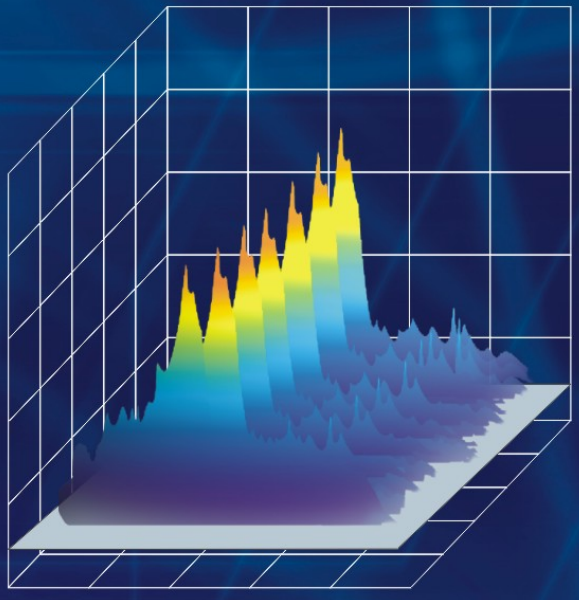
AIR COOLED 'LS' SERIES VIBRATION TESTING SYSTEMS

◎Classical Shock
◎Random Test
◎Sine-on-Random
◎Swept Sine
◎Sine and Random on Random
◎Step Sine
◎Sine Resonance Phase Track & Dwell
◎Random-on-Random
◎Shock Response Spectra
◎Road Simulation



◎Shaker Systems
◎Power Amplifier
◎Vertical Guidance System
◎Guided Oil Film Slip Tables
◎Hydrostatic Bearing Slip Tables
◎Load Bearing Platform
◎Head Expanders
◎Customized Fixtures
◎Combined Vibration - Climatic System
◎Vibration Control System

ets solutions
ADVANCING TECHNOLOGY IN DYNAMIC TESTING

Vibration Testing System — 'LS' Series

Vibration system rating from
1,500 kgf to 4,000 kgf.

System Models:

MPA404/LS232A
MPA406/LS232A
MPA406/LS437A
MPA408/LS437A

The Long Stroke Series vibration testing systems are designed for long stroke displacement test requirements normally performed by hydraulic shakers. Compared to a hydraulic shaker where maximum test frequency is typically around 400 Hz. The Long Stroke Series is capable to testing up to 3,000 Hz with a maximum of 100 g (bare table) bounded by 2 m/s maximum velocity. This provides users time and cost savings for wide test requirements. These shakers are suitable for test application such as package testing and vehicle testing.

Features

The Performance

- ◎ Specimen payload up to 800 kg
- ◎ Excellent random performance meeting ISO standard with 3 sigma peak current rating
- ◎ Armature diameters ranges from 320 mm to 370 mm
- ◎ Up to 90mm continuous displacement
- ◎ Test frequency up to 3,000 Hz

The Shaker

- ◎ Rugged trunnion design with bearing guidance
- ◎ Air bag isolator built-in reducing dynamic floor stress
- ◎ Dual layer reinforced armature for high acceleration performance
- ◎ Roller bearing flexture with load support bearing suspension system achieving high cross axial stiffness

The Amplifier

- ◎ Integrated with high performance MPA400 Series amplifier
- ◎ Modular designed amplifier
- ◎ 12 kVA power module with two self-reliant compact 6 kVA 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

Operational Reliability & Safety

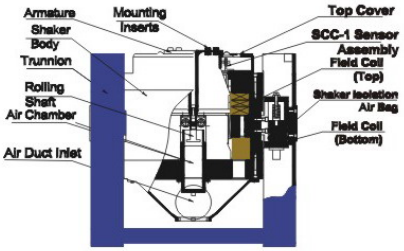
- ✓ Simple system operation
- ✓ State-of-the-art microprocessor logic control unit
- ✓ High energy conversion efficiency (greater than 90%)
- ✓ Reasonably priced optimal performance system for major test standards
- ✓ Compact shaker and amplifier size saving valuable floor space
- ✓ Shaker air cooled by rugged outdoor blower for continuous long period operation
- ✓ Air cooled amplifier power electronics for safe and reliable operation
- ✓ Designed to reduce reliance on mechanical switch gears with CPU logic controlled
- ✓ All-encompassing fuse protection designs for high current system components
- ✓ Detailed scope of system interlock protections
- ✓ Complies with USA, European and international safety and EMC regulations

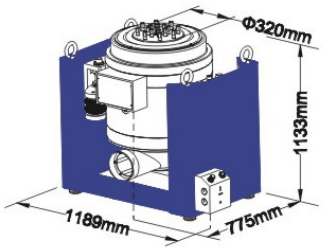
Compatiblilty

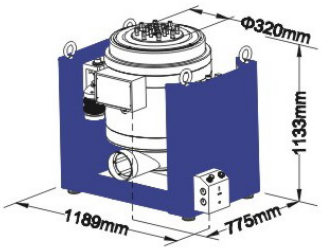
- ✓ Compatible with any vibration controller
- ✓ Remote control panel available with full functional features
- ✓ Low profile body design ready for chamber integration
- ✓ Integration with unibase or standalone slip table

Serviceability

- ✓ Simple initial self system setup
- ✓ Interactive diagnostic "System Status" displayed on LCD
- ✓ Easy maintenance and rapid servicing
- ✓ Full three years warranty on armature and field coil
- ✓ Worldwide spare parts support

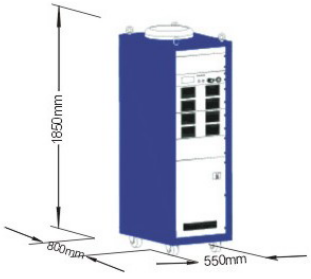




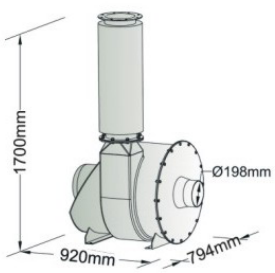


System Model	Metric MPA404/LS232A	Metric MPA406/LS232A
Sine Force	1,500 kgf	2,000 kgf
Random Force	1,500 kgf	2,000 kgf
Shock Force (6 ms)	3,000 kgf	4,000 kgf
Usable Frequency Range	DC-3,000 Hz	DC-3,000 Hz
Continuous Displacement①	90 mm	90 mm
Shock Displacement	100 mm	100 mm
Max. Velocity (Sine)	2 m/s	2 m/s
Max. Acceleration (Sine)	686.7 m/s^2	882.9 m/s^2
Shaker Unit	**LS232A**	**LS232A**
Armature Diameter	320 mm	320 mm
Effective Moving Element Mass	22 kg	22 kg
Load Attachment Points	16 stainless steel inserts	16 stainless steel inserts
Inserts Size (Standard)	M10	M10
Grid Pattern (Diameter, Circle)	8 on 120 mm Φ;8 on 250 mm Φ	8 on 120 mm Φ;8 on 250 mm Φ
Nominal, Bare Table ②	2,400 Hz	2,400 Hz
Max. Static Payload	300 kg	300 kg
Natural Frequency-Thrust Axis	<5 Hz	<5 Hz
Stray Flux Density③	Less than 5 gauss	Less than 5 gauss
Dimension(Uncrated)(L x W x H)	1189x775x1133 mm	1189x775x1133 mm
Shaker Weight (Uncrated)	1,700 kg	1,700 kg
Amplifier Unit	**MPA404**	**MPA406**
Amplifier Output	16 kVA	21 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 KΩ 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 KΩ for full output (120 V rms)	
Amplifier Frequency Response④	From DC(0.1 Hz) to 4,500 Hz:± 3 dB; From 10 Hz to 3,000 Hz:±1dB	
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)	540 kg	550 kg
Blower Unit	**HP-3**	**HP-3**
Power Requirement	7.5 kW	7.5 kW
Air Flow	1.16 m^3/s	1.17 m^3/s
Air Pressure	0.054 kgf/cm^2	0.055 kgf/cm^2
Dimension(Uncrated)(L x W x H)	920x794x1700 mm	920x794x1700 mm
Weight (Uncrated)	230 kg	230 kg

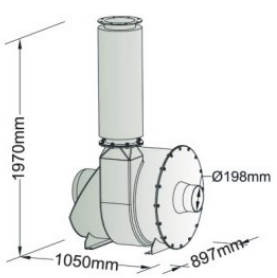
MPA400 Series

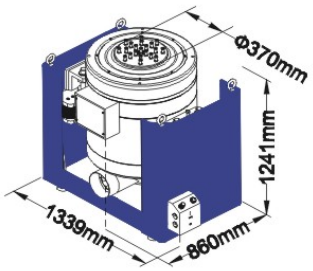


HP-3



HP-4





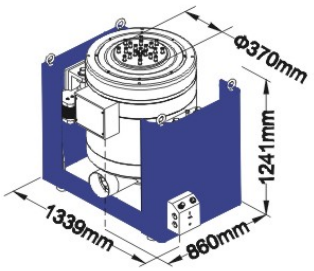
Metric

MPA406/LS437A
3,060 kgf
3,060 kgf
6,120 kgf
DC-2,500 Hz
90 mm
100 mm
2 m/s
882.9 m/s²

LS437A
370 mm
34 kg
20 stainless steel inserts
M10
4 on 100 mm ϕ ;8 on 200 mm ϕ ;8 on 300 mm ϕ
2,200 Hz
500 kg
<5 Hz
Less than 5 gauss
1355x860x1241 mm
2,800 kg

MPA406
30 kVA
From DC(0.1Hz) to 500 Hz less than 0.5%; From 500 Hz to 4,500 Hz less than 1.0%
More than 65 dB at 100 V rms output, 10 KΩ 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 KKΩ for full output (120 V rms)
From DC(0.1 Hz) to 4,500 Hz: ±3 dB; From 10 Hz to 3,000 Hz: ±1dB
112 kHz
120 V rms
50 A rms
150 A rms
> 90%
550x800x1850 mm
550 kg

HP-3
7.5 kW
1.19 m³/s
0.062 kgf/cm²
920x794x1700 mm
230 kg



Metric

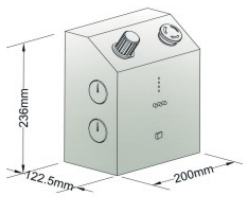
MPA408/LS437A
4,000 kgf
4,000 kgf
8,000 kgf
DC-2,500 Hz
90 mm
100 mm
2 m/s
981 m/s²

LS437A
370 mm
34 kg
20 stainless steel inserts
M10
4 on 100 mm ϕ ;8 on 200 mm ϕ ; 8 on 300 mm ϕ
2,200 Hz
800 kg
<5 Hz
Less than 5 gauss
1355x860x1241 mm
2,800 kg

MPA408
40 kVA
From DC(0.1Hz) to 500 Hz less than 0.5%; From 500 Hz to 4,500 Hz less than 1.0%
More than 65 dB at 100 V rms output, 10 KΩ 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 KKΩ for full output (120 V rms)
From DC(0.1 Hz) to 4,500 Hz: ±3 dB; From 10 Hz to 3,000 Hz: ±1dB
112 kHz
120 V rms
50 A rms
150 A rms
> 90%
550x800x1850 mm
590 kg

HP-4
15 kW
1.361 m³/s
0.075 kgf/cm²
920x794x1700 mm mm
290 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 = (Ma + Mf + Ms) *A

Where:

F = Shaker required Rated Force (N)

Ma = Armature Effective Mass

Mf = Fixtures mass

Ms = 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/s²	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/s²
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 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.

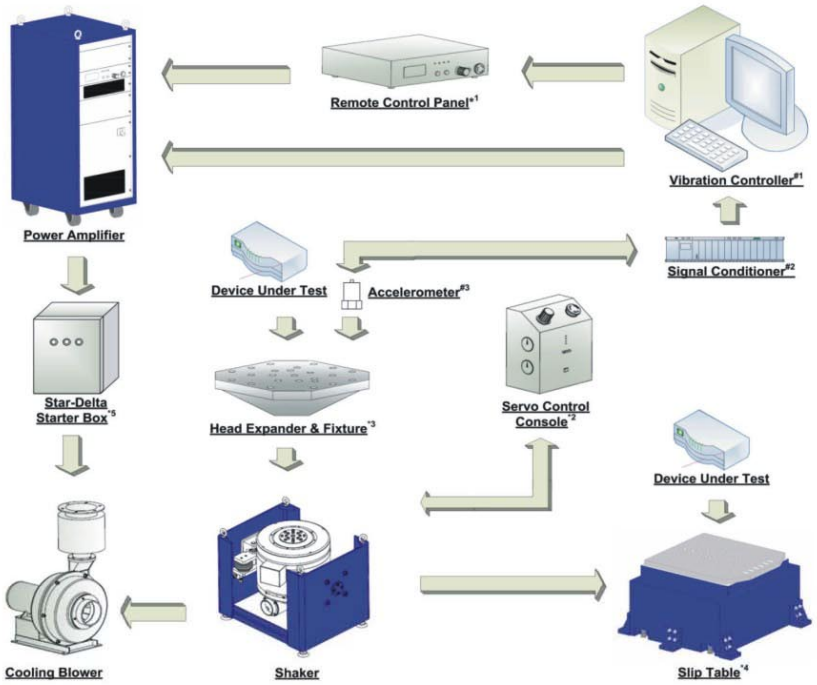
Vibration Testing and Why?

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 analyse 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 500 m.

*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	MPA404/LS232A	MPA406/LS232A	MPA406/LS437A	MPA408/LS437A
Max. Heat Rejection to Air(Shaker)(kW)	1.25	1.5	2.18	2.23
Max. Heat Rejection to Air(Amplifier)(kW)	2.7	3.15	3.9	4.35
Max. Heat Rejection to Air(Blower)(kW)	6.38	6.38	6.38	12.75
Working Ambient Temperature (℃)*	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(℃)	0~35	0~35	0~35	0~35
Air Line Supply Required(Compressed Air) (bar)	8	8	8	8
Input Voltage (Standard)	380 VAC, 50 Hz, 3 Phase			
Power Requirements(kW)	36	42	58	70

*Full power to 35 ℃, derate at 5% per ℃ to 50 ℃

System Options

System Options	MPA404/LS232A	MPA406/LS232A	MPA406/LS437A	MPA408/LS437A
Table Inserts				
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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