Was Getriebe voneinander lernen können –
Ein Vergleich unterschiedlicher Getriebekonzepte

What Transmissions Can Learn From Each Other –
A Comparison of Various Transmission Concepts
Various transmission types

- Manual transmission
- Automated manual gearbox
- Double clutch transmission
- Continuously variable transmission (belt, chain, rubber belt)
- Continuously variable transmission (Half / Full Toroid) Geared Neutral
- Continuously variable transmission conical ring
- Automatic planetary gear set
- Prius Hybrid
## Combinations of gearbox principles

<table>
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<tr>
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## Comparison of transmission types with their most important characteristics

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<tr>
<th>Transmission type</th>
<th>undesired</th>
<th>desired</th>
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<tr>
<td>Manual transmission</td>
<td>not automated</td>
<td>no auxiliary energy necessary</td>
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<tr>
<td>Automated gearbox</td>
<td>interruption during shifts</td>
<td>no auxiliary energy necessary</td>
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<td>Double clutch transmission</td>
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<tr>
<td>AT with torque converter</td>
<td>oil pump, start/stop not possible</td>
<td>planetary gear</td>
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<td>AT with start-up clutch</td>
<td>oil pump, start/stop not possible</td>
<td>planetary gear cost effective</td>
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<tr>
<td>CVT with pulley / chain</td>
<td>energy for ratio adjustment necessary, not for highest torques</td>
<td>continuously variable</td>
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<tr>
<td>CVT half / full Toroid</td>
<td>heavy and expensive</td>
<td>continuously variable</td>
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<tr>
<td>CVT conical ring</td>
<td>only 1 friction contact</td>
<td>min. effort for ratio adjustment</td>
</tr>
<tr>
<td>CVT power split</td>
<td></td>
<td>high torques</td>
</tr>
<tr>
<td>CVT Geared Neutral</td>
<td></td>
<td>replaces reverse gear</td>
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<tr>
<td>Hybrid Prius</td>
<td>high cost and weight for electric motors and batteries</td>
<td>no clutches or brakes</td>
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Double clutch transmission based on a manual transmission
Shematic of a 7-gear automatic transmission with dry clutches and brakes
Design of a 7-gear automatic transmission with dry clutches and brakes
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Audi multitronic®
Simple power-split CVT

\[ \frac{|P_{\text{variator}}|}{P_{\text{in}}} \]

100%

50%

VDI 2004, LuK
Simple power-split CVT

\[ \frac{|P_{\text{variator}}|}{P_{\text{in}}} \]

\( 100\% \)

\( 50\% \)

UD  K1 → K2  OD

VDI 2004, LuK
Design of multi-range power-split CVT

- Transmission allowing 3 regimes + Geared Neutral
- Planetary gear for power-split
- 620 mm
Conventional torque converter
Forward operation

Engine

Pump

Turbine

Stator

Input shaft

Transmission Case

Forward torque

Reverse torque
Torque reverse converter
Reverse operation

- Engine
- Turbine
- Stator
- Pump
- Input shaft
- Transmission case

Forward torque: Green
Reverse torque: Orange
Torque reverse converter
Design concept - forward
Cone-ring transmission
Chain CVT with mechanical clamping

PIV 1970:
power-range:
2.5 kW
Electromechanical Clamping

- Worm gear on ratio adjustment ring gear
- Housing-fixed ring gear
- Shaft-fixed sun gear
- Double epicyclic gear set
- Meshing gears
- Planetary nut
- Pull rod
- Clamping force adjustment ring gear

Primary
- Moveable sheaves
- Planetary nut

Secondary

SAE 2004, TU Eindhoven
Hydraulic balance with double piston
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Mild Hybrid (ESG)

consumption reduction

0  -5%  -10%  -15%

start-stop

recuperation
ESG: Max. functionality with min. effort

- cold start
- start-stop
- power shift
- generating
- recuperation
- stationary air-conditioning
- electrical drive
- boosting
Principle of power-split

- Electric motor
- Planetary gear
Design of the Toyota Hybrid system (PRIUS)
Design of the SEL 120/3

Tenberge
Design of the SEL 120/3

- 2 electric motors
- 3 gear transmission
- DMF
- B0
- power pack
- hydraulic control

Tenberge
From power-split CVT to power-split hybrid CVT
From power-split CVT to power-split hybrid CVT

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- KB slip/open
- KB applied

EM
KB
K1
K2
OD
UD
1/i

K1 > K2
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Vielen Dank für Ihre Aufmerksamkeit

Thank you for your attention