



# Dynamic Simulation System



# World's leading vibration company in building reliable systems.

Established since 1957, being in the forefront of research and development in the field of Vibration dynamics, IMV are proud to provide technical solutions for vibration testing with safety, reliability and durability in mind.

IMV supply single axis, sequential or simultaneous up to 6 degree of freedom multi-axis vibration simulation systems and vibration measurement or diagnostic instruments. Furthermore, our specialist engineers can assist our customers with vibration testing, measurement and analysing.

## Reality

Reproducing enviromental vibration  
for realistic testing.

## Qua

Pursuit of qual  
best accuracy





lity

ity to guarantee the

# Possibility

Development of New Technology  
to expand Possibility

# Contribution to “Advanced Future Quality” in various fields of industries by Vibration

IMV manufactures and markets “Vibration Simulation Systems” which simulate vibration environments, and “Measuring Systems” which visualise states of vibrations, and also runs the business of “Test and Solution Service” providing consultations or laboratory tests of the products.

We proudly keep contributing to improvements on safety and comfortableness of society by helping upgrade reliability of products as “the partner for solution” of all industries including automotives, aerospace, electrical machineries, structural constructions etc., where they need to solve the problems caused by vibrations. As an expert in vibration system, we are focusing on upgrade our proposing and development skills and overall ability in order to serve society today and tomorrow.







A close-up photograph of green leaves, likely from a plant like a geranium, with the word "Ecology" overlaid in a white serif font. The leaves are vibrant green and show some signs of wear, such as small holes and discoloration. The background is a soft-focus green.

# Ecology

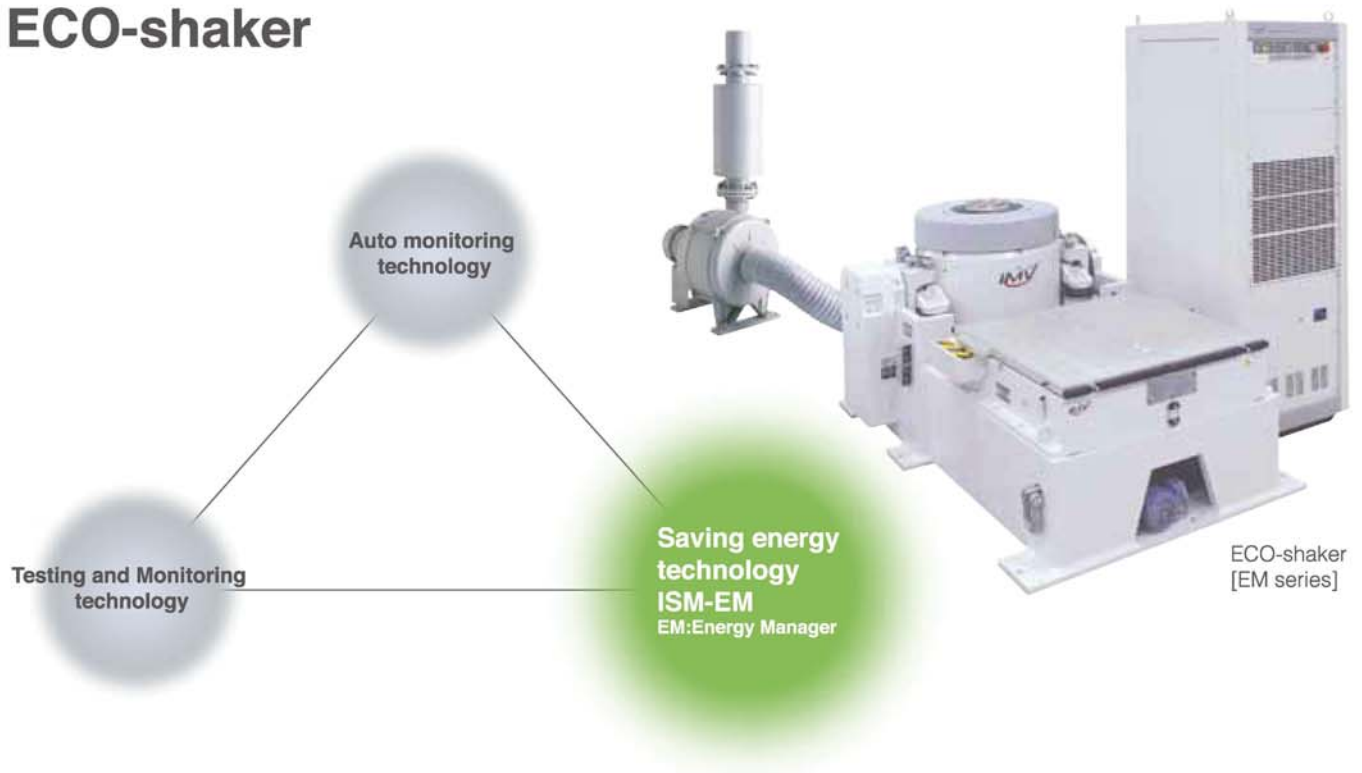
# Ecology

Environmentally friendly vibration system

## Always developing vibration simulation systems

IMV's dynamic simulation systems have been developed with "intelligence" in mind and endeavour to support customers testing. The new Eco technology has been used in the IMV range.

## ECO-shaker



### Achievement of low acoustic noise and better working environment conditions.

#### Expect improvement of low acoustic noise and better working environment conditions.

Noise from ambient air interference and cooling system during testing may create limitations of installment and working place. Our ECO-Shaker can control the noise level by controlling the blower at optimum speed. Controlling of the cooling system will not only cut waste in power consumption or noise level according to test conditions, but also maintain room temprature around the unit from rising.



### Contribution to ECO environment

#### Contribution to well being of society through quality and environment.

By Clean Development Mechanism (CDM) in January 2008 and revision of Rationalisation in Energy Use law in April 2009 were introduced in Japan, all enterprises have been obliged to be more energy efficient. ECO-Shaker promotes reduction of costs and CO<sub>2</sub> by saving electricity consumption, costs, and consequently contributes to society.







# System



# System

Each component is independently controllable and harmonises each other

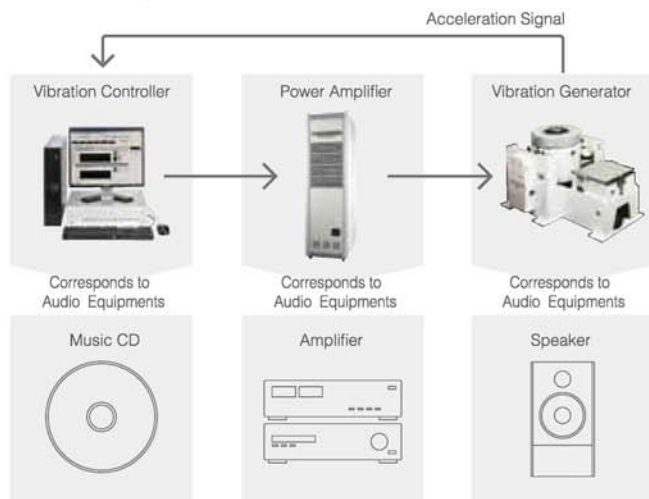
## Mechanism of Vibration Simulation System

### Electrodynamic Vibration Simulation System

The principle is same as of Audio Systems in which the electronic signals from the sources as the CDs are amplified by the amplifiers and converted to sound by loud speakers. For the Vibration Simulation Systems, the vibration generators correspond to the loud speakers of the audio systems.

They have the vibration controllers instead of the sound source to drive the vibration generators feeding the electric current through the amplifiers.

The difference is that the signals from the transducers mounted on the specimens and/or vibration tables to monitor their motions are fed back to the vibration controllers in order to control the vibrations to meet the requested test conditions.



### Vibration Controller

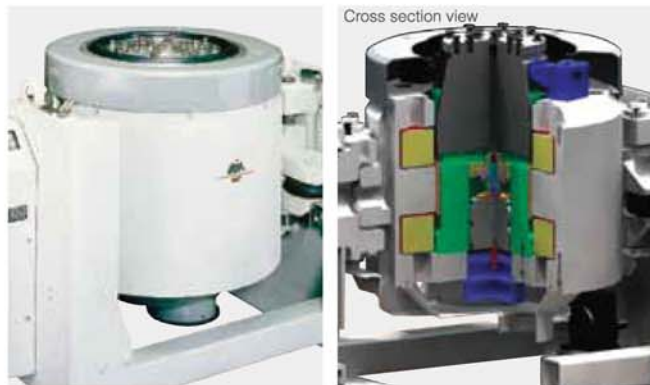
The original waveforms will not be reproduced by just applying the vibration data obtained in the field or from test specimens. The waveforms will be totally deformed due to the characteristics of the amplifiers, combined dynamics of the vibration generators and test specimens. The vibration controllers the equipments to have the vibration generators generate the designated vibration compensating automatically these characteristics or dynamics. All IMV vibration controllers are of originally designed and made in house reflecting the demands of customers. "User Friendly" has been always pursued.



Complicated tests are possible to be programmed and executed easily.

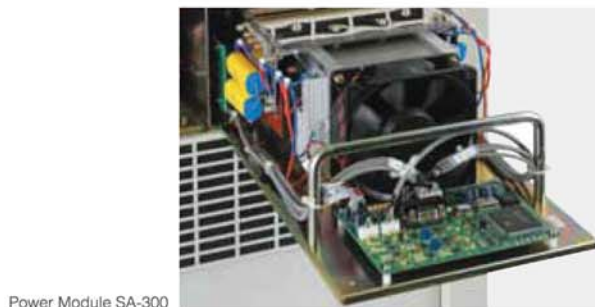
### Vibration Generator

The operation principle is based on "Fleming's left hand rule". When an electric current flows in a wire put in a magnetic field, it gets a force perpendicular both to that field and the direction of that current.



### Power Amplifier

The role of the Power Amplifier is to feed driving current to the Vibration Generator converting the small electrical signal generated in the vibration controller to the large current of higher voltage. IMV's Power Amplifiers employ the Switching amplifier system. They use mainly the compact and highly efficient power modules of the top level in this industry to contribute to energy and space saving.



Power Module SA-300



# Originality



# Originality

Invention with IMV's originality

## Original technology utilised to improve durability and performance of vibration generators

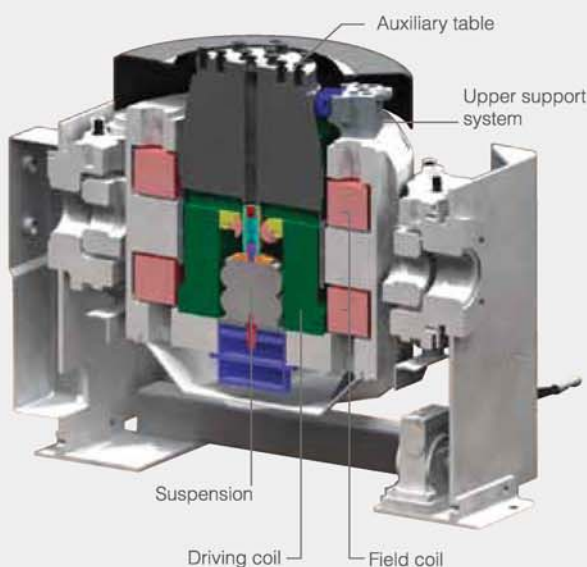
### Upper (armature) support system PS Guide



Vibration generator is given a dynamic stress by its own vibration. The Parallel Support Guide (PSG) design is a patented design to support the armature. PSG significantly improves durability and reliability of the system, and quality of vibration at the same time.

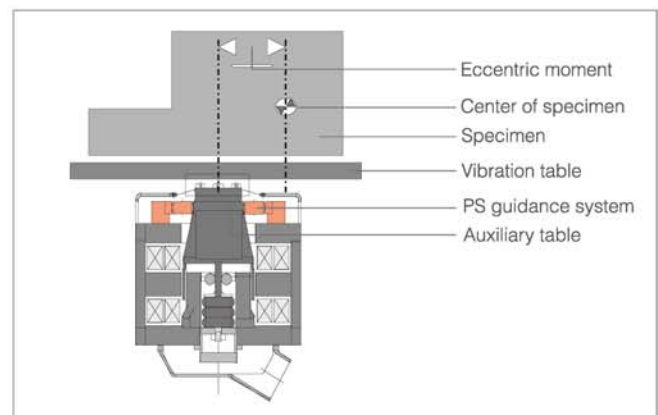
This compact design provides enough stiffness which exceeds such function of roller support system and realized high durability and self-holding supporting system by alternative alignment of gears that have a unique curve.

Vibration Generator cross section view (Image)



### Large allowable eccentric moment

When the table working surface of the vibration generator is not wide enough to mount the specimen, it must be expanded using some fixture or auxiliary table. Large lateral rigidity of the table guidance systems is important, because it is hard to bring the center of gravity of the specimen on the center line of the vibration table. The larger the specimen is, its importance is increasing. Our PS guidance system (Parallel Slope Guide) realizes 130% increase of rigidity over those of the same force range conventional models. It achieved that the specimens whose center of gravity are not located on the center line of the vibration table can be tested being applied higher acceleration.



### Compatibility of lateral rigidity and Waveform Regeneration accuracy

Usually lateral rigidity and Waveform accuracy conflict each other. PS Guidance system achieved their compatibility. It realizes vibrations of lower waveform distortion with high fidelity.

### Improvement of durability

10 times longer (compared to conventional system's) life was achieved to make much longer the interval of maintenance.

### Flexibility to respond to demand for large displacement tests

Flexibility is provided to respond to demand for 100mm stroke vibration tests.



A person wearing a blue uniform and a blue cap is seen from behind, looking at a computer monitor. The monitor displays a software interface with various charts and data. The word "Control" is overlaid in white text on the person's back.

# Control

# Control

## Control Vibration as you want

Vibration Controller is the device which you operate to carry out vibration simulation tests. It acts as a brain of the vibration simulation system.

We are particular about vibration controllers as the vibration simulation system manufacturer so that you may carry out your tests as you want.

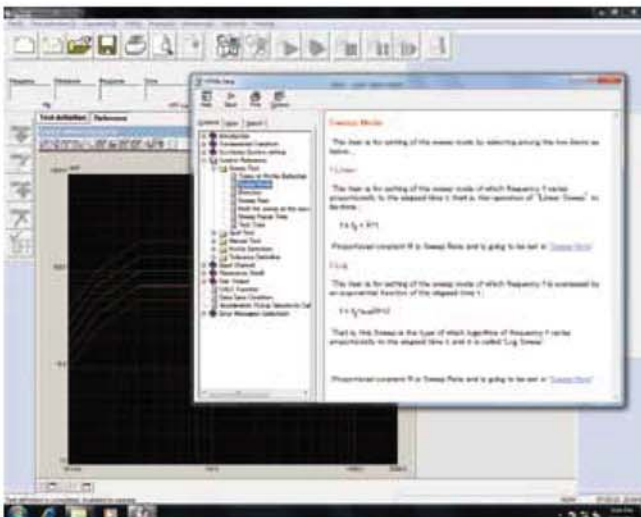
### Totally original products

IMV has persisted to develop in-house both of software and hardware of vibration controllers. All vibration controllers are our totally original products. It has been carried on the data base of Center of History of Japanese Industrial Technology in recognition of our achievement.



### User friendly operation

It was our pleasure to hear from our customers of our newest model K2 that they could operate them without reading the instruction manuals in detail. The setting procedures are guided step by step and any parameter input discrepancies are checked on the P.C. screen. HELP function to see meaning of the items etc. is fully provided.



### New functions responding to requests from customers

Responding to the requests from the customers as "want to monitor the status of the test at the remote place" "need to make test reports", such useful functions have been added.



#### Web Monitor (K2)

The status of the specimens under excitation is monitored periodically being shown on the HTML. The test status is possible to be observed remotely.



#### E-mail delivery (K2)

Finish of the Test or Abnormal stop is notified by E-Mail to the designated address



#### Report Generator (K2)

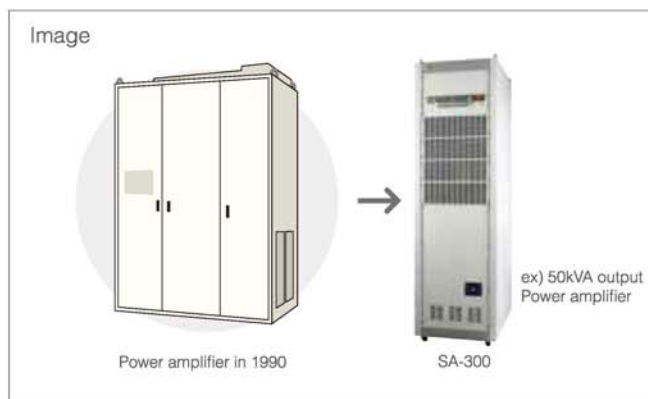
Designated test conditions, Response plots or other graphs etc. are available as WORD format. It helps operators to make reports easily.



## Compact space realised an Intense Energy

### Power module SA-300

The system output is proportional to the size of power amplifier resulting that the size of amplifier console get larger for the large system. IMV has developed a new module SA-300 which is the advanced version of switching type power module. Compared with 1990's, the advanced type power module is one third in volume which reduces occupation space within the console. For example, even the class i260 of rated Sine force only takes one power module in the amplifier.



### Reduction in Installation Space

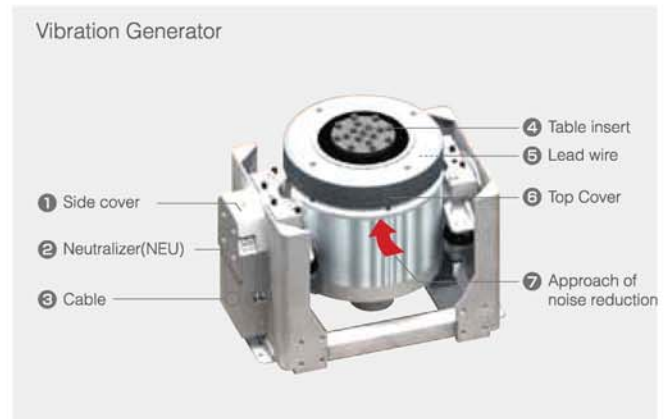
We achieved as maximum as 100kVA per console. The twin-rack is applied to the power amplifier of a larger output vibration simulating system K080/SA10M of excitation force 80kN.

### Outstanding Robustness

A stable output in each power module is applied by a feedback and DPWM (Digital Pulse Width Modulator). In addition to the failure detecting function which detects the blowout of a fuse, RMS overcurrent protection and peak current limit functions are also mounted. Along with the monitoring function of the controller, the amplifier provides over load protection forming double protection system. Regarding the peak output faculty as important, a customized module was developed for use in output stage. These comprise the strong power module which minimises the breakdown from transient output.

## Advanced Features of IMV Vibration Generators

### i · J series



#### 1 Side cover

Connection terminal for sensor cable and operation indication lamp for vibration-isolation air spring are located inside the side cover.

A : Junction terminal for sensor cable  
B : Operation bulb for vibration-proof air spring



#### 4 Table insert

Table inserts can get damages by repeated removal of the fixtures or the specimens. Mount inserts used to be removed in the factory, while, new type allows customer to replace it by themselves.

#### 2 Neutraliser (NEU)

When putting the specimen on the vibration table, the mechanism of "Armature center (neutral) position" starts to work to detect the position gap from the neutral position, automatically adjust it by air spring.



#### 5 Lead wire

Lead wires which supply current to drive coil are usually exposed to severe vibration. The wires need to be changed regularly and regarded as the consumable components. IMV vibration generator adapted the flexible cable, it is no longer consumable.



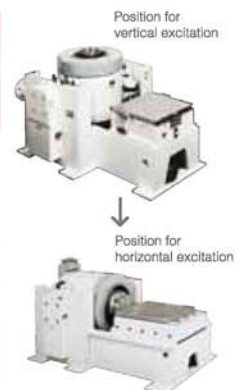
#### 6 Top Cover

FRP (Fiber Reinforced Plastics) top cover makes work maintenance easier and secures safety by covering the whole cable connection terminal.



#### 7 Approach to noise reduction

Our optimised design of top cover and intake for cooling air flow which are based on fluid dynamics have much lower air flow rate and air-intake noise if compares to conventional systems.



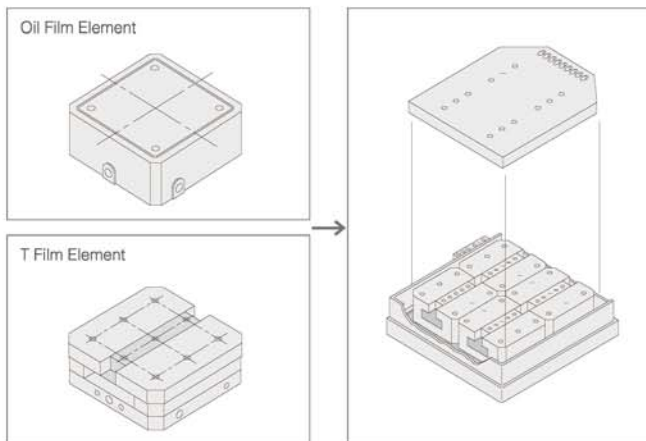


# Breaking through common knowledge of Horizontal Auxiliary Table

## T-Film Bearing type Horizontal Table

T-Film Bearing type Horizontal Tables support the horizontal vibration tables rigidly by the U.S.patented "T-Film Bearing Elements" and "Oil Film Elements" arranged in grid pattern. The oil films which are forming between the bottom of the tables and the top surface of these elements act to suppress their resonance modes. Horizontal Vibrations which free from serious transverse motions or waveform distortions are applied to the specimens of complicated dynamics. These T-Film Bearing type Horizontal Tables have been highly appreciated in the Aerospace industries as the standard type of the high quality vibration tests.

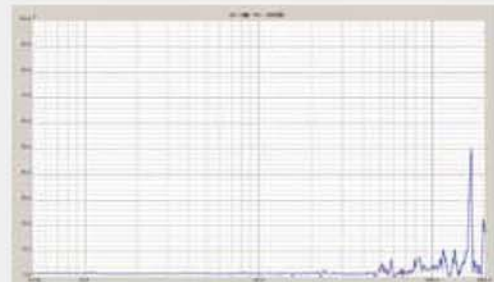
"T-Film Bearing Element" is excellent in rigidity and damping having a slider of high stiffness and a function to make an oil film on the top surface. "Oil Film Element" has a function to support load and give tables and specimen assemblies enough damping by means of an oil film. The effects of drastic reduction of vibration waveform distortion and transverse motions are achieved by proper arrangement of these elements



## Very little Transverse Motion

Transverse Motion smaller than 5% (typical) in the frequency range up to 1,500 Hz (Crosstalk sensitivity of accelerometer is about 1%) was achieved ,which had never been realised before.

X direction



Z direction



# Customised Produce

IMV Vibration Simulation Systems are used in various industries.

## Electrodynamic Multi-axis: 4 Posters



Accurate waveform regenerations are achieved in wide frequency range up to 500Hz by employing electrodynamic vibration generators as actuators.

## All Weather Simulation System



Combined Environmental Testing System combining vibration, surround temperature, gasoline circulation, oil circulation and rotational driving.

## Muffler Durability Test System



Heat and Vibration durability tests are possible by supplying 2-10m³/min, 200-900 °C hot air flow into mufflers.

## Turbine Blade Vibration Simulation System



Measurements of resonance frequency, resonance amplitude amplification factor and resonance dwell tests in turbine spinning temperature are possible.

## Dynamic Spring Constant measuring system



Highly accurate tests and analysis are possible in wide frequency range down from 1Hz up to 2000Hz.

## 2 Axial Simultaneous Vibration Simulation System with Sound Insulation Box



Usage of the sound insulation box to house the vibration generator assembly allows acoustic noise measuring on the exciting specimens. This system has high durability and easiness of maintenance.



### Squeak & Rattle Test System



Natural air cooling type aiming at evaluating Squeak & Rattle noise problem in dashboard or other in-car accessories.

### Thermal/Shock Combined Environmental Test System



Combined Environmental Test System provides Heat and Dynamic stress to the specimen simultaneously.

### Bi-Axial Sequential Vibration Simulation System for Combined Environmental Tests



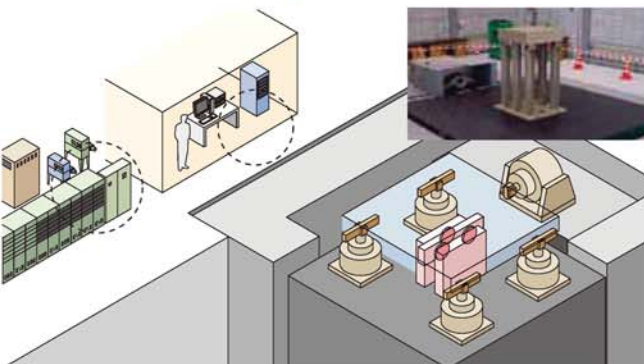
Temperature/Humidity Chamber moves up and down to carry out Vertical / Horizontal sequential vibration test in one chamber.

### Multi-axis All Weather Simulation System



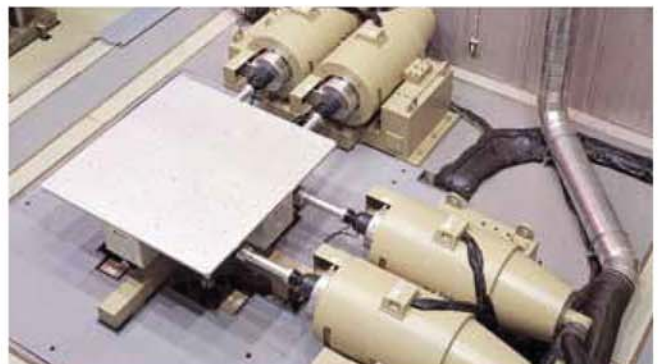
Multi-axis plus Combined Environmental Test System applied for simultaneous X,Y,Z directions vibration plus Heat, cool and humidity testing.

### Large Bi-axial Simultaneous Multi- point Excitation Vibration Simulation System



Large Vibration Simulation System with Table size: 4,500mmx4,500mm, Rated Horizontal Displacement: 400mm<sup>P-P</sup>, Rated Vertical Displacement: 200mm<sup>P-P</sup>, Rated Pay Load: 20,000Kg

### 6 Degree of Freedom Vibration Simulation System



Long stroke 6 Degree of Freedom Excitation reaching up to 100Hz or higher are realized by employing Hydro-static Spherical Couplings



# Customised Produce

IMV Vibration Simulation Systems are used in various industries.

## Large Exciting Force Vibration Simulation System



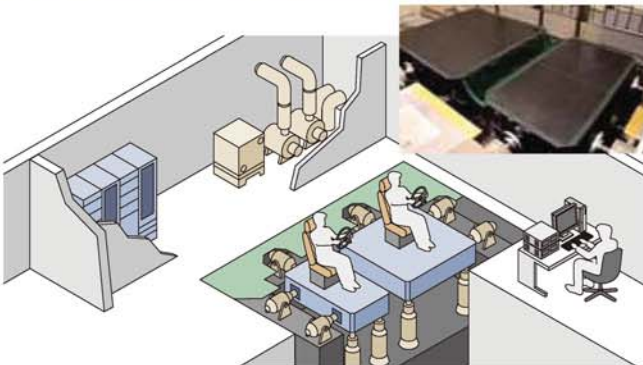
Excitation Force 294KN Rated Acceleration  $980\text{m/s}^2$   
Large force excitation in Wide frequency range is achieved.

## Multi-axial Multi-point Vibration Simulation System



Multi-point Vibration Simulation system of three axis simultaneous excitation by adding single axis excitation together can carry out tests of very long specimens in high frequency range.

## 6 DOF Ride Comfort Evaluation System



Road Data are accurately regenerated as 6 Degree of Freedom Motion. By use of 6 Axis Vibration Measurement System, ride comfort evaluation in accordance with ISO-2631 Mechanical vibration and shock –Evaluation of human exposure to whole-body vibration.

## 6 DOF Squeak Noise Evaluation System



Combined 8 compact vibration generators aiming at evaluation of squeak noise.

## Multi-axial Tire Dynamic Characteristics Measuring System



Tire Dynamic Characteristic Measuring system covering frequency range up to 500Hz. Electrodynamic Vibration Simulation System makes tests in high frequency range realised.

## Sensor Calibration Vibration Simulation System



Pure Single axis Vibration which had been hard to be generated by conventional single axis systems, is obtained by locating 4 vibration generators around the vibration table assembly.

### Earthquake Vibration Simulation System



Implementing a large electrodynamic vibration simulation system to simulate real earthquake generation.

### Human body Vibration Simulation System



Measurements and evaluations of vibration transmission through vibration isolation globes ( ISO10819)

### Long Stroke Low Frequency Vibration Simulation System



A system to regenerate low frequency vibrations of earthquakes. These systems are used for the production lines or any development purpose.

### Electrodynamic Mechanical Shock Simulation System



Mechanical shock test system used on the production line of passenger car air bag sensors. Mechanical shocks of long displacement are obtained in excellent accuracy.

### Energy Saving Vibration Simulation System



Energy Saving during vibration test is difficult for the conventional vibration generators to be realised. ECO-shaker automatically enable vibration tests carried out at optimum power consumption only by inputting normal test conditions.

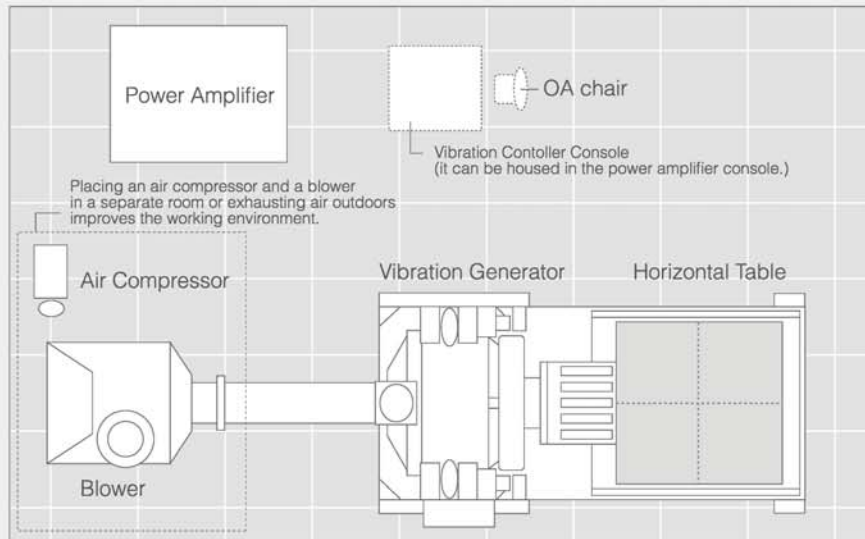
### Large-scale 6 DOF Vibration Simulation System



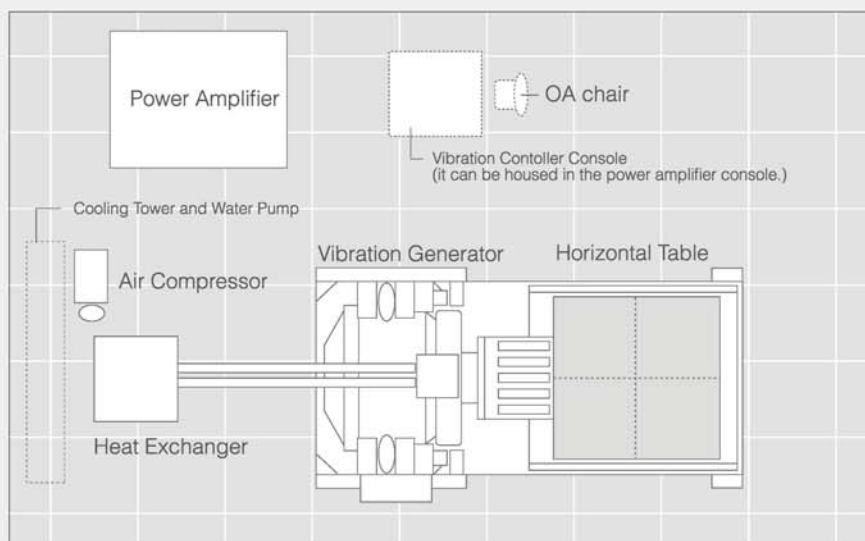
Combination of 10 vibration generators (6 vertical and 4 horizontal) and 4000 by 3500 millimeter large-scale table allows the simultaneous multi-point vibration testing. This versatile vibration platform is ideal for testing large items such as railway carriage parts and fuel battery.

# How to Select System

## Installation Image of Air cooling system (with an air cooled system and a horizontal table)

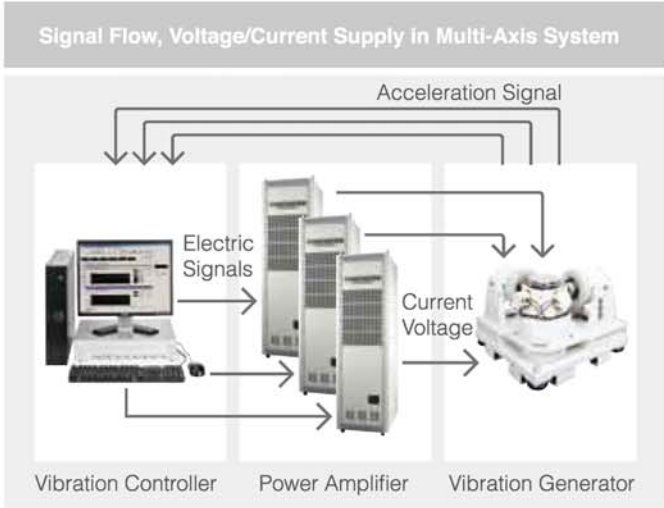
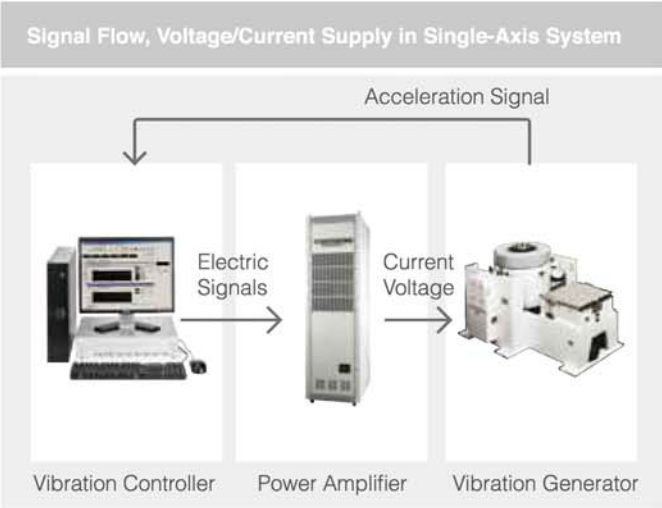


## Installation Image of Water cooling system (with an water cooled system and a horizontal table)





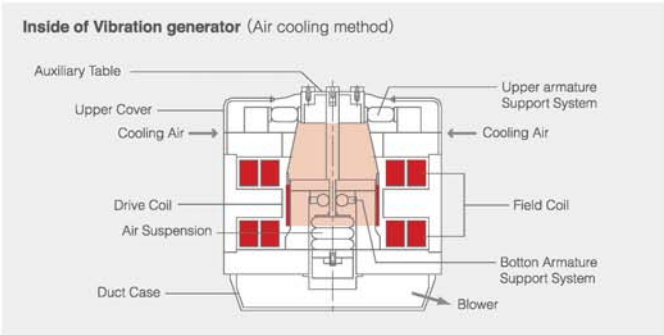
## Principles of Operation



### Vibration generator

The operation principle is based on "Fleming's left hand rule".

The formula below represents the Fleming's left hand rule.



### Cooling method of vibration generator

The Vibration Simulation System can employ either of two methods to cool : air or water cooling. Each method has its own key feature. Selecting a cooling method that meets to your installation requirements based on the key feature as below;

Cooling method	Air cooling	Water cooling
How to cool	Cools the coils by using air from outside. Forces exhaust by blower.	The coils are made of pipe and distilled water is circulated to cool the coils using a heat exchanger and a cooling tower.
Key feature	Employs only a blower as cooling equipment. Easy to install.	Operation noise is significantly lower compared to air cooling.
Points to ponder	Duct connection or soundproof treatments may be necessary to reduce suction noise from the vibration generator and exhaust noise from the blower.	A primary cooling water facility is necessary.

### Power Amplifier

A power amplifier in the system supplies electric power to the vibration generator. The power amplifier generates higher current of higher voltage in response to low power electric signals from the vibration controller.

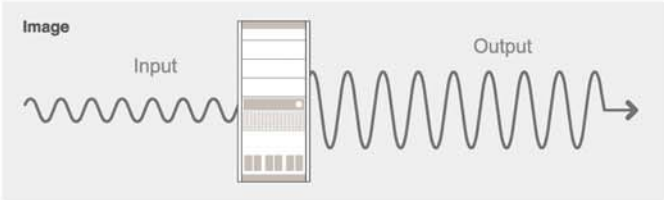
Electric power (VA)

=

Electric Voltage (V)

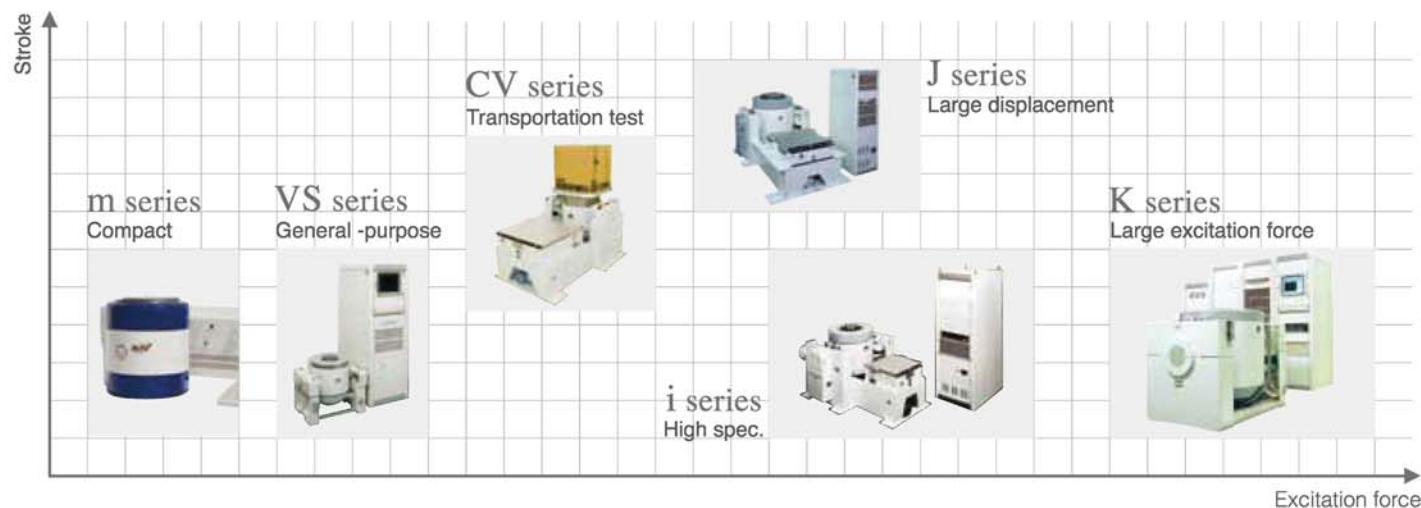
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Electric Current (A)



# Series Arrangements

## Vibration Simulation System Lineup Chart



	Automobile 	Aerospace 	Electronic Parts 	Information and Telecommunications 
EM series	*Reduction of Power Consumption* & *Improvement of Laboratory Environment*			
i•J VS series	Car Audio • Navigation system • Door mirror • Inverter • Motor • Light associated part • ECU associated part • Solenoid • Car-mounted meter • Electric power station motor • Combination meter • Fuel pump • Inlet system part • Hybrid associated part • ECU • Battery • Electric pump • Muffler • Catalyst • Fuel battery • ABS coil • Seat belt • Braking system	Personal monitor TV • Communications equipment • Resin product • Seal material • Dish • Chair • Aircraft engine component • Space environment utilization • Airborne equipment • Rocket-mounted equipment • Defense associated equipment	LCD television • Connector component • Car mounted electric component • General-purpose motor • In-rack equipment • PC • Printed-circuit board • Impact from transportation	Navigation system • Car mounted telecommunication equipment • Vending machine on the expressway • Industrial motor • Antenna associated component • Large antenna
CV series	Door mirror		Packaged products • Packaging & shipping • Usage environment shipping • Usage environment shipping • Major Home Appliance • Projector	Packaging associated component
K series	Brake • Catalyst • Heat insulation • Hydraulic sensor • Starter • alternator • muffler • Hybrid Motor • Battery • Sensor • dynamo • Power unit	Satellite equipment • Rocket-mounted component • Defense associated equipment • Rocket • Missile associated component • Propeller • Engine	Servomotor • Refrigerator • Heater • Washing machine • Major electronics	Large parabolic antenna • Antenna associated component
m series	Airconditioner vent • ETC • ITS device • Car-mounted sensor • Car audio • Navigation system		Board • Mobile phone • Mobile products • Electronic component • Compact motor	ETC for two-wheeled car • Mobile phone
Compact series	O <sub>2</sub> sensor • Exhaust sensor		Filled material • Piezoelectric element • Sensor associated component • SW associated component	
3 axis	Car Audio • Navigation system • Air conditioner • Vibration-proof mount • Radiator	Total Rocket • Total Space Vehicle	Real environmental shipping • Car audio • LCD panel • Major Home Appliance	Navigation system (Jumpness of HDD and DVD)
6 DOF	Ride quality • Construction equipment	Total Rocket • Total Space Vehicle		





	<b>Precision Equipment</b>	<b>Electrical Equipment</b>	<b>Transportation Environment</b>	<b>Usage Environment</b>
	Industrial robot • Digital camera • Lens • Optical equipment • Surface mounter associated component • Mobile phone • Copy machine • Video camera	Withstanding voltage transformer • Fuel battery • Inverter associated component • Space battery • Large lithium battery	Rail vehicle component • Equipment for construction • Shipping on a rough dirt road	Combination meter • Instrument panel associated component • Solar system • Other car-mounted component • PC
	Packaging products • Packaging & Shipment • Usage environment shipping • Video game instrument	Inverter equipment	Shipping medicines • Packaging products	Packaging material
		Large battery equipment	Rail vehicle component • Railway component	Display
	Medical Instrument • Usage board • Digital camera • Semiconductor component			Structure (Miniature)
	Video camera • Digital camera	Large battery equipment	Cushioning material	Earthquake simulation machine
				Cabin for construction equipment



**ThermoFisher**  
S C I E N T I F I C

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JQA-1573



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