

Development of VR Resolver system for hybrid electric vehicles



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1. Abstract

Development of angle sensor (VR type resolver) and Resolver to Digital conversion IC (RD converter) that is built into in traction motor and on an ECU board for hybrid electric vehicles. This VR Resolver system detects the rotational position of the rotors inside the motor and generator in high resolution and high accuracy with excellent reliability under harsh environmental conditions.

2. Outline of technology

The resolver is an electromagnetic induction type angular sensor. The rotor consists of laminated silicon steel, and it has no coil. The feature is the shape of the rotor. Gap permeance between the rotor and the stator changes sinusoidal according to the angle. One exciting coil and two output coils are distributed in all slots of the stator (Fig.1). When an AC current is applied to it, it generates a magnetic field. Each output coil generates the induced voltage with the amplitude proportional to $\sin\theta$ and $\cos\theta$ respectively (Fig.2). The output signal has no effect from temperature drift and offsets, so it makes the resolver a stable sensor. The outputs from the VR resolvers are digitized by the RD converter on an ECU board by tracking loop technology (Fig.3). The VR resolvers cope perfectly in the harsh environment of the motor where it's hot and there's transmission oil circulating for cooling (Fig.4).

The features are described in the following.

- 1) Thin flat shape with large bore-hole
- 2) Wide operating temperature range of -40 to 150 degree C
- 3) High reliability under harsh environmental conditions, such as vibration, Shock, oil-resistant
- 4) High resolution and absolute angle detection
- 5) Low cost and mass production capability

3. Conclusion

The resolver system is adopted for most of the angle sensor for the traction motor of the hybrid electric vehicles. And it will become a major angular sensor as the motor for the automotive. It is expected to be a key component technology for motorization in the 21st century.

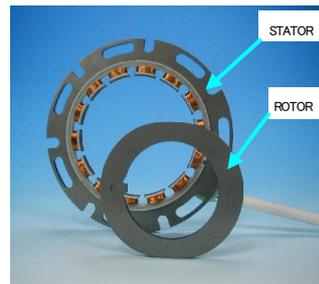


Fig. 1 VR type resolver

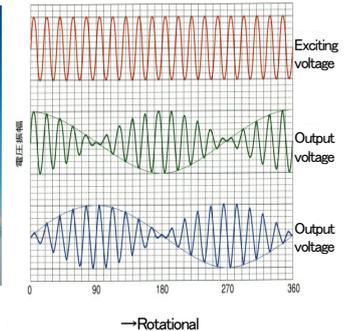


Fig.2 Resolver output signals

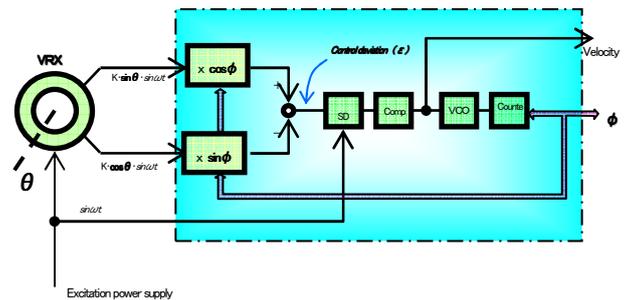


Fig.3 Block diagram of RD converter

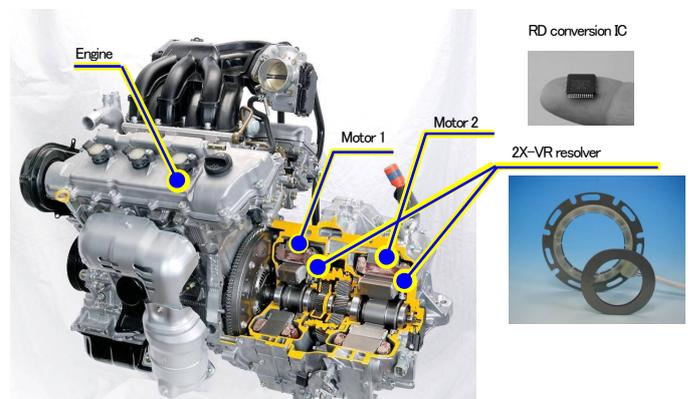


Fig.4 VR resolver system installed into Hybrid power unit

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