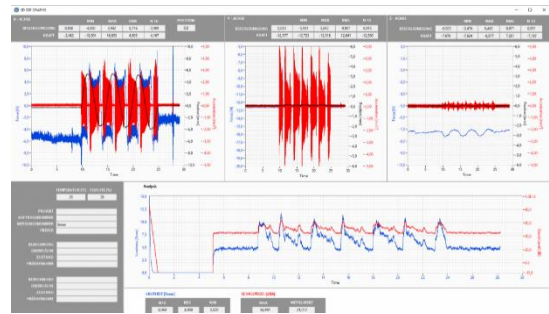
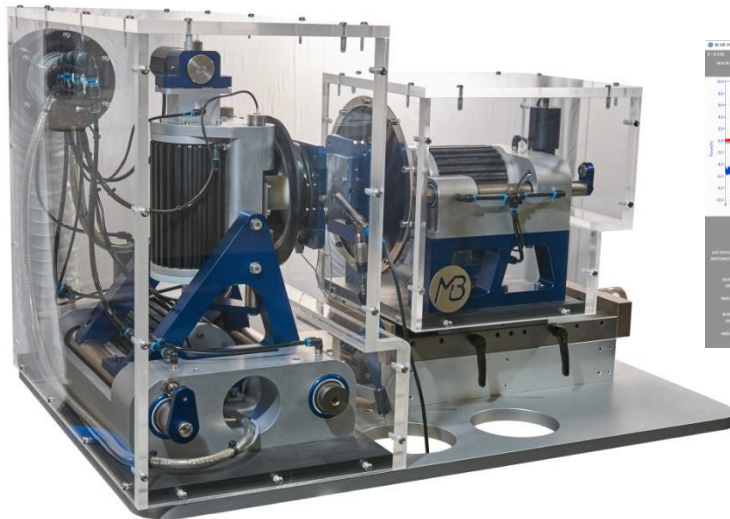


# 3D Stick-Slip Test System



MB DYNAMICS  
Sound & Vibration Testing Technology



## New Dimensions in the Analysis of Stick-Slip, Friction and Wear

The jerky transition from static to dynamic friction known as stick-slip effect creates structure-borne noise in the material and is the cause of unpleasant squeaking and creaking noises. In addition, stick-slip leads to increased wear and material fatigue and is undesirable in most technical applications. Conventional stick-slip test systems only allow a one-dimensional movement of the two materials or surfaces to each other. For the first time, our new 3D stick-slip test stand enables the simulation of real, highly dynamic relative movements and excitation states in three axes and provides important new insights into the origin and targeted avoidance of stick-slip. The frictionless and noiseless movement of the three axes and the direct measurement on the two material samples enable high-precision and high-resolution measurements of the occurring friction forces. If required, the optional automatic mode controls a climatic chamber and carries out freely configurable, fully automated test sequences. New dimensions in the analysis of stick-slip and friction forces: Simultaneous excitation in three axes, precise, high-resolution and efficient!

### Features & Benefits:

- Highly dynamic simulation of real relative movements, forces and accelerations in 3 axes
- Freely definable motion profiles
- Extremely quiet, friction-free exciters, no influence on measurement data by noise and vibration of the exciters
- Measurement of acceleration, force, position, temperature and humidity
- Detection of airborne and structure-borne noise for analysis and evaluation of stick-slip
- Precise measurement of static and sliding friction
- Measurement of spring forces and force-displacement diagrams in 3 axes
- No influence of stick-slip and force measurement by leaf spring elements
- Suitable for use in a climatic chamber in a temperature range from -40°C to +85°C

### Typical Applications:

- Analysis and evaluation of the stick-slip risk of various material pairings and surfaces, especially on soft-elastic materials and sealing systems
- Measurement of friction forces and friction coefficients
- Aging, abrasion and wear tests

### Options / Accessories:

- Automatic mode for fully automatic execution of predefined test cycles
- BSR Suite measurement and test system for recording relative motions and accelerations in the vehicle as well as for comprehensive analysis of the airborne and structure-borne sound signals recorded on the test bench.

# 3D Stick-Slip Test System

## Frictionless motion enables high-resolution force measurements

To avoid any influence on the dynamic behavior and the measured values, all three axes are equipped with a frictionless linear guidance system. This enables high-resolution direct measurements of very small normal and lateral forces on sealing systems and soft-elastic materials without influencing and damping the dynamic behavior of the test specimens by coupled springs or superimposed friction forces in the guides of the moving axes.

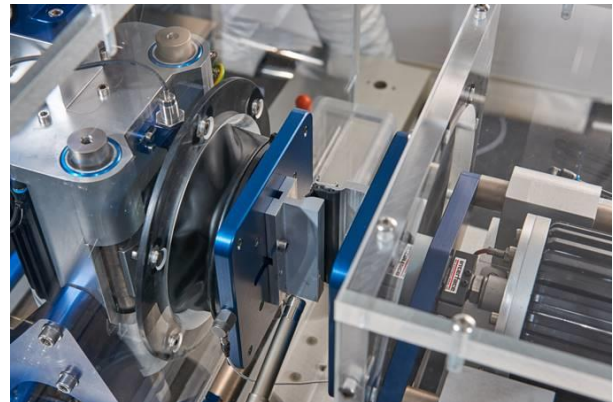


Figure 1: Air bearings enable frictionless motion of the mounting tables in x-, y- and z-axis

## Reproducible highly dynamic reproduction of measured excitations

The closed-loop multi-axis vibration control system enables highly dynamic and accurate reproduction of recorded excitation signals. The vibration controller includes SINE, RANDOM and TIME HISTORY control software. Recorded force, acceleration or displacement time signals or synthetically generated excitation signals such as rectangle, sawtooth or wavelets can be quickly and easily transferred to the controller using the DRIVE-FILE-PROCESSOR software.

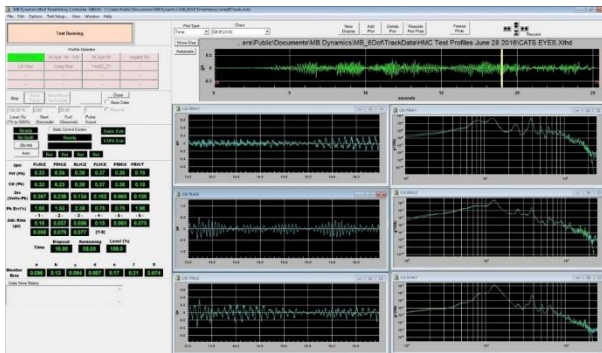


Figure 2: Multi-axis vibration control system enables reproducible reproduction of recorded excitation signals

## Profile editor for easy and quick generation of sine and ramp profiles

An integrated profile editor enables the definition of sinusoidal and ramp-shaped motion profiles. Start and stop position, frequency, amplitude, phase, duration of the ramp, number of repeats and dwell time on a fixed position are defined directly in the profile editor.



Figure 4: Definition of a ramp-shaped motion profile

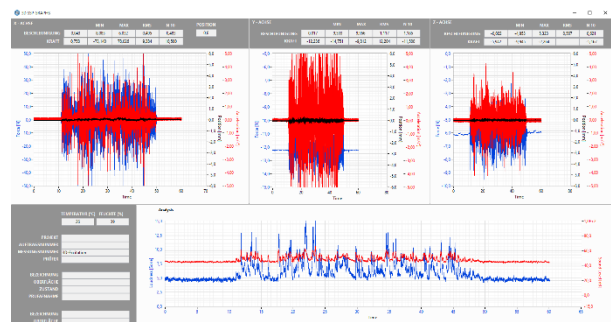


Figure 3: Stick-slip test with simultaneous excitation in x-, y- and z-axis based on recorded excitation signals.

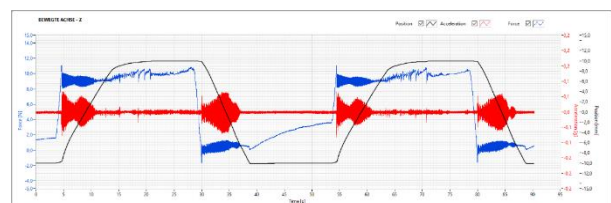


Figure 5: Stick-slip measurement during excitation with ramp-shaped motion profile

# 3D Stick-Slip Test System

Measurement of accelerations, forces, displacements and noises

The integrated 16-channel measuring system enables the acquisition and recording of acceleration, force and position on all three axes. A precision measurement microphone records and analyzes the acoustic behavior at the contact surface of the materials or test specimens. In addition, temperature and humidity in the area of the contact surface are recorded. The configuration and calibration of the measuring channels is carried out directly in the user interface of the test bench software. Configurable high-pass, low-pass and bandpass filters optimize the signal-to-noise ratio and thus further increase the resolution of the measurement signals. The measurement data is stored in TDMS file format. Acceleration and microphone data can also be stored in WAV audio format for subjective acoustic evaluation or further signal analysis.

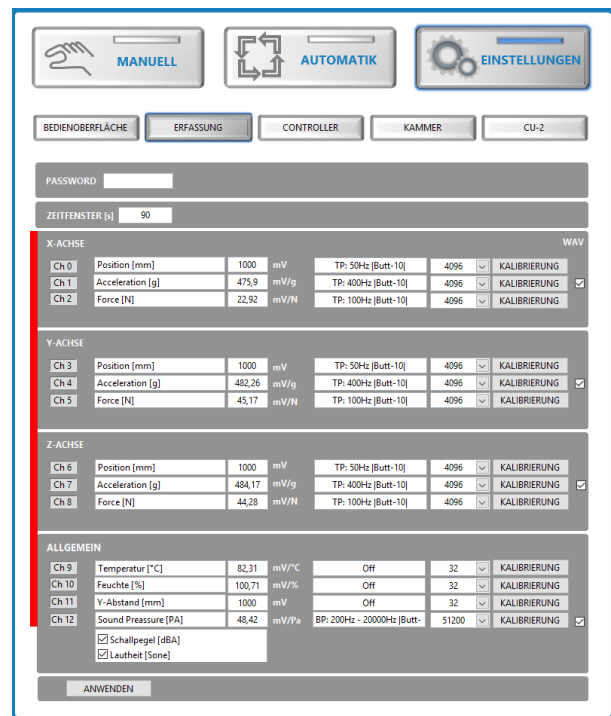


Figure 6: Configuration, scaling and calibration of the input channels

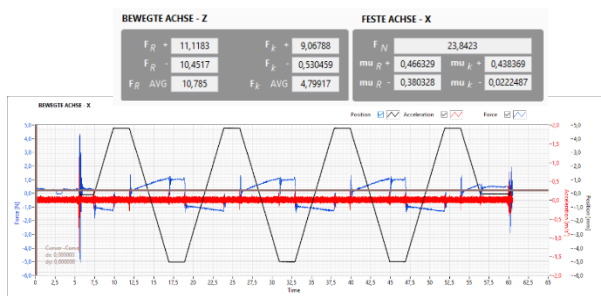


Figure 7: Calculation of average friction coefficients by separate averaging for each direction of motion

## Automatic mode for executing predefined test sequences

The optional automatic mode allows the definition and fully automated execution of predefined test cycles. Temperature, humidity and operating status of the climatic chamber, the position of the excitation axes, the excitation signals to be used, dwell times at a given position as well as test and measurement duration can be defined, fully automatically executed and stored in various test steps.

## Static and sliding friction & calculation of friction coefficients

Ramp-shaped excitation signals with definable amplitude and speed allow the systematic analysis of friction forces at different speeds, compressions and normal forces. The resulting friction forces and friction coefficients are measured over a definable number of cycles and calculated separately for each direction of motion.

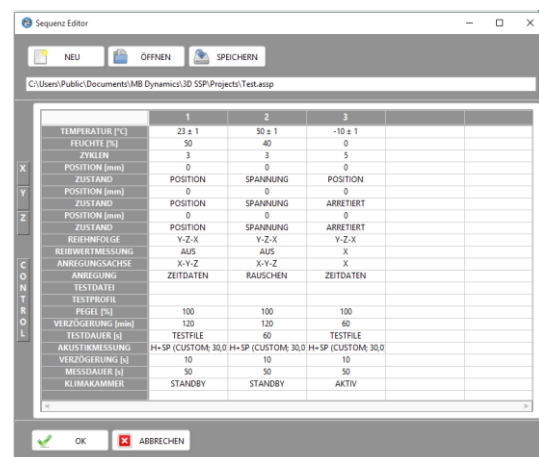


Figure 8: Definition of complete test sequences

# 3D Stick-Slip Test System



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## Technical Data:

<b>3D Stick-Slip Test System</b>			
	<b>x-axis</b>	<b>y-axis</b>	<b>z-axis</b>
Max. displacement	25mm pk-pk	25mm pk-pk	25mm pk-pk
Locking of individual axes	Yes, software controlled	Yes, software controlled	Yes, software controlled
Adjustable overpressing / position	Yes, position controlled or locked	Yes, position controlled or locked	Yes, position controlled or locked
Max. velocity	1m/s	1m/s	1m/s
Max. stat. preload force	200N	100N	200N
Max. dyn. excitation force			
	Sine 300N peak	150N peak	300N peak
	Random 200N rms	100N rms	200N rms
Frequency range	DC-500Hz, useable up to 1000Hz	DC-500Hz, useable up to 1000Hz	DC-500Hz, useable up to 1000Hz
Maximum payload	2kg	2kg	2kg
Types of excitation	Sine, Random, Time History	Sine, Random, Time History	Sine, Random, Time History
Controlled variables	Position or acceleration, Force control available as an option	Position or acceleration, Force control available as an option	Position or acceleration, Force control available as an option
Overtravel protection	Yes	Yes	Yes
Overtemp protection	Yes	Yes	Yes
Operating Noise *			
Noise Rating Curve (NR)	NR18, typical	NR18, typical	NR18, typical
Sound Pressure Level **	<25dB(A)	<25dB(A)	<25dB(A)
Time Varying Loudness ***	<0,2 Sone	<0,2 Sone	<0,2 Sone
Measured quantities	Position, acceleration, force	Position, acceleration, force	Position, acceleration, force
Acoustic analyses	Sound Pressure Level [dB(A)], level over time, mean value & max. value Time Varying Loudness, level over time, N10, N50 & N90 percentile level		
Other measured variables	Temperature and humidity in the area of material samples		
Data formats	All data is stored in TDMS-format, time signals from the accelerometers and the microphone can also be saved in WAV format.		
Dimensions (W*H*D)	955mm*630mm*763mm		
Weight	200kg		
Mains connection	3 phases, 220-240VAC @50-60Hz, secured with 16A circuit breaker		
Compressed air supply	Filtered, oil-free compressed air, 6 bar@150 liters/min		

\* Measured at 70cm from the shaker when excited with a typical Squeak & Rattle test profile in the frequency range from 5Hz to 100Hz with an averaged acceleration level of 0.3gRMS

With simultaneous operation of all axes, the resulting noise level can increase by up to 9dB(A).

\*\* A-weighted Sound Pressure Level, FAST (125ms), 20Hz to 20kHz

\*\*\* N10 Percentile Level, loudness according to DIN45631/A1, measured in accordance with GMW14011