**3GPP TSG-RAN WG4 Meeting #94-e draft R4-2002441**

**Electronic Meeting, 24 Feb. – 6 Mar., 2020**

**Source:** Huawei

**Title:** TP to the TR 37.941: Out-of-band blocking requirements

**Agenda Item:** 8.19.2

**Document for:** Agreement

# Introduction

In this contribution we provide TP to External TR on OTA BS testing for the out-of-band blocking requirements section.

Technical content is based on the draft TR shared on the RAN4 Drafts reflector before the e-meeting. Technical content is sourced from the following legacy TRs (indicated by individual Track Changes IDs), with additional text corrections applied by the Rapporteur:

* TR 37.842, v13.3.0
* TR 37.843, v15.6.0
* TR 38.817-02, v15.6.0

Structure of sections is based on the TR Skeleton as in [2].

The MU / TT values in the text were highlighted for the purpose of values cross-checking in the final version of the TR, once the MU and TT sections are completed with corrected and updated inputs from the Excel spreadsheet.

# References

[1] RP-193225 Over the air (OTA) base station (BS) testing TR, WID

[2] R4-2001807 Skeleton for TR 37.941 on OTA BS testing, Rel-15

# TP to the External TR on OTA BS testing

*------------------------------ Modified section ------------------------------*

# 14 Out-of-band blocking requirements

## 14.1 General

Clause 14 captures MU and TT values derivation for the OTA out-of-band blocking requirement in Normal test conditions.

The OTA out-of-band blocking requirement requires both a wanted in-band signal and an interferer out-of-band signal to be transmitted with the chamber. The wanted signal is defined in the far field, the interferer is defined as a field strength, due to the large range for frequencies it will not always be in the far field.

Hence any acceptable measurement chamber for the OTA sensitivity requirement is also suitable for the OTA out-of-band blocking requirement, it may be necessary that the interfering signal is transmitted from a separate antenna due to the large frequency range of the interferer.

**AAS BS**

Test system Calibrated point

θ

ϕ

0

AAS declared coordinate reference point and orientation

Test system enclosure

Test antenna (out of band)

Signal Generator for the interfering signal

Signal Generator for the wanted signal

Test antenna (in band)

Test antenna polarisation can be adjusted

Figure 14.1-1: General blocking test set-up using a different antenna

Worst case the wanted and interfering signal are transmitted from separate test antennas, hence they each may have a different uncertainty associated with the OTA chamber. This differs from the in-band interference measurements where the wanted signal and the interferer are added together outside the chamber and applied to the same test antenna and hence have a common OTA chamber uncertainty.

The uncertainty of the interferer is analysed in this clause using a general chamber assumption. The requirement may be tested in any suitable chamber (e.g. IAC, CATR) that is capable of measuring EIS accurately and also applying the out-of-band interferer. For interferer frequencies where it can be applied from a common antenna (like the in-band requirements) this is acceptable but it is expected the MU will be lower so will not influence the final MU value. The chosen chamber must of course be specified to handle the frequency of both the interferer and the wanted signal. The complete out-of-band blocking test may be completed using multiple chambers for different frequency ranges if necessary.

The distance between the test object and test antenna injecting the interferer signal is adjusted when necessary to ensure specified interferer signal level to be received.

## 14.2 General chamber

### 14.2.1 Measurement system description

Measurement system description is captured in subclause 7.8.

A general chamber is analysed for the interferer MU value, this is considered worst case for setting the MU value.

### 14.2.2 Test procedure

#### 14.2.2.1 Stage 1: Calibration

*Editor’s note: Calibration procedure to be verified, i.e. description on how you calibrate the chamber to secure that OOB interferer is correct at the test object.*

For the wanted signal the calibration procedure and MU for the OTA sensitivity in subclause 10.2 can be assumed for each chamber type and FR.

The interferer path is calibrated using the same method with appropriate antennas.

#### 14.2.2.2 Stage 2: BS measurement

The testing procedure consists of the following steps:

1) Place test antenna(s) in at appropriate test directions, at appropriate distance, aligned in all supported polarizations (single or dual) with the BS.

2) Connect test antenna(s) to the measurement equipment.

3) The test antenna(s) shall be dual (or single) polarized covering the same frequency ranges as the BSand the blocking frequencies. If the test antenna does not cover both the wanted and interfering signal frequencies, separate test antennas for the wanted and interfering signal are required.

4) The OTA blocking interferer is injected into the test antenna, with the blocking interfererproducing specified interferer field strength level for each supported polarization. The interferer shall be polarization matched to the BS in band and the position maintained for OOB measurements.

5) The BS receives the wanted signal and the interferer signal for all supported polarizations (single or dual), in the reference direction from the test antenna(s).

### 14.2.3 MU value derivation, FR1

The MU value for OTA out-of-band blocking consists of the MU value for the wanted signal and the MU value for the interfering signal.

The unwanted signal is defined as a field strength so can be applied in the near field with the assumption that the test antenna fully illuminated the BS under test. For the purposes of calculating a MU value of the interfering signal the same general out-of-band OTA chamber used for the TX spurious emissions requirement in subclause 12.2 is assumed.

The out-of-band blocking is analysed using the same methodology as the other receiver interference requirements where:

 

The MUwantedsignal of the wanted signal is the same as that for the OTA sensitivity requirement.

The Noiseeffect MU from the signal generator for the broad band noise effect is the same as the conducted requirement (i.e. 0.1 dB).

The MU assessment for the general chamber is as follows:

Table 14.2.3-1: MU assessment for out-of-band blocking interferer

The OTA chamber is one part of the total interferer MU value. The rest of the MU is from the conducted signal accuracy, for this the conducted accuracy is used as a guide. In addition care is taken to ensure the mismatch is not added twice (from the chamber and the conducted value) and also it is considered if a PA is needed to achieve sufficient test signal power level.

The interferer is specified as a field strength of 0.36 V/m, the required conducted power level depends one chamber size (the FSPL) the test antenna gain and the conducted signal path, and example is given in table 14.2.3-2.

Table 14.2.3-2: Example of required conducted interferer level

|  |
| --- |
| OOB blocking interferer level |
| Field strength | 0.36 | V/m |
| d | 4 | m |
| EIRP | 18.40 | dBm |
| Antenna | 5 | dBi |
| Cables, filers, etc. | 10 | dB |
| Signal generator | **23.40** | dBm |

Some signal generators can provide 23.4 dBm but it is at the top end so it is sensible to consider a PA in the test set up.

The MUinterferer value is hence given by:

 

For each of the frequency ranges this gives the value in table 14.2.3-3.

Table 14.2.3-3: MUinterferer values

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Frequency range | cond. int. (mod) | PA | cond. matching | out-of-band chamber | OTA interferer |
| 30 MHz < f ≤ 3 GHz | 1 | 0.2 | 0.294 | 0.93 | 1.35 |
| 3 GHz < f ≤ 6 GHz | 1.2 | 0.2 | 0.294 | 0.93 | 1.50 |
| 6 GHz < f ≤ 12.75 GHz | 3 | 0.2 | 0.55 | 1.12 | 3.16 |

*Editor’s note: placeholder for the MU table based on the Excel spreadsheet.*

The final MU for the OTA out-of-band blocking requirement is calculated as follows:

 

The Noiseeffect from the signal generator is 0.1 dB and the MUwantedsignal value is MUEIS from subclause 10.2.

The final values are given in table 14.2.3-4:

Table 14.2.3-4: MU values for out-of-band blocking

|  |
| --- |
|  |
| OOB blocking MU (dB) | Wanted signal operating band |
| 30 MHz < f ≤ 3 GHz | 3GHz < f ≤ 4.2 GHz | 4.2 GHz < f ≤ 6 GHz |
| Interferer frequency | 30 MHz < f ≤ 3 GHz | 2.0 | 2.2 | 2.2 |
| 3 GHz <f ≤ 6 GHz | 2.1 | 2.1 | 2.3 |
| 6 GHz < f ≤ 12.75 GHz | 3.5 | 3.6 | 3.6 |

*Editor’s note: placeholder for the MU table based on the Excel spreadsheet.*

### 14.2.4 MU value derivation, FR2

It has been agreed that the MU for the out-of-band blocking requirement can be calculated as follows:

 

With

 $MU\_{TestEquipment4.2-6GHz}(1.96σ)=$

 $MU\_{TestEquipment4.2-6GHz}(1.96σ)=$

 $MU\_{TestEquipment4.2-6GHz}(1.96σ)=$

 

And

 $MU\_{Matching4.2-6GHz}(1.96σ)=$

Substituting the variables above into the formula, the MU in FR2 for the out-of-band blocking requirement can be calculated as 4.1 dB, as shown in table 14.2.4-1 below.

Table 14.2.4-1: MU for out-of-band blocking

|  |  |
| --- | --- |
| Test System Uncertainty | Standard uncertainty ui (dB)IAC, CATR |
| MUEIS (Expanded uncertainty) | 2.4 |
| MUTestEquipment (Uncertainty of the RF signal generator) | 0.9 |
| MUOOBint (Additional uncertainty for the OOB interferer signal) | 1.1 |
| MUPA (Uncertainty due to use of PA) | 0.2 |
|  Broadband noise effect (Impact of interferer broadband noise) | 0.4 |
| Combined standard uncertainty (1σ) | 2.09 |
| Expanded uncertainty (1.96σ - confidence interval of 95 %) | 4.10 |

*Editor’s note: placeholder for the MU table based on the Excel spreadsheet.*

## 14.3 Maximum accepted test system uncertainty

The final values are given in table 14.3-1.

Table 14.3-1: MU values for out of band blocking

|  |
| --- |
|  |
| OOB blocking MU (dB) | Wanted signal operating band |
| 4.2GHz<f ≤6.0GHz |
| Interferer frequency | 30MHz<f≤3 GHz | 2.2 |
| 3GHz<f ≤6GHz | 2.3 |
| 6GHz<f ≤12.75GHz | 3.6 |

*Editor’s note: placeholder for the MU table based on the Excel spreadsheet.*

## 14.4 Test Tolerance for OOB blocking

It has been agreed that the TT for the out-of-band blocking requirement should be zero.

*----------------------------- End of modified section ------------------------------*