



Honda Develops World's First Super Handling All-Wheel-Drive Available this fall in the Acura RL (North America) and the Legend (Japan)

TOKYO - April 1, 2004 --- Honda Motor Co., Ltd. today announced the development of a new Super Handling All-Wheel-Drive system, called SH-AWD, that provides cornering performance that responds faithfully to driver input, and outstanding vehicle stability. A world's first, the SH-AWD system combines front-rear torque distribution control with independently regulated torque distribution to the left and right rear wheels to freely distribute the optimum amount of torque to all four wheels in accordance with driving conditions. The new system will be available this fall in the Acura RL (North America) and the Legend (Japan).

By monitoring driver input and driving conditions, the SH-AWD system determines the optimum front-rear and lateral (left-right) torque distribution. This information is then conveyed to the rear differential, where direct electromagnetic clutches continuously regulate and vary front-rear torque distribution between ratios of 30:70 and 70:30, and lateral torque distribution in the rear wheels between ratios of 100:0 and 0:100. Torque is used not only for propulsion, but for cornering as well, resulting in a significant enhancement in vehicle maneuverability.

The SH-AWD system is composed of sensors to detect steering angle, lateral g, and other vehicle information; an ECU; and the rear differential. The direct electromagnetic clutches inside the rear differential, another world's first, employ electromagnets to obtain precise control over the multi-plate clutches. Built-in search coils monitor the gaps between the electromagnets and the magnetic body to achieve precise, continuously variable torque regulation.

The rear differential is also equipped with a built-in acceleration device, yet another world's first. During cornering, the track of the outside rear wheel normally falls outside the average of the tracks of the front wheels. The outside rear wheel does not rotate fast enough to keep up with the front wheels, preventing efficient transmission of torque. To counteract this problem, the SH-AWD acceleration device alters the gearing to speed up the outside rear wheel's rotation relative to the front wheels. This reduces torque transmission losses and significantly improves vehicle maneuverability.

At Honda, driving pleasure is regarded as one of the most important factors in vehicle development. The new SH-AWD system features "feed-forward" control, which utilizes the degree of driver input to determine appropriate torque distribution. This results in a super-neutral steering feel that responds with optimal faithfulness to the driver's handling of the steering wheel, realizing outstanding driving comfort and stability.



SH-AWD system (rear differential cutaway model)

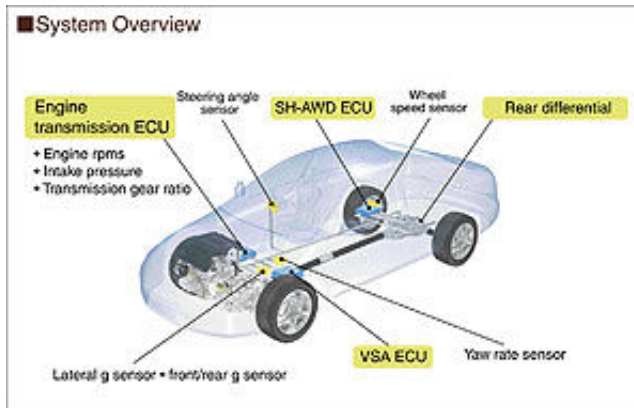
● Torque Distribution Regulation

- Acceleration during cornering
Torque to the rear wheels is continuously varied to supply up to 100% to the outside wheel and 0% to the inside wheel. This creates an inward yaw moment, significantly improving vehicle handling.
*Yaw moment is turning torque relative to the vertical axis running through the vehicle's center of gravity.
- Deceleration during cornering (throttle closed)
Torque to the outside rear wheel is freely varied to change from an inward to an outward yaw moment, ensuring vehicle stability at all times.
- Straight-line driving
Front-rear torque distribution is regulated for optimum performance in accordance with the amount of torque produced. During rapid acceleration the load on the front wheels is reduced; conversely, rear-wheel load is reduced during cruising. The result is stable driving at all times.

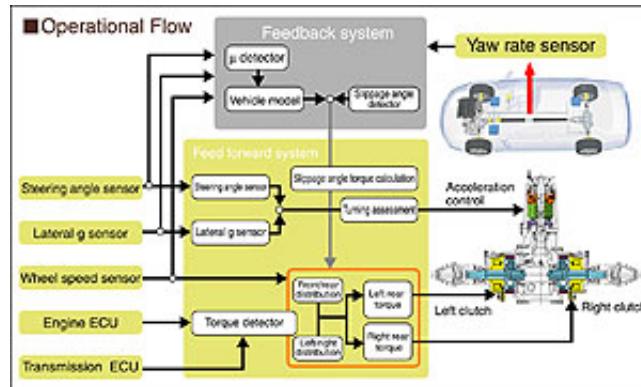
● System Configuration

- World's first direct electromagnetic clutch
An electromagnetic coil (electromagnet) attracts a magnetic body which, in turn, presses on the multi-plate clutch to facilitate torque transmission. A compact clutch unit, equipped with a planetary gear step-up mechanism to increase torque, permits transmission of substantial amounts of torque. A built-in search coil monitors the gap between the electromagnetic coil and the magnetic body. Current flow in the electromagnetic clutch is then adjusted to achieve highly precise torque regulation.
- Acceleration device
During straight-ahead driving, the twin-pinion planetary carrier spins in synchronization with the propeller shaft, causing the front and rear wheels to turn at the same speed. When the vehicle enters a curve, however, the planetary carrier is locked to the case, releasing the device from synchronization with the propeller shaft and accelerating the rotation speed of the rear wheels. A hydraulic actuator which turns the clutches on and off, and a one-way clutch are included in this compact configuration.
- Sensors, ECU
The input of steering angle, lateral g, yaw rate, wheel speed and other sensors monitor driver input, vehicle demeanor, and driving conditions such that the SH-AWD ECU can calculate ideal torque distribution.

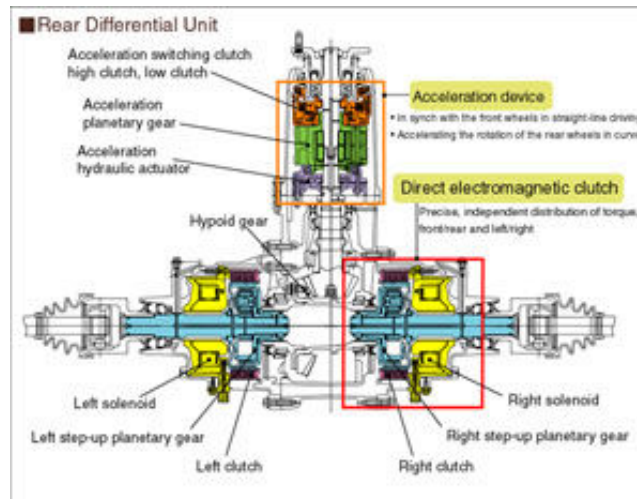
● System Overview



● Operational Flow



● Rear Differential Unit



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