

# Modular transmissions

A new dedicated hybrid transmission family with modular flexibility can be implemented as a conventional AT, 48V or HEV/PHEV system

▶ The ongoing trend of reducing the fleet CO<sub>2</sub> emissions of passenger cars offers the opportunity for hybrid vehicles to become a considerable proportion of the overall vehicle market. Growth in mild and full hybrid powertrains can be expected until 2025 (see right), according to predictions.

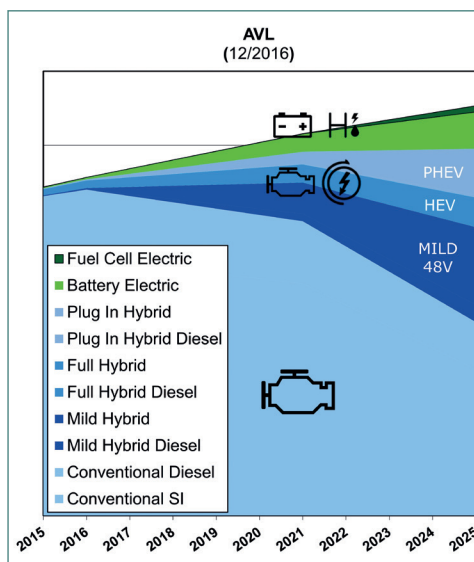
Such forecasts also raise challenging questions for developers of future transmissions. A wide variety of concepts already exist and this range will likely grow in the future. The results of this development are hard to predict. The risk of unnecessarily increased development and higher production costs must be considered, and given resources have to be managed intelligently.

Bearing this in mind, a holistic development approach must be taken to come up with dedicated hybrid transmission (DHT) or hybrid transmission concepts with intrinsic practical benefits.

AVL's new Future Hybrid X-Mode is a solution that can reduce certain risks. The DHT system is a result of the experience gained from

previous developments (Future Hybrid 7 Mode and 8 Mode), as well as efficient economics and an improved development process.

The AVL Future Hybrid X-Mode transmission is fully power shiftable and has state-of-the-art hybrid functionality such as boost, recuperation, ICE impulse start, and powerful EV driving and eCVT (torque-split) modes. The eCVT modes in an HEV, for example, allow sufficient launch and low-speed driving performance even when the vehicle's battery is depleted. Hybridization also offers the possibility of high performance – for example, providing highly dynamic acceleration by the ICE and electric motor. On the other hand, however, the technology can be extremely fuel efficient without compromising comfort, due to its hybrid and EV features. The AVL Future Hybrid X-Mode consists of one electric motor, directly assembled power electronics with a common interface, and a low number of transmission components and shift elements (four to five), which makes it simpler and smaller.



Left: Expected global passenger car production from 2016 by AVL

Below: AVL Future Hybrid X-Mode family layouts, left: HV, middle: 48V & HV+, right: AT

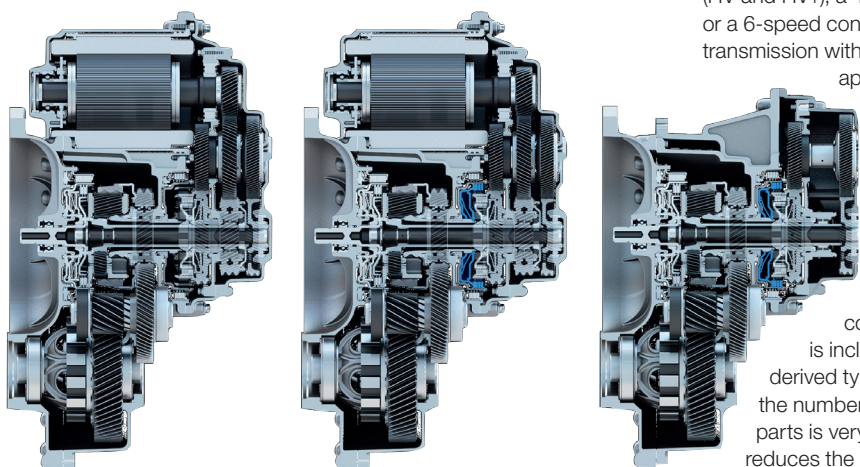
One important feature is the transmission's modularity. The concept revolves around a core transmission and interchangeable component modules. By combining different modules with the core, one can freely create different types of transmissions in terms of hybridization. It is possible to generate two HEV/PHEV systems (HV and HV+), a 48V system or a 6-speed conventional AT transmission with a spread of approximately 6.

The main characteristics and design of these transmissions can be seen on the left.

Since the core transmission is included in every derived type of transmission, the number of common parts is very high. This reduces the unit price at large-scale production levels.

In terms of production, these different types of transmissions can be manufactured on a single assembly line, if the corresponding modules are supplied by intelligent line logistics. The production becomes lean, which saves resources. The proportions of the different types of transmissions can be changed, so reactions to changing market demands can be made quickly.

Thanks to its modularity, AVL's Future Hybrid X-Mode is a transmission family with a widened range of application compared with standalone solutions. It is characterized by a minimalistic and compact design with uncompromised functionality and enhanced flexibility, in view of predicted market development and its challenges. ©



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