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The Chassis & Safety Division has summed up its objectives: “Safe and Dynamic Driving towards Vision Zero.” The division has formulated its core competencies into three different stages - Sense.Plan.Act - in the “Driving” process chain. In all of these areas, Chassis & Safety products are shaping the act of driving. Extending all the way through to highly advanced driver assistance functions, their goal is to support safe and dynamic driving. For each of the three process stages – vehicle status and vehicle environment sensing (Sense), action planning and selection (Plan) and action implementation (Act) – the Chassis & Safety Division offers integrated active and passive safety technologies which save lives as well as products that support driving dynamics. With these high performance products and with the networking of the components and our system approach, we create functions along the action chain of effects which pave the way for automated driving.

We will therefore continue to drive safety technology toward our vision of zero accidents and to make safety available to everyone around the globe. For one thing is sure: only the widespread use of active safety technologies will help to achieve the goals of the EU: to half the number of road fatalities by 2020.

The Chassis & Safety division is one of five divisions of the Continental Corporation with the focus on developing and producing intelligent and integrated systems for a safer automotive future. Chassis & Safety integrates the full range of active and passive safety systems, resulting in comprehensive vehicle safety and dynamics.

Our structure reflects our core competences: vehicle dynamics for cars that are safe and a pleasure to drive are an integral part of our mindset. Globalization, growth, and excellence are the major strategic thrusts in our division, which is organized into four business units:

- Vehicle Dynamics
- Hydraulic Brake Systems
- Passive Safety & Sensorics
- Advanced Driver Assistance Systems
Key Figures – an Overview

Sales

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<th>Division</th>
<th>2013</th>
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Sales by Markets: Continental Corporation

Dec 31, 2013: € 33,331.0 millions

- **24%** Germany
- **30%** Europe without Germany
- **19%** Asia
- **22%** NAFTA region
- **5%** Other countries

Sales by Markets: Chassis & Safety

Dec 31, 2013:

- **26%** Germany
- **20%** Europe without Germany
- **29%** Asia
- **22%** NAFTA region
- **3%** Other countries

Employees at year end

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<th>Division</th>
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Employees by Markets: Continental Corporation

Dec 31, 2013: **177,726 Employees**

- **28%** Germany
- **31%** Europe without Germany
- **19%** Asia
- **16%** NAFTA region
- **6%** Other countries
Chassis & Safety Division
within Continental Corporation

Continental Corporation

CEO Dr. Degenhart
CFO Schäfer
HR Dr. Reinhart
Dr. Cramer (China)

Automotive Group

Chassis & Safety
Jourdan

Powertain
Avila

Interior
Matschi

Vehicle Dynamics
Bietenbeck

Controlling
Volz

Hydraulic Brake Systems
Matic

Human Resources
Hetzer

Passive Safety & Sensorics
Dr. Klumpp

Communications
Orgnon

ADAS
Haupt

Chassis & Safety NAFTA
Salman

Systems & Technology
Dr. Rieth

Chassis & Safety Japan/Korea
Hagedorn

Purchasing
Angerbauer

Chassis & Safety China
N.N.

Rubber Group

Tires
Setzer

ContiTech
Wente
Continental.
Developing Your Profile – Together and Worldwide

Our recipe for your professional success: a dynamic company, flat hierarchical structures and flexible decision-making channels

Our employees represent the success and the reputation of Continental. They are driven by the idea of doing great things, always giving their best and letting their actions speak for themselves. We combine technological, ecological, economic, and personal aspects of performance. With us, you can find the ingredients for your own recipe of professional success: challenging projects, early responsibility, appreciation of your personal commitment, and an inspiring as well as international environment shaped by openness, integrity, team spirit, and equal opportunities.

We help everyone who wants to get ahead to find the right career path for them. For high potentials who do not wish to embark on a traditional management career, a career as a Continental expert is an attractive career path. We select technical experts in R&D and production and develop them so that they can use their highly specialized knowledge to accelerate and shape technological progress in strategically important fields.

Whether management or expert career, we value our employees because they play a key role in the long-term business success of Continental. Our experts ensure that we maintain and expand our strong market position.

Europe, Asia, North and South America, Africa and Australia – we’re offering you a world of opportunities

At Continental, we take a no-limit approach to mapping your career. We are globally active with almost 291 locations for production and research & development in about 49 countries. There’s plenty of scope for your ideas worldwide.

Getting started: how to score at Continental

Are you self-confident, team-oriented and not short of empathy and persuasiveness? Then you have some of the fundamental soft skills that we expect from our present and future employees. Hard facts, together with soft skills, also form the basis of your career at Continental. Why not take the quick test and find out if you can answer the following questions to your satisfaction? If you do, we look forward to meeting you in person.

› Are you visionary?
› Do you work interactively?
› Do you like learning?
› Are you ready for action?
› Are you good at getting things done?
› Can you act and think entrepreneurially?

If the automotive future makes your heart beat faster, then we’re the right choice for you.

www.careers-continental.com
www.facebook.com/ContinentalCareers
Driving You Safely: ContiGuard

The Chassis & Safety division networks first-class vehicle components and established systems know-how in driving safety and driving dynamics into the comprehensive safety concept ContiGuard. “Vision Zero” is an evolutionary approach to reaching Zero fatalities, achieving Zero injuries and finally striving for Zero accidents. For Continental, this means intelligent and safer driving for all and in all markets of the world. Continental distinguishes between five driving or safety phases, from normal driving to a final, unavoidable crash situation.

ContiGuard opens up a new dimension of driving safety technology
ContiGuard networks active and passive safety systems, enhanced by surrounding sensors and their coordinated interaction. With ContiGuard, our customers can efficiently achieve a significant reduction in accidents and number of fatalities on the road to Vision Zero, or at least minimize the consequences and the risk of injury for all road users. With ContiGuard we identified five different driving phases:

- Normal Driving
- Hazard
- Pre-crash
- In-crash
- Post-crash

During every driving phase, various technologies interact in a variety of ways to offer the driver, passengers, and all traffic participants an even safer driving experience.

The different driving phases

Normal driving: information
During normal driving the driver is kept informed of the driving situation and is supported by advanced driver assistance systems on the evaluation of such.

Drivers can maintain a safe distance to the car in front by means of an intelligent cruise control system and distance warning alerts. Lane departure warning systems improve lane discipline with the aid of camera data, steering intervention and haptic warnings. Lights are adjusted according to the weather conditions and time of day, speed restrictions are displayed, and the radio or navigation device give traffic updates.

Hazard: warning and support for avoiding accidents
Forward-looking brake assist functions from pre-braking to autonomous emergency braking become active in critical situations of distance. When performing an avoiding maneuver the driver is also actively supported to keep the car safely on the road through adaptive chassis systems, such as active suspension systems. If necessary, stabilizing functions like ESC (electronic stability control) actively stabilize the vehicle.
If an accident does occur, then the following three driving phases play an important role in reducing the risk of injuries:

Pre-crash: preparation
Reducing the speed of collision using an emergency brake assist can decisively minimize the risk of injury. During a pre-crash situation, additional protective functions like seat belt tensioners are initiated to prepare the vehicle and its occupants for a crash.

If a crash is unavoidable, pre-crash information on the crash severity and crash type results in situation-dependent deployment of the restraint systems, in order to offer occupants a maximum of protection.

In-crash: impact protection
To ensure the best possible protection of the occupants, situation-dependent airbag deployment, based on pre-crash information, is initiated to offer a maximum of protection. Technologies such as rollover sensing and crash impact sound sensing (the optimization of the airbag deployment, dependent on the structure-borne sound) play an important role because of their swift and precise response behavior. The Emergency Brake Assist also remains active during a collision.

Post-crash: mitigation of impact
Shortly after the primary impact, measures are taken to avoid or mitigate the secondary impact, in addition to alerting rescue services. After the primary impact has been detected by an airbag deployment, the car is autonomously decelerated to a standstill by the electronic brake system. The life-saving "eCall" is an automatically generated emergency call. It indicates the location of the crashed car and additionally provides the Minimum Set of Data (MSD). This is important for emergency services in order to locate vehicles, especially when an accident occurs at night, for example.

The Decade of Driving Safety
The United Nations General Assembly has proclaimed the period from 2011 to 2020 the Decade of Action for Road Safety, and based on a proposal put forward by the Directorate-General for Mobility and Transport (DG MOVE), the European Commission has published guidelines for road traffic safety for the same period. The goals of the new guidelines include reducing the number of traffic fatalities by a further 50 percent.

Every year, the equivalent of the entire population of a small city is killed in traffic accidents in the EU alone. As a result, there is a clear need for further improvements in traffic safety throughout Europe. One thing is clear: driver assistance systems and networked safety systems like ContiGuard are considered key technologies when it comes to enhancing driving safety. Without them, it would be difficult to achieve the goal of cutting traffic fatality figures in half by 2020.
Automated Driving - an Evolutionary Path to Greater Driving Safety

As we move toward even safer, more efficient and more comfortable vehicles, the development of automated driving represents a key technology. Automated driving is our motivation for accelerating Vision Zero.

Today’s driver assistance systems form the first building block
Driver assistance systems already help prevent accidents – or at least mitigate their effects. They relieve strain on the driver in coping with the task of driving and support the driver in operating the vehicle safely and efficiently.

Increasing positive responses to driver assistance systems, the ever-growing need to communicate with others while driving, and tightening requirements for energy-efficient vehicle operation form the basis for acceptance of automated driving.

System reliability guarantees traffic safety
The basic technical prerequisite for the realization of automated driving is system reliability. Guaranteed traffic safety at the highest possible level is therefore the crucial basis on which automated driving must be founded. In concrete terms, that means what is needed is a failsafe architecture that keeps the vehicle in a safe driving condition in the event of an error.

Driver retains full control
Automated driving will not lead to a loss of control by the driver, as is often feared. Rather, the connected vehicle – which can drive automatically if desired – will give the driver added freedom in utilizing individual mobility options. It will provide drivers with valuable time and leeway for actions as needed while also offering all of the options available for even greater enjoyment of the pleasure of driving.

For example, the driver is free to choose whether to drive himself or herself or have the system drive automatically so the driver can concentrate on other activities, such as reading the latest headlines on the Internet. At the same time, a car that can drive automatically will become even safer as it is more connected both internally and with the surrounding environment – with the infrastructure, other road users, and data services such as the Internet. In addition, a broad-based “blanket” of data will optimize energy management in the vehicle and how the vehicle drives, enabling even more energy-efficient driving.

We can see that the car of the future will offer automated driving in an increasing number of driving situations (traffic jams, construction sites). Depending on the driving situation, the driver will be able to turn over the task of driving to the vehicle’s electronics, but without giving up responsibility.

The evolutionary path to automated driving
On the technology side, automated driving represents the next step in the evolution of the technological path already started by driver assistance systems. Consistent, ongoing interlinking of these systems with driver information and drive systems is steadily leading to automated driving.

System connectivity as a core competency
In our role as a system supplier, Continental is ideally positioned to develop solutions for partially automated applications for its customers and launch series production of these solutions by as early as 2016. One possible application is stop-and-go traffic on the highway, at least at low speeds. We will develop initial applications for fully automated driving even at higher speeds and in more complex driving scenarios to the point of readiness for series production by 2025.
Vehicle Dynamics
Mastering Unexpected Situations Safely

Adaptability is more than just an evolutionary success strategy. With its active chassis technology and electronic brakes, Continental leverages a wide range of possible interventions to adjust the vehicle’s behavior to unknown factors such as the condition of the road surface, load changes, and cornering. The goal is to ensure optimum contact with the road, no matter what the conditions. What that means for the driver is noticeable comfort, optimum cornering stability, and sporty handling.

Chassis Domain Control Unit
As a control unit, the Chassis Domain Control Unit (CDCU) can play a central part in ContiGuard when it comes to taking over the integration of electronic chassis components and safety systems. It thereby reduces the complexity of vehicle electronics through the integration of systems that have until now operated in isolation. The centralized coordination results in the optimal harmonization of the simultaneous intervention of different systems.

Chassis control units for vertical dynamics
Well-adjusted, rapid control of the damping function and the air spring is essential to maintaining ideal vehicle position and is thus a fundamental precondition for establishing the highest level of safety. Tires, as well, must grip the ground firmly at all times. With active damping, the suspension system adjusts to the road and driving conditions within milliseconds. Thus an intelligent control of damping and leveling increases the vehicle’s comfort in every driving situation. The goal of this interconnectedness is the control and management of these systems in one electronic control unit. Our scalable platform concept provides the automotive industry with the benefit of reducing the number of control units. Communication takes place via bus systems such as CAN or Flexray. The AUTOSAR compliant software offers the possibility to integrate the automotive manufacturers software using standardized interfaces.

Electronic air suspension systems
The electronic air suspension system from Continental represents a milestone in the development of chassis technology. With the possibilities offered by electronics and the introduction of an intelligent bellows technology, we have developed a groundbreaking chassis that offers the driver the utmost in driving safety, with top comfort and sporty handling. The electronic air suspension system automatically adapts damping and spring characteristics, along with the vehicle’s body level, to changing driving conditions and vehicle load status, thereby:

› reducing rolling and pitching movements
› and other movements of the vehicle body
› reducing wheel load fluctuations
› markedly improving driving dynamics and comfort

Dynamic Body Roll Stabilization
We are developing the Dynamic Body Roll Stabilization together with the Schaeffler Group. Continental supplies the control electronics for it. This system reduces body roll of the vehicle and enhances the lateral vehicle stability when cornering. The major components of the next electro-mechanical generation are a motor, a gear, and control electronics. The advantages of the dynamic body roll stabilization are a more agile and safer ride with an accurate steering response, especially in curves. In addition, the overall ride comfort is considerably improved.

Characteristics:
› Reduction of body roll when cornering
› Higher level of agility and cornering stability of the vehicle
Electronic Stability Control (ESC)

ESC intervenes when the car threatens to oversteer by braking the outer wheels of the car. As a general rule, most of the brake force goes to the front of the wheel, where wheel slip is set at about 50 percent. This gives rise to a counter torque which compensates the yawing torque that causes oversteer. At the same time, the increase in wheel slip reduces the lateral forces.

ESC intervenes when the car understeers and seeks to drift straight ahead in a curve. Here, ESC brakes the inside wheels, applying the largest brake force to the rear wheel.

Supports neutral self-steering characteristics
Electronic brakes for controlling driving dynamics

Anti-lock Brake System (ABS)

In the event of an emergency braking, there is a risk that the vehicle’s wheels will lock. ABS prevents this by electronically controlling the braking force so that the vehicle remains capable of steering and stable. ABS offers additional safety, especially in critical situations, and is practically standard in today’s cars.

Electronic Stability Control (ESC)

ESC, presently the most important active safety system, prevents critical vehicle states from developing. The system constantly evaluates the data from the wheel speed sensors, the steering angle sensor, the yaw rate, and lateral acceleration sensor and compares the driver’s input with the vehicle’s actual behavior. If an unstable state is detected, for instance as the result of a sudden direction change, ESC responds in milliseconds and stabilizes the vehicle through wheel-specific brake intervention and adjustment of the engine torque. The ESC systems offer analog-controlled, infinitely variable valves for minimal pedal vibration and optimally dosed pressure build-up in the automatic braking process of Adaptive Cruise Control (ACC) right up to bringing the vehicle to a complete standstill in stop-and-go traffic.

In addition, our EBS family utilizes the ESC pump for brake boosting, among others, to avoid the increase in the pedal force in the event of brake fade, and to support the driver when there is temporarily a low engine vacuum (e.g. in the cold start phase of direct injection engines). The high-performance MK 100 system offers all functions, from basic ESC to a high-end system with the convenience and performance features of future brake-by-wire technology.

MK 100 – the new generation of electronic brakes

MK 100-modular kit

The MK 100 is based on a modular product family and can be scaled as desired: from a motorcycle ABS, with or without an integral brake function, to high-end solutions with extremely powerful, low-pulsation pump variants with a high level of running smoothness. The safety and assistance functions already mentioned earlier can also be configured with the MK 100 ESC. The MK 100 additionally represents a new dimension in installation space and weight. Dimensions and weight will be reduced by more than 30 percent compared with the current ESC generation.
The MK 100 went into series production in 2011 in European and Asian platforms. Many more car manufacturers in Europe, NAFTA and Asia have also already awarded or opted for the MK 100 and will be bringing it into series production in their future vehicle platforms. The positive response by vehicle manufacturers globally proves that the concept and the technology behind the MK 100 is a success.

MK 100 ABS Entry
Low in its project application efforts, the MK 100 ABS Entry has been designed for the vehicle segments A, B and C in the growing markets, and with the XT version, can be extended to cover the D vehicle segment as well. The packaging is compact and extremely light, at less than 1,200 g, and fits in the MK 100 ESC M box dimensions. Furthermore, throughout the MK 100 product family, the hydraulic and electrical interfaces are compatible with each other, which makes the MK 100 easily applicable for platform concepts of car manufacturers wanting to benefit from a truly scalable product range. The MK 100 ABS Entry is produced locally in the markets of China, India and Brazil.

MK 100 XT – designed for heavy duties and improved hydraulic dynamics
The most recent addition to the MK 100 brake family is the MK 100 XT, which has been designed for heavy vehicles or vehicles with heavy loads, such as E segments, SUVs and pickups. It is an extension of the MK 100 set up with larger valves and higher pump dynamics (QESP ≥ 13.5 cm³/s) in order to meet the respective requirements.

With two model types available, the MK 100 XT Base offers all standard ESC functions up to Adaptive Cruise Control functionality, whereas the MK 100 XT Premium offers additional Full Speed Range Adaptive Cruise Control as well as best Noise Vibration Harshness (NVH) and brake comfort. Furthermore, thanks solely to a small software customization, it can be used in hybrid vehicles with an efficiency of 98 percent.

As part of the MK 100 family of brakes, the MK 100 XT can offer all possible functional options since it is based on the same proven technology (including PYA, IPB, EIP (ESC Integration Platform), etc.).

The application process is easily implemented through parameterization and is therefore ideal for the implementation together with MK 100 systems. Third-party actuators can also be controlled and electric interfaces US CAR and EuCon are also offered. A special focus is on the hydraulic flow rate, thus improving active safety through high brake dynamics.

High level of integration ability
The new generation of electronic brakes distinguishes itself in particular through its high level of integration ability. The ESC sensors can already today be integrated on the circuit-board of the controller (PYA technology). In addition, the control of the new generation of the electric parking brake is integrated into the ESC which results in no separate controller being required for the triggering of the integrated parking brake. It is also possible to control third-party actuators. A result thereof is a minimization of the number of controllers that need to be integrated and thus an increase of available storage space in the vehicles.

MK 100 ESC Premium Hybrid – system layout
ESC Hybrid is based on a standard hydraulic brake system. The only additional part needed is a brake pedal position sensor. When the driver depresses the brake pedal, the driver activates the hydraulic brake. Simultaneously, the pedal position sensor measures the brake pedal stroke. The brake HECU converts the brake pedal stroke into a deceleration torque and commands an electric generator to achieve the torque. In essence, the driver simultaneously activates the conventional hydraulic brake and the electric generator based brake. The recuperation focuses on the dominant vehicle deceleration range (up to 0.2 g – dependent on the availability of the generator).
The driver compensates the decreasing generator torque at low vehicle speed. To increase the recuperation efficiency, the hydraulic brake is activated only when high deceleration is necessary, whereas with normal braking the braking energy is recuperated by the generator (i.e. the eGap). The eGap takes advantage of the already existing valves in the ESC HECU.

**Regenerative braking with the MK 100**

The regenerative braking with Continental’s MK 100 makes the recuperation of braking energy possible. The braking energy is converted into electric power, which is used to charge the vehicle battery. Only if the required deceleration is not sufficient, is the conventional brake system then activated. This generates the remaining braking effect based on the driving state determined by sensors for wheel speed, yaw rate, lateral acceleration, etc.

**Additional added value functions of the electronic brake**

With a clear increase in comfort and safety, drivers benefit from the precise, convenient and quiet control applied by our additional safety and assistance functions. These functions range from ARP (Active Rollover Protection), TSA (Trailer Stability Assist), HSA (Hill Start Assist) and FSA (Full Speed Range Adaptive Cruise Control) to complex autonomous overlay functions for vehicle stabilization and the hydraulic brake assistant.

**MK C1 – more dynamic and efficient braking through integration**

With the MK C1, the brake actuation feature, the brake booster and the control systems (ABS, ESC) are combined into a compact, weight-saving braking module. The electro-hydraulic MK C1 can build up braking pressure significantly faster than conventional hydraulic systems, thereby fulfilling the increased pressure dynamics requirements for new advanced driver assistance systems in order to prevent accidents and protect pedestrians. In addition, the system can fulfill the requirements for a recuperative braking system without any additional measures, while providing a high level of convenience.
Motorcycle Anti-lock Brake System (MAB)

The MAB offers improved braking control and thus greater driving safety thanks to optimum braking. The MAB’s compact dimensions and light weight make it easier to integrate or “package” into the motorcycle’s design. If the ABS unit only takes up a small amount of installation space, less adjustment is needed to the motorcycle’s existing structures, to its frame, fuel tank, or fairings.

One-Channel Motorcycle ABS – MiniMAB

The one-channel ABS for small and recreational motorcycles is small, light, and can be easily applied to various motorcycles. In the event of a panic brake by the driver, the ABS control on the front wheel can save the driver from falling. The one channel ABS went into series production in April 2014.

Benefits:
- A high level of integration reduces the number of individual components in the braking system
- Increase in braking performance
- Fuel savings thanks to reduction in weight
- Ideal for the realisation of functions for automated driving
- Fulfills increased pressure dynamics requirements for new ADAS functions
- Fulfills requirements for regenerative braking system
- Provides a high level of comfort

Safety on two wheels – Electronic Brake Systems for motorcycles

To improve the active safety of motorcycles we have developed electronic brake systems for scooters and motorcycles of all classes on the basis of our tried-and-tested passenger car ABS technology.

Motorcycle Integral Brake Systems (MIB)

With the MIB system, both wheels can be used for braking, although the driver only activates one brake. The system recognizes the request of the driver to brake and actively builds up pressure on the other brake circuit, which results in both wheels being activated for braking. Both systems can support the Rear-Wheel Lift-off Protection (RLP) functionality. This prevents lift-off of the rear wheel. In addition, the RLP function prevents the motorcycle from somersaulting through countermeasures such as moderate pressure modulation in the front brake.
Braking Quickly and Safely
When Every Second Counts

Continental disc brakes - high-performance in all situations

As one of the world’s leading suppliers of hydraulic brake systems, Continental offers solutions for traditional brake technology and optimally adjusted actuation systems. Our product portfolio ranges from disc brakes, parking brakes and drum brakes to brake hoses.

FN brake caliper
For years we have enjoyed extremely good success with our FN brake caliper. Consistent further development has allowed us to achieve constantly improved braking performance and a reduction in space requirements and weight, as well as significantly optimized values for NVH and low frictional resistance.

Our FN calipers offer the familiar positive features concerning their corrosion resistance. Furthermore, the weight can be significantly reduced by using aluminum. We remain true to our strategy of developing high-tech solutions at affordable prices. Our cost-optimized FN-L calipers are therefore ideal for expanding markets such as Asia and Latin America, for example, and for affordable cars.

ZeroSplit 4MN: generation of fixed calipers in a sporty look
Our new generation of fixed calipers combines our years of positive experience with floating and fixed caliper disc brakes.

We applied all our knowledge concerning performance, corrosion and NVH (Noise Vibration Harshness), combined with the structural benefits of a fixed caliper, to create the new generation of fixed calipers from Continental. As a result of the stable structure of the brake, a constant high level of braking performance can be achieved, along with an excellent pedal feel. Corrosion resistance is ensured by permanent freedom of movement among moving parts.

2FA brake caliper (double piston pinslider)
With the 2FA pinslider for SUVs and light commercial vehicles, the fairly heavy brake housing for these applications is positioned exactly at the brake pads and discs through the service free anchor guides. The function offers a high level of comfort and includes a reduced and parallel pad wear, reduced residual brake torque and a low noise and brake judder.

Fixed caliper ZeroSplit 4MN

The new fixed-type caliper has an extremely sporty look. The lower power-to-weight ratio contributes to reducing CO₂ emissions and enhancing fuel economy. The fixed-type caliper is easily scalable in various sizes.
Parking brake systems
Parking at the push of a button: our customers have the choice.

Conventional parking brakes

Duo servo brakes
A highly efficient, self-boosting drum brake, fitted in the brake disc hat. It is operated mechanically and is completely separate from the service brake. Its main field of application is premium-class vehicles and SUVs.

Combined caliper
The combination of service brake and parking brake in the classic FN or pinslider design is a cost-optimized solution for vehicles in the lower and upper mid-size class.

Electric parking brake systems (EPB)
In electronic parking brake systems, the parking brake is not activated by pulling on a parking brake lever, but by activating an electrical switch. In response, an electronic system controls the electrical actuators that are integrated into the wheel brakes. In addition to manual operation via the switch, these systems also offer a range of automatic assistance functions for enhanced safety and comfort. We offer various EPB system solutions for different rear axle brake configurations.

Shared advantages of EPB systems:
› Simple operation at the touch of a button
› Emergency brake function in the event of service brake failure
› Implementation of various assistance functions for safety and comfort in conjunction with the electronic brake system
› Since there is no parking brake lever, OEMs additionally have new options in terms of design in the vehicle's interior.

EPB-CI
The “caliper integrated” electric parking brake (EPB-CI) is a solution for floating caliper disc brakes. A floating caliper is combined with the components of an electric parking brake. The electrical operation takes place via an electronic system integrated into the ESC (Electronic Stability Control) system. The system also consists of two electrical combined calipers as well as the EPB-specific operation software.

EPB-DS
The EPB-DS (“duo-servo”) is a solution for duo-servo brakes. This is a highly efficient self-boosting drum brake, fitted in the brake disc hat. The EPB-DS is used especially in premium-class vehicles, sports cars, and SUVs in whose case separating the service brake and the parking brake is particularly important.
**EPB-Si**

The electric drum brake with or without parking brake (EPB-Si) is a solution for vehicles with only drum brakes on the rear axle. The way a drum brake works is via the “simplex” principle.

The EPB-Si is especially tailored to smaller vehicles which to date have only been equipped with a mechanical parking brake.

In this instance, the so-called actuator is adapted to the virtually unchanged drum brake. The activation of the parking brake function is then controlled electrically by the integrated lever. The electronics are – as with the caliper version – integrated into the electronic stability program. This offers a high level of reliability at favorable costs.

Since the basic drum brake can remain nearly unchanged, a so-called mixed installation can be realized. One part of the platform receives an electrical, the other a hand operated parking brake function - this results in cost advantages for the vehicle manufacturer.

**Proven safety for emerging markets: drum brakes**

Drum brakes are radial brakes with two brake shoes that are typically pressed outward against the friction surface of the drum through hydraulic wheel cylinder actuation in service braking and through the lever in parking braking. When braking ends, springs pull the brake shoes back inward.

Drum brakes are a good combination of service braking and parking braking and offer good values for both residual torque and cost. We offer a variety of different drum brakes in the well-known simplex design. These types of brakes are suitable for entry-level vehicles up to light commercial vehicles.

**Brake actuation and brake assistance systems**

We offer customer-specific, robust and attractively priced brake actuation systems from our modular concept. All actuation components originate from our modular system and can be individually combined with each other as needed:

- Brake booster
- Tandem master cylinder
- Brake fluid reservoir
- Additional functions, such as for crash optimization or applied sensorics

This freedom to combine units enables us to implement individual solutions for vehicles of all classes and for all markets, including low-cost and light-weight solutions. This can make a significant contribution toward reducing both CO₂ emissions and costs. The availability of standard components also significantly reduces development time.

**Optimized actuation systems that suit vehicles of all classes, assembled from the components of our modular system:**
- 6 sizes of single boosters, 7 sizes of tandem boosters,
- 2 TMC types, and application-specific designed reservoirs.
The international benchmark in high performance: our brake actuation components

**Brake boosters**
We supply vacuum brake boosters in both single and tandem design, in all required sizes. All product variants are available in conventional steel, but also in lightweight aluminum housing versions. The tie rod version, available for all designs, features further weight reduction and also optimized deflection characteristics. Front bolt designs on a tie rod basis simplify assembly at the OEM. The latest brake booster generation (Booster Gen. III) features further weight reduction (full aluminum with reduced wall thickness) and an ultrashort installation length.

**Affordable products for the expanding markets of the world**
With our modular designed products we are in a position to meet all customer requirements, also those in low-cost markets. This includes the Affordable Brake Actuation booster (ABAC).

**Tandem master cylinders (TMCs)**
We offer master cylinders in the highly compact plunger design for all required diameters and strokes as well as for various types of brake circuit designs (straight or stepped bore).

**Brake fluid reservoirs**
We design reservoirs specifically for each vehicle application, but use standardized subassemblies such as filler caps and fluid level indicators as much as possible.

**Brake assist systems**
Danger detected – braking force boosted: brake assist systems ensure maximum vehicle deceleration in emergencies, even when little force is exerted on the pedal. Brake assistants are important helpers in emergencies in which the driver reacts quickly, but does not brake energetically enough, leading to dangerously long stopping distances. The brake assist detects panic situations based on the speed at which the pedal is depressed and activates the booster or the EBS hydraulic unit. This means that even when little force is exerted on the pedal, the vehicle achieves maximum deceleration. We offer the following technology to accomplish this:

**Mechanical brake assistant**
In this system, a mechanism uses the effect of inertia to recognize high brake pedal speed combined with heavy pressure exerted by the driver’s foot. The driver’s wish for greater deceleration is supported through activation of the brake booster, supplying maximum boosting.
Brake hoses – experience counts
Continental is one of the world’s leading brake hose suppliers and the only one offering many years of experience in entire hydraulic brake technology. Various assembly locations serve all markets with a quality performance of below 1 ppm. A high degree of automation and sophisticated processes ensure this world-class quality standard.

Brake hose Type 9 – proven competence
Continental’s hose Type 9 started with series production in 2005, and its combination of EPDM inner and outer rubber with double layer PVA yarn offers a high degree of dynamic strength, pressure and thermal resistance as well as chemical robustness to oil, fuel and all environmental impacts. Extensive own test benches and laboratories are available for testing according to all customer-specific requirements.

Brake hose Type 11
Continental’s hose Type 11, which went into series production in 2012, is the consequent development of the Type 9 brake hose with the same material properties, but with design modifications for optimized functional characteristics. The brake hose Type 11 combines the excellent performance of Type 9 with a weight reduction, in order to meet the requirements of our customers on environmental compatibility and considerate usage of resources.

Thanks to the design modifications, a hose diameter of just 9 mm has been developed. This therefore allows for optimized routing even in limited corner space situations, such as within the wheel arch, for example. The smaller diameter therefore results in a weight reduction of a standard brake hose assembly by 8 percent or 0.03 kg per vehicle.

Type 12 – High performance brake hose
Continental’s Type 12 - in series production since January 2013 - is a subsequent evolution of the Type 11 brake hose focusing on the improved volumetric expansion at an increased temperature. All hose types benefit from the many years of experience of Continental in brake hose development and production. Type 12 combines the advantages of Type 11, with the hose diameter of 9 mm allowing for an optimized routing, also in limited corner space situations. With the new braid material, an advanced volumetric expansion at an increased temperature has been achieved at a maximum 1.5 cm³/m at 100 °C and 200 bar.
Windscreen Washer Systems and Headlight Cleaning Nozzles

Having a dirty windscreen or headlights is a risk to any driver. For these conditions, Continental offers modular products and solutions with intelligent applications, increasing the safety of drivers and the oncoming traffic. The result is a clean windscreen and headlights, providing a clear view ahead.

Our scalable, modular products offer vehicle manufacturers either complete water-conserving washer systems or individual components, tailored specifically to any vehicle class – from affordable cars to premium models. The products can be matched to any car manufacturer’s requirements and installation prerequisites. Our considerable experience allows us to provide our customers with optimum support during the technical design and configuration phases of their washer systems.

New automotive trends mean that the washer systems of the future will have to meet different requirements: reduced overall vehicle weight, tighter requirements with regard to pedestrian protection, design and aerodynamics, and the increasing installation of sensors and passive safety systems. Our engineers develop the products to meet these challenges:

Water reservoirs - two production technologies
Water reservoirs from Continental are produced using either blow molding processes or injection molding processes, depending on customer requirements. They are typically supplied as pre-assembled systems with integrated or attachable filling supports in which components such as pumps, fill level sensors, hoses, or wire harnesses are already installed. All reservoir systems are shipped ready to install into the vehicle and have been checked for functionality and leak tightness.

Reliable pump systems for all vehicle classes
Our single and dual pumps are known for their functional reliability and scalability for all performance classes. Their shape, geometry of electrical and hydraulic connections, noise emissions, and EMC (electromagnetic compatibility) interference suppression can be tailored to customers’ requests.

Hoses: cost-optimized models to customer requirements
All hose systems from Continental are made from materials that can withstand high pressure and extreme temperatures. Depending on the specific use, a number of different materials are available, including EPDM, TPV, PP, PA, and mixed forms, so that the optimum solution for each customer can be generated. The portfolio is supplemented by solutions for fully and partially heated hose systems.

Connectors for easy installation with the utmost safety
Continental can provide various modular component connector systems for hoses, in order to offer customized hose connection assemblies for all vehicle classes. Our snap-on and plug-in connections support fast installation and removal of these hose systems. An audible clicking noise during installation confirms to the operator that the connection is assembled correctly, giving our customers greater certainty during installation.
Washer Systems

Washer nozzles for clean front and rear windscreens

**Spot and fan jet nozzles**
Spot jet nozzles with one to three washer jets as well as fan jet nozzles (fluidic) remove soiling from the front windscreen and rear window. Various types of nozzles can be used and adjusted depending on customer specific requirements regarding the spray pattern. To achieve optimum water distribution with outstanding washer results and minimal water consumption, the fluidic nozzle is recommended. The advantage of the spot jet nozzle, by contrast, lies in the precision of the targeted spots on the windshield, and thus the ability to calibrate the spray pattern. In a heated configuration, the vehicle’s windows can be cleaned reliably even at critical temperatures. Continental also offers its customers different heating options, from heating the nozzle only to fully heated systems.

Front nozzle-hose assembly
For especially challenging visual requirements, and to reduce work on OEM assembly lines, Continental’s portfolio includes preassembled front nozzle-hose systems. In these products, the nozzles and hoses are assembled in our production plant together with all required grommets, markings, tapes, protectors and fasteners. Smooth transitions between the nozzle and hose meet our premium customers’ exacting requirements when it comes to design and functionality. The full range of heating options is available for use with these versions as well.

Headlight cleaning

**Hydraulic telescoping nozzles**
Dirty light-emitting surfaces in headlights can break the beam of light, causing glare for oncoming traffic. With different stroke lengths and nozzle heads (one or two heads) as well as customer-specific snap-on or plug-in connectors, hydraulic headlight nozzles from Continental can be adjusted to the equipment requirements of various vehicle classes. The hydraulic telescoping nozzle is extended via pressure generated by a pump and works on the same principle as a piston. We verify the cleaning performance of our headlight systems in our own TÜV certified test center light room. We also perform CAD cleaning simulations and support our customers during the homologation process. Geometric downsizing of the telescoping nozzle combined with an adjusted extension principle makes it possible to use the full range of our components (hose diameter, connector, pump) for the windshield wiper and headlight cleaning systems. The advantage: lower weight and costs without any loss in performance.
All Sensing Systems on for More Safety
Integrated Safety Through the Networking of Sensors and Passive Safety

We combine the competence of passive safety and that of sensorics to a system of integrated safety. One specific strength is the networking of passive safety with driving dynamics and environmental sensors of the immediate surrounding.

Innovative protection systems for occupants, as well as pedestrians and cyclists, also belong to our product portfolio as does an active accelerator force feedback pedal. In order to increase networked safety still further, we are developing cutting edge C2X systems.

Sensors for different types of applications like for the controlling of the chassis, for brake systems, as well as for monitoring the battery, compliment our product portfolio, in addition to speed sensors for wheels, engines and transmissions.

From sensor to sensor system

In today’s design of E/E (electric/electronic) vehicle architectures, engineers are increasingly moving away from the former tendency to allocate one sensor to each function. As part of our ContiGuard activities, the Chassis & Safety division is developing a new approach to E/E architecture that takes sensor allocation into account.

The central task here is the fusion of different driving dynamic sensor signals in a scalable virtual software node. This node prepares the signals it receives and provides them to as many functions as possible, across a range of different domains. Some of the signals can be used to calculate measurement variables (virtual sensors). Merging and reconciling the signals in this way makes it possible to achieve both an improvement in precision and mutual monitoring and support among the signals in the event that one signal is lost. The software node, including the sensor hardware, can either be implemented as a separate module or integrated into existing control units.

Preventing dangerous situations before they occur with C2X-Communication and M2XPro

C2X Application Unit with M2XPro

One initial implementation will make it possible to visualize the relative and absolute position of the vehicle (precise position within the lane) with the Motion Information to X Provider (M2XPro), using dynamics sensors and GPS data. Sensor information relevant to safety from other vehicles or service providers can also be integrated via the so-called C2X communication (car-to-car, car-to-infrastructure, etc.) in an extended sensor node module, in order to enable driver assistance functions to be more cost-effective.

“Sensor System Inertial,” a related project, is developing the sensor driver (software component) for the processing of longitudinal and lateral acceleration as well as yaw rate. These drivers can then be applied flexibly in various control units.

The benefit provided by this additional information helps enlarge the field of vision (like being able to “see around the corner”) and leads to forward-looking driving. This head start in terms of information makes it possible to recognize dangerous situations earlier. This extends the available reaction time and prepares the driver and the vehicle for circumstances even before they become apparent. And that means C2X is an important building block on the way to accident-free driving (Vision Zero).

The application unit with M2XPro can also calculate and perform functions and applications for C2X scenarios. A competitively priced, flexible and modular C2X-system according to the ETSI standard can therefore be integrated into existing vehicle architectures.
Sensor cluster for sensing the vehicle dynamics

The sensor cluster makes available to all devices in the vehicle the vehicle’s current movement status (yaw rate, longitudinal and lateral acceleration, and optionally, pitch and roll rates) in the form of electronic signals. The verified signals are transmitted to the data bus via a standardized interface, which can also be adjusted on a customer-specific basis. In complex control algorithms, these signals are used to initiate vehicle stabilization when ESC control is activated. The signals are also needed for driver assistance systems.

One of our core competencies lies in processing the MEMS (micro-electromechanical) signals and making adjustments to the mounting location in terms of vibrations and temperature. Our use of the latest technologies for MEMS elements and ASICs enables a high level of component integration and compact design. With its fully developed technology, low application costs, and low complexity, the sensor cluster is an ideal product for existing and future vehicle architectures.

Derivatives of the standard sensor cluster for the Continental ESC in passenger cars have the following applications:

- Sensor cluster with customer-specific interface for applications in external systems
- Redundant sensor cluster for high safety requirements regarding the control system (SIL3)
- Sensor cluster for ESC applications in the truck market with freely programmable MCU
- Sensor box to measure the tilt angle during motorcycle operation
- Sensor cluster with several degrees of freedom for the industrial sector as a catalog part with a J1939 interface

SC2012 Sensor - highest integration of signal sensing

An innovation in inertial measurement technology is the measurement of the yaw rate and the acceleration in a single component (SC2012 Sensor). The integration in one housing includes the MEMS elements for measurement of the acceleration and the yaw rate, and the corresponding combi ASIC for signal processing.

Due to its compact design as an SMD component, and the capability of adapting the calibration flexibly to the relevant requirements, the SC2012 Sensor is used not only in sensor clusters, but also in other control devices. The introduction of this innovation enables manufacturers to considerably reduce the size of all electronic devices that measure yaw rates and acceleration.
Passive safety

Efficient, flexible and affordably priced – control units on a modular basis: SPEED (Safety Platform for Efficient & Economical Design)

The automotive markets around the world vary considerably. While vehicles for highly industrialized regions are equipped with a large number of airbags, the safety equipment in other parts of the world is often limited to the driver’s airbag.

With SPEED, we have therefore developed a control unit concept that is based on a modular structure and can be adjusted easily to the wishes of car manufacturers. Five product lines in total cover the typical development levels for control units:

- SPEED XS serves as an airbag control unit providing basic functions
- SPEED S, M and L offer versions of a more comprehensive safety control unit with different levels of capability.

Integrating chassis functions such as driving dynamics sensors makes it possible to reach the first level of networked active and passive safety components.

- SPEED XL, a safety domain control unit, opens up the possibility of powerful processing of sensor data from sources such as driver assistance systems for adaptive activation of safety systems. It is especially suitable for interconnecting complex active and passive safety components.

This scalable concept covers the needs of all markets worldwide. And that also applies to the requirements for the various vehicle classes and sizes.

From airbag control unit to safety domain control unit – SPEED XL

Continental’s new generation of passive safety improvements will enhance the safety of vehicle occupants and pedestrians. By assessing data from the Electronic Stability Control (ESC) function and by incorporating innovative radar or camera sensors from driver assistance systems into passive safety controls, it becomes possible to recognize an imminent accident earlier and thus better assess the severity of the accident.

The networking of classic crash detection with technologies from driver assistance systems provides passive safety systems with completely new possibilities of recognizing critical situations as such, before an accident actually occurs, and therefore reacting more quickly. As a result, vehicle occupants and pedestrians can be even better protected.

Benefits of SPEED:
- Flexibility and cost optimization through modular building blocks
- 100 percent fulfillment of customer-specific requirements
- Fast development times and marketability
- Worldwide standards in quality, reliability and safety
- Extendable functionalities, e.g. sensor cluster integration, integration of pre-crash or post-crash functions
- Integration platform for additional functions
A faster way to determine accident severity - Crash Impact Sound Sensor

When an accident occurs, the airbag safety system has to decide in split seconds what needs to be done: Was the impact so strong that the airbags need to be deployed? Or are the airbags not needed at all, meaning that the other elements of passive safety, such as crumple zones and safety belts, are sufficient? The analysis of how severe the crash will actually be has to take place in fractions of a second.

The crash impact sound sensor detects the accident and determines its severity from the characteristic sound of the collision with the vehicle’s body, a sound that travels at up to five meters per millisecond. Every material makes a specific sound in the event of deformation. Different accidents thus yield varying signals. Crash impact sound sensing can dependably categorize the crash situation and provide crucial time savings: a danger warning is transmitted to the airbag control unit up to 15 milliseconds earlier than with conventional systems. The restraint systems are therefore activated more quickly, resulting in vehicle occupants being considerably better protected.

Another plus: crash impact sound sensing technology can be integrated into the SPEED control unit - a cost advantage paired with markedly improved performance capacity.

Decentralized crash sensors provide all-around protection - our acceleration and pressure satellites

A big step forward toward comprehensive safety, all thanks to a small, inconspicuous piece of electronics: Intelligent crash sensors are the perfect complement to the SPEED control unit in a crash. Take a frontal collision, for example. In this case, the well-established gSAT acceleration satellites deliver that additional plus in support. They measure and supply the information on the acceleration values in the rigid vehicle structures to the control unit in the event of a crash. SPEED can determine both the duration of intrusion and the intensity of the crash, and activate life-saving restraint systems in just milliseconds.

Quick reaction to side crashes

Our pSAT pressure satellites, which have put Continental at the forefront of the world market since 1996, were developed specifically for side crashes. Substantially faster reaction times are required for the deployment of the side airbags because the system has to fire the life-saving airbags within just five to ten milliseconds.

In addition, vehicle crumple zones offer hardly any protection for the occupants in side crashes compared to frontal collisions. Here the pressure satellite delivers excellent results also in situations such as pole crashes in which the vehicle suffers a side impact with a narrow obstacle or when the vehicle is hit by a raised bumper as is the case with many sports utility vehicles (SUVs).

The standard pSAT dry-zone pressure satellite moreover, offers cost and time advantages in terms of installation: without any need for additional tools or fasteners, it can be pressed into place in the counterpart on the door with just a single motion, thanks to a novel mechanical concept.
Passenger protection: an innovative pressure sensor recognizes impact

Pedestrians don’t have any crumple zones – that puts them at particular risk. Continental’s pedestrian protection system reduces the risk of head injury in the event of a collision. Within 10–15 milliseconds of an impact, the active hood of the vehicle is triggered and raised by special actuators. This reduces the risk of death or severe injury to the pedestrian from hitting the hood and underlying engine block.

Pedestrian protection sensor improves frontal crash detection

Refinement of the proven PPS pSAT system also permits analysis of a front-end crash. Especially the differentiation between particularly complicated types of crashes, such as those with small overlap or those at an angle, can be reliably detected. If the deployment order of passive restraints can adapt to the accident scenario, protection of a vehicle’s occupants will increase.

The crash sensor consists of an air hose that is laid across the entire width of the car in its front bumper. The hose is therefore situated directly behind the foam block that is fitted at the front of the vehicle to absorb energy. Standardized pressure sensors (pSAT) are installed at either end of the airfilled pressure hose. When a vehicle collides with an obstacle, the resulting pressure exerted on the hose through the front bumper and foam block creates a typical waveform that is detected by the two sensors at the ends of the hose and forwarded to the SPEED control unit. The product received a PACE award in 2014.

Benefits:

› Rapid recognition of every required pedestrian impact situation
› Excellent robustness
› Easy to integrate and cost-optimized design
› Redundant system for maximum safety

Chassis & position sensors

Sensors for active chassis control systems

Active chassis control systems use wheel path sensors and low-g acceleration sensors to measure the wheel and body acceleration in the direction of the vehicle’s vertical axis (the z-axis). The system control unit uses these incoming signals and additional information to determine the vehicle status. Depending on the control strategy, the optimum shock absorption force is calculated for each wheel and the active shock absorber is set to that amount. This resolves the traditional conflict of goals between sporty and comfortable chassis tuning, at least in part. Continental offers the sensor types needed for this task.

Regulating the main beams with the CPS for greater road safety
Chassis Position Sensor (CPS)

Movements of a vehicle’s body and changes in the vehicle’s position – such as those depending on the load of the vehicle and in the case of uneven driving surfaces – can lead to the vehicle’s main headlights, especially those using high-pressure gas discharge lamps (mostly xenon), blinding oncoming traffic. The European Union has taken this into account, passing new legislation to regulate headlight ranges and improve traffic safety. CPS-type angle sensors are used to determine the vehicle’s current position and adjust the range of the main headlights accordingly. In principle, CPS sensors are also suitable for other tasks that require position information, such as chassis control or to determine the position of the gas, clutch, or brake pedal.

Vertical axis acceleration sensors (BSZ)

Continental offers analog and digital acceleration sensors to measure horizontal and vertical acceleration as part of chassis control. With their different areas of measurement, these BSZ sensors capture both the movements of the vehicle’s body and the acceleration of axles and wheels.

Additional fields of application for acceleration sensors:

- Active damping systems for engine mountings
- Rear flap control systems
- Incline sensors for motorcycles, passenger cars, trucks and construction and agricultural machines
- Vibration measurement in systems for the active engine bearing or for preventive maintenance and service in vehicles

Battery sensors and sensors for hybrid and electric vehicles

Intelligent Battery Sensor (IBS)

The Intelligent Battery Sensor (IBS) is used primarily for the wide-spread start-stop function, which helps reduce CO₂ emissions. The IBS analyzes the charge status of the 12-volt lead acid battery on an ongoing basis. It then informs a control unit at the next higher level, such as the engine control unit or body controller, whether there is enough energy in the battery for the engine to be automatically switched off and restarted. Monitoring the battery’s current, voltage and temperature makes it possible to enhance the reliability of the entire vehicle power system. Since many vehicle breakdowns have traditionally been due to batteries that have weakened with age or are too overloaded, the IBS is an important component in advanced energy management. It utilizes battery capacity intelligently in order to save fuel, while keeping the vehicle available.

For example, if the battery is charged sufficiently, the electronics interrupt the transportation of energy from the generator to the battery so the engine does not need to use as much power to operate the generator. This reduces CO₂ emissions, even as the driving style remains the same, thereby expanding the vehicle’s range.

High-Voltage Current Sensor (CSM)

The CSM High-Voltage Current Sensor is ideally suited to be used in lithium-ion high-voltage batteries in hybrid and electric vehicles. It is based on the same measurement principle as the Intelligent Battery Sensor (IBS), supplying important information to the next higher battery management system by meeting the precision requirements that apply to electric and hybrid vehicles.

Our safety contribution toward electric mobility: evSAT – sensor for high-voltage battery cut-off

“evSAT” stands for “Satellite for Electric Vehicles” and essentially consists of an independent, triaxial sensor with a CAN interface. During the charge phase, the other vehicle electronics, including the airbag system, are not operational. Then this acceleration sensor employs an algorithm to detect a frontal, rear, or side collision with another vehicle and immediately transmits a signal via the CAN interface to the battery management system which then switches off the battery within half a second. In the event of an accident during normal driving mode the airbag system assumes the task of cutting off the battery.
If the electric or plug-in hybrid vehicle has been switched off and is not being charged, the evSAT moves to a standby mode to prevent the battery discharging. evSAT therefore represents an additional passive safety system function for electric and plug-in hybrid vehicles.

**Driver intention sensors: Pedal Angle Sensor (PAS)**

Hybrid and electric vehicles need sensors that seamlessly bridge the gap between regenerative braking and activation of the wheel brakes. To accomplish this, the driver’s braking intentions must be detected electronically at the brake pedal and a signal to that effect must be sent to the control unit.

The Pedal Angle Sensor (PAS) is a product derived from the CPS. Equipped with an adapter, it can be used to detect the angle of the brake pedal in hybrid or electric vehicles.

In the event of an accident during charging, the evSAT switches off the high-voltage battery.

**Fuel optimization and driving safety: Accelerator Force Feedback Pedal (AFFP)**

The Accelerator Force Feedback Pedal is an active accelerator with integrated actuator which provides the driver with a haptic feedback for the current traffic situation.

In connection with eHorizon the driver is prompted when he/she should either take his/her foot slightly off the accelerator or when he/she needs to shift up a gear for an optimized fuel saving. Furthermore, AFFP also warns in a hazardous situation and provides an immediate feedback to the foot of the driver, which the driver is more susceptible to than acoustic or visual warnings.

The AFFP is integrated with driver assistance systems, and as a Human-machine interface is a sensible addition when, due to inattentiveness, the primary measures for safety cannot be adequately complied with.

AFFP helps to save fuel and can warn of hazardous situations.
Wheel, engine and transmission speed sensors

Continental’s speed sensor portfolio includes wheel speed sensors which are used to measure vehicle speed for ABS and ESC, as well as engine and transmission sensors that are used to determine position, speed and turning direction of the combustion engine cam and crank. For transmissions, the application target is the input/output shaft rotational speed measurement.

Active wheel speed sensors

The control systems for ABS, TCS and ESC determine the wheel speed based on signals sent by the wheel speed sensors. This information is used to prevent the wheels from locking and determine when the wheels are spinning, taking appropriate control action to maintain the vehicle’s stability and steering responses. In addition, it is possible to capture the rotational direction – this function supports the hill start assist and the park assistance system, for example.

Wheel speed is measured using the anisotropic magnetoresistance (AMR) effect. This method and the integrated information processing feature enable our latest generation of sensors to handle the following functions:

- Measurement of rotational speed (even at low vehicle speed)
- Air gap measurement
- Dependable functionality with large air gaps (up to 4.5 mm between sensor and encoder)
- Standardized VDA data protocol
- High resistance to extreme temperatures, from -40 °C to +150 °C
- Internal signal monitoring

The latest generation of our wheel speed sensors is the “Mini Speed Sensor Element.” This sensor stands out especially for the fact that all of the functional components, including the AMR bridge, ASIC and magnet are integrated into a housing just 3.2 mm in size, and the fact that despite these small measurements, the sensor can easily be inserted into a mold and injection-molded in plastic. The process of injection molding using a thermoplastic synthetic material creates the exterior shape required for the specific application. The new Mini Speed Sensor Element’s tiny size offers vehicle manufacturers greater flexibility in choosing an installation location within the vehicle, and with its costoptimized design, the Mini Speed Sensor Element will take on an important role in the production of affordable cars.

The essential features of the new wheel speed sensor are:

- High reliability and robustness due to the use of AMR technology
- Enhanced resistance to thermomechanical strain
- Compatibility with today’s series-produced sensors (interchangeable if air gap is comparable)
- Small installation space for future applications
- Low operating voltage (goal: < 4.5 V)
- Air gap measurement during customer’s installation process
Wheel speed sensors and electric parking brake cables integrated into a single harness
Continental has integrated the cables for wheel speed sensors and the electric parking brake (EPB) into a single harness, making the company one of the first manufacturers to offer such a combination of components.

Combining wheel speed sensors with the EPB cable results in lower development-, product- and assembly costs compared to individual components. We can therefore offer car manufacturers a high-quality, robust and cost optimized solution for a growing market trend.

The cable is highly durable and has a high level of fold and bendability. Furthermore, a complete integration of wheel speed functions is possible. The integrated wheel speed sensor and EPB cable underline our approach of integrating functions and are suitable for all vehicle classes. In series production as of the end of 2014 with a Japanese car manufacturer.

Engine and transmission rotational speed sensors
For the engine management, speed and position sensors (so-called phase sensors) provide information on the exact position of the crankshaft or camshaft.

This information provides the basis for the modern engine control for the regulation of ignition and injection times, and the fresh gas and exhaust gas regulation. In addition to observing legal exhaust gas levels, this also ensures optimization of the engine performance, a reduction in fuel consumption, and improved running smoothness. Modern speed and position sensors must in this case comply with the increasing requirements with regard to rapid engine synchronization and fast, optimized starting (Start & Stop).

The essential characteristics of the engine speed and position sensors are:

※ Determination of the position, the rotational direction and the speed of the engine (speed of the target wheel)
※ Determination of the exact position of the crankshaft/camshaft = piston position (electronic mapping of the target wheel position)
The main functions of modern engine speed and position sensors include:

- “True Power On” (camshaft) and “direction sensing” (crankshaft) respectively
- Axial or radial reading
- Use of “self-learning” IC (“optimization” of the signal precision by the “adaptive” reading of the target wheel profile)
- Very high level of precision (±1° typical) and reliability of the signal (repetition accuracy)
- High temperature resistance (−40 °C to +150 °C)/vibration resistance

On a manual transmission, the speed sensor captures the vehicle speed at the gearbox and provides this information to the speedometer. In the case of automated transmissions (step automated transmission, continuous variable transmission, dual clutch transmission or automated manual transmission), one to three sensors are mounted in the gearbox delivering the input, or output, or the intermediate gear speed to the transmission control unit (TCU), responsible for managing the whole system.

**Brake pad wear indicator**

One major component of driving safety is monitoring the thickness of the brake pads on an ongoing basis. The sensor developed to do this works by ceasing to display an electrical channel for signal electricity to flow from the vehicle’s power network once the brake pad wear reaches a certain point. As soon as the relevant electronic components detect this, a warning light is activated in the instrument cluster so the driver knows it is time to have the brake pads changed.

**Electronic control units for various applications**

Continental is highly innovative and is a leader in the product development of control units (ECUs) tailored specifically to customers. This ensures an appropriate level of flexibility. With our build-to-print control unit business, we meet our customers’ requirements with regard to reliability, functional scope and quality.

**Electric Parking Brake Control Unit**

The Electric Parking Brake control unit (EPB-ECU) provides a fully automated control of different types of EPB actuators, e.g. caliper integrated actuators or cable pullers.

The EPB-ECU controls the actuator and provides smart functionality, recognizing when to apply and release the parking brake. To do this, the EPB-ECU is fully integrated into the vehicle’s network architecture. The EPB-ECU evaluates data from various engine, transmission and wheel sensors, as well as tracking the position of the clutch and throttle.

**Electric Vacuum Pump Control Unit (EVP-ECU)**

The Electric Vacuum Pump Control Unit provides safe and reliable control of the vacuum pump, including driver warning in case of a malfunction within the vacuum system. In addition, it also provides a full diagnostic capability by using integrated safety master slave controllers, the evaluation of one or two vacuum sensor(s), a power module with soft start capability and a CAN bus communication.

**Control Unit for Electric Power Steering**

The Electric Power Steering Control Unit constantly monitors the torque and angle of the power steering column and controls the electric motor, which provides steering assistance to the driver. The electric power steering reduces fuel consumption and CO₂ emissions since it only becomes active when it is actually needed.
Service Provider for Integral Safety
With more than 20 years of experience, we are one of the leading system engineering and testing service suppliers for active and passive vehicle safety. From testing services to full system engineering, we take responsibility for developing vehicle safety technology throughout the entire vehicle development process.

Based in our headquarters in Alzenau, Germany, we provide a state-of-the-art test infrastructure with crash and sled testing as well as a test track dedicated to active safety testing in an urban environment, known as Continental Safety Park.

The Continental Safety Park has been established as a proving ground for the testing of ADAS and active safety systems. Specific test rigs are available for the latest testing demands concerning predictive pedestrian protection and forward looking safety systems. Position and data acquisition is supported by sophisticated measurement equipment.
Forward-looking technologies provide drivers and passengers with additional safety, an increase in comfort and protection of the environment.

Driver assistance systems make road traffic on the whole safer. They are an essential element in our Vision Zero - the vision of accident-free driving. They act discreetly in the background, either as individual functions or as an integrated system: Using sensors for the surrounding area - camera, infrared or radar - they ensure a maximum level of safety and comfort. These systems do two main things: First, they assist the driver both in everyday situations, such as parking and driving in flowing traffic, and second, they are available in dangerous situations, when they warn the driver and even intervene in driving when necessary. By doing this, they play a crucial role in avoiding accidents, thereby helping to save lives.

Driver assistance systems avoid rear-end collisions

Integrated into the ContiGuard concept, forward-looking driver assistance systems can considerably reduce stopping distance. Should it still come to a crash, the severity is significantly reduced.

Emergency Brake Assist

The bulk of all rear-end collisions could be avoided - or at least, their severity could be significantly reduced - through timely braking. The forward-looking emergency braking assistant responds by activating an automatic braking system as soon as the driver’s own vehicle comes within a dangerous distance from a preceding vehicle if the driver does not respond appropriately. As a result, it can considerably reduce stopping distance.

The Emergency Brake Assist feature is available in different configurations. Rear-end collisions mostly occur in inter-urban areas. The Emergency Brake Assist-City, the entry-level version, can prevent accidents in these areas at speeds of up to 25 km/h. The Short Range Lidar sensor used to do this delivers a favorable cost-benefit ratio and is already establishing itself in the compact car segment as another standard active safety element, along with ABS and ESC. Another configuration is EBA Urban, which also works effectively at higher speeds.

Benefits:

 › Reduced risk of accidents, less severe consequences of accidents
 › Optimized stopping distance
 › Reduced costs associated with accidents
 › More favorable insurance rating

Multi Function Camera with Lidar - MFL

The fusion of the mono camera and lidar can avoid rear-end collisions with a speed difference of up to 50 km/h. Through the redundancy of two technologies, safety is furthermore enhanced by the distinct identification of obstacles.

Short Range Lidar – SRL

Is fitted behind the windshield and monitors the traffic ahead. With its “Emergency Brake Assist-City” functionality it can avoid rear-end collisions in urban settings - in the speed range of up to 50 km/h at a difference of up to 25 km/h.
Adaptive Cruise Control

Adaptive Cruise Control (ACC) is a function to increase driver comfort, especially when following traffic. To accomplish this, a radar sensor continuously observes the vehicle's surroundings, monitoring traffic in front of the vehicle. As opposed to traditional cruise control functions, Adaptive Cruise Control makes it possible to adjust the following distance without the driver having to intervene, whether in flowing traffic, stop-and-go situations, or traffic jams.

Benefits:
› Less stressful, more comfortable driving with the flow of traffic, e.g. on sections of road where speeds are restricted, in heavy traffic and even in traffic jams
› ACC is a real support for the driver on the daily route to work
› Forward looking and fuel saving driving

Surround View

The scalable surround view solutions is based on fish eye cameras with a horizontal view of more than 180°. It supports the driver with a 3D all around view when parking and also when maneuvering at low speeds. Consisting of four cameras – in front, in the rear and on the outside rear view mirrors – the whole area around the car can be safely viewed.

In addition, Surround View makes it easier to add a trailer and to maneuver with it.

Benefits:
› Optimal surround view in difficult situations
› Generation of multiple views and angles

Long Range Radar Sensor – ARS

With its range of 250 meters it can realize adaptive cruise control, including stop & go, up to a speed of 200 km/h. In addition, it offers an emergency brake assist with forward collision warning.

Blind Spot Detection

The Blind Spot Detection (BSD) function warns the driver when there are vehicles in the blind spot of the side-view mirror. This makes traffic situations such as overtaking and lane changes much safer and more comfortable, both in the city and on the highway. One extended feature is Lane Change Assist (LCA), which monitors an even larger area behind the vehicle, so the driver can receive a warning of vehicles approaching from the rear much sooner.

Benefits:
› No longer overlook anything in the blind spot
› Changing lanes is safer and more relaxed

Short Range Radar – SRR

Monitors the blind spot as well as the area behind the vehicle and can therefore help to prevent accidents when changing lanes or when reversing out of a parking space.

Easy reversing out of a parking space – Rear Cross Traffic Alert

The Rear Cross Traffic Alert (RCTA) system uses the same radar infrastructure as for detecting vehicles in the blind spot (Blind Spot Detection, BSD) and can help to avoid accidents with crossing vehicles when reversing out of a parking space. These can often lead to serious accidents involving personal injuries. To accomplish this, the area behind the vehicle is monitored using two short-range radar sensors. If the system detects an imminent collision with a crossing vehicle, the driver
is warned by means of a warning strategy coordinated with the vehicle manufacturer. This strategy can include warning sounds, LEDs that light up, or even active intervention in the vehicle’s braking system.

RCTA requires precise information on the position, direction and speed of the crossing vehicle. This is achieved through Continental’s unique signal processing capability.

**Benefits:**
- Enhanced safety when reversing out of a parking space
- Lower stress when leaving a parking space

**Traffic Sign Recognition**
Nowadays, there are a lot of signs out there, so it isn’t always easy to keep an eye on everything. The automatic Traffic Sign Recognition function displays the most important information in the driver’s field of vision at all times. The camera used for this recognizes speed limits, areas where overtaking is prohibited, and no-entry signs. This allows the driver to relax, and it even has the potential to prevent dangerous situations such as driving the wrong way in traffic.

**Benefits:**
- Safer and less stressful driving, because one is always well informed
- Easy way to avoid speeding
- Prevents driving the wrong way in traffic
- Do not pass signs are displayed

**Lane Departure Warning**
A momentary lapse in attention can easily lead to an inadvertent lane change. The Lane Departure Warning function provides the driver with acoustic or haptic warnings, such as steering wheel vibration, in the event of an unintended lane change. Lane Departure Warning is also able to automatically keep the vehicle in its proper lane.

**Benefits:**
- Prevents dangerous situations due to inattention or micro-sleep
- More relaxed driving and enhanced safety without distracting the driver

**Intelligent Headlamp Control**
Intelligent Headlamp Control delivers optimum visual conditions when driving at night or at twilight. High beams are controlled to ensure that oncoming vehicles and those traveling ahead of the driver’s vehicle are not blinded, while at the same time providing optimum lighting of the road. This results in improved visibility in all driving situations, relieving strain on the driver and thereby enhancing safety.

**Benefits:**
- Safe, relaxed driving through optimized lighting of the road

**Combined sensors for more complex driving situations**
In the future, combining sensors and other sources of information (such as the navigation system) will enable advanced driver assistance systems to support the driver in increasingly complex driving situations, up to and including highly automated driving. The camera-based Surround View system from ADAS represents another component of this approach. The system gives the driver a full 360° view around the vehicle and provides additional information for driver assistance functions, which then unlock further options, such as fully automated parking.
Quality Automobile manufacturers and car drivers worldwide expect our products to be of the highest quality. And rightly so, after all, millions of people entrust their lives to their cars. Quality is thus an essential basis for the success of Continental. In short, it is both a core competence and a competitive advantage.

The basis for the highest level of quality is a common understanding of quality which is determined in our quality policy “Our Global Quality Understanding” with five principles:

› **Customer Satisfaction**
  
  We know that quality is crucial to our customers’ satisfaction and therefore to our business success. We are committed to a target of zero defects.

› **Together**
  
  We all influence the quality of our products and services.

› **From the Beginning**
  
  We do things the right way from the very beginning and set new quality standards together.

› **Structured**
  
  We agree on binding rules for our work and collaboration. At the same time, we encourage commitment and autonomy to move quality forward.

› **Holistic**
  
  We understand quality as the continuous and holistic effort to optimize our company’s performance.

Quality First emphasizes not only our common quality understanding, but the program also aims to keep given commitments to our customers and their expectations, consistently and reliably meeting the highest standards.
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