Markus Steinberger - Hybrid Modules Supporting Many Needs

U.S. light-vehicle sales?

- 17.2 million
- 6.5 million
Market

- 6.5 million vehicles
- Electrification: series hybrids
- Fleet and niche solutions
- Small percentage of electrification

- Using existing transmissions
- Gaining efficiency
- Increasing performance

Hybrid Module

P2 RWD Architecture

- Combustion-engine driving
- RWD architecture space
- Electric driving
- Electric boost and recuperation
- Engine start

6.5 million RWD vehicles
The Appeal of Hybrids

What do drivers like about hybrids?

Features
- Electric drive
- High power
- High torque
- Instantaneous powertrain feedback

Properties
- Improved fuel economy
- Smooth launch
- Adequate price

Hybrid Module

Hybrid Modules Supporting Many Needs
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6.5 million RWD vehicles
Hybrid Modules Supporting Many Needs

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Hybrid Module

- Combustion-engine driving
- Electric driving

- Engine torque
- Torus Lockup clutch
- Transmission shaft Torque
- Disconnect clutch
- E-motor
- Lockup clutch
- Transmission shaft Torque
Hybrid Module

- Combustion-engine driving
- Electric driving
- Electric boost
- Battery charge / recuperation
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Hybrid Module

- Combustion-engine driving
- Electric driving
- Electric boost
- Battery charge / recuperation
- Engine start

Hybrid Module

- Dry clutch with Hydrostatic Clutch Actuator
- Wet clutch with Electric Pump Actuator
- Wet clutch controlled by valve body

Disconnect-clutch alternatives

Modular actuation
Hybrid Module Sub-Assemblies

- P2 Hybrid launch element
- Double clutch
- Single-face clutch
- Torque converter

Front DCT
- Minimal towing
- Low weight
- Dynamic feel

Towing
- High torque
- Smooth launch

Advantage of TC in P2 RWD
- High-slip capacity
- High-towing capacity
- Torque ratio
- No change over lifetime
- No sensors or actuators
- Smooth launch

RWD application
Hybrid Module – Sub-Assembly

- HV connector
- LV connector
- Disconnect clutch
- E-motor
- Engine
- Transmission
- Engine flange
- Transmission flange
- Torque converter

Hybrid Modules – Voltage

- 48V
  - Recuperation
  - Fuel efficiency
- 300V
  - Electric drive
  - Fuel efficiency
  - Performance
- 800V
  - Electric drive
  - Fuel efficiency
  - Performance
  - Power density

Electrical alternatives
Hybrid Module – Integrated E-Motor

E-motor is attached to torque converter shell.
Hybrid Module – Integrated E-Motor

Integrated E-motor allows reduced
- ... number of components
- ... number of drag sources
- ... space by ≈ 50 mm
- ... inertia

Removed parts:
- Shaft
- Seals
- Bearings
- Flexplate
- Aluminum wall
- Bolts
- Flexplate bolting
Hybrid Module - Cooling

- Primary cooling circuit
  - Disconnect clutch
  - Rotor
  - Stator

- Secondary cooling circuit
  - Stator

P2 Module

- Better fuel economy ✔
- Instantaneous feedback ✔
- Higher performance ✔
- Smooth launch ✔
Modular actuation
Modular attachment
Space saving
Durability
There is more

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Modular actuation
Modular attachment
Space saving
Durability
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Housing

E-motor

KO

TC
P2 Front-Wheel Drive

Engine space:
- Power
- Number of cylinders

Transmission space:
- Frame
- Number of gears

Space

P1 design: space neutral
P2 design: +20 mm
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Hybrid Modules Supporting Many Needs

17.2 million vehicles

P2 drives

FWD design
RWD and FWD P2

FWD P2 module

RWD P2 module
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