A Measurement for the SAR Probe Gain Response against TDD Modulated Signal for Probe Calibration at the frequency of 3.7 GHz

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1. Introduction

In a human exposure assessment of wireless communication devices, specific absorption rate (SAR) is used as a safety criterion at the frequency from 100 kHz to 6 GHz [1]. The conformity assessment based on the SAR is performed according to the standard [2]. The SAR probe calibration is important for the conformity assessment. Typically, the SAR probe is calibrated by CW signal. On the other hand, since the SAR probe detects the modulated signal in the actual measurement, the probe calibration against the modulated signal has been proposed to improve the measurement accuracy [3]. The calibration against 4G signal was considered, but not against 5G signal. In this study, the SAR probe gain response against the time division duplex (TDD) modulated signal used in 5G was measured at the frequency of 3.7 GHz for the basic study for the probe calibration.

2. Measurement Setting

The SAR probe gain can be calculated by dividing the probe output voltage by the squared electric field, since the electric field is squared by the diode in the probe. In this study, to evaluate the SAR probe gain response, the output voltage was measured by varying the electric field strength. The SAR probe was inserted to the waveguide as the electric field source. To observe the probe gain response against the random or burst signals such as TDD signal, the Uplink-Downlink configurations of 5G TDD signals were varied as shown in Table 1. Since the configuration is not strictly defined, it was set by ourselves based on some application notes for 5G signals. The modulation scheme was CP-OFDM QPSK 100 MHz band width at 3.7 GHz.

3. Measurement Result

Fig. 1 shows the measured SAR probe gain versus the electric field intensity. The probe gain decreased as increasing the electric field intensity in all configuration patterns. It was caused by the non-linear characteristic of the detection diode in the probe. However, the electric field intensity beginning the non-linear effect was higher level, and this level rarely observed in SAR measurement for commercially smart phones. In addition, the probe linearity characteristics of 5G TDD was the almost same as that of TD-LTE in [3]. Comparing the probe gain between each pattern, the characteristics can be divided into two parts, burst as pattern 1 or random as pattern 2 to 5.

Table. 1 Uplink-Downlink configuration

	Downlink fixed							Flexible									Uplink fixed				
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Pattern 1	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	U	U	U	U	U
Pattern 2	D	D	D	D	D	D	D	D	U	D	U	D	U	D	U	D	U	U	U	U	U
Pattern 3	D	D	D	D	D	D	D	D	D	U	U	D	D	U	U	D	U	U	U	U	U
Pattern 4	D	D	D	D	D	D	D	D	D	D	U	U	U	D	D	D	U	U	U	U	U
Pattern 5	D	D	D	D	D	D	D	D	D	D	D	U	U	U	U	D	U	U	U	U	U

D: downlink, U: uplink

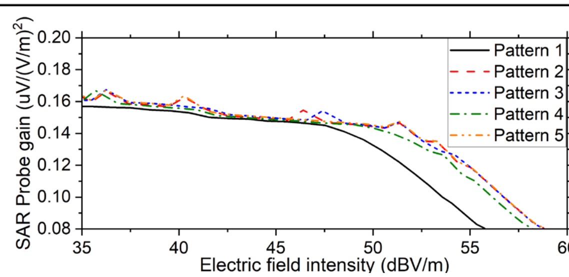

Fig. 1 SAR probe gain response

4. Conclusion

The SAR probe gain response against 5G TDD signal was measured. These results showed the applicability of TD-LTE signal calibration to 5G TDD signal and importance of classifying the signal as burst or random to calibrate the probe against the 5G TDD signal.

Acknowledgments

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References

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