Ground speed sensor technology developed for motor vehicles

October 20 2008

Hitachi, Ltd. announced the development of a compact and low cost speed sensor technology for motor vehicles which provides accurate measurement of relative velocity using an mm–wave radar (77GHz band). The technology enables the relative velocity of a motor vehicle to the ground to be measured by beaming millimeter–wavelength radio waves (mm–wave) on to the ground. Compared to conventional wheel–speed sensors which calculate velocity by detecting wheel rotation, the new sensor is able to measure velocity even during braking or slipping when the tires are not rotating.

Further, by dedicating to near–range sensor applications, an innovative design enabled the antenna and mm–wave transceiver to be integrated into one chip, to achieve a compact unit in a plastic resin–molded package measuring 6.5mm (l) x 4.4mm (w) x 6.0mm (h). The design innovation enabled stable sensor operation even with standard plastic resin packaging used for conventional semiconductor chips, and dispensed with the need to design a dedicated module configuration normally required for mm–wave applications. A dome–shaped compact lens structure fabricated with the plastic resin was also proposed to focus the radio waves. As a result, the issue of minimizing costs in mm–wave radars was addressed as well as achieving a compact unit.

In test runs, measurement accuracy with 2% variation was confirmed with a prototype ground speed sensor module integrating the single chip radar together with signal processing unit and power supply circuits. This technology is expected to contribute to improving the performance of

vehicular drive control systems such as ABS (anti–lock brake system). Further, an extension of its application can also be expected as a near–range monitoring sensor on the rear or side of a vehicle to prevent collision with objects which cannot be seen from the driver's seat.

In recent years, with the increasing demand for safety and comfort in driving, drive control systems to support safe–driving such as ABS and ACC (adaptive cruise control) have been introduced, resulting in a rapid transformation towards electronically–controlled motor vehicles. In order to improve the performance of these electronically–controlled systems, there is a need to increase the precision of the various types of vehicular sensors as well as reduce costs due to the large numbers used.

Currently, to measure vehicle velocity, a wheel–speed sensor which determines velocity by detecting the wheel rotation is used. This method however has the drawback of being unable to measure velocity during slips or braking when the tire is not rotating.

In response to this need, Hitachi has developed compact and low–cost vehicular sensor technology using a mm–wave radar to support safe driving, which can accurately measure relative automotive ground speed even when the tire is not rotating.

Details of the mm–wave radar automotive speed sensor technology developed are as follows:

(1) Transceiver circuit on a single–chip
The measurement range was limited to near range, and the circuit size was reduced. To prevent interference in transmission and reception signals which occur between circuits in close proximity, an optimal circuit for stable operation was designed based on analysis of the electromagnetic fields.

(2) Low–cost packaging using plastic resin
In the past, a dedicated module configuration needed to be designed for mm–wave radars which operate at a high frequency to prevent in–package signal resonance in the transceiver circuit. In this development, by limiting measurement to near–range and by applying an optimal design, stable operation was achieved even when the chip was encapsulated in a plastic resin packaging used for conventional semiconductor chips.

(3) Ultra–small dome–shaped wave focusing lens
In order to improve precision, it is necessary to narrow the radiation beam, and thus an ultra–small compact dome–shaped wave focusing lens structure was proposed. This lens is also fabricated with the plastic resin and can be easily mounted.

This technology was presented at the 2008 IEEE Compound Semiconductor IC Symposium (CSICS) in Monterey, California.

Provided by Hitachi