講演番号 045 文献番号 20226045

Construction of a Predicting Method for Radiated Noise from Motor System Bench Below 30 MHz

Ayumi Yamashita [1)] Soichiro Ota [1)] Hirotoshi Izawa [1)] Daisuke Funahashi [1)]

1) Toyota Motor Corporation

1 Toyota-cho, Toyota, Aichi, 471-8571, Japan

KEY WORDS: **EV and HV systems, Motor drive system, Electromagnetic compatibility,** Common mode current path [A3]

With the spread of electrification systems, there has been a serious problem that the high-frequency harmonics of switching power semiconductors used in high-voltage driving systems have strongly effects on AM radios and other in-vehicle electronic devices as electromagnetic noises. In this paper, among high-voltage components, we focused on a motor system, which has a high load and a large amount of noises.

There are two types of test methods for the motor system bench (CISPR25 Ed4 Annex I), one is the conducted noise, and the other is a radiated noise.For the conduced noise test method, high voltage cables are targeted as measurement subjects. And prediction method of this type of noise, circuit simulation using equivalent circuit is developed. For the radiated noise test method, high voltage cables are also targeted, but for this noise prediction, it is more challenging because there are common mode currents, conducting from GND plane to chamber floor and wall, which also contribute to the radiation.For this reason, we aim to develop a prediction model for radiated noise of the motor system bench for the frequency range below 30 MHz, which focuses on the common mode current paths including the environment around the bench.

When performing modeling, attention was paid to correctly reproducing the stray capacitance and parasitic inductance that exist on the propagation paths of the common mode currents, and the 3D structure of the whole environment of bench including dynamo case and chamber wall. If the parasitic inductance on the path changes, the frequency of the radiation peak will also changes. Here, we compared the radiation noises when there is a current passing through the path L (the common mode path between the dynamo case and the GND plane shown in Fig.1) and when there is no current passing through it.

As a result of comparing the radiation noise using the prediction method, as shown in Fig.2, the peak moved to the high frequency side by 4.5 MHz (to 9 MHz) when there was no path L. A similar situation has been also verified by measurements (see details in the full paper). Thus, we were able to confirm the accuracy of the prediction method and also confirmed that the change in parasitic inductance affects the radiation noise peak. In addition, using a prediction method, we were also able to clarify the change in the common mode current path due to the change in the parasitic component of path L, and analyzed its effect on the radiated emission peak.

If there is a structure such as a dynamo case connected directly to the chamber wall and formed a common mode current path, it is necessary to model the common mode current path including the chamber wall and floor. In addition, even in the actual motor system bench, there is concern that the common mode path will be different due to the difference in the grounding method, resulting in a difference in the radiation noise peak. So, it is also necessary to consider the common mode current path during measurements.

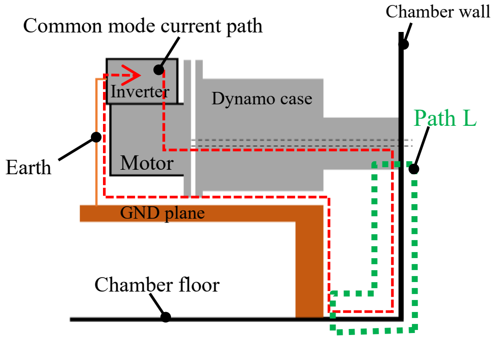

Fig.1 Common mode current path via dynamo case and chamber

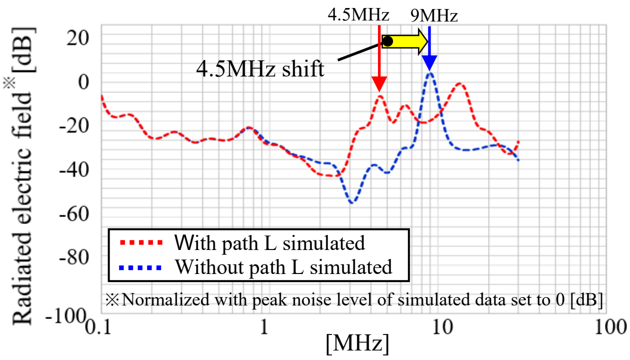

Fig.2 Change of peak frequency with/without path L

2022 JSAE Congress (Autumn) - Summarized Paper
Issued on October 7, 2022