AB DYNAMICS™

Solution Brochure

SPMM™ Plus

Exceptional accuracy by design.

The next generation of kinematics
and compliance test machine.

Introducing the SPMM™ Plus

The latest generation of the Suspension Parameter Measurement Machine (SPMM)

For decades the SPMM has been a fundamental tool used by engineers throughout the vehicle development cycle. Now, the SPMM Plus provides automotive innovators with the tools needed to develop the next generation of mobility solutions.

“The SPMM has proven to be an excellent product; efficient and flexible in use, accurate and exceptionally reliable.”

Ian Willows, Consultant Engineer, Horiba MIRA

Speed up development time while lowering development costs

Designed around the core principle of faithfully simulating on-road vehicle behaviour, the SPMM Plus is the industry’s most technically advanced, reliable, and cost-effective kinematics and compliance (K&C) test machine. Accommodating the smallest city cars up to light commercial vehicles, its unique moving body and fixed ground-plane design replicates a vehicle’s interactions with the road surface with unrivalled precision. It provides all the suspension and steering system data you need to develop vehicles that outperform your competitors.

What's new?

We've built our global reputation on the extremely reliable and efficient design of the SPMM, and this respected formula remains at the core of the SPMM Plus. As the automotive industry grapples with the future of mobility, our machines have never worked harder. Now our latest class-leading K&C machine has been enhanced for industry's ever-evolving challenges.

The SPMM Plus features:

/ New high-speed digital control system
/ Increased vertical stroke capacity
/ Optional high-velocity vertical actuators
/ New table extension options to test a wider range of vehicles
/ Optional moment of inertia (MoI) and centre of gravity (CoG) testing of vehicles and objects

The SPMM Plus elevates testing capabilities and offers an extended product lifecycle thanks to its unique design and our commitment to continual development and software releases.

Lower infrastructure costs, lower maintenance costs, lower whole-of-life costs.

SPMM™ Plus solution

Informative, insightful, incomparable

The SPMM Plus features the finest quality components to ensure the highest levels of accuracy, coupled with easy-to-use software and an extensive range of options that allow you to tailor the solution to your specific requirements. Plus our comprehensive support packages ensure that you'll always be able to get the most out of your investment.

The SPMM Plus solution includes the following components:

- **Electro-mechanically actuated moving table**
- **Piezoelectric wheel measurement stations**
- **Dynamic Arm wheel position measurement system**
- **EtherCAT control system**
- **CoG and MoI measurement capability**
- **Easy-to-use software**
- **First year of email, phone and online support included**

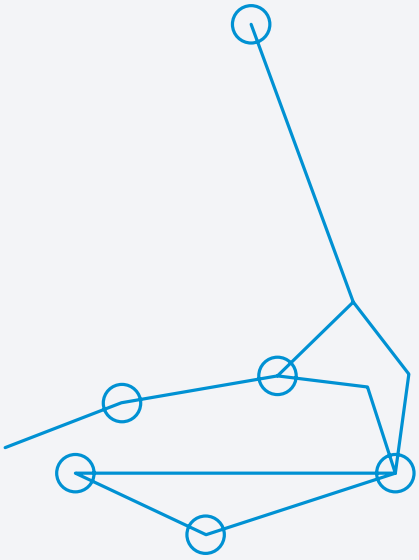
The SPMM Plus is invaluable for OEMs, Tier 1s, testing houses and motorsport teams that need to:

/ Generate accurate digital vehicle models
/ Rapidly benchmark competitor vehicles
/ Monitor early series production vehicles
/ Extend measurement capability to CoG and MoI
/ Accelerate vehicle development sustainably

Understanding kinematics and compliance

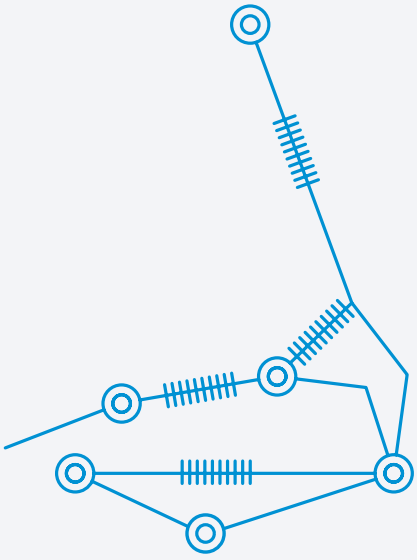
Transforming information into usable data

A K&C test machine provides a thorough understanding of a vehicle's kinematic and compliance characteristics by applying simple but very accurate inputs. The resulting data informs on the vehicle's ride and handling characteristics.



Kinematics

Kinematic testing examines the motion of a suspension system in the absence of force. A suspension's kinematic characteristics are governed by its geometry, specifically the position of the pivots and linkages.



Compliance

Compliance testing examines the motion of a suspension system in the presence of load inputs. A suspension's compliance characteristics are governed by the stiffness of its components: elastomeric bushes, springs and component deformations.

"The system from AB Dynamics is the most elegant solution, offering an excellent combination of precision, high load capacity and appropriate applications of technology."

Bob Simons, President, Morse Measurements

How the SPMM™ Plus works

The SPMM Plus has two key areas of measurement: wheel position and wheel force.

The test vehicle is clamped to the table and suspension kinematics are analysed by moving the table to simulate the motions of the vehicle body that occur on the road. The resulting wheel centre movement is measured using our Dynamic Arm measurement system, whilst controlling the tyre contact patch loads to zero.

To measure compliance, horizontal inputs are applied at the tyre contact patch by the wheel stations. The wheel stations apply these loads by moving longitudinally (X), laterally (Y) and rotationally (δ). Forces and displacements are measured by the wheel stations' integrated piezo-electric load cells.

A unique moving table design

At the heart of the SPMM Plus is the moving table, which uniquely moves the test vehicle's body, not its wheels. Controlled in six degrees of freedom by precision electromechanical actuators, the moving table applies a combination of roll, pitch, bounce and yaw motion to the vehicle body. Unlike K&C solutions that move the test vehicle's wheels, the moving table means the ground plane (road) remains fixed during vehicle cornering, braking and traction simulations. As a result, our machine provides the most precise and faithful simulation of on-road vehicle behaviour.

Due to the SPMM Plus moving the test vehicle body and not its wheels, the test input is decoupled from the resulting vehicle behaviour. This means that unlike other K&C measurement systems, the motion of the wheel centre is measured directly, resulting in significantly higher accuracy of measurement.

"The SPMM rig has made a significant impact to Chrysler's vehicle development, allowing us to perform efficient, accurate and repeatable vehicle measurements."

David Sobolak and Jonathan Claussen, Chrysler

Wheel position measurement

The SPMM Plus uses our Dynamic Arm system to measure the test vehicle's wheel centre motion in six degrees of freedom, with class-leading accuracy made possible through the use of high-precision incremental encoders. The system ensures exceptional accuracy and cross-talk specifications up to 5Hz in a robust, maintenance-free design.

Wheel force measurement

The test vehicle's wheels sit on two or four wheel stations depending on the configuration. They automatically adjust in the horizontal plane to accommodate the wheelbase and track of the vehicle under test for fast loading. The wheel stations define a fixed ground plane and their gritted surface mimics the grip of a road.

The static ground plane ensures the loads being applied to the measurement cells are in a fixed coordinate system so there is no computational requirement to compensate for out-of-axis loading, which can introduce errors. The result is a significantly more accurate machine.

Hybrid simulation capability

Our latest generation of the SPMM has been fully digitised with a new and optimised control system. Using powerful CPUs ensures the SPMM continues to support the industry's needs as testing moves towards virtual validation. This update includes an EtherCAT real-time protocol and a high-bandwidth data pipeline.

Digitising the control system means you'll receive regular updates and can upgrade as necessary. It also simplifies troubleshooting and means we can provide direct support to you anywhere in the world.

The increased data bandwidth of the EtherCAT control system also enables real-time communications between the test bench and external simulation environments, making the SPMM Plus Hardware-in-the-Loop (HIL) capable. The high-bandwidth data pipeline enables the test vehicle's control software to be stimulated under test so that the required conditions of a vehicle travelling at speed can be simulated for realistic testing of active steering and suspension systems.

Servo-electric actuators

The SPMM Plus' electromechanical actuators provide precise inputs to the vehicle in six degrees of freedom at frequencies up to 5Hz. New to the SPMM Plus is the option to upgrade the velocity of vertical actuators from 140mm/s to 280mm/s, for testing damper influence at the wheel.

Our all-servo electric solution is reliable, clean, quiet, and low maintenance. Being a closed-loop control system, you can streamline testing as there is no time-consuming warm-up cycle or iterations to reach desired drive commands.

Example use cases

Accelerating time to market through efficient benchmarking

Ensuring your vehicle will be competitive early in the development process is critical. The SPMM Plus can be used to quickly and thoroughly benchmark competitor vehicles to determine trends in the market. The vehicle's complete suspension characteristics, including CoG and MoI properties, can be accurately identified.

De-risk new product launches with end-of-line testing

The SPMM Plus can be used throughout a vehicle's development cycle, from initial digital vehicle model generation to prototype correlation. It can also be used to monitor the performance of early production vehicles to ensure they remain within the prescribed tolerances.

The benefits of the SPMM™ Plus

Two machines in one

With the Moment of Inertia Measurement System (MIMS) option, the SPMM Plus can generate all the chassis-based data necessary for the creation of digital vehicle models in just a few hours. Plus class-leading accuracy helps to significantly improve vehicle model correlation. With just one click, this data can be simply processed and exported to all the popular modelling packages, such as CarMaker and CarSim.

The industry's most accurate K&C test machine

Unlike traditional offerings that hold the body still and move the test vehicle's wheels, our solution moves the vehicle's body to correctly represent the road in the real world, which remains fixed. It also enables the measurement devices located on the wheels to remain relatively static so the vehicle's movements are more accurately replicated, and the measurement of this movement is more precise.

Exceptional repeatability

The superior level of accuracy translates into high levels of repeatability across machines. You can rely on the data from another SPMM, for example, when using a test house to increase testing capacity or using another department's machine. We are proud to be selected as the supplier of choice for the majority of testing houses globally, with 12 currently using the SPMM across three continents and six countries.

Market-leading throughput

Throughput, which includes installing the test vehicle, running the test sequence, retrieving the results, and removing the vehicle, is three times faster than our nearest competitor thanks to our unique design and our bespoke software. With the SPMM Plus, a typical K&C benchmarking test suite can be conducted in a matter of hours, and more than 150 vehicles can be processed annually on a single-operator, single-shift basis.

A sustainable product lifecycle

State-of-the-art electromechanical actuators make the SPMM Plus a low-maintenance solution with low total cost of ownership. The first SPMM we delivered almost 30 years ago is still being used today and has required less than 10% of the initial purchase cost on maintenance and replacement parts, due to our design and use of recyclable materials. Machines approaching end of life will be considered for trade-in discounts.

Options and upgrades

We have an extensive range of options so you can tailor your SPMM Plus to meet your specific requirements.

Centre of gravity (CoG) and moment of inertia (MoI) measurement

With our Moment of Inertia Measurement System (MIMS) option, the CoG and MoI of a vehicle can be quickly and easily measured. Switching from K&C measurement to CoG/MoI mode takes less than 30 minutes. The SPMM Plus is the only system to lift, roll and tilt the vehicle to derive the full moment of inertia properties, which are critical to creating an accurate digital vehicle model.

In addition to this our MIMS Object add-on provides the capability of measuring CoG and MoI properties of standalone objects, such as electric drive units.

The MIMS option is available as an upgrade for both two and four-wheel station arrangements.

High fidelity vehicle model generation

The SPMM Plus is an essential tool for generating the data that populates vehicle models used extensively in vehicle development. Our machine can directly generate data and models in the formats of all the popular modelling packages for example CarMaker and CarSim, but we don't stop there. You can also measure the rigidity matrix of the suspension corner, which can be used to generate the highest fidelity CarMaker model. This is made possible by our unique Rigidity Matrix Measuring Device, which applies pure forces and moments about the wheel centre in six degrees of freedom.

Table extensions

The SPMM Plus is available with a range of table extenders to allow a wide range of vehicles to be tested:

/ Standard Table Extender - Provides clamping points for a wide variety of passenger vehicles removable to accommodate smaller wheelbase vehicles
/ Intermediate Table Extender – Allows the underbodies of long-wheelbase vehicles to be clamped more effectively. The extenders are low profile adding only 30mm of height to the table surface which makes them specifically suited to vehicles with low ground clearance
/ Large Table Extender – Provides extra clamping points for long-wheelbase vehicles. The extenders add 120mm of height to the table surface, which makes them specifically suited to vehicles with high ground clearance such as light commercial trucks

High-speed capability

Typically, K&C testing is conducted at quasistatic conditions. The optional Dynamic Control Module allows test inputs of up to 5Hz to be applied. In addition to the Dynamic Control Module, the SPMM Plus can be specified with uprated vertical actuators capable of 280mm/s. This combination of high frequency and high velocity allows the influence of the damper to be explored and basic characteristics derived.

Specifications

Capacity

	Minimum	Maximum
Vehicle wheelbase range	1960 mm	4540 mm*
Vehicle track range	1100 mm	2082 mm
Vehicle mass	-	5000 kg**
Rear wheelpan	400 mm	600 mm***

*With intermediate or secondary table extenders fitted
**6800 kg if centrally loaded
***With large wheelpan adaptor fitted

Body motions

	Range	Accuracy	Max velocity*
Bounce	±230 mm	±0.15 mm	140 mm/s**
Roll	±10 °	±0.02 °	7 °/s
Pitch	±8 °	±0.02 °	6 °/s

*Maximum velocity available with dynamic option
**Upgradable to 280 mm/s

Wheel motions

	Range	Accuracy	Max velocity*
Fore & aft (X)	±150 mm	±0.15 mm	100 mm/s*
Lateral (Y)	±150 mm	±0.15 mm	100 mm/s*
Powered rational (δ)	±80 ° Nom	±0.02 °	30 °/s*

*Maximum velocity available with dynamic option

Dynamic Arm wheel position measurement

Accuracy	Sub range*	Accuracy (0-5Hz)	Resolution
Fore/aft (X) & Lateral (Y)	±10 mm	±0.02 mm	0.005 mm
Vertical (Z)	±10 mm	±0.02 mm	0.005 mm
Steer	±1 °	±0.004 °	±0.001 °
Camber	±1 °	±0.005 °	±0.001 °
Wheel spin	±30 °	±0.01 °	±0.003 °

*Contact AB Dynamics for full range accuracy

Wheel force measurement

	Calibrated range	Accuracy
Fore/aft (Fx) or lateral (Fy)	±1750 N	±5 N
	±15000 N	±30 N
Vertical (Fz)	0->5000 N	±5 N
	0->30000 N	±30 N
Steer moment (Mz)	±500 Nm	±1 Nm
	±750 Nm	±2 Nm

Room Installation

Length	7415 mm
Width	4570 mm
Height	2460 mm
Ground plane height	1545 mm
Electrical Power	Typ. 415V, 3 phase, 30 kVA peak, 15 kVA cont.
Compressed air	7 Bar, 1.6 litres/second peak, 0.005 litres/second average

Warranty & support

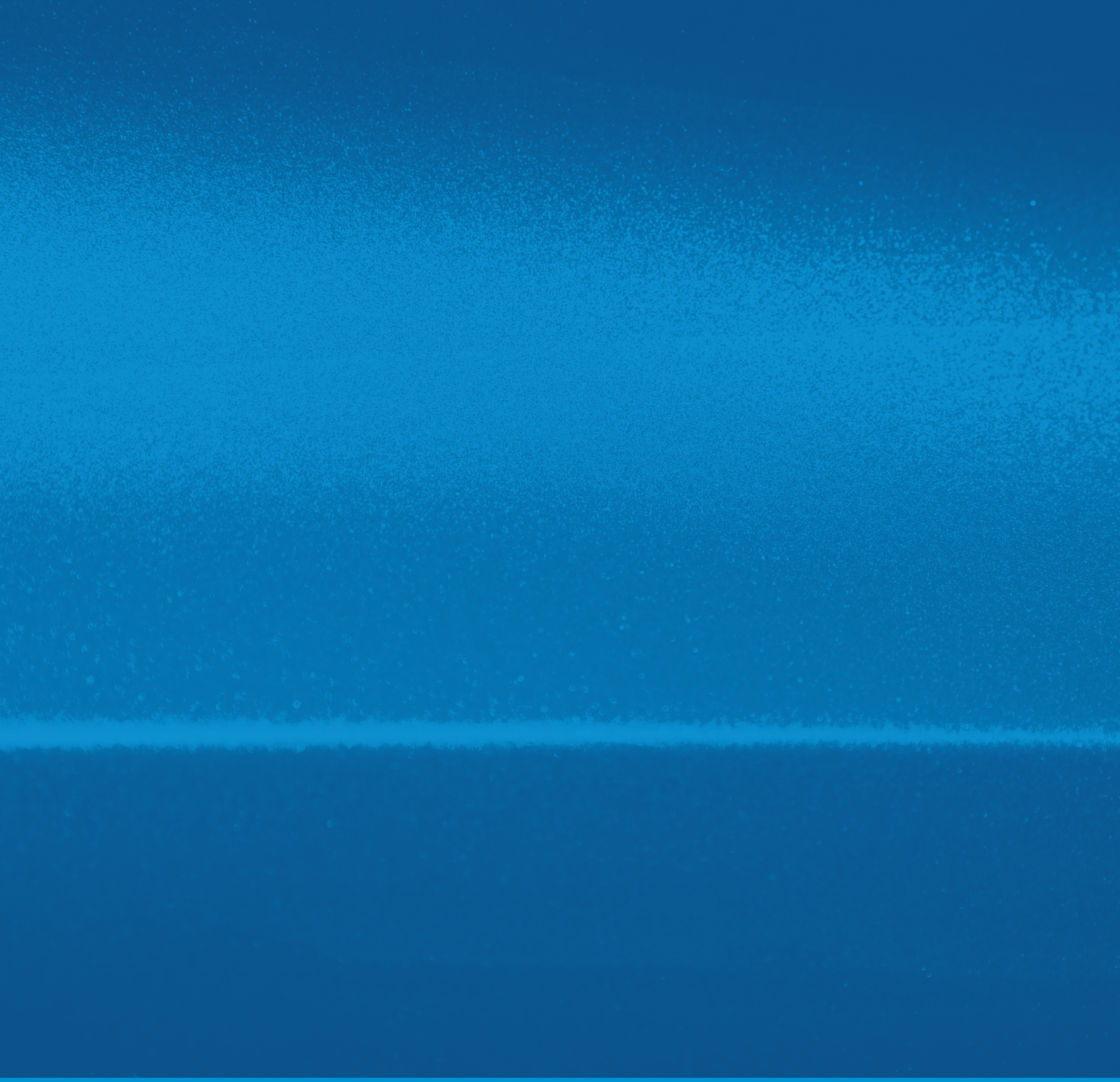
The SPMM Plus comes with a one-year Silver support package, which includes software upgrades and remote technical support via email, phone and online. The machine also comes with a 12-month warranty, which can be upgraded to 24 months.

About AB Dynamics

When you choose a solution engineered by AB Dynamics, you're benefitting from proven hardware, trusted software, 40 years of knowledge and experience, plus unrivalled service and support. Our range of automotive testing, verification and validation solutions encompass dynamics, suspension and steering characterisation, durability, advanced driver assistance systems and autonomy.

We pride ourselves on delivering solutions that enable the development of safer, more enjoyable, efficient, and eco-friendly vehicles. As a key partner to the global automotive industry, our customers include the top 25 vehicle manufacturers, Tier 1 suppliers, test facilities and autonomous vehicle developers.

As part of the AB Dynamics Group of companies, we offer a wide range of vehicle autonomy, simulation, and testing solutions. As a group, we enable customers to develop and test vehicles in laboratory and virtual environments, validate on the track before finally evaluating vehicles in the real world on public roads.



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