4 All-wheel-drive Porsche Traction Management (PTM)

Intelligent all-wheel-drive Porsche Traction Management (PTM) comes as a standard feature for the first time in the high-performance 911 Turbo sports car to actively influence longitudinal and lateral dynamics. PTM enables the high performance potential of the new 911 Turbo to be exploited to the full. Enhanced driving stability, traction or more agile handling can be mobilized, according to the given driving situation. This means that the vehicle is highly agile on narrow country roads, offers outstanding traction and ensures a high level of driving safety in the high speed range, even when undertaking extreme manoeuvres.

Porsche Traction Management comprises the following systems:

- Full-time all-wheel drive with electronically controlled center differential lock to distribute torque between the front and rear axles
- Automatic brake differential (ABD) for improved traction
- Anti-slip regulation (ASR) to limit slip during acceleration and improve vehicle stability

A mechanical rear differential lock is an optional feature that can be added to the PTM.

Traction and dynamics

Porsche Traction Management (PTM) actively improves handling in the new 911 Turbo and provides enhanced traction. Strictly speaking, it is not actually possible to separate driving dynamics and traction, as the transitions are fluid within the systems. In example: Only when a vehicle has good traction, that is, when the tires do not build up excessive slip, can lateral forces be transmitted. This means steerability for the front axle and lateral stability for the rear axle. Spinning of the drive wheels can be reduced or, in ideal circumstances, eliminated entirely through the use of PTM.

The improvements in active handling with PTM in comparison to the viscous multiple-disc clutch on the 911 Turbo (996) are demonstrated most clearly in dynamic cornering on a slippery surface, e.g. on snow or wet roads.

If the vehicle oversteers, e.g. with spinning rear wheels, the viscous multiple-disc clutch will only result in drive torque being transmitted to the front axle according to the differential speed between the front and rear axles (slip). The level of drive torque is determined here by the specific characteristic of the viscous multiple-disc clutch. PTM results in electronically controlled power distribution to the front axle, whereby when necessary the oversteering correction function and the slip controller (see section 4.2, PTM control) enable a higher level of drive power to be transmitted to the front axle than applies in the case of the viscous multiple-disc clutch. This function results in active stabilization of the vehicle with additional power and acceleration of the front axle. Another advantage of PTM is that it takes the steering angle into account in distributing power to the front axle. In the event of countersteering by the driver in response to oversteering, for example, PTM will adapt the drive power to the front axle accordingly. This optimizes stabilization of the vehicle. These functions provide additional driving stability in comparison to the viscous multiple-disc clutch without compromising on driving dynamics and agility.

In the case of understeering in a bend under load, with the viscous multiple-disc clutch a level of drive power is distributed to the front axle according to the differential speed between front and rear axles (slip) which may in certain circumstances further diminish the steerability of the vehicle and increase the understeering tendency. In this situation, PSM brakes individual wheels to stabilize the vehicle and the vehicle cornering manoeuvre is slowed down. With PTM, the understeering correction function (see section 4.2, PTM control) reduces the drive power to the front axle in this situation. This enhances steerability and lateral stability at the front axle. The result is faster and active stabilization of the vehicle for quicker and more dynamic cornering, as there is less intervention by the PSM.

The improved traction with PTM in comparison to the viscous multiple-disc clutch on the 911 Turbo (996) is demonstrated most clearly when driving off and accelerating with spinning rear wheels. When driving off, the viscous multiple-disc clutch requires differential speeds at the front and rear axles before the drive power can be transmitted to the front axle. With PTM, the anticipatory control function (see section 4.2, PTM control) closes the PTM clutch directly on identifying a drive-off situation. As a result, all four wheels are supplied with the maximum possible drive power right from the first moment of the drive-off process and spinning wheels are largely avoided. During acceleration also, on the slip controller (see section 4.2, PTM control) detecting spinning wheels, PTM rapidly initiates more pronounced intervention by the multiple-disc clutch, thus increasing the drive power to the front axle and increasing traction overall.

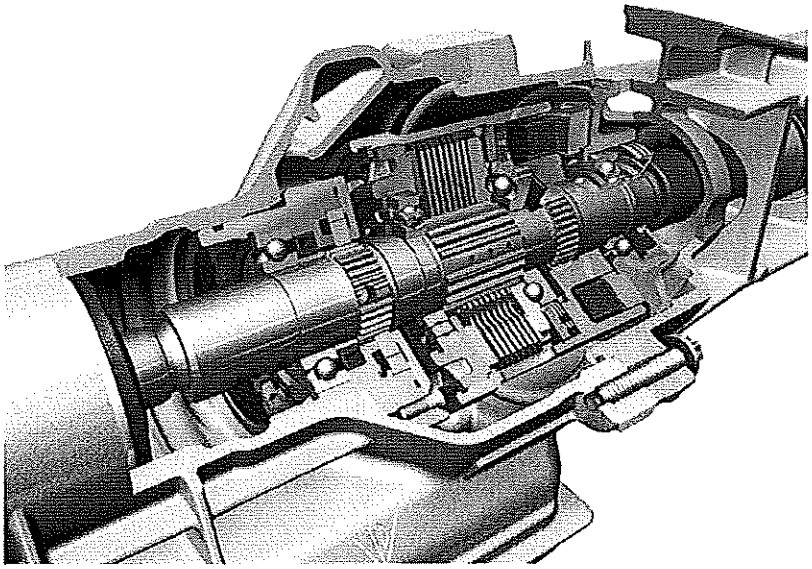

Fig. 29: PTM clutch

The control strategies for PTM have been closely linked to Porsche Stability Management (see also "Integrated chassis systems" in section 5.5). The distribution of drive power to the front and rear axles in accordance with the given requirements enables the four driven wheels to exploit the available potential for adhesion between road and tires to the full. The vehicle's driving stability and steerability are noticeably enhanced and the Porsche Stability Management (PSM) control system intervenes less frequently to stabilize the vehicle. All-wheel drive is always active and cannot be deactivated.

4.1 Advantages offered by the PTM system

PTM offers the following advantages over the all-wheel-drive system of the 911 Turbo (996) with viscous multiple-disc clutch:

- Enhanced driving stability and traction in all driving situations, irrespective of the prevailing road conditions
- Improved manageability in extreme driving situations
- Improved straight-ahead tracking and stability in the high speed range through the specific distribution of additional drive power to the front axle
- Increased agility through the variable distribution of drive torque to the front axle according to the given driving situation

A mechanical rear differential lock is additionally available as an option for particularly sporty drivers. This lock supports PTM with further enhanced driving dynamics and traction, increases lateral acceleration and enables improved race track performance. Further information on the mechanical rear differential lock is to be found in section 4.4.

4.2 PTM control

The intelligent all-wheel-drive control system employed in the new 911 Turbo actively controls the distribution of drive torque between front and rear axles according to the given driving situation and the driver's wishes. To this end, PTM evaluates the various CAN networking variables, such as the current wheel speeds (all 4 wheels), lateral acceleration, longitudinal acceleration and steering angle. The aim of this torque distribution is to offer the driver excellent driving dynamics and traction and maximum driving safety at all times.

In the PTM controller, several functional sequences are tested in parallel, evaluated and integrated to produce a control strategy. This strategy determines the required locking torque of the interaxle clutch (PTM) for the given driving situation.

PTM comprises the following basic functions:

• Basic torque distribution
Continuously variable basic distribution of the current engine torque between front and rear axles in accordance with the current driving situation.

• Anticipatory control
Early detection of dynamic changes to the driving conditions in order to avoid slip.
Example (acceleration from a standing start, e.g. on loose surface or snow): Directly on detecting a drive-off situation, the PTM clutch is closed to such an extent as to largely rule out the possibility of spinning wheels. As a result, all four wheels are supplied with the maximum possible drive power as soon as the vehicle starts off and the fastest possible acceleration is achieved.

• Slip controller
Active prevention of axle slip to increase traction.
Example (additional acceleration with spinning wheels): If the wheels on the rear axle go into a spin during acceleration, for example, more pronounced intervention of the multiple-disc clutch results in the supply of more torque and thus more drive power to the front axle.

• Oversteering correction
Detection of vehicle oversteering and support of corrective action via torque redistribution.
Example (oversteering during cornering): If the vehicle oversteers while cornering as a result of external factors (e.g. black ice), more drive power will be distributed to the front axle in order to stabilize the vehicle's driving dynamics.

• Understeering correction
Detection of vehicle understeering and support of corrective action via torque redistribution.
Example (understeering during cornering): Before the vehicle understeers during cornering, more drive power is distributed to the rear axle in order to stabilize the vehicle's driving dynamics.

In addition to the basic functions, the PTM controller also incorporates higher-level control functions to ensure component protection.