The new 911 Carrera Technology Workshop
Powertrain
The new 911 Carrera – Motivation and challenge
The new flat-six engine (9A2 evo)

911 Carrera S

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement</td>
<td>2,981 cm³</td>
</tr>
<tr>
<td>Bore</td>
<td>91.0 mm</td>
</tr>
<tr>
<td>Stroke</td>
<td>76.4 mm</td>
</tr>
<tr>
<td>Compression</td>
<td>10.2:1</td>
</tr>
<tr>
<td>Power output</td>
<td>331 kW (450 hp)</td>
</tr>
<tr>
<td>Max. torque</td>
<td>530 Nm</td>
</tr>
<tr>
<td>Max. engine speed</td>
<td>7,500 min⁻¹</td>
</tr>
</tbody>
</table>
The new flat-six engine (9A2 evo)

**Crankcase**
- Aluminium closed deck
- PTWA Fe-coated running surfaces

**Oil circulation**
- Integrated dry sump
- Fully-variable, optimised oil pump

**Valvetrain**
- Four valves per cylinder technology with Vario Cam Plus technology
- Intake/exhaust stroke switchover
- Intake/exhaust camshaft adjuster
- Asymmetrical small stroke

**Modular charging technology**
Biturbo (wastegate) with
- cast manifold,
- electric wastegate adjuster and recirculation air,
- encapsulated wastegate kinematics

**Fuel direct injection**
- Central injector position
- Piezo injector (200 bar)

**CO₂ measures**
- Reduced friction
- Optimised mixture formation
- Higher compression ratio
- Reduced number of vacuum consumers

**Fulfilment of legislation worldwide**
- Petrol particulate filter (PPF)
- New turbochargers (catalytic converter heat optimisation)
- Optimised fuel system
- Electric exhaust flaps

**New engine mounts**
- Engine mount bracket directly on cylinder head, cylinder head cover

**One-piece cylinder head**
- Cross-flow cooling
- Exhaust side downward
The new 911 Carrera – Optimised combustion method

**Piezo injector** (A-nozzle)
- Multiple injections possible (up to 5)
- High-quality atomisation and rate of evaporation – good mixture formation even with very late injection
- Precise metering of small volumes and high flow-through

**Asymmetrical (small) valve stroke**
- Optimised Vario Cam Plus valve timing with different valve strokes of 2 mm and 4.5 mm for the small stroke.
- Intake valve can close earlier → dethrottling

**Higher compression**
- Effective compression increase

→ Efficiency boost, smooth running, lower emissions
The new 911 Carrera – New turbocharging

**Symmetrical turbocharger layout**
- Electric wastegate
- Optimised catalytic converter intake flow
- Turbine wheel 48 mm (+ 3 mm)
- Compression wheel 55 mm (+ 4 mm)

**New exhaust manifold**
- Cast iron manifold instead of sheet metal
- Air cooled instead of air gap insulated

→ Lower full-load fuel consumption
→ Better cold-start heating of catalytic converter
→ Faster response of turbochargers
Exhaust air mass flow, catalytic converter inflow (wastegate 37.5° open, catalytic converter heating)
Higher cooling air throughput due to new position
14% bigger intercooling
50% dethrottled process air path
The new 911 Carrera – particulate filter (PF)

- PF integrated in tight engine compartment
- No noticeable effects for customer
- Exhaust back-pressure is compensated
- Emotional sound
991 II

Engine blade
- Soft mount via bracket on crankcase

992

Engine bracket
- Stiff/short mount via cylinder head
- Engine mount shifted forward

The new 911 Carrera – Optimised engine mounts

Potential for PADM and chassis tuning can be better exploited
Spread between better ride comfort and more sportiness has been further increased
The new 911 Carrera – Power/torque

Comparison of 3.0-litre B6 Biturbo 991 II vs. 992

**Engine speed [rpm]**

**Torque [Nm]**

**Power [kW]**

- 911 Carrera S (991 II) – 309 kW (420 hp)/500 Nm
- 911 Carrera S (992) – 331 kW (450 hp)/530 Nm
The new eight-speed Porsche dual-clutch transmission
The new eight-speed PDK – Key characteristics

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>Performance</th>
<th>Comfort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eight speeds with an 8.06 spread of ratios</td>
<td>Optimised shifting strategy</td>
<td>Full shift-by-wire</td>
</tr>
<tr>
<td>System pump with demand-based control</td>
<td>Torque capacity &gt; 800 Nm</td>
<td>Starting performance with engine speed control</td>
</tr>
<tr>
<td>New low-viscosity transmission fluids</td>
<td>Actuating torque of up to 1000 Nm in differential lock control</td>
<td></td>
</tr>
<tr>
<td>Optimisation of efficiency (dual clutch, synchronisation, hydraulics, direct lubrication, seals, etc.)</td>
<td>3-fold synchronisations of gears 1-4 for enhanced shifting performance</td>
<td></td>
</tr>
<tr>
<td>Hybridisation option</td>
<td>Improved speed shift</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wet Mode</td>
<td></td>
</tr>
</tbody>
</table>

Modularity
- Modular transmission system
  - First use in Panamera (gear set and hydraulics concept, dual clutch family, shifting actuators, pump, etc.)
  - Also used in Group vehicles
  - Other uses in 911 derivatives
The new eight-speed PDK – Gear set

- Main shaft 1
- Pinion shaft
- Reverse gear shaft
- Main shaft 2
- Summation shaft
- Input shafts
- Front axle output
- Four-shaft gear set
- Separate reverse gear
- Separate pinion shaft
- Front axle output via spur gear stage
The new eight-speed PDK – Gear set

- Controlled torque vectoring
- Input shaft 1
- Input shaft 2
- Main shaft 1
- Main shaft 2
- Summation shaft
- Front axle output
- Crown wheel
- Differential
- Pinion shaft
- Reverse gear shaft
- Parking lock
The new eight-speed PDK – Gear set

Multiple use of gears 6/8 and 5/7

Engine to differential

Summation shaft (K3 meshes with K1 and K2)

Cardan shaft to front axle drive

8 gears

Unlimited direct shift matrix

Flexible gear ratio selection

8 gears

Unlimited direct shift matrix

Flexible gear ratio selection
Gear ratios of the 911 Carrera S (991 II) with seven-speed PDK

\[ \text{Spread: } 6.28 \]

\[ v_{\text{max}} = 306 \text{ km/h} \]
Gear ratios of the 911 Carrera S (992) with eight-speed PDK

First gear is defined for maximum starting performance.
Ride comfort and improved fuel economy in overdrive gears 7 & 8.
Optimal gear ratio progression up to $v_{\text{max}}$ gear (6 + 2 layout).

$v_{\text{max}} = 308 \text{ km/h}$

Spread: 8.06
The new eight-speed PDK – Structure

- Dual clutch (wet)
- Direct lubrication
- Shifting actuator
- Hydraulic control
- Vane pump (variable)
The new eight-speed PDK – Innovative pump concept

- Very low hydraulic energy consumption
- Allows strategies (Normal, Sport, Sport Plus)
- Losses 77% lower than 1st generation

Adjustable vane pump to control volume flow (engine-driven)

- Lubrication and cooling of gear set
- Tandem layout via Oldham clutch
- 37% lower losses compared to 1st PDK

Auxiliary gerotor pump
### Optimisation of existing functions
- Adapts to driving style, driving situation and environment
- Special functions for low friction (wheel slip and yaw rate)
- Support of PSM control interventions

### Use of predictive information from ACC and route data
- Information on traffic ahead
- Road classes and municipalities
- Junctions
- Predicted inclines
- Distance to next bend
- Predicted transverse acceleration (bend curvature and vehicle speed)

### Functions based on predictive data
- a) Use of engine overrun instead of upshifting with slow-moving vehicle ahead
- b) Upshift preventer before start of hill
- c) Earliest possible upshifting at end of a hill
- d) Driving style / sport factor
  - Quicker reduction of sport factor when “long straight section” is detected
  - Sport factor is limited in municipalities
- e) Bend upshift preventer with approaching bend
Functions based on predictive data

- a) Use of engine thrust instead of upshifting with slow-moving vehicle ahead
- b) Upshift preventer before start of hill
- c) Earliest possible upshifting at end of a hill
- d) Driving style / sport factor
  - Quicker reduction of sport factor when “long straight section” is detected
  - Sport factor is limited in municipalities
- e) Bend upshift preventer with approaching bend

The new eight-speed PDK – Optimised shifting strategy

- a) Slower vehicle ahead
- b) Start of hill
- c) End of hill
- d) Straight section / within municipalities
- e) Bend ahead
The new eight-speed PDK in the 911 – important component of a future-oriented drivetrain
The new front axle drive in the 911 Carrera 4S

Efficiency  Performance  Driving fun
### Efficiency
- Electromechanically controlled hang-on all-wheel drive
  - Torque boost to max. torque transfer at front wheels
  - Plate heat exchanger to increase cooling performance
- Need-based control of cooling
  - Moderate effort
  - Enables strategies (Normal, Sport, Sport Plus)
- New low-viscosity transmission fluid

### Performance
- Optimised central control strategy
  - Torque capacity +10 %
  - Rear-biased tuning
- Cooling performance +300 %
- Longer system availability in drift operation

### Driving fun
- Increased availability for brief, high-energy inputs
- Wet Mode
- Optimisation of efficiency (Bearings, lubrication, seals, etc.)
New turbocharging
Mid-positioned intercooler
Lateral air filters
Optimised B6 biturbo engine with optimised combustion
Particulate filter
New, higher performance engine cooling
New eight-speed PDK
New front axle drive
## The new 911 Carrera – comparison to previous model

<table>
<thead>
<tr>
<th></th>
<th>911 Carrera S (991 II)</th>
<th>Improvement</th>
<th>911 Carrera S (992)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power output</strong></td>
<td>309 kW (420 hp)</td>
<td>+22 kW/30 hp (7.1 %)</td>
<td>331 kW (450 hp)</td>
</tr>
<tr>
<td><strong>Torque</strong></td>
<td>500 Nm</td>
<td>+30 Nm (6.0 %)</td>
<td>530 Nm</td>
</tr>
<tr>
<td><strong>Top speed</strong></td>
<td>306 km/h</td>
<td>+2 km/h (0.65 %)</td>
<td>308 km/h</td>
</tr>
<tr>
<td><strong>Acceleration 0-100 km/h</strong></td>
<td>3.9 s</td>
<td>-0.4 s (10.3 %)</td>
<td>3.5 s</td>
</tr>
<tr>
<td><strong>Lap time Nürburgring – Nordschleife [min]</strong></td>
<td>7 min. 30 sec.</td>
<td>-5 s (0.7 %)</td>
<td>7 min. 25 sec.</td>
</tr>
</tbody>
</table>