Improvement of the Radiated Immunity Test Using a Broadband Signal

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Abstract— In this paper, we have investigated improvement of the radiated immunity test using a broadband signals. We have analyzed the recent standardization activity related with radiated immunity test based on IEC 61000-4-3 and have proposed a new test method using digitally modulated broadband signals to improve the testing time and frequency step. The possibility of this new test method has been practically verified through a radiated immunity test on GTEM cell. The results show that the devices were influenced same or much more by digital modulation signal than by AM signal. It shows that we can use the broadband signal for a radiated immunity test and it is possible to improve the RS test using new method.

1. INTRODUCTION

Owing to progress of Information Communication Technology convergence, sources of electromagnetic interference have proliferated and the immunity requirements for electronic products have been strengthened to prevent the interference caused by those sources [1].

The radiated immunity test according to IEC 61000-4-3 is performed with the amplitude modulation (AM) signal source and is tested using 1% step increment to reduce the testing time on the frequency band from 80 MHz to 1 GHz [2].

The wireless communication services are being evolved to long-term evolution (LTE) technology where it transmits information through broadband signal. Research results reported that the influence caused by the digital modulation (DM) signal sources has been elevated and it is greater than that of AM, and therefore the DM signal should be incorporated into RS test sources in order to reflect these changes on wireless environment [3, 4].

In this paper, we investigate a method using the broadband signal as a signal source for RS test, to solve a problem of frequency omission caused by 1% step increment and reduce a long spent time during radiated susceptibility (RS) test.

We have performed a RS test using a giga transverse electromagnetic (GTEM) cell to verify that the AM signal for a RS testing is possible to be alternate with a broadband signal. And then we have compared and analyzed the test results obtained using with a AM and broadband LTE signal.

2. IMPROVEMENT PLAN OF RS TEST BY USING A BROADBAND SIGNAL

As mentioned in the above paragraph, the test in this study uses the broadband signal instead of the narrow band AM to solve a problem of frequency omission and to reduce extended time spent during radiated susceptibility (RS) test.

First, let us suppose that a EUT has a weak point at 100.2 MHz.

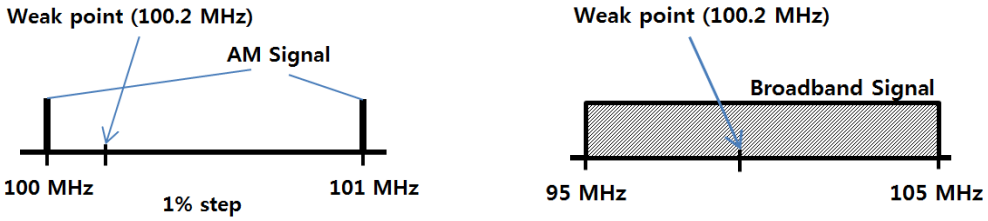

Figure 1: Improvement effect of a broadband signal. (a) Frequency omission issues of AM signal. (b) Effect of whole frequency band test of a broadband signal.

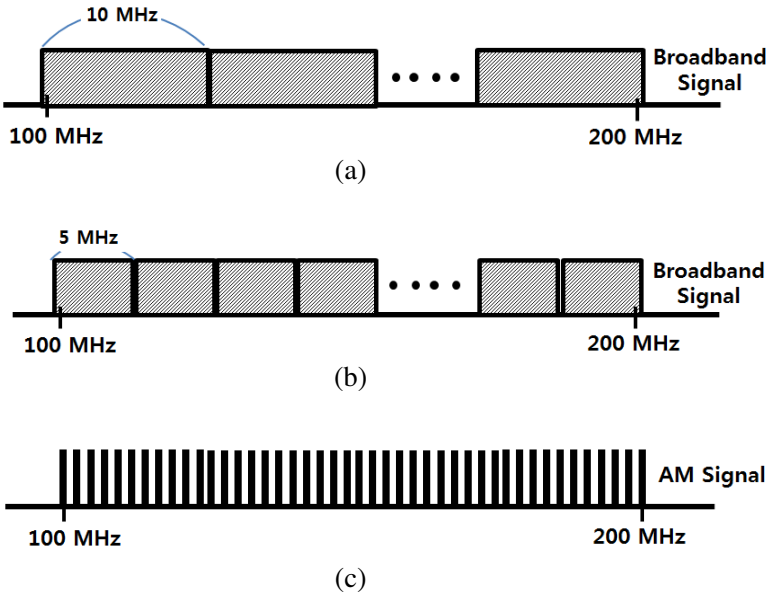

Figure 2: Effect of the test time reduction using a broadband signal. (a) Testing by 10 MHz bandwidth signal. (b) Testing by 5 MHz bandwidth signal. (c) RS test by AM signal.

In case that the weak frequency is located among frequencies to be tested during RS test, there arise a problem of skipping this frequency. It is shown in Figure 1(a). However, when the broadband signal is used, the entire frequency band as a bandwidth of broadband signal can be tested while the weak point is included within the bandwidth. It is shown in Figure 1(b).

Second, let's suppose that a EUT have causing an error between from 100 MHz to 200 MHz during RS test. If we use a broadband signal with 5 or 10 MHz bandwidth, it is achieved the effect that the test time could be shorten. It's shown at Figure 2.

3. TEST SET-UP AND CONDITIONS

To verify the effect of using a broadband signal for RS test, a RS test has been performed within a GTEM cell according to IEC 61000-4-20. To easily recognize the influence of RS, an EUT is used as a speaker with an amplifier. As a signal source the LTE signal of 10 MHz bandwidth is used with no load condition because this load condition of LTE is the worst condition reported [5].

In order to make the peak level of two signals equivalent, the signal generator is set with output level of −30 dBm at AM and −20 dBm at LTE.

The radiated signal spectra are presented in Figure 3.

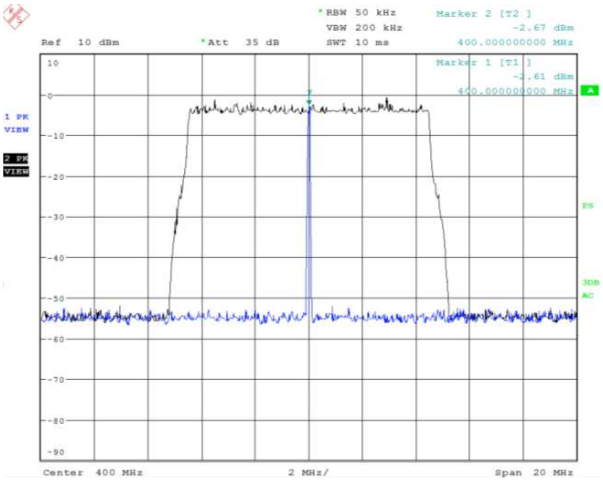

Figure 3: Generated AM and LTE signal spectrums.

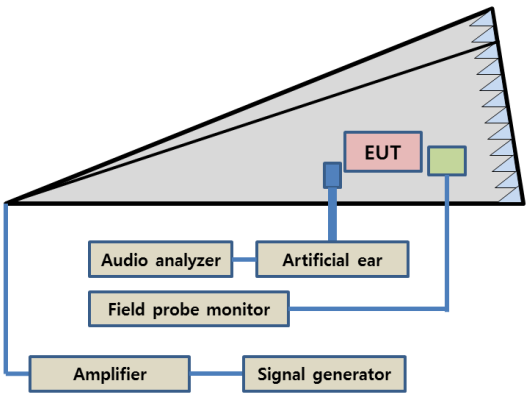

Figure 4: Test set-up.

The test setup is configured as shown in Figure 4.

In order to measure the output sound of the EUT, an artificial ear and an audio analyzer are utilized.

The calibration is performed to make a uniform field at the field strength of 3 V/m within the frequency range from 80 MHz to 1 GHz in accordance with IEC 61000-4-20. Test signal is generated by using a Vector Signal generator and is applied to the GTEM Cell through the amplifier. The signal level is set with the calibration level.

The RS test is performed at the frequency band between 80 MHz to 1 GHz.

Influence of RS for the EUT is measured by the value of noise level as the audio analyzer measures the noise sound generated by the speaker during RS test. Noise level is 5 mV at the absence of RS source, and that value of recognizable noise is 22 mV.

4. TEST RESULT AND ANALYSIS

The test result is shown in Figure 5.

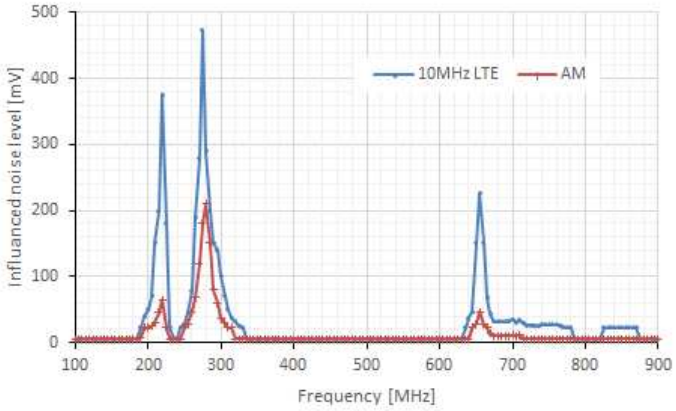

Figure 5: Test result.

In case of radiating the AM source, the RS disturbance is caused by the frequency band from 185 MHz to 235 MHz. In case of radiating the LTE source, the RS disturbance is caused by the frequency band from 190 MHz to 229 MHz. As predicted above, the disturbance is occurred during the overlap between the weak points and the spectrum of the broadband signal. And also the broadband signal has made a disturbance on wider band than that caused by AM. The weak points may have been skipped because AM is a narrow band signal. In the contrary, since the LTE is the broadband signal, the whole frequency band can be tested without omission.

5. CONCLUSION

In these days, broadband signals such as LTE and Wi-Fi are more widely used than AM signals. And the requirements for RS testing using them are getting more strict and complex.

In this study, we have suggested a method using the broadband signal to cover current RS test problems and then verified it experimentally.

Test result demonstrates that the broadband signal generates interference in a wider frequency band than AM signal and it covers AM bandwidth range.

And therefore we conclude that the AM signal sources can be replaced by broadband signals.

By using the broadband signal, frequency omission due to 1% step scan can be effectively prevented and it leads to reduced test time due to the wide bandwidth of the broadband signal.

ACKNOWLEDGMENT

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