



## The secrets of Alfa Romeo driving dynamics

- **The secrets of the famous Alfa Romeo driving dynamics are revealed for the first time in an original event that combines technical workshops and specific driving sessions at the Balocco Proving Ground.**
- **A journey of discovery into the most innovative, exclusive technological solutions, that make the driving experience on board the new Alfa Romeo generation even more thrilling.**
- **Focus on the all-wheel drive with Q4 technology, designed for real-time management of the vehicle's grip on the road, and the Integrated Brake System, which significantly reduces the braking distance on any surface.**
- **We also touch on the Torque Vectoring, for unbeatable traction control, and the exclusive architecture of the AlfaLink™ suspensions, for superlative handling, supported by flawless weight distribution and an excellent weight/power ratio.**

For the first time Alfa Romeo reveals the secrets of its renowned driving dynamic in four in-depth technical workshops and track sessions that have been purposefully studied to test Alfa Romeo's technological solutions. The unconventional tests were run at the FCA Group Experimental Centre at Balocco, where engineering and technology put the most innovative technological solutions to the test, making driving the Giulia sports sedan and the Stelvio premium SUV still more of an exhilarating experience, even in the most powerful Quadrifoglio versions.

Significantly, Giulia Quadrifoglio and Stelvio Quadrifoglio, at the cutting edge of Alfa Romeo design, were the first to feature these sophisticated systems, subsequently extended to the entire range. This "top-down" approach, unique in the automotive industry, is at the core of the Alfa Romeo spirit: a globally unique formula, which combines the right balance of Italian design, state-of-the-art engines, flawless weight distribution, unique technical solutions and an excellent weight/power ratio in every one of its mechanical creations.

Getting into Giulia or Stelvio means entering a new dimension, where the fulcrum of these mechanical masterpieces is the driver, with his emotions and his desire for a thrilling driving experience. A principle reflected in the precision steering, the responsive throttle and the immediate reactions of the transmission and brakes. Not to mention the choice between rear-wheel or all-wheel drive, which is more than merely a tribute to the most authentic roots of the Alfa Romeo legend: it is also a technical solution which secures high performance and astounding fun. This makes the breath-taking driving experience ensured at the wheel of an Alfa Romeo a pleasant surprise to even the most highly skilled, demanding driver.



The workshops and driving sessions to unveil Alfa Romeo's renowned driving dynamic have been organised into four workshops discussing in depth, for example, the degree of innovation of the all-wheel drive with Q4 technology, designed to control of the vehicle's traction reactively and predictively, to deliver the very highest levels of performance, efficiency and safety. To put it in a nutshell, the Alfa Romeo Q4 system provides all the advantages of all-wheel drive, plus good fuel economy, responsive performance and all the driving pleasure of a rear-wheel drive car. The Q4 all wheel drive versions can also be integrated with a Q2 mechanical self-locking rear differential, available on request also on versions with only rear wheel drive. The self-locking rear differential accentuates the agility and sporty nature, ensuring perfect traction for an unforgettable driving experience.

The event will also focus on another Alfa Romeo brand exclusive system: the Integrated Brake System (IBS), the electromechanical system that combines stability control with a traditional servo brake to deliver instantaneous brake response and hence shorten stopping distances, while also making a significant contribution to weight optimisation. The braking system is also available with carboceramic disks on Quadrifoglio versions.

There has also been an interest in the Alfa™ Active Torque Vectoring, a state-of-the-art technological feature designed to achieve the best performance of a sports car. In detail, the two clutches in the rear differential make it possible to control torque delivery to each wheel separately. So power is transferred to the ground more effectively, even when the car is driven to its dynamic limits. This makes the car safe and fun to drive at all times, without ever needing the stability control system intervening intrusively. Alfa™ Active Torque Vectoring, like all the other active control systems, is overseen by the Chassis Domain Control: a unique central vehicle "intelligence" that Alfa Romeo created with its own algorithms to handle harmoniously and in real time all the electronic devices that intervene on the car's behaviour, making driving extremely natural, instinctive and safe.

Lastly, the four workshops shed light on the sophisticated suspension systems, the most evolved in the segment, equipped with *exclusive Alfa™ Link*; a double wishbone suspension with a semi-virtual steering axis (an Alfa Romeo exclusive) was selected for the front, optimising the filtering effect and lets you steer quickly and precisely. On the rear, a multilink solution was opted for, with four and a half arms - an Alfa Romeo patent - that ensure enhanced handling combined with excellent comfort. The suspension scheme enables the system to be very rigid when cornering and at the same time very flexible in the longitudinal direction. Furthermore, on request, available are the active suspensions, *Alfa™ Active Suspension*, with an electronically controlled damping system, which adapts to driving conditions instant by instant, enabling the driver to opt for more performance-biased or comfort-oriented handling. Another factor in superlative driving pleasure is the flawless weight distribution between the two axles and an excellent weight/power ratio, achieved through the use of ultra-lightweight materials such as carbon fibre for the driveshaft throughout the range.



## **Alfa™ Link patented suspension and vehicle dynamic**

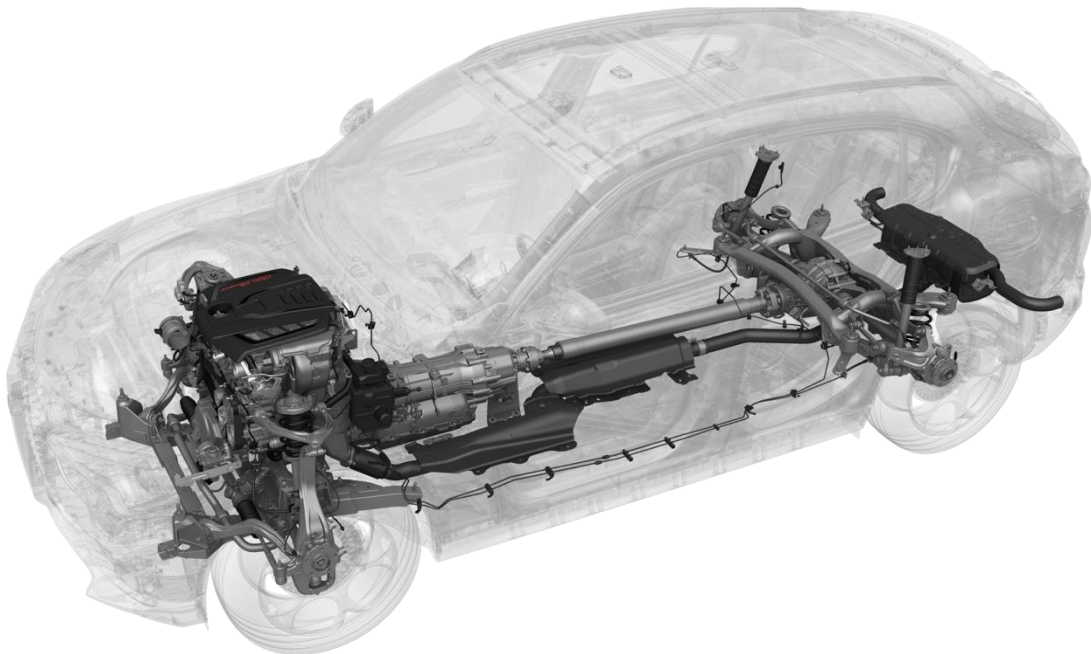
Driving an Alfa Romeo is an unmistakable, unforgettable sensation. This thanks to a unique suspension scheme.

On the front, a double wishbone suspension with a semi-virtual steering axis lets the driver steer quickly and precisely, thanks to a perfect tyre grip on the track and a strong sensation of control.

On the rear, Giulia and Stelvio are equipped with the new Alfa™ link, an Aluminium multilink scheme.

When designing vehicle suspension, the main required features involve safety, comfort and optimising the NVH (noise, vibrations and harshness) performances. For an Alfa Romeo, however, this is not enough: the driver needs to feel a thrill, and he can thanks to searching for an exclusive steering feeling, to high definition and to performance without compromise.

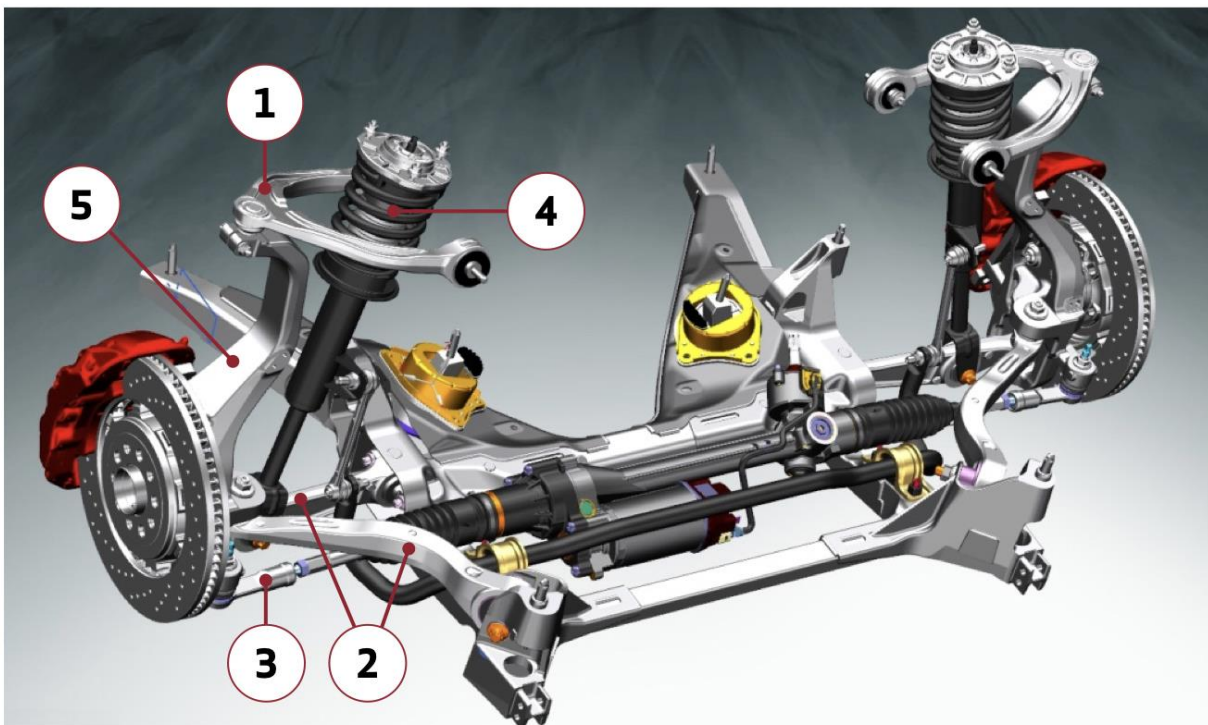
This is why the Alfa Romeo team has been working on the entire Giulia and Stelvio range, starting with the Quadrifoglio versions. This also lets the less powerful engine versions benefit from the more extreme models.



### Front suspension – Alfa Romeo patented structures and solutions

The aims that have guided the suspension design phases have maximised handling and comfort performance, creating an unmistakable, unforgettable steering feeling, preventing steering wheel reactions caused by the engine torque on the Q4 versions. Achieving these objectives meant selecting a double wishbone suspension with a semi-virtual steering axis instead of a McPherson; in fact this archetype ensures more suspension angle controllability, which is needed to better take advantage of the tyre characteristics and thus ensure maximum road grip. The Alfa Romeo Giulia and Stelvio double wishbone suspension with a semi-virtual steering axis consists of:

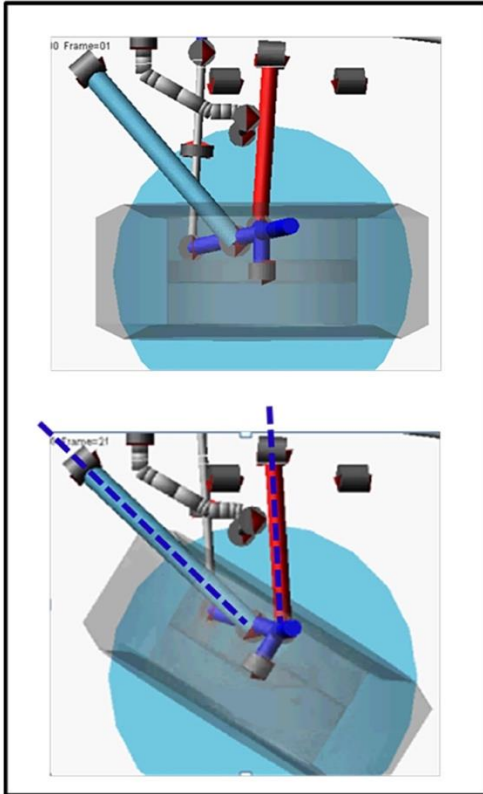
1. An upper control arm;
2. Two decoupled lower links (handling and comfort link);
3. A tie-rod steering arm;
4. A co-axial spring and shock absorber group;
5. A hollow aluminium knuckle.



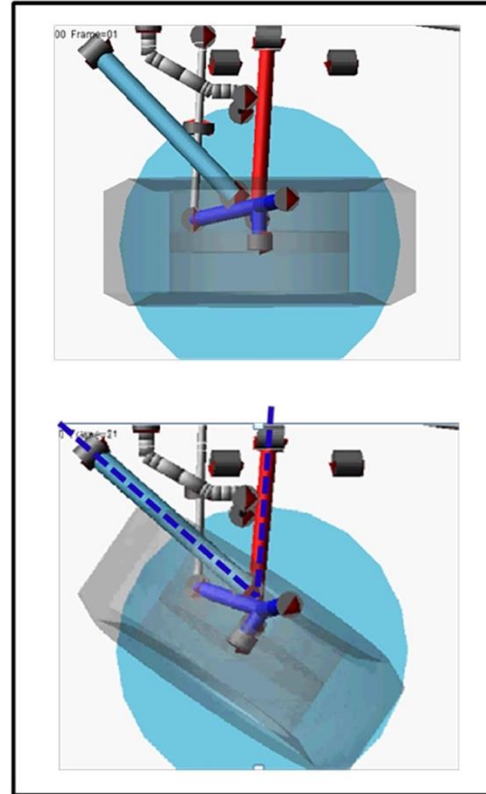
The unique feature of the front suspension is in the fact that there are two separate lower levers, hinged to the strut differently: this double lower link (Alfa Romeo patent) performs a “scissors” movement that keeps the linear steering feeling in all conditions. Results like these simply cannot be achieved with a conventional suspension with a single lower link



STANDARD SOLUTION

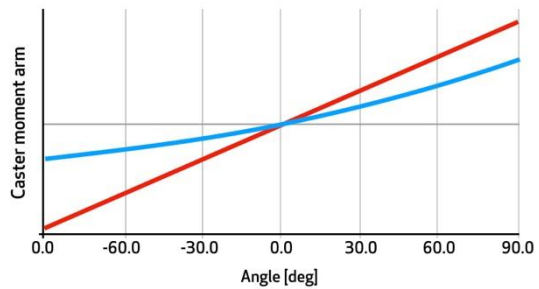
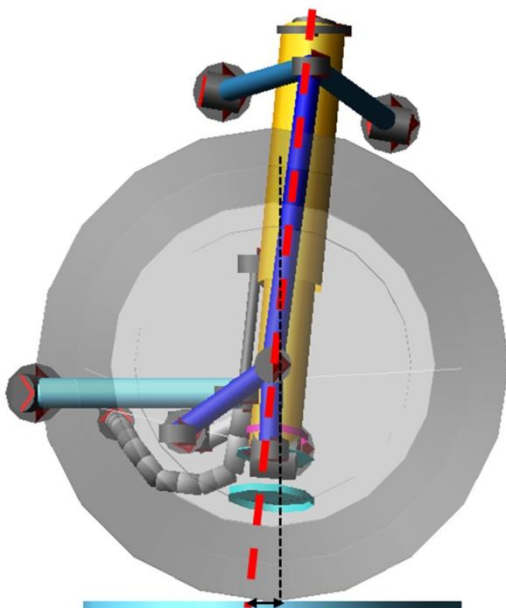


PATENTED SOLUTION



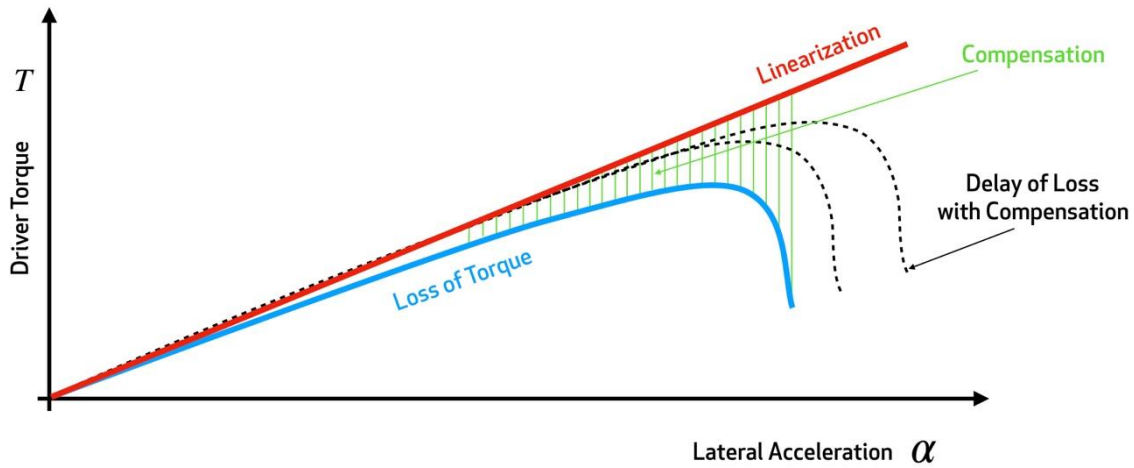
ALFA™ LINK PATENTED FRONT SUSPENSION

This solution ensures full control of the longitudinal arm on the ground depending on the suspension direction, it optimises the steering speed and precision in all types of conditions, it guarantees the typical Alfa Romeo central driving feeling, and ensures a linearity of response to the upper limits that can be used in total safety. A high definition steering feeling that has no equal.

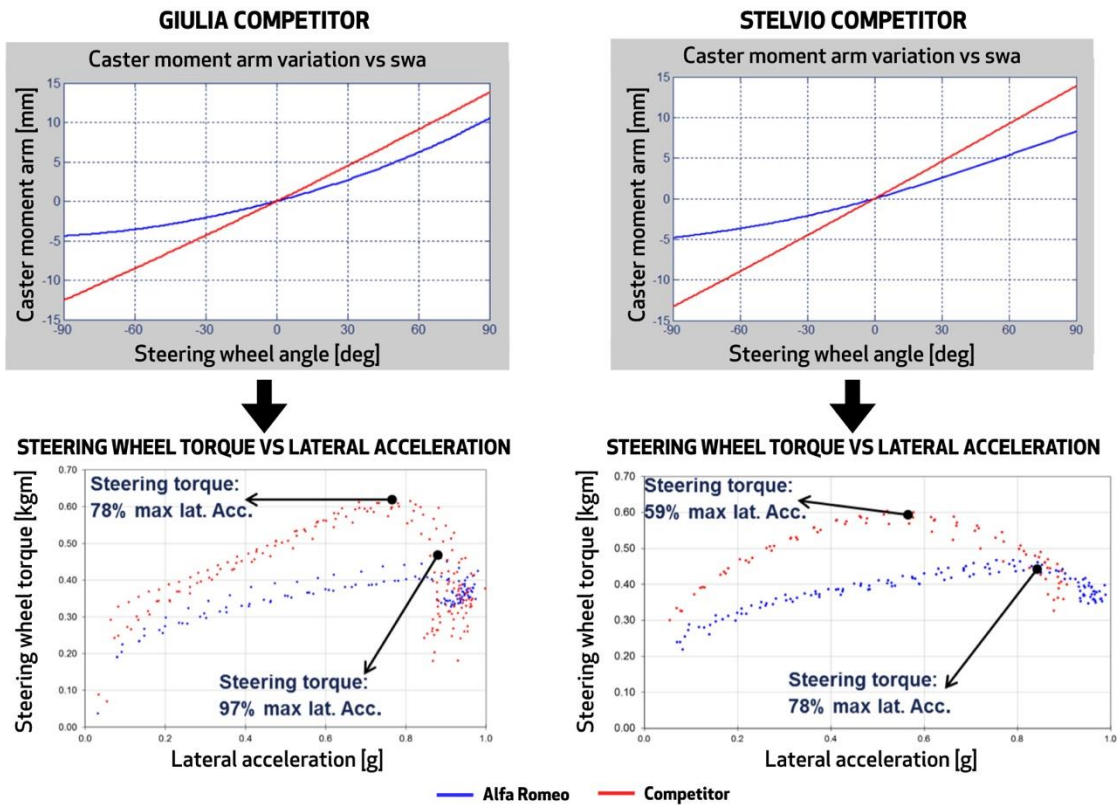


— Patented Solution  
— Standard Solution

The electric power steering with the motor fitted on the rack, together with an extremely direct steering ratio (12:1), has been designed to work in harmony with the suspension characteristics and guarantee the torque linearity to the steering wheel in the entire lateral acceleration range.

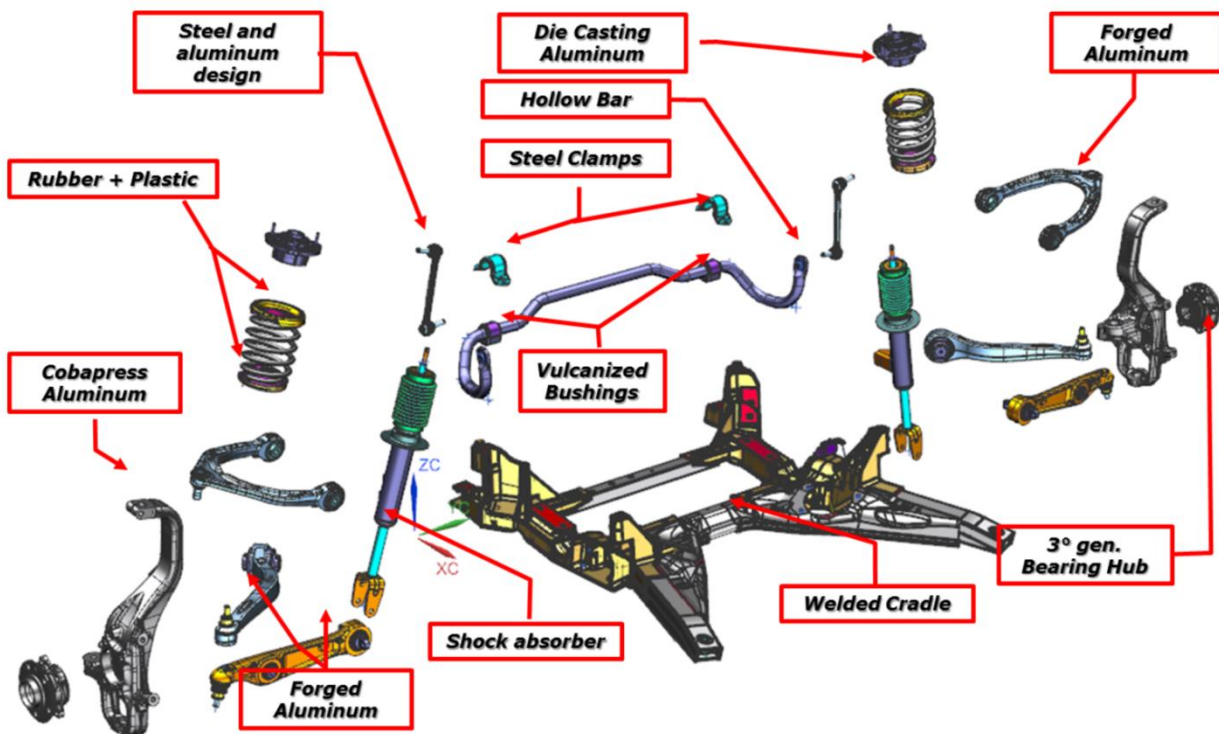


STEERING WHEEL TORQUE – ALFA ROMEO VS COMPETITORS



CASTER MOMENT ARM AND STEERING WHEEL TORQUE –ALFA ROMEO VS COMPETITORS

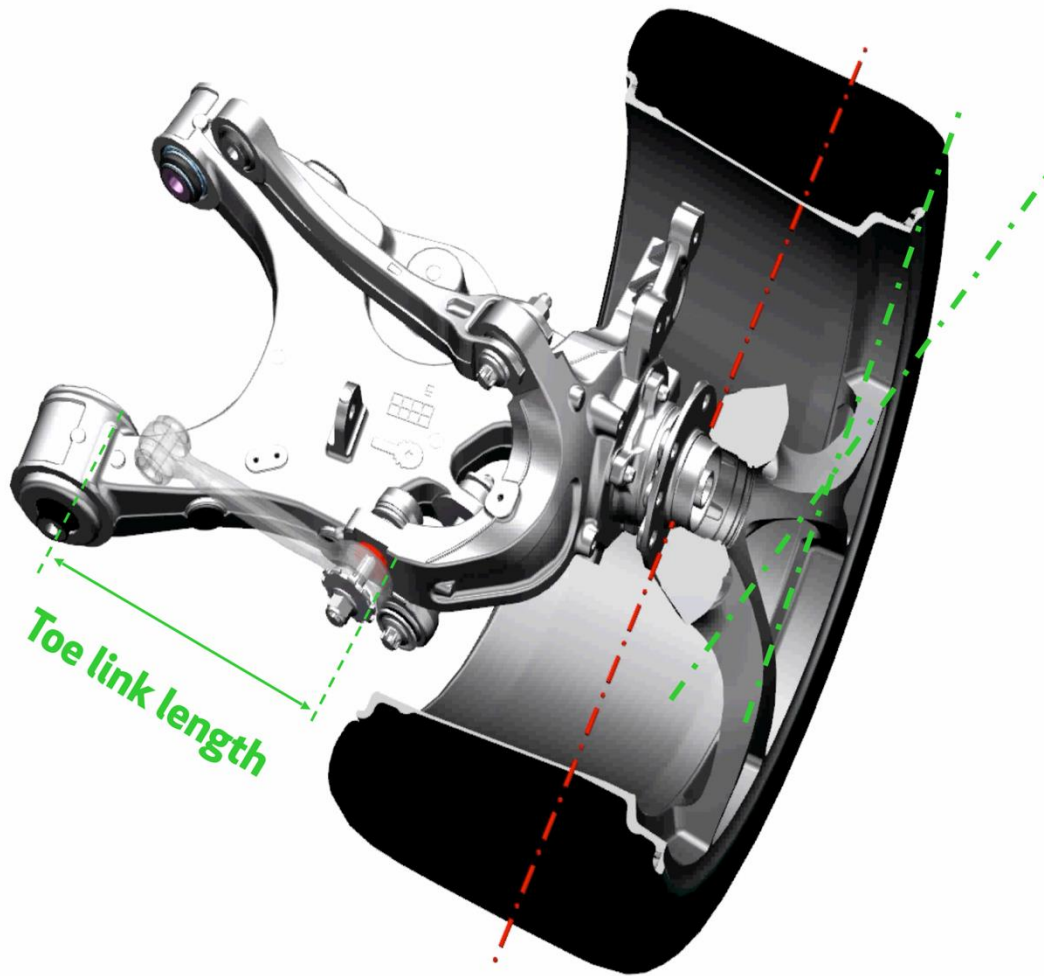
Compared to our competitors, the adoption of a high wishbone suspension instead of McPherson allows us to achieve higher performance in terms of handling and ride comfort, but at the same time this choice involves higher costs and more suspension parts. In order to decrease weight all components are made in aluminium. On some components the manufacturing technology has evolved into hollow or forged aluminium.



### Rear suspension

A multi-link solution with four and a half links was chosen for the rear axle. This patented Alfa Romeo scheme called "Alfa™ Link" ensures extremely precise control of the characteristic wheel angles, that translates into a road behaviour at the top of its category. Excellent handling combined with outstanding comfort. The suspension scheme enables the system to be very rigid on corners and at the same time to be very flexible in the longitudinal direction. The filtering of uneven roads is very good, also courtesy of the use of elastic connections with hydraulic damping.

The toe adjustment can be done using a patented device which allows the hardpoints of the suspension to remain unchanged even when changing the toe and camber is necessary. This solution does not change the elasto-kinematic behaviour of the suspension even if it is necessary to adjust the static angles: the same thing does not happen using the conventional solutions found in other cars.

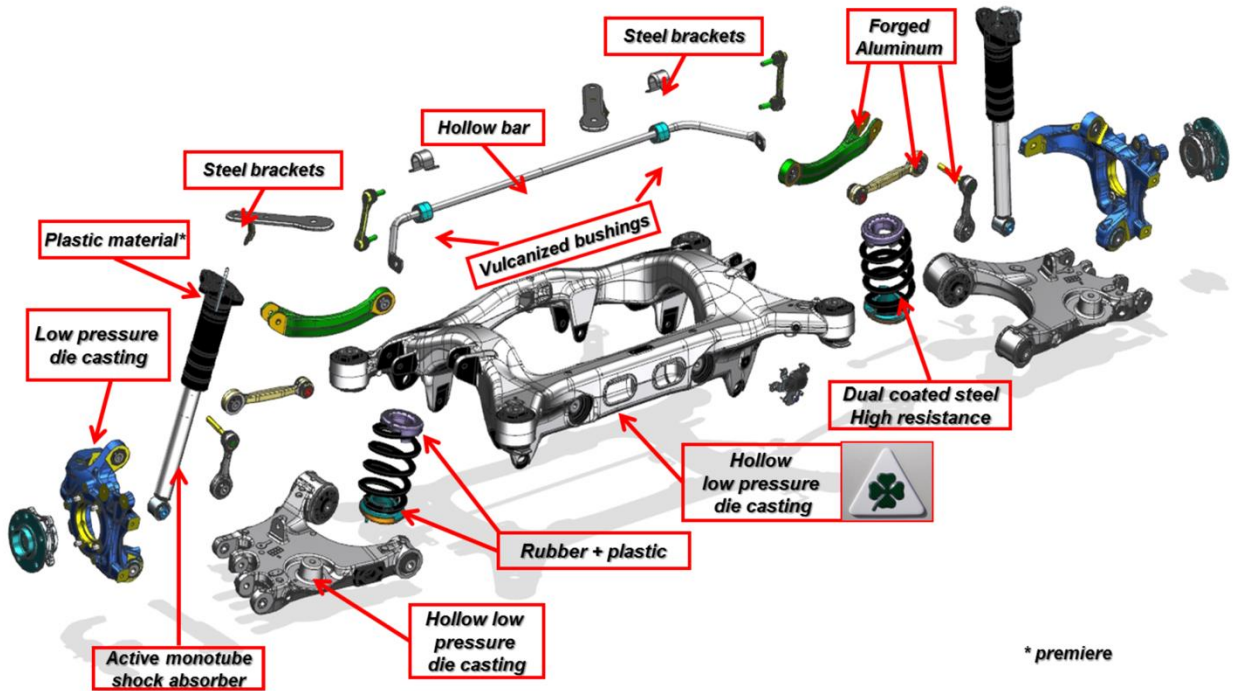


#### TOE ADJUSTMENT

The longitudinal dimension of the suspension is the most compact of the segment. This feature allows an increase in the space available for the rear seats, without increasing the size of the car and keeping a wheelbase aligned to the size of the segment.

The suspension components are made using high-strength materials. 45% of the components are made of aluminium to reduce the weight of the wheel assembly and thereby optimise comfort. The lateral stiffness of the suspension is at the maximum value of the segment.





## **All-wheel drive with Q4 technology**

A mountain hairpin, a gravel road, a snowy surface, cornering on wet tarmac: enjoy effective driving and exploit the unique agility and power of the new Alfa Romeo range with full confidence thanks to Q4 proactive All Wheel Drive system.

Q4 ensures all the advantages of all wheel drive and, at the same time, without compromising the driving fun of a rear wheel driven vehicle and its unique thrills and superior driving dynamic.

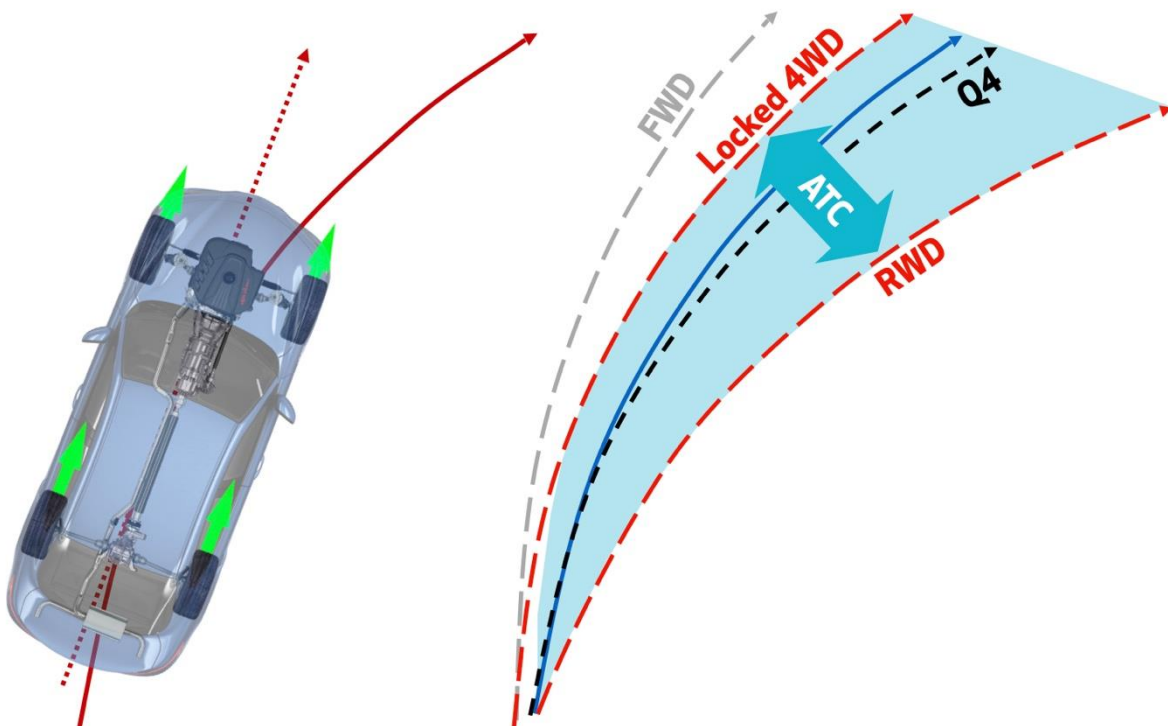
At the heart of the Q4 system is the Active Transfer Case (ATC) which monitors grip conditions and driver inputs in real time to ensure the best performance and, whenever needed, can transfer up to 50% of the engine torque to the front wheels via an extremely compact, lightweight front differential.

Combine maximum safety with maximum performance in every driving situation, from racetrack to snowy roads: these ambitious goal inspired the development of an proactive on demand all wheel drive system designed to challenging specifications, and whose control strategies, internally implemented by the Alfa Romeo team, enhance the vehicle's sporty attitude and driving pleasure.

Mainstream solutions in the segment are mainly based on permanent AWD systems, with low dynamic, that are biased to a fixed torque distribution value (e.g. 70% Rear - 30% Front in normal conditions) and, once one of the axles starts slipping, the speed difference between the axles leads to a different torque distribution value between front and rear axles (e.g. 50% Rear - 50% Front) purely achieved by mechanical means.

Alfa Romeo's Q4 system instead allows the vehicle to travel as a pure rear wheel drive and, if tyre grip is approaching its traction limit, or in case of high dynamic manoeuvres, it can instantly deliver up to 50% of the engine torque to the front thus preventing wheel slip and ensuring maximum vehicle performance and driving effectiveness.

Torque distribution is then constantly modulated with high dynamic and extreme precision according to the effective traction conditions and driver commands: this translates into best in class vehicle control in terms of traction and directional stability when cornering.



*TORQUE VECTORING OPTIMISED CORNERING*

Q4 system ensures that traction is used to max out the performance in any condition, increasing vehicle handling, and, if needed in extreme conditions, stabilising it before the intervention of the brake electronic stability control without impairing performance.

Between the "On Demand" all wheel drive systems, Q4 represents a generational leap: enthusiasts have always known that traditional AWD vehicles tend to be basically understeering. But with the Q4, Alfa Romeo's sporting heart beats at a different rhythm in every configuration of the DNA selector, creating the maximum emotional involvement in the Dynamic configuration, whose traction control designed by the Alfa Romeo team, lets you drive a car that gives you the pure driving feeling of rear wheel drive in the maximum safety guaranteed by having traction available on all the four wheels.



In order to further enhance vehicle dynamics and handling Alfa Romeo has opted for a unique feature within its Q4 System: different transmission ratios between front and rear axles. Even on variants without staggered tyres, this allows the vehicle to come out of a corner faster thanks to early vehicle stabilisation (up to -0,5s Vs. best competitors in a 50m radius corner driven @70km/h). Therefore driving out of a corner becomes faster thanks to the possibility to accelerate earlier than an all wheel drive vehicle without this feature, meaning using identical transmission ratios in front and rear axles.

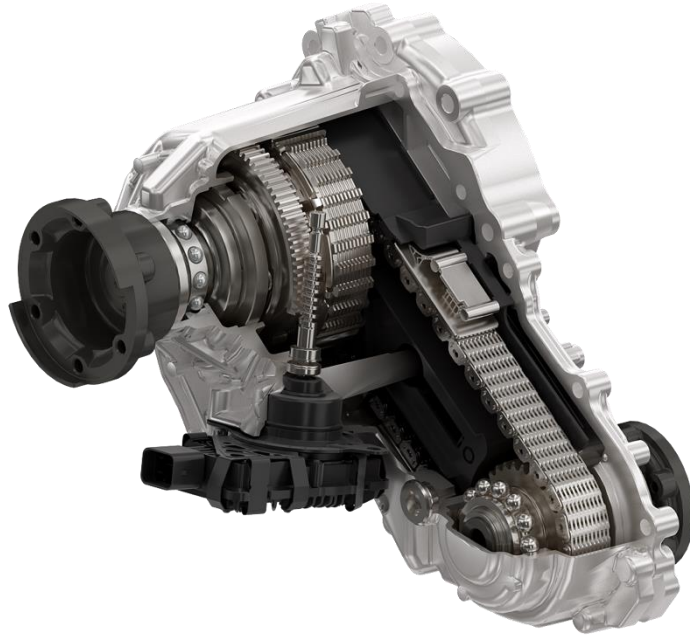
In order to be able to offer this level of performance, the entire system has been designed with challenging, innovative specifications: the active transfer case (ATC) was designed to rapidly and accurately adjust the amount of torque sent to the front axle, instantly modifying it according to the traction progress, to the driver's requests and to the vehicle's dynamic behaviour.

Reaction times are a reference in its class: the system can send almost 1000Nm to the front differential pinion in under 150ms, and decrease from 1100Nm to 100Nm in barely 120ms.

Q4 can withstand intensive use, e.g. driving to the max on race track or on low grip surfaces, dissipating very high energy in the clutch assembly without adding external cooling systems. This is a unique feature on the market, able to guarantee extremely dynamic, long-term driving without overheating.

The Alfa Romeo Q4 active torque distribution system (Active Transfer Case or ATC) also has unrivalled input/output torque levels in its class, being capable of accepting up to 5000Nm input torque from the transmission and deliver (ratio 1:1) up to 1200Nm to the front axle pinion via chain transmission which ensures that ensures quiet, efficient reliable operation thanks to its pumpless design.

The peculiar clutch operation strategy, enabling pure RWD driving in normal conditions, allows for high efficiency and reduced fuel consumption in comparison with other AWD solutions on the market.



*INTEGRATED ACTUATION CHAIN DRIVEN ACTIVE TRANSFER CASE*

The Alfa Romeo Q4 front differential unit is extremely compact and lightweight. It is also very efficient thanks to specific design elements that have been designed to reduce drag losses to a minimum. A little masterpiece.



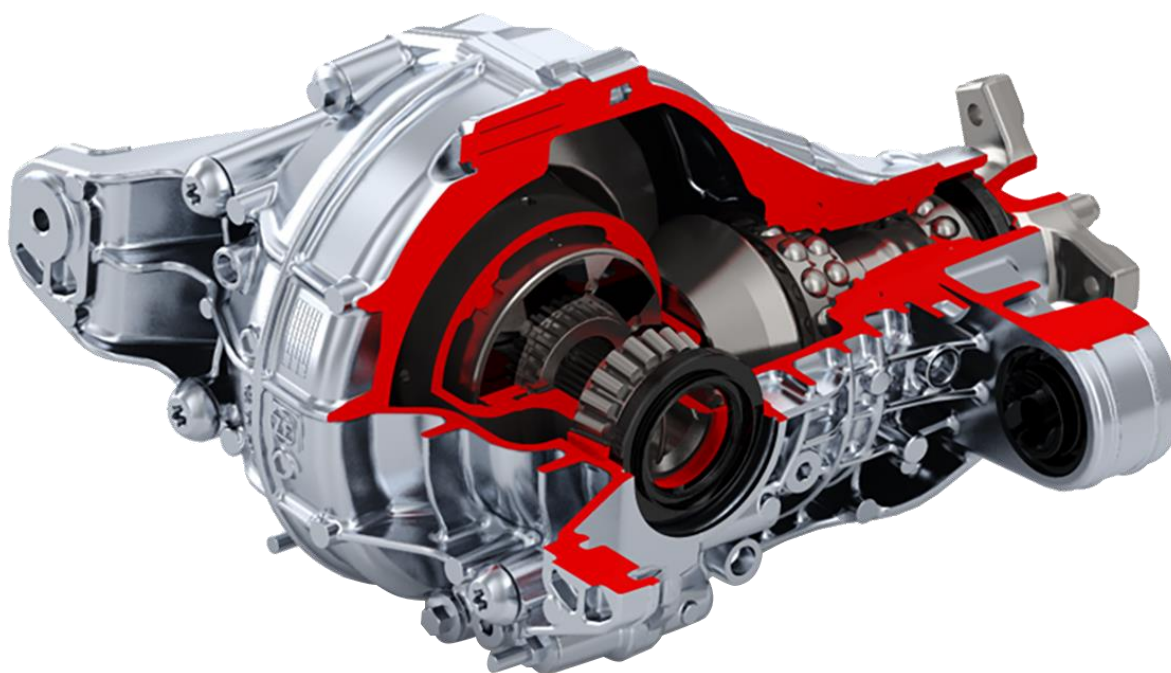
*HIGH EFFICIENCY FRONT AXLE*

The overall weight increase of the AWD System, including the front sideshafts, is less than 50kg with oil, an absolute reference value.

### ***Q2 mechanical self-locking differential***

The Q4 all-wheel drive versions can be integrated with a mechanical self-locking rear differential, available on request also on versions with only rear wheel drive.

The self-locking rear differential emphasises the agility and sporty nature of the new Alfa Romeos. The differential guarantees perfect traction in all conditions for a fluid driving experience. It was designed with 1.5-way clutch pack, pressure rings and no preload.



*Q2 LIMITED SLIP REAR AXLE*

The Q2 mechanical self-locking differential accentuates the vehicle's agility, letting you use it in utmost safety. The system ensures:

- enhanced driving performance, with locking up differential;
- greater vehicle stability in curves at high speed and higher side acceleration;
- increased vehicle traction even in differentiated grip conditions on the axle;
- extraordinary stability and control when driving straight in all grip conditions;
- top safety in wet or slippery road conditions by keeping the wheels constantly in check and reducing slippage.



## **Chassis Domain Control, Torque Vectoring and active suspensions**

All Alfa Romeo vehicles have been designed to achieve the best dynamic performance, and to offer a unique driving experience. To ensure this result, the platform development followed these guidelines: 50/50 weight distribution, rear-wheel drive and maximum lightness.

The starting point was to research passive vehicle excellence: suspensions, steering, differential, brakes. However, all this does not guarantee unique performance in its class: a “brain” is needed to command and coordinate the entire control system on board equipment, from the active suspensions to Torque Vectoring. All this was coordinated by the Chassis Domain Control, designed by Alfa Romeo, with proprietary algorithms.

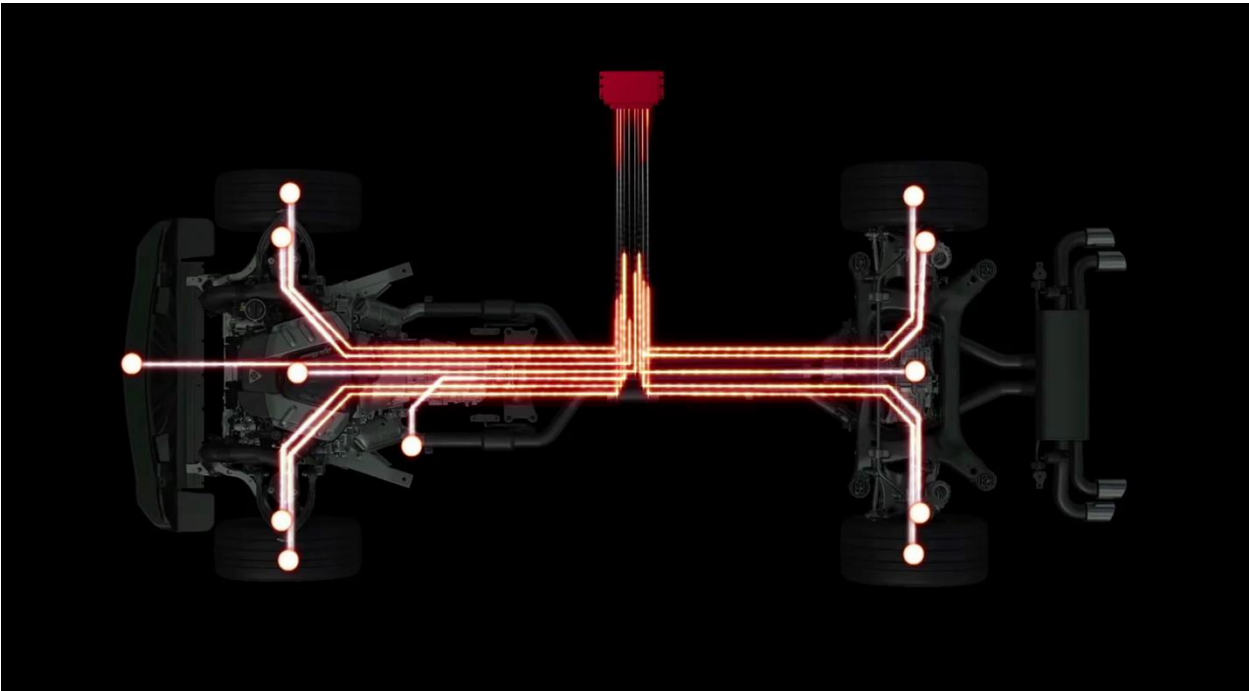
This is the car's “second brain” (apart from the driver’s): it is a single central intelligence unit that harmoniously oversees all the electronic devices that intervene in real time on road comportment, making driving extremely natural, instinctive and safe.

Alfa Romeo’s philosophy is that active systems must not distort the response of refined mechanisms, but provide the necessary support to get best performance in maximum safety in all driving conditions.

### **Alfa CDC**

Developed in collaboration with Magneti Marelli, the Alfa™ Chassis Domain Control (CDC) represents the “brain” of the car that coordinates all on-board electronics.

The system handles interventions of varying content: DNA driving system, Torque Vectoring, all wheel drive (Q4), Active Aero Splitter, Active suspensions. And it assigns each of them a precise task to optimise performance and driving pleasure.



*CDC CONNECTION SCHEME*

The CDC unit in particular orchestrates all the car's active systems in real time based on acceleration data and yaw detected by the sensors, ensuring utmost performance in all conditions and in safety. It also prevents and manages critical situations, informing in advance the specific control units involved in the vehicle's electronic system: chassis, powertrain, suspension, braking system, steering, assistance and cornering differential.

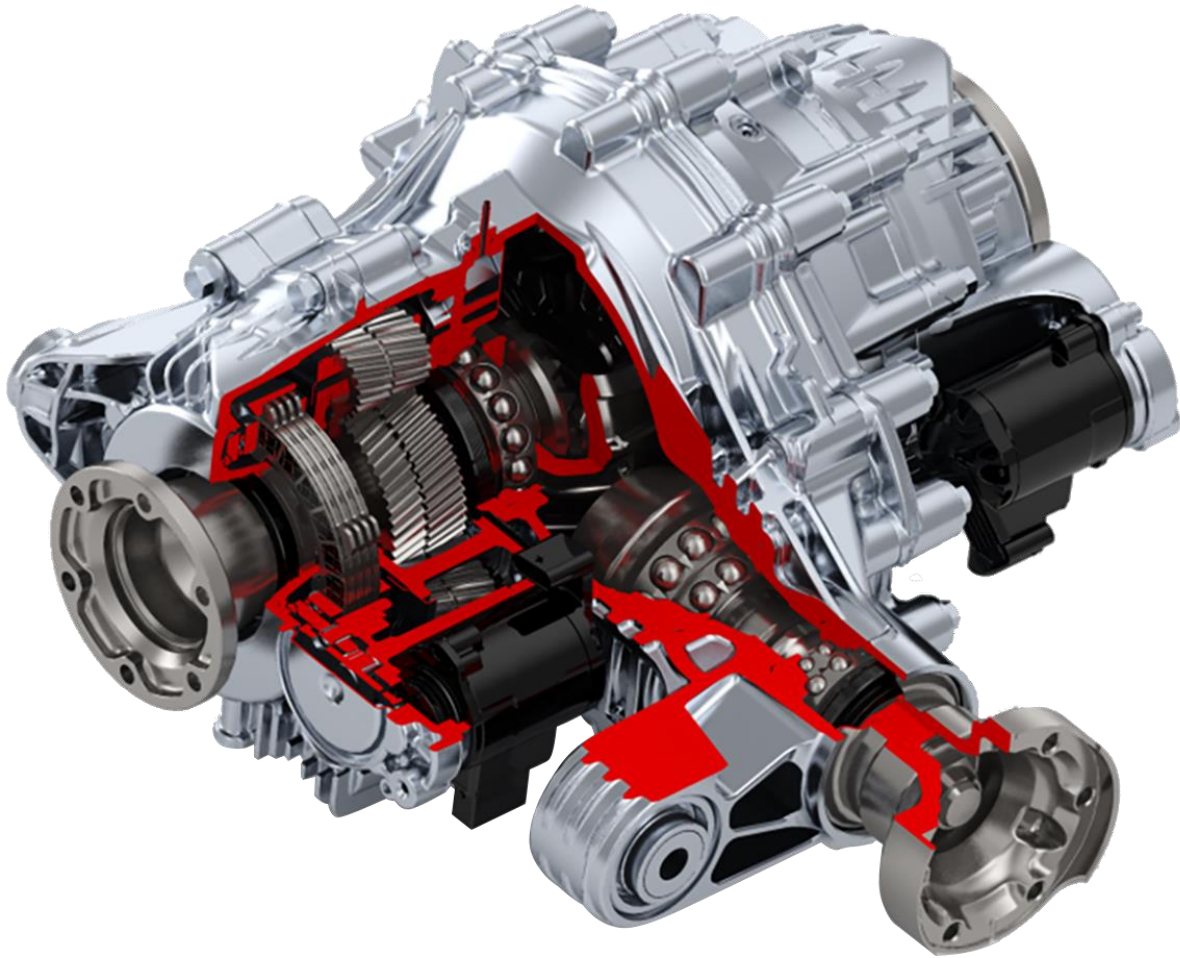
In Alfa Romeo's technical culture, the control systems have to play second fiddle to style and not "get in the driver's seat" instead of the person already there. They have to improve the car's mechanical excellence and not correct its mistakes.

All these systems and their related proprietary control strategies have been designed and implemented so as not to be invasive and to reach unique levels of performance and control. On an Alfa Romeo model, the driver is the one who always decides why Alfa Romeo continues to believe in cars and in the pleasure of those who drive them.

The Chassis Domain Control, developed by Alfa Romeo with proprietary algorithms, together with a distinctly sporty aspect, has brought this philosophy to Giulia and Stelvio at the top levels.

### **Torque Vectoring**

One of the most advanced technological features developed by Alfa Romeo engineering Team is the Torque Vectoring system.

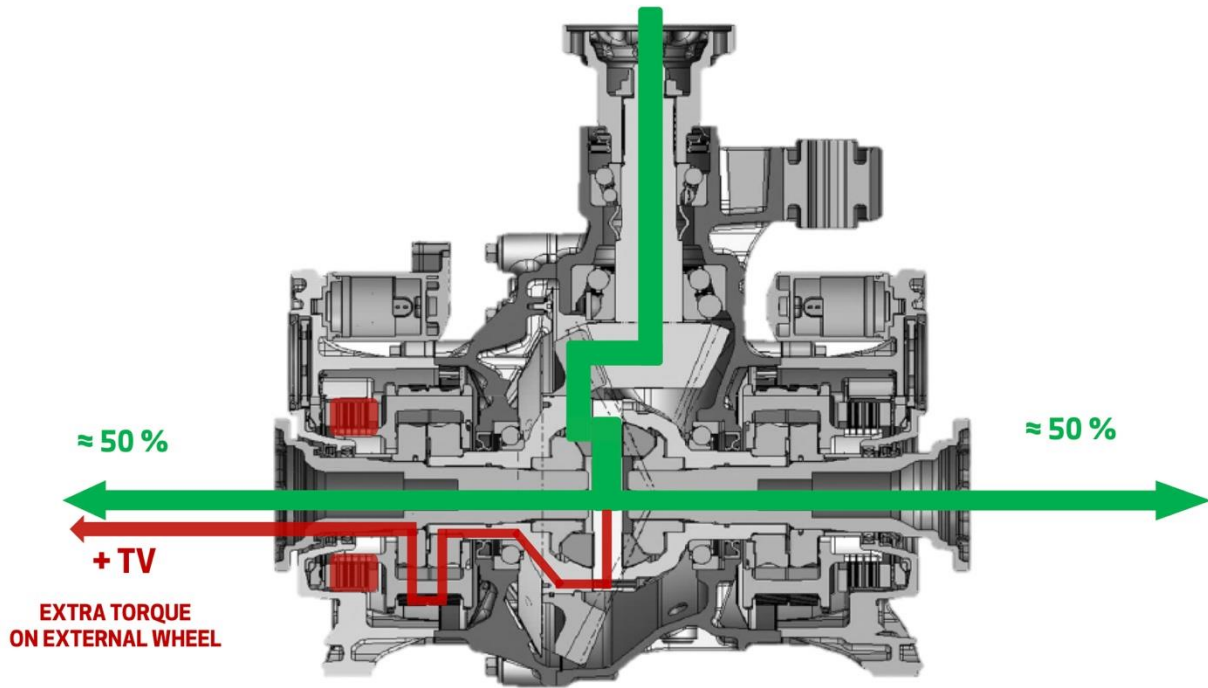


*ACTIVE TORQUE VECTORING REAR AXLE*

It is a system that allows the rear differential to vary the power to each wheel, improving traction and performance. This technology guarantees fast steering reaction and excellent tyre stability, even at high speeds and in extreme weather conditions.

The system consists of two electro-mechanical clutches integrated into the rear differential; this enables the system to distribute the torque mechanically to each of the two rear shafts independently, simplifying driving even in difficult weather conditions. Thanks to the interaction with the CDC (Chassis Domain Control), this system improves the car's agility, safety and traction.





TORQUE VECTORING SCHEME

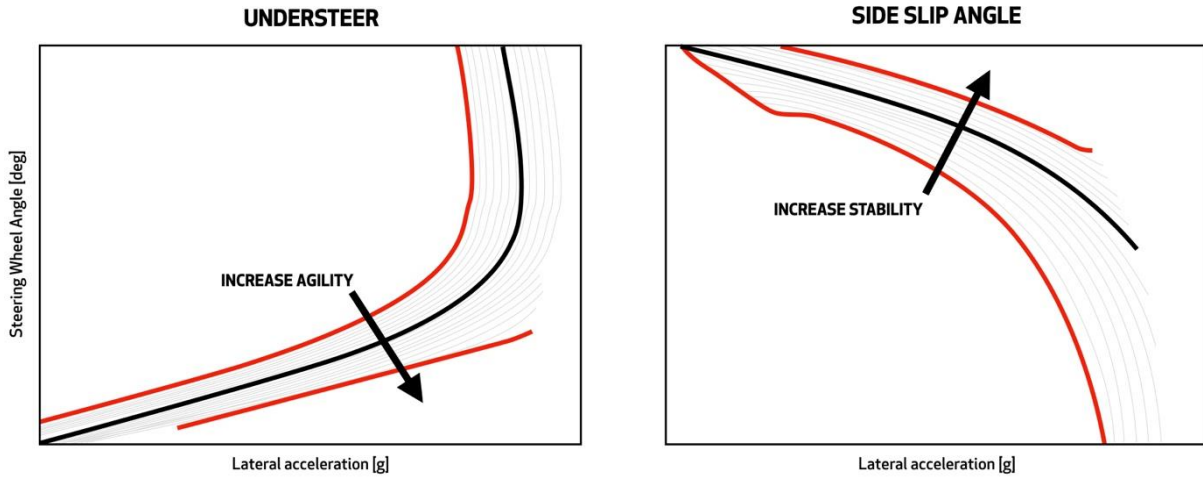
***Torque Vectoring lets the car's agility to optimise thanks to:***

- increasing maximum lateral acceleration and speed limit;
- compensating the tendency to understeer
- improving the vehicle response to driver commands;

***Guaranteeing maximum safety all the time:***

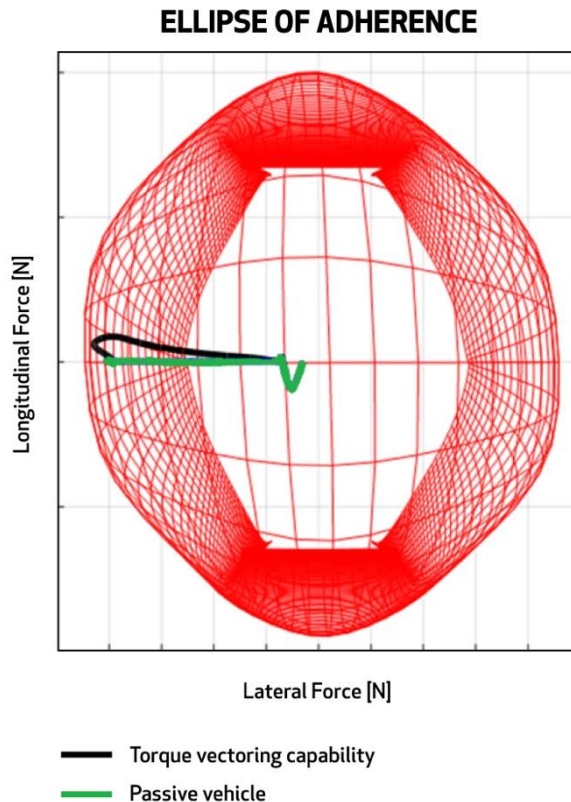
- Improving stability;
- Discharging the driver in critical situations;
- Stabilisation of the vehicle behaviour;
- Supporting the driver to keep full vehicle control.

The Alfa Romeo team developed the Torque Vectoring control strategies based on an extensive use of the most accurate and advanced virtual simulation tools, simulator driving sessions, and then completed the development with extensive testing campaigns to the most varied conditions of use and grip. All this allows a 4% increase in lateral acceleration, 17% in understeering reduction and about a 20% increase in agility at the same time.



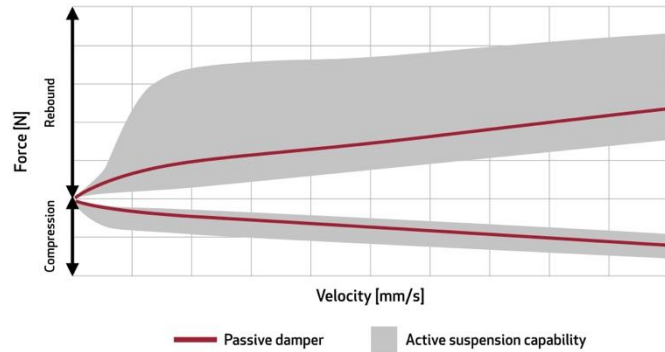
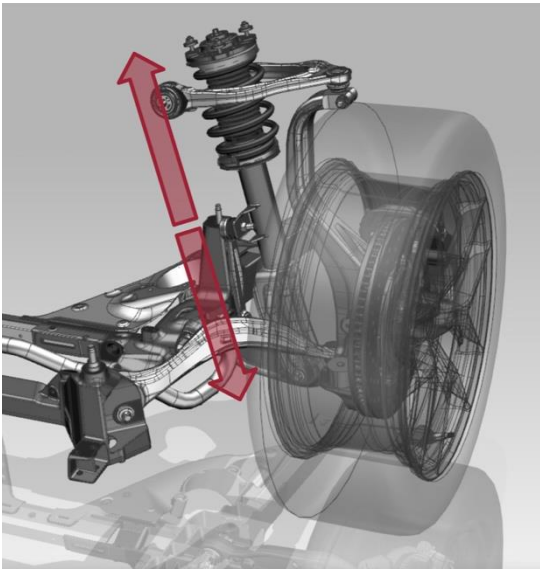
Last but not least, the effect on the vehicle performance is maximisation of tyre performances in terms of grip. The forces produced by tyre-road interaction can be maximised thanks to Torque Vectoring.

**Tyre Adherence Ellipse:**



**Active Suspension**

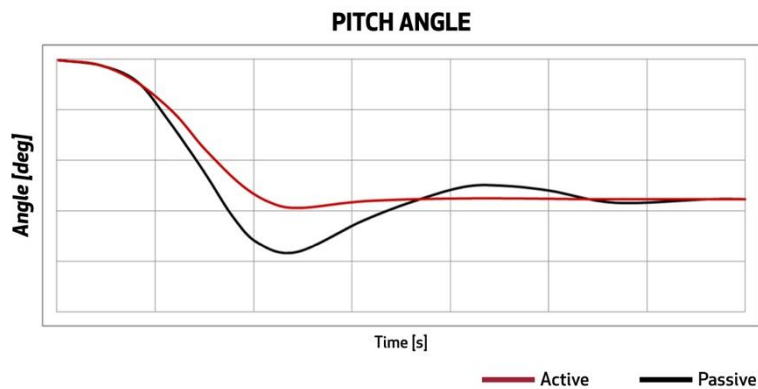
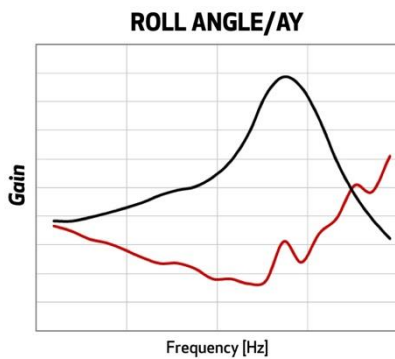
Thanks to a high level control strategy integrated into the CDC unit, the active suspensions absorb shocks not only in proportion to the speed (as in a passive shock absorber) but also dependent on the DNA selector position and road condition.



**DNA in N:** The “Natural” position allows for improvement in handling compared with passive shock absorbers. At the same time, the vehicle feels softer and more comfortable when driving on uneven roads.

**DNA in D:** the “Dynamic” position allows for improvement in handling; at the same time comfort is not worsened compared to regular conditions.

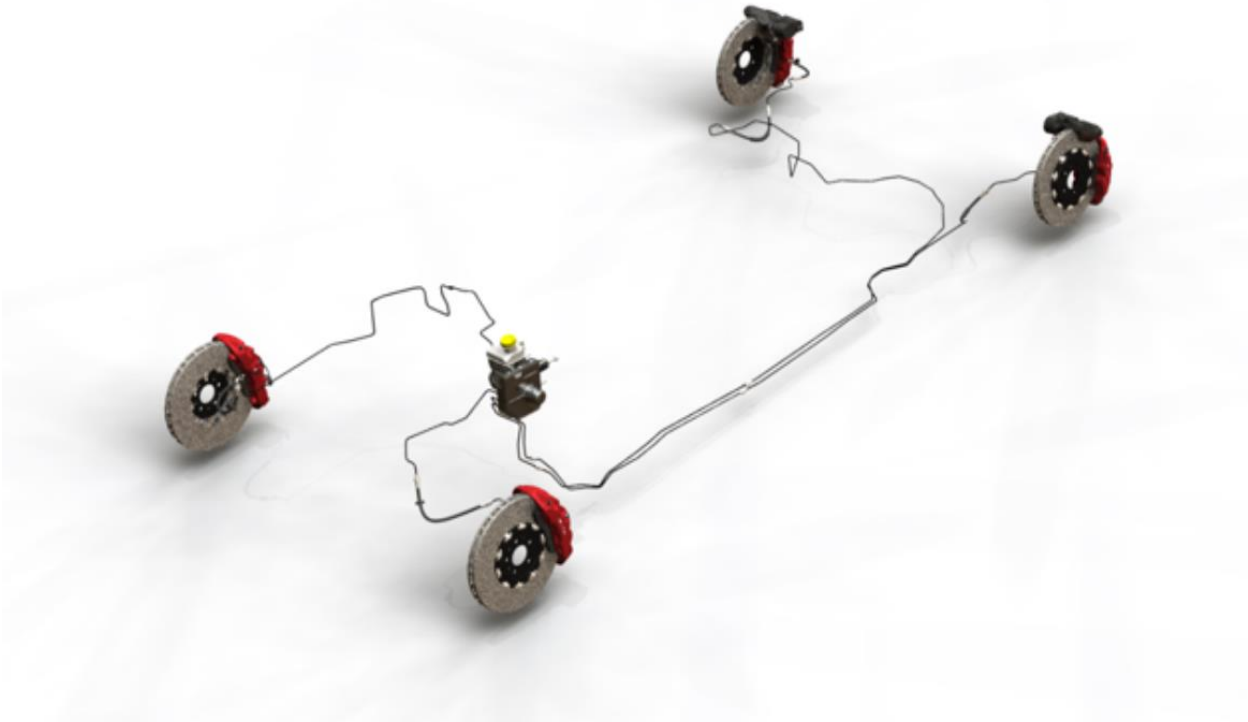
Controlled shock absorbers, available on the Quadrifoglio series version and as an optional on all the other versions, further reduce the dynamic pitch when braking and the Skyhook control calibration minimises the dynamic roll gradient and body oscillation



## Intelligent Braking System



Since the beginning of its history, Alfa Romeo has been characterised by a sporty DNA dedicated to racetracks and racing. The customer who drives an Alfa always feels and is aware he is driving a high performance vehicle that differs from its direct competitors because of its higher level of sportiness.



How did this happen? This is achieved through a “TOP-DOWN” type of development system, where the best performing car in the range, the Quadrifoglio, is the reference even for versions with less powerful engine.

To achieve top performance in braking, we worked on two of the braking system’s main components: the basic system and the actuation system. Alfa Romeo engineers worked during the entire development to integrate the two systems and maximise their performance. Regarding the two main braking system components:

### ***The Brembo-based system***

In order to maximise reduction of the unsuspended masses, the entire Alfa Romeo range has a front axle braking system with aluminium callipers. Compared to the traditional cast iron floating calliper, the aluminium one weighs about half the total car mass; the reduction in the unsuspended mass contributes to improvement in wheel-road contact. The aluminium calliper design is the product of an optimisation job where the following objectives were sought:

- Least material for maximum calliper body rigidity.



- Design optimisation to ensure the comfort features.
- Design: the aluminium calliper gives the car a sense of sportiness.

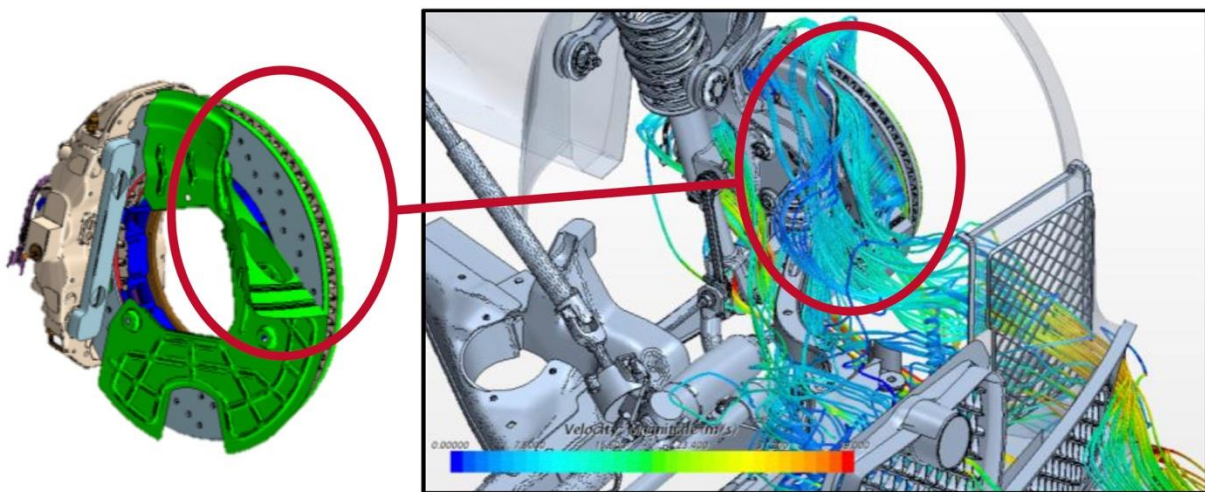
In particular, in applying the range to face the demands of compactness and rigidity, the totally new callipers were developed, starting with a blank page and subsequent development and optimisation work.



For the Quadrifoglio applications, we pushed even beyond the braking system. To respond to pre-set targets at the start of the design in terms of weight and performance on the track, aluminium callipers were adopted for both the front and rear axles. Extreme use on the track resulted in the development of a carboceramic system for both Stelvio and Giulia, to take advantage of the car's dynamic to the max. The carboceramic disks did not only ensure greater stability of the friction coefficient even at high temperatures, they also contributed substantially to a reduction in car mass; compared to the cast iron disks, the CCM weighs about 5kg less, for an overall saving of 20kg.



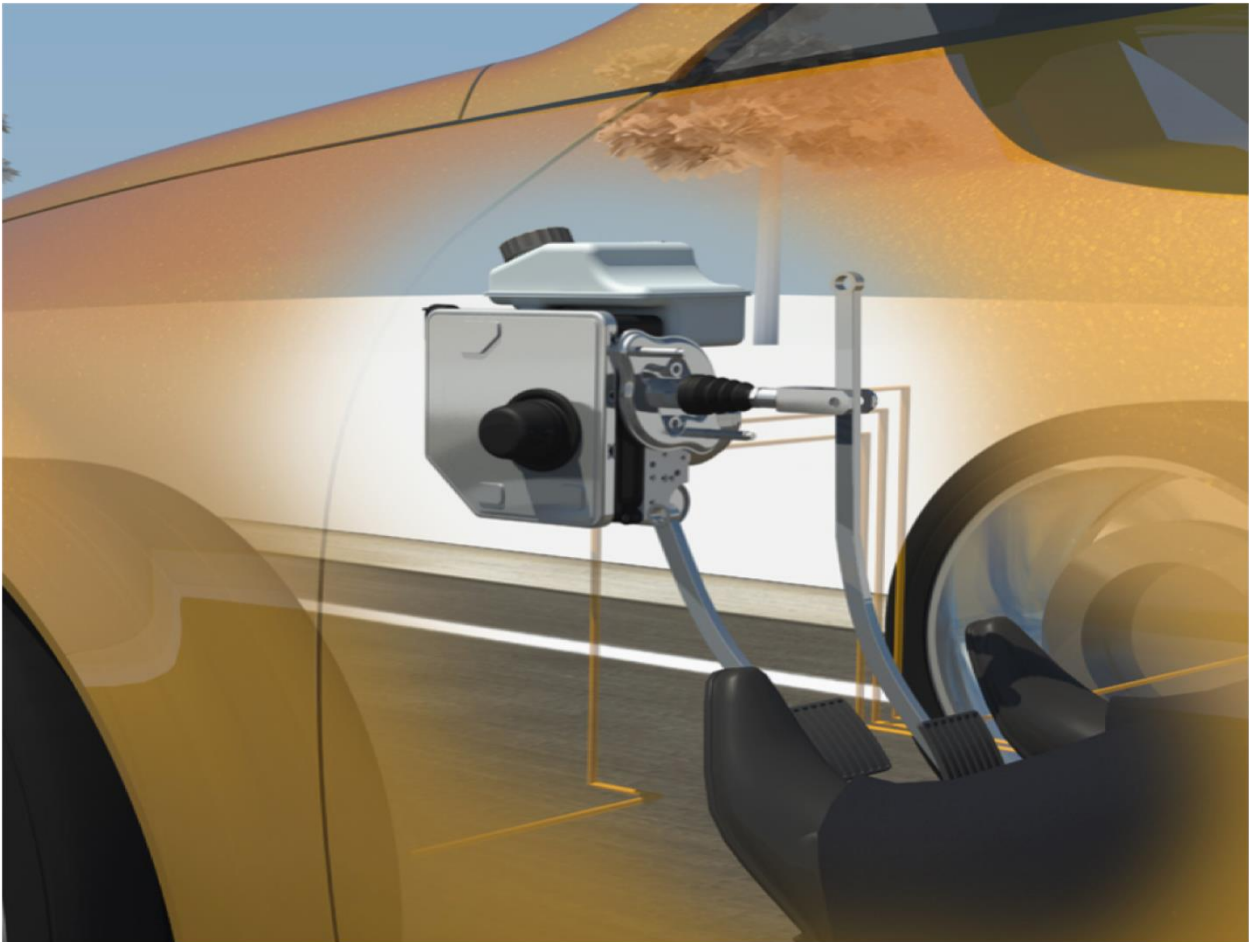
Extreme use for braking performance does not only come from the brakes but also from their integration with other systems; maintaining the system at lower temperatures means allowing the car to get the most out of its dynamic capabilities and raise its limits on the track in terms of duration. In order to pursue this objective, the front aero splitter (active aerodynamic), in addition to generating downforce, has been designed in such a way that the air flow generated by it, combined with a relevant heat shield geometry, conveys an additional flow to the normal convection, which contributes to prolonging the system's life and efficiency.



***Brake by Wire – IBS activation system***

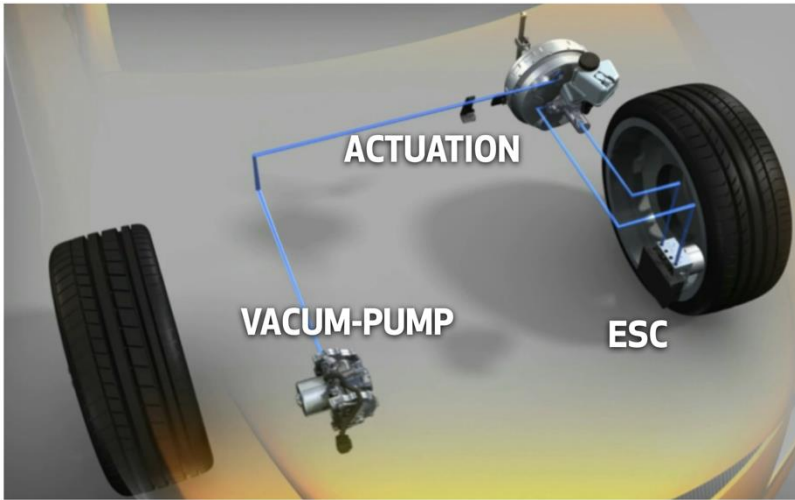


The main innovation that Alfa Romeo introduced to the range is in the Continental MKC1 brake by wire system.



The new activation system is a world premiere in the automotive and at this time no other car in production comes with this system. The main advantages offered by the system are:

- *Packaging*: as shown in the picture below, using this system means a notable reduction in the component inside the engine compartment, replacing one single hardware with a unit made up of pump, power brakes and ESP. Apart from being consistent with the philosophy of reducing mass, which has guided the Giorgio project since the beginning, reducing the components allows everything to be more compact inside the engine compartment, guaranteeing less cantilevered mass, making the car more agile.



- *Weight:* the pump, power brake and ESP unit weighs a great deal less than the MKC1 (ca +50%)

**8" / 9" BOOSTER**

**EVP**

**MK 100ES C HYBRID**



**~ 9Kg - 10Kg**



**~ 6Kg**

- *Pedal decoupling from the braking system:* the brake by wire system decouples the brake pedal from the hydraulic circuit of the callipers. The main advantages deriving from this solution are:
  1. *Tuning the brake pedal feeling:* the brake pedal feeling is the way the driver senses the car's ability to slow down. In traditional systems, the rules of the road, the load and deceleration was achieved by balancing the system's HW components (calliper pump and power brakes) with the limit of being variable with temperature and independent of speed. In the brake by wire system, the feeling in terms of load is achieved through a simulator that can be completely customised. The response in terms of slowing down becomes one calibration that can be optimised according to the driving conditions; a less aggressive pedal feeling can be made for relaxed





driving in traffic or more aggressive in track driving conditions; this increases flexibility of the system and its usage capability.

2. *Stability of pedal feeling when used for sport:* with the brake by wire system, the pedal length can be shortened when it is connected to the system and subjected to extreme overheating on the track, where normal applications are subject to a progressive increase in pedal travel.
3. *Increase in performance:* pressure is generated through a linear actuator, allowing pressure gradient and much lower wheel locking times compared to traditional systems. This feature translates into optimum control of the wheel dynamic, with the consequent drastic reduction in braking distances.