

MOTION SYSTEMS

PERFORMANCE, RELIABILITY,
AND GLOBAL SUPPORT FOR
SIMULATION SOLUTIONS



Rev E, March 2021

MOTION BASES FOR A WIDE VARIETY OF
PAYLOAD AND STROKE APPLICATIONS



LATEST SOLUTIONS FROM A WORLD LEADER IN ELECTRIC MOTION SYSTEMS

Unsurpassed innovation and technological expertise combined with close customer collaboration make Moog a leader in the design and development of 6-Degree of Freedom (DOF) motion platforms.

With 40 years of high fidelity performance associated with legacy systems, we have become synonymous with electric technology since designing the first 4,500 kg (10,000 lb) electric platform in 1994. In fact, Moog motion systems provide the highest level of performance available in the industry.

Around the world, our motion platforms for payloads ranging from 1,000 kg to 16,000 kg (2,200 to 38,000 lb) help customers provide highly realistic motion cues in simulators for trucks, armored vehicles, tanks, trains, and fixed wing and rotary wing aircraft.

Working closely with customers to provide solutions that are precisely matched to their unique requirements, our design teams offer a wealth of technical knowledge and real-world experience for all 6-DOF and special systems.

Our turnkey approach encompasses complete systems including motion bases, generic- or application-specific software, training, replacement parts, repair, and assistance in tuning, installation and system acceptance.

Advantages:

- High performance motion cueing and tuning algorithms provide high fidelity and the smallest turn around bump available
- High reliability with digital control loops that do not drift or deteriorate for greater fidelity
- High degree of modularity for greater flexibility in system design for easy integration with control loading, vibration tables and G-seats
- Cost-effective design and operation
- Redundant mechanical and software safety architecture provides virtually the safest system on the market
- Built-in test features that record performance parameters
- Integrated features such as return to home upon critical failure mode
- Easy to install, use and maintain
- Simple troubleshooting via Moog Simulation Software including a new GUI and deterministic error codes
- Extensive product support and service facilities in Europe, Americas and Asia/Pacific

HELPING YOU MEET TODAY'S SIMULATION CHALLENGES

Around the world, our forward-thinking engineers help customers design and implement motion platform solutions that set new standards in performance, fidelity and versatility. Through close collaboration and a willingness to tailor our approach to meet your unique needs, Moog gives you the leadership edge.

Higher levels of fidelity with the latest technology

Increased reliance on simulator-based pilot training drives the need for constant innovation in training systems. Our second generation level B, C or D certified all-electric solutions are designed to offer an unprecedented level of fidelity to match the motion cues to the sophisticated visuals and the reliability needed to ensure more availability. Our systems are delivered with Moog Simulation Software, a single real-time interface for system installation, maintenance, tuning and troubleshooting.

Adding flexibility to training systems

Our integrated systems can accommodate payloads from low to high and can meet the training needs of customers including business jets, commercial aircraft, helicopters and new categories like Very Light Jets (VLJs). Common software and hardware interfaces across all our subsystems mean easier and faster installation, commissioning and user training. Our experience means we can help you reduce development time and ensure that the subsystems we recommend have the best performance/size ratio to meet your exact requirements.

EMC compliance

Moog motion systems are compliant with the Electromagnetic Compatibility (EMC) directive, which aims to ensure that electromagnetic interference does not affect the performance of products and systems.

Tapping into worldwide support

The surging demand for pilot training in developing countries means OEMs and training centers require a partner with global reach and experience. Over the years, we've installed more than 1,400 simulators working in tandem with some of the world's most recognized organizations. In addition, our operations in 25 countries worldwide mean that a team of trained engineers is there to support you wherever you are.

Finding the right solution

Our deep knowledge of motion platforms ensures you have resources and the proven solutions you require to meet your specific challenges. Incorporating advances in motion control, Moog is there for you with ideas, expertise and ongoing support. With many legacy systems currently in the field, we can upgrade your equipment from analog to digital without needing to replace it.

SPECIAL SYSTEMS

When you require a performance envelope that has to be customized we can meet your needs.

With special payloads, stroke lengths, motion cueing changes, number of DOF or platform characteristics Moog can precisely match your unique application.

Contact us through www.moogsimulation.com.



Turret Test System



8-DOF system with tilt table



7-DOF system with lateral rail



5-DOF



Vibration Platform



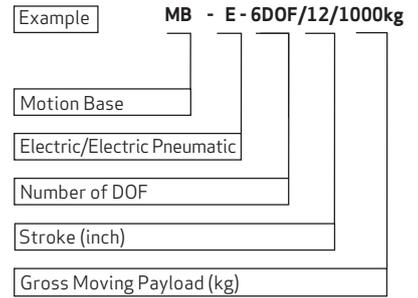
2-DOF

SPECIFICATIONS

Specifications below show minimum capabilities based on software limiting. Additional performance is readily available.

Model	MB-E-6DOF/12/1000KG	MB-E-6DOF/12/1500KG
DOF max. excursion		
Surge (single) (max.)	-0.24 m/+0.27 m -9.5 in/+10.8 in -0.24 m/+0.28 m -9.6 in/+10.9 in	
Sway (single) (max.)	± 0.23 m ± 9.2 in ± 0.24 m ± 9.3 in	
Heave (single) (max.)	± 0.19 m ± 7.5 in ± 0.19 m ± 7.6 in	
Roll (single max.)	± 19.6 ° ± 20.0 °	
Pitch (single max.)	-19.0 °/+19.8 ° -19.3 °/+20.1 °	
Yaw (single max.)	± 23.3 ° ± 23.7 °	
DOF max. velocity		
Surge	± 0.51 m/s ± 20.0 in/s	
Sway	± 0.51 m/s ± 20.0 in/s	
Heave	± 0.30 m/s ± 12.0 in/s	
Roll	± 30.0 °/s	
Pitch	± 30.0 °/s	
Yaw	± 40.0 °/s	
DOF max. acceleration		
Surge	± 5.9 m/s ² ± 0.60 g	
Sway	± 5.9 m/s ² ± 0.6 g	
Heave	-4.9 m/s ² , 6.9 m/s ² -0.5 g, +0.7 g	
Roll	± 500 °/s ²	
Pitch	± 500 °/s ²	
Yaw	± 500 °/s ²	
Gross moving load (GML) up to	1,158 kg 2,554 lb	1,558 kg 3,436 lb
GML moment of inertia about X-axis	650 kg.m ² 479 slug.ft ²	881 kg.m ² 650 slug.ft ²
GML moment of inertia about Y-axis	650 kg.m ² 479 slug.ft ²	881 kg.m ² 650 slug.ft ²
GML moment of inertia about Z-axis	400 kg.m ² 295 slug.ft ²	598 kg.m ² 441 slug.ft ²
GML CoG above moving platform centroid	≤ 0.61 m ≤ 24.0 in	
Top of platform	0.71 m 28.0 in	
Ground frame diameter	Approximately 2.0 m 40.0 in	
Actuator stroke	0.3 m 12.0 in	
Power requirements	208-240 VAC, 3 ph - 30,0 A 380-414 VAC, 3 ph - 30,0 A 440-480 VAC, 3 ph - 20,0 A	380-414 VAC, 3 ph - 30,0 A 440-480 VAC, 3 ph - 20,0 A
Average power consumption	208-240 VAC, 4,0 kW 380-414 VAC, 5,5 kW 440-480 VAC, 6,0 kW	380-414 VAC, 7,5 kW 440-480 VAC, 9,0 kW
Peak power consumption	208-240 VAC, 12,0 kW 380-414 VAC, 14,5 kW 440-480 VAC, 15,0 kW	380-414 VAC, 7,5 kW 440-480 VAC, 20,0 kW
Electronics & Software	Motion control computer, control cabinet, motion software, Ethernet UDP maintenance and diagnostics software (integral to motion computer, accessed through separate Ethernet UDP)	
Typical simulation application	Low cost vehicle training, R&D, small aircraft, trains & marine training	

MODEL NUMBER EXPLANATION



SERVICE AND SUPPORT

Our number one goal is to eliminate downtime that will deliver reliability and cost savings for years to come.

- Moog Factory Repair and Spares deliver increased uptime and like-new performance for actuators and more
- Periodic computer upgrades available to bring the latest and most efficient operation to your system
- Flexible parts options: regional stocking depots in Americas, Europe and Asia Pacific for quick delivery, on-site spares and exchange programs



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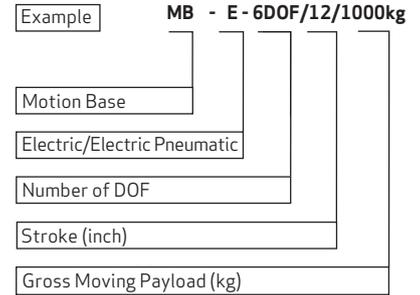


SPECIFICATIONS

Specifications below show minimum capabilities based on software limiting. Additional performance is readily available.

Model	MB-E-6DOF/26/1800KG	MB-EP-6DOF/26/3000KG
DOF max. excursion		
Surge (single) (max.)	-0.48 m / +0.60 m -18.8 in / +23.6 in -0.64 m / +0.63 m -25.1 in / +24.8 in	-0.48 m / +0.60 m -18.8 in / +23.6 in -0.64 m / +0.63 m -25.1 in / +24.8 in
Sway (single) (max.)	-0.50 m / +0.50 m -19.6 in / +19.6 in -0.66 m / +0.66 -25.9 in / +25.9 in	±0.50 m ±19.6 in ±0.66 m ±25.9 in
Heave (single) (max.)	-0.41 m / 0.41 m -16.1 in / +16.1 in -0.41 m / 0.41 m -16.1 in / +16.1 in	±0.41 m ±16.1 in ±0.41 m ±16.1 in
Roll (single max.)	-23.8° / +23.8° -29.2° / +29.2°	±23.8° ±29.2°
Pitch (single max.)	-23.7° / +26.0° -28.2° / +32.9°	-23.7° / +26.0° -28.2° / +32.9°
Yaw (single max.)	-25.4° / +25.4° -28.7° / +28.7°	±25.4° ±28.7°
DOF max. velocity		
Surge	0.80 m/s 31.4 in/s	0.80 m/s 31.4 in/s
Sway	0.80 m/s 31.4 in/s	0.80 m/s 31.4 in/s
Heave	0.60 m/s 23.6 in/s	0.60 m/s 23.6 in/s
Roll	± 35.0 °/s	± 35.0 °/s
Pitch	± 35.0 °/s	± 35.0 °/s
Yaw	± 40.0 °/s	± 40.0 °/s
DOF max. acceleration		
Surge	7 m/s ² 0.7 g	6.3 m/s ² 0.63 g
Sway	7 m/s ² 0.7 g	6.3 m/s ² 0.63 g
Heave	10.0 m/s ² 1.0 g	9.0 m/s ² 0.90 g
Roll	250 °/s ²	± 200 °/s ²
Pitch	250 °/s ²	± 200 °/s ²
Yaw	500 °/s ²	± 400 °/s ²
Gross moving load (GML) up to	1,800 kg 3,968 lb	3,000 kg 6,613 lb
GML moment of inertia about X-axis	2,000 kg.m ² 1,475 slug.ft ²	5,000 kg.m ² 3,688 slug.ft ²
GML moment of inertia about Y-axis	2,000 kg.m ² 1,475 slug.ft ²	5,000 kg.m ² 3,688 slug.ft ²
GML moment of inertia about Z-axis	2,000 kg.m ² 1,475 slug.ft ²	5,000 kg.m ² 3,688 slug.ft ²
GML CoG above moving platform centroid	< 1.00 m < 40.0 in	< 1.00 m < 40.0 in
Top of platform	1.22 m 48.0 in	1.22 m 48.0 in
Ground frame diameter	Approximately 3.1 m 122 in	Approximately 3.1 m 122 in
Actuator stroke	0.66 m 26.0 in	0.66 m 26.0 in
Power requirements	400 VAC, 3 ph - 50/60 Hz	400 VAC, 3 ph - 50/60 Hz
Average power consumption	10 kVA	10 kVA
Peak power consumption	22 kVA	22 kVA
Electronics & Software	Motion control computer, motion software, Ethernet UDP, reflective memory, SCRAM net host interface	Motion control computer, motion software, Ethernet UDP, reflective memory, SCRAM net host interface
Typical simulation application	Rail vehicles, low cost car, truck and tank driving	Rail vehicles, low cost car, truck and tank driving

MODEL NUMBER EXPLANATION



ADDITIONAL SIMULATION PRODUCTS

Moog has a full offering of flight simulation products to complete your program.

Control Loading Systems: Moog control loading solutions range from basic flight training to high fidelity full flight simulation that meet global certifications from JAA, FAA and military equivalents.



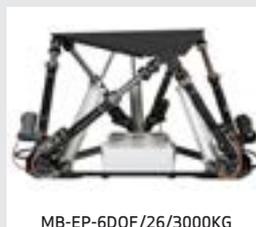
G-Seats: Get realistic, sustained G-Force simulation for helicopter and fighter G-Seats with high-fidelity controllers and user-friendly interfaces.



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MB-E-6DOF/26/1800KG



MB-EP-6DOF/26/3000KG

SPECIFICATIONS

Specifications below show minimum capabilities based on software limiting.
Additional performance is readily available.

Model	MB-E-6DOF/42/8000KG	MB-EP-6DOF/40/8000KG	MB-EP-6DOF/60/8000KG
DOF max. excursion			
Surge (single) (max.)	-0.73 m/+0.88 m -29.0 in/+34.9 in -0.82m/+0.98m -32.4 in/38.6 in	-0.77 m/+0.93 m -30.0 in/+36.0 in -0.96m/+0.94 m -37.8 in/+37.0 in	-1.15 m/+1.40 m -45.0 in/+55.0 in 1.43 m ± 56.0
Sway (single) (max.)	± 0.73 m ± 28.8 in ± 0.81 m ± 32.1 in	± 0.77 m ± 30.0 in ± 1.03 m ± 40.6 in	± 1.15 m ± 45.0 in ± 1.23 m ± 48.0 in
Heave (single) (max.)	± 0.62 m ± 24.6 in ± 0.70 m ± 27.7 in	± 0.64 m ± 25.2 in ± 0.64 m ± 25.2 in	± 0.98 m ± 38.0 in ± 0.98 m ± 38.0 in
Roll (single max.)	± 23.0 ° ± 25.5 °	± 22.0 ° ± 26.0 °	± 26.0 ° ± 29.0 °
Pitch (single max.)	-20.9°/+22.5° -23.6°/+25.6°	-21.0°/+22.0° -27.0°/+29.0°	-25.0°/+28.0° -33.0°/+37.0°
Yaw (single max.)	± 26.0 ° ± 29.3 °	± 25.5 ° ± 27.0 °	± 30.0 ° ± 33.0 °
DOF max. velocity			
Surge	± 0.71 m/s ± 28.0 in/s	± 0.7 m/s ± 27.6 in/s	± 1.00 m/s ± 40.0 in/s
Sway	± 0.71 m/s ± 28.0 in/s	± 0.70 m/s ± 28.0 in/s	± 1.00 m/s ± 40.0 in/s
Heave	± 0.61 m/s ± 24.0 in/s	± 0.55 m/s ± 22.0 in/s	± 0.80 m/s ± 32.0 in/s
Roll	± 20.0 °/s	± 21.0 °/s	± 23.0 °/s
Pitch	± 20.0 °/s	± 19.0 °/s	± 22.0 °/s
Yaw	± 20.0 °/s	± 23.0 °/s	± 25.0 °/s
DOF max. acceleration			
Surge	5.9 m/s ² 0.60 g	± 5.0 m/s ² ± 0.50 g	± 7.0 m/s ² ± 0.70 g
Sway	5.9 m/s ² 0.60 g	± 5.0 m/s ² ± 0.50 g	± 7.0 m/s ² ± 0.70 g
Heave	7.9 m/s ² 0.81 g	± 7.5 m/s ² ± 0.75 g	± 9.0 m/s ² ± 0.90 g
Roll	± 100 °/s ²	± 120 °/s ²	± 160 °/s ²
Pitch	± 100 °/s ²	± 120 °/s ²	± 160 °/s ²
Yaw	± 100 °/s ²	± 240 °/s ²	± 240 °/s ²
Gross moving load (GML) up to	8,992 kg 19,836 lb	8,000 kg 17,600 lb	8,000 kg 17,600 lb
GML moment of inertia about X-axis	56,944 kg.m ² 42,000 slug.ft ²	30,000 kg.m ² 22,000 slug.ft ²	67,790 kg.m ² 50,000 slug.ft ²
GML moment of inertia about Y-axis	56,944 kg.m ² 42,000 slug.ft ²	30,000 kg.m ² 22,000 slug.ft ²	30,000 kg.m ² 22,000 slug.ft ²
GML moment of inertia about Z-axis	56,944 kg.m ² 42,000 slug.ft ²	30,000 kg.m ² 22,000 slug.ft ²	30,000 kg.m ² 22,000 slug.ft ²
GML CoG above moving platform centroid	< 1.52 m < 60.0 in	< 1.52 m < 60.0 in	< 1.52 m < 60.0 in
Top of platform	1.89 m 74.3 in	2.04 m 80.3 in	2.32 m 91.3 in
Ground frame diameter	5.99 m 236 in	Approximately 5.195 m 204.53 in	Approximately 7.0 m 276 in
Actuator stroke	1.07 m 42.0 in	1.016 m 40.0 in	1.5 m 60.0 in
Power requirements	400 -600 VAC, 3 ph, 50/60 Hz	400 -480 VAC, 3 ph - 50/60 Hz	400 -480 VAC, 3 ph - 50/60 Hz
Average power consumption	10 kVA	10 kVA	10 kVA
Peak power consumption	50 kVA	35 kVA	35 kVA
Electronics & Software	Motion control cabinet, computer, software, maintenance & diagnostic web interface, Ethernet UDP API.	Motion control cabinet, computer, software, maintenance & diagnostic web interface, Ethernet UDP API.	Motion control cabinet, computer, software, maintenance & diagnostic web interface, Ethernet UDP API.
Typical simulation application	FAA & EASA level B flight simulation, car, truck and tank simulation	FAA & EASA level B full flight simulation, car, truck and tank simulation	FAA & EASA level C/D full flight simulation, car, truck and tank simulation

MODEL NUMBER EXPLANATION:

MB = Motion Base, **E or EP** - Electric or Electric Pneumatic, **6 DOF** = 6 Degrees of Freedom, **XX or 60** = actuator stroke inches, **XXXXX or 16000 KG** = Gross Moving Payload

This technical data is based on current available information and is subject to change at any time by Moog. Specifications for specific systems or applications may vary.



SPECIFICATIONS

Specifications below show minimum capabilities based on software limiting.
Additional performance is readily available.

Model	MB-E-6DOF/60/14000KG	MB-E-6DOF/63/14000KG	MB-E-6DOF/60/16000KG
DOF max. excursion			
Surge (single) (max.)	-1.07 m/+1.30 m -42.4 in/+51.7 in ± 1.32 m ± 51.8 in	-1.14 m/+1.38 m -45.0 in/+54.5 in -1.26/+1.51 m -49.5/+59.55 in	-1.03 m/+1.23 m -40.6 in/+48.3 in -1.14/+1.40 m -45.0/+55.1 in
Sway (single) (max.)	± 1.08 m ± 42.7 in ± 1.20 m ± 47.2 in	± 1.45 m ± 45.2 in ± 1.26 m ± 49.7 in	± 1.07 m ± 42.0 in ± 1.18 m ± 46.6 in
Heave (single) (max.)	± 0.87 m ± 34.3 in ± 0.97 m ± 38.4 in	± 0.90 m ± 35.5 in ± 1.00 m ± 39.4 in	± 0.92 m ± 36.2 in ± 1.03 m ± 40.4 in
Roll (single max.)	± 26.2° ± 28.9°	± 27.2° ± 29.8°	± 23.7° ± 25.9°
Pitch (single max.)	-24.1°/+26.5° -27.0°/+29.9°	-25.0°/+27.3° -27.8°/+30.7°	-21.8°/+24.8° -24.3°/+28.0°
Yaw (single max.)	± 33.0° ± 36.9°	± 35.2° ± 39.2°	± 28.8° ± 32.2°
DOF max. velocity			
Surge	± 1.00 m/s ± 39.4 in/s	± 0.711 m/s ± 28.0 in/s	± 0.711 m/s ± 28.0 in/s
Sway	± 1.00 m/s ± 39.4 in/s	± 0.711 m/s ± 28.0 in/s	± 0.711 m/s ± 28.0 in/s
Heave	± 0.80 m/s ± 31.5 in/s	± 0.610 m/s ± 24.0 in/s	± 0.610 m/s ± 24.0 in/s
Roll	± 22.0°/s	± 20.0°/s	± 20.0°/s
Pitch	± 21.0°/s	± 20.0°/s	± 20.0°/s
Yaw	± 25.0°/s	± 20.0°/s	± 20.0°/s
DOF max. acceleration			
Surge	± 7.0 m/s ² ± 0.71 g	5.89 m/s ² 231.89 in/s	5.89 m/s ² 231.89 in/s
Sway	± 7.0 m/s ² ± 0.71 g	5.89 m/s ² 231.89 in/s	5.89 m/s ² 231.89 in/s
Heave	± 9.0 m/s ² ± 0.91 g	7.85 m/s ² 309.06 in/s	7.85 m/s ² 309.06 in/s
Roll	± 150°/s ²	± 100°/s ²	± 100°/s ²
Pitch	± 150°/s ²	± 100°/s ²	± 100°/s ²
Yaw	± 150°/s ²	± 100°/s ²	± 100°/s ²
Gross moving load (GML) up to	14,000 kg 30,865 lb	14,000 kg 30,865 lb	17,237 kg 38,000 lb
GML moment of inertia about X-axis	50,000 kg.m ² 36,878 slug.ft ²	67,790 kg.m ² 50,000 slug.ft ²	84,072 kg.m ² 62,000 slug.ft ²
GML moment of inertia about Y-axis	50,000 kg.m ² 36,878 slug.ft ²	81,348 kg.m ² 60,000 slug.ft ²	90,839 kg.m ² 67,000 slug.ft ²
GML moment of inertia about Z-axis	50,000 kg.m ² 36,878 slug.ft ²	40,674 kg.m ² 30,000 slug.ft ²	94,920 kg.m ² 70,000 slug.ft ²
GML CoG above moving platform centroid	≤ 1.80 m ≤ 70.9 in	≤ 1.651 m ≤ 65.0 in	≤ 1.35 m ≤ 53.0 in
Top of platform	2.40 m 94.5 in	2.25 m 92.34 in	2.06 m 81.06 in
Ground frame diameter	Approximately 7.0 m 275.6 in	6.71 m 264 in	6.88 m 271 in
Actuator stroke	1.52 m 60.0 in	1.59 m 62.5 in	1.52 m 60.0 in
Power requirements	400 VAC, 3 ph - 50/60 Hz	400 -600 VAC, 3 ph, 50/60 Hz	400 -600 VAC, 3 ph, 50/60 Hz
Average power consumption	20 kVA	20 kVA	25 kVA
Peak power consumption	70 kVA	70 kVA	80 kVA
Electronics & Software	Motion control cabinet, computer, software, maintenance & diagnostic web interface, Ethernet UDP API..	Motion control cabinet, computer, software, maintenance & diagnostic web interface, Ethernet UDP API.	Motion control cabinet, computer, software, maintenance & diagnostic web interface, Ethernet UDP API.
Typical simulation application	FAA & EASA level C/D full flight simulation, car, truck and tank simulation	FAA & EASA level C/D full flight simulation, car, truck and tank simulation	FAA & EASA level C/D full flight simulation, car, truck and tank simulation

MODEL NUMBER EXPLANATION:

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MB-P-6DOF/60/14000KG



MB-E-6DOF/63/14000KG



MB-E-6DOF/60/16000KG

TAKE A CLOSER LOOK

Motion System Solutions from Moog are available around the world. For more information, visit our web site or contact one of the locations below.

Australia
+61 3 9561 6044
info.australia@moog.com

Brazil
+55 11 3572 0400
info.brazil@moog.com

Canada
+1 716 652 2000
info.canada@moog.com

China
+86 21 2893 1600
info.china@moog.com

France
+33 1 4560 7000
info.france@moog.com

Germany
+49 7031 622 0
info.germany@moog.com

Hong Kong
+852 2 635 3200
info.hongkong@moog.com

India
+91 80 4057 6666
info.india@moog.com

Ireland
+353 21 451 9000
info.ireland@moog.com

Italy
+39 0332 421 111
info.italy@moog.com

Japan
+81 46 355 3767
info.japan@moog.com

Korea
+82 31 764 6711
info.korea@moog.com

Luxembourg
+352 40 46 401
info.luxembourg@moog.com

The Netherlands
+31 252 462 000
test@moog.com

Russia
+7 831 713 1811
info.russia@moog.com

Singapore
+65 677 36238
info.singapore@moog.com

South Africa
+27 12 653 6768
info.southafrica@moog.com

Spain
+34 902 133 240
info.spain@moog.com

Sweden
+46 31 680 060
info.sweden@moog.com

Turkey
+90 216 663 6020
info.turkey@moog.com

United Kingdom
+44 168 485 8000
info.uk@moog.com

USA
+1 716 652 2000
info.usa@moog.com

www.moogsimulation.com

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