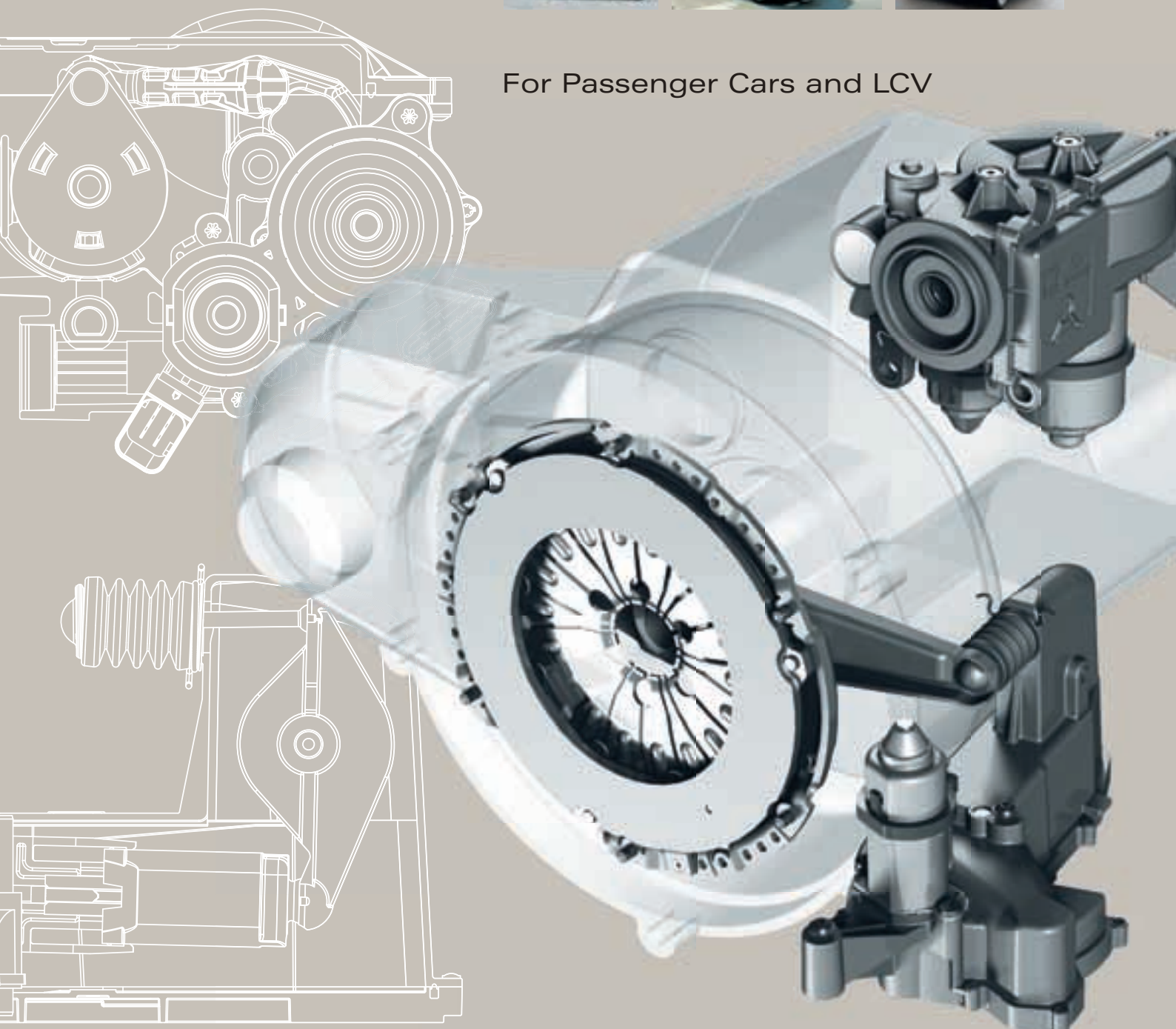


Automated Manual Transmission



For Passenger Cars and LCV



Comfort, Performance, Environmental Protection: Powertrain Components and Systems for Passenger Cars

The demands placed on suppliers in the automotive sector are changing dramatically. Increasingly, suppliers are being called upon to integrate components into complex systems – a development task that can only succeed on the basis of close partnerships with vehicle manufacturers. The future will bring continued demands for reduced fuel consumption, emissions, weight and installation space, along with enhanced comfort, safety, and driving dynamics. To meet these goals, innovative solutions and new products are essential.

ZF Sachs has taken responsibility here, demonstrating expertise in generating comprehensive solutions with its integrated powertrain systems. In doing so, it consistently pursues a systems approach in developing and manufacturing new products and technologies that represent real advances. Together with ZF, it provides overall solutions that meet the demands of overall systems. One example: As a powertrain specialist and manufacturer of electric drives, ZF Sachs can also provide superior integration for the full spectrum of hybrid powertrain designs and thus offer production-ready solutions that are already reducing fuel consumption and emissions for the vehicles of tomorrow.

Automated Manual Transmission

For automated manual transmissions, the clutch is opened by an electromechanical clutch actuator. After the clutch is opened, the shift operations within the gearbox are taken over by an electromechanical transmission actuator. These two actuators are controlled by an electronic control unit. If required, the system determines the shift points fully automatically, controls the shift and clutch processes, and influences the engine management system during the shift process with respect to rpm and torque. Overall, this results in vehicle operations that are easy on the materials and low on fuel consumption. The service lives of the clutch components are lengthened, while fuel consumption and the associated CO₂ emissions can be reduced.

Clutch Actuation System

The electronic clutch actuator uses an electric motor to open the clutch. In the clutch actuator, the rotary movement of the electric motor is transformed via a toothed gear segment into a linear movement, which is then used to open the clutch with the help of the release lever and release bearing.



Clutch actuation system

	Actuation paths	Actuation time	Nominal power input of the electric motor	Max. current (starting current)
Release path	~ 8 mm	< 100 ms	~ 75 W	~ 30 A
Wear path	~ 7 mm			

Transmission Actuation System

After the clutch is opened, the shift operations within the gearbox are taken over by an electromechanical transmission actuator. In the transmission actuator, the movements needed to shift and select are generated by two electric motors and the requisite mechanics.



Transmission actuation system

	Actuation forces	Actuation paths	Actuation time	Nominal power input of the electric motor	Max. current (starting current)
Shifting	< 1200 N	~ ± 12 mm	> 120 ms	~ 320 W	~ 60 A
Selecting	< 150 N	~ ± 8 mm		~ 60 W	~ 15 A

Automated Manual Transmission – Intelligent Gear Shifting

The task:

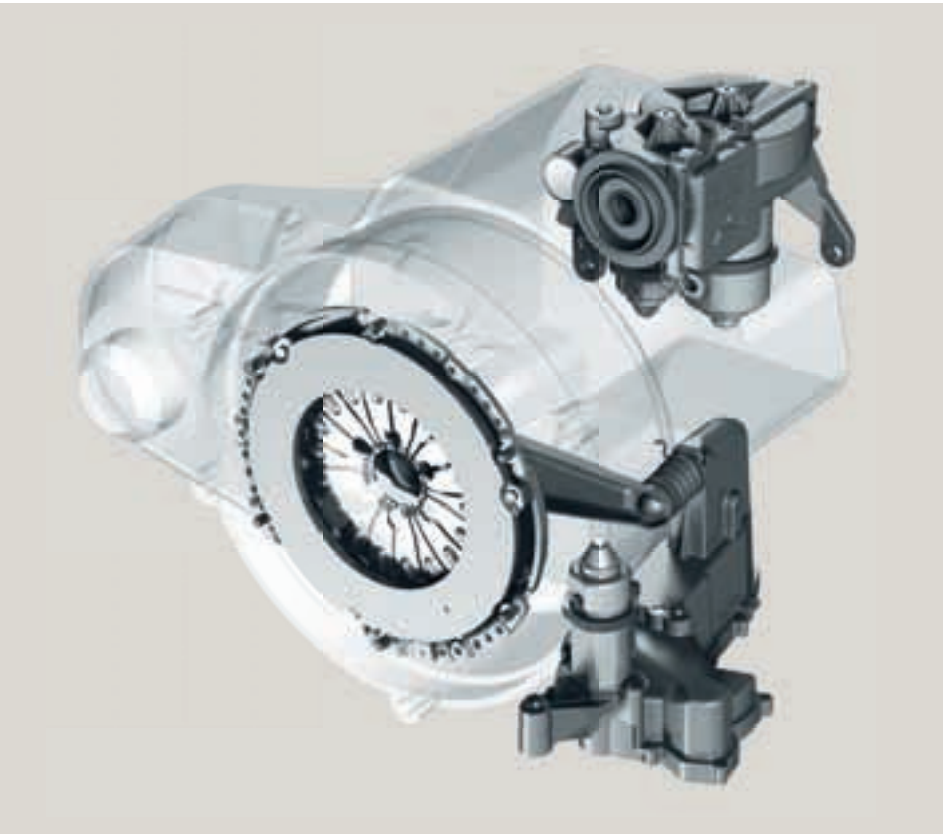
In order to best meet the wishes of drivers, the automobile industry, and legislators for lower fuel consumption and emissions, it is essential to raise the level of efficiency in the powertrain. Moreover, components from ZF Sachs can also be used to automate manual transmissions and thus improve comfort in vehicle categories that cannot have automatic transmissions for reasons of weight, installation space, or cost. ZF Sachs provides the overall system with actuators, TCU and software from a single source. Complete expertise with the system and its interfaces means that the individual actuation components can be adapted optimally to vehicle designs.

The technology:

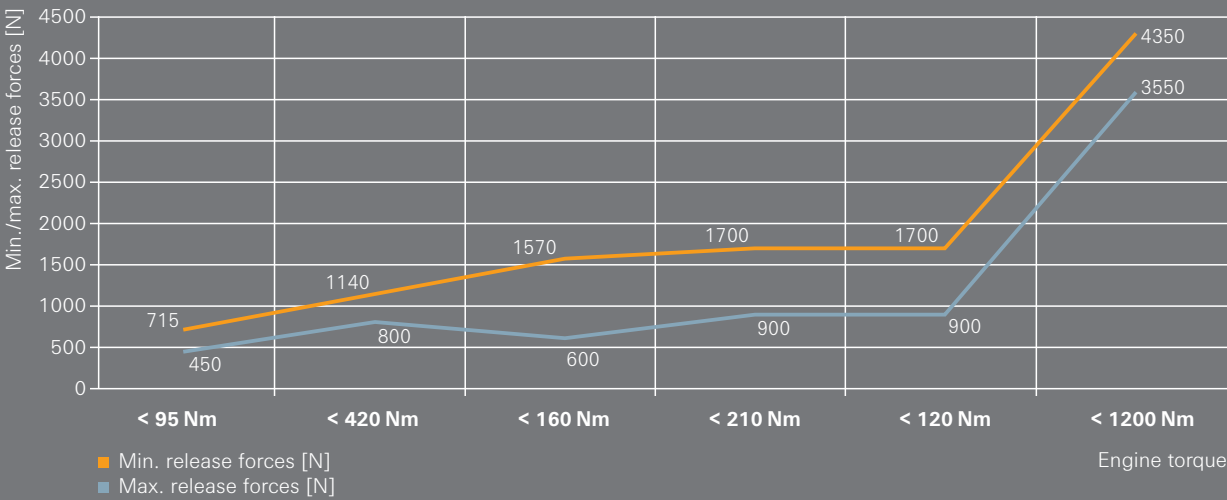
In automated manual transmissions, electromechanical or hydraulic actuators take over the clutch and shift actions. In either case, individual driving pleasure is not diminished because drivers can decide whether they want to use the automatic mode or shift manually using switches or levers.

With their optimized shift strategies, automated manual transmissions reduce torque interruption to a minimum. Sensors register and convey all the relevant information to the control system. Using this data, the system calculates the shift points and controls the shift and clutch processes automatically. The technology even intervenes in driving operations to improve safety – such as automatically interrupting the torque flow briefly to counter the risk of skidding. Buyers of standard cars are already enjoying greater comfort thanks to ZF Sachs components for automated manual transmissions.

Automated manual transmission

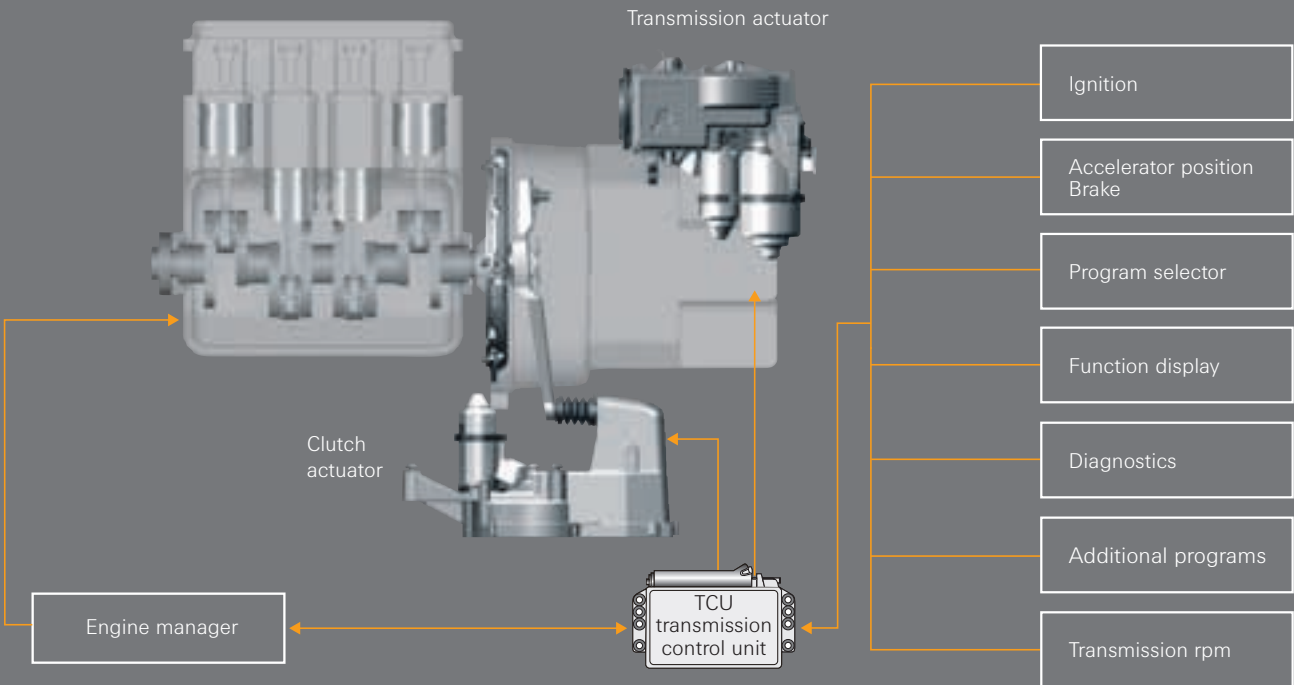


Release forces generated depending on engine torque



- Benefits**
- Full driving comfort – no clutch actuation, no shifting
 - Prevents error during shifting
 - Lower cost and weight, smaller space claim than automatic transmissions
 - Allows manual shifting and thus individual driving styles
 - Separate programs for sportive driving, bad weather conditions or slippery or icy road conditions and trailer use
 - Reduced fuel consumption due to electronically optimized shift points and high mechanical efficiency

Schematic diagram of an electromechanical system automation



Company

ZF is a leading worldwide automotive supplier for Driveline and Chassis Technology. With total sales of euro 12.5 billion in 2008 and 61,156 employees at 125 production companies in 26 countries, ZF is among the top fifteen companies on the ranking list of the largest automotive suppliers worldwide.

ZF Sachs is the Powertrain and Suspension Components division of the ZF Group. For more than 100 years, ZF Sachs has been a renowned partner of the automotive industry. Our products are not only used with traditional applications in cars, commercial vehicles, rail, construction and agricultural technology but also in motorsports.

Leading technology, quality and service are integral parts of the company’s strategy. By implementing a company-wide “Global Performance System”, known as GPS, ZF Sachs has adapted to international market requirements. The objective is to promote customer-supplier relations by means of process orientation, innovation, flexibility, and standardization. GPS as a Corporate Mission Statement represents improved cost management, employee commitment, and increased productivity at a global scale.

In the corporate group:
ZF Sachs AG is a partner of vehicle makers worldwide for the development and production of powertrain and suspension components. A variety of R&D and systems advantages arise for vehicle makers in conjunction with the divisions of the ZF Friedrichshafen AG corporate group. Examples include the 8-speed hybrid transmission and the 8-speed automated transmission. Both transmissions enable substantial fuel savings.



Powertrain and Suspension Components

Powertrain Components
Strategic Business Units
and Product Program

Clutch Systems PC	Dual Mass Flywheel, XTend – Clutch Cover with wear compensation, Clutch Discs, Multi Disc Clutch, Actuation System, Mechanical Torsional Damper, Actuators for Automated Manual Transmissions
Active Launch Systems	Torque Converter for PC, CV and Construction Vehicles, Dual Wet Clutch, HCC – Hydrodynamically Cooled Clutch
Clutch Systems CV	Single and Dual Disc Clutches, XTend – Clutch Cover with wear compensation, Dual Mass Flywheel, ConAct – Pneumatic Actuation System, Torsional Damper
Electric Drives	Electric Drives and hybrid modules for PC, CV and Construction Vehicles

The continuous advancement and integration of components and modules into complex systems are one of the demanding tasks of the Powertrain division. Automotive manufacturers are aiming at lower fuel consumption and reduced CO₂ emissions with simultaneously enhanced comfort. New converter concepts, optimized dual mass flywheels, hydrodynamic launch systems, and the intensive development work on the hybrid modules make a considerable contribution to achieving the automotive industry’s targets.

Suspension Components
Strategic Business Units
and Product Program

Conventional Dampers PC	Monotube and Twin-Tube Damper, Suspension Strut, Stroke-Dependent Damping, Sensitive Damping Control – Amplitude Selective Damping, HID – High Impact Damping
Active Suspension Systems PC	Nivomat – Leveling System, CDC – Variable Damping System, Active Roll Stabilization, Monotube, Twin-Tube, Steering Damper and Suspension Forks for Motorcycles, Damper and Clutches for Racing
Damper Systems CV/Railway	Monotube and Twin-Tube Damper, Air Spring/Damper Module, CDC and PDC – Variable Suspension Systems, Cabin Damping for CV, Agricultural and Construction Vehicles, Primary-, Secondary- and Yaw Dampers for Rail Vehicles

The optimization of conventional shock absorbers as well as the integration and networking of intelligent dampers in complex and adjustable chassis systems determine the processes of the Suspension division. Increased safety, comfort, and driving dynamics are the market requirements to be met in all vehicle classes. ZF Sachs allows for a new dimension in the field of suspensions by providing innovative products, such as the CDC electronic damping system, or the amplitude-selective damping system Sensitive Damping Control.



ZF Sachs AG

Ernst-Sachs-Straße 62

D-97424 Schweinfurt

Germany

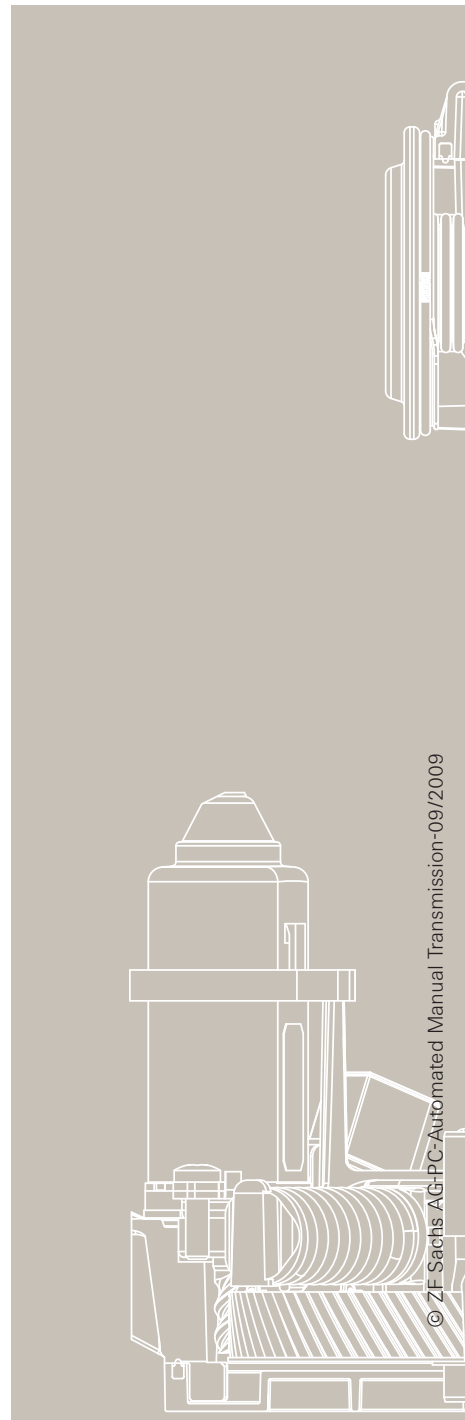
Phone: +49 9721 98-0

Fax: +49 9721 98-2290

www.zf.com



Driveline and Chassis Technology



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