



The sixth generation of integrated AWD Actuators

Mattias Magnusson

2019-05-10

Background

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

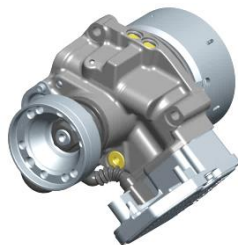
History

Gen I



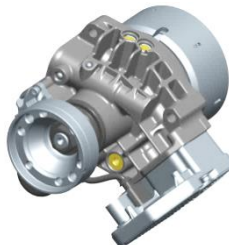
1998 -

Gen II



2002 -

Gen III



2004 -

Gen IV



2007 -

Gen V



2012 -

Gen VI



2019 -

Weight
Index

100

53

53

53

42

36

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)



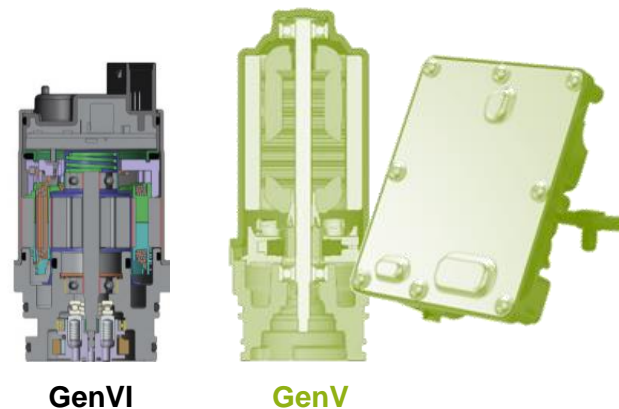
GenVI Actuator – Customer Benefits

- Physical Improvements

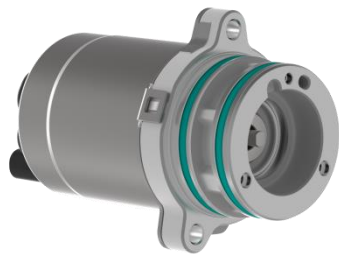
- Actuator weight only ~0.7kg
- Modular and compact design
- No external cable harness

- Increased performance

- Motor speed always known – High torque accuracy
- Response time improvements



Overview



Combustion



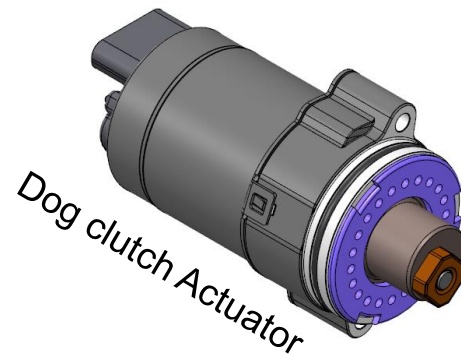
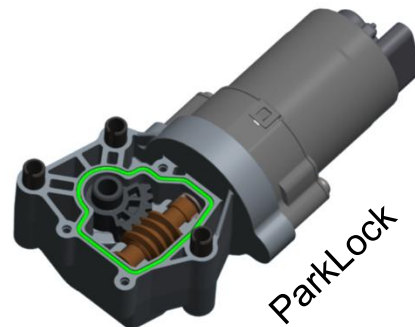
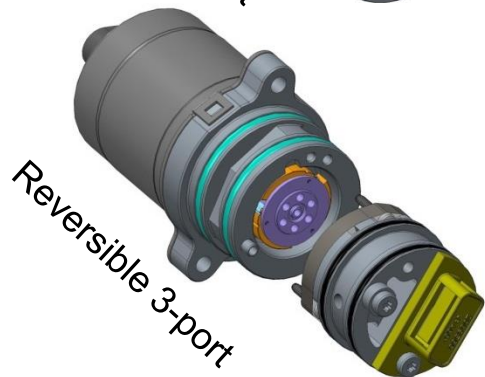
Hybrid



Electric

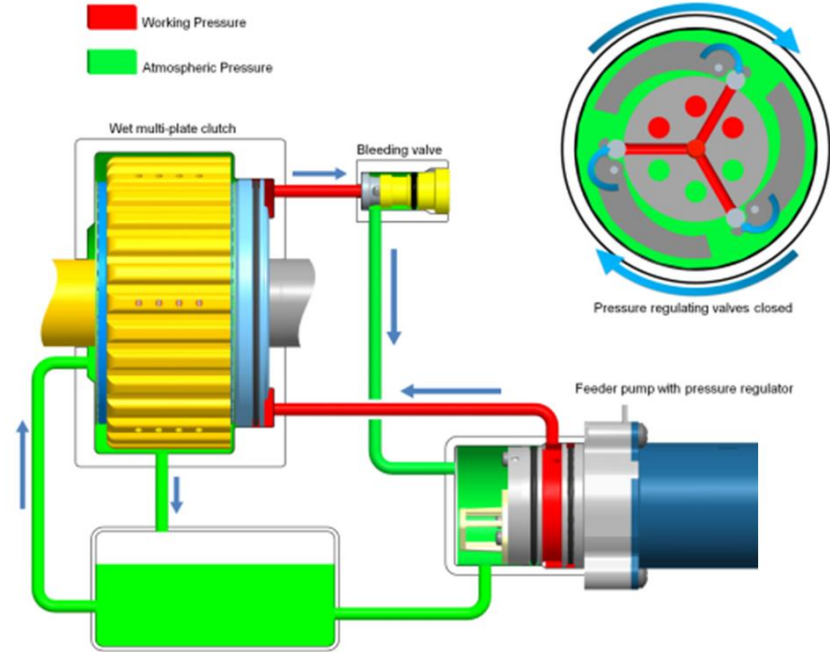
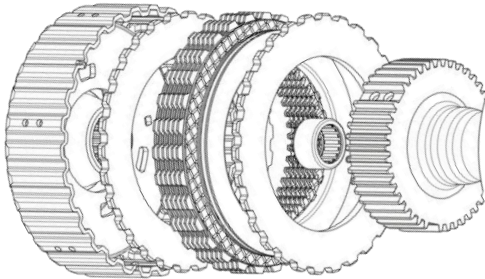


GenVI Variants



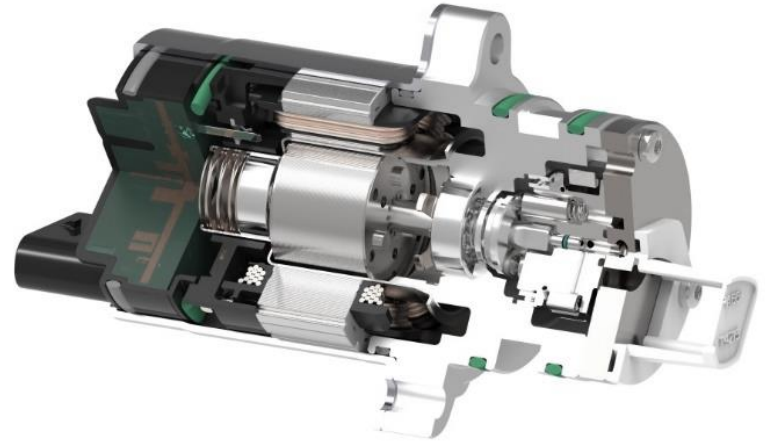
Hydraulic System

- 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

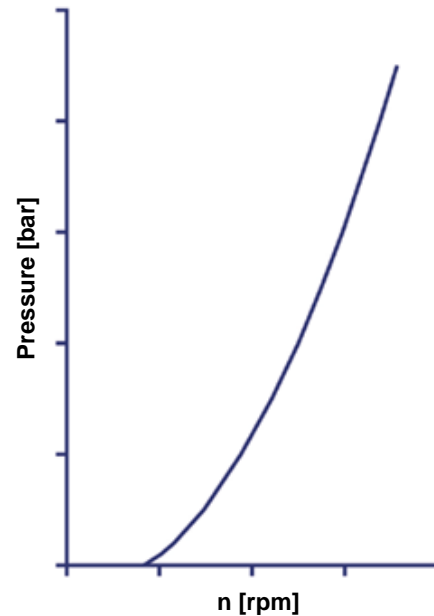
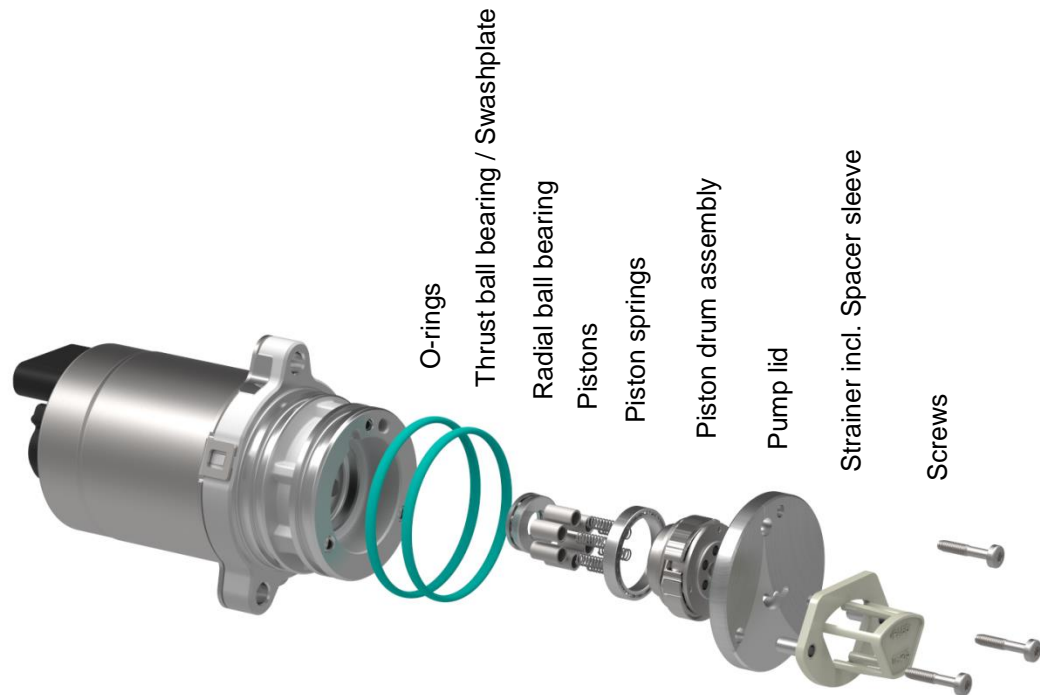


GenVI Actuator – Plug-On ECU

- 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

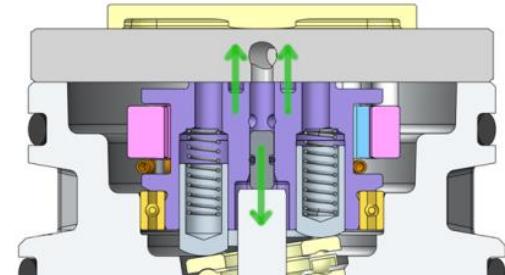
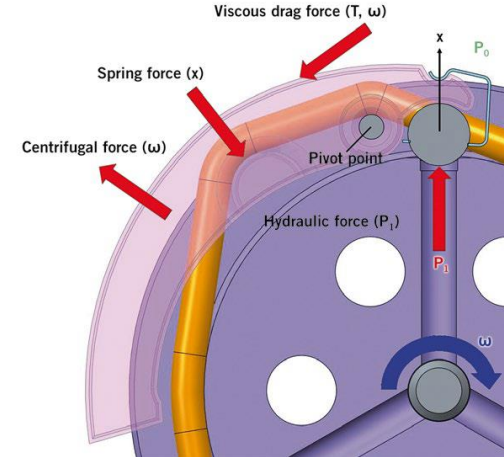


Pump Concept

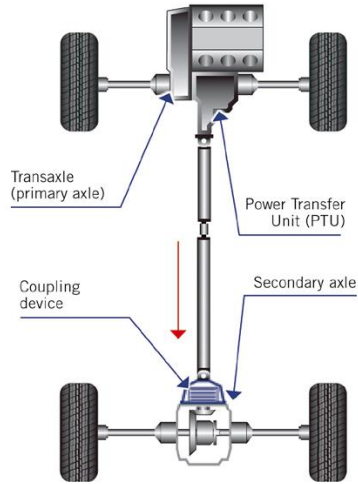


Pump Function

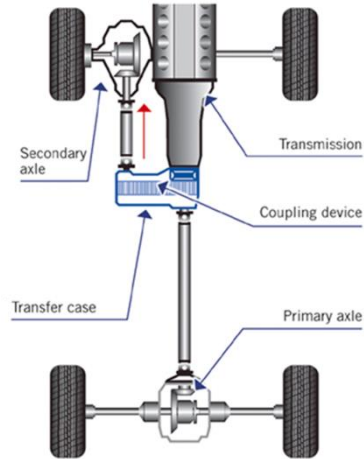
- Centrifugal regulator to control pressure at pump outlet
- A certain pressure, P_1 , is needed to reach moment equilibrium around the pivot point for a certain pump speed ω
- This pressure is accomplished by a certain flow and displacement x of the ball



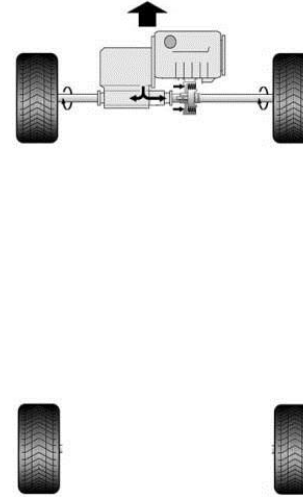
Couplings - Vehicle setup



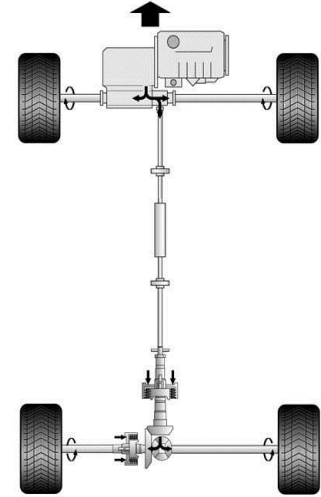
FWD-based
AWD



RWD-based
AWD



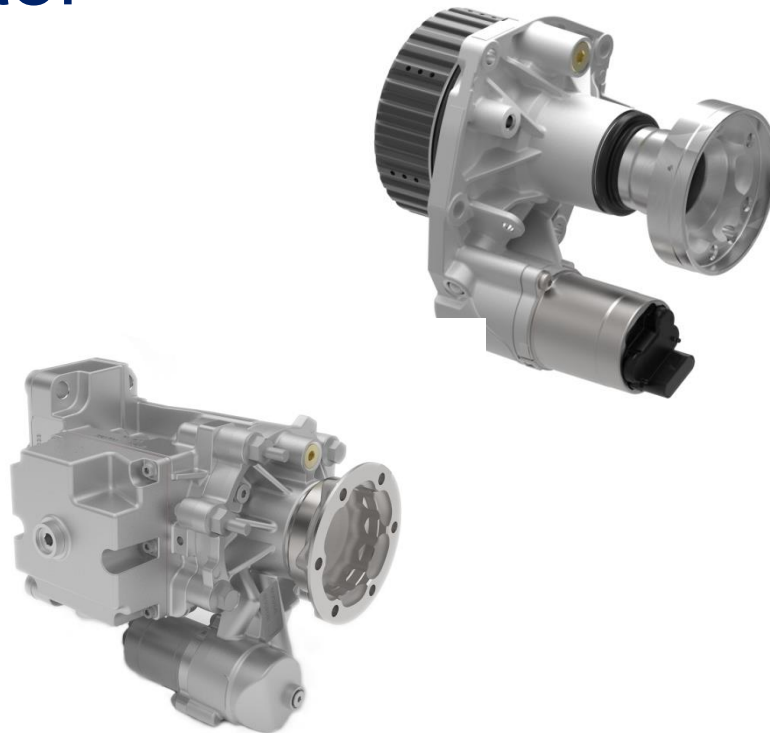
FWD eLSD



FWD-based
AWD with eLSD

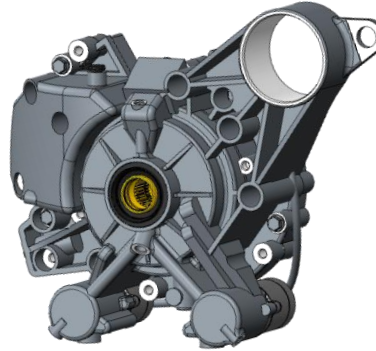
Standard GenVI Actuator

- 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!



Combustion



Hybrid



Electric