

300 Suspension, Steering and Brakes—General

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GENERAL

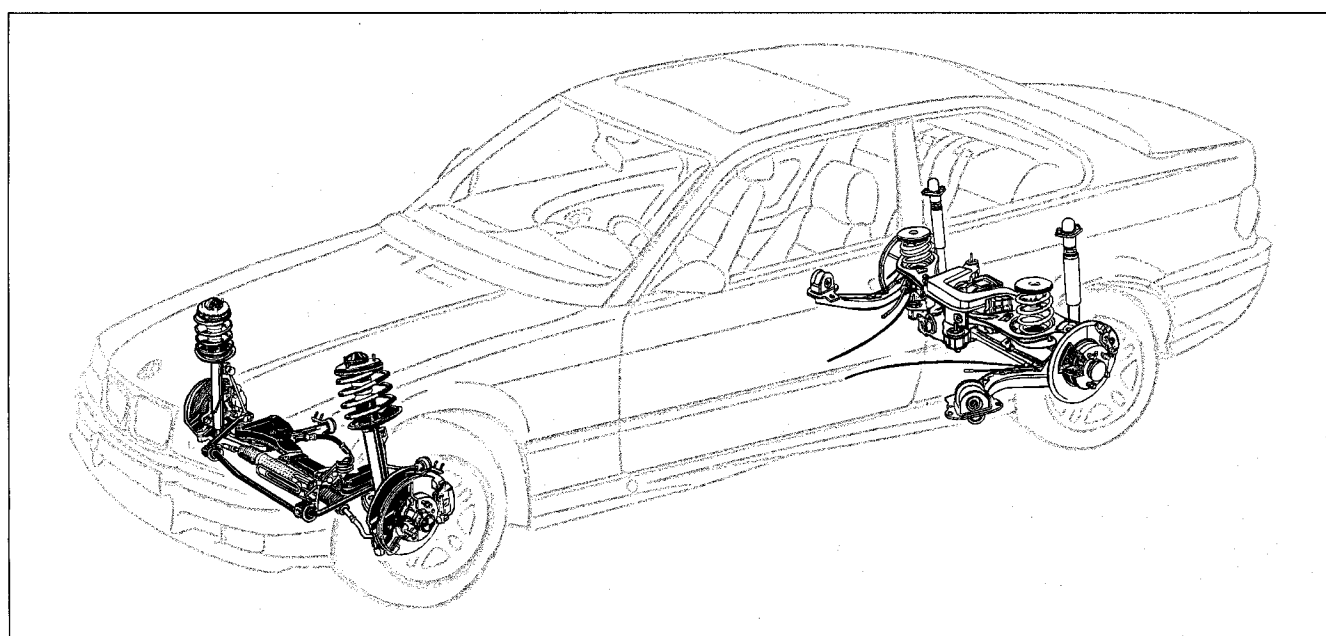
This section covers general information for front and rear suspension, the steering system, and the braking and traction control systems.

The BMW E36 suspension and steering systems are engineered to provide a compromise between taut, responsive handling and ride comfort. Although the front and rear suspension assemblies are independent subsystems, they work together to achieve BMW's overall combination of precise handling and comfort. See Fig. 1.

Front Suspension

The lower control arms connect the front suspension struts to mounting points on the subframe crossmember and the body. See Fig. 2.

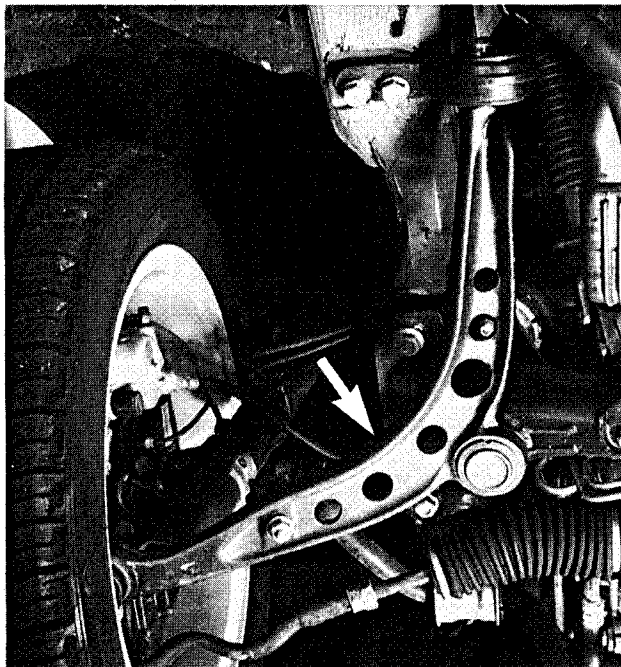
Each front strut assembly includes a shock absorber cartridge inside the tubular strut housing and a large coil spring. The upper strut mount bearing allows the strut to turn with the wheels. The lower end of the strut, which includes the stub axle for the front wheel, connects to a ball-joint on the control arm.



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Fig. 1. BMW E36 front and rear suspension systems.

GENERAL



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Fig. 2. Front suspension control arm (arrow).

The front suspension is designed with minimum positive steering offset. This geometry contributes to stability when traction is unequal from side to side. Suspension travel is limited by rubber bump stops.

The three point mounting of each L-shaped control arm precisely controls the front-to-rear and side-to-side position of the strut, while the flexibility of the joints and mounts also allows the movement necessary for suspension travel. The control arm mounting points are designed with anti-dive geometry. The suspension reduces the normal tendency for the front of the vehicle to dive under hard braking.

Control arm position is fixed, with no adjustment provisions on the control arms for altering front wheel alignment. A stabilizer bar mounted to both control arms helps to reduce body roll when cornering.

Steering

The variable-assist power steering system consists of an engine-driven hydraulic pump, a rack-and-pinion type steering gear, and connecting linkage to the road wheels. The E36 utilizes an engine-speed dependent variable effort steering system. At low speeds, maximum power assist is provided to ease parking and city driving. At high speeds, assist is reduced to ensure stability.

The steering linkage connects the rack-and-pinion unit through tie rods to the steering arms. The tie rod ends allow the wheels to pivot and react to suspension travel.

Rear Suspension

The rear axle carrier is the main mounting point for the final drive housing and the rear suspension components.

Trailing arms locate the rear wheels and anchor the springs, shocks and stabilizer bar. Drive axles with constant-velocity (CV) joints at both ends transfer power from the differential to the road wheels. The differential is mounted to the rear axle carrier through rubber mounts and bushings to help isolate drivetrain noise and vibration.

Brakes

E36 cars are equipped with power disc brakes with an integral antilock brakes (ABS). The parking brake is a dual-drum system integrated with the rear brake rotors. See Fig. 3.

Power assist is provided by a vacuum booster when the engine is running. The brake pedal pushrod is connected directly to the master cylinder, so failure of the vacuum booster does not normally result in total brake failure.

Each disc brake uses a caliper with a single hydraulic cylinder. Brake pads in the left front and right rear contain wear sensors. When the pads need replacement, the sensors illuminate a light on the dashboard.

Tires and Wheels

Tire size is critical to the proper operation of the E36 ABS or ABS/AST system. Several different styles of wheels, in 15, 16 and 17 inch diameters, are available from an authorized BMW dealer.

NOTE—

Aftermarket wheels should be selected with care. Improperly fitted wheels can contact and damage suspension, brake or body components and may adversely affect vehicle stability.

INTEGRATED SYSTEMS

Antilock Brake System (ABS) is standard on all E36 cars. Standard on some models and installed as optional equipment on others, is All Season Traction (AST).

Antilock Brake System (ABS)

The electronically-controlled ABS maintains vehicle stability and control during emergency braking by preventing wheel lock-up. ABS provides optimum deceleration and stability dur-

INTEGRATED SYSTEMS

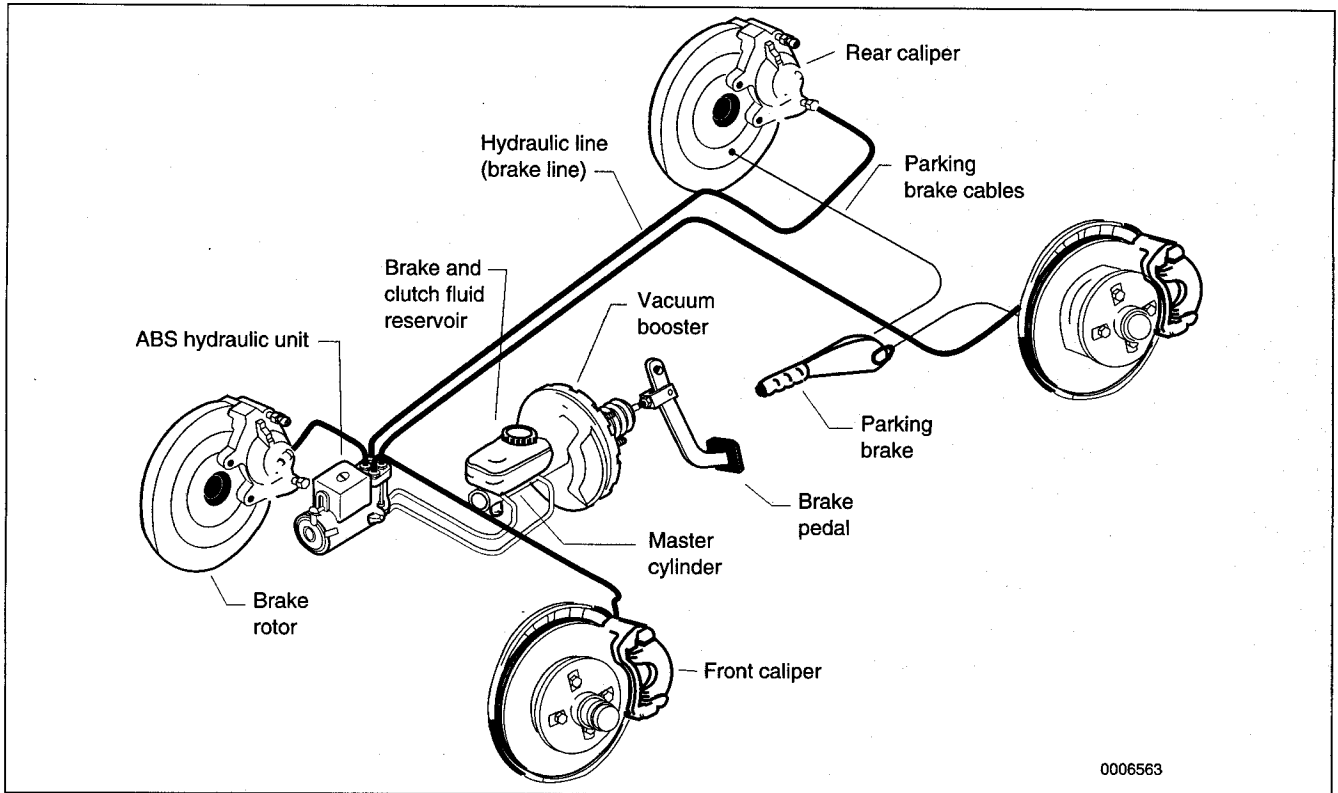


Fig. 3. Schematic view of dual circuit brakes with 4-channel ABS.

ing adverse conditions. It automatically adjusts brake system hydraulic pressure at each wheel to prevent wheel lock-up.

The system's main components are the wheel speed (pulse) sensors, the ABS control module, and the hydraulic control unit. See Fig. 4.

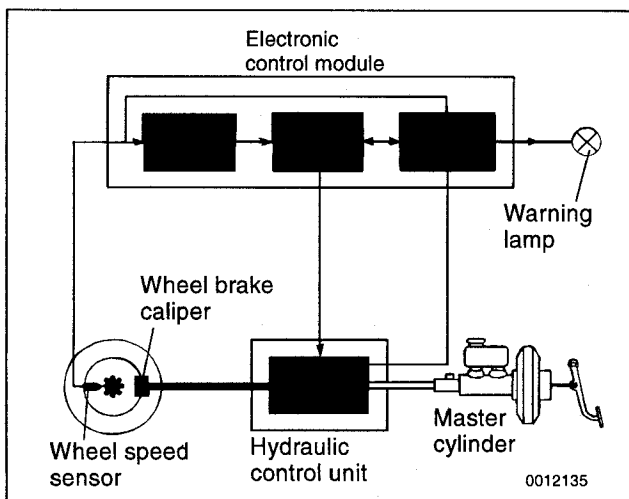


Fig. 4. Schematic representation of ABS.

The wheel speed sensors continuously send wheel speed signals to the control module. See Fig. 5. The control module compares these signals to determine, in fractions of a second, whether any of the wheels are about to lock. If any wheel is nearing a lock-up condition, the module signals the hydraulic unit to maintain or reduce pressure at the appropriate wheel(s). Pressure is modulated by electrically-operated solenoid valves in the hydraulic unit.

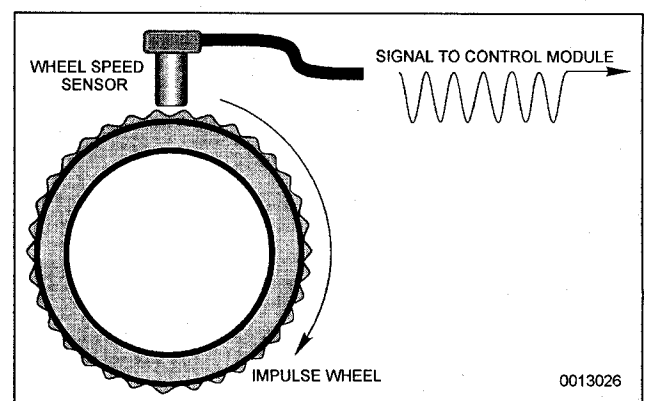


Fig. 5. ABS wheel speed sensor.

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Three-channel ABS is used on all E36 cars equipped with standard ABS. Each front wheel has a separate solenoid valve to modulate hydraulic pressure to that brake caliper. The rear wheels are modulated as a pair, controlled by a single solenoid valve.

E36 cars equipped with ABS/AST utilize a four channel system, which functions exactly as the three channel system above, except that the rear wheels are modulated individually.

All Season Traction (AST)

The traction control system works in conjunction with ABS and the engine management system to enhance vehicle control. The main function of the AST system is to maintain the rolling contact between the tires and the road surface under all driving conditions. This is achieved through exact application and management of braking and drivetrain forces.

The throttle control system used in AST is illustrated in Fig. 6.

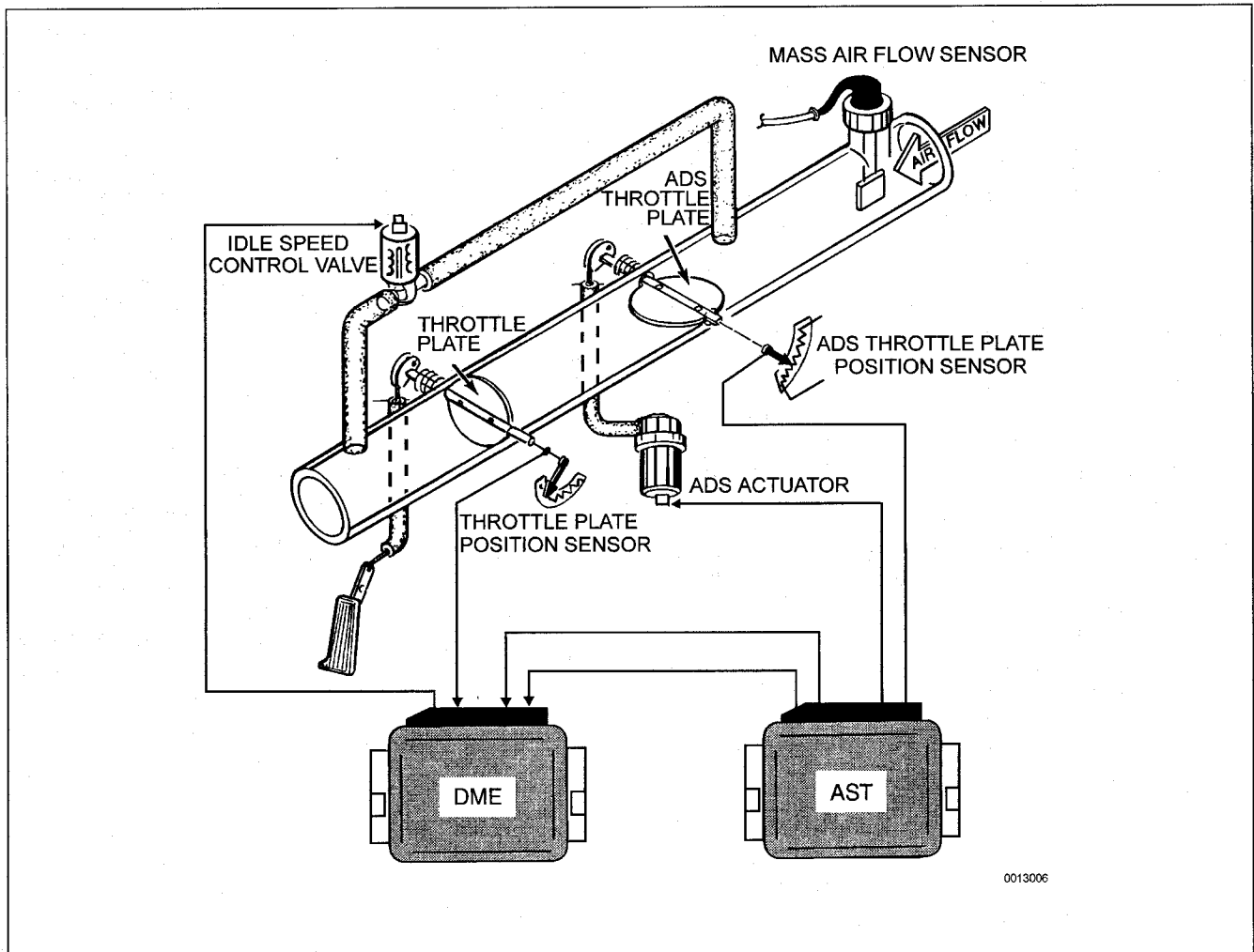


Fig. 6. All Season Traction (AST) works with other drivetrain systems to enhance vehicle control.

NOTE—

The traction control system referred to as AST (all season traction) may also be referred to as ASC (Automatic Stability Control) and ASC+T (Automatic Stability Control+Traction).

The AST system improves traction by electronically applying the rear brakes when the rear drive wheels are spinning at a faster rate than the front wheels. The combined ABS/AST control module, operating through the ABS hydraulic control unit, modulates braking force at the rear wheels.

In addition, AST uses retarded ignition timing and an auxiliary engine throttle plate to reduce engine torque and maintain vehicle stability.

The auxiliary throttle plate is held open by spring pressure. The AST system activates the auxiliary throttle position motor (ADS) to close the AST throttle as needed. This reduces the volume of engine intake air. Due to the throttle closing very rapidly during AST operation the driver cannot increase the engine power output regardless of how far the accelerator pedal is pushed to the floor.

The auxiliary throttle plate is placed ahead of the conventional throttle plate in the throttle body.

Traction control also comes into operation during deceleration. Decelerating on snowy or icy road surfaces can lead to rear wheel slip. If a rear wheel starts to drag or lock up when the throttle is closed rapidly or during downshifting, the AST system can limit the problem by advancing the ignition timing.

A switch on the center console is used to toggle the AST on or off.

The AST system is designed to be maintenance free. There are no adjustments that can be made. Repair and troubleshooting of the AST system requires special test equipment and knowledge and should be performed only by an authorized BMW dealer. **Table a** lists the conditions indicated by the AST indicator light in the instrument cluster

Table a. AST Indicator Lamp Function

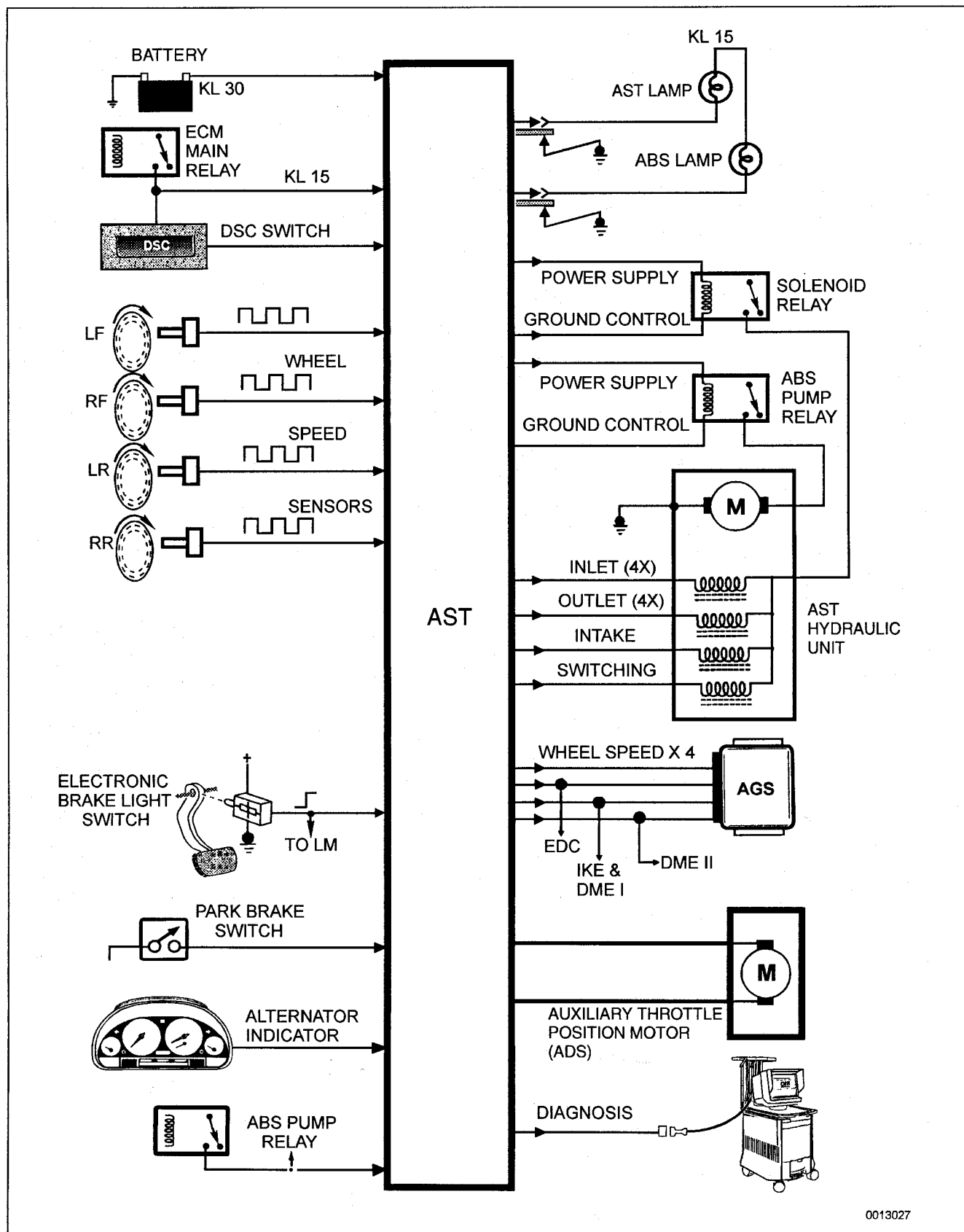
Indicator lamp	Condition	Comment
Light on	Normal AST start-up	Automatic AST self-test
Light off	AST monitoring mode	Automatic AST operation
Press AST button, light comes on	AST off (disabled)	Rocking the car to get out of snow or other loose surface Driving with snow chains
Press AST button: light goes out	AST monitoring mode	Automatic AST operation
Light flashes	AST active mode	Normal AST operation as it controls wheel speed
Light stays on after start up or comes on while driving	Defect in AST	Consult BMW dealer for diagnosis/repair (Vehicle operation remains normal)

WARNING—

Even a car with AST is subject to the normal physical laws. Avoid excessive speeds for the road conditions encountered.

CAUTION—

- If the tires on the car are of different makes, the AST system may over-react. Only fit tires of the same make and tread pattern,
- In adverse conditions, such as trying to rock the car out of deep snow or another soft surface, or when snow chains are fitted, it is advisable to switch off AST and allow the car's driveline to operate conventionally.



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Fig. 7. Schematic of All Season Traction (AST) system.

INTEGRATED SYSTEMS

M3 SUSPENSION AND BRAKES

The E36 M3 was introduced in late 1994 as a 1995 model. The design of the M3 suspension, steering and brakes is a modification of existing E36 systems which accommodates increased power output and road-handling demands.

The steering geometry is modified by changing the caster/camber angles slightly. This is accomplished by repositioning the upper strut mounting holes in the front strut towers and through different front and rear control arms.

M3 Front Suspension Improvements

- Reinforced spring plates, control arms, control arm bushings, steering arms.
- Recalibrated struts, firmer springs.
- Stiffer stabilizer bar, larger stabilizer bar bushings.
- Front stabilizer linked to struts.

M3 Rear Suspension Improvements

- Reinforced trailing arms.
- Recalibrated shock absorbers, firmer springs.

M3 Brake System Improvements

- Vented directional front rotors: 315 mm dia. x 28 mm thick.
- Vented directional rear rotors: 312 mm dia. x 20 mm thick.
- Larger brake pads and calipers.
- Modified Teves ABS system.

NOTE—

M3 brake rotors are directional, having a different part number for each side. Rotors with an odd part number go on the left while rotors with an even part number go on the right.

M3 Wheels/Tires

- Front wheels 1992-1998: 7.5J x 17 in. light alloy
- Rear wheel 1992-1997: 7.5J x 17 in. light alloy
- Rear wheel (option) 8.5 J x 17 in. light alloy
- Front and rear tire
1992-1997 235/40 x 17 in.
- Front tire 1998 only 225/45 x 17 in.
- Rear tire 1998 only. 245/40 x 17 in.

CAUTION—

In an emergency, an M3 front wheel/tire assembly may be mounted on the rear axle. However a rear wheel/tire assembly must **not** be mounted on the front axle.

SUSPENSION AND STEERING TROUBLESHOOTING

Stable handling and ride comfort both depend on the integrity of the suspension and steering components. Any symptom of instability or imprecise road feel may be caused by worn or damaged suspension components.

When troubleshooting suspension and steering problems, also consider the condition of tires, wheels, and their alignment. Tire wear and incorrect inflation pressures can dramatically affect handling. Subtle irregularities in wheel alignment angles also affect stability. Mixing different types or sizes of tires, particularly on the same axle, can affect alignment and may unbalance a car's handling.

Table b lists the symptoms of common suspension and steering problems and their probable causes, and suggests corrective actions. Bold type indicates the repair groups where applicable test and repair procedures can be found.

300-8 SUSPENSION, STEERING AND BRAKES-GENERAL

Table b. Suspension and Steering Troubleshooting

Symptom	Probable cause	Repairs (Repair Groups shown in bold)
Car pulls to one side, wanders	a. Incorrect tire pressure b. Incorrect wheel alignment c. Faulty brakes (pulls only when braking)	a. Check and correct tire pressures. 020 b. Check and adjust wheel alignment. 320 c. Check for sticking/damaged front caliper. 340
Steering heavy, poor return-to-center	a. Worn upper strut bearing(s) b. Incorrect tire pressure c. Power steering system faulty	a. Replace strut bearings. 310 b. Check and correct tire pressures. 020 c. Check power steering fluid level. Test system pressure. 320
Front-end or rear-end vibration or shimmy	a. Worn strut cartridges or shock absorbers b. Worn suspension bushings (control arm or trailing arm) c. Worn front suspension ball joints (control arm, steering arm or steering tie-rod end) d. Unbalanced or bent wheels/tires e. Loose wheel lug bolts	a. Replace strut cartridges. 310, 330 b. Replace worn bushings. 310, 330 c. Replace worn ball joints. 310 d. Balance tires. Check tires for uneven wear patterns. Check wheels for damage. e. Tighten lug bolts to proper torque.
Poor stability, repeated bouncing after bumps, suspension bottoms out easily	a. Worn strut cartridges or shock absorbers	a. Replace strut cartridges. 310, 330
Suspension noise (especially over bumps)	a. Worn front upper strut bearings b. Loose front strut cartridge c. Worn suspension bushings (control arm or trailing arm) d. Worn stabilizer bar rubber mounts e. Loose suspension crossmember	a. Replace upper strut bearings. 310 b. Check/tighten strut cartridge collar nut. 310 c. Replace worn bushings. 310, 330 d. Replace stabilizer bar rubber mounts. 310, 330 e. Check crossmember for damage. Tighten mounting bolts.
Uneven ride height	a. Incorrect coil springs b. Bent or damaged suspension components c. Sagging coil springs	a. Measure ride height and replace springs as required. 310, 330 b. Inspect, repair/replace as necessary. 310, 330 c. Measure ride height and replace springs as required. 310, 330
Wheel noise, continuous growling, may be more noticeable when turning	a. Worn wheel bearing	a. Replace wheel bearing. 310, 330
Steering loose, imprecise	a. Incorrect tire pressure b. Loose steering gear mounting bolt(s) c. Worn tie rod end(s) d. Faulty front wheel bearing e. Worn or damaged steering gear f. Worn tires	a. Check and correct tire pressures. 020 b. Inspect and tighten bolts. 320 c. Replace tie rod(s) and align wheels. 320 d. Replace wheel bearing. 310 e. Adjust or replace steering gear. 320 f. Replace tires. 010

