

# Anti Lock Braking

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July 5, 2009, Toyota Motor Sales, U.S.A., Inc. – Over the past several years, driver assistance features have become commonplace. The functionality and convenience of these systems continue to help develop vehicle collision avoidance capabilities. By their very nature, driver assistance systems are designed to detect, judge, and react to anticipated collision scenarios.

Anti lock braking (ABS) is probably the best known driver assistance feature. ABS has evolved from simple lockup control only during braking to more advanced systems that control traction during acceleration, braking, and cornering by braking wheels individually while integrating other vehicle operating factors such as engine power output.

Most new vehicles are equipped with ABS these days, but ABS is not a one-size-fits-all system. ABS can include a number of additional features, which are found on a number of Toyota vehicles:

Electronic Brake force Distribution (EBD) ? modifies braking force at individual wheels to compensate both for changes in vehicle load (occupants and cargo) and to help increase braking efficiency during cornering.

Brake Assist (BA) ? monitors the force with which the driver depresses the brake pedal and provides additional brake fluid pressure when the system detects an emergency stop.

Traction Control (TRAC) ? helps reduce drive wheel spin during acceleration using ABS and control of engine power output.

Vehicle Stability Control (VSC) ? helps prevent skidding or spinning while cornering by controlling ABS and engine power output to help keep the vehicle traveling in the steered direction, even if the driver enters a turn too fast or steers the vehicle too sharply for road conditions.

Vehicle Dynamics Integration Management (VDIM) ? combines a range of vehicle stability control functions into a single, seamless process to help provide overall vehicle dynamic drivability.

SUVs and trucks, such as Toyota Tundra and 4Runner, may be equipped with specialized ABS-based functions such as:

- Active TRAC (A-TRAC) — During 4-wheel-drive operation on a snow-covered road or in rugged off-road conditions, A-TRAC controls engine output and brake fluid pressure so that the drive force is distributed to the wheels that have traction. This enhances drivability in extreme road conditions, an effect that is similar to a Limited Slip Differential (LSD). Off-road drivability is equivalent to having the center differential locked and a limited-slip differential on both front and rear axles.
- Auto Limited Slip Differential (Auto LSD) — Auto LSD uses the TRAC system to achieve the capability of a Limited Slip Differential (LSD) when driving in 2WD mode (On a 4WD vehicle, Auto LSD only operates when the vehicle is being driven in 2WD mode). Because Auto LSD and Rear Differential Lock perform similar functions, vehicles may have one system or the other, but

not both. While Auto LSD components are similar to those in the TRAC system, there are important differences.

- Downhill Assist Control (DAC) — DAC allows the vehicle to descend a steep hill in a stable manner without the wheels locking. It does this by controlling hydraulic brake pressure at all four wheels, maintaining a constant, low vehicle speed.
- Hill-start Assist Control (HAC) — Without HAC, when starting from a stop on a steep or slippery hill, the driver would have to quickly release the brake and apply the throttle to prevent the vehicle drifting backward. To engage hill-start assist control, further depress the brake pedal when the vehicle is stopped completely. A buzzer will sound once to indicate the system is activated. The slip indicator will also start flashing. HAC operates for about 2 seconds and warns the driver (buzzer) when braking force is about to be released.

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