

Thomson and Kollmorgen Motion Solution Drives High Performance Formula One Simulator

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WOOD DALE, IL – [Thomson](#) and [Kollmorgen](#) have delivered a complete motion control solution for UK-based Ball Racing Developments Ltd (BRD) [BRD-05 Formula One Race Car Simulator](#). The new motion platform, which consists of [Kollmorgen AKM servomotors](#), [Kollmorgen servo drives](#), [Thomson ball screw assemblies](#) and [Thomson 500 Series profile rails](#), is more compact, cost-effective and higher performing than the previous motion control solution implemented by BRD, helping to fulfill the company's aim of making motorsport - often a prohibitively expensive sport - accessible to its millions of fans around the world.

After many years of evaluation and working with a range of motion systems for various clients, UK-based Ball Racing Developments Ltd (BRD) came to the conclusion that there was nothing on the market that could provide the accurate simulation of a racing car's motion. For this reason, the company commenced the development of a new type of system dedicated to the motions experienced in a racing car, particularly the high velocity forces of a Formula One car. Such a project would have a wide range of potential markets, including racing driver training, high-end entertainment applications, and private owners with a keen interest in motorsport.

The first of this new generation of dedicated driving motion systems was released in November 2007 and sent to a theme park in Macau that wanted accurate motorsport simulators as part of its entertainment offering to clientele. However, BRD was unhappy with the delivery of timescales and the performance of the equipment offered by its existing supplier of motion control products. The simulation technology specialist particularly wanted a more compact and higher performing motor solution, a specification that was ultimately fulfilled by Kollmorgen AKM-7 and Kollmorgen AKM-6 brushless AC servomotors.

Kollmorgen AKM motors offer 0.16 to 53Nm torque and speeds up to 8,000 rpm in a compact frame-size that gives users the highest power density capabilities on the market. This is an important factor to BRD, where any weight savings can provide significant benefits to performance and reaction times. The Kollmorgen AKM motors were approximately half the size of the conventional servo motors they replaced.

With one motor required for each degree of freedom on the new BRD V1-500 motion platform, one Kollmorgen AKM-7 motor was supplied to provide movement in the surge direction (forward and backwards acceleration and deceleration), while Kollmorgen AKM-6 variants were supplied to provide motion in the side slip (side-to-side lateral thrust) and yaw (angular motion

in the horizontal plane) directions. Yaw is an integral and unique function of the BRD system that is achieved by changing the centre of rotation between the front and rear wheel positions.

Each motor is powered by a Kollmorgen S600 AC servo drive, a fully digital servo amplifier that is ideal for complex drive tasks. Fast feedback and best-in-class control circuits support high performance applications. In light of the fact that a growing number of engineers are moving towards Ethernet-based communications such as EtherCAT and SynqNet, the next generation motion platforms will be using new Kollmorgen AC servo drives geared to the future with an integrated Ethernet connection. The new drives onboard interface means that customers such as BRD no longer have to rely on additional expansion cards for this kind of compatibility.

With the next two motion platforms bound for Singapore where they would be used to promote the first Formula One Grand Prix held in the country (also Formula One's first night race) during September 2008, time was of the essence. Now convinced by the performance credentials of the Kollmorgen motor and drive technology, it made sense to include Thomson ball screw and linear guide systems in the same package, a decision that would minimize lead-time and simplify the build process.

By BRD's own admission there are a "bewildering number" of motion control products on the market, but the concise and easy-to-understand Kollmorgen and Thomson family of products helped to ease any confusion. This would prove essential to the project, which witnessed the completion of two V1-500 BRD motion platforms in just 10 weeks from signing the order, including design, build and installation.

The actual movement of the Formula One car mounted on the motion platform is provided by three 40mm x 40mm Thomson ball screws. All are the same length for commonality purposes and each offers 1.2m of travel. These Thomson ball screw assemblies consist of a precision rolled screw shaft and a nut (the outer race) with an internal groove and circuits of precision steel balls that re-circulate in the grooves between the screw and nut. This highly efficient and backlash-free anti-friction design converts torque to thrust as either the screw or nut turns and the other component moves in a linear direction. All Thomson ball screws supplied to BRD featured a high lead, which is necessary to generate the 1m/sec acceleration required.

Alongside the ball screws and supporting the loads and high acceleration forces is a pair of Thomson 500 Series Profile Rail linear guide systems. These highly configurable linear guides are designed in accordance with DIN standard 645-1. They provide extremely high rigidity and load capacity to withstand the acceleration forces experienced in this realistic F-1 simulation. The linear guide bearing systems were supplied to BRD with an option to plate with thin-dense chrome (TDC) in order to withstand the exceptionally humid atmosphere in Singapore.

All of the Thomson and Kollmorgen products supplied for use on the motion platforms were assembled by BRD's team of engineers at its Surrey headquarters. Thomson and Kollmorgen provided the services of an on-site applications engineer to help set up the first system and

ensure any trouble-shooting issues were quickly and efficiently resolved. All of the products were supplied within the short lead-time required by BRD with full technical & design support from Thomson and Kollmorgen before and after delivery.

When mechanically complete, the two motion control platforms were linked with visual and sound technology created by BRD by mapping and modeling the Singapore street circuit. Based on BRD's netKar Pro software platform, anyone can download a free copy of the Singapore night race circuit from www.singtelrace.com and practice driving the difficult track that twists and turns it way around many of Singapore's famous landmarks. Users can even post lap times to the on-line leader board to see how they compare with others.

Delivered in April 2008, the two full size, full motion BRD racing simulators exclusively for Singapore Telecommunications (SingTel – race sponsor), are designed to give the most realistic racing experience, short of being in an actual race car. Apparently crashing into the barriers originally produced such a sudden jolt that the effect was softened by BRD in the interests of health and safety. Approximately 1.0 to 1.5G-force can be generated in each axis of motion by the platform. As an added safety measure all drivers have to wear a four-point racing harness. The two BRD simulators have been available to the general public to test drive at various venues around Singapore in the build up to September's Formula One Grand Prix.

There has been plenty of interest from racing teams - A leading Formula One driver has already tested the V1-500 and managed to reduce his lap time by up to 0.7 seconds with the motion system activated. This provided the driver with greater 'feel' for effects present in a real racing environment such as under-steer, over-steer, weight transfer braking and wheel-spin, and helped improve his reactions.

