

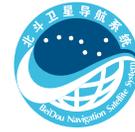


# A Compatibility Experiment of the BDS RDSS and 5G

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## Background

- The BDS RDSS uses the S-band (2483.5-2500MHz, Carrier: 2491MHz) to send the text messages from satellites to users.
- 2515-2675MHz is one of the working bands of the China Mobile 5G network.
- Interferences between the BDS RDSS terminals and 5G base stations may exist.

02

## EMC analysis

- Electromagnetic Interferences (EMI) from 5G: The unwanted emission outside the 5G bandwidth will affect the BDS RDSS in a way of in-band interferences, while the wanted emission within 5G bandwidth will affect BDS RDSS in a way of out-of-band interferences.
- Electromagnetic Sensitivity(EMS) of the BDS RDSS terminals: the power level from 5G **unwanted** emission fall into the in-band of the BDS RDSS terminals; and the power level from 5G **wanted** emission fall into out-of-band of the BDS RDSS terminals.



**Figure 1 Frequency bands of BDS RDSS and 5G**

- The test conditions of BDS RDSS terminal:
  - ❑ BER is less than  $1e^{-5}$ ;
  - ❑ The BDS RDSS signal power is 1dB higher than the receiving sensitivity.
- According to our calculation, if 5G **unwanted emission** is modeled as a 20MHz band limited signal with the flat power spectrum, the tolerable power of the BDS RDSS terminals to the 5G unwanted emission is about -102dBm.
- The tolerance of the BDS RDSS terminals to 5G **wanted emission** is related to its out-of-band suppression at the 5G signals, it relies on the actual filter characteristics of the BDS RDSS terminals.

- The EMC tests include the sensitivities tests in the laboratory(in-door), and the actual tests under practically operational 5G base stations(out-door).
- We can obtain the in-band and out-of-band interference tolerability of BDS RDSS terminal to 5G through the laboratory test , and obtain minimum coupling loss(MCL) for 5G signal through the actual test .
- The results of these two test scenarios are enough to reflect the compatibility between the RDSS signal and 5G signal.

# 1. Laboratory test

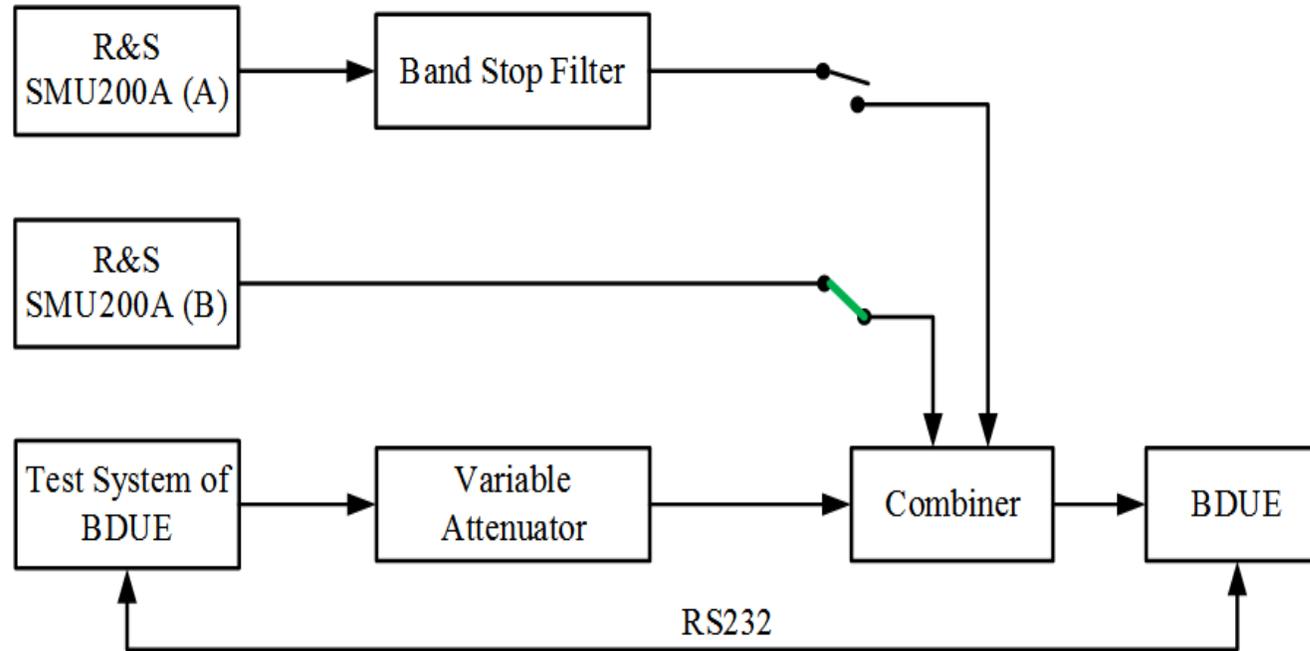


Figure 2 BDS terminal sensitivity to the 5G unwanted emission

- The generator produces 5G signal in  $2491.75 \pm 20\text{MHz}$ , the power of 5G signal are recorded while the BDS RDSS terminal reaches the test conditions.
- For six types of BDS RDSS terminals, the tolerability to 5G unwanted emission is from  $-102.8\text{dBm}$  to  $-101.8\text{dBm}$ .

# 1. Laboratory test

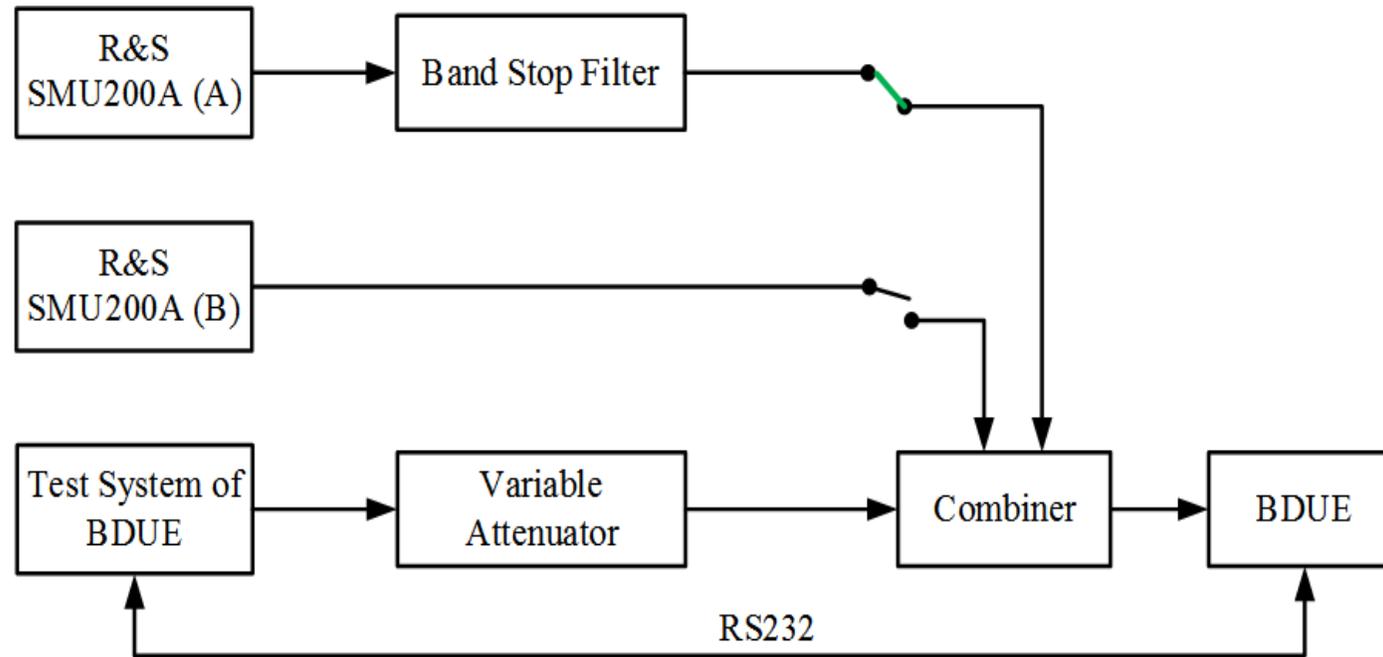
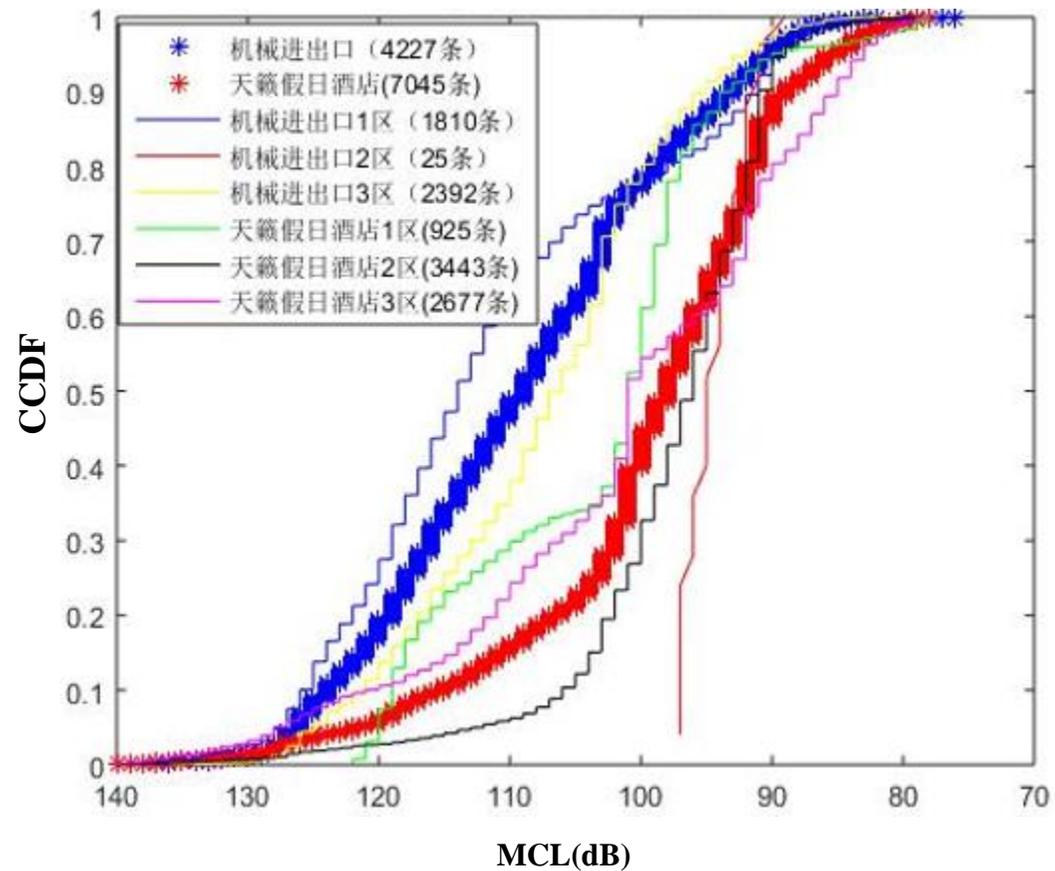


Figure 3 BDS terminal sensitivity to the 5G wanted emission

- For 5G signal in 2515-2535MHz, 2515-2555MHz, 2515-2575MHz, the tolerability of BDS RDSS terminals is from -37.6dBm to -34.9dBm.

## 2. Actual test under operational base station

- **Minimum coupling loss(MCL):** The difference between base station transmitting power and terminal receiving power were measured .
- **Test Environment:**
  - ◆ **Location:** Tianlai Holiday Hotel, Center Business District of Hangzhou City, Capital of Zhejiang Province, surrounding with 6 cellular sectors of the 5G network.
  - ◆ **5G base station:** Operational.
  - ◆ **Test route:** Crossing all accessible positions of 6 cellular sectors.



**Figure 4 Complementary Cumulative Distribution Function (CCDF)**

03

## EMC evaluation

# I. Evaluation on 5G **unwanted** emission to BDS RDSS terminal

## The test shows:

**1,** Assuming that the spurious emission of 5G base station is about  $-40\text{dBm} / \text{MHz}$ , the MCL thresholds of BDS RDSS terminal unaffected by 5G unwanted emission are from  $74.8\text{dB}$  to  $75.8\text{dB}$ .

**2,** According to the CCDF curve, the probability of actual MCL higher than  $74.8\sim 75.8$  is  $100\%$ . That is to say, BDS RDSS terminals are unaffected by 5G unwanted emission.

## II. Evaluation of 5G **wanted** emission on BDS RDSS terminal

### The test shows:

**1,** For the wanted emission at 43dBm/20MHz, 46dBm/40MHz, 47.78dBm/60MHz, the MCL thresholds of BDS RDSS terminal unaffected by 5G wanted emission can be obtained.

**2,** According to the CCDF curve, the probability of actual MCL higher than 82.7~85.4dB is 99%~97%. Thus BDS RDSS terminals are basically unaffected by 5G wanted emission.

04

## EMC recommendation

- **The compatibility between RDSS and 5G could be achieved.**
- **The spurs of 5G base stations should be suppressed.**
- **While designing BDS RDSS terminals and filters, the 5G base station spurs should be considered.**

# Thanks for your attention!

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