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Investigation about conducted emission and radiated emission coming from charging vehicle

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In the uniform provisions for vehicle approval, UN-R No.10, electromagnetic emission coming from charging vehicle is prescribed as conductive emission of charging cable. Target frequency is from 150kHz to 30MHz. On the other hand, a rule is added for conducted emission of IEC that target consumer appliances or electrical equipment. The rule is to set test frequency depending on charging cable length that is influenced for electromagnetic emission. The purpose of this investigation is to measure conducted emission in a charging cable and radiated emission from the cable. Then we check the correlation of these result in order to investigate if the rule can be used for vehicle test.

As we refer to IEC61000-6-3 Annex B, if the cable length L[m] between off-board charging equipment to electrical vehicle is between 3m to 30m, start frequency of test for conducted emission is prescribed as 60/L[MHz].

The test method of conducted emission was refered to UN-R No.10 Annex 13 and the test method of magnetic emission was refered to CISPR11 clause 7.5. We measured each emissions with cable length of 9m, 15m and 24m.We focused amplitude of narrow band emission which was criated by on-board electrical control unit. We found that the longer cable was used, the lower amplitude was observed in both conducted emission and magnetic emission. We guess this is because effect of inductance of cable length.

In order to compare correlation between conducted emission and magnetic emission of before and after 60/L[MHz], results of conducted emission and magnetic emission about cable length was 15m were shown in Fig 1 and Fig 2 as representative. We compared margin against creteria by selecting 6 frequencies that ware outstanding. The results were shown in table 1. In this results, 60/L was 4MHz.

If we compared the gap of margin between conducted emission and magnetic emission under 4MHz, the gaps were over 3dB. On the other hand, over 4MHz, the gaps were under 3dB. From the results, we guess correlation become better by using 60/L.

When cable length is 15m, 1/4 wave length resonance happens when wave length is 60m and 1/2 wave length resonance happens when 30m. each resonance frequencies are 5MHz and 10MHz. Regarding point ④⑤, the reason why gap of margine was small is because it is considered that the frequencies of ④⑤ were same as the resonance frequencies. On the other hand, ①②③ are far from resonance frequency. So contribution for magnetic emission was low even if conducted emission level was high.

Because of this study, we think this is reasonable to use the rule of 60/L for conducted emission measurement of charging vehicle.

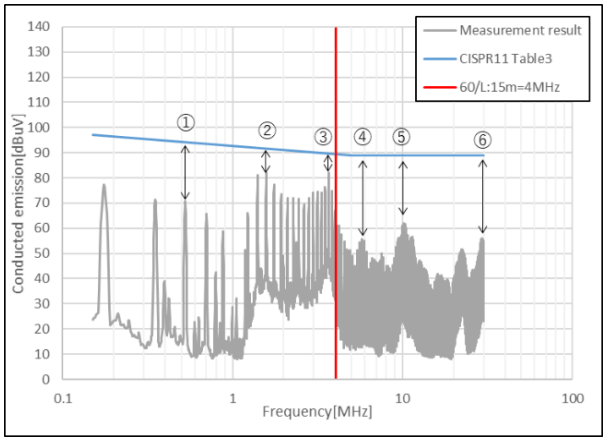

Fig.1 Representative frequency points of conducted emission about cable length 15m

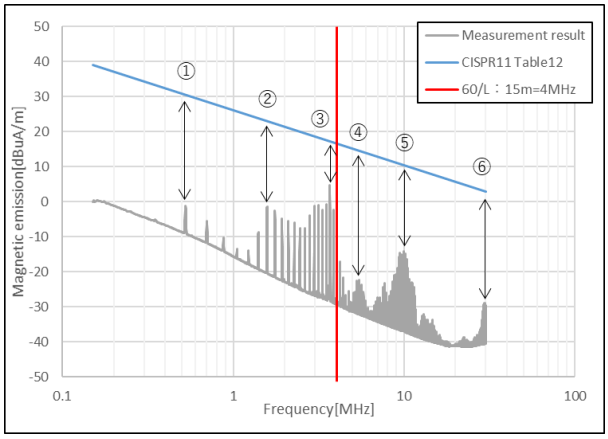

Fig.2 Representative frequency points of magnetic emission about cable length 15m

Table 1 Difference between margin of radiated emission and conducted emission

Point	①	②	③	④	⑤	⑥
Frequency[MHz]	0.53	1.58	3.68	5.44	9.64	29.46
A.Margin of conducted emission[dB]	24.62	10.14	7.77	34.89	27.97	34.37
B.Margin of magnetic emission[dB]	32.89	24.75	13.03	37.00	25.72	34.22
B-A gap[dB]	8.27	14.61	5.26	2.11	2.25	0.15