Vertical Pitch & Roll Shaker

MB DYNAMICS
Sound & Vibration Testing Technology

Realistic simulation of complex excitation conditions in up to 5 axes

The latest generation of Vertical Pitch-Roll (VPR) shakers enables the multi-axial simulation of complex motion and excitation profiles, such as those experienced in vehicles, aeroplanes, helicopters and unmanned aerial vehicles. Highly dynamic, simultaneous excitation in the vertical direction, as well as synchronised inclinations around the transverse and longitudinal axes, realistically simulate multidimensional excitation forces and loads caused by uneven road surfaces, flight manoeuvres, and engine and drive vibrations. Simultaneously mapping several load scenarios enables coupling effects to be detected and analysed, providing more realistic data on material fatigue, structural strength and the long-term behaviour of test specimens, while significantly reducing test times. With excitation forces of up to 4 kN and a wide frequency range of DC–500 Hz, the systems can be used flexibly for testing sensors, cameras, navigation systems and radars. Integrated automatic load compensation supports larger components weighing up to 300 kg. Thanks to the low operating noise typical of the ALPHA shakers used, the system is also ideal for Buzz, Squeak & Rattle analyses on a wide range of vehicle components.

Figure 1: The VPR 2825 Vertical Pitch & Roll shaker enables the simultaneous excitation of test specimens weighing up to 300 kg in up to five axes and is characterised by its versatility and small footprint.

Features & benefits:

- Simultaneous excitation in 5 axes
  - o Controlled excitation in
    - ▪ Vertical (Z),
    - ▪ Pitch (rotation around X) and
    - ▪ Roll (rotation around Y)
  - o Coupled motion in X and Y
- Vibration displacement of up to 50mm pk-pk
- Excitation in the frequency range DC to 500Hz
- High excitation forces of up to 4000N
- Vibration displacement of up to 50mm pk-pk
- Rotation angle in Pitch & Roll of up to 5.7°
- Max. Angular acceleration of up to 1400 rad/s²
- Low operating noise - ideal for Buzz, Squeak & Rattle tests
- Suitable for test specimens up to 300kg
- Low space requirement, flexible installation
- Can be upgraded to simultaneous excitation in 5 axes by adding two shakers in the X and Y axes
- High efficiency and low power consumption
- Robust design, low maintenance, reliable and durable

Typical applications:

- Highly dynamic simulation of complex vehicle and aircraft motion
- Validation of sensors, camera and navigation systems
- Testing of gimbal and image stabilisation systems
- Vibration and endurance tests with and without climate superposition
- Buzz, Squeak & Rattle tests on seats and other automotive components
- Investigation of seat comfort and ride comfort
- Transport simulation & packaging test

Options / accessories:

- Mounting tables in various sizes
- Mounting adapters and fixtures for various components
- Water cooling for ALPHA shakers
- Climate option for use within a climate chamber (-40°C to +80°C)

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Vertical Pitch & Roll shaker generates simultaneous excitation in 5 DOFs

Four low-noise ALPHA MK2 series shakers provide excitation in the vertical direction at the corners of the shaker table. A multi-axis closed-loop vibration control system actively controls the amplitude and phase angle of the exciters. This enables vertical (z-axis) motion as well as rotary motion around the y-axis (pitch) and x-axis (roll) to be generated and controlled. The special geometry of the setup leads to mechanically coupled responses in the x and y directions, enabling excitation in up to five axes simultaneously. This enables complex, realistic load scenarios to be simulated, such as those experienced in vehicles, aircraft or ships. With a maximum vibration displacement of up to 50 mm (pk-pk), the four electrodynamic shakers enable the simulation of large vibration amplitudes as well as low-frequency motions such as pitching, tilting and wobbling, for example due to unevenness in the road surface or flight manoeuvres. At the same time, high-frequency excitation signals from drives, motors, and shock loads can be superimposed.

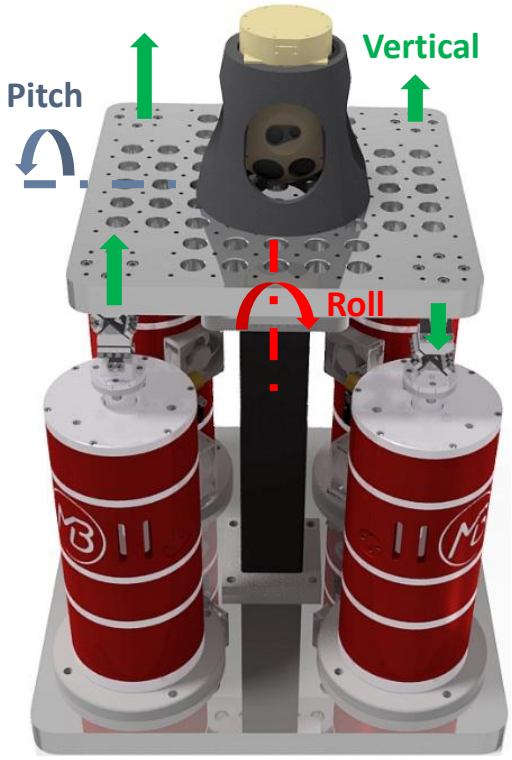

Figure 2: Compact design and excitation of the Vertical Pitch & Roll shaker table by four low-noise ALPHA MK2 electrodynamic shakers

Powerful, efficient, compact & versatile

High excitation forces of up to 4kN and the precise simulation of complex multi-axial excitations create realistic, reproducible test conditions for vibration and endurance tests and enable the targeted optimisation of the robustness and reliability of mechanical and electrical components - for example in gimbal, camera, radar or image stabilisation systems - under controlled laboratory conditions. Testing and development times can be significantly shortened.

Thanks to the innovative design with a compact layout without external arms or pivot points, the shaker requires significantly less space than classic VPR systems. For example, the VPR 2825 model with an excitation force of 2800 N requires a footprint of just 0.49 m² - ideal for use in space-limited test environments. The free accessibility to the test specimen from all four sides creates ideal conditions for assembly, troubleshooting, noise analyses and other accompanying testing procedures-

Figure 3: The free accessibility from all sides and the low operating noise create ideal conditions for Buzz, Squeak & Rattle tests and fault analyses on a wide range of components

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Technical data:

	VPR 2825	***VPR 4050***
Shaker used	4 ALPHA 725Mk2	4 ALPHA 1050MK2
Mounting surface shaker table	500mm*500mm	600mm*600mm
Mounting hole pattern	M8 threaded inserts on 50mm*50mm hole pattern	M8 threaded inserts on 50mm*50mm hole pattern
Max. payload	300kg	300kg
Max. excitation force vertical		
Sine	2800N peak	4000N peak
Random	1600N rms	2400N rms
Time History Replication	5000N peak, instantaneous	7200N peak, instantaneous
Max. vibration displacement vertical	25mm pk-pk	50mm pk-pk
Max. rotation angle Pitch & Roll	3,6°	5,7°
Max. velocity vertikal	1m/s	1m/s
Max. acceleration SINE vertical bare table *	96,5m/s² peak	71,4m/s² peak
Max. acceleration SINE vertical, @50kg payload	35,4m/s² peak	37,7m/s² peak
Max. angular acceleration Pitch & Roll bare table *	1000rad/s²	1400rad/s²
Frequency range	DC-500Hz, usable up to 1000Hz	DC-250Hz, usable up to bis 500Hz
Moving mass (without test specimen)	29kg	56kg
Operating noise **		
Sound level ***	<35dB(A)	<38dB(A)
Loudness, N10 percentile ****	<1,5 Sone	<1,8 Sone
Overtravel protection	Yes	Yes
Temperature monitoring	Yes	Yes
Automatic load balancing	Yes	Yes
Integrated cooling	Yes, air cooled	Yes, air cooled
Water cooling	Optional	Optional
Dimensions (W*D*H)	700mm*700mm*746mm	800mm*800mm*846mm
Electrical connection	3*400V-50Hz/N/PE-16A	3*400V-50Hz/N/PE-16A

* Depending on the applied test mass

** Measured at a distance of 70cm above the centre of the empty vibration table during excitation with typical Squeak & Rattle test profiles in the frequency range from 5Hz to 100Hz, mean value of acceleration 0.3gRMS.

*** A-weighted sound pressure level, FAST (125ms), 100Hz to 20kHz

**** N10 percentile level, loudness according to DIN45631/A1, measured in accordance with GMW14011