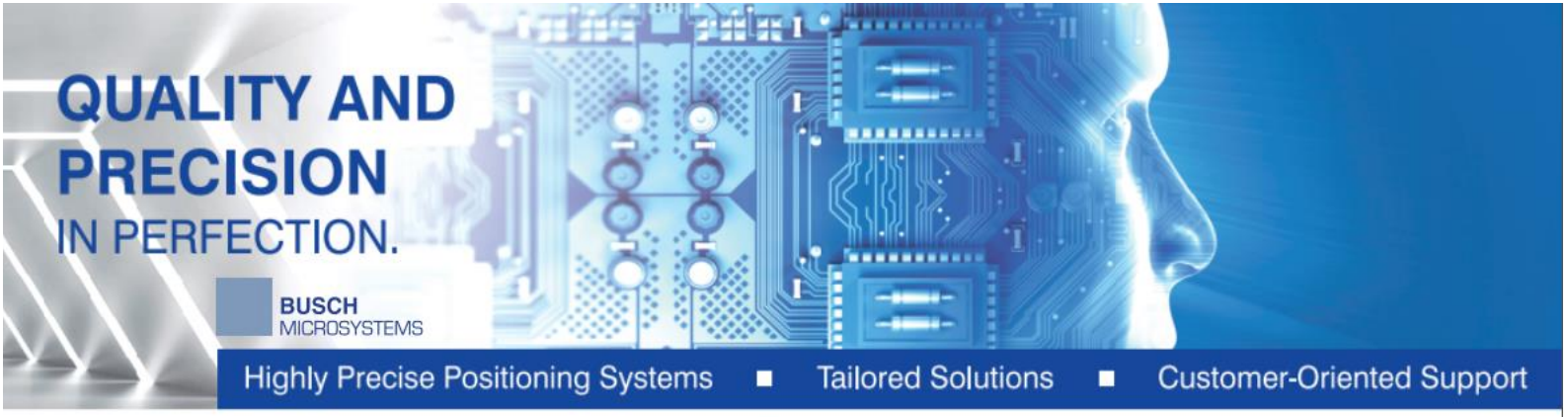



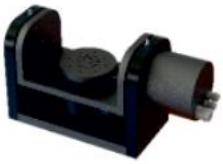


Air-compensated z-axis

February 27th 2020, Version 1.00, Detlev Kunz

1. Introduction

More and more applications require higher dynamics of the z-axes, which cannot be achieved with conventional spindle-driven axes.
However, the use of direct linear motors in compact vertical axes presents some challenges:

- Compensation of the weight of the load by the motor is hardly to realize with compact z-axes due to the limited installation space
- Holding brakes which impede the load from being lowered when the drive is switched off cannot be used due to the limited installation space

To respond to the challenge, the new z-axis uses a complete weight compensation of the moving mass by an air spring element.
This allows the axis to be adjusted by applying a suitable air flow so that the load remains stable in any position even when the drive is switched off.
By eliminating the weight forces, the full motor power is also disposable for the movement, thus enabling much greater dynamics.

Possible applications for this axis are highly dynamic pick and place and autofocus applications.

2. Performance data of the air-compensated z-axis

2.1 Reaction of the axis at maximum travel

The axis reaches a maximum speed of 30 mm/s and an acceleration of 500 mm/s² on the maximum travel distance of 25 mm.

The following positioning accuracies are maintained:

- ± 4 µm during the acceleration phases
- ± 0.5 µm at constant speed
- ± 0.2 µm at standstill (already 10 ms after end of movement)

These performance values enable the axis to be moved very quickly to a precise position (e.g. focus height)

2.2 Reaction of the axis at 2mm jump

The axis reaches the following values with a jump of 2 mm:

- Maximum speed 17 mm/s
- Jump duration including settling time to ± 0.2µm: approx. 200 ms
- ± 2 µm Position accuracy during the acceleration phases

This makes it possible to stay within a position tolerance of ± 2 µm for shorter jumps during the entire movement. This allows, for example, contour tracking of a surface in the xy-plane with this accuracy.