Preliminary Measurement Analysis for Different EMC standards

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Abstract

It is a challenge to control the EMI generated by all kinds of electrical devices for radio telescope integrating due to extremely high EMC requirements. In order to better evaluate the tested results from the different EMC measurement standards, we established two test systems to meet the MIL-STD-461 and the CISPR 22 measurement requirements, and then conducted the related test in the same 3-meter anechoic chamber. Measured results show that the MIL-STD-461 measurement method is more sensitive and more signals can be detected than that of CISPR 22.

1 Introduction

In the context of radio astronomy, Radio Frequency Interference (RFI) is defined as any unwanted, non-astronomical electromagnetic signals received by a radio telescope, which include licensed or unlicensed wireless signals and the unintentionally generated signals emitted from electrical equipment in operation. As we know there are many kinds of electrical devices employed for radio telescope construction, which inevitably generates the RFI impacting on astronomical observations. Therefore, it is necessary for us to analyze the accuracy and differences for varies Electro Magnetic Compatibility (EMC) measurement standards, on which we can further evaluate whether the Electro Magnetic Compatibility EMC of each electrical equipment meet the requirements.

For radio astronomy equipment, we care more about the Radiate Emission (RE) performance at 30MHz-6GHz. The EMC measurement standards are widely used in commercial and military fields. International Electro technical Commission (IEC) established the IEC CISPR 22, IEC CISPR 14-1 and IEC CISPR 15 standards to apply the commercial field [1, 2, 3]. In addition, the U.S. military standard MIL-STD-461F is generally used for military electronic equipment [4]. And it establishes interface and verification requirements for the control of the EMI and susceptibility of electronic, electrical, and electromechanical equipment.

In this paper, we would like to analyze the differences of the main EMC measurement standards above in the 3-meter anechoic chamber, that we can evaluate the EMC, and have a great engineering significance.

2 RE test and differences analysis

To accurately compare the difference between the two EMC measurement standards, we established the different EMC measurement system according to the related standards in the same 3-meter anechoic chamber. And In order to achieve better sensitivity of the test system, all microwave devices and RF cables are required to have the lowest possible noise temperature and insertion loss.

2.1 Test system

(1) In order to better compare the difference between the two EMC measurement standards, we built an Equipment under Test (EUT) system including a signal generator and am omnidirectional antenna, which can transmit one reference signal.

(2) For meeting to the CISPR 22 measurement, the HL562E antenna (30-1000 MHz) and the HF907 antenna (1-6 GHz) are used respectively, we also use the low-noise amplifiers and Rohde & Schwarz EMI receiver to meet measurement requirements, the system link is presented in Fig.1. In addition, the EUT is installed on the tunable table with a 3-meter measurement distance from the testing antennas.

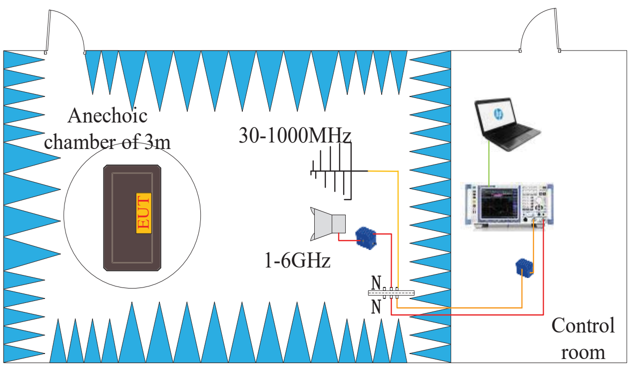


Figure 1. CISPR 22 test system link

(3) To meet the MIL-STD-461F testing, the BBHA 9120F antenna (200-1000 MHz) and HF907 antenna (1-6 GHz) are employed respectively, and the low-noise amplifiers and the EMI receiver above are applied as well. The test system link diagram is shown in Fig.2. In addition, the same EUT is placed on the testing desk which meets the MIL-STD-461F measurement requirements with a 1-meter measurement distance from the antennas.

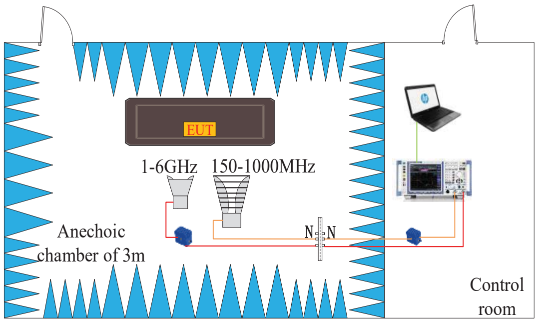


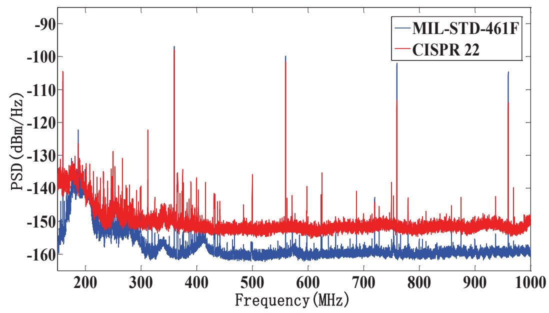
Figure 2. MIL-STD-461F test system link

2.2 Test results analysis

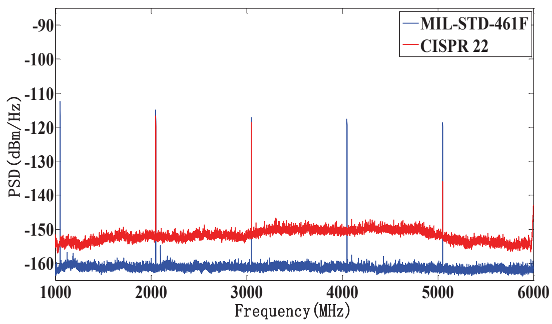
Based on the above test system, a control program is used to control the signal source generating a reference signal. Then the different EMC measurements are conducted in term of the related standards at the frequency range of 150MHz-6GHz. All the tested data were calibrated use the same method, and the results are then normalized according to Equation (1) to acquire the power spectral density.

$$\mathrm{PSD}\left(\frac{dBm}{Hz}\right) = \mathrm{P(dBm)/RBW(Hz)} \qquad (1)$$

Where P is the power in dBm, RBW is the resolution bandwidth of the EMI receiver.



(1). 150-1000MHz



(2). 1000-6000MHz

Figure 3. The tested results comparison between CISPR 22 and MIL-STD-461F

The testing results are presented in Fig.8, showing the differences of these two EMC measurement standard. The differences are as follows by comparison: (1). we can see that the noise level of the MIL-STD-461F method are lower than that of the CISPR 22 by the comparison, indicating that MIL-STD-461F method is more sensitive. (2). Some of the signals cannot be detected completely by the CISPR 22, or the signal measured is weaker.

3 Conclusion

In order to analyze the testing difference for the two EMC measurement standards, we are trying to build the test systems and conduct the two kinds of measurements in the 3-meter anechoic chamber. We found that the signals obtained by the MIL-STD-461F method are more than that of the CISPR 22. Therefore, we think that the MIL-STD-461F is more suitable for radio astronomy equipment evaluation. However, how do we evaluate the measurement results obtained by the CISPR 22 method according to the EMC requirement of the radio astronomy equipment? Maybe we should do more measurements and analysis with the different chambers and measurement systems in our future work, to further quantify the differences of these two measurement standards, to more accurately evaluate the tested results.

4 Acknowledgments

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5 References

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