The Importance of an Electronic Stabilization System

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Annotation. Mechanics is an industry that is digitizing the world today. Including the automotive and engineering industries. This article details the engineering, how the ESP program works, and how well it works for automobiles.

Keywords: engineering, ESP, automotive, technical part, mechanics, physical properties, technical age, information technology, etc.

ESP (Electronic Stability Program) is, literally translated, "electronic stabilization program", but more correctly - an electronic stabilization system. ESP is also called "anti-skid" or "stability control". The main task of ESP is to control the lateral dynamics of the car and help the driver in critical situations. Simply put, the stabilization system should prevent skidding and side slip of the car in case of its occurrence, as well as help maintain directional stability, trajectory of movement and stabilize the position of the car during maneuvers at high speed or slippery surfaces under the wheels.

Mercedes-Benz was the first to use the stabilization system on its models, which patented it in 1994. And a year later, in 1995, ESP began to be installed on the Mercedes-Benz S-Class Coupe. It later appeared on the S-Class sedan and the SL sports car. Then ESP began to appear on other models of the brand, and later on in the assets of other major automakers. Moreover, many of them patented their own trade name for the system. And, as a rule, also in the form of an abbreviation. So the stabilization system of some other manufacturers may be called ESC, VDC, VSC, DSC, DSTC, but its essence and principle of operation does not change from this. The work of ESP is interconnected with the brake mechanisms of the car, ABS, as well as with the traction control system and the electronic engine control unit. In its work, ESP actively uses all these components, combining their actions in a complex and providing several countermeasures during the occurrence of lateral dynamics or, in other words, uncontrolled sliding of the rear axle of the car.

In fact, the ESP consists of a microprocessor (also called an electronic control unit) that constantly processes signals from the wheel speed sensors integrated into the ABS system, the position of the steering wheel and the pressure in the brake system. In addition, the processor receives information from two other sensors that measure the angular velocity relative to the vertical axis and the lateral acceleration of the vehicle. They detect sudden lateral acceleration, which is the main marker of slip, and, having determined its magnitude, give further orders to the system. To this data is also added the value of the speed at which the car is moving at this moment, the magnitude of the angle of rotation of the steering wheel, as well as the speed of the engine crankshaft. Analyzing this data, ESP “understands” that a skid has occurred and then gives a command to selectively brake one or more wheels of the car, based on the direction of the skid and lateral acceleration. The brake commands themselves are sent through the ABS modulator, which creates pressure in the vehicle's brake system. At the same time, ESP sends a command to the engine control unit to reduce fuel supply and reduce traction on the wheels. The system works always and in any driving modes: during acceleration, braking, coasting. And the triggering algorithm depends on each specific situation and the type of car drive. For example, in a turn, the angular acceleration sensor detects the beginning of the skid of the rear axle. In this case, the engine control unit receives a command to reduce the fuel supply. If this was not enough, the outer front wheel is braked by means of the ABS.

However, it is important to understand that the possibilities of ESP to correct skid and stabilize the car in a critical situation are not endless. The laws of physics cannot be canceled by any electronic system. And if the speed at which the skid occurs is too high or the friction coefficient of the slippery surface under the wheels is too low, then even smart electronics can be helpless. It is always important to remember that the stabilization system significantly reduces the risk of skidding and accidents on the road, but does not eliminate them. Globally, problems with the system can arise for several main reasons. A fairly common case is when there is a malfunction of the wheel speed sensors that are connected to the traction device and the engine control unit. Each wheel has a separate sensor, and even if one of them fails, the system is no longer notified about changes in speed, and as a result of such an error, the ESP malfunction signal lights up on the dashboard. Another common cause of an ESP error on the dashboard can be a faulty steering angle sensor. In the event of its failure, the system also ceases to receive signals about the steering angle and, accordingly, cannot work correctly.

In addition, often ESP malfunctions can be associated with software interruption. In such a case, the entire traction system may require a complete reprogramming simply due to problems with the current software. However, these are only the most common faults. However, it must be remembered that the stabilization system consists of many complex components, and the failure of any of them can cause a light on the dashboard to light up. So when the corresponding signal appears, it is still better to contact the service center and fix the problem. ESP consists of many sensors: wheel speed, steering wheel position, brake pressure, yaw rate and lateral acceleration (G-sensor). Information from these sensors enters the main controller unit, which, processing the information, in the event of a critical situation, helps to restore the position of the car in the trajectory by braking one or more wheels. ESP is closely related to the ABS system and the engine control unit. ESP (Electronic Stability Program) is an electronic system for dynamic vehicle stabilization. This system is designed to help you drive a car. Its main task is to maintain directional stability, that is, it should help prevent skidding and side slip in critical situations. The idea of such a system first appeared in 1959 and was patented by Daimler-Benz, but it was only a prototype of the modern ESP system. In a modified form, it first appeared in 1995 on the production Mercedes CL600. Now the system of course stability is equipped with most modern cars. Electronic stability control works by manipulating both the engine throttle and each wheel's brake. Similar to other driver aids, ESC turns on when you start your car. It operates in the background as it monitors steering wheel activity along with speed sensors on each wheel. When sensors determine that the driver is losing control, the ESC system engages automatically to adjust for oversteering and understeering. It applies or eases the brakes of each wheel on the car to bring the vehicle back onto the intended path. ESC involves the traction control systems and adjusts engine power to reduce speed and apply the brakes if the driver gives too much gas.

ESC activates when it detects if a driver might be losing control of the car. The system automatically adjusts individual wheel brakes to help stabilize the vehicle during a momentary loss of control. When your ESC activates and makes adjustments, a warning light flashes on the dashboard. You may feel slight jerks and lurches as the brakes are applied and engine power is reduced. Spin-outs can happen when drivers take turns too sharply and quickly. Reduce your speed when driving, and be sure to take turns slowly and carefully. Computerized driver aids such as electronic stability control can help in dangerous driving situations. ESC is not a substitute for responsible driving habits on slippery roads. The technology behind the ESC system is highly effective in assisting a driver to maintain control of the car during hard-steering maneuvers. ESC does not explicitly prevent a vehicle from flipping over. Still, the safety feature helps keep the tires on the pavement, where a car is much less likely to roll over. ESC is marketed using many different names, including Vehicle Stability Control (VSC), Electronic Stability Program (ESP), Dynamic Stability Control (DSC), and several others.

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