Practical Development of Wireless Power Transfer Inverters

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Decarbonization is essential for environmental protection, and promoting BEV adoption is important for reducing vehicle CO_2 . However, limited charging infrastructure and long charging times hinder BEV uptake. Consequently, practical deployment of Static (SWPT) and Dynamic (DWPT) Wireless Power Transfer is being advanced.

We applied high-frequency electromagnetic induction expertise from our induction-heating business to develop a wireless power inverter(Figure 1) and system that uses magnetic-resonance coupling to transfer power from a ground transmitter coil to a BEV-mounted receiver coil (equivalent to SAE J2954 WPT3, 11.1 kW).

Fig.1 Wireless Power Transfer Inverter

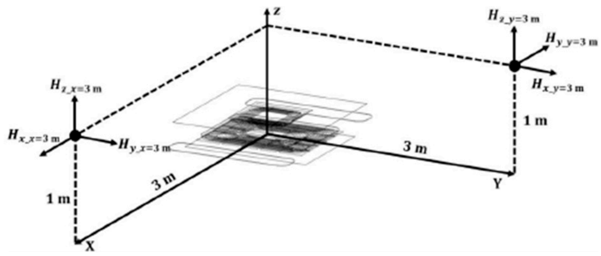

Fig.2 Measurement points

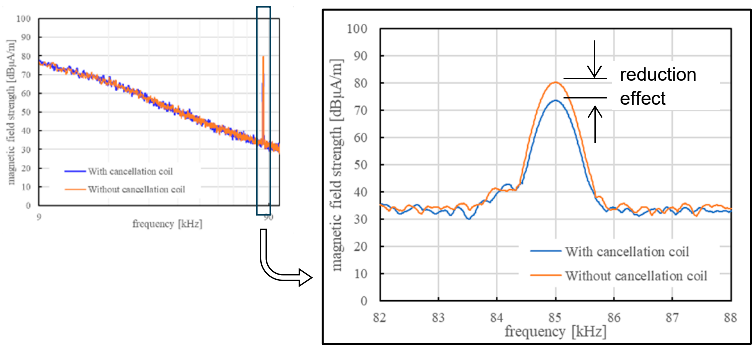

Fig.3 Leakage Magnetic Field Reduction

Wireless power transfer generates induced magnetic fields and electromagnetic noise; therefore, field trials must comply with the Radio Equipment Regulations (Article 65, Paragraph 1, Item 3). At the current output of 11.1 kW, compliance was achieved by applying the Ministry of Internal Affairs and Communications Notice No. 207 (leakage magnetic field limits). Future operation at higher power raises significant concerns about leakage in the primary 85 kHz frequency band.

In collaboration with Saitama University, we designed and prototyped a "cancel coil" comprising a single turn driving (induction) coil and two reduction coils positioned around or above the transmitter coil. The driving coil picks up current induced by the transmitter flux and supplies it to the reduction coils to generate canceling currents. By optimizing the coil geometry, the canceling current is phase inverted relative to the transmitter current, thereby reducing leakage while preserving power transfer performance.

Measurements were performed with a spectrum analyzer using peak detection at points located 3 m in the x and y directions from the coil center and 1 m above the coil base. The measured three axis magnetic fields (Hx, Hy, Hz) were combined for evaluation (Figure 2).

Leakage reductions of 6.64 dBμA/m (x direction) and 9.63 dBμA/m (y direction) were observed (Figure 3). Applying these reductions to previous radiated emission results suggests that compliance with Article 65 may be achievable without relying on Notice No. 207.