THE FULL-HYBRID POWERTRAIN OF THE NEW BMW ACTIVE HYBRID 5.

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BMW ACTIVE HYBRID 5.
INTRODUCTION.

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BMW ACTIVE HYBRID 5.
ENGINEERING TARGETS.

- **Significant reduction of CO₂ emissions.**
  (compared to standard powertrain).

- **Distinctive electric driving experience.**
  (sufficient agility in urban driving conditions, high availability).

- **ConnectedDrive meets EfficientDynamics.**
  (intelligent use of onboard navigation data).

- **Create a modular solution:**
  - Scalable from Mild Hybrid to Plug-In Hybrid.
  - Compatible with all BMW vehicles.
  - Maximize synergies with standard powertrain (e.g. combustion engine, gearbox).
  - In-house development and production of HV battery.

- **Preserve the Character of the BMW 5-Series:**
  BMW-adequate driving dynamics and vehicle character of the BMW 535i.

→ **Concept Decision: full hybrid design with P2 architecture.**
BMW ACTIVE HYBRID 5.
SYSTEM OVERVIEW.
BMW ACTIVE HYBRID 5.
COMBUSTION ENGINE N55.

6-Cylinder inline TwinPower Turbo:

- Max. Torque: 400 Nm @ 1200-5000 min\(^{-1}\)
- Max. Power: 225 kW @ 5800-6400 min\(^{-1}\)

Twin scroll Turbo

Gasoline Direct Injection in combination with VALVETRONIC

Starter integrated in Belt Drive

Belt tensioner

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BMW ACTIVE HYBRID 5. STARTER SYSTEM.

- Additional starter system integrated in belt drive.
- Superior start comfort (acoustics, vibration).
- Starter function is independent from electrical driving → no torque reserve necessary in HV system.
BMW ACTIVE HYBRID 5.
HYBRID 8-SPEED AUTOMATIC TRANSMISSION.

TV damper  E-Machine  Separating clutch K0

Integrated start-up element

Mechatronics  Electrical Oilpump

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BMW ACTIVE HYBRID 5.
HYBRID 8-SPEED AUTOMATIC TRANSMISSION.

- Modular and scalable transmission concept.
- High synergies with non-hybrid transmission (Gearsets, Clutches, TCU, Package, Interfaces).
- E-Machine replaces torque converter.

**Technical Data:**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. input torque capacity</td>
<td>700 Nm</td>
</tr>
<tr>
<td>Max. input speeds</td>
<td>7,200 rpm</td>
</tr>
<tr>
<td>Ratio spread</td>
<td>7.071</td>
</tr>
<tr>
<td>Full hybrid functionality</td>
<td></td>
</tr>
<tr>
<td>(Engine start-stop, Electrical</td>
<td></td>
</tr>
<tr>
<td>drive, Recuperation, e-Coasting</td>
<td></td>
</tr>
</tbody>
</table>

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ELECTRIC DRIVE SYSTEM.

E-Machine:
- PSM
- 40 kW / 210 Nm max.
- Water cooled

Power Electronics:
- DC/DC converter (HV to 12 V)
- Inverter for EM control
- HV supply for A/C
- Electronic Control Unit
- Water cooled

Electric A/C compressor

12 V Electrical system
BMW ACTIVE HYBRID 5.
LITHIUM ION HV BATTERY SYSTEM.

BMW In-house Development and Production
Power Oriented Design
Stable Aluminium Housing
Connector Panel - HV Connector - Cooling
Holder with Mounting Device

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### Battery - System

**Cells**

**Electric/Electronic, Hardware**

**Battery Management (Functions, Diagnostics)**

**Cooling**

**Housing and Structural Elements**

<table>
<thead>
<tr>
<th>Producer</th>
<th>BMW Group</th>
<th>Voltage, nominal</th>
<th>317 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of cells</td>
<td>96</td>
<td>Voltage range</td>
<td>200...385 V</td>
</tr>
<tr>
<td>No. of modules</td>
<td>8</td>
<td>Capacity, nominal</td>
<td>4 Ah</td>
</tr>
<tr>
<td>Weight</td>
<td>&lt; 46 kg</td>
<td>Stored energy, nominal</td>
<td>1,350 Wh</td>
</tr>
<tr>
<td>Volume</td>
<td>approx. 40 l</td>
<td>Max. discharge power</td>
<td>43 kW</td>
</tr>
</tbody>
</table>

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BMW ACTIVE HYBRID 5.
SYSTEM PERFORMANCE.

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Electric Overboost
Dynamic Response

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BMW ACTIVE HYBRID 5.
FUEL ECONOMY AND PERFORMANCE.

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## BMW ACTIVE HYBRID 5. HYBRID SYSTEM FUNCTIONS.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel consumption @ NEDC:</td>
<td>6.4 l/100 km</td>
</tr>
<tr>
<td>Vehicle weight (EU):</td>
<td>1925 kg (+ 150 kg to BMW 535i)</td>
</tr>
<tr>
<td>Emission levels:</td>
<td>EU 5, ULEV II, Japan Green Car 4 Star</td>
</tr>
<tr>
<td>$V_{\text{max}}$ e-drive*:</td>
<td>60 km/h</td>
</tr>
<tr>
<td>$V_{\text{max}}$ e-coast:</td>
<td>160 km/h</td>
</tr>
<tr>
<td>e-drive range*:</td>
<td>3-4 km</td>
</tr>
<tr>
<td>Comfort engine start stop function</td>
<td></td>
</tr>
<tr>
<td>Intelligent State-of-Charge Control</td>
<td></td>
</tr>
<tr>
<td>ActiveHybrid Damping function</td>
<td></td>
</tr>
<tr>
<td>Navigation-based hybrid operating strategy</td>
<td></td>
</tr>
</tbody>
</table>

(*on a level track)

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BMW ACTIVE HYBRID 5.
ACTIVE HYBRID DAMPING.

- Use of the E-Machine for active vibration damping.
- Significant improvement in comfort for dynamic response situations.

Load step in 1st gear

<table>
<thead>
<tr>
<th>Acceleration [g]</th>
<th>Torque AHD</th>
<th>Acceleration [g]</th>
<th>Torque AHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6</td>
<td>-0.2</td>
<td>0.6</td>
<td>-0.2</td>
</tr>
<tr>
<td>0.4</td>
<td>-0.2</td>
<td>0.4</td>
<td>-0.2</td>
</tr>
<tr>
<td>0.2</td>
<td>-0.2</td>
<td>0.2</td>
<td>-0.2</td>
</tr>
<tr>
<td>0.0</td>
<td>-0.2</td>
<td>0.0</td>
<td>-0.2</td>
</tr>
</tbody>
</table>

Active Damping on

Active Damping off

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Use Case: downhill gradient.

- Start discharge by load reduction of combustion engine.
- Maximize eDrive limits.

- Battery fully charged.
- Shift to normal operating strategy.

- End discharge.
- No load shifting.

First-time use of route data from navigation system in hybrid operating strategy.
Optimized adjustment to driving situation.
Use Case: slow driving zone.

- Start load shifting.
- Reduction eDrive limits.

- Increased availability of e-drive.
- Improved fuel economy.
- Similar functionality for target zone.
- Battery cooling strategy is also adapted.

- End charging of HV battery.
- Maximize eDrive limits.

- Shift to normal operating strategy.

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BMW ACTIVE HYBRID 5.
SUMMARY.

- Future-oriented fuel economy combined with the BMW-typical vehicle character.
- Significant CO₂ reduction of 16 % without compromise in driving dynamics.
- Distinctive electric driving experience, enhanced by intelligent connection of vehicle systems.
- The ActiveHybrid 5 is another important milestone in the EfficientDynamics strategy.
THE FULL-HYBRID POWERTRAIN OF THE NEW BMW ACTIVE HYBRID 5.

THANK YOU FOR YOUR ATTENTION.