Porsche 911 Carrera GTS with efficient performance hybrid system

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Each generation of the Porsche 911 becomes a unique source of appeal. Porsche continuously and carefully develops its icon with that famous sequence of numbers. The new 911 proves this by introducing a technological milestone into the world of Porsche sports cars: the principle of the performance hybrid drive. The new T-Hybrid in the 911 Carrera GTS **911 Carrera GTS (WLTP)*:** Fuel consumption combined: 10.6 – 10.1 l/100 km; CO_2 emissions combined: 242 – 230 g/km; CO_2 class: G models is particularly lightweight and can be smoothly integrated into the architecture of the 911.

This concept is based on a wealth of experience gained from motorsport. Porsche's engineers designed a lightweight drive unit specifically for the 911, consisting of an electric exhaust turbocharger (eTurbo), a compact and lightweight high-voltage drive battery, efficient power electronics, a newly developed 3.6-litre boxer engine, and a strengthened eight-speed dual clutch transmission (PDK) with an integrated electric motor. The combination of these components gives the T-Hybrid system an outstanding balance of high performance and efficiency with low weight.

The electric turbocharger in the new T-Hybrid system

The eTurbo without a wastegate was specially developed for the new 911. Its design includes an electric motor that sits between the compressor and turbine wheel. It is connected directly to the turbine shaft and can bring it up to speed in an instant, regardless of engine speed or load. This makes a significant contribution to the performance and efficiency of the drive system while achieving low emissions: to guarantee sustained performance with an ideal air-fuel mixture ratio (lambda = 1) in the engine, extensive widening of the exhaust tract is necessary. But, without remedial measures, these larger flow cross-sections in the exhaust components would result in significant 'turbo lag'. The electric motor drastically shortens the time required for the turbo to spool up, meaning that the full boost pressure is consistently available within a very short time. This ensures that the 3.6-litre boxer engine maintains the ideal air-fuel mixture ratio and still builds up torque quickly. It responds instantly in all driving situations and offers linear power delivery. Even at an engine speed of 1,500 rpm, a system torque output of 500 Nm is produced, and the full torque of 610 Nm is even available from less than 2,000 rpm.

The eTurbo is designed so that the integrated electric motor can both deliver torque to the turbocharger shaft and generate electrical power from its rotation. As a generator, it produces up to 11 kW of electrical power. It uses this energy to feed the electric motor in the Porsche dual clutch transmission (PDK) or to charge the high-voltage battery. With its responsiveness and performance capability, the eTurbo makes it possible to dispense with the second turbocharger. The innovative system regulates the boost pressure automatically using the generator function of the electric motor, which means that it isn't necessary to have a wastegate to limit the pressure. The eTurbo is positioned on the right behind the boxer engine. New exhaust manifolds guide the exhaust gases to it from both cylinder banks. The corresponding charge-air cooler is located above the boxer engine. It receives its cooling air through the grilles in the rear lid. Compared to its predecessor, Porsche engineers were able to increase the efficiency of the cooler.

Porsche dual clutch transmission (PDK) and electric motor in detail

Porsche developed a separate PDK specifically for the T-Hybrid. It is based on the gearbox from the previous models but differs in several important aspects. The clutches, gear sets and bevel-gear drive are designed to be stronger in order to cope with the significant increase in system torque. Furthermore, a taller final-drive ratio reduces the engine speed, especially at high road speeds.

A permanently excited synchronous motor is fully integrated into the gearbox housing. It fits into the existing gearbox oil cooling system and is coupled directly to the crankshaft via the dual-mass flywheel. This integration allows a weight-saving design and immediate assistance to the powertrain. The compact module measures just 286 mm in diameter and 55 mm in length. Nevertheless, it delivers a drive torque of 150 Nm from idling speed and provides a power output of up to 40 kW (54 PS). In generator mode, it can feed up to 40 kW to the high-voltage battery. This happens, for example, when

braking, during recuperation when coasting on flat ground or a downhill gradient, or from the engine (known as load point shifting): the system is able to raise the 'load point' of the combustion engine in order to drive the generator with the excess power. The electric motor also performs the tasks of the starter and alternator, thereby saving weight.

The high-voltage battery of the performance hybrid system

The T-Hybrid system is based on a compact and lightweight high-voltage battery. It combines an operating voltage of 400 volts and a gross capacity of 1.9 kWh with a compact design: its weight (approximately 27 kg) and dimensions correspond to those of a conventional 12-volt AGM starter battery. For reasons of weight distribution, it is located in the front, under the bonnet in the new 911 Carrera GTS. The battery, which consists of 216 round cells, has a water-cooling system and efficient thermal management to ensure consistently high performance. It monitors and controls the temperatures at cell and module level.

The 12-volt starter battery for the T-Hybrid drivetrain was specially developed for use in the performance hybrid system. With an energy capacity of 40 Ah, the lightweight lithium iron phosphate battery ($LiFePO_4$) measures just 90 mm in height and weighs seven kilograms. A standard 70 Ah lead-acid starter battery is around three times heavier. The lightweight battery offers high-voltage stability, better charge acceptance, high cycle stability and a long service life.

The new 3.6-litre boxer engine

The centrepiece of the 911 Carrera GTS remains its exhilarating combustion engine. Porsche has developed a new six-cylinder boxer engine that is resolutely designed to be future-proof. The engineers increased the displacement from 3.0 to 3.6 litres – with a bore enlarged to 97 mm and a stroke increased to 81 mm – and installed the proven VarioCam technology. With precise camshaft control that is matched to the respective speed and load conditions, the drive achieves high power and torque values with optimised fuel consumption. As the electric motor performs the functions of the alternator, and the air conditioning compressor is powered electrically, the belt drive otherwise required is no longer necessary. This creates space above the engine to install a pulse inverter and DC-DC converter.

The six-cylinder boxer engine of the new 911 Carrera GTS has adopted the solid roller cam followers used in motorsport. Compared to the bucket tappets in the previous model, they reduce frictional losses and, therefore, improve efficiency. At the same time, they increase the robustness of the valve train at high speeds. Manual adjustment of the valve clearance during maintenance is not necessary.

More dynamic, with better emission values

Even without electrical assistance, the boxer engine delivers 357 kW (485 PS) and 570 Nm of torque.

In combination with the high-voltage system, the eTurbo, and the electric motor in the new Porsche dual clutch transmission (PDK), the T-Hybrid achieves a system output of 398 kW (541 PS) and 610 Nm. Compared to its predecessor, the increase in power is 45 kW (61 PS). The additional electrical power and the drastically reduced response time of the electric turbocharger improve performance, particularly off the line: at full acceleration from a standstill and from idle speed, the new 911 Carrera GTS covers a distance more than a third greater in 2.5 seconds than its predecessor. At this point, its lead is more than the length of a car.

The new 911 Carrera GTS Coupé with Launch Control Start takes just 3.0 seconds to reach 100 km/h and reaches a top speed of 312 km/h.

Every component in the drive unit also fulfils other fundamental functions. In combination with its components, the performance hybrid system achieves greater driving performance with optimised CO_2 emissions and low additional weight. Compared to its predecessor, the overall weight increase is only 50 kg. During combustion, the drive system maintains the ideal air-fuel ratio in every situation: the lambda value is 1 in all operating modes, even at full load.

The innovative T-Hybrid system of the new 911 Carrera GTS merges seamlessly into the Porsche electrification strategy and demonstrates the consistent progress made when it comes to the implementation of particularly high-performance solutions. “Water cooling, turbocharging, performance hybridisation: with the T-Hybrid system, we are taking the next logical step in the continuous, innovation-driven development of our core models. It significantly increases efficiency and future-proofs the 911 philosophy with even better performance,” as Frank Moser, Vice President Model Line 911 and 718, sums up.

MEDIA ENQUIRIES

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Consumption data

911 Carrera (WLTP)*: Fuel consumption combined: 10.4 – 9.9 l/100 km; CO_2 emissions combined: 237 – 227 g/km; CO_2 class: G

911 Carrera GTS (WLTP)*: Fuel consumption combined: 10.6 – 10.1 l/100 km; CO_2 emissions combined: 242 – 230 g/km; CO_2 class: G

*Further information on the official fuel consumption and the official specific CO_2 emissions of new passenger cars can be found in the "Leitfaden über den Kraftstoffverbrauch, die CO_2-Emissionen und den Stromverbrauch neuer Personenkraftwagen" (Fuel Consumption, CO_2Emissions and Electricity Consumption Guide for New Passenger Cars), which is available free of charge at all sales outlets and from DAT (Deutsche Automobil Treuhand GmbH, Helmuth-Hirth-Str. 1, 73760 Ostfildern-Scharnhausen, www.dat.de).

Video

https://newstv.porsche.com/porschevideos/289175_en_3000000.mp4

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