

Chassis & Safety Division

Driving Safety and Dynamics

The Chassis & Safety Division (C&S) is one of the five divisions that make up Continental AG. Chassis & Safety develops and produces products and components in the field of driving safety and dynamics. Its core competence is the integration of innovative, high-quality components and its profound systems expertise into the ContiGuard® safety concept. In 2011, C&S achieved sales of approximately 6.5 billion euros and employed a workforce of some 33,000 throughout the world.

Continental is one of the world's leading automotive suppliers, generating sales revenue of approx. 30.5 billion euros in 2011. As a supplier of brake systems, powertrain and chassis systems and components, instrumentation, infotainment solutions, vehicle electronics, tires and technical elastomer products, Continental is contributing to greater driving safety and to global environmental protection. Continental is also a competent partner in networked automotive communication. Continental currently has around 164,000 employees in 46 countries.

Chassis & Safety's expertise covers the entire driving safety spectrum. The Division develops and produces electronic and hydraulic brake and chassis control systems, sensors, advanced driver assistance systems, airbag electronics and sensors, washer systems and electronic air suspension systems. Dr. Ralf Cramer heads the C&S Division which has over 57 plants, research centers and test tracks in 20 countries. Over 6,000 development engineers work together in close collaboration on the world market. Every day, local customer focus and global knowledge management are converted into safety technologies and successful products.

Actively shaping future driving safety

The Chassis & Safety vision of accident-free driving embodies the conviction that, thanks to innovative technologies, accident and injury-free driving will be a possibility in every category of vehicle and every market in the world.

For Continental, driving safety means using every available active safety measure to completely prevent the accident in the first place, and, if it cannot be avoided, using every available passive safety measure to provide road users with maximum protection.

The wide range of active and intelligently networkable accident avoidance technology offers great potential which should be exploited.

1. Driving safety is about protecting people's lives in today's busy traffic, mostly consisting of private cars. Anyone discussing the 'Future of Mobility' today cannot ignore the safety aspect. Regardless of the type of drive trains, vehicle category or market, every vehicle and every form of automotive transport must always be safe.
2. Active safety, i.e. the active prevention of accidents, has been given a new focus; at the forefront are dynamic high-performance brakes, electronic stability control, emergency braking assistance, electric steering and advanced driver assistance systems such as lane departure warning and blind spot detection.

The Chassis & Safety Division is based in Frankfurt am Main, Germany. Through its business units - Electronic Brake Systems, Hydraulic Brake Systems, Passive Safety & Sensorics, Advanced Driver Assistance Systems and Chassis Components - the Division concentrates on three technology and development areas:

- ▶ Electronic and hydraulic brake systems, chassis, sensor and advanced driver assistance systems for a future in which road traffic accidents are avoided and injuries prevented.
- ▶ ContiGuard[®] represents a new dimension in driving safety technology. ContiGuard[®] integrates active and passive safety systems, making them more comprehensively effective through the coordinated interaction of surrounding sensors. Together, the three function clusters - driver assistance systems, global chassis control and integrated occupant protection - provide the best possible protection in all driving and traffic situations.
- ▶ Safety for everyone: because of the modular design and scalability of all the C&S Division's products and systems, and with development centers and production sites throughout the world, we can react to the widest range of customer and market requirements. Our aim is both to equip small and compact vehicles with life-preserving safety and assistance systems and to install safety products in less expensive cars intended for the world's growth markets.

The Division's product portfolio extends from intelligent, integral safety and electronic brake systems via occupant protection and life-preserving driver assistance systems to the challenging area of chassis electronics. The success of these technologies is evident from products which now occupy a strong market position, such as ESC, the multi-function camera which combines three assistance systems, sensors and future-oriented developments such as active rear axle kinematics, and the accident and injury prevention vehicle equipped with ContiGuard®.

The Chassis & Safety Core Competences

- ▶ We combine mechanical engineering and electronics to achieve high-performing technologies in automotive safety & drive dynamics
- ▶ Comprehensive systems know-how with the integrated ContiGuard® safety concept
- ▶ Zero-defect quality culture
- ▶ Global engineering and manufacturing excellence in close partnership with our customers
- ▶ Global network of automotive professionals
- ▶ Proactive and cooperative supplier management

Driving You Safely: ContiGuard®

Continental has combined the life-saving elements of active and passive driving safety to produce an innovative, integrated safety strategy. ContiGuard® represents a new dimension to driving safety by interlinking safety technologies with their related surrounding sensors and telematics. With ContiGuard®, our customers are on the way to Vision Zero by effectively avoiding accidents or by minimizing the consequences of accidents and the risk of injuries for all road users. Together, the three mutually interacting function clusters - driver assistance systems, global chassis control and integrated occupant protection - provide the best possible protection in all driving and traffic situations.

Under normal driving conditions, drivers are supported by assistance systems such as lane departure warning and speed limit monitoring. If drivers get into a possible hazardous situation, they will be warned by the adaptive cruise control and the blind spot detection system. At the same time, ESC will actively stabilize the vehicle. Brake assistance functions, from brake preconditioning to the autonomous emergency braking, become active in critical situations. Additional protective measures (e.g. seat-belt pre-tensioner activation) to prepare the vehicle for a possible collision are also initiated during this pre-crash phase. If it is too late to prevent the accident, and depending on analysis of the data on its likely severity, a decision to initiate the restraint systems is rapidly taken so that the vehicle occupants are

protected in the best possible and most reliable way. In the post-crash situation, functions such as eCall and Car-to-Car communication accident warning provide further assistance.

This modular, scalable approach adopted by ContiGuard[®], depending on the relevant vehicle category and customer requirement, makes safety available worldwide. ContiGuard[®] is, consequently, an important element of the Chassis & Safety 'Safety for Everyone' approach.

The way ahead towards the accident-avoiding car is clear – many of the advantages of ContiGuard[®] are already being exploited in production vehicles:

- ▶ Much shorter stopping distance
- ▶ Comprehensive protection against injury for vehicle occupants and pedestrians
- ▶ Expanded, optimized functionality as a result of system integration
- ▶ Efficient prevention of accidents and/or a reduction in their severity.

ContiGuard[®] benefits from a safety philosophy which is based on long years of experience of integrating complete systems, components and Human-Machine-Interfaces. ContiGuard[®] is designed to allow constant upgrades of new safety functions and offers significant future potential for all customer and market requirements throughout the world.

The Business Units

Through collaboration with our customers in the automotive industry, we are developing components and system solutions which are perfectly tailored to their requirements. We have one single objective: to ensure that road users enjoy the greatest possible safety in every driving situation.

Electronic Brake Systems (EBS)

This business unit develops and produces innovative electronic brake systems and software solutions to ensure vehicle stability and increase driving ease (e.g. Hill Start Assist).

- ▶ Electronic brake systems, e.g. ABS and ESC
- ▶ Electrohydraulic combi brake
- ▶ Control units for integral motorcycle brake systems
- ▶ ABS for motorcycles based on tried-and-tested passenger car technology
- ▶ Regenerative brake systems for hybrid and electric vehicles
- ▶ Software for extended brake control functions and driver assistance systems

- ▶ Ability to integrate sensors and 3rd party software
- ▶ Analog-controlled, continuously variable hydraulic valves

Hydraulic Brake Systems (HBS)

As one of the world's leading suppliers of brake and brake actuation systems, this business unit is constantly developing new and ever better classical brake designs, including optimally adapted actuation systems for vehicles of all classes. Washer systems, individually-tailored to customer requirements, ensure clean headlamps and windshields in all weathers.

- ▶ Brake disks
- ▶ Drum brakes
- ▶ Brake calipers
- ▶ Hand brakes
- ▶ Electrical parking brakes
- ▶ Brake boosters
- ▶ Tandem brake master cylinders
- ▶ Mechanical, electronic and hydraulic brake assist systems
- ▶ Brake actuation modules
- ▶ Brake pressure controllers
- ▶ Brake hoses
- ▶ Duo-servo parking brake systems
- ▶ Windshield and headlamp cleaning systems

Passive Safety & Sensorics

This business unit offers integrated solutions for more safety, by combining passive safety and sensor know-how. By doing this, a systems approach is offered to our customers, in order to meet their individual requirements on a global scale.

- ▶ Steering angle and steering torque sensor for electric power steering
- ▶ Acceleration sensors for active chassis control
- ▶ Brake system sensors (Linear Position Sensor, Pedal Angle Sensor)
- ▶ Intelligent Battery Sensor
- ▶ Satellites (Acceleration and pressure satellites)
- ▶ Pedestrian Protection
- ▶ Occupant Safety

- ▶ Inertial sensors
- ▶ Integral occupant safety through integrated surrounding sensors and active safety components
- ▶ Wheel speed sensors for ABS and ESC
- ▶ Transmission speed sensors and engine speed sensors
- ▶ Integration and validation of vehicle safety systems

Advanced Driver Assistance Systems (PSAD)

Pioneering systems for driver assistance safety electronics in a proactive and reactive vehicle will relieve the stress on drivers and allow them to overcome complex or critical driving situations.

- ▶ Driver assistance systems based on radar, camera and infrared sensors for
 - ▶ Emergency brake assist
 - ▶ Adaptive cruise control
 - ▶ Lane departure warning
 - ▶ Intelligent headlamp control
 - ▶ Traffic sign recognition
 - ▶ Blind spot monitoring

Chassis Components

Chassis electronics offers a wide range of solutions for active chassis technology, all contributing to greater driving safety, comfort and driving pleasure. These systems range from the control of active axles to the fully autonomous chassis. Electric power steering systems are designed to achieve precise and efficient control of the vehicle in all driving situations.

- ▶ Steering systems
- ▶ Suspension systems
- ▶ Chassis electronics
- ▶ Electronic components
- ▶ Accelerator Force Feedback Pedal (AFFP®)

Environment (Efficiency) & Safety

In view of climate change, diminishing reserves of fossil fuels and the increasing use of private cars, the aim of reducing pollutant emissions to zero can no longer be ignored in any current discussion of environmental matters. Continental is committed to further reducing carbon dioxide emissions from vehicles. The opportunities for safety features to play their part can be illustrated by the following Chassis & Safety Division products:

- ▶ Regenerative and dry braking
- ▶ Accelerator Force Feedback Pedal (AFFP[®]): the world's first series-production active accelerator pedal developed by Continental issues a sensory signal to recommend the optimum gearshift point, leading to potential fuel savings of up to seven percent.
- ▶ Considerable fuel savings from electric steering systems: the electric motor only has to be activated if steering assistance is really needed. Moreover, electric steering systems require fewer components to be installed and there is no need for hydraulic fluid. This combination of weight savings and a significantly reduced energy requirement for the power steering produces fuel savings of 0.4 liters per 100 kilometers
- ▶ Weight-saving design (light-weight construction) due to optimized manufacturing processes and choice of materials, as is the case with our brake calipers and electronic brake systems
- ▶ Use of pro-active advanced driver assistance systems and eHorizon
- ▶ Adaptive Cruise Control (ACC): using the intelligent cruise control can achieve fuel savings of up to ten percent.

Electromobility & Safety

Electromobility must still be safe, irrespective of the market or vehicle category. The Chassis & Safety Division is the leading supplier of energy-efficient solutions such as regenerative braking systems. Compact cars benefit from the 'virtual crumple zone' because this is exactly the area in which active and passive driving safety must not be compromised. Continental's systems expertise combines energy efficiency with maximum driving safety and comfort using ContiGuard[®], recuperation and motion control. 'Power-on-Demand' components which supply energy exactly when it is required will further increase electromobility ranges and enhance overall energy efficiency.

Affordable Cars & Safety

There are innumerable vehicle categories and a wide spectrum of automotive markets throughout the world. Driving has to be affordable and safety technologies must be available everywhere. Continental regards 'Safety for Everyone' as a vital and decisive step on the road towards 'Vision Zero'.

- ▶ Safety Platform for Efficient & Economical Design (SPEED): SPEED is an airbag control unit of modular design developed by the Chassis & Safety Division. The multi-level concept meets the demands of all global markets and allows even entry-level models to be fitted with a high-performance airbag system.
- ▶ ABS for growth markets: smaller and lighter, yet less expensive. These were the challenges that had to be met in developing a new ABS for the mature markets. Smaller vehicles with less installation space made the reduction in size necessary, while lower engine outputs and lower overall vehicle weights enabled the ABS to be downsized. The MK 100[®] currently in development is far smaller and lighter than its MK 70 predecessor.
- ▶ Advanced driver assistance systems: even people who buy inexpensive compact or small cars ought to be able to enjoy advanced driver assistance systems which improve road safety. Safety can be enhanced in all vehicle categories by introducing a medium-range early warning radar. Its sensor scans the road ahead of the vehicle to a distance of up to 150 meters and warns of impending rear-end collisions.