



Enabling energy recuperation technology, the IBSe ensures safe braking without affecting pedal feel and brake balance



ACTIVE BRAKING SYSTEM

The IBSe electrohydraulic brake-by-wire system enables efficient, stable braking behavior for the Formula E Gen2 car ahead of the new season

» For the upcoming Formula E season, Munich-based automotive company LSP will be supplying a majority of teams with a new active brake-by-wire system: the IBSe. The main goal of the system is to ensure more efficient energy recuperation without affecting the pedal feel, overall brake balance and, of course, braking power.

What's more, it enables variable brake balance between the front and rear axles – even while actuated – and safe braking is also always guaranteed due to inclusion of an integrated fallback mode. And at 1.5kg (3.3 lb), the IBSe is lightweight. All of this considerably increases the efficiency and performance of Formula E vehicles as well as improving overall vehicle safety.

Previously, Formula E cars used a passive braking system. Deceleration was actuated by

a friction brake applied directly with pedal force augmented by an electric machine on the rear axle. However, the recuperation performance of the EV machine depended on vehicle speed and battery charge. Since there was no direct interaction between the two systems, the driver had to manually balance them during the race. In order to maintain control over the vehicle, a more efficient and less dynamic driving strategy was required. Naturally, drivers would prefer an active braking system, allowing them to brake later, more dynamically and with better recuperation. Especially for Formula E cars, where efficient recuperation is directly connected to vehicle range, passive braking systems have become antiquated. This is why the FIA will be permitting active braking systems as of Season 5.

For 12 years, LSP Innovative Automotive Systems has looked to pioneer the development of active braking systems, profiting from its years of cooperation with the inventors of ABS and ESP, Heinz Leiber and Dr Anton van Zanten. The robustness and high quality of the company's active braking technology has now been proven over a number of LMP1 seasons, as well as the Le Mans 24 Hours race.

Against this backdrop, it took the experienced team only six months to develop a completely operational customized system. The patented hydraulic braking system is located between the tandem master cylinder and the brake calipers of the rear axle. It consists of three modules: an integrated electronics module with microcontroller and power stages; a drive module with motor and gearbox as well as a hydraulic module with hydraulic pistons and valves.

The drive module generates braking pressure via hydraulic piston, while highly sophisticated algorithms and patented system diagnosis procedures ensure high levels of reliability. Only the

finely tuned coordination of all these modules ensures accurate control of dynamic braking. The target pressure of the vehicle control unit (VCU) is transmitted to the IBSe by a redundant CAN interface. If the braking system is active, the brake pedal can be hydraulically disconnected from the rear-wheel brakes and then the IBSe takes over control of rear-wheel brake pressure. The crucial point is that feel of the pedal and braking behavior will remain constant, regardless of how much pressure is applied to the rear wheels of the car. Thus guaranteeing maximum recuperation performance. The IBSe can handle any propulsion architecture used by the Formula E teams, and since all individual race teams use their own VCU to calculate the EV's recuperation performance, their experience, know-how and distinguishing features make the difference.

The distinct advantages of utilizing an LSP electrohydraulic brake has convinced 80% of all Formula E teams to use the IBSe for the upcoming season. Tests are currently being conducted in workshops and on racetracks. Now it's up to the teams to get the best possible performance out of their cars. In the meantime, LSP is working on the next development stages. <

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