

This guide can assist you in setting up the beam stabilisation for the first time. It shows all main steps. For a more comprehensive description we refer to the user manual which you can find on the enclosed memory stick or download from our website www.mrc-systems.de/en.

1. Standard scope of delivery

The following table shows the standard scope of delivery of a 4-axis beam stabilisation. There are many optional functions and components for the system so that your individual scope of delivery might differ. You can find it on the packing list which you received with the system.

Component	Qty.	Component	Qty.
Compact controller	1	Quick installation guide	1
Piezo-driven steering mirror mount with attached cable	2	Extension cable for actuator, length: 10m	1
Position detector with embedded optical filters	2 2x2	Extension cable for detector, length: 4m	2
Detector adapter cable	2	Pin for push buttons, screwdriver	1 1
Measurement cable, length: 2m	2	USB memory stick with user manuals and software	1

Many customers order the optional computer interface and can connect a PC. These customers can use the communication and visualization software on the memory stick. To install the software you can follow the instructions in the software manual which is also on the memory stick.

2. Before the first operation

Please store the components for at least 24 hours in a dry environment before the first operation.

3. Introduction

A 4-axis beam stabilisation comprises two independent control stages each with a Piezo-driven actuator and a position detector. With these components you can either stabilize two positions along the beam path or one position and the angle.

4. Start of operation

You can follow the steps in the following sections to put the beam stabilisation into operation.

4.1. Stable setup of optical components

Our modular system allows various configurations of the optical components in the beam path. You can find detailed information and examples in the user manual.



Take care for stable posts, especially if you have large beam heights. This is important for the detectors in order to guarantee their high accuracy as well as for the steering mirror mounts in order to avoid oscillations.

Place the two pairs of steering mirrors and position detectors at suitable positions in your setup. Take care for sufficient distances between each mirror and the corresponding detector. We recommend distances of 0.5 m or more.

The detectors define the beam position. They need only low power and can (but don't have to) be placed behind mirrors.

The first detector should be placed close to the second steering mirror. In that way it can fix the beam position on this mirror. If you have only little space you can add a lens and image the mirror's surface onto the detector. You can find further examples in the user manual.

4.2. Connection of cables

Figures 1 and 2 show the side panels of the controller with the connections for the Piezo actuators, the power supply and the detectors.



Figure 1: On/off-switch, power plug, and output connections on the left side



Figure 2: Input connections, P factor adjustment and switches on the right side

Connect the first mirror actuator to *Actuator 1* and the second mirror actuator to *Actuator 2*. Similarly, connect the first detector to *Det1* and the second detector to *Det2*.



If you use a detector in the lying / horizontal orientation, connect its x line to the y input and its y line to the x input.

Note: Some options can lead to a changed layout of the side panels and require additional cable connections.

4.3. Power connection

Connect the power supply to the 12V input at the controller. Switch on the controller by toggling the on/off-switch on the left side. After that the four green *Range* LEDs on the top of the controller should shine.

4.4. Adjustment of intensity on detectors

The detectors have LED indicators for the beam position and the intensity level on the back. You can adjust the intensity level by means of a digital potentiometer with two push-buttons at the detectors' housings. A pin for pushing the buttons is included in the delivery. Pushing the upper button increases the gain. For some detectors, staying on a button for a longer time changes the gain continuously. (Some detectors have a rotary potentiometer. In this case, turning the potentiometer counter-clockwise increases the gain.)

In the optimal case you get 9 LEDs shining. If this is not possible, you can exchange the optical filters which are placed in front of the sensors or remove one of the two filters. However, it's also possible to achieve a good stabilisation with less intensity.

4.5. Pre-adjustment of laser beam

Don't activate the control stages (Active LEDs off), but adjust the laser beam onto the two detectors until you only see the central green LEDs of the position indicators. If you use the software you can also observe the positions in the displays there.



The controller must be powered in this step in order to bring the Piezos into the zero position.

4.6. Direction coding

Now activate the first control stage by pushing the *Start/Stop* button on the keyboard of the controller (see figure 3) or in the software (see figure 4). The *Active* LED should shine now.

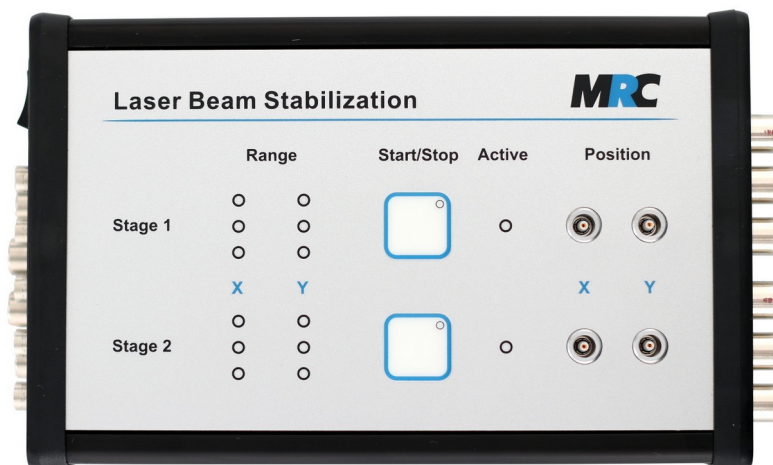


Figure 3: *Start/Stop* button, *Active* / *Range* indicators and position outputs on the controller's keyboard

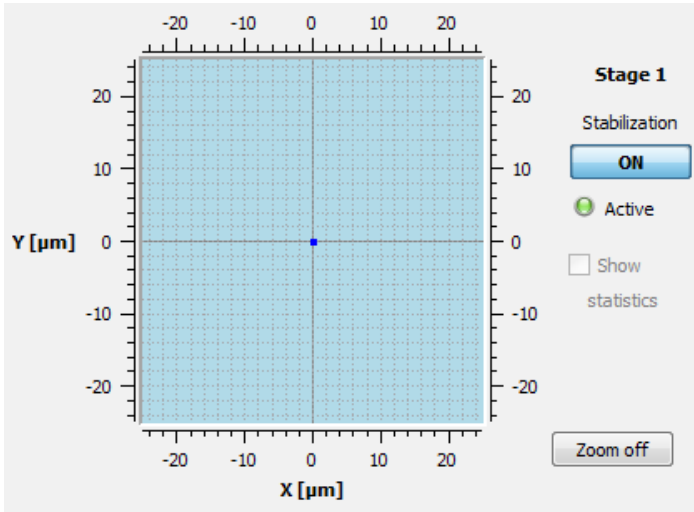


Figure 4: Section of the software with on/off switch

If red *Range* LEDs on the controller light up when you activate the stage (or the *Range* indicators in the software go to an extreme position), it is very likely that you have an incorrect direction coding. In this case toggle the corresponding *Directions* switch x or y at the controller (see figure 2). The *Range* indicators tell you which directions are affected.

Once you have stage 1 running, apply the same steps for the second stage.

4.7. Fine-adjustment of stage 1

For the fine-adjustment inactivate both control stages once again by pressing the *Start/Stop* button (*Active* LEDs off). Manually adjust the laser beam by means of the adjustment screws of the steering mirrors or any other mirrors in your setup until it precisely hits the centers of the

detectors. You can observe the LED crosses at the housings or the read-out of the x / y position outputs on the keyboard with an oscilloscope. If your system is equipped with the communication interface, you can also read out the positions via the software. The outputs provide voltages which reflect the deviation from the target position. The voltages should be close to 0 V. Good values are typically 10 – 100 mV, depending on the beam fluctuations without stabilisation.



The better the zero position in the inactive state (*Active LEDs off*) matches the target position, the smaller will be the beam shift when you activate the stabilisation.

4.8. Fine-adjustment of stage 2

Activate only stage 1 by pressing its *Start/Stop* button. Leave stage 2 inactive. Proceed with stage 2 as you did with stage 1.

4.9. Full operation

After this step the Piezos have their largest tilting range into each direction. For the stabilized 4-axis operation you can now activate both stages. With activated control the laser beam should show no fluctuations of the beam position after the last mirror.

4.10. Determination of accuracy

The position outputs of the controller provide voltages which reflect the deviation from the target position. In the user manual you can find equations on how you can calculate real positions from these voltages. In the software you can switch between voltages and positions in μm .

4.11. Optional: Optimization of bandwidth

At the controller you find two potentiometers $P1$ and $P2$ for adjustment of the P factors of both control stages (see figure 2). The factors can also be changed in the software. With the P factors you can optimize the stabilisation bandwidth. You can use the delivered screwdriver to turn the potentiometers. Make sure that both stages are active (*Active LEDs on*). Turn $P1$ in clockwise direction until the position on detector 1 starts to oscillate. Then reduce the P factor until the oscillation stops and a stable operation is guaranteed. Do the same with $P2$ for stage 2.



At the right side of the controller there are also the *Bandwidth* switches L (low) and H (high). Usually you can choose the H position. However, if your setup tends to oscillate e.g. due to unstable mechanical mounts or a mixing between the two control stages it can be of advantage to choose L . The switches independently adjust the P factors of both stages with a large step.

5. If it doesn't work right away ...

If you observe problems with the stabilisation you may have a suboptimal setup. Please consider the section “Set-up of optical components” in the user manual. You can also check the section “Troubleshooting” at the end of the manual.

Please don't hesitate to contact us in case of questions:

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