The New VW Passat CC

The VW Passat CC combines the elegant appearance of a Coupé with the comfort of a classic Sedan. This concept is implemented in a four-door four-seater vehicle. Numerous assistance systems complete the convenience of this model.

1 Frameless Doors

Four frameless doors are a design feature of the Passat CC. These frameless doors enabled a lower roof, creating a silhouette typical for a Coupé. The development of an aeroacoustic level appropriate to the vehicle class posed a difficult challenge during the conceptual implementation of a frameless door system. The VW Passat limousine and a benchmark vehicle with frameless doors from the premium segment served as a reference during development. It was possible to achieve the aeroacoustic targets for this development, **Figure 1**. The level of the new vehicle is lower than that of the Passat limousine, which is already very good, and is at the same height as that of the higher-class benchmark vehicle.

This was made possible by a variety of individual measures, such as an acoustic polyvinyl butyral (PVB) windscreen, side windows that are 4.85 mm thick, and an insulation system with a large cover over the side windows, which are enclosed in three-lip roof frame insulation. The area around the B-pillar is insulated by tensioning the door window against the insulation profile.

The challenge for this insulation concept is that the side window must be moved out of the insulation before the door can be opened. This challenge was resolved by adding an extremely fast short stroke function to the electric window system. It was possible to achieve a system time that is noticeably shorter than that of

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Figure 1: Aeroacoustics

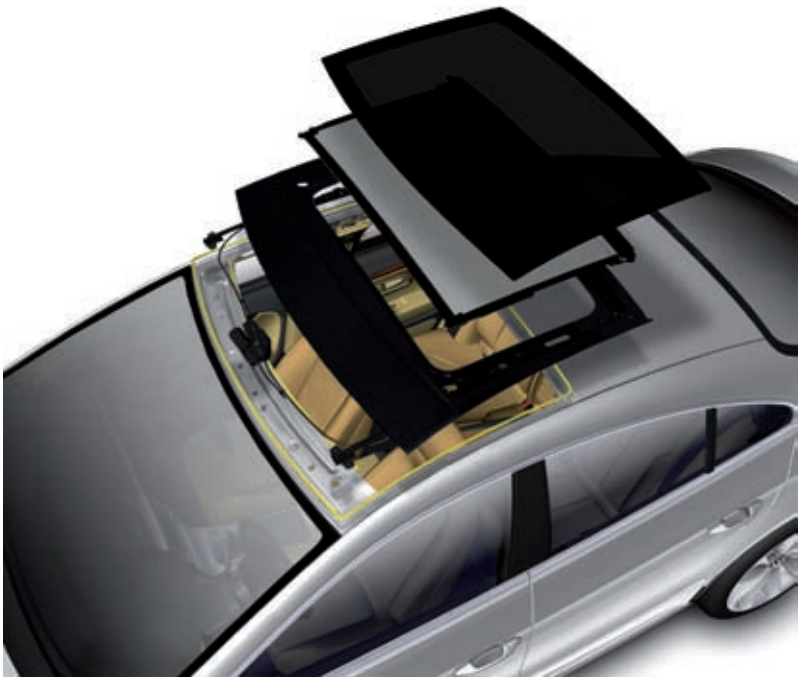

Figure 2: Panorama flip-up roof

the benchmark vehicle by adding an additional switch in the outer door handle and optimising all the effective parameters in the process chain, such as signal processing by the electric window controllers and the mechanics of the electric windows.

2 Electric Panorama Flip-Up Roof

The panorama flip-up roof (PAD) meets a number of requirements: The optimised height of the roof system (maximum 40 mm) makes it suitable even for very flat vehicles such as the Passat CC without impinging on the head room.

The PAD has an opening function 40 mm gap) to improve the climate in the interior. The roof opening area is more than twice as large as that of a conventional sliding/flip-up roof (+ 112 %). This makes the Passat CC seem even more roomy. The tinted and heat-insulating glass cover provides the maximum shade possible (transmission: light 8.2 %, UV radiation 2.8 % and energy radiation 6.9%).

Another objective when developing this roof system was an especially efficient assembly concept to reduce manufacturing costs. This was achieved through a module concept, whereby the PAD is installed as a completely assembled and tested system including a sunblind system, a glass cover, guide rails, mechanics, reference body, electrical drive and insulation system. The insulation system of the module also provides water drainage, which means that a separate water drainage with expensive hose routing is not required. Assembly as a top-load system is a further optimisation, **Figure 2**.

The supporting frame receives the entire system and provides the vehicle's stiffness, and is made from long fibre injection (LFI), which is a glass-fibre-reinforced polyurethane (PUR) system. The front area of the roof between the windscreen and the glass cover of the PAD has been integrated into the module, and is high-gloss black thanks to back-injected film. The PAD therefore visually extends the windscreen to the B-pillar, which increases the Coupé-like impression of the Passat CC.

The manual sunblind system is a complete and complex redevelopment of existing sunblind systems. The following technical requirements were considered and implemented for this shade-providing system:

- opaque material for the blinds to increase the degree of shade provided

Figure 3: Active climatic seat

- continuous adjustment of the blind, regardless of whether and how far the window is open
- lateral guide for the blind so the material is taut
- additional blind holder at the front
- blind shaft is adapted to the spline, which is to say that it is bent so as not to interfere with the headroom.

3 Active Climatic Seat

High-quality seats are one of the most important prerequisites for optimum comfort and a special driving experience. The seats in the new Passat CC have a very sporty character. The design of the front and rear seats show the dynamic concept for the seats. The prominent side cushions especially support a sporty driving style.

The optional ventilated front seats provide a wonderful degree of comfort, **Figure 3**. Air flows through the seat area and seat back with the help of cooler fans. Air channels in the foam cushions guide the air homogeneously through the whole seat and to the person sitting in it. The seat covers, leather perforation and seat cover structure are designed for optimum permeability. The ventilation air comes from the vehicle's interior, which means that the cooling effect of the seat ventilation depends on the temperature. The system is controlled by a switch that is located directly next to the seat adjustment elements. The three ventilation levels (low, medium and high) can be set individually. It is possible to activate seat heating while seat ventilation is active to prevent the body from becoming too cold. A feeling of well-being is achieved because the dampness of the body is reduced.

4 Mobility Tyres

The Passat CC is the first vehicle produced in Europe that contains this tyre type globally in its initial equipment. These tyres are conventional, but with one difference: during an additional production stage, the inner area of the tread is coated with a stationary, highly viscous polymer film. The insulating layer is a two-component system: component A contains polymers, extenders, softening agents and stabilisers, while component B consists of processing promoters and adhesives. The two components are mixed just before they are added to the tyres.

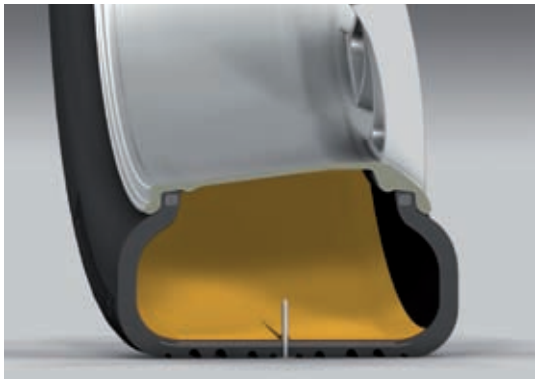

Figure 4: Mobility tyre

This layer encloses any foreign materials that intrude through the tread, and seals any holes up to 5 mm in diameter that are caused by these foreign bodies, **Figure 4**. The sealing function is retained for the entire life cycle.

Unlike other mobility solutions, such as emergency tyres with reinforced side walls or support ring systems, Mobility tyres do not have any disadvantages, such as increased rolling resistance, acoustic and mechanic loss of comfort and lower uniformity. The increased weight caused by the polymer mass (approximately 1 kg per tyre, depending on the tyre size) is more than compensated in the overall vehicle weight as a spare tyre is no longer required.

5 Adaptive Chassis Control System DCC

The chassis settings are extremely important to the character of the vehicle concept. In the Passat CC, this means a sporty-dynamic driving behaviour with a high level of comfort. In a conventional chassis, this can only be achieved through a compromise. The conflict between the objectives can be resolved if the suspension and damping system adapts to the road surface, the driving situation and the customer's requirements. This is why the adaptive chassis control system (DCC) was developed for the Passat CC.

In order to adapt to the road, DCC uses wheel movement sensors and body acceleration sensors to determine the positions and speeds of the wheels and the motion of the body, and then adjusts the damping for each wheel individually every millisecond. DCC considers the driving situation by analysing the signals it receives from the steering, engine, gearbox, brake system and driver assistance systems.

DCC adapts the control parameters to customer requirements; the customer can use a button to change the system behaviour from the normal mode to convenience driving or sporty driving. These three modes have different damping control, and the electromechanical steering EPS is adapted to be convenient or sporty. The selected DCC mode appears in the button and in the multi-function instrument. The vehicle memorises the modus even after ignition change, so it can offer the preferred mode at the start of the journey.

DCC is implemented in a CAN-based architecture, **Figure 5**. The gateway control unit is the function master and communicates the required DCC mode to the affected control units and to the multifunction instrument. This method has made it possible to integrate the system into the Volkswagen module strategy.

The control device hardware is based on the high-performance Infineon TriCore 1766 processor and provides the processing power required for fast control, as well as optimised control electronics for the dampers. The vehicle is equipped with self-adjusting dampers with a broad grip, high power-current linearity and low reaction times so that it can implement commands from the control unit quickly. Capacity-measuring body acceleration sensors and high-resolution wheel movement sensors with a sampling rate of 800 Hz measure the motion status of the wheels and body. When

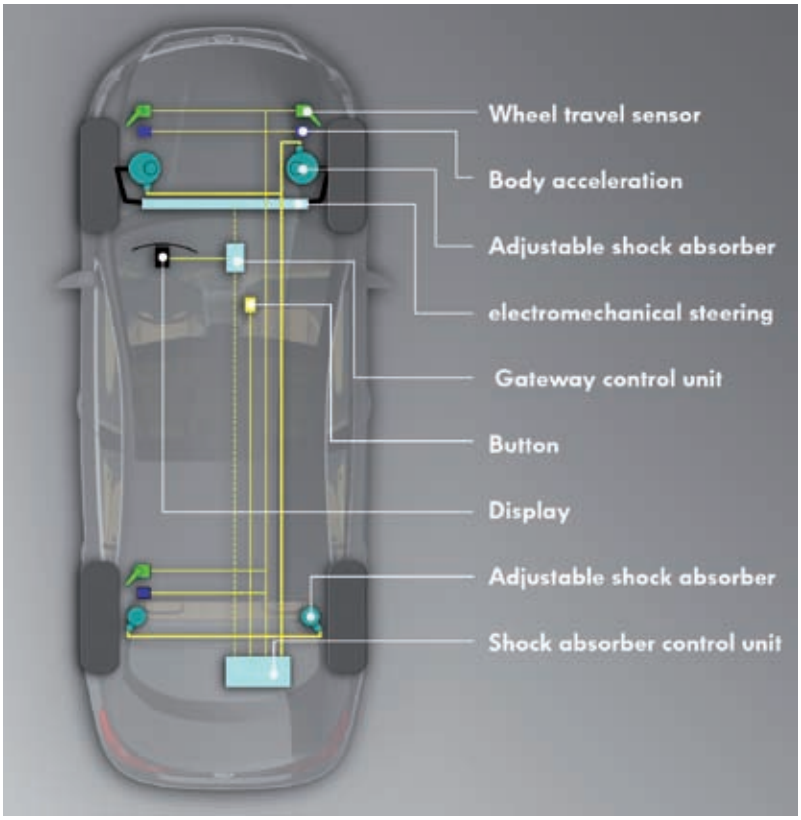

Figure 5: DCC – system structure and networking

the system was tuned, the body suspension rates and the stabiliser stiffness were adapted to the high damping potential in order to provide the required comfort. The soft and hard characteristic curves on the dampers are geared towards the minimum damping requirement and to the forces required to implement the requirements of driving dynamics.

The driver can choose whether the different modes are shown by the vertical dynamic control. However, damping is optimised for maximum security in driving situations relevant to longitudinal and transverse dynamics.

Figure 6 uses the power density spectrum of the structure acceleration in the z direction to compare the DCC modes with those of a conventional chassis. The Sport mode has a better structure connection as regards the structure's own frequency. At higher frequencies near to the wheel's own frequency, Comfort provides better insulation from uneven road surfaces.

All DCC modes have advantages over a conventional chassis regarding the driving dynamic behaviour, especially during interstationary processes, as the damping is controlled in all modes in accordance with steering angle information and other figures dependent on the driving situation.

The adaptive chassis control system in the Passat CC strengthens the sporty and dynamic character of the vehicle while emphasising its convenient and elegant appearance. It adapts to the road surface, driving situation and to customer requirements. A new control algorithm and modern development methods have created a harmonious system that fits the Volkswagen module strategy.

6 Lane Assist

The Passat CC is the first Volkswagen containing the new Lane Assist, **Figure 7**. This system provides corrective steering in many driving situations, which assists the driver in keeping the vehicle on the lane. Naturally, this system does not remove the responsibility for driving from the driver.

The system is activated via the multifunction display in the Passat CC. The driver selects system from the Lane Assist menu item once. Lane Assist will now be activated automatically at speeds over 65 km/h unless deactivated. Lane Assist uses a camera near the rain sensor in the interior mirror to record the lane markings. It makes no difference whether the lines are solid or intermittent. Lane Assist also works in the dark or fog. It does not function if there are no detectable road markings.

When Lane Assist is switched on, this information is displayed to the driver by a yellow road-shaped control symbol in the multi-function instrument. As soon as the camera detects a road marking, the symbol turns green. The system is now completely active. If it detects that the vehicle is leaving the lane unintentionally, Lane Assist will counter-steer. The important part is that the counter-steering is continuous and gentle, so the driver can override it easily. When the driver wishes to cross a line, by, for example an active steering movement, the Lane assist intervention is reduced so that it is almost undetectable to the driver.

Lane Assist does not react if the driver activates the turn signal before driving over a lane marking. If the driver removes his or her hands from the steering wheel, the system detects this, emits an acoustic signal, displays a take over prompt in the multi-function display and then switches itself off.

If Lane Assist intervenes during cornering, the vehicle is subject to centrifugal forces and the opposing steering forces. At high speeds around narrow corners, the torque of the steering is too low to keep the vehicle in the lane. The steering wheel will vibrate in this case to warn the driver.

Lane Assist was developed as a convenient technology for journeys on motorways and well-developed highways. For this reason, the system requires two lane markings on the left and right of the vehicle. The system can potentially avoid accidents in certain situations. Background information: Approximately 14 % of all one-car accidents involving injuries are caused by the vehicle leaving the road.

The system operates with a grey-scale camera. The camera contains the lane detection mechanism and a warning algorithm that calculates the steering interference that can be implemented by the electromechanical power steering.

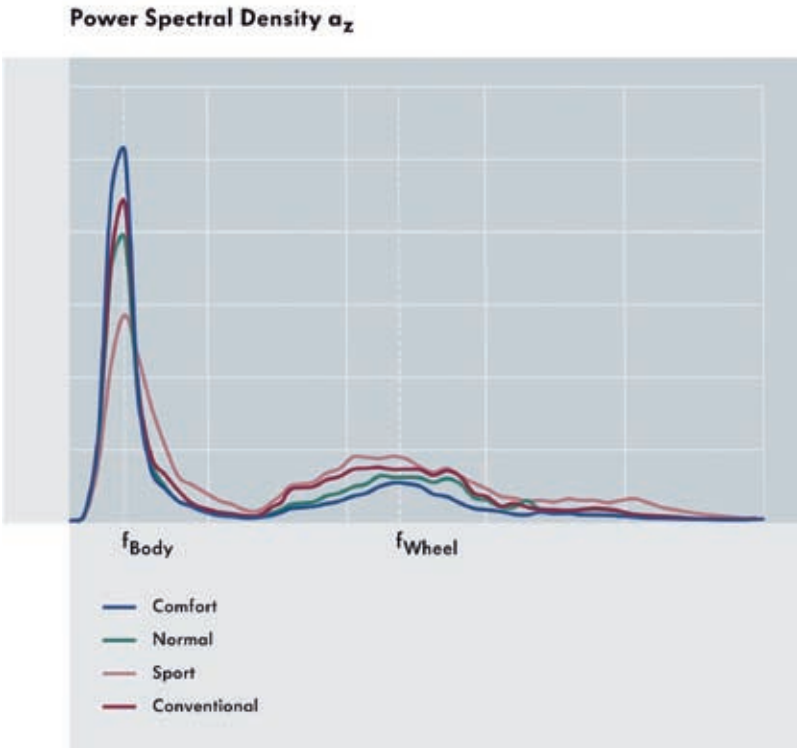

Figure 6: Convenience evaluation of DCC and a conventional chassis

7 ACC With Follow-to-Stop and Front Assist

Systems like the Adaptive Cruise Control (ACC) are now available in many vehicle classes. With the introduction of the new Passat CC, a radar-based ACC able to brake a vehicle to a stop is being offered in mid-class vehicles for the first time. This extension of the ACC increases the comfort of the driver considerably.

The driver's speed is automatically adapted to that of the vehicle in front, if that vehicle is slower than the driver's vehicle. The driver can select a number of different time gaps to adjust the distance set by the ACC. The Follow-to-Stop extension makes the user of the ACC possible at low speeds. This provides an increased level of convenience, especially in slow-moving traffic and traffic jams. If the vehicle has to stop behind the vehicle ahead due to traffic, the own vehicle remains stationary until the driver activates the accelerator pedal. In addition to the comfort functions for the speed and distance control, the Front Assist function has been implemented in the ACC system in the new Passat CC to increase safety. This function can be activated separately, so it also works when the ACC is switched off.

Front Assist reacts in two stages, **Figure 8**: In a critical approach situation, the vehicle is prepared for emergency braking. This is done by applying the brake pads to the brake discs unnoticeably and conditioning the hydraulic brake assistant. At the same time, a visual/acoustic warning in the multi-function instrument warns the driver of the danger. If the driver does not react, the second level briefly applies the brakes to warn the driver of the impending collision, and the braking assistant is sensitised further.

8 VW Swivel Emblem With Integrated Reversing Camera

The VW swivel emblem with integrated reversing camera is used for the first time in the Volkswagen Passat CC. Two existing systems with their different functions are combined in the smallest possible area: the swivel emblem is well-known as the element for manually opening the boot lid on the Golf and the Passat limousine. The reversing camera is just as well-known, and is integrated in the boot lid handle of different VW models.

The VW emblem as a design component, a locking system for the boot and a container for the reversing camera becomes an integrated element, **Figure 9**. When the driver engages the reverse gear, the emblem is set up electromechanically, the protective cover opens and the reversing camera swings out.

The wide angle objective of the reversing camera records the area behind the vehicle, from the bumper to the horizon. The camera control device inte-

Figure 7: Lane Assist – system components

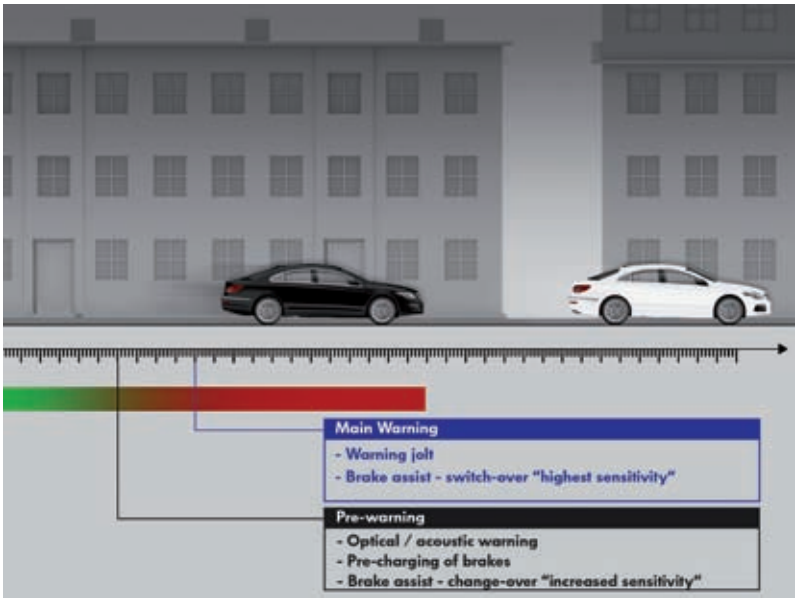

Figure 8: Front Assist

Figure 9: Swivel emblem with reversing camera

grated in the vehicle equalises the image and adds static and dynamic lines that describe the driving direction. The edited image is displayed in the display of navigation system RNS 510 or of radio RCD 510.

Mounting the reversing camera in the swivel emblem provides a number of benefits: When the reverse assistant is deactivated, the camera is located behind a protective lid in the swivel emblem, which means that it does not interfere when the handle is activated manually. The operating forces are therefore no higher than for the mechanical version. The reversing camera is protected from rain, dirt and outside interference during normal driving operation.

9 Adaptive Xenon Front Lighting System

Since February 2007, ECE directive R123 permits the distribution of the dipped beams to be controlled according to the driving situation. Volkswagen is producing this new dipped beam concept for the first time as standard equipment in the Passat CC.

Until now, the horizontal beams of the light modules for dipped and main beams were allowed to move horizontally in dependence on the steering angle, but the left-hand and right-hand lamps were not permitted to be angled individually to adapt to the road lighting in different traffic situations.

ECE R123 now allows individual light distribution on country roads and motorways, and in bad weather or fog. This is achieved through settings for the left-hand and right-hand lamps that differ from the basic setting. This light setting creates an added light distribution suitable for the driving situation. The lighting that does not depend on the driving situation is still controlled by the existing dynamic headlamp levelling (LWR).

Driving situations are detected using the speed, the brightness of the environment and a signal from the wiper system. The permitted driving speeds and corresponding light distribution permitted for individual driving situations are described exactly in ECE directive ECE R123. A different light distribution is permitted for every one of the driving situations mentioned above, and can be recognised from the key letters for light distribution on the headlamps.

The processes switching between the different light distributions for different driving situations are applied to appear seamless to the driver. This process is ensured by a vehicle-specific set of parameters in the AFS control unit. ■

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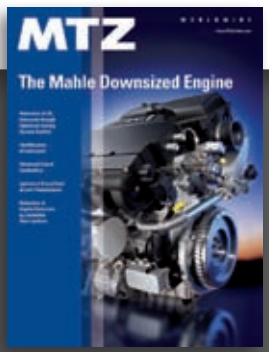

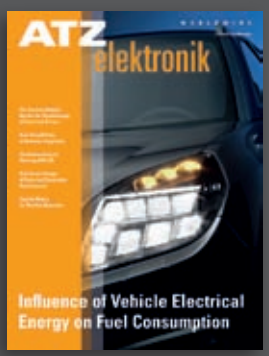

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