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Press release

25 years of Bosch ESP®: no more skidding
Breakthrough for road safety

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- In the EU alone, the electronic stability program has saved some 15,000 lives.
- Worldwide, 82 percent of all new passenger cars feature the anti-skid system.
- Harald Kroeger: “The development of ESP® was a milestone on the path to our ‘vision zero’ of no more road deaths.”

Stuttgart, Germany – A wet road and a sudden evasive maneuver: there was a time when such a situation would frequently have ended in a ditch or against a crash barrier, and not rarely with fatalities or severe injuries. Almost 25 years ago to the day, a remedy was finally provided in the shape of a pioneering invention – the ESP® electronic stability program that Bosch and Daimler-Benz first launched in S-class vehicles in 1995. Since then, ESP® has been keeping vehicles safely on track, also in critical situations. Bosch accident researchers estimate that in the EU alone, the anti-skid system has saved some 15,000 lives over the past 25 years, as well as preventing just under half a million accidents involving personal injury. Together with the seatbelt and airbag, ESP® is one of the most important life-savers in a vehicle. “The development of the electronic stability program was a milestone on the path to our ‘vision zero’ of no more road deaths,” says the Bosch board of management member Harald Kroeger. “ESP® is an outstanding example of what we mean by ‘Invented for life.” The innovation may be from 1995, but there is nothing dated about it: Bosch has continuously improved its anti-skid system, and produced more than 250 million ESP® systems to date. Modern cars are inconceivable without this electronic guardian angel. Worldwide, 82 percent of all new vehicles are equipped with ESP®. In 2016, this figure was 64 percent.

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ESP® can prevent up to 80 percent of all skidding accidents

Especially when roads are wet or icy, when evading unexpected obstacles such as animals on the road, and also when driving into a bend too fast, the electronic stability program intervenes. With ESP® on board, up to 80 percent of all skidding accidents can be prevented. It combines the functions of the ABS antilock braking system and the TCS traction control system, but can do considerably more. It also detects vehicle skidding movements, and actively counteracts them.

The anti-skid system uses information about vehicle dynamics to detect whether the car is heading in the direction the driver is steering. If there is a discrepancy between these two factors, ESP® intervenes. This may sound simple, but is in fact a complex process. Smart sensors help compare steering angle and vehicle trajectory 25 times a second. If the two diverge, ESP® reduces engine torque and brakes individual wheels. In this way, the system helps the driver prevent the vehicle from breaking away or skidding – effectively nipping many accidents in the bud.

Breakthrough following the elk test

The story behind this achievement is a long one. It started in the 1980s with initially independent efforts by Bosch and Daimler-Benz to achieve more vehicle stability. From 1992 until market launch, experts from the two companies worked together in a project unit. The legendary elk test of 1997 helped the system achieve a breakthrough: during tests for a Swedish automotive magazine, a Mercedes Benz A-class tipped over when making an abrupt evasive maneuver. Mercedes-Benz responded by making ESP® standard equipment. Since that time, more and more vehicles of many different automakers have adopted the anti-skid system.

Fewer accidents, fewer injuries, fewer fatalities – legislators have also recognized the benefits of ESP® and made it a mandatory feature of vehicles in many parts of the world. In the EU, the mandating process was gradual. From November 2011, it was initially mandatory for new passenger-car and commercial-vehicle types, and from November 1, 2014, for all newly registered passenger cars and commercial vehicles. And also in Argentina, Australia, Brazil, Canada, China, Ecuador, Israel, Japan, Malysia, New Zealand, Russia, South Korea, Turkey, and the United States, the anti-skid system is either legally mandated or a self-imposed commitment. Experience from Europe shows that if the proportion of vehicles featuring the system rises, accident numbers fall.

Basis for automated driving

"ESP® has taken road safety to a new level," Kroeger says. And it has done so across a diverse range of vehicle types. Bosch offers customized ESP® systems for all powertrain types, from combustion engines to electric motors, and for vehicles of all kinds, from micro cars to commercial vehicles. Even for motorized two-wheelers, the company has developed a kind of ESP®. The MSC motorcycle stability control that Bosch launched in 2013 ensures the best possible stability in all riding situations, and is a further pioneering road-safety achievement.

At the same time, ESP® is the basic technology for many driver assistance systems, as well as for the automated driving with which Bosch is pursuing its vision zero. "Whether new or tried and tested, Bosch technologies alert and support drivers in critical situations. And increasingly, they are in a position to assume monotonous and fatiguing tasks. This gives us an opportunity to further reduce the number of accidents and road deaths," Kroeger says. Whether with or without a driver at the wheel, Bosch will be nipping accidents in the bud in the future as well.

Press photos: #2978892, #2978893, #2978894, #2982730, #2978896, #2978897

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Mobility Solutions is the largest Bosch Group business sector. It generated sales of 46.8 billion euros in 2019, and thus contributed 60 percent of total sales from operations. This makes the Bosch Group one of the leading automotive suppliers. The Mobility Solutions business sector pursues a vision of mobility that is safe, sustainable, and exciting, and combines the group's expertise in the domains of personalization, automation, electrification, and connectivity. For its customers, the outcome is integrated mobility solutions. The business sector's main areas of activity are injection technology and powertrain peripherals for internal-combustion engines, diverse solutions for powertrain electrification, vehicle safety systems, driver-assistance and automated functions, technology for user-friendly infotainment as well as vehicle-to-vehicle and vehicle-to-infrastructure communication, repair-shop concepts, and technology and services for the automotive aftermarket. Bosch is synonymous with important automotive innovations, such as electronic engine management, the ESP anti-skid system, and common-rail diesel technology.

The Bosch Group is a leading global supplier of technology and services. It employs roughly 400,000 associates worldwide (as of December 31, 2019). The company generated sales of 77.7 billion euros in 2019. Its operations are divided into four business sectors: Mobility Solutions, Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT provider, Bosch offers innovative solutions for smart homes, Industry 4.0, and connected mobility. Bosch is pursuing a vision of mobility that is sustainable, safe, and exciting. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group's strategic objective is to facilitate connected living with products and solutions that either contain artificial intelligence (AI) or have been developed or manufactured with its help. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life." The Bosch Group comprises Robert Bosch GmbH and its roughly 440 subsidiary and

regional companies in 60 countries. Including sales and service partners, Bosch's global manufacturing, engineering, and sales network covers nearly every country in the world. The basis for the company's future growth is its innovative strength. Bosch employs some 72,600 associates in research and development at 126 locations across the globe, as well as roughly 30,000 software engineers.

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Press release
Fact sheet

Staying on track
Milestones from 25 years of ESP® at Bosch

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Just under half a million accidents involving personal injury avoided and 15,000 lives saved in the EU alone – this is the track record of ESP®, first launched in 1995. The story behind this achievement is one that began more than 25 years ago. The following text present the milestones in the development of the electronic stability program at Bosch:

1983: Bosch researchers float some first ideas about how to improve stability when braking hard in bends. They base their ideas on the ABS antilock braking system launched in 1978. An initial proposal is to flexibly adapt each wheel's slip to improve control over the vehicles when braking in bends.

1984: Effective July 1, a development team is set up. Its task is to use ABS as the basis for developing a brake control system offering improved vehicle control when skidding is imminent in a bend. In such a situation, the vehicle has to remain stable and steerable as far as the laws of physics will allow.

1992: A joint project unit is set up near the Bosch location in Schwieberdingen. It is made up of engineering experts from Bosch and the automaker Daimler-Benz, which is subsequently the first to install the system. An agreement is made to develop a system for production in 36 months.

1995: ESP® has its press debut in a Mercedes-Benz S-class coupé in May, and its market launch in the coupé and sedan in September (as an extra, standard feature only with the most powerful, 12-cylinder engine).

1997: A Mercedes-Benz A-class vehicle rolls over while performing an extreme swerving maneuver during testing. The model was only recently launched. Following this "elk test" for a Swedish automotive magazine, the automaker decides to make ESP® a standard feature. Other automakers soon follow suit.

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1998: For the first time, the yaw-rate sensor that is at the heart of the ESP® is produced as a micromechanical sensor. Bosch has been mass-producing these sensors with microscopically small movable structures since 1995. This means ESP® can be smaller, while at the same time longer-lasting, less sensitive, more reliable, and less expensive.

2003: Bosch celebrates the delivery of its 10 millionth ESP® system. The technology has now been in the market for ten years. In the years that follow, increasing volumes pave the way for this lifesaver to become established in the compact class.

2011: Traffic experts and policymakers increasingly acknowledge the benefits of ESP®. The anti-skid system is mandated in various countries, including EU member states. In the EU, the mandating process is gradual. From November 2011, it is initially mandatory for new passenger-car and commercial-vehicle types, and from November 1, 2014, for all newly registered passenger cars and commercial vehicles.

2016: In the Life Achievement category, the European Patents Office confers its European Inventor Award on Anton van Zanten. Born in the Netherlands, van Zanten headed up the 35-strong group of ESP® developers at Bosch.

2020: ESP® turns 25. Over the past quarter of a century, Bosch has continuously improved its anti-skid system, producing more than 250 million ESP® systems to date.

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Press release
Bosch Compact

From windshield wiper to e-bike ABS
Twelve Bosch innovations for more road safety

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ESP® – three letters that make all the difference. Since its debut in 1995, the electronic stability program has prevented skidding accidents and saved lives – year in and year out. With innovations such as ESP®, Bosch has been enhancing road safety for decades. Here, we present a selection:

1926: Windshield wiper
Goodbye to poor visibility: comprising an electric motor that drove a rubber-coated arm via a worm screw and gear, the Bosch electric windshield wiper finally gave drivers a clear view of the road ahead. It was followed in 1959 by an electric windshield washer system. Activated at the push of a button, an electric pump precisely sprayed water on to the windshield through one or several nozzles that were mounted on the hood.

1927: Power-assisted brake for commercial vehicles
In the years after 1900, vehicles became increasingly fast and powerful, but braking force was unable to keep up. This prompted Bosch to develop a pneumatic brake booster for heavy trucks, whose heavy loads meant especially long braking distances. The system used the vacuum that arises in the induction tract of the engine, so that only one-third as much pressure now had to be applied to the brakes.

1928: Bosch brake assistant
Bosch also used this innovative brake technology, premiered in 1927, in passenger cars. There were two challenges: to achieve a compact design that would allow it to be installed in the tight space available in the engine compartment, and to make it more affordable. The technology became established as standard equipment. As in the case of the Bosch brake for trucks, drivers now only had to apply one-third of the pedal pressure, and braking distance was also reduced by one-third.

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1957: Asymmetric low-beam headlights

In 1913, Bosch started production of a new automotive lighting system. The system comprised a generator, headlights, a battery, and a regulator. And while these lighting systems were continuously improved, they still had one disadvantage: they dazzled oncoming vehicles. The more cars there were on the roads, the more inconvenient and dangerous the situation became. In 1957, Bosch premiered asymmetric low-beam headlights. This system causes less dazzle for oncoming traffic and illuminates the driver's own side of the road better.

1978: ABS antilock braking system

Following nine years of development work, 1978 marked the start of the success story of ABS, the electronically controlled antilock braking system for four-wheeler passenger cars. If the wheels lock up, ABS reduces brake pressure then increases it again – up to 40 times a second. This keeps braking distances short, even on slippery surfaces, and the vehicle remains steerable. For motorcycles, the EU mandated the system for all new type approvals from 2016.

1980: Electronic airbag control

In 1980, Bosch was the first European company to manufacture electronic triggering units for passive safety systems. This set the standard in road safety. The triggering unit comprised three components made up of some 170 individual parts, and controlled the driver airbag. It was first installed in the Mercedes-Benz S-class. Up to nine airbags are installed in today's vehicles. They are deployed individually, depending on the accident scenario.

1986: TCS traction control system

The TCS traction control system prevents the driven wheels from spinning. The electronic control unit reduces the speed of the spinning wheels until they recover their grip. TCS is an early example of networking diverse automotive electronic systems. When traction control is activated, it intervenes in the engine management or brake control system. Despite actuation of the accelerator, engine power is continuously lowered, or the brake is actuated, until the wheels recover their grip. Traction control can also brake a wheel individually in order to divert engine power to another drive wheel if the latter offers better traction.

1995: MEMS in mass production

In the 1980s, Bosch worked on making sensors smaller, more reliable, and more energy efficient, as a way of providing ever more sensor data in cars. Following the start of mass production in 1995, these miniature helpers became ever more prevalent, furnishing control units with data about when the car brakes or

accelerates, as well as about the direction the car is traveling. Information such as this is important for safety systems such as ESP®.

1995: ESP® electronic stability program

Using smart sensors, ESP® compares 25 times per second whether the car is actually moving in the direction that the driver is steering it in. If it is not, the system intervenes. By reducing engine torque and deliberately braking each wheel individually, the system helps the driver stabilize the vehicle and prevent skidding accidents. Since its market launch in 1995, ESP® has prevented just under half a million accidents and saved more than 15,000 lives in the EU alone. Bosch celebrates a milestone this year: it has sold 250 million ESP® systems since production began 25 years ago.

2010: Predictive emergency braking system

Ever more sensors in cars, sharing information with each other, make completely new applications possible: the emergency braking system that went into production in 2010 makes use of the information radar and video sensors share with the ESP®. If there is a threat of collision, it offers drivers multi-stage support. First, it alerts to the need to brake hard. If this alert is not heeded, the system initiates partial braking, and if the driver still does not react, it triggers emergency braking.

2013: MSC motorcycle stability control

In 2013, Bosch took its ESP® success story, which began in 1995, and applied it to two-wheelers. In all riding situations, MSC motorcycle stability control ensures maximum stability: when braking and accelerating, on straight stretches and in bends. Wheel sensors measure wheel speed, and a further sensor measures lean and pitch angles. If the system detects a wheel on the verge of locking up, braking pressure is lowered and built up again within a fraction of a second, ensuring that the correct amount of pressure is constantly applied to prevent each wheel from locking up. This can save motorcyclists' lives.

2018: eBike ABS

Bosch has been manufacturing antilock braking systems for cars since 1978, and for motorcycles since 1995. They were joined in 2018 by an ABS for eBikes, which Bosch developed in collaboration with the brake manufacturer Magura. The world's first production antilock braking system for pedelecs reduces the risk of becoming unseated in critical situations. In this front-wheel ABS, the hydraulic brakes and electronic brake system are perfectly tuned to each other. Wheel-speed sensors monitor the speed of both wheels. As soon as the front wheel threatens to lock up, the system regulates brake pressure to optimize riding

stability. This is a huge added boost to rider safety. In addition, the rear wheel lift control function reduces the risk of a head-over-heels accident. If far too much brake force is applied, the ABS regulates the pressure applied to the front wheel, so that the rear wheel can quickly regain traction.

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