The sixth generation of integrated AWD Actuators
Background

- Fuel Efficiency
- Weight reduction
- Size reduction
- Increased performance
- Hybrid and Electric vehicles
## History

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GenVI Actuator Family Overview

- BorgWarners Next Generation of Actuators
  - Couplings
  - Transfer Cases
  - Disconnect Modules and eTV
  - Park lock

- GenVI Actuators based on
  - Brushless DC-motor (BLDC)
  - Integrated Plug-On ECU
  - Proven GenV Pump Concept (for hydraulic actuators)
GenVI Actuator – Customer Benefits

- Physical Improvements
  - Actuator weight only ~0.7kg
  - Modular and compact design
  - No external cable harness

- Increased performance
  - Motor speed always known – High torque accuracy
  - Response time improvements
Overview
GenVI Variants

Reversible 2-port

Reversible 3-port

Standard Actuator

ParkLock

Dog clutch Actuator
Hydraulic System

- Wet lamella package
- Electro-Hydraulic Actuator
- Centrifugal Over-Flow Valve
- Bleeding Valve
BLDC Motor

- Enhanced Lifetime performance
  - No mechanical commutation system
- Improved thermal capacity
  - Rotor to be running in oil
  - Windings close to motor surface
- Increased performance
  - Motor speed always known
  - Response time improvements due to less inertia of the rotor
GenVI Actuator – Plug-On ECU

- ECU integrated in motor
- Running AUTOSAR
- CAN, CAN FD or FlexRay
- Functional safety (ASIL B)
- Robust electromagnetic compatibility
- Capacity to include both BLDC control and Vehicle Control Software
Pump Concept

- O-rings
- Thrust ball bearing / Swashplate
- Radial ball bearing
- Pistons
- Piston springs
- Piston drum assembly
- Pump lid
- Strainer incl. Spacer sleeve
- Screws

Pressure [bar] vs. n [rpm]
Pump Function

- Centrifugal regulator to control pressure at pump outlet

- A certain pressure, \( P_1 \), is needed to reach moment equilibrium around the pivot point for a certain pump speed \( \omega \)

- This pressure is accomplished by a certain flow and displacement \( x \) of the ball
Couplings - Vehicle setup

FWD-based AWD

RWD-based AWD

FWD eLSD

FWD-based AWD with eLSD
Standard GenVI Actuator

- AWD Hang-on Couplings
- eLSD - Cross Axle Couplings
- Transfer Cases
- P2 Off-axis Hybrid Modules
Reversible Pump

- 2-Port Reversible pump
  - T-Case 1-speed Disconnect
  - Electric Torque Vectoring

- 3-Port Reversible pump
  - T-Case 2-speed Disconnect
Dog Clutch Actuator

- Various mechanical solutions used to move dog clutch position
  - AWD Disconnect Modules
  - Electric Drive Disconnect Module
- Fast synchronization
  - eMachine, Coupling or Transfer Case with fast response and high Torque Accuracy
  - Dog clutch teeth design
- Mode Change
  - Torque Vectoring, Disconnect
Park Lock

- BLDC motor connected to planetary drive used to actuate conventional park lock systems
Thank you!