

# AIR COOLED 'M' SERIES — I VIBRATION TESTING SYSTEMS

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© Swept Sine

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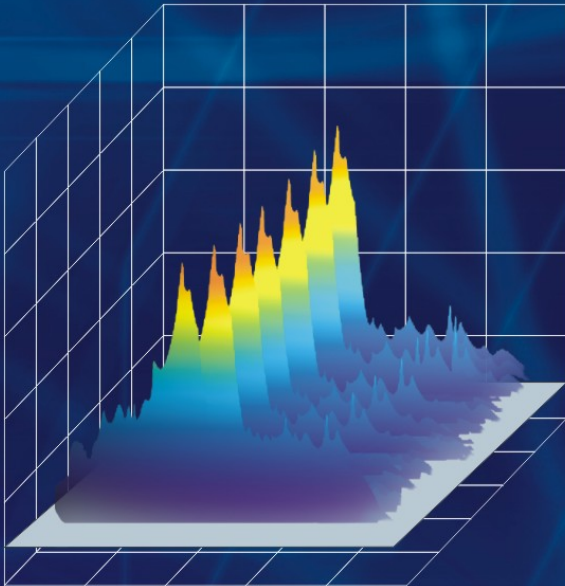
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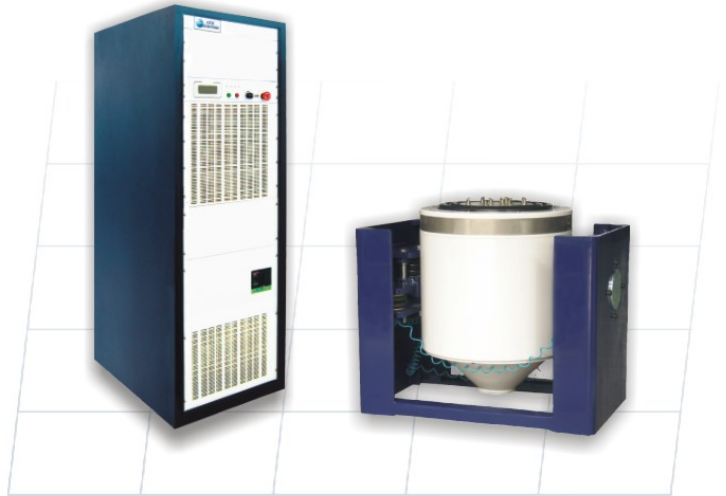
# Vibration Testing System — 'M' Series- I

Vibration system rating from  
1,000 kgf to 3,000 kgf.

## System Models:

MPA403/M124M  
MPA404/M232A  
MPA406/M232A  
MPA406/M337A

The 'M' Series-I vibration testing system is ideal for screening of small size assemblies with high acceleration test requirements, and can also meet typical vibration test requirements of other medium sized electronic assemblies, automotive components, road navigation units and home appliances. The 'M' Series-I is designed to meet military and international test standards including MIL, ASTM, IEC, ISO, BS and JIS. A wide diameter armature with high cross axial stiffness when coupled to proportional head expander to test multiple specimens simultaneously yet achieving a good vibration transmissibility ratio. Other test requirements including transportation vibration simulation, combined vibration-climatic test and seismic simulations for small size components can easily be fulfilled by the 'M' Series- I.



## Features

### The Performance

- ⊙ Specimen payload up to 500 kg
- ⊙ Excellent random performance meeting ISO standard with 3 sigma peak current rating
- ⊙ Armature diameters range from 240 mm to 370 mm
- ⊙ Up to 51mm continuous displacement
- ⊙ Test frequency up to 3,000 Hz

### The Shaker

- ⊙ Rugged trunnion design with bearing guidance
- ⊙ Air bag or elastomer isolator built-in reducing dynamic floor stress
- ⊙ Dual layer reinforced armature for high acceleration performance
- ⊙ Roller-truss flexure suspension system with high cross axial stiffness

### The Amplifier

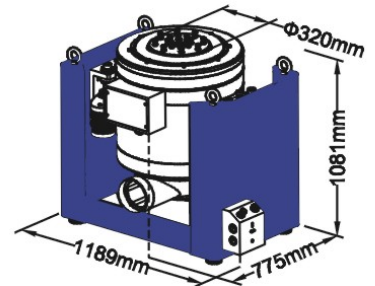
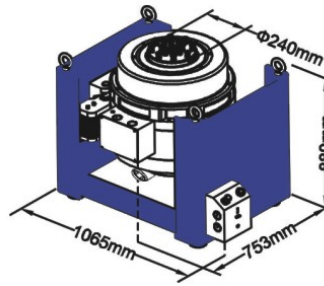
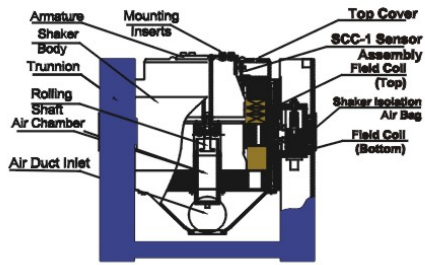
- ⊙ Integrated with high performance MPA400 Series amplifier
- ⊙ Modular designed amplifier
- ⊙ 12kVA power module with two self-reliant compact 6kVA sub-modules
- ⊙ High modulation switching frequency
- ⊙ High signal to noise ratio
- ⊙ Low total harmonic distortion
- ⊙ Individual power module operation indication light

### The Accessories

- ⊙ Air load support for armature centering
- ⊙ Dynamic and static armature centering available
- ⊙ Rotary worm-gear built-in for uni-base slip table
- ⊙ Thermal barrier for combined climatic chamber test available
- ⊙ Remote control capabilities available

## Benefits

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>✓ Simple system operation</li> <li>✓ State-of-the-art microprocessor logic control unit</li> <li>✓ High energy conversion efficiency (greater than 90%)</li> <li>✓ Reasonably priced optimal</li> <li>✓ Operational system for major test standards</li> <li>✓ Compact shaker and amplifier size saving valuable floor space</li> </ul> | <ul style="list-style-type: none"> <li>✓ Shaker air cooled by rugged outdoor blower for continuous long period operation</li> <li>✓ Air cooled amplifier power electronics for safe and reliable operation</li> <li>✓ Designed to reduce reliance on mechanical switch gears with CPU logic controlled</li> <li>✓ All-encompassing fuse protection designs for high current system components</li> <li>✓ Detailed scope of system interlock protections</li> <li>✓ Complies with USA, European and international safety and EMC regulations</li> </ul> |
| <ul style="list-style-type: none"> <li>✓ Compatible with any vibration controller</li> <li>✓ Remote control panel available with full functional features</li> <li>✓ Low profile body design ready for chamber integration</li> <li>✓ Integration with unibase or standalone slip table</li> </ul>   | <ul style="list-style-type: none"> <li>✓ Simple initial self system setup</li> <li>✓ Interactive diagnostic "System Status" displayed on LCD</li> <li>✓ Easy maintenance and rapid servicing</li> <li>✓ Full three years warranty on armature and field coil</li> <li>✓ Worldwide spare parts support</li> </ul>   |



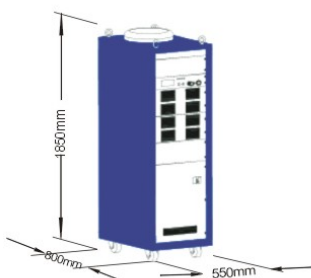
System Model	MPA403/M124M	MPA404/M232A
Sine Force	1,000 kgf	1,500 kgf
Random Force	1,000 kgf	1,500 kgf
Shock Force (6 ms)	2,000 kgf	3,000 kgf
Usable Frequency Range	DC-4,500 Hz	DC-3,000 Hz
Continuous Displacement ①	51 mm	51 mm
Shock Displacement	51 mm	51 mm
Max. Velocity (Sine)	2 m/s	2 m/s
Max. Acceleration (Sine)	981 m/s <sup>2</sup>	735.8 m/s <sup>2</sup>

Shaker Unit	M124M	M232A
Armature Diameter	240 mm	320 mm
Effective Moving Element Mass	10 kg	20 kg
Load Attachment Points	16 stainless steel inserts	16 stainless steel inserts
Inserts Size (Standard)	M10	M10
Grid Pattern (Diameter, Circle)	8 on 100 mm $\phi$ ; 8 on 200 mm $\phi$	8 on 120 mm $\phi$ ; 8 on 250 mm $\phi$
Nominal, Bare Table ②	3,700 Hz	2,500 Hz
Max. Static Payload	140 kg	300 kg
Natural Frequency-Thrust Axis	<5 Hz	<5 Hz
Stray Flux Density ③	Less than 10 gauss	Less than 10 gauss
Dimension(Uncrated)( L x W x H)	1065x753x880 mm	1189x775x1081 mm
Shaker Weight (Uncrated)	960 kg	1,650 kg

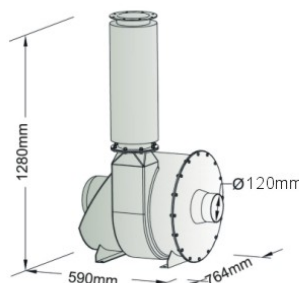
Amplifier Unit	MPA403	MPA404
Amplifier Output	13 kVA	16 kVA
Total Harmonic Distortion (At Rated Output)	From DC(0.1 Hz) to 500 Hz less than 0.5%; From 500 Hz to 4,500 Hz less than 1.0%	
Signal-Noise-Ratio	More than 65 dB at 100 V rms output, 10 K $\Omega$ input termination with rated resistive load	
DC Stability	Less than 0.05% of full output voltage with 10% change in line voltage	
Input Drive	1.5 V rms into 10 K $\Omega$ for full output (120 V rms)	
Amplifier Frequency Response ④	From DC(0.1 Hz) to 4,500 Hz: $\pm 3$ dB; From 10 Hz to 3,000 Hz: $\pm 1$ dB	
Switching Frequency	112 kHz	112 kHz
Max. Output Voltage	120 V rms	120 V rms
Max. Output Current Per Module (Continuous)	50 A rms	50 A rms
Max. Output Current Per Module (Transient)	150 A rms	150 A rms
Amplifier Efficiency	> 90%	> 90%
Dimension(Uncrated)( L x W x H)	550x800x1850 mm	550x800x1850 mm
Amplifier Weight (Uncrated)	420 kg	540 kg

Blower Unit	HP-2	HP-3
Power Requirement	4 kW	7.5kW
Air Flow	0.25 m <sup>3</sup> /s	1.14 m <sup>3</sup> /s
Air Pressure	0.048 kgf/cm <sup>2</sup>	0.052 kgf/cm <sup>2</sup>
Dimension(Uncrated)( L x W x H)	590x764 x 1280 mm	920x794x1700 mm
Weight (Uncrated)	153 kg	230 kg

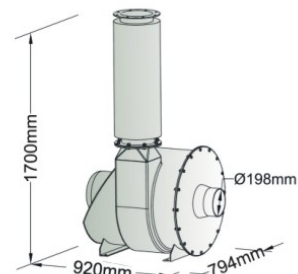
### MPA400 Series

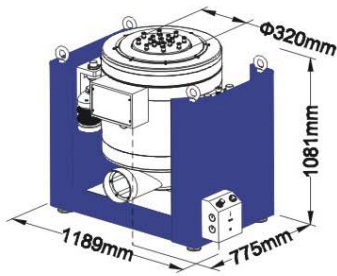


### HP-2



### HP-3





Metric

**MPA406/M232A**

2,000 kgf  
2,000 kgf  
4,000 kgf  
DC-3,000 Hz  
51 mm  
51 mm  
2 m/s  
981 m/s<sup>2</sup>

**M232A**

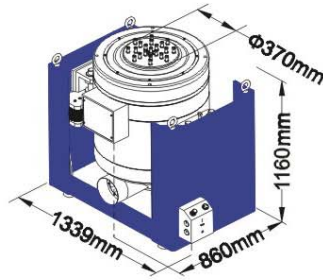
320 mm  
20 kg  
16 stainless steel inserts  
M10  
8 on 120 mm  $\phi$ ; 8 on 250 mm  $\phi$   
2,500 Hz  
300 kg  
<5 Hz  
Less than 10 gauss  
1189x775x1081 mm  
1,650 kg

**MPA406**

21 kVA  
From DC(0.1 Hz) to 500 Hz less than 0.5%; From 500 Hz to 5,000 Hz less than 1.0%  
More than 65 dB at 100 V rms output, 10 K  $\Omega$  input termination with rated resistive load  
Less than 0.05% of full output voltage with 10% change in line voltage  
1.5 V rms into 10 K  $\Omega$  for full output (120 V rms)  
From DC(0.1 Hz) to 4,500 Hz:  $\pm 3$  dB; From 10 Hz to 3,000 Hz:  $\pm 1$  dB  
112 kHz  
120 V rms  
50 A rms  
150 A rms  
> 90%  
550x800x1850 mm  
550 kg

**HP-3**

7.5 kW  
1.15 m<sup>3</sup>/s  
0.053 kgf/cm<sup>2</sup>  
920x794x1700 mm  
230 kg



Metric

**MPA406/M337A**

3,000 kgf  
3,000 kgf  
6,000 kgf  
DC-2,500 Hz  
51 mm  
51 mm  
2 m/s  
981 m/s<sup>2</sup>

**M337A**

370 mm  
30 kg  
16 stainless steel inserts  
M10  
8 on 150 mm  $\phi$ ; 8 on 300 mm  $\phi$   
2,350 Hz  
500 kg  
<5 Hz  
Less than 10 gauss  
1339x860x1160 mm  
2,470 kg

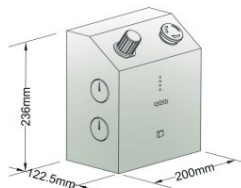
**MPA406**

28 kVA  
From DC(0.1 Hz) to 500 Hz less than 0.5%; From 500 Hz to 5,000 Hz less than 1.0%  
More than 65 dB at 100 V rms output, 10 K  $\Omega$  input termination with rated resistive load  
Less than 0.05% of full output voltage with 10% change in line voltage  
1.5 V rms into 10 K  $\Omega$  for full output (120 V rms)  
From DC(0.1 Hz) to 4,500 Hz:  $\pm 3$  dB; From 10 Hz to 3,000 Hz:  $\pm 1$  dB  
112 kHz  
120 V rms  
50 A rms  
150 A rms  
> 90%  
550x800x1850 mm  
570 kg

**HP-3**

7.5 kW  
1.17 m<sup>3</sup>/s  
0.055 kgf/cm<sup>2</sup>  
920x794x1700 mm  
230 kg

**Servo Control Console (SCC-1 Unit)**



**Remote Control Panel (RCP)**



**Basic Guide on Choosing Shaker**

**Guide 1 - Determine Required Shaker Force Rating**

Using the fundamental formula ( $F = MA$ ), to determine the required shaker force rating. Below is a more detailed illustration.

$$F = (M_a + M_f + M_s) \cdot A$$

Where:

- F = Shaker required Rated Force (N)
- M<sub>a</sub> = Armature Effective Mass
- M<sub>f</sub> = Fixtures mass
- M<sub>s</sub> = Test Specimen Mass
- A = Acceleration

**Guide 2 - Calculating Displacement and Velocity Factor**

Below is an illustration on the fundamental sinusoidal vibration relationship between acceleration, velocity, displacement and frequency.

	SI Units	Gravitational Units	Imperial Units
Force (F)	N	kgf	lbf
Mass	kg	kg	lbs
Acceleration (A)	m/s <sup>2</sup>	G	G
Frequency (f)	Hz	Hz	Hz
Displacement (D)	mm (pk - pk)	mm (pk - pk)	in (pk - pk)

**Useful Conversion Factor**

Force	1 kgf = 9.807 N	1 kgf = 2.2 lbf
Mass	1 kg = 2.2 lbs	
Acceleration	1 G = 9.807 m/s <sup>2</sup>	
Length	1 inch = 25.4 mm	
Velocity	1 m/s = 39.37 in/s	

**Remarks**

- ① Test payload should be less than 10% of shaker weight.
- ② Natural frequency at  $\pm 5\%$  tolerance.
- ③ Measured at 152 mm above armature table.  
Contact us for lower gauss level requirement.
- ④ Sine mode, resistive load.
- ⑤ Optional Remote Control Panel.
- ⑥ Amplifier power rating includes the field supplies and blower motor.

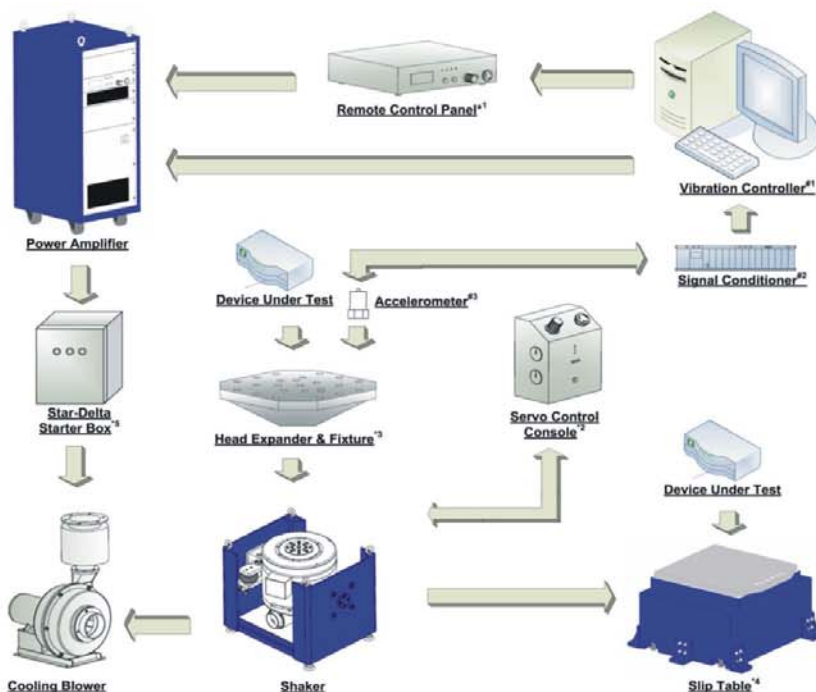
# Vibration Testing and Why?

The use of vibration in Environmental Stress Screening (ESS) has expanded from the past in purely military applications until today commonly applied in the commercial sector. The use of ESS becomes a standard customer-defined requirement in the aerospace and defence-related products to ensure safe operation of critical equipment. Commercial product manufacturers today typically have full ESS programs in place with vibration test or combined with thermal cycling. The ESS programs are designed to comply with military and other international standards such as MIL, ASTM, IEC, ISO, BS etc.

The use of vibration in ESS has been proven to be a way to increase product reliability. It is also a tool to assist engineers in the product development process. Simulating the environment condition on the developing product will allow the design engineer to classify and analyze screening data to identify problem areas and recommend early corrective action.

Vibration testing as a part of ESS ensures the occurrence of failures in the product infantile period is precipitated "artificially". These failures then occur before the units leave the manufacturing facility, dramatically improving field reliability. The optimal screening will maintain field failure cost savings.

## Vibration Testing System Setup



### Prerequisite System Components

- #1 Vibration controller required for test profiling control. ETS shakers are compatible with all major vibration controllers.
- #2 Signal Conditioner required to provide current source for accelerometer or function as a charge amplifier.
- #3 Accelerometer built-in amplifier type or charge-type for signal feedback to vibration controller or data acquisition.

ETS is able to provide a complete system package with a suitable controller of your choice. Please contact ETS for a quote.

### Shaker Accessories Units

- \*1 Optional Remote Control Panel with full logic module replication function at remote site of up to 500m.
- \*2 Servo Control Console for static and dynamic and armature auto-centering.
- \*3 Customised head expanders and fixtures. Contact ETS for more information.
- \*4 Different sizes of slip table available for horizontal testing. Contact ETS for more information.

# Operating Environmental Data

Operating Environment	MPA403/M124M	MPA404/M232A	MPA406/M232A	MPA406/M337A
Max. Heat Rejection to Air(Shaker)(kW)	0.8	1.25	1.5	2.23
Max. Heat Rejection to Air(Amplifier)(kW)	2.03	2.7	3.15	4.35
Max. Heat Rejection to Air(Blower )(kW)	3.4	6.38	6.38	6.38
Working Ambient Temperature (°C)*	5~35	5~35	5~35	5~35
Working Ambient Pressure (mPa)	0.1	0.1	0.1	0.1
Relative Humidity (Non Condensing)	≤80%	≤80%	≤80%	≤80%
Max. Acoustic Noise(dB)	92	92	92	92
Temperature Range of Air Flow at Shaker Inlet (°C)	0~35	0~35	0~35	0~35
Air Line Supply Required (Compressed Air Supply) (bar)	8	8	8	8
Input Voltage (Standard)	380 VAC, 50 Hz, 3 Phase			
Power Requirements(kW)	22	36	42	58

\*Full power to 35°C, derate at 5% per °C to 50°C.

# System Options

System Options	MPA403/M124M	MPA404/M232A	MPA406/M232A	MPA406/M337A
<b>Table Inserts</b>				
M10	■	■	■	■
M12	□	□	□	□
1/2"UNC	□	□	□	□
3/8"UNC	□	□	□	□
Internal Load Support	■	■	■	■
Thermal Barrier	□	□	□	□
Unibase Slip Table	□	□	□	□
Air Caster	□	□	□	□
Degauss Coil	■	■	■	■
Air Compensator	□	□	□	□
Air Isolated Trunnion	■	■	■	■
Geared Aided Rotation(Ratchet Crank)	—	■	■	■
Servo Control Console(SCC-1 Unit)	■	■	■	■
Auxiliary Interlock Unit (AIU)	□	□	□	□
Remote Control Panel (RCP)	□	□	□	□

■ Standard    □ Optional    — Not Available

Specifications are correct at the time of publication. In keeping with our commitment to continuous product improvement, the information herein is subject to change. ETS reserves the rights to amend specifications without prior notice.



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