



Traction, comfort and safety: Mercedes-Benz SUVs and off-road models



Mercedes-Benz has a leading position in the SUV segment. No premium manufacturer offers a comparable choice of off-road-capable vehicles: from the new GLK-Class compact SUV via the the luxury M and GL-Class off-roaders up to the G-Class - the unique combination of luxury and rustic off-road vehicle. Permanent all-wheel drive and converter automatics - the ideal combination for driving dynamics and assertiveness - are standard in all Mercedes-Benz off-roaders. Comfort, dynamics and good off-road capability are however not the only strengths of the Mercedes-Benz all-wheel drives. Customers who need vehicles with powerful traction appreciate the combination of superior traction and uncompromising safety.

ADVANTAGEScompact presents the three different all-wheel drive systems from Mercedes-Benz and takes a look at the key competitors. Mercedes-Benz sets standards in the compact SUV class with its new GLK-Class, not least due to its own, independent all-wheel drive in this segment.

The GLK-Class - new standards in the compact SUV segment

Compared with all the competitors, the GLK-Class sets standards in driving dynamics, ride comfort and off-roadcapability thanks to 4MATIC, a purely Mercedes-Benz development. The lengthways installation of engine and gearbox and other innovative design details provide advantages over the compact SUVs from the competition:



The GLK-Class offers an impressive overall package of design, agility and comfort. The 4MATIC has a decisive share in this

- > Permanent all-wheel drive - always active and without the reaction time of systems that have to be engaged.
- > Asymmetric torque distribution of 45% front/55% rear supports agility, stability and longitudinal traction at all times.
- > Twin-disc clutch with 50 Nm locking torque between front and rear axles improves the traction on and off the road.
- > The driving behaviour is always very predictable.
- > Distributor gearing, epicyclic differential and multi-disc clutch are integrated into the gearbox: no sacrifices in foot space of the front passenger.
- > The only vehicle in the segment with 7-speed converter automatic (7G-TRONIC) and all-wheel drive.
- > Converter automatic as standard: up to 3-fold increase in torque brings benefits when pulling away with a trailer and when off-road. Clutch wear or damage as in manual gearboxes is not possible.
- > Low consumption due especially to high efficiency and low weight of the drive train.

Audi Q5: the only competitor to the GLK with permanent all-wheel drive

The only compact SUV with permanent all-wheel drive is the Audi Q5 that is available in Germany



A Torsen differential distributes the torque between the front and rear in the new Audi Q5

from November 2008. Like the GLK-Class, it also has the lengthways built-in drive unit and asymmetric torque distribution (here: 40% front/60% rear). The drive is already well known from the Audi A4. The difference to the 4MATIC is however the torque distribution using a self-regulating Torsen differential:

- > Torque distributions of 15% front/85% rear and 65% front/35% rear are possible.
- > The torque distribution without including driving dynamic parameters can lead to unharmonious over/understeer.

BMW X3: an all-wheel drive for high agility.

The BMW X3 certainly also has a lengthways built-in drive train, but does without a permanent all-wheel drive: the drive to the front wheels is only engaged via an electrically actuated multi-disc clutch with a continuous adjustment from 0% front/100% rear to 50% front/50% rear as required. The developers had the high driving dynamics especially in mind. This is matched by the very stiff springing that already limits the traction over light terrain and so necessitates braking action from the all-wheel drive system.



In the BMW X3, the drive is subordinate to the driving dynamics

- > The xDrive can certainly simulate a central differential lock for a short period of time but a mid-differential brake is lacking.
- > The transition from rear to all-wheel drive causes unaccustomed under/oversteer. When manoeuvring, the X3 only uses rear-wheel drive in order to avoid stressing the transmission.
- > The friction clutch is subject to a certain wear due to its design - in contrast to the differential in the GLK-Class.

Haldex everywhere: Land Rover Freelander, Volvo XC60 and VW Tiguan

Land Rover Freelander, Volvo XC60 and Volkswagen Tiguan require an (uneconomical) torque redirection to the rear axle because of their transversely installed engines. This is why they nearly always drive using the front wheels. An active, electronically controlled multi-disc clutch from the Swedish supplier, Haldex, connects the rear axle to the front drive train only if required. *"Fast computers, such as those in the Tiguan, can certainly simulate a ... four-wheel drive, but cannot react quickly enough when under pressure"* (Off Road/D, 02/08).



The system from the Swedish supplier, Haldex, is making advances: Land Rover Freelander

- > Only 10% of the torque gets to the rear. The multi-disc clutch responds to slip on the front axle and then involves the rear axle up to 50% in the propulsion. When manoeuvring, only the front wheels are driven in order to avoid stressing the transmission.
- > As the Haldex clutch normally distributes 90% of the torque to the front, the typical disadvantages of front-wheel drive are retained: steering effects and the tendency to understeer.



... Volvo XC60 share the same all-wheel drive technology with the Haldex clutch ...



... while VW uses a similar system - also with clutch supplied by Haldex

The G-Class: permanent all-wheel drive, three locks plus 4ETS

The G-Class is rightly called an off-road legend. Other than in the few other off-roaders that today still have a ladder frame chassis and two rigid axles, the G-Class has been fitted with a perfect all-wheel drive system supplemented by electronic control systems that make driving even easier to operate and more comfortable: Today the G-Class is worldwide the only off-road vehicle with three genuine differential locks, a transfer box that can be engaged at up to 40 km/h and an additional traction system (4ETS). There is also ESP and BAS.



The G-Class is a classical off-roader and is the only vehicle to provide three locks

- > Converter automatic as standard: up to 3-fold increase in torque brings benefits when pulling a trailer and when off-road. Clutch wear or damage as in manual gearboxes is not possible.
- > Permanent all-wheel drive with variable torque distribution 50% front/50% rear.
- > 4ETS transfers the torque to the wheels that have traction: perfect for easier off-road areas.
- > The driver can manually lock all three differentials in succession for extreme stretches. The efficiency is unsurpassed, especially with experienced drivers.
"The three differential locks had the power to master all the unmetalled roads in the world" (Automobil Revue/A, 10/07)

Comfortable, safe - and very off-road capable: M and GL-Classes

Other than most of the competitors in the segment, the M and GL-Classes provide a high degree of comfort and safety on the road and are also very capable off-road. This is thanks to their converter automatics that, with up to three times the torque, provide benefits in trailer and off-road operation and to the permanent all-wheel drive (torque distribution of 50% front/50% rear). Also making a contribution are the Offroad Pro Technology package "OPTP" with reduction box (2.93:1, can be engaged at up to 40 km/h), AIRMATIC and differential brakes with mid and rear lock functions. As with the G-Class, 4ETS



M and GL-Classes are the off-road benchmarks in their respective segments

initially increases the torque to those wheels with good surface adhesion. For higher loads, the automatic differential brakes take effect and these increase the drive efficiency. Further benefits of automatic differential brakes:

- > Can be engaged at any time when under way and in bends.
- > Immediate response - lock immediately.
- > Prevent damage to drive train and lock.
- > Self-releasing when not used, so averting accident risk on the road.

Audi Q7: the focus is on agility

The drive train of the Q7 is characterised by permanent all-wheel drive, 40% front/60% rear torque distribution designed for driving dynamics, and self-locking Torsen central differential. Reduction box and differential locks are however not available. The only traction aid available is brake intervention. The all-wheel system designed in this way certainly increases the agility of the Q7 but hardly its off-road-capability:



The Q7 is a large estate that merely flirts with the subject of "off-road"

- > With no reduction available, the drive is quickly over-taxed off road by the great weight of the Q7.
- > Braking action as the only locking substitute is not sufficient in view of the low suspension mobility.
- > With no transfer case, the increase in torque is missing that is so important off-road or when towing and also the ability to drive slowly off road, so lessening damage to material.

BMW X5 xDrive: all-wheel drive only when required

The X5 provides rear-wheel drive with all-wheel drive controlled via an electrically actuated multi-disc clutch that can be continuously adjusted from 0% front/100% rear to 50% front/50% rear as required. This system, which has been designed for driving dynamics, offers neither off-road reduction nor differential locks and a traction control only by means of brake intervention. In principle it is the same as in the smaller BMW X3, but in a heavier vehicle with greater trailer load. The hard springing also means that the traction is lost much earlier. The all-wheel drive is then over-taxed even with the typical SUV requirements.



Driving dynamics rather than the art of climbing: a typical BMW

- > The xDrive can simulate a central differential lock for a short period of time but there are no axle differential locks or brakes.
- > With no transfer case, the increase in torque so important off-road or when towing and the ability to drive slowly off road so lessening damage to material, has to be dispensed with.

"It makes no sense to leave the asphalt road as the orientation is consistently towards on-road driving" (Off Road/D, No. 03/07).

Land Rover Range Rover: all-wheel drive with programme preselection

The distinguished Briton provides permanent all-wheel drive, an electronically controlled multi-disc brake with lock function in the central differential and an off-road reduction gear of 2.93:1 (the distributor gearbox from Magna Steyr Powertrain is the same as that in the M and GL-Classes). A traction control is standard, an automatic multi-disc brake with lock function is available for the rear differential as an optional extra.



The Range Rover is very capable off road, but with reductions in agility

- > "Terrain Response" (TRS), an automatic control of the all-wheel drive system for different surfaces, sets braking action and locks and controls the shift speeds.
- > An off-road reduction of 2.93:1 gives very good crawling speed qualities and high torque at the drive wheels.
- > The Range Rover is certainly on a par with the M and GL-Classes off-road, but offers little agility on-road.

Porsche Cayenne: flexible with off-road technology

The Porsche Cayenne is fitted with permanent all-wheel drive and off-road reduction. The torque distribution with 38% front /62% rear is designed for driving dynamics. There is in addition an automatic multi-disc lock in the central differential. The reduction is rather short at 2.7:1 and can be engaged at up to 15 km/h. An Off-road package (optional extra) includes a multi-disc lock at the rear and decouplable stabilisers. The latter increase the axle mobility by 60 mm and so improve the traction. The sports-positioned Cayenne GTS launched at the beginning of 2008 only exploits the advantage of all-wheel drive and dispenses with all off-road features.



Technically related to the VW Touareg, the Cayenne places the emphasis on driving dynamics

- > The Porsche Cayenne needs the complete, complicated off-road technology (optional extra) to compensate for the traction drawbacks caused by the driving dynamically-stiff suspension design.
- > Transfer case and off-road package manage to walk the interesting tightrope between agility and climbing ability - but only after changing the tyres.

Toyota Land Cruiser: new edition with two Torsen differentials

The Land Cruiser series, that has been running since 1951, has permanent all-wheel drive in its latest generation - also a manually lockable Torsen limited-slip differential (LSD) with a drive torque distribution ranging from 40% front/60% rear to 30% front/70% rear. It also has an off-road reduction (2.618:1). There is a second Torsen differential in the rear axle. The terrain-dependent speed control system ("Crawl Control") is only available in the petrol-engined version.



Toyota completely backs Torsen differentials; the Land Cruiser even has two

- > The Land Cruiser has high axle mobility and good traction thanks to the rigid rear axle.
- > The good articulation has been further improved by an active control of stabilisers and springs (optional extra).
- > The use of traction aids and locks is only necessary relatively late.
- > The rear differential only reacts automatically and cannot be manually locked.

Volkswagen Touareg: a well-balanced compromise

Volkswagen has also decided on permanent all-wheel drive; the standard torque distribution here is 50% front/50% rear. An automatic multi-disc brake with lock function in the central differential and an off-road reduction of 2.7:1 are standard. This can, however, only be engaged at up to 15 km/h. There is an option of an automatic rear multi-disc brake with locking function. The decouplable stabilisers also cost extra. They increase axle mobility and thus improve the traction.



The VW Touareg provides comfort but is somewhat less off-road capable than the M-Class

- > The comfortable Volkswagens achieve usable performance with the off-road options. They get close to the M and GL-Classes without actually reaching that level.
- > As a comparison, three off-road figures in VW vs. Mercedes-Benz:

| | |
|-----------------------------|------------------|
| Reduction: | 2.7:1 vs. 2,93:1 |
| Reduction engageable up to: | 15 vs. 40 km/h |
| Wading depth: | 580 vs. 600 mm |

"the Touareg has no chance against the successful Mercedes ML all-wheel drive" (Auto Bild/D, No. 06/07).

Conclusions: Mercedes-Benz SUVs and off-roaders offer unique advantages

Mercedes-Benz demonstrates the highest degree of consistency with its all-wheel drive designs in the area of SUVs and off-roaders and fits permanent all-wheel drive to the entire range. This type of drive offers undoubtedly the greatest benefit to the customer both on-road and in difficult terrain. Not even Land Rover, the declared off-road specialist, offers its customers so much competence today.



The Mercedes-Benz SUV range provides the right vehicle for every use

But it is not only the all-wheel drive that counts. The Mercedes-Benz SUVs and off-roaders, as in the entire Mercedes-Benz range, impress with their innovative details, high quality, comprehensive safety and exclusive equipment.

Mercedes-Benz stands out with the best long-term prospects in this above-average growth market of off-road capable, all-wheel drive vehicles.