

ACTIVE SUSPENSION

Active suspension systems are advanced vehicle suspension systems designed to improve ride quality, handling, and overall vehicle dynamics compared to traditional passive suspension systems. These systems utilize electronic controls and various sensors to actively adjust the suspension characteristics based on real-time driving conditions. Here's a detailed overview of how active suspension systems operate.

Application Note



1. CORE COMPONENTS OF ACTIVE SUSPENSION SYSTEMS

1.1 Sensors

- Active suspension systems are equipped with various sensors, including accelerometers, speed sensors, and position sensors. These sensors monitor various parameters such as road conditions, vehicle speed, body motion, and wheel displacement
- Ride height sensors monitor the distance between the vehicle chassis and the ground to ensure optimal suspension response

1.2 Control Unit

- A central electronic control unit (ECU) processes data from the sensors and uses algorithms to determine the optimal suspension settings for different driving conditions. The ECU makes rapid adjustments, typically in milliseconds, to maintain ride quality and vehicle stability

1.3 Actuators

- Active suspension systems use actuators (like hydraulic, air or electric motors) to adjust the stiffness and damping characteristics of the suspension in real-time. These actuators can alter the height and response of individual wheels or the entire suspension system
- Adaptive dampers adjust the damping force based on the control signals received from the ECU, allowing for softer settings during normal driving and firmer settings during aggressive maneuvers

1.4 Power Supply

Active systems often require a power source, such as a dedicated hydraulic/air pump or an electric power source, to drive the actuators and control mechanisms

ACTIVE SUSPENSION APPLICATIONS

- Passenger cars
- Transit buses
- RV's and campers
- Box trucks
- Emergency response vehicles



2. OPERATING PRINCIPLE

2.1 Real-Time Data Acquisition

- As the vehicle encounters various road conditions, the sensors continuously collect data on vertical motion, road irregularities, and vehicle dynamics. The sensors feed this information to the ECU, which assesses the current driving scenario

2.2 Data Processing

- The ECU processes the sensor data using predefined algorithms and control strategies. The system may prioritize various performance aspects, such as comfort, stability, and handling, depending on the driving conditions and driver preferences

2.3 Actuator Adjustment

- Based on the processed data, the ECU sends commands to the actuators to adjust the suspension characteristics. This may involve changing the stiffness of the shock absorbers, altering the ride height, or modifying the compression and rebound rates of the suspension system
- For example, if the vehicle detects rough terrain, the system may increase the shock absorber's damping to minimize the vertical motion transmitted to the vehicle chassis, enhancing comfort

2.4 Continuous Adaptation

- The system continuously adapts to changing conditions. For instance, during cornering or rapid acceleration, the suspension can be adjusted to improve grip by stiffening the damping or lowering the ride height to reduce body roll

3. BENEFITS OF ACTIVE SUSPENSION SYSTEMS

3.1 Improved Ride Comfort

- Active suspension systems can significantly enhance ride comfort by actively responding to road conditions and minimizing vibrations and jolts transmitted to the passengers

3.2 Enhanced Vehicle Stability

- These systems enhance vehicle stability by adjusting the suspension dynamically to maintain optimal tire contact with the road surface, preventing loss of traction

3.3 Increased Handling Performance

- Active suspension allows for better handling characteristics. By adjusting suspension stiffness during cornering, vehicles can maintain better control and minimize body roll

3.4 Adaptive Performance

- The ability to switch between comfort and sport modes within fractions of a second allows for a customizable driving experience tailored to both comfort-oriented cruising and performance driving

4. APPLICATIONS

Active suspension systems are increasingly found in more types of vehicles like, buses and coaches, RVs & campers, emergency response vehicles, box trucks, and other on- and off-road applications. Manufacturers leverage these systems to differentiate their offerings by providing enhanced driving dynamics and comfort.

5. SOLUTION

To assist in monitoring and detecting such conditions Honeywell offers the Hall-effect Based RTY Position Sensor.

Sensors are attached to individual moving elements of the suspension, to provide movement detection and integrated into the equipment to provide real time feedback, and compensating for road conditions or changes in terrain.

The Honeywell Hall-effect rotary position sensors provide data for demanding applications in industries such as heavy-duty, on and off-highway transportation.

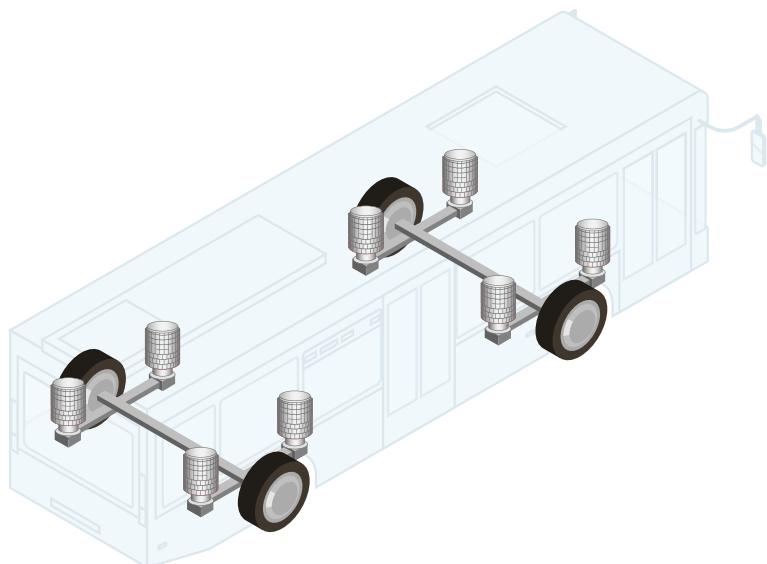


RTY Series Dual Hall-effect Rotary Position Sensor

6. SUMMARY

Active suspension systems represent a significant advancement in vehicle suspension technology. By employing real-time data processing and electronic controls, these systems are capable of dynamically adjusting to a wide range of driving conditions, resulting in improved ride comfort, vehicle stability, and handling performance.

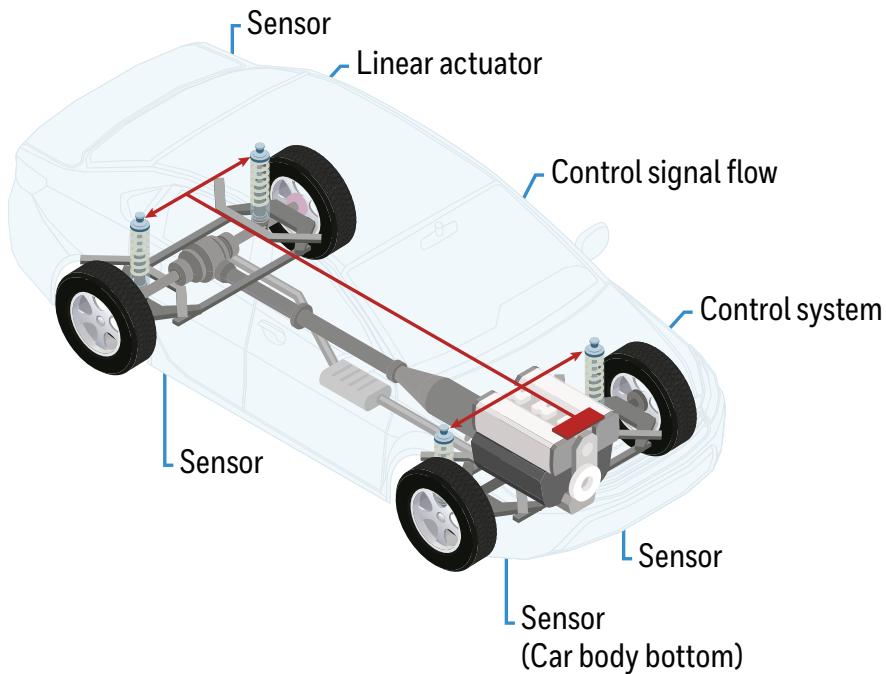
Figure 1. Suspension Points for a Traditional Bus



7. FEATURES AND BENEFITS

- **35 M cycle product life** delivers long life in the application
- **Solid-state Hall-effect technology** provides non-contact operation, long service life, low torque actuation and reduces worn-out mechanisms
- **Rugged IP67& IP69K sealed package** with integral connector allows for use in harsh environments
- Stable performance over temperature range
- Vibration immunity and diagnostic functions
- Automotive-grade EMI/EMC testing, integrated reverse polarity, and short circuit allows for protection against installation errors and frequencies in the environment
- Industry-standard six position AMPSEAL-16 connector
- **Eight operating ranges up to 360°** delivers flexibility in multiple applications, allowing OEMs the range of travel needed for the application
 - Linearity $\pm 1\%$
 - Accuracy $\pm 1.6\%$
 - Sensor provides two independent analog output signals for enhanced system integrity
 - Sensor available with or without levers for easy installation

Figure 2. Cross Section of Active Suspension Components in Passenger Cars





⚠WARNING IMPROPER INSTALLATION

- Consult with local safety agencies and their requirements when designing a machine control link, interface and all control elements that affect safety.
- Strictly adhere to all installation instructions.

Failure to comply with these instructions could result in death or serious injury.

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