DHD Duo

The Scalable Dedicated Hybrid Drive

Magna DHD Duo
2025 Technical Paper

Overview

Magna's DHD Duo is a dedicated serial-parallel hybrid transmission with two e-motors providing uncompromising electric and hybrid operation efficiency. Its electric traction motor covers the entire vehicle speed range, offering the performance and comfort of an all-electric drive. The DHD Duo offers pure electric, serial, and parallel hybrid operation. The number of gears can be scaled from 1 to 4 for parallel operation.

The DHD Duo suits both full hybrid and plug-in hybrid applications. It is functionally scalable and can be adapted to a wide variety of B to E-segment vehicles, relying on a modular system of building blocks. This flexibility allows the DHD Duo to be tailored to various vehicle applications within the same vehicle platform.

Background: hybrid drives go electric

The latest registration figures have shown that the demand for full hybrid (HEV) and plug-in hybrid vehicles (PHEV) is rising in many markets. In North America and China, the regulations support this development.

In California's environmental regulations, BEVs, FCEVs, and PHEVs are ZEVs (Zero Emission Vehicles). As a part of California's Advanced Clean Cars program defined in 2022, taking effect from 2026 to 2035, PHEVs are officially a viable alternative to EVs. After 2035, PHEVs could still be regarded as ZEVs, even under stricter range and emissions requirements. So far, 17 other US states have adopted California's regulations.

In China, BEVs, FCEVs, and PHEVs are similarly considered NEVs (New Energy Vehicles) due to their capability of emission-free driving. China expects the combustion engine as part of a hybrid drive to be needed up to 2060. Two-E-machine designs have become common in China and apply to both HEVs and PHEVs.

In Europe, the combustion engine ban from 2035 has been decided but is currently being revisited. HEV registrations have recently been increasing more than those of BEVs. It remains to be seen if the 2026 review leads to modifications and approaches like those in China and North America. However, when looking at regions like India, South America, etc., it seems clear that advanced hybrid technology is essential in CO_2 reduction globally.

In this context, a paradigm shift is taking place, and hybrid vehicle technology is increasingly driven by BEV platform technology. That again speaks for "dedicated", e.g., serial-parallel hybrid architectures, which can share components like e-motors, inverters, battery modules, etc., and have smaller packaging requirements than traditional multi-speed hybrid drives.

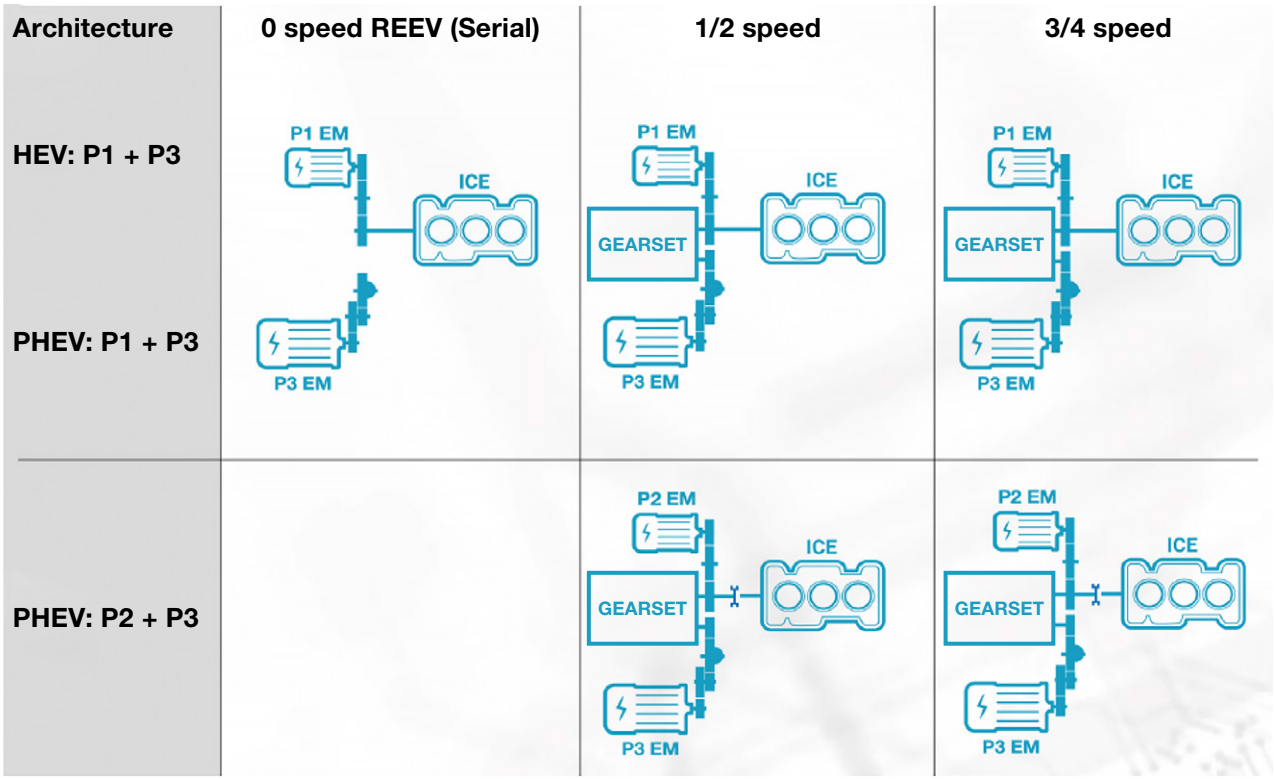
Versatility through scalability and modularity

The DHD Duo differs significantly from the competition in terms of hardware and software scalability. The standard architecture has a 90 kW P1 generator and a 140 kW P3 propulsion motor. In this P1/P3 configuration, the P3 motor defines the ‘always-available’ electric vehicle performance. In parallel mode, this can be combined with the ICE power output.

The DHD Duo can be fitted with 1 to 4 gears for parallel operation – without any transmission changes except the gearset. Another option is to omit the gearbox altogether, resulting in a serial-only hybrid drive. This variant primarily meets requirements for small cars that mostly drive in an urban environment. Another option is to use a 90-kW traction motor instead of the 140-kW version. Again, this primarily meets the requirements of small cars.

Adding a C0 clutch between the ICE and the transmission can change the P1/P3 to a P2/P3 configuration. The additional benefit is that the power of both e-motors can be combined for traction when driving purely electrically.

Summing up, the DHD Duo can be widely adapted to individual requirements. However, all variants rely on a standard building block kit. That includes the gear set, shift system, park lock, cooling, software, and dual inverters. The TCU is part of the dual inverter, and the modular hybrid manager software is scalable for different applications.



Typical DHD Duo operation modes

Except for the purely serial version, the DHD Duo offers three drive modes – purely electric, serial, and parallel. The vehicle launches electrically or in serial mode, depending on the SOC of the traction battery. Thanks to the 140-kW output of the P3 motor, the vehicle performs like an electric car, with comparable performance.

In practice, the control strategy software alternates between the three modes to achieve optimal efficiency and performance. The P3 motor is decoupled from the transmission and ICE in electric and serial modes, effectively driving like an EV. There are no mechanical losses in the upstream torque path. In parallel mode, too, losses are kept to a minimum due to high efficient gearset design and gearset elements.

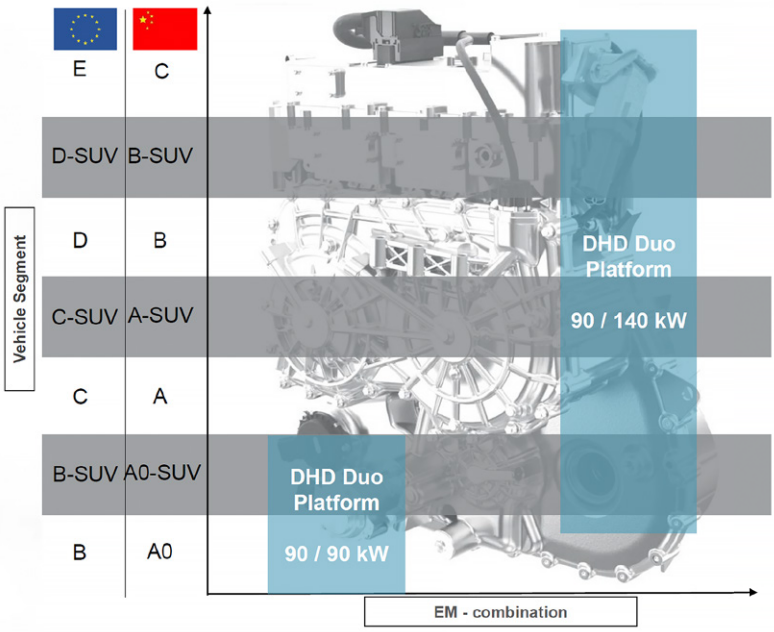
When driving, the serial operation can optimally use the engine sweet spot, provide charging current, or enable more acceleration in the parallel hybrid mode. The latter depends on the number of available gears. In other words, the number of gears affects the serial and parallel operation share.

Adding two, three, or four gears provides more ICE traction force, which benefits demanding traction or towing requirements. For example, just one gear for parallel operation may be adequate to optimize efficiency during highway driving for many applications. Otherwise, three or four gears may be a good choice for SUVs that are often used for towing in hybrid operation on longer journeys. The DHD Duo offers the utmost flexibility to tailor its layout to different use cases.

For parallel hybrid operation, there are two possible performance strategies. One is to always limit the system power to the power of the e-propulsion e-motor. The other option is to allow for combining the e-motor and ICE power for higher performance. The latter only applies to hybrid driving but may be an option when, for example, high towing capacity in hybrid operation is a requirement.

On the other hand, the P2/P3 design is a suitable measure to increase traction force in electric driving by combining the power of both e-motors. This increased performance may suit applications where electric tractive power is also the focus.

These examples show that the DHD Duo can help address almost any functional requirement in the B to E segment and scale efficiency and utility value in a wide range.



HEV and PHEV outlook

The prospects for hybrid passenger cars have improved since the beginning of 2024. This development may be partly a result of a slower-than-expected ramp-up of pure EVs. However, there are markets where HEVs and PHEVs are explicitly regarded to help reduce CO_2 emissions. Including North America and China, these markets account for a considerable share of vehicle sales worldwide. Beyond that, many countries will not be able or willing to adopt pure EVs large-scale due to the missing energy infrastructure in the foreseeable future.

Nevertheless, future-oriented hybridization requires concepts that are compatible with mainly electrified vehicle platforms and allow for sharing as many components and technology as possible.
Hybrid drives must be flexible regarding efficiency, electric range, performance, and towing capacity. Other than EVs, the ICE is part of the equation. The DHD Duo offers maximum flexibility by combining a strictly dedicated and electrification-oriented approach with the capabilities of multi-speed hybrid drives, where required.

Thus, it can grow with stricter regulation requirements in crucial markets, including increasing electric range, more demanding utility factors, or further tightened tailpipe emission requirements for HEVs and PHEVs.

Interview with Marc Gukelberger

Marc Gukelberger,
Sr. Manager, Product Management – Transmissions
Magna Powertrain, Untergruppenbach, Germany

WHAT ARE THE OEMS' MAIN REQUIREMENTS REGARDING HYBRID TRANSMISSIONS, ESPECIALLY THE 2-EM DESIGNS?

I think there are two main requirements, one of which is efficiency. Secondly, OEMs are looking for drive solutions that are readily developed, in series production, and can be integrated instantly without much development expense. That means they only have application costs, primarily through software development for the operation strategy. In this context, the DHD Duo has an advantage over conventional solutions, as the electric traction motor dominates the operation, and the combustion engine functionality is relatively simple to integrate into the operation strategy.

WHICH EXPERIENCE HAVE YOU GAINED WITH THE DHD DUO IN PRACTICAL VEHICLE USE, AND WHAT DO DRIVERS THINK ABOUT IT?

One impression that everyone has is the driving experience that comes very close to a purely electric vehicle. The DHD Duo enables a high share of electric driving in operation, and serial driving delivers precisely the same experience without gear shifts. And when gear shifts at higher speeds occur in parallel mode, the traction motor conceals them through its torque. So, the driving comfort is rated highly by its drivers. Another feature that is often rated favorably is the flexibility. You can scale the DHD Duo to different vehicle applications by varying the number of gears or implementing a P2/P3 design instead of the P1/P3 layout. But this e-vehicle feel is there in any case.

MAGNA

Forward. For all.

Magna Powertrain | Marc Gukelberger, Sr. Manager, Product Management – Transmissions
Magna Powertrain, Untergruppenbach, Germany

Transforming mobility. Making automotive technology that is smarter, cleaner, safer and lighter. That's what we're passionate about at Magna Powertrain, and we do it by creating world-class powertrain systems. We are a premier supplier for the global automotive industry with full capabilities in design, development, testing and manufacturing of complex powertrain systems. Our name stands for quality, environmental consciousness, and safety. Innovation is what drives us and we drive innovation. Dream big and create the future of mobility at Magna Powertrain.