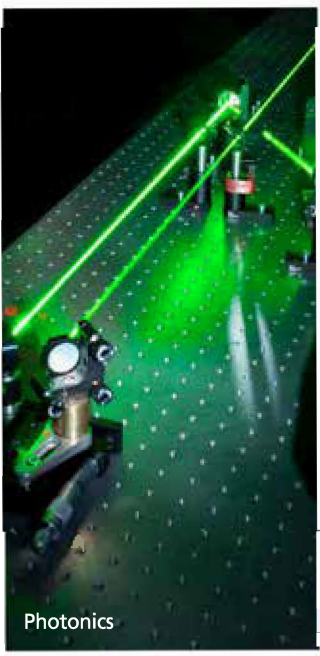
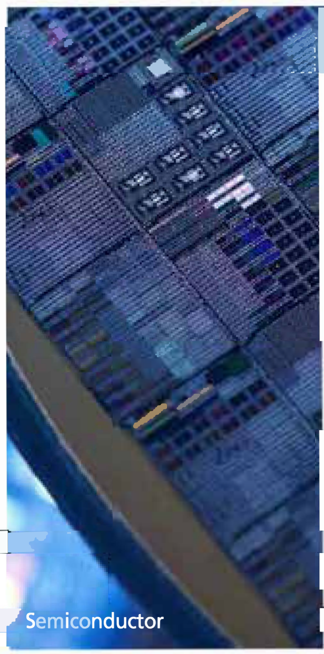
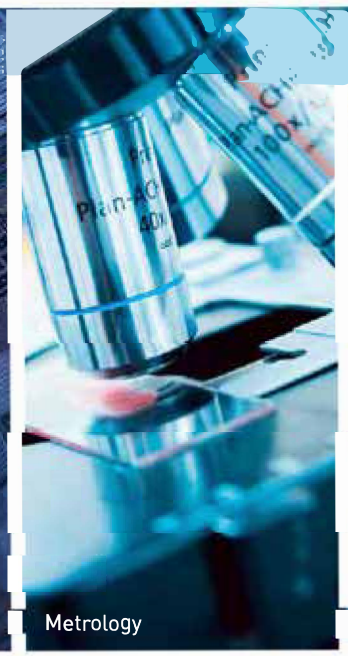
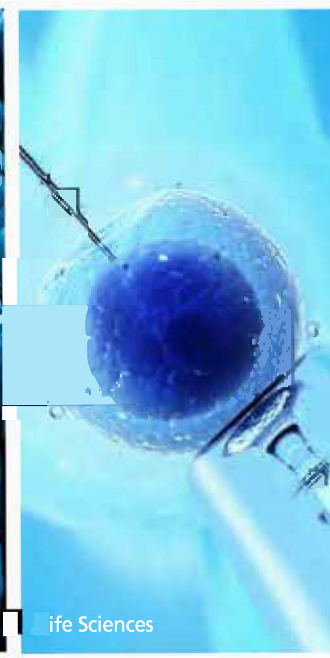
VIBRATION ISOLATION SYSTEMS







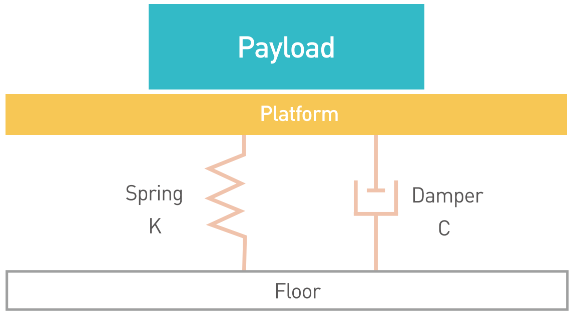


DAEIL SYSTEMS

Passive Vibration Isolation System

A passive vibration isolation system consists of three components: an isolated mass (payload), a spring (K) and a damper (C) and they work as a harmonic oscillator. The payload and spring stiffness define a natural frequency of the isolation system. While the spring (isolator) reduces floor vibrations from being transmitted to the isolated payload, the damper eliminates the oscillation that is amplified within the isolation system. In most cases, the passive isolation systems employ a pneumatic spring due to its low resonant frequency characteristic that provides outstanding vibration isolation and damping.

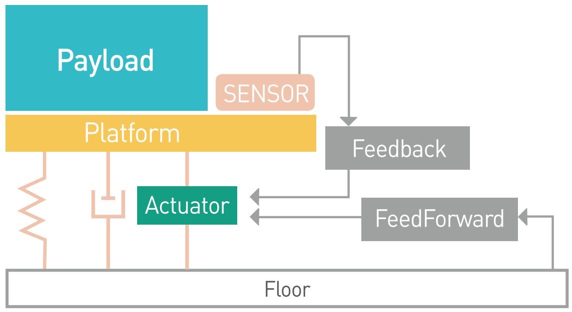
While the simple composition of isolation system can achieve the maximum vibration isolation efficiency, there are also limitations, such as a resonance phenomenon in the low frequency range, a longer settling time, and lack of controllability.



Passive Vibration Isolation System

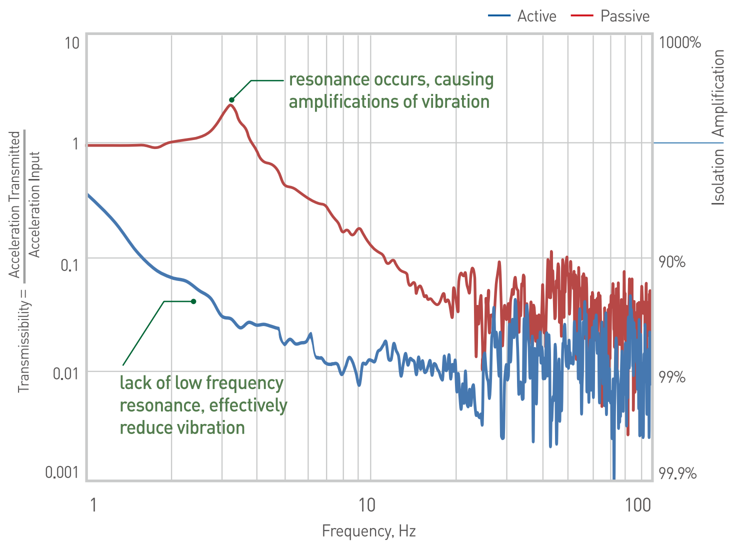
Active Vibration Isolation System

An active vibration isolation system is consisting of feedback and feedforward control systems with integrated sensors and actuators to isolate the most sensitive equipment from the extremely low frequency vibration which the passive isolation systems amplify vibrations at resonant frequencies. The extremely sensitive sensors detect incoming vibrations in all six degrees of freedom and a digital controller processes the measured vibration data received from the sensors into the digital signals. Then, the controller sends the signals to the actuators and the actuators cancel the vibrations by generating equal and opposite force.



Active Vibration Isolation System

Passive vs Active Isolation Systems



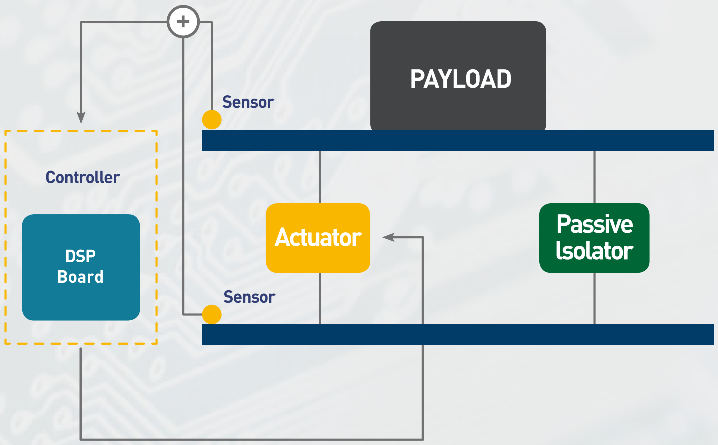
Passive vs Active Comparison

CATEGORIES	ACTIVE	PASSIVE
Natural frequency	0.5 Hz	1.5 – 10 Hz
Stiffness	Hard	Soft
Vibration Isolation Performance in 10 – 100 Hz	YES	YES
Vibration Isolation Performance in 1 – 10 Hz	No resonance, sub-hertz vibration isolation performance	Resonance occurs (amplifications of vibration)
Instantaneous Response	YES	NO
Controllability	Control the system precisely and delicately	Lack of controllability
Center of gravity	Stable	Unstable
Position accuracy	Around 1 μm	Around 0.05 mm–1mm
Degrees of freedom	6 DOF	3 DOF
Settling time	10 – 20 ms	2 – 10 ms

What is an active vibration isolation sytem?

An active isolation system is used to effectively control the low frequency vibrations through feedback and feedforward control system employing sensors and actuators. The active vibration isolation system is designed to isolate nanoscale metrology and inspection tools that are extremely susceptible to the low frequency vibrations and the tools.

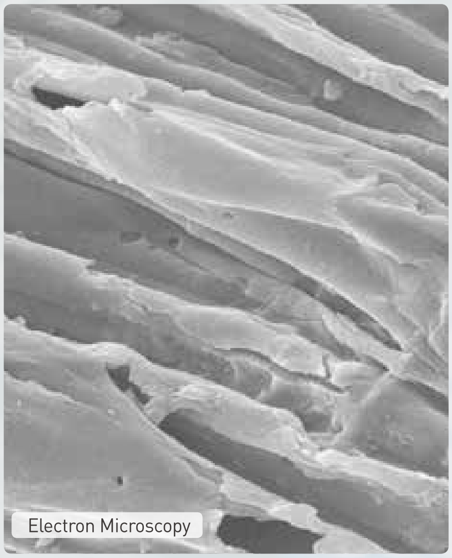
The integrated sensors constantly measure floor vibration and vibration originating from the tools, and send this data to the digital signal processor (DSP), then the DSP processes the data into digital signals to operate the actuators to generate equal and opposite force to the incoming vibrations. As the isolation system reduces vibrations in real–time, the effective isolation occurs in all frequency bands.

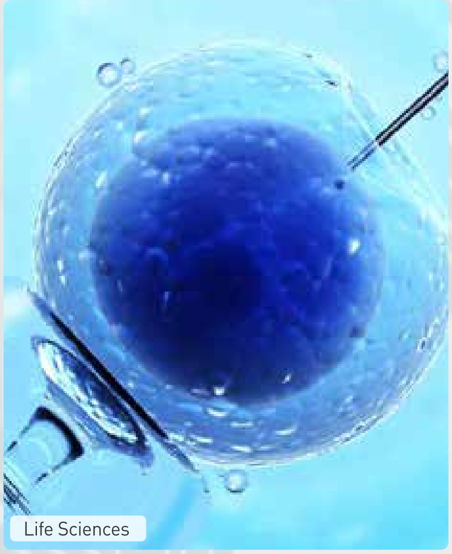


Applications

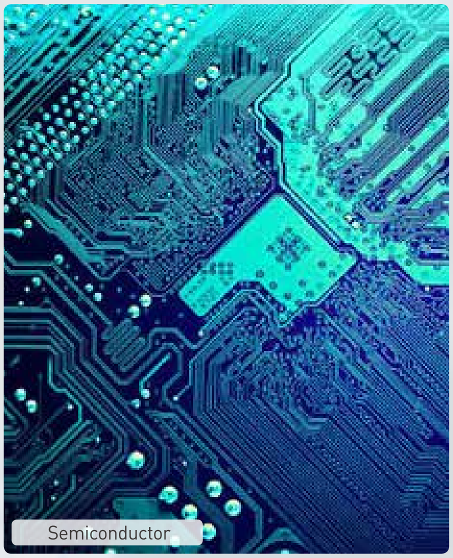

Microscopy


Metrology

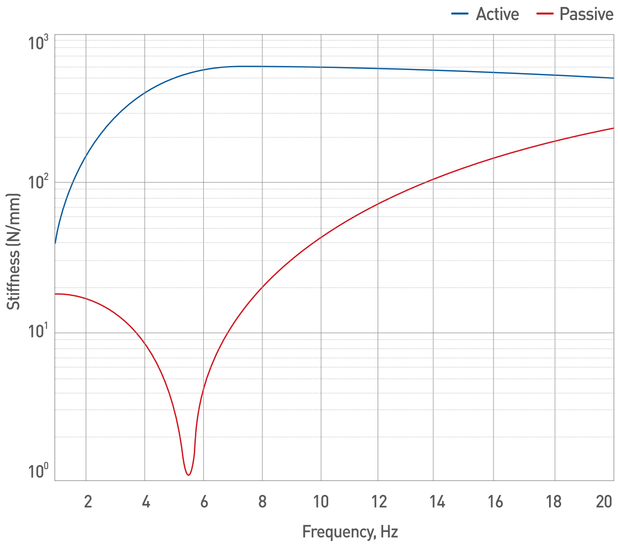

Electron Microscopy


Life Sciences

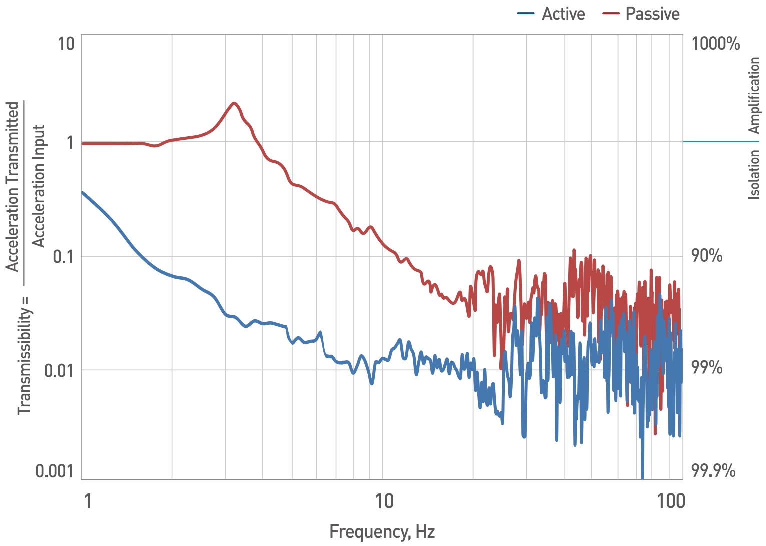

Display


Semiconductor

DVIA Series – Features & Benefits



Maximum Stiffness & Stability



Outstanding Vibration Isolation Performance

DVIA series does not suffer from the limitations of passive vibration isolation systems as the feedback control system employs actuators to generate an equal and opposite force to the external force continuously and instantly. The active isolation system sustains its the maximum stiffness and stability; therefore, the top plate of the active isolation system is resistant to vibrations, ensuring the maximum stiffness and stability of the system.

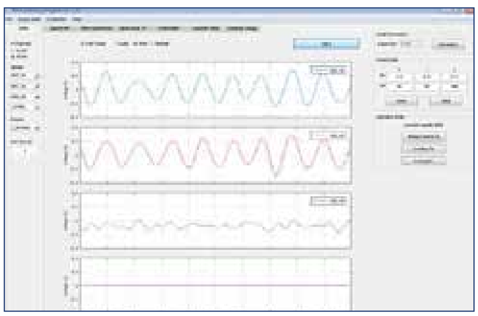
The passive isolation system normally has its natural frequency from 1.5 to 10 Hz, in which vibrations with the low forced frequency coincides with the natural frequency, amplifying incoming vibrations rather than reducing them.

Our DVIA series overcomes this weakness by lowering the natural frequency of the system down to the sub–hertz, in other words, practically our DVIA series does not allow resonance in the low frequency. Therefore, DVIA series is incredibly effective in controlling 1 – 5 Hz where the vibration–sensitive tools tend to be unstable and disruptive that cannot yield its optimal results. DVIA series starts to reduce vibrations from 0.5 Hz, delivering 80 – 90% at 2 Hz.

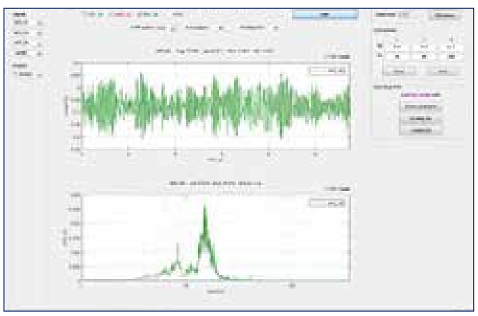
User Interface Software

We use our own software with User Interface to employ the feedback and feedforward control systems for DVIA series and with the software, users can monitor the real time vibration isolation performance and the floor activities. In addition, the optimal vibration isolation performance can be only achieved through the on–site tuning by our professional engineers.

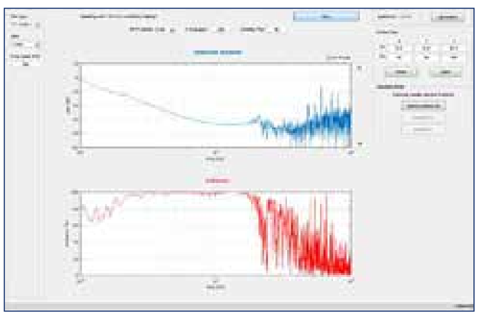
Initial screen



Sensor signal



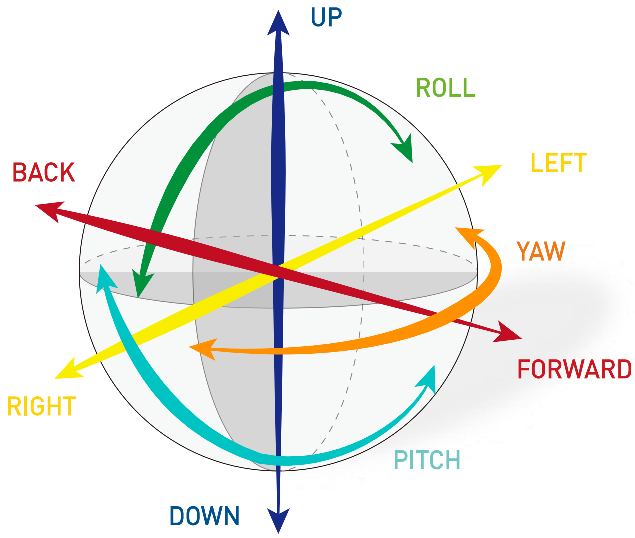
Autospectrum



Transmissibility

Six degrees of freedom

Sensors and actuators that are integrated in the active vibration isolators, controls vibrations in three translational degrees of motions (X, Y and Z), and three rotational degrees of motions (pitch, roll and yaw).

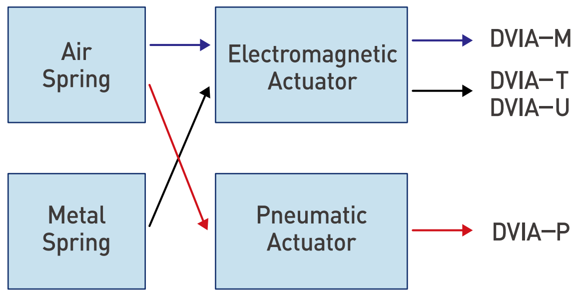


Configuration of Passive + Actuator

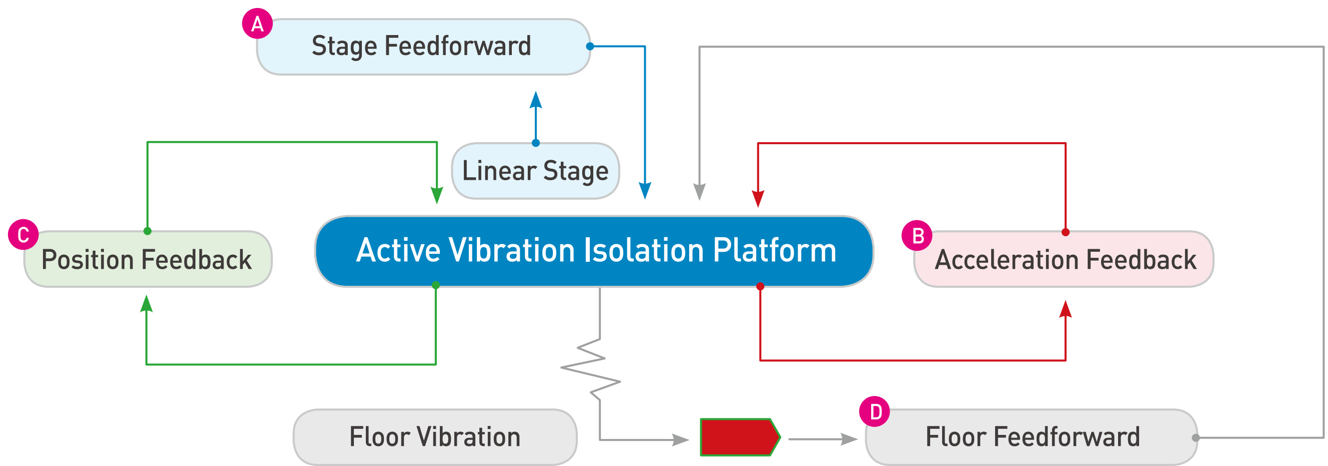
Air Spring + Electromagnetic Actuator → DVIA–M Series

Metal Spring + Electromagnetic Actuator → DVIA–T Series, DVIA–U Series

Air Spring + Pneumatic Actuator → DVIA–P Series



Feedback & Feed forward Control System



A	**Stage FeedForward**	If the isolation system has information about motorized linear stages in advance, the system can produce the force that equal in size to the forces from dynamic linear stage motions in the opposite direction. As a result, the external force caused by the motorized linear stages is effectively minimized.
B	**Acceleration Feedback**	The acceleration feedback control system employs sensors and actuators to continuously detect vibrations which disturb the isolated payload, then reacts to minimize vibrations. The acceleration feedback system not only reduces vibrations from the floor but also effectively minimizes vibrations from the motorized linear stages.
C	**Position Feedback**	When the isolation platform is disturbed by vibrations, the position feedback measures displacement through position sensors, then transmit signals to a digital controller. After receiving the digital signals from the sensors, the digital controller drives actuators to return its original position.
D	**Floor FeedForward**	The floor feedforward control system reduces floor vibration in a predefined way. If the system acquires information about the floor vibration data, the floor vibration can be significantly reduced by the feedfoward tuning.

DVIA-T Series

Tabletop Active Vibration Isolation Platform

Features

· Isolating Sub-Hertz Vibration

DVIA-T series provides excellent vibration isolation performance in1-10 Hz, where the low frequency vibration critically disturb nanoscale measuring tools. The vibration control range of DVIA-T series starts from 0.5 Hz, acheiving 90% vibration isolation at 2 Hz.

· Automatic Leveling to Payload Weight

If there are changes in an environment and location or placing other instruments, users can adjust a level of DVIA-T by simply pressing a button.

· Portable Design

The smallest model is 420 mm x 500 mm 93m which weighs only 25 kg, allowing user to hand carry and install on any place at all.

· Optimal Vibration Solution

Our own software provides the optimized vibration solution by employing the software to tune the feedback and feedforward control systems depending on users' instruments weight and environments, if required by users.

· It's Simple, Plug and Play!

DVIA-T incorporating a Plug & Play operation system, allowing users to use all functions by simply plugging a power cable in to AC power and pressing buttons.

· Real-Time Monitoring

With the GUI software and integrated active sensors allow users to monitor real time vibration levels and isolation performance. Furthermore, an LCD display on the front side of DVIA-T, enables users to monitor the automatic leveling and real time vibration levels.

· No Air

Metal springs are integrated in DVIA-T series as to reduce high frequency vibrations and compressed air is not required.

Electron Microscopy

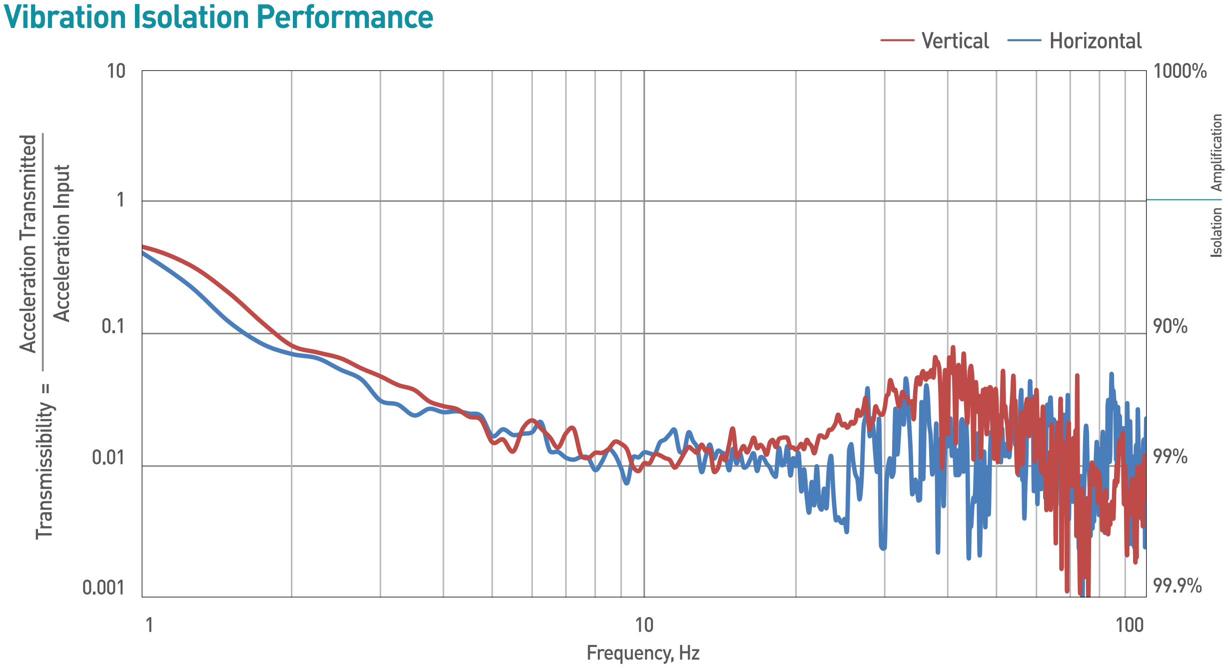
3D Optical Surface Metrology

AFM

Application

- Tabletop SEM
- Atomic Force Microscopy
- Scanning Probe Microscopy
- Optical Microscopy
- Confocal Microscopy
- Interferometry
- Micromanipulation
- Nanoindentation
- Ultra-Precision Metrology Tools

Vibration Isolation Performance



Specifications

Model No.		DVIA–T45	DVIA–T56	DVIA–T67	DVIA–T78
Dimensions (W x D x H)		420 x 500 x 93 mm	500 x 600 x 93 mm	600 x 700 x 95 mm	700 x 800 x 95 mm
Maximum Load Capacity		90 kg / 150 kg	90 kg / 150 kg	90 kg / 150 kg	90 kg / 150 kg
Weight		25 kg	32 kg	47 kg	56 kg
Actuator		Electromagnetic Actuator			
Maximum Actuator Force		Vertical : 6 N, Horizontal : 3 N			
Active Isolation Range		0.5 – 100 Hz			
Degrees of Freedom		6 degrees			
Vibration Isolation Performance		≥90% at 2 Hz / 99% at 10 Hz			
Settling Time		≤0.3 sec*			
Automatic Leveling / Load Adjustment		Yes			
Real–Time Monitoring		Active isolation status and automatic leveling on LCD display			
Top Plate		No Mounting Holes / M6 Mounting Holes / Custom			
Transportation		Internal Lock System			
Input Voltage (V)		AC 80 – 260 V / 50 – 60 Hz			
Power Consumption (W)		Less than 36 W			
Operating Range	Temperature (°C)	5 – 50 °C			
	Humidity (%)	20 – 90%			

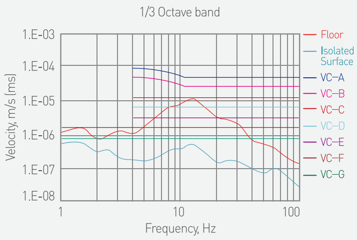
*0.3 sec settling time is measured after 90% reduction of input. (The settling time varies with several conditions, such as payload, force, natural frequency, etc.)

DVIA–T Case Studies

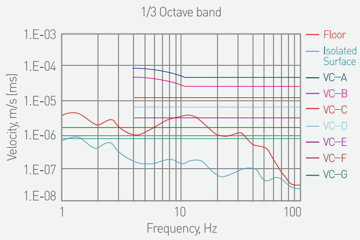
AFM Cantilever

The comparison of silicon substrate images measured on DVIA–T and a normal work table, clearly indicates that the DVIA–T remarkably reduces the vibration seen in the images.

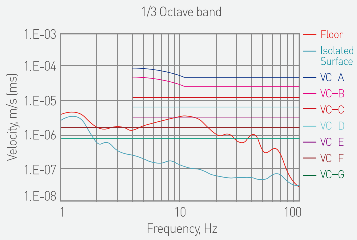
Z–axis



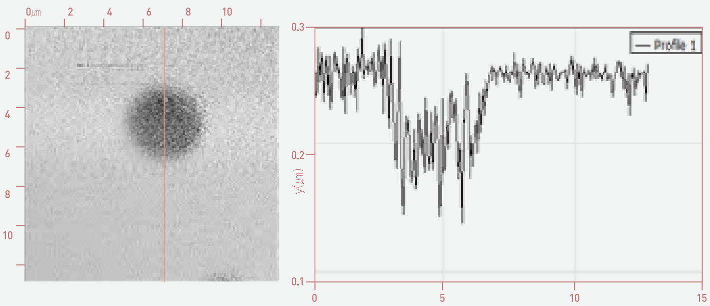
X–axis



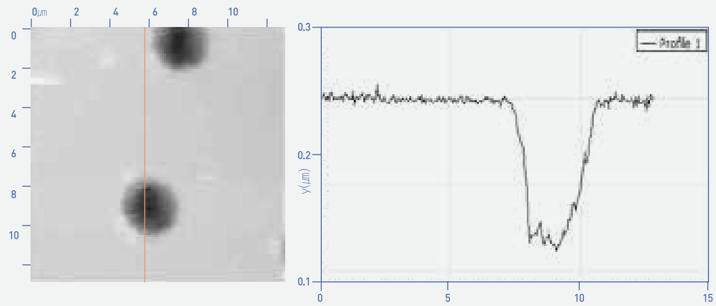
Y–axis



Silicon sbustrate images measured on the normal table (without vibration isolation)



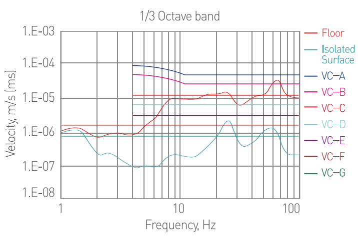
Silicon substrate images measured on the DVIA–T (active vibration isolation)



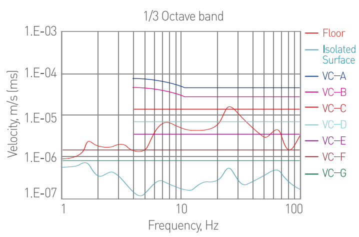
Bruker MULTIMODE8–U AFM

We compared line profile images that were measured on the DVIA–T placed inside the acoustic enclosure and on the pneumatic vibration isolation table.

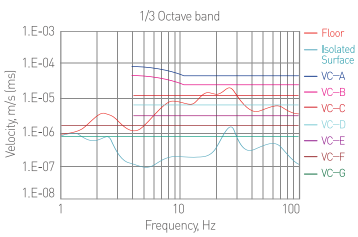
Z–axis



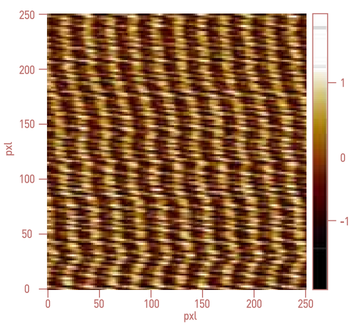
X–axis

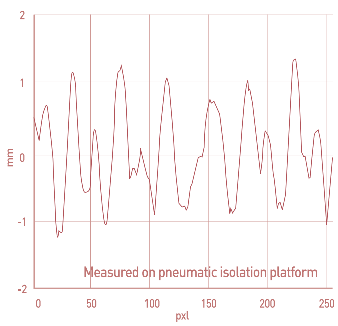


Y–axis

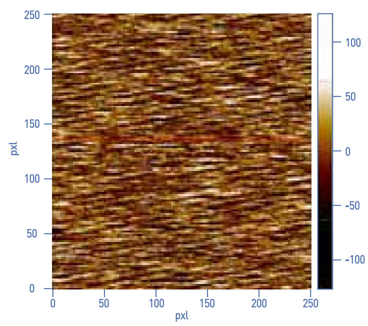


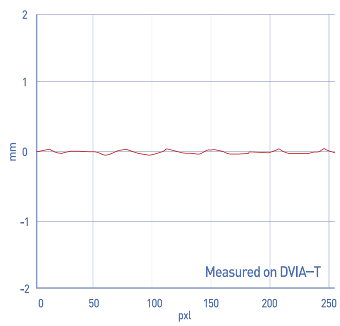
Pneumatic Vibration Isolation Platform





Set point of DVIA–T : 563.25 (nN)





The comparison of the line profile images demonstrated that the noise originating from the pneumatic vibration isolation table were 10 times bigger than the noise coming from the DVIA–T.

Enabling Vision for the Future.

DAEIL SYSTEMS

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