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**Audi takes to the race track with the sportiest piloted driving car in the world**

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* The collective fuel consumption of all models named above and available on the German market can be found in the list provided at the end of this Basic Info.
Summary
Audi has developed the world’s sportiest piloted driving car. Following the spectacular drive by the Audi RS 7 piloted driving concept at the German Touring Car Masters (DTM) season finale in Hockenheim, the innovative technology platform is now making an appearance on the challenging circuit of the Ascari Race Resort – at racing speed, without a driver.

“We are pressing forward with one of the most important trends in the automotive world with our technical solutions for piloted driving,” says Prof. Dr. Ulrich Hackenberg, Board Member for Technical Development at AUDI AG. “We presented the sheer fascination of this development at the DTM race in Hockenheim. Now we are demonstrating just what this technology platform is capable of on a circuit that is famous for an even more challenging profile with a wide variety of bends and chicanes. This will clearly reinforce the technical achievements of the Audi engineers once more.”

Audi has long been a driving force in the area of highly automated driving. The brand’s development efforts have produced a number of spectacular feats. In 2010, for instance, a driverless Audi TTS* conquered the legendary Pikes Peak mountain race circuit in Colorado, USA. Audi has time and again showcased the potential of the technology with demonstrations at the limit. With 560 hp and a top speed of 305 km/h (189.5 mph), the Audi RS 7 piloted driving concept car exemplifies Vorsprung durch Technik.

The Audi RS 7 piloted driving concept car on the race track

The Audi RS 7 piloted driving concept car is a technology platform with which Audi is exploring the possibilities of piloted driving at its most dynamic. The large, five-door coupe is largely identical to the production model, but its electro-mechanical power steering, the brakes, the throttle valve and the eight-speed tiptronic that distributes the power to the mechanical quattro drive system are controlled automatically.

There are two primary technological considerations during piloted driving at the physical limit: the highly precise orientation of the vehicle on the road and absolute control of the vehicle at the handling limits.
The technology platform uses specially corrected GPS signals for orientation on the track. Accurate down to a centimeter, these differential GPS data are transmitted to the vehicle via WLAN according to the automotive standard and redundantly via high-frequency radio. Parallel to this, 3D camera images are compared in real time against graphical information stored on board. The system searches in each of the countless individual images for several hundred known features, such as building patterns behind the track, which it then uses as additional positioning information.

Control of the vehicle at the handling limits is another outstanding feature of the Audi RS 7 piloted driving concept car. Comprehensive on-board networking coupled with the highly precise control of all actors relevant to driving enable the technology platform to drive at the physical limits. The Audi engineers intensively investigated piloted driving at the handling limits, putting the technology platform through several thousand test kilometers on a variety of routes.

To demonstrate its capabilities on the race circuit, the Audi RS 7 piloted driving concept car drives a clean ideal line – with full throttle on the straights, precisely metered deceleration at the ideal braking point before the corners, precise turn-in and perfectly metered acceleration when exiting the corners. Forces of over 1.3 g occur during braking, and lateral acceleration in the corners can reach 1.1 g.

On the track in Hockenheim, the RS 7 piloted driving concept reached a maximum 240 km/h (149.1 mph). Its top speed is 205 km/h (127.4 mph) in Ascari. With its challenging ascents and descents, tight chicanes and banked bends, the Ascari circuit poses an even greater challenge for the technology of the Audi RS 7 piloted driving concept. As well as high longitudinal and lateral acceleration, this track subjects the car to dynamic axle load changes.

The race track is also the most demanding test bed for production when it comes to piloted driving. The future systems must also work extremely precisely and with zero errors in critical situations. They therefore must be capable of properly assessing the current situation even at the physical limit. This test bed provides the Audi engineers with a variety of insights for production development, such as for the development of automatic avoidance functions in critical driving situations.

Press material has been compiled in a digital press folder (www.audi-mediaservices.de/presskit/en/piloted_driving_2014).
Piloted driving – highlights

Audi has been working intensively on the subject of “piloted driving” for many years now. The development efforts have produced numerous spectacular driving feats – on public roads, on the race track and even on a salt bed.

2009: Bonneville Salt Flats
In fall 2009, Audi took to the Bonneville Salt Flats in Utah, USA, with a driverless Audi TTS. Driving in precise curves, the white coupe carved the brand’s four rings into the salt bed. It also set a new speed record for piloted driving cars of 130 mph (approx. 210 km/h).

As homage to former Audi rally driver Michèle Mouton, the technology platform was dubbed “Shelley.” Its specific data technology was developed jointly by Audi, Volkswagen and the Center for Automotive Research at Stanford University in California.

2010: Pikes Peak
The next year, the piloted driving “Shelley” conquered the legendary Pikes Peak mountain race circuit in Colorado, USA. The technology platform covered the 20 kilometer (12.4 mi) course with a total of 156 corners in roughly 27 minutes, reaching a top speed of 45 mph (72 km/h). Navigation was already via differential GPS and accurate to just a few centimeters.

2012: Thunderhill Race Track
In 2012, Audi garnered its initial experience with the Audi TTS on a race track – the Thunderhill Race Track north of Sacramento, California. The lap time on the roughly three-mile (nearly five kilometers) course was under 2 minutes and 30 seconds. The tests were focused on how a piloted driving car behaves at high loads and under extreme conditions.

2013: Las Vegas
The authorities in the US state of Nevada made the Audi the world’s first automobile maker to receive a permit to operate piloted driving cars in public traffic. In January 2013 and 2014, the brand presented new systems for piloted driving in traffic jams and for piloted parking at the International Consumer Electronics Show (CES) in Las Vegas. International trade journalists were on board both times.
2014: Florida and California

Audi is rapidly expanding its testing competence for piloted driving in the USA. This summer, the brand was once again the world’s first automobile maker to conduct a public test on the Lee Roy Selmon Expressway outside Tampa, Florida. The company this fall received the first test license under the new regulations in California, where test drives on the freeways are now generally permitted.

Piloted driving – future production technology

The production technologies for piloted driving currently under development at Audi will make their way into cars before the end of this decade. The new systems will then take over the driving in certain situations, such as in traffic jams or when parking, making it even more convenient and safe.

Piloted driving in traffic jams

In the future, the “traffic jam pilot” will help Audi drivers by taking over the steering at speeds between 0 and 60 km/h (37.3 mph) in addition to accelerating and braking automatically.

To do this, the new system assesses the status of the car as well as the entire surroundings. If the customer activates the system, the car completely takes over longitudinal and lateral guidance when it detects a traffic jam on a highway at speeds between 0 and 60 km/h (37.3 mph).

When the traffic jam pilot reaches its limits, such as when the traffic jam dissolves or the end of a divided road is reached, it prompts the driver to take over the wheel again.

A key component of the system of sensors is the radar system. As with today’s adaptive cruise control with stop & go function, it monitors a 35-degree field in front of the car at a range of up to 250 meters (820.2 ft). A video camera with a wide angle of aperture detects the lane markings as well as pedestrians and objects, such as other vehicles and guard rails. Up to twelve ultrasonic sensors are used to monitor the immediate space around the car.

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A new member of the sensor portfolio is the laser scanner, which delivers highly precise data at a distance of up to 80 meters (262.5 ft). Its laser diode emits nearly 100,000 infrared light pulses per second that are invisible to the human eye. The laser scanner covers a 145-degree field on six levels. The controller computes a surroundings profile from the light reflections that shows both other vehicles and guard rails.

The laser scanner offers key advantages. Because of its wide angle of aperture, it detects cars entering the lane very early and also remains fully functional in the dark. It can detect all types of objects, including those with a homogeneous pattern, such as fences, or with no visible structure, such as white walls.

**Piloted driving for parking maneuvers**

Parking maneuvers in tight situations are unpleasant – narrow parking spaces or garages make it difficult for the driver to get in and out of the car. With the “parking pilot” system from Audi, drivers can get out and control the car remotely using the remote key fob or a smartphone. This system uses the same sensor systems as the traffic jam pilot, but also uses its four 360° cameras to generate additional key information about its surroundings.

The parking pilot offers the piloted parking function to the driver when the environmental sensors detect a suitable parking space or garage. If the driver gets out of the car, he or she needs only to press the key fob or the corresponding button on their smartphone to initiate the process.

The system checks to make sure that the key is in the vicinity of the car. If the on-board sensors detect obstacles in the driving corridor during piloted parking, the car stops immediately. When the car arrives at its parking position, the system turns off the engine and locks the doors. The driver receives a confirmation message. The push of a button is likewise all that is required to retrieve the car from the garage or parking space.

**The central driver assistance control unit (zFAS)**

Today’s driver assistance systems are usually managed by spatially separated control units. Audi, in contrast, is taking the novel approach of a central domain architecture. In the future, all available sensor information will flow into a central control unit (zFAS). This computes a complete model of the vehicle surroundings that is used by all of the assistance systems. The future systems for piloted driving will also draw on this redundantly computed information.

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The central driver assistance control board uses cutting-edge multi-core processors. All together, they have the computing power of the entire electronics architecture of today’s Audi A4*. The new board currently has about the same area as a tablet PC, but its space requirements will continue to shrink. Its modular concept ensures high scalability and future viability. Audi will be introducing the central driver assistance control module to production along with the systems for piloted driving by the end of this decade.

**Relaxed and under control— today’s driver assistance systems**

Audi already offers numerous driver assistance systems to make driving more relaxed and under control. No need is left uncovered, and the full capabilities of these systems are on display in the updated Audi A6* and Audi A7 Sportback* model series.

**Adaptive cruise control with stop & go function**

Of all the optional driver assistance systems offered by Audi, adaptive cruise control with stop & go function including Audi pre sense front is the most complex. It regulates the speed and the distance to the vehicle ahead by accelerating and braking in a range from 0 to 250 km/h (155.3 mph), and brakes automatically within certain limits. The driver can use Audi drive select to switch between four settings to specify just how comfortable or sporty the system should be.

The ACC stop & go function uses data from two radar sensors, a video camera, ultrasound sensors and additional systems. In addition, it uses predictive route data from the navigation system to reliably calculate the proper line on the highway, even in curves. In city traffic, the ACC stop & go automatically slows the car to a stop.

**Audi side assist**

Audi side assist including Audi pre sense rear is activated at 30 km/h (18.6 mph). Two radar sensors at the rear of the car monitor what goes on behind it. If the system detects another vehicle moving into the critical zone from behind, a yellow LED display lights up in the housing of the exterior mirror. If the driver nevertheless activates the turn signal to change lanes, the indicator becomes brighter and begins to flash quickly – a signal that is hard to miss.

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**Audi active lane assist**

Audi active lane assist employs a video camera to detect lane markings at speeds above 65 km/h (40.4 mph). If the car approaches a line without the turn signal being activated, the system helps the driver to steer back into the lane by intervening gently in the electromechanical power steering. Drivers use the MMI to specify how quickly this assistance system should intervene and whether the steering wheel should vibrate as well. If the driver selects early intervention, the system also helps to keep the car in the center of the lane.

In the new Audi A6 and A7 Sportback models, Audi active lane assist works closely together with Audi side assist. If both are activated, the warning before a critical lane change is accompanied by targeted intervention in the steering.

**Camera-based speed limit display**

The camera-based speed limit display recognizes speed limit signs on the side of the road, their supplemental signs and the signs canceling speed limits. It presents these as graphics on the display of the driver information system or on the optional head-up display. Software compares images supplied by the video camera with map data from the optional MMI navigation plus.

**Night vision assistant**

Another high-end feature is the night vision assistant. Its thermal imaging camera uses far infrared technology to “see” up to 300 meters (984.3 ft) ahead. Data is converted into black-and-white images that are displayed on the large driver information system screen. People and animals appear conspicuously bright on the screen due to the heat they give off, whereas the surroundings appear dark. The software can detect people and large animals and highlights them in the display in yellow.

If the computer anticipates a hazardous situation, the brake system is automatically prefilled. A warning signal sounds and a red warning also appears on the driver information system’s screen and in the optional head-up display. If the car is equipped with the high-beam assistant or Matrix LED headlights, persons detected outside of town limits are illuminated with three short flashes of light.

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**Park assist with 360° display**
Audi offers various options that make parking easy. The park assist system with 360° display uses ultrasonic sensors to locate and measure parking spaces along the side of the road at low vehicle speeds. If a sufficiently large space is found, the system takes over parallel parking at the push of a button. The driver has to apply the gas and brake.

The park assist system can maneuver the car into a space either parallel or perpendicular to the road. In addition, a 360° display warns of obstacles to the sides. Front-mounted and reversing cameras are also available.

**Audi pre sense**
The Audi pre sense safety system is available in a number of different versions. In the standard version – Audi pre sense basic – the system intervenes immediately upon detecting an unstable driving situation via the ESC sensors. The front seat belts are electrically tensioned and the sunroof and the side windows are closed, leaving just a small gap. The vehicle's hazard warning lights will warn the traffic behind.

The Audi pre sense front version is available in combination with ACC stop & go. This system is intended to prevent rear-end collisions – or at least reduce the consequences of such accidents. The integrated Audi braking guard is activated in a dangerous situation to warn the driver, first with an acoustic signal and a visual signal. At the same time, the brake system is prefilled and the dampers of the optional adaptive air suspension are also set to hard.

If the driver still does not react, then the system briefly brakes the vehicle – a jolt which serves as the second warning; the belts are slightly pretensioned. If the driver depresses the brake pedal now, the hydraulic brake assist increases braking power as appropriate for the situation. Should the driver ignore the warning jolt, autonomous partial braking will be initiated – provided that the vehicle ahead is in motion Deceleration is at a rate of 3.5 m/s². The windows and sunroof will be closed, seat belts tensioned considerably, and hazard warning lights activated.
If the car is equipped with the full version of Audi pre sense – Audi pre sense plus – a third and a fourth stage follow in the event of an emergency. The system will then increase deceleration initially to 6 m/s² and tighten the belts completely. The last braking phase – the autonomous full brake application – occurs roughly half a second before an inevitable collision. The consequences of such a collision can thus be greatly reduced.

At speeds below 30 km/h (18.6 mph), the car will brake autonomously with full force in an emergency – regardless of whether the car in front is moving or standing still. Below 20 km/h (12.4 mph), this full braking frequently prevents the accident altogether or greatly reduces the impact speed.

Immediately after a collision, the secondary collision brake assist helps the driver by initiating braking automatically. This reduces the risk of skidding and additional collisions during the course of the accident.

Yet another Audi pre sense subfunction, Audi pre sense rear, is coupled with Audi side assist. If the system detects an imminent rear-end collision, it uses the adaptive brake light to warn the traffic behind.
Fuel consumption of the models named above:

**Audi TTS:**
Combined fuel consumption in l/100 km: 7.5 – 6.9** (31.4 – 34.1 US mpg);
Combined CO₂ emissions in g/km: 174 – 159** (280.0 – 255.9 g/mi)

**Audi A4:**
Combined fuel consumption in l/100 km: 10.7 – 4.0** (22.0 – 58.8 US mpg);
Combined CO₂ emissions in g/km: 249 – 104** (400.7 – 167.4 g/mi)

**Audi A6:**
Combined fuel consumption in l/100 km: 9.6 – 4.2** (24.5 – 56.0 US mpg);
Combined CO₂ emissions in g/km: 224 – 109** (360.5 – 175.4 g/mi)

**Audi A7 Sportback:**
Combined fuel consumption in l/100 km: 9.5 – 4.7** (24.8 – 50.0 US mpg);
Combined CO₂ emissions in g/km: 221 – 122** (355.7 – 196.3 g/mi)

**The fuel consumption and the CO₂ emissions of a vehicle vary due to the choice of wheels and tires. They not only depend on the efficient utilization of the fuel by the vehicle, but are also influenced by driving behavior and other non-technical factors.**