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Service Tips and Best Practices

ABS Signal Type- Difference between Passive and Active Sensors

Brand	Supreme/TTX	Product	Wheel Bearings and Hub Assemblies	Date	May 2021
Part Number(s)	N/A				

Modern vehicles rely on wheel speed data for a variety of safety, comfort and driver assistance systems. This wheel speed data is typically transmitted at the wheel end by the wheel bearing and or hub assembly. Depending on the design of the wheel bearing and or hub assembly, this can be achieved by an encoder which is integrated into the seal or located on the CV shaft and the sensor on the vehicle side or both unitized into the hub assembly.

It is important to distinguish between the type of sensors and signal type- Passive and Active- especially when diagnosing a fault related to the ABS system.

Passive (Analogue/AC/Variable-Reluctance)

Passive sensors generate an induction signal, which may be represented by a sinusoidal wave form on an oscilloscope (**see Figure 1**).

A passive sensor is located in close proximity to a "toothed" impulse or encoder ring; as part of the wheel hub or CV shaft. The sensor contains a coiled magnet which creates a magnetic effect, in relation to the encoder ring.

As the toothed encoder rotates, the magnetic field will change polarity creating an alternating voltage in the sensor coils; producing the sinusoidal waveform. The frequency and amplitude of this alternating voltage changes in direct relation to wheel speed. As wheel rotation increases, the larger the frequency and amplitude of the signal.

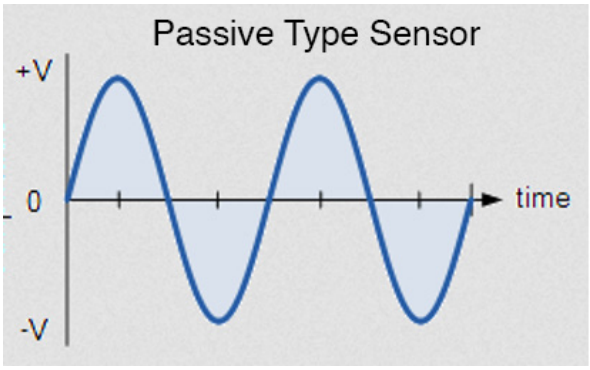

Figure 1: Passive sensor wave form

As passive sensors require somewhat substantial movement (rotation of the wheel) to read the generated signal (not enough amplitude), they are only "useful" above 4-5 MPH (6-8 KPH). For the most part, this disqualifies them for use with modern safety, comfort and driver assistance systems.

Additionally, as passive sensors depend on the magnetic field created by the sensor magnet and the encoder, the distance between the two is crucial. If the gap between the sensor and the encoder is out of specification, the ability to generate a correct signal may be impacted. Compounding this, the magnetic field may attract fine metallic particles from the road over time. These may accumulate on the sensor end and impair correct operation. If placed on a CV shaft, the encoder may also become damaged or worn from road debris. A missing or damaged tooth can lead to inconsistent signal output.

ABS Signal Type: Difference between Passive and Active Sensors

Active (Digital/DC/Magneto-Resistive)

When compared to passive sensors, active sensors have significantly improved low-speed performance and are able to read a signal up to when almost all vehicle motion has ceased. Moreover, the direction (forward or reverse) of wheel rotation can also be determined.

Active sensors are designed around a package of integrated electronics which are supplied voltage from the ABS module. There are a number of different versions of active sensor implementation but generally, a type of the encoder ring with alternating pole directions is located in the seal of the bearing on a hub assembly.

Similar to the passive sensor, as the ring rotates, the integrated electronics identify the alterations in the magnetic field. However, the electronics are able to convert this information into a digital output, which can be easily processed and utilized by vehicle safety, comfort and assistance systems. This signal may be represented by a square waveform on an oscilloscope (**see Figure 2**).

Using aspects of Hall sensor design, active sensors are more precise and accurate, able to detect the smallest variations in the magnetic field and allow for a larger gap between sensor and ring, compared to passive sensors. As they do not rely on an external ring, active sensors are less prone to fluctuations in signal generation and interpretation due to environmental or road conditions

When diagnosing an ABS trouble code, ensure to verify which sensor type is applicable to the vehicle. For example, Active sensors should not be resistance tested via an ohmmeter as a resistance reading may be produced when leads are connected in one direction and then an open circuit when connected in the other. Always ensure to reference original factory service manual for proper diagnostic, removal and replacement procedures and all related specifications and values.

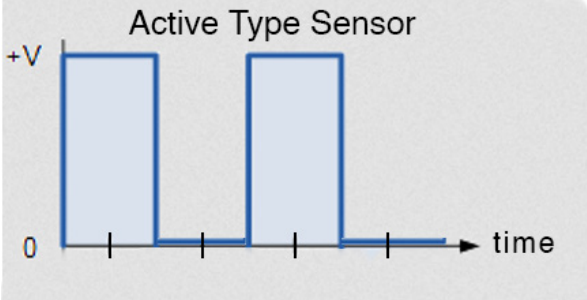

Figure 2: Active sensor wave form