version of the beam stabilization system includes the compact controller, two Si-4-quadrant detectors and two piezo-actuated mirror mounts (model P2S30).

With this configuration you can stabilize a laser in its position and angle against fast disturbances and slow drifts.

The following diagram and table illustrate the standard system as well as a selection of optional functions and components.

Most of our customers choose the 4-quadrant detectors, our high-end piezo-actuated mirror mounts P4S30 and a controller with USB interface.

Standard system



Options

- ◆ **WID** - wide intensity
dynamic power factor >1000
- ◆ **PSD**
free positioning of target
- ◆ **UV**
190 nm - 1000 nm
- ◆ **IR**
800 nm - 3000 μ m
- ◆ **Software interface**
USB/RS232/Ethernet
- ◆ **Sample&Hold**
bridge laser off times
- ◆ **Adjust-In**
move your target
- ◆ **Set&Hold**
hold the current position
- ◆ **P4S30**
"gold standard"
- ◆ **Different mirrors**
0.5 - 4 inch
- ◆ **Clean room**
avoid contamination
- ◆ **Vacuum models**
down to 10^{-11} mbar

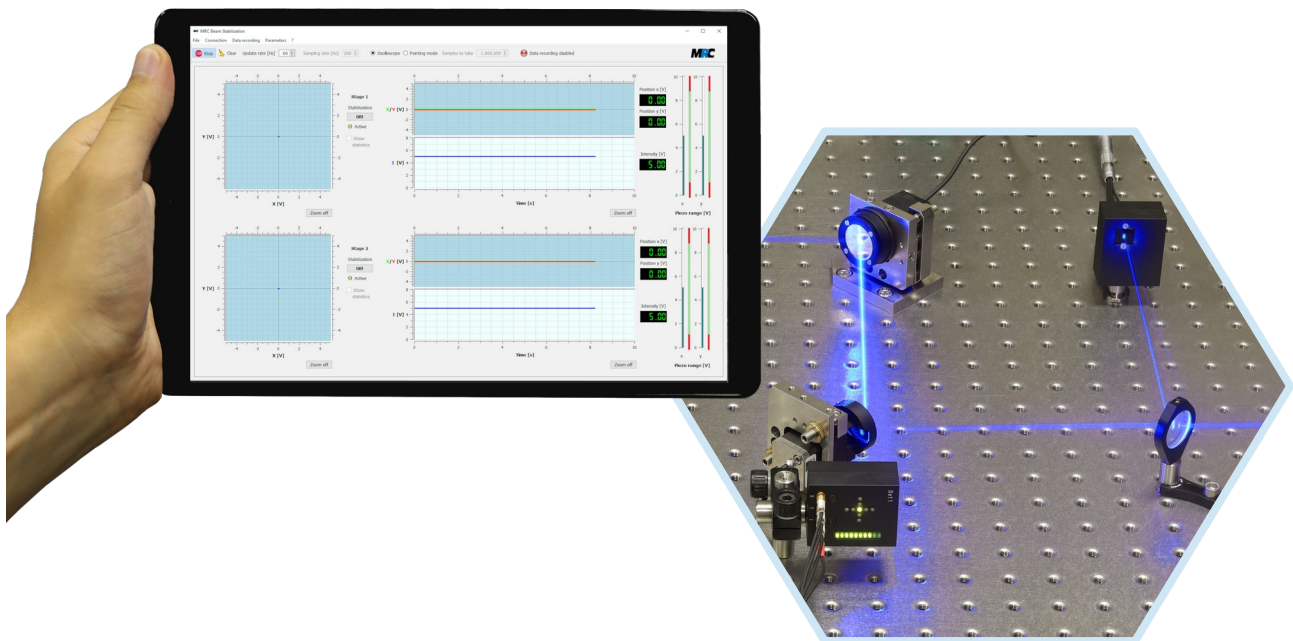
You can find more options and details in the system description area on our website.

Controller options

Serial interface with software

The *Compact* laser beam stabilization system can be equipped with a serial interface. It allows the setting of parameters, the read-out of values, and data logging. The communication runs via USB. Ethernet and RS-232 are also available.

The associated software makes use of this interface and communicates with the stabilization system. It offers real-time displays of the positions, intensities, and piezo voltages and includes functions to control the stabilization system.



Sample&Hold function (ADDA)

With the Sample&Hold function, which can be integrated into the controller, the piezo tilting mirrors remain in their last stabilized position during periods without laser power.

This ensures beam stability even for lasers with low repetition rates or lasers with on-off times.

The function is recommended for:

- Lasers with low repetition rates
- Lasers with on and off times
- Setups with long distances
- Processes in laser machines

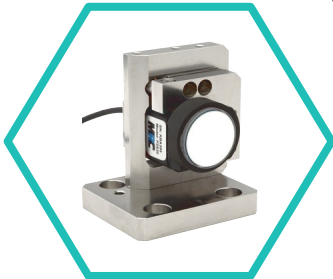
Adjust-In / Set&Hold - Move and apply the target position on PSD

With PSDs instead of 4-quadrant diodes, the target position on the detectors can be shifted electronically. By adding an offset voltage to the signals of the PSDs the target position where the laser beam shall hit the PSDs can be moved. Still, the beam stabilization will provide full stabilization

of the beam position, but the position itself can be manipulated. The external signal can be applied to the system via the Adjust-in functionality. You can also use the Set&Hold function of the software, which allows to apply the currently detected position signals for the stabilization.

Mirror mounts & detectors

Fast steering mirror mounts



	P2S30	P4S30
mechanical tilt	2 mrad (\pm 1 mrad)	4 mrad (\pm 2 mrad)
optical tilt	4 mrad (\pm 2 mrad)	8 mrad (\pm 4 mrad)
features	high bandwidth transmission detectable	highest performance best for large mirrors

Our previous steering mirror mounts PKS and PSH are available on request.

Broadband detectors



	4QD	PSD	4QD-WID
wavelength	320 – 1100 nm	320 – 1100 nm	320 – 1100 nm
detection area	10 x 10 mm ²	9 x 9 mm ²	10 x 10 mm ²
features	highest lateral resolution	adjustable target position	high dynamic intensity factor > 1000

UV 4QD	UV 4QD-WID	UV PSD 4x4 or 10x10	IR 4QD InGaAs	IR 4QD Germanium
190 – 1000 nm	190 – 1000 nm	200 – 1000 nm	900 – 1700 nm	800 – 2000 nm
3 x 3 mm ²	3 x 3 mm ²	4 x 4 or 10 x 10 mm ²	Ø = 3 mm	Ø = 5 mm
sensor for UV lasers	sensor for UV lasers, high dynamic intensity factor	sensors for UV lasers, adjustable target position	sensor for NIR lasers	sensor for NIR lasers

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**We are looking forward
to hearing from you!**



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