**3GPP TSG-RAN4 Meeting #106 *draft R4-2302875***

**Athens, Greece, 27th Feb 2023 - 3rd Mar 2023**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.141-2** | **CR** | **0470** | **rev** | **1** | **Current version:** | **17.8.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **x** | Core Network |  |

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|  | | | | | | | | | | |
| ***Title:*** | Big CR to TS 38.141-2: FR2-2 BS RF test requirements introduction, Rel-17 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_ext\_to\_71GHz-Perf | | | | |  | ***Date:*** | | | 2023-02-17 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Based on the draft CR Endorsed in R4-2220307, in this contribution a final CR is provided for Agreement.  Additional modifications based on the endorsed R4-2302229 and R4-2301915 were implemented.  MU values for Tx and Rx were agreed in R4-2302994 and R4-2302916, respectively. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Introduction of FR2-2 BS test requirements. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Implementration of FR2-2 feature would not be complete. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 1,2,3, 4.1.2.2, 4.1.2.3, 6.2.5, 6.3, 6.4, 6.5, 6.6, 6.7.1, 6.7.2, 6.7.2.4.2, 6.7.3, 6.7.4, 7.3.5.3, 7.5.1.5.3, 7.5.2.5.3, 7.6, 7.7, 7.8, 7.9, C.1, C.2, L | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | |  | | |
| ***affected:*** | |  | **x** | Test specifications | | | |  | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

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

### 4.1.2 Acceptable uncertainty of OTA Test System

#### 4.1.2.1 General

The maximum acceptable uncertainty of the OTA Test System is specified below for each radiated test defined explicitly in the present specification, where appropriate.

The OTA Test System shall enable the stimulus signals in the test case to be adjusted to within the specified tolerance and the EUT to be measured with an uncertainty not exceeding the specified values. All tolerances and uncertainties are absolute values, and are valid for a confidence level of 95 %, unless otherwise stated.

A confidence level of 95% is the measurement uncertainty tolerance interval for a specific measurement that contains 95% of the performance of a population of test equipment.

For details on measurement uncertainty budget calculation, OTA measurement methodology description (including calibration and measurement stage for each test range), MU budget format and its contributions, refer to TR 37.941 [29].

#### 4.1.2.2 Measurement of transmitter

The maximum OTA Test System uncertainty for OTA transmitter tests minimum requirements are given in tables 4.1.2.2-1 and 4.1.2.2-2. Details for derivation of OTA Test System uncertainty are given in corresponding clauses in TR 37.941 [29].

Table 4.1.2.2-1: Maximum OTA Test System uncertainty for FR1 OTA transmitter tests

| Clause | Maximum OTA Test System uncertainty |
| --- | --- |
| 6.2 Radiated transmit power | Normal condition:  ±1.1 dB, f ≤ 3 GHz  ±1.3 dB, 3 GHz < f ≤ 7.125 GHz  ±1.8 dB for band n96 |
|  | Extreme condition:  ±2.5 dB, f ≤ 3 GHz  ±2.6 dB, 3 GHz < f ≤ 7.125 GHz |
| 6.3 OTA base station output power | ±1.4 dB, f ≤ 3.0 GHz  ±1.5 dB, 3.0 GHz < f ≤ 4.2 GHz  ±1.5 dB, 4.2 GHz < f ≤ 7.125 GHz |
| 6.4.2 OTA RE power control dynamic range | N/A |
| 6.4.3 OTA total power dynamic range | ±0.4 dB |
| 6.5.1 OTA transmitter OFF power | ±3.4 dB, f ≤ 3.0 GHz  ±3.6 dB, 3.0 GHz < f ≤ 7.125 GHz(NOTE 1) |
| 6.5.2 OTA transmitter transient period | N/A |
| 6.6.2 OTA frequency error | ±12 Hz |
| 6.6.3 OTA modulation quality | ±1 % |
| 6.6.4 OTA time alignment error | ±25 ns |
| 6.7.2 OTA occupied bandwidth | ±100 kHz, BWChannel 5 MHz, 10 MHz  ±300 kHz, BWChannel 15 MHz, 20 MHz, 25 MHz, 30 MHz, 40 MHz, 50 MHz  ±600 kHz, BWChannel 60 MHz, 70 MHz, 80 MHz, 90 MHz, 100 MHz |
| 6.7.3 OTA ACLR/CACLR | f ≤ 3.0 GHz  ±1 dB, BW ≤ 20MHz  ±1 dB, BW > 20MHz  3.0 GHz < f ≤ 7.125 GHz  ±1.2 dB, BW ≤ 20MHz  ±1.2 dB, BW > 20MHz  Absolute power ±2.2 dB, f ≤ 3.0 GHz  Absolute power ±2.7 dB, 3.0 GHz < f ≤ 4.2 GHz  Absolute power ±2.7 dB, 4.2 GHz < f ≤ 7.125 GHz |
| 6.7.4 OTA operating band unwanted emissions | Absolute power ±1.8 dB, f ≤ 3.0 GHz  Absolute power ±2 dB, 3.0 GHz < f ≤ 4.2 GHz  Absolute power ±2 dB, 4.2 GHz < f ≤ 6.0 GHz |
| 6.7.5.2 OTA transmitter spurious emissions, mandatory requirements | ±2.3 dB, 30 MHz < f ≤ 6 GHz  ±4.2 dB, 6 GHz < f ≤ 26 GHz |
| 6.7.5.3 OTA transmitter spurious emissions, protection of BS receiver | ±3.1 dB, f ≤ 3 GHz  ±3.3 dB, 3 GHz < f ≤ 4.2 GHz  ±3.4, 4.2 GHz < f ≤ 7.125 GHz(NOTE 1) |
| 6.7.5.4 OTA transmitter spurious emissions, additional spurious emissions requirements | ±2.6 dB, f ≤ 3 GHz  ±3.0, 3 GHz < f ≤ 4.2 GHz  ±3.5, 4.2 GHz < f ≤ 6 GHz |
| 6.7.5.5 OTA transmitter spurious emissions, co-location | ±3.1 dB, f ≤ 3 GHz  ±3.3 dB, 3 GHz < f ≤ 4.2 GHz  ±3.4, 4.2 GHz < f ≤ 7.125 GHz(NOTE 1) |
| 6.8 OTA transmitter intermodulation | The value below applies only to the interfering signal and is unrelated to the measurement uncertainty of the tests in6.7.3 (ACLR), 6.7.4 (OBUE) and 6.7.5 (spurious emissions) which have to be carried out in the presence of the interferer.  ±3.2 dB, f ≤ 3.0 GHz  ±3.4 dB, 3.0 GHz < f ≤ 4.2 GHz  ±3.5 dB, 4.2 GHz < f ≤ 6 GHz  (NOTE 1) |
| NOTE 1: Fulfilling the criteria for CLTA selection and placement in clause 4.12 is deemed sufficient for the test purposes. When these criteria are met, the measurement uncertainty related to the selection of the co-location test antenna and its alignment as specified in the appropriate measurement uncertainty budget in TR 37.941 [29] shall be used for evaluating the test system uncertainty.  NOTE 2: Test system uncertainty values are applicable for normal condition unless otherwise stated. | |

Table 4.1.2.2-2: Maximum OTA Test System uncertainty for FR2 OTA transmitter tests

|  |  |
| --- | --- |
| Clause | Maximum OTA Test System uncertainty |
| 6.2 Radiated transmit power | Normal condition:  ±1.7 dB (24.25 – 29.5 GHz)  ±2.0 dB (37 – 43.5 GHz)  ±2.2 dB (43.5 GHz < f ≤ 48.2 GHz)  ±[3.0] dB (52.6 GHz ≤ f ≤ 71 GHz) |
|  | Extreme condition:  ±3.1 dB (24.25 – 29.5 GHz)  ±3.3 dB (37 – 43.5 GHz)  ±3.5 dB (43.5 GHz < f ≤ 48.2 GHz)  ±[3.9] dB (52.6 GHz ≤ f ≤ 71 GHz) |
| 6.3 OTA base station output power | ±2.1 dB (24.25 – 29.5 GHz)  ±2.4 dB (37 – 43.5 GHz)  ±2.6 dB (43.5 GHz < f ≤ 48.2 GHz)  ±[4.7] dB (52.6 GHz ≤ f ≤ 71 GHz) |
| 6.4.2 OTA RE power control dynamic range | N/A |
| 6.4.3 OTA total power dynamic range | ±0.4 dB |
| 6.5.1 OTA transmitter OFF power | ±2.9 dB (24.25 – 29.5 GHz)  ±3.3 dB (37 – 43.5 GHz)  ±3.6 dB (43.5 GHz < f ≤ 48.2 GHz)  ±[5.6] dB (52.6 GHz ≤ f ≤ 71 GHz) |
| 6.5.2 OTA transmitter transient period | N/A |
| 6.6.2 OTA frequency error | ±12 Hz |
| 6.6.3 OTA modulation quality | 1% |
| 6.6.4 OTA time alignment error | ±25 ns |
| 6.7.2 OTA occupied bandwidth | 600 kHz |
| 6.7.3 OTA ACLR | Relative ACLR:  ±2.3 dB (24.25 – 29.5 GHz)  ±2.6 dB (37 – 43.5 GHz)  ±2.8 dB (43.5 GHz < f ≤ 48.2 GHz)  ±[5.2] dB (52.6 GHz ≤ f ≤ 71 GHz)  Absolute ACLR:  ±2.7 dB (24.25 – 29.5 GHz)  ±2.7 dB (37 – 43.5 GHz)  ±2.9 dB (43.5 GHz < f ≤ 48.2 GHz)  ±[5.3] dB (52.6 GHz ≤ f ≤ 71 GHz) |
| 6.7.4 OTA operating band unwanted emissions | ±2.7 dB (24.25 – 29.5 GHz)  ±2.7 dB (37 – 43.5 GHz)  ±2.9 dB (43.5 GHz < f ≤ 48.2 GHz)  ±[5.3] dB (52.6 GHz ≤ f ≤ 71 GHz) |
| 6.7.5.2 OTA transmitter spurious emissions, mandatory requirements | ±2.3 dB, 30 MHz ≤ f ≤ 6 GHz  ±2.7 dB, 6 GHz < f ≤ 40 GHz  ±5.0 dB, 40 GHz < f ≤ 60 GHz  ±[4.7] dB (52.6 GHz < f ≤ 71 GHz)  ±FFS dB (60 GHz < f ≤ [110] GHz)  ±FFS dB ([110] GHz < f ≤ 142 GHz) |
| 6.7.5.4 OTA transmitter spurious emissions, additional requirements | ±2.3 dB, 30 MHz ≤ f ≤ 6 GHz  ±2.7 dB, 6 GHz < f ≤ 40 GHz  ±5.0 dB, 40 GHz < f ≤ 60 GHz  ±FFS dB (60 GHz < f ≤ [110] GHz)  ±FFS dB ([110] GHz < f ≤ 142 GHz) |
| NOTE: Test system uncertainty values are applicable for normal condition unless otherwise stated. | |

#### 4.1.2.3 Measurement of receiver

The maximum OTA Test System uncertainty for OTA receiver tests minimum requirements are given in tables 4.1.2.3-1 and 4.1.2.3-2. Details for derivation of OTA Test System uncertainty are given in corresponding clauses in TR 37.941 [29].

Table 4.1.2.3-1: Maximum OTA Test System uncertainty for FR1 OTA receiver tests

|  |  |
| --- | --- |
| Clause | Maximum OTA Test System uncertainty |
| 7.2 OTA sensitivity | ±1.3 dB, f ≤ 3.0 GHz  ±1.4 dB, 3.0 GHz < f ≤ 4.2 GHz  ±1.6 dB, 4.2 GHz < f ≤ 6.0 GHz  ±1.9 dB, 6.0 GHz < f ≤ 7.125 GHz  ±1.9 dB for band n96 |
| 7.3 OTA reference sensitivity level | ±1.3 dB, f ≤ 3.0 GHz  ±1.4 dB, 3.0 GHz < f ≤ 4.2 GHz  ±1.6 dB, 4.2 GHz < f ≤ 6.0 GHz  ±1.9 dB, 6.0 GHz < f ≤ 7.125 GHz |
| 7.4 OTA dynamic range | ±0.3 dB |
| 7.5.1 OTA adjacent channel selectivity | ±1.7 dB, f ≤ 3.0 GHz  ±2.1 dB, 3.0 GHz < f ≤ 4.2 GHz  ±2.4 dB, 4.2 GHz < f ≤ 6.0 GHz  ±2.8 dB, 6.0 GHz < f ≤ 7.125 GHz |
| 7.5.2 In-band blocking (General) | ±1.9 dB, f ≤ 3.0 GHz  ±2.2 dB, 3.0 GHz < f ≤ 4.2 GHz  ±2.5 dB, 4.2 GHz < f ≤ 6.0 GHz  ±2.9 dB, 6.0 GHz < f ≤ 7.125 GHz |
| 7.5.2 In-band blocking (Narrowband) | ±1.7 dB, f ≤ 3.0 GHz  ±2.1 dB, 3.0 GHz < f ≤ 4.2 GHz  ±2.4 dB, 4.2 GHz < f ≤ 6.0 GHz |
| 7.6 OTA out-of-band blocking (General) | fwanted ≤ 3.0 GHz:  ±2.0 dB, finterferer ≤ 3.0 GHz  ±2.1 dB, 3.0 GHz < finterferer ≤ 6.0 GHz  ±3.5 dB, 6.0 GHz < finterferer ≤ 12.75 GHz  3 GHz < fwanted ≤ 4.2 GHz:  ±2.0 dB, finterferer ≤ 3.0 GHz  ±2.1 dB, 3.0 GHz < finterferer ≤ 6.0 GHz  ±3.6 dB, 6.0 GHz < finterferer ≤ 12.75 GHz  4.2 GHz < fwanted ≤ 7.125 GHz:  ±2.2 dB, finterferer ≤ 3.0 GHz  ±2.3 dB, 3.0 GHz < finterferer ≤ 6.0 GHz  ±3.6 dB, 6.0 GHz < finterferer ≤ 12.75 GHz |
| 7.6 OTA out-of-band blocking (Co-location)  (NOTE 1) | fwanted ≤ 3.0 GHz:  ±3.4 dB, finterferer ≤ 3.0 GHz  ±3.5 dB, 3.0 GHz < finterferer ≤ 4.2 GHz  ±3.7 dB, 4.2 GHz < finterferer ≤ 6.0 GHz  3 GHz < fwanted ≤ 4.2 GHz:  ±3.5 dB, finterferer ≤ 3.0 GHz  ±3.6 dB, 3.0 GHz < finterferer ≤ 4.2 GHz  ±3.7 dB, 4.2 GHz < finterferer ≤ 6.0 GHz  4.2 GHz < fwanted ≤ 6.0 GHz:  ±3.6 dB, finterferer ≤ 3.0 GHz  ±3.7 dB, 3.0 GHz < finterferer ≤ 4.2 GHz  ±3.8 dB, 4.2 GHz < finterferer ≤ 6.0 GHz  6.0 GHz < f ≤ 7.125 GHz:  ±3.6 dB, finterferer ≤ 3.0 GHz  ±3.8 dB, 3.0 GHz < finterferer ≤ 4.2 GHz  ±3.9 dB, 4.2 GHz < finterferer ≤ 6.0 GHz |
| 7.7 OTA receiver spurious emissions | ±2.5 dB, 30 MHz ≤ f ≤ 6.0 GHz  ±4.2 dB, 6.0 GHz < f ≤ 26 GHz |
| 7.8 OTA receiver intermodulation | ±2.0 dB, f ≤ 3.0 GHz  ±2.6 dB, 3.0 GHz < f ≤ 4.2 GHz  ±3.2 dB, 4.2 GHz < f ≤ 6.0 GHz  ±3.5 dB, 6.0 GHz < f ≤ 7.125 GHz |
| 7.9 OTA in-channel selectivity | ±1.7 dB, f ≤ 3.0 GHz  ±2.1 dB, 3.0 GHz < f ≤ 4.2 GHz  ±2.4 dB, 4.2 GHz < f ≤ 6.0 GHz  ±2.8 dB, 6.0 GHz < f ≤ 7.125 GHz |
| NOTE 1: Fulfilling the criteria for CLTA selection and placement in clause 4.12 is deemed sufficient for the test purposes. When these criteria are met, the measurement uncertainty related to the selection of the co-location test antenna and its alignment as specified in the appropriate measurement uncertainty budget in TR 37.941 [29], shall be used for evaluating the test system uncertainty.  NOTE 2: Test system uncertainty values are applicable for normal condition unless otherwise stated. | |

Table 4.1.2.3-2: Maximum OTA Test System uncertainty for FR2 OTA receiver tests

|  |  |
| --- | --- |
| Clause | Maximum OTA Test System uncertainty |
| 7.3 OTA reference sensitivity level | ±2.4 dB, 24.25 GHz < f ≤ 29.5 GHz  ±2.4 dB, 37 GHz < f ≤ 43.5 GHz  ±[3.5] dB, 43.5 GHz < f ≤ 48.2 GHz  ±[3.0] dB (52.6 GHz ≤ f ≤ 71 GHz) |
| 7.5.1 OTA adjacent channel selectivity | ±3.4 dB, 24.25 GHz < f ≤ 29.5 GHz  ±3.4 dB, 37 GHz < f ≤ 43.5 GHz  ±[5.1] dB, 43.5 GHz < f ≤ 48.2 GHz  ±[4.0] dB (52.6 GHz ≤ f ≤ 71 GHz) |
| 7.5.2 In-band blocking (General) | ±3.4 dB, 24.25 GHz < f ≤ 29.5 GHz  ±3.4 dB, 37 GHz < f ≤ 43.5 GHz  ±[5.1] dB, 43.5 GHz < f ≤ 48.2 GHz  ±[4.0] dB (52.6 GHz ≤ f ≤ 71 GHz) |
| 7.6 OTA out-of-band blocking | ±3.6 dB, 24.25 GHz < f ≤ 43.5 GHz  ±[4.5] dB, 43.5 GHz < f ≤ 48.2 GHz  ±[4.0] dB (52.6 GHz ≤ f ≤ 142 GHz)  ~~±FFS dB (48.2 GHz < f ≤ [110] GHz)~~  ~~±FFS dB ([110] GHz < f ≤ 142 GHz)~~ |
| 7.7 OTA receiver spurious emissions | ±2.5 dB, 30 MHz ≤ f ≤ 6 GHz  ±2.7 dB, 6 GHz < f ≤ 40 GHz  ±5.0 dB, 40 GHz < f ≤ 60 GHz  ±FFS dB (48.2 GHz < f ≤ [110] GHz)  ±FFS dB ([110] GHz < f ≤ 142 GHz) |
| 7.8 OTA receiver intermodulation | ±3.9 dB, 24.25 GHz < f ≤ 29.5 GHz  ±3.9 dB, 37 GHz < f ≤ 43.5 GHz  ±[5.4] dB, 43.5 GHz < f ≤ 48.2 GHz  ±[4.5] dB (52.6 GHz ≤ f ≤ 71 GHz) |
| 7.9 OTA in-channel selectivity | ±3.4 dB, 24.25 GHz < f ≤ 29.5 GHz  ±3.4 dB, 37 GHz < f ≤ 43.5 GHz  ±[5.1] dB, 43.5 GHz < f ≤ 48.2 GHz  ±[4.0] dB (52.6 GHz ≤ f ≤ 71 GHz) |
| NOTE: Test system uncertainty values are applicable for normal condition unless otherwise stated. | |

*------------------------------ Next modified section ------------------------------*

#### 4.7.2.1 Test signal used to build Test Configurations

The signal's *BS channel bandwidth* and subcarrier spacing used to build NR Test Configurations shall be selected according to tables 4.7.2.1-1 and 4.7.2.1-2.

Table 4.7.2.1-1: Signal to be used to build NR TCs for *BS type 1-H* and *BS type 1-O*

|  |  |  |  |
| --- | --- | --- | --- |
| *Operating band* characteristics | | FDL\_high – FDL\_low < 100 MHz | FDL\_high – FDL\_low ≥ 100 MHz |
| TC signal | BWchannel | 5 MHz (Note) | 20 MHz (Note) |
| characteristics | Subcarrier spacing | Smallest supported subcarrier spacing declared per operating band (D.7) | |
| NOTE: If this *BS channel bandwidth* is not supported, the narrowest supported *BS channel bandwidth* declared per *operating band* (D.7) shall be used. | | | |

Table 4.7.2.1-2: Signal to be used to build NR TCs for *BS type 2-O*

|  |  |  |  |
| --- | --- | --- | --- |
| *Operating band* characteristics | | FDL\_high – FDL\_low ≤ 3250 MHz | 3250 < FDL\_high – FDL\_low ≤ 14000 MHz |
| TC signal | BWchannel | 100 MHz (Note 1, Note 2) | 400 MHz (Note 1, Note 2, Note 3) |
| characteristics | Subcarrier spacing | Smallest supported subcarrier spacing declared per operating band (D.7) | |
| NOTE 1: BS vendor can decide to test with 50 MHz *BS channel bandwidth* and smallest supported SCS declared per *operating band* (D.7) instead of 100 MHz *BS channel bandwidth* in certain regions, where spectrum allocation and regulation require testing with 50 MHz.  NOTE 2: If this *BS channel bandwidth* is not supported, the narrowest supported *BS channel bandwidth* declared per *operating band* (D.7) shall be used.  NOTE 3: For FR2-2 only NRTC1 and NRTC2 are applicable. | | | |

*------------------------------ Next modified section ------------------------------*

#### 4.9.2.2 NR FR2 test models

The set-up of physical channels for transmitter tests shall be according to one of the NR test models (NR- FR2-TM) below. A reference to the applicable test model is made within each test.

The following general parameters are used by all NR test models:

- For FR2-1, duration is 2 radio frames for TDD (20 ms). For FR2-2, duration is twice of 80 slots in time length (160 slots time length).

- The slots are numbered 0 to 10×2µ – 1 where µ is the numerology corresponding to the subcarrier spacing

- NRB is the maximum transmission bandwidth configuration seen in table 5.3.2-2 and table 5.3.2-3 in TS 38.104 [2].

- Normal CP

- Virtual resource blocks of localized type

For NR FR2 TDD, test models are derived based on the uplink/downlink configuration as shown in the table 4.9.2.2-1 using information element *TDD-UL-DL-ConfigCommon* as defined in TS 38.331 [22].

Table 4.9.2.2-1: Configurations of TDD for *BS type 2-O* test models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field name | Value | | | |
| referenceSubcarrierSpacing (kHz) | 60 | 120 | 480 | 960 |
| Periodicity (ms) for dl-UL-TransmissionPeriodicity | 1.25 | 1.25 | 1.25 | 1.25 |
| nrofDownlinkSlots | 3 | 7 | 29 | 59 |
| nrofDownlinkSymbols | 10 | 6 | 10 | 6 |
| nrofUplinkSlots | 1 | 2 | 9 | 18 |
| nrofUplinkSymbols | 2 | 4 | 2 | 4 |

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Common physical channel parameters for all FR2 test models are specified in the following tables: table 4.9.2.2-2 for PDCCH, table 4.9.2.2-3 and table 4.9.2.2-4 for PDSCH. Specific physical channel parameters for FR2 test models are described in clauses 4.9.2.2.1 to 4.9.2.2.3.

*------------------------------ Next modified section ------------------------------*

##### 4.9.2.3.1 PDCCH

-

- PDCCH modulation to be QPSK as described in TS 38.211 [20], clause 5.1.3.

- For each slot the required amount of bits for all PDCCHs is as follows: 1(# of PDCCH) \* 1(# of CCE per PDCCH) \* 6(REG per CCE) \* 9(data RE per REG) \* 2(bits per RE) with these parameters according to the NR-FR2-TM definitions in clause 4.4.9.2.2.

- Generate this amount of bits from the output of the PN23 sequence generator [28]. For FR2-1, the PN sequence generator is initialized with a starting seed of "all ones" in the first allocated slot of each frame. The PN sequence is continuous over the slot boundaries. For FR2-2, the PN sequence generator is initialized with a starting seed of "all ones" in the first allocated slot of each 80 slots time period of test model length.

- 1 CCE shall be according to TS 38.211 [20], clause 7.3.2. PDCCH using non-interleaved CCE-to-REG mapping. PDCCH occupies the first two symbols for 6 resource-element groups, where a resource element group equals one resource block during one OFDM symbol.

- Perform PDCCH scrambling according to TS 38.211 [20], clause 7.3.2.3.

- in DM-RS sequence generation in TS 38.211 [20], clause 7.4.1.3.

- in scrambling sequence generation in TS 38.211 [20], clause 7.3.2.3.

- Perform mapping to REs according to TS 38.211 [20], clause 7.3.2.5.

##### 4.9.2.3.2 PDSCH

- Generate the required amount of bits from the output of the PN23 sequence generator [28]. For FR2-1, the PN sequence generator is initialized with a starting seed of "all ones" in the first allocated slot of each frame. For FR2-2, the PN sequence generator is initialized with a starting seed of "all ones" in the first allocated slot of each 80 slots time period of test model length. The PN sequence is continuous over the slot boundaries. For TDD TMs, the PN sequence can be generated for all symbols (in the DL, UL or special slots) or only DL symbols (in the DL or special slots). For TMs with multi-users, the PN sequence can be generated per user ().

- NR-FR2-TMs utilize 1 or 2 user PDSCH transmissions distinguished by . For each NR-FR2-TM, PRBs are mapped to user () as follows:

*------------------------------ Next modified section ------------------------------*

### 6.2.5 Test requirement

For each declared conformance *beam direction pair*, the EIRP measurement results in clause 6.2.4.2 shall remain within the values provided in table 6.2.5-1, relative to the manufacturer's declared rated beam EIRP (D.11) value:

Table 6.2.5-1: Test requirement for radiated transmit power

|  |  |  |
| --- | --- | --- |
|  | Normal test environment | Extreme test environment |
| BS type 1-H | f ≤ 3 GHz: ± 3.3 dB | N/A |
|  | 3 GHz < f ≤ 7.125 GHz: ± 3.5 dB  For band n96: ± 4.0 dB |  |
| BS type 1-O | f  ≤ 3 GHz: ± 3.3 dB | f  ≤ 3 GHz: ± 5.2 dB |
|  | 3 GHz < f ≤ 7.125 GHz: ± 3.5 dB | 3 GHz < f ≤ 4.2 GHz: ± 5.3 dB |
|  |  | 4.2 GHz < f ≤ 7.125 GHz: ± 5.3 dB |
| BS type 2-O | 24.15 GHz < f ≤ 29.5 GHz: ± 5.1 dB  37 GHz < f ≤ 43.5 GHz: ± 5.4 dB  43.5 GHz < f ≤ 48.2 GHz: ± 5.6 dB  52.6 GHz < f ≤ 71.0 GHz: ± [6.4] dB | 24.15 GHz < f ≤ 29.5 GHz: ± 7.6 dB  37 GHz < f ≤ 43.5 GHz: ± 7.8 dB  43.5 GHz < f ≤ 48.2 GHz: ± 8.0 dB  52.6 GHz < f ≤ 71.0 GHz: ± [8.4] dB |

*------------------------------ Next modified section ------------------------------*

#### 6.3.5.2 *BS type 2-O*

The final TRP measurement result in clause 6.3.4.2 shall remain:

- within +5.1 dB and -5.1 dB of the manufacturer's declared *rated carrier TRP* Prated,c,TRP carrier frequency 24.25 GHz < f ≤ 29.5 GHz.

- within +5.4 dB and –5.4 dB of the manufacturer's declared *rated carrier TRP* Prated,c,TRP for carrier frequency 37 GHz < f ≤ 43.5 GHz.

- within +5.6 dB and –5.6 dB of the manufacturer's declared *rated carrier TRP* Prated,c,TRP for carrier frequency 43.5 GHz < f ≤ 48.2 GHz.

- within +[7.7] dB and –[7.7] dB of the manufacturer's declared *rated carrier TRP* Prated,c,TRP for carrier frequency 52.6 GHz ≤ f ≤ 71 GHz.

*------------------------------ Next modified section ------------------------------*

##### 6.4.3.5.2 *BS type 2-O*

OTA total power dynamic range minimum requirement for *BS type 2-O* is specified such as for each NR carrier it shall be larger than or equal to the levels specified in table 6.4.3.5.2-1 in FR2-1 and table 6.4.3.5.2-2 in FR2-2.

Table 6.4.3.5.2-1: Minimum requirement for *BS type 2-O* total power dynamic range in FR2-1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SCS | 50 MHz | 100 MHz | 200 MHz | 400 MHz |
| (kHz) | OTA total power dynamic range (dB) | | | |
| 60 | 17.7 | 20.8 | 23.8 | N/A |
| 120 | 14.6 | 17.7 | 20.8 | 23.8 |

Table 6.4.3.5.2-2: Minimum requirement for *BS type 2-O* total power dynamic range in FR2-2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| SCS | OTA total power dynamic range (dB) | | | | |
| (kHz) | 100 MHz | 400 MHz | 800 MHz | 1600 MHz | 2000 MHz |
| 120 | 17.7 | 23.8 | N/A | N/A | N/A |
| 480 | N/A | 17.7 | 20.8 | 23.8 | N/A |
| 960 | N/A | 14.7 | 17.7 | 20.8 | [21.5] |

NOTE: Additional test requirements for the EVM at the lower limit of the dynamic range are defined in clause 6.6.

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##### 6.5.2.5.1 *BS type 1-O*

The mean power spectral density measured according to clause 6.5.2.4.2 shall be less than -102.6 dBm/MHz for carrier frequency f ≤ 3.0 GHz.

The mean power spectral density measured according to clause 6.5.2.4.2 shall be less than -102.4 dBm/MHz for carrier frequency 3.0 GHz < f ≤ 7.125 GHz.

For *multi-band RIB*, the requirement is only applicable during the transmitter OFF period in all supported operating bands.

##### 6.5.2.5.2 *BS type 2-O*

The measured mean EIRP spectral density according to clause 6.5.2.4.2 shall be less than -33.1 + Prated,c,EIRP- Prated,c,TRP dBm/MHz for carrier frequency 24.15 GHz < f ≤ 29.5 GHz, where Prated,c,EIRP is the value declared for the *reference beam direction pair* (D.8) for the beam identifier (D.3) which provides the highest intended EIRP.

The measured mean EIRP spectral density according to clause 6.5.2.4.2 shall be less than -32.7 + Prated,c,EIRP- Prated,c,TRP dBm/MHz for carrier frequency 37 GHz < f ≤ 43.5 GHz, where Prated,c,EIRP is the value declared for the *reference beam direction pair* (D.8) for the beam identifier (D.3) which provides the highest intended EIRP.

The measured mean EIRP spectral density according to clause 6.5.2.4.2 shall be less than -32.4 + Prated,c,EIRP- Prated,c,TRP dBm/MHz for carrier frequency 43.5 GHz < f ≤ 48.2 GHz, where Prated,c,EIRP is the value declared for the *reference beam direction pair* (D.8) for the beam identifier (D.3) which provides the highest intended EIRP.

The measured mean EIRP spectral density according to clause 6.5.2.4.2 shall be less than –[30.4] + Prated,c,EIRP- Prated,c,TRP dBm/MHz for carrier frequency 52.6 GHz ≤ f ≤ 71 GHz, where Prated,c,EIRP is the value declared for the *reference beam direction pair* (D.8) for the beam identifier (D.3) which provides the highest intended EIRP.

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##### 6.6.3.5.2 *BS type 2-O*

For *BS type 2-O*, the EVM of each NR carrier for different modulation schemes on PDSCH shall be less than the limits in table 6.6.3.5.2-1 for FR2-1 and table 6.6.3.5.2-1a for FR2-2.

Table 6.6.3.5.2-1: EVM requirements for *BS type 2-O* for FR2-1

|  |  |
| --- | --- |
| Modulation scheme for PDSCH | Required EVM (%) |
| QPSK | 18.5 |
| 16QAM | 13.5 |
| 64QAM | 9 |
| 256QAM | 4.5 |

Table 6.6.3.5.2-1a: EVM requirements for *BS type 2-O for FR2-2*

|  |  |
| --- | --- |
| Modulation scheme for PDSCH | Required EVM (%) |
| QPSK | [18.5] |
| 16QAM | [13.5] |
| 64QAM | [9.0] |

EVM requirements shall apply for each NR carrier over all allocated resource blocks and downlink slots. PT-RS should be configured for localized setting for every fourth symbol for every second RB. Different modulation schemes listed in table 6.6.3.5.2-1 and table 6.6.3.5.2-1a shall be considered for rank 1.

For FR2-1, for all bandwidths, the EVM measurement shall be performed for each NR carrier over all allocated resource blocks and downlink slots within 10 ms measurement periods. The boundaries of the EVM measurement periods need not be aligned with radio frame boundaries.

For FR2-2, for all bandwidths, the EVM measurement shall be performed for each NR carrier over all allocated resource blocks and downlink slots within 80 slots measurement periods. The boundaries of the EVM measurement periods need not be aligned with radio frame boundaries.

Table 6.6.3.5.2-2, 6.6.3.5.2-3, 6.6.3.5.2-4, and 6.6.3.5.2-5 below specify the EVM window length (*W*) for normal CP for *BS type 2-O*.

Table 6.6.3.5.2-2: EVM window length for normal CP, FR2-1, 60 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth (MHz) | FFT size | Cyclic prefix lengthin FFT samples | EVM window length *W* | Ratio of *W* to total CP length (Note)  (%) |
| 50 | 1024 | 72 | 36 | 50 |
| 100 | 2048 | 144 | 72 | 50 |
| 200 | 4096 | 288 | 144 | 50 |
| NOTE: These percentages are informative and apply to all OFDM symbols within subframe except for symbol 0 of slot 0 and slot 2. Symbol 0 of slot 0 and slot 2 may have a longer CP and therefore a lower percentage. | | | | |

Table 6.6.3.5.2-3: EVM window length for normal CP, FR2, 120 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth (MHz) | FFT size | Cyclic prefix length in FFT samples | EVM window length *W* | Ratio of *W* to total CP length (Note)  (%) |
| 50 | 512 | 36 | 18 | 50 |
| 100 | 1024 | 72 | 36 | 50 |
| 200 | 2048 | 144 | 72 | 50 |
| 400 | 4096 | 288 | 144 | 50 |
| NOTE: These percentages are informative and apply to all OFDM symbols within subframe except for symbol 0 of slot 0 and slot 4. Symbol 0 of slot 0 and slot 4 may have a longer CP and therefore a lower percentage. | | | | |

Table 6.6.3.5.2-4: EVM window length for normal CP, FR2-2, 480 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth (MHz) | FFT size | Cyclic prefix length in FFT samples | EVM window length *W* | Ratio of *W* to total CP length (Note)  (%) |
| 400 | 1024 | 72 | 36 | 50 |
| 800 | 2048 | 144 | 72 | 50 |
| 1600 | 4096 | 288 | 144 | 50 |
| NOTE: These percentages are informative and apply to all OFDM symbols within subframe except for symbol 0 of slot 0 and slot 16. Symbol 0 of slot 0 and slot 16 may have a longer CP and therefore a lower percentage. | | | | |

Table 6.6.3.5.2-5: EVM window length for normal CP, FR2-2, 960 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth (MHz) | FFT size | Cyclic prefix length in FFT samples | EVM window length *W* | Ratio of *W* to total CP length (Note)  (%) |
| 400 | 512 | 36 | 18 | 50 |
| 800 | 1024 | 72 | 36 | 50 |
| 1600 | 2048 | 144 | 72 | 50 |
| 2000 | 2048 | 144 | 72 | 50 |
| NOTE: These percentages are informative and apply to all OFDM symbols within subframe except for symbol 0 of slot 0 and slot 32. Symbol 0 of slot 0 and slot 32 may have a longer CP and therefore a lower percentage. | | | | |

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##### 6.6.4.5.2 *BS type 2-O*

The minimum requirement for TAE is given in Table 6.6.4.5.2-1.

Table 6.6.4.5.2-1: TAE requirements for *BS type 2-O*

|  |  |  |  |
| --- | --- | --- | --- |
| Requirement | TAE | | |
| 60, 120 kHz SCS  (ns) | 480 kHz SCS  (ns) | 960 kHz SCS  (ns) |
| MIMO transmission | 90 | 57.5 | 57.5 |
| *intra-band contiguous carrier aggregation*, with or without MIMO | 155 | 57.5 | 57.5 |
| *intra-band non-contiguous carrier aggregation*, with or without MIMO (Note) | 285 | N/A | N/A |
| inter-band *carrier aggregation*, with or without MIMO | 3025 | 3025 | 3025 |
| NOTE: *Intra-band non-contiguous carrier aggregation* is not supported for FR2-2 in this release. | | | |

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### 6.7.1 General

OTA unwanted emissions consist of so-called out-of-band emissions and spurious emissions according to ITU definitions ITU-R SM.329 [5]. In ITU terminology, out of band emissions are unwanted emissions immediately outside the *BS channel bandwidth* resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emission, intermodulation products and frequency conversion products, but exclude out of band emissions.

The OTA out-of-band emissions requirement for the *BS type 1-O* and *BS type 2-O* transmitter is specified both in terms of Adjacent Channel Leakage power Ratio (ACLR) and operating band unwanted emissions (OBUE). The OTA Operating band unwanted emissions define all unwanted emissions in each supported downlink operating band plus the frequency ranges ΔfOBUE above and ΔfOBUE below each band. OTA Unwanted emissions outside of this frequency range are limited by an OTA spurious emissions requirement.

The maximum offset of the operating band unwanted emissions mask from the operating band edge is ΔfOBUE. The value of ΔfOBUE is defined in table 6.7.1-1 for *BS type 1-O* and *BS type 2-O* for the NR operating bands.

Table 6.7.1-1: Maximum offset ΔfOBUE outside the downlink operating band

|  |  |  |
| --- | --- | --- |
| BS type | Operating band characteristics | ΔfOBUE (MHz) |
| BS type 1-O | FDL\_high – FDL\_low < 100 MHz | 10 |
| 100 MHz ≤ FDL\_high – FDL\_low ≤ 900 MHz | 40 |
| n104 | 100 |
| BS type 2-O | FDL\_high – FDL\_low ≤ 4000 MHz | 1500 |
| 4000 < FDL,high – FDL,low ≤ 14000 MHz | 3500 |

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##### 6.7.2.4.2 Procedure

1) Place the BS at the positioner.

2) Align the manufacturer declared coordinate system orientation (D.2) of the BS with the test system.

3) Orient the positioner (and BS) in order that the direction to be tested aligns with the test antenna..

4) Configure the beam peak direction of the BS according to the declared beam direction pair.

5) Set the BS to transmit signal.

6) Measure the spectrum emission of the transmitted signal using at least the number of measurement points, and across a span, as listed in table 6.7.2.4.2-1, table 6.7.2.4.2-2, and table 6.7.2.4.2-3. The selected resolution bandwidth (RBW) filter of the analyser shall be 30 kHz or less.

NOTE: The detection mode of the spectrum analyzer will not have any effect on the result if the statistical properties of the out-of-OBW power are the same as those of the inside-OBW power. Both are expected to have the Rayleigh distribution of the amplitude of Gaussian noise. In any case where the statistics are not the same, though, the detection mode is power responding. There are at least two ways to be power responding. The spectrum analyser can be set to "sample" detection, with its video bandwidth setting at least three times its RBW setting. Or the analyser may be set to respond to the average of the power (root-mean-square of the voltage) across the measurement cell.

Table 6.7.2.4.2-1: Span and number of measurement points for OBW measurements for FR1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bandwidth | BS channel bandwidth  BWChannel (MHz) | | | | | Aggregated BS channel bandwidth BWChannel\_CA (MHz) |
|  | 5 | 10 | 15 | 20 | > 20 | > 20 |
| Span (MHz) | 10 | 20 | 30 | 40 |  |  |
| Minimum number of measurement points | 400 | 400 | 400 | 400 |  |  |

Table 6.7.2.4.2-2: Span and number of measurement points for OBW measurements for FR2-1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bandwidth | BS channel bandwidth  BWChannel (MHz) | | | | Aggregated BS channel bandwidth BWChannel\_CA (MHz) |
|  | 50 | 100 | 200 | 400 | > 50 |
| Span (MHz) |  | | | |  |
| Minimum number of measurement points |  | | | |  |

Table 6.7.2.4.2-3: Span and number of measurement points for OBW measurements for FR2-2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Bandwidth | BS channel bandwidth  BWChannel (MHz) | | | | | Aggregated BS channel bandwidth BWChannel\_CA (MHz) | |
|  | 100 | 400 | 800 | 1600 | 2000 | ≦ 400 | > 400 |
| Span (MHz) |  | | | | |  | |
| Minimum number of measurement points |  | |  | | |  |  |

7) Compute the total of the EIRP, P0, (in power units, not decibel units) of all the measurement cells in the measurement span. Compute P1, the EIRP outside the occupied bandwidth on each side. P1 is half of the total EIRP outside the bandwidth. P1 is half of (100 % - (occupied percentage)) of P0. Measure the EIRP for any two orthogonal polarizations (denoted p1 and p2) and calculate total radiated transmit power for particular *beam direction pair* as EIRP = EIRPp1 + EIRPp2.

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##### 6.7.3.5.2 *BS type 2-O*

For the OTA ACLR requirement either the OTA ACLR limits in tables 6.7.3.5.2-1/3 or the OTA ACLR absolute limits in table 6.7.3.5.2-2 shall apply, whichever is less stringent. The OTA CACLR limits in table 6.7.3.5.2-4 or the OTA CACLR absolute limits in table 6.7.3.5.2-4a shall apply, whichever is less stringent.

The CACLR in a sub-block gap is the ratio of:

a) the sum of the filtered mean power centred on the assigned channel frequencies for the two carriers adjacent to each side of the sub-block gap, and

b) the filtered mean power centred on a frequency channel adjacent to one of the respective sub-block edges.

The assumed filter for the adjacent channel frequency is defined in table 6.7.3.5.2-4 and the filters on the assigned channels are defined in table 6.7.3.5.2-5.

The OTA ACLR measurement result shall not be less than the OTA ACLR limit specified in table 6.7.3.5.2-1.

Table 6.7.3.5.2-1: *BS type 2-O* ACLR limit

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *BS channel bandwidth* of lowest/highest NR carrier transmitted  BWChannel (MHz) | BS adjacent channel centre frequency offset below the lowest or above the highest carrier centre frequency transmitted | Assumed adjacent channel carrier | Filter on the adjacent channel frequency and corresponding filter bandwidth | OTA ACLR limit  (dB) |
| 50, 100, 200, 400, 800, 1600, 2000 | BWChannel | NR of same BW (Note 2) | Square (BWConfig) | 25.7 (Note 3)  23.4 (Note 4)  23.2 (Note 5)  [18.8] (Note 6) |
| NOTE 1: BWChannel and BWConfig are the *BS channel bandwidth* and transmission bandwidth configuration of the lowest/highest NR carrier transmitted on the assigned channel frequency.  NOTE 2: With SCS that provides largest transmission bandwidth configuration (BWConfig).  NOTE 3: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz.  NOTE 4: Applicable to bands defined within the frequency spectrum range of 37 – 43.5 GHz.  NOTE 5: Applicable to bands defined within the frequency spectrum range of 43.5 – 48.2 GHz.  NOTE 6: Applicable to bands defined within the frequency spectrum range of 52.6 – 71.0 GHz. | | | | |

The absolute total power measurement shall not exceed the OTA ACLR absolute limit specified in table 6.7.3.5.2-2.

Table 6.7.3.5.2-2: *BS type 2-O* ACLR absolute limit

|  |  |  |  |
| --- | --- | --- | --- |
| BS class | ACLR absolute limit (Note 1) | ACLR absolute limit (Note 2) | ACLR absolute limit (Note 3) |
| Wide area BS | -10.3 dBm/MHz | -10.1 dBm/MHz | -[7.7] dBm/MHz |
| Medium range BS | -17.3 dBm/MHz | -17.1 dBm/MHz | -[14.7] dBm/MHz |
| Local area BS | -17.3 dBm/MHz | -17.1 dBm/MHz | -[14.7] dBm/MHz |
| NOTE 1: Applicable to bands defined within the frequency spectrum range of 24.25 – 43.5 GHz  NOTE 2: Applicable to bands defined within the frequency spectrum range of 43.5 – 48.2 GHz.  NOTE 3: Applicable to bands defined within the frequency spectrum range of 52.6 – 71.0 GHz. | | | |

For operation in non-contiguous spectrum, the OTA ACLR measurement result shall not be less than the OTA ACLR limit specified in table 6.7.3.5.2-3.

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6.7.4.5.2.2 OTA operating band unwanted emission limits (Category A)

The power of unwanted emission shall not exceed the limits in table 6.7.4.5.2.2-1, 6.7.4.5.2.2-2 or 6.7.4.5.2.2-3.

Table 6.7.4.5.2.2-1: OBUE limits applicable in the frequency range 24.25 – 33.4 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter -3 dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | Test limit | Measurement bandwidth |
| 0 MHz ≤ Δf < 0.1\*BWcontiguous | 0.5 MHz ≤ f\_offset < 0.1\* BWcontiguous +0.5 MHz | Min(-2.3 dBm, Max(Prated,t,TRP – 32.3 dB, -9.3 dBm)) | 1 MHz |
| 0.1\*BWcontiguous ≤ Δf < Δfmax | 0.1\* BWcontiguous +0.5 MHz ≤ f\_offset < f\_ offsetmax | Min(-13 dBm, Max(Prated,t,TRP – 43 dB, -20 dBm)) | 1 MHz |
| NOTE: For non-contiguous spectrum operation within any operating band the limitwithin sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub blocks on each side of the sub block gap. | | | |

Table 6.7.4.5.2.2-2: OBUE limits applicable in the frequency range 37– 43.5 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter -3 dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | Test limit | Measurement bandwidth |
| 0 MHz ≤ Δf < 0.1\*BWcontiguous | 0.5 MHz ≤ f\_offset < 0.1\* BWcontiguous +0.5 MHz | Min(-2.3 dBm, Max(Prated,t,TRP – 30.3 dB, -9.3 dBm)) | 1 MHz |
| 0.1\*BWcontiguous ≤ Δf < Δfmax | 0.1\* BWcontiguous +0.5 MHz ≤ f\_offset < f\_ offsetmax | Min(-13 dBm, Max(Prated,t,TRP – 41 dB, -20 dBm)) | 1 MHz |
| NOTE: For non-contiguous spectrum operation within any operating band the limitwithin sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub blocks on each side of the sub block gap. | | | |

Table 6.7.4.5.2.2-3: OBUE limits applicable in the frequency range 43.5– 48.2 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter -3 dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | Test limit | Measurement bandwidth |
| 0 MHz ≤ Δf < 0.1\*BWcontiguous | 0.5 MHz ≤ f\_offset < 0.1\* BWcontiguous +0.5 MHz | Min(-2.1 dBm, Max(Prated,t,TRP – 30.1 dB, -9.1 dBm)) | 1 MHz |
| 0.1\*BWcontiguous ≤ Δf < Δfmax | 0.1\* BWcontiguous +0.5 MHz ≤ f\_offset < f\_ offsetmax | Min(-13 dBm, Max(Prated,t,TRP – 41 dB, -20 dBm)) | 1 MHz |
| NOTE: For non-contiguous spectrum operation within any operating band the limitwithin sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub blocks on each side of the sub block gap. | | | |

Table 6.7.4.5.2.2-4: OBUE limits applicable in the frequency range 52.6 – 71.0 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter -3B point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | Limit | *Measurement bandwidth* |
| 0 MHz ≤ Δf < 0.1\*BWcontiguous | 0.5 MHz ≤ f\_offset < 0.1\* BWcontiguous +0.5 MHz | Min([0.3] dBm, Max(Prated,t,TRP – [25.7] dB, - [6.7] dBm)) | 1 MHz |
| 0.1\*BWcontiguous ≤ Δf < Δfmax | 0.1\* BWcontiguous +0.5 MHz ≤ f\_offset < f\_ offsetmax | Min(-13 dBm, Max(Prated,t,TRP – [33.7] dB, -20 dBm)) | 1 MHz |
| NOTE: For *non-contiguous spectrum* operation within any *operating band* the limitwithin *sub-block gaps* is calculated as a cumulative sum of contributions from adjacent *sub-blocks* on each side of the *sub-block gap*. | | | |

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6.7.4.5.2.3 OTA operating band unwanted emission limits (Category B)

The power of unwanted emission shall not exceed the limits in table 6.7.4.5.2.3-1, 6.7.4.5.2.3-2 or 6.7.4.5.2.3-3.

Table 6.7.4.5.2.3-1: OBUE limits applicable in the frequency range 24.25 – 33.4 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter -3 dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | Test limit | Measurement bandwidth |
| 0 MHz ≤ Δf < 0.1\*BWcontiguous | 0.5 MHz ≤ f\_offset < 0.1\* BWcontiguous +0.5 MHz | Min(-2.3 dBm, Max(Prated,t,TRP – 32.3 dB, -9.3 dBm)) | 1 MHz |
| 0.1\*BWcontiguous ≤ Δf < ΔfB | 0.1\* BWcontiguous +0.5 MHz ≤ f\_offset < ΔfB +0.5 MHz | Min(-13 dBm, Max(Prated,t,TRP – 43 dB, -20 dBm)) | 1 MHz |
| ΔfB ≤ Δf < Δfmax | ΔfB +5 MHz ≤ f\_offset < f\_ offsetmax | Min(-5 dBm, Max(Prated,t,TRP – 33 dB, -10 dBm)) | 10 MHz |
| NOTE 1: For non-contiguous spectrum operation within any *operating band* the limitwithin sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub blocks on each side of the sub block gap, where the contribution from the far-end sub-block shall be scaled according to the measurement bandwidth of the near-end sub-block.  NOTE 2: ΔfB = 2\*BWcontiguous when BWcontiguous ≤ 500 MHz, otherwise ΔfB = BWcontiguous + 500 MHz. | | | |

Table 6.7.4.5.2.3-2: OBUE limits applicable in the frequency range 37 – 43.5 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter -3 dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | Test limit | Measurement bandwidth |
| 0 MHz ≤ Δf < 0.1\*BWcontiguous | 0.5 MHz ≤ f\_offset < 0.1\* BWcontiguous +0.5 MHz | Min(-2.3 dBm, Max(Prated,t,TRP – 30.3 dB, -9.3 dBm)) | 1 MHz |
| 0.1\*BWcontiguous ≤ Δf < ΔfB | 0.1\* BWcontiguous +0.5 MHz ≤ f\_offset < ΔfB +0.5 MHz | Min(-13 dBm, Max(Prated,t,TRP – 41 dB, -20 dBm)) | 1 MHz |
| ΔfB ≤ Δf < Δfmax | ΔfB +5 MHz ≤ f\_offset < f\_ offsetmax | Min(-5 dBm, Max(Prated,t,TRP – 31 dB, -10 dBm)) | 10 MHz |
| NOTE 1: For non-contiguous spectrum operation within any *operating band* the limitwithin sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub blocks on each side of the sub block gap, where the contribution from the far-end sub-block shall be scaled according to the measurement bandwidth of the near-end sub-block.  NOTE 2: ΔfB = 2\*BWcontiguous when BWcontiguous ≤ 500 MHz, otherwise ΔfB = BWcontiguous + 500 MHz. | | | |

Table 6.7.4.5.2.3-3: OBUE limits applicable in the frequency range 43.5 – 48.2 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter -3 dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | Test limit | Measurement bandwidth |
| 0 MHz ≤ Δf < 0.1\*BWcontiguous | 0.5 MHz ≤ f\_offset < 0.1\* BWcontiguous +0.5 MHz | Min(-2.1 dBm, Max(Prated,t,TRP – 30.1 dB, -9.1 dBm)) | 1 MHz |
| 0.1\*BWcontiguous ≤ Δf < ΔfB | 0.1\* BWcontiguous +0.5 MHz ≤ f\_offset < ΔfB +0.5 MHz | Min(-13 dBm, Max(Prated,t,TRP – 41 dB, -20 dBm)) | 1 MHz |
| ΔfB ≤ Δf < Δfmax | ΔfB +5 MHz ≤ f\_offset < f\_ offsetmax | Min(-5 dBm, Max(Prated,t,TRP – 31 dB, -10 dBm)) | 10 MHz |
| NOTE 1: For non-contiguous spectrum operation within any *operating band* the limitwithin sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub blocks on each side of the sub block gap, where the contribution from the far-end sub-block shall be scaled according to the measurement bandwidth of the near-end sub-block.  NOTE 2: ΔfB = 2\*BWcontiguous when BWcontiguous ≤ 500 MHz, otherwise ΔfB = BWcontiguous + 500 MHz. | | | |

Table 6.7.4.5.2.3-4: OBUE limits applicable in the frequency range 52.6 – 71.0 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter -3 dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | Limit | *Measurement bandwidth* |
| 0 MHz ≤ Δf < 0.1\*BWcontiguous | 0.5 MHz ≤ f\_offset < 0.1\* BWcontiguous +0.5 MHz | Min([0.3] dBm, Max(Prated,t,TRP – [25.7] dB, -[6.7] dBm)) | 1 MHz |
| 0.1\*BWcontiguous ≤ Δf < ΔfB | 0.1\* BWcontiguous +0.5 MHz ≤ f\_offset < ΔfB +0.5 MHz | Min(-13 dBm, Max(Prated,t,TRP – [33.7] dB, -20 dBm)) | 1 MHz |
| ΔfB ≤ Δf < Δfmax | ΔfB +5 MHz ≤ f\_offset < f\_ offsetmax | Min(-5 dBm, Max(Prated,t,TRP – [23.7] dB, -10 dBm)) | 10 MHz |
| NOTE 1: For non-contiguous spectrum operation within any *operating band* the limitwithin sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub-blocks on each side of the sub-block gap, where the contribution from the far-end sub-block shall be scaled according to the measurement bandwidth of the near-end sub-block.  NOTE 2: ΔfB = 2\*BWcontiguous when BWcontiguous ≤ 500 MHz, otherwise ΔfB = BWcontiguous + 500 MHz. | | | |

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#### 7.3.5.3 Test requirements for *BS type 2-O*

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in annex A.1 when the OTA test signal is at the corresponding EISREFSENS level and arrives from any direction within the *OTA REFSENS RoAoA*.

EISREFSENS levels are derived from a single declared basis level EISREFSENS\_50M, which is based on a reference measurement channel with 50 MHz *BS channel bandwidth*. EISREFSENS\_50M itself is not a requirement and although it is based on a reference measurement channel with 50 MHz BS channel bandwidth it does not imply that BS has to support 50 MHz *BS channel bandwidth*.

For Wide Area BS, EISREFSENS\_50M is an integer value in the range -96 to -119 dBm. The specific value is declared by the vendor.

For Medium Range BS, EISREFSENS\_50M is an integer value in the range -91 to -114 dBm. The specific value is declared by the vendor.

For Local Area BS, EISREFSENS\_50M is an integer value in the range -86 to -109 dBm. The specific value is declared by the vendor.

Table 7.3.5.3-1 FR2-1 OTA reference sensitivity requirement applicable in the frequency range 24.25 – 43.5 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| BS channel bandwidth  (MHz) | Sub-carrier spacing  (kHz) | Reference measurement channel  (annex A.1) | OTA reference sensitivity level, EISREFSENS  (dBm) |
| 50, 100, 200 | 60 | G-FR2-A1-1 | EISREFSENS\_50M + 2.4 + ΔFR2\_REFSENS |
| 50 | 120 | G-FR2-A1-2 | EISREFSENS\_50M + 2.4 + ΔFR2\_REFSENS |
| 100, 200, 400 | 120 | G-FR2-A1-3 | EISREFSENS\_50M + 3 + 2.4 + ΔFR2\_REFSENS |
| NOTE 1: EISREFSENS is the power level of a single instance of the reference measurement channel. This requirement shall be met for each consecutive application of a single instance of the reference measurement channel mapped to disjoint frequency ranges with a width corresponding to the number of resource blocks of the reference measurement channel each, except for one instance that might overlap one other instance to cover the full *BS channel bandwidth*.  NOTE 2: The declared EISREFSENS\_50M shall be within the range specified in table 10.3.3-2. | | | |

Table 7.3.5.3-2 FR2-1 OTA reference sensitivity requirement applicable in the frequency range 43.5 – 48.2 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| BS channel bandwidth  (MHz) | Sub-carrier spacing  (kHz) | Reference measurement channel  (annex A.1) | OTA reference sensitivity level, EISREFSENS  (dBm) |
| 50, 100, 200 | 60 | G-FR2-A1-1 | EISREFSENS\_50M + [3.5] + ΔFR2\_REFSENS |
| 50 | 120 | G-FR2-A1-2 | EISREFSENS\_50M + [3.5] + ΔFR2\_REFSENS |
| 100, 200, 400 | 120 | G-FR2-A1-3 | EISREFSENS\_50M + 3 + [3.5] + ΔFR2\_REFSENS |
| NOTE 1: EISREFSENS is the power level of a single instance of the reference measurement channel. This requirement shall be met for each consecutive application of a single instance of the reference measurement channel mapped to disjoint frequency ranges with a width corresponding to the number of resource blocks of the reference measurement channel each, except for one instance that might overlap one other instance to cover the full *BS channel bandwidth*.  NOTE 2: The declared EISREFSENS\_50M shall be within the range specified in table 10.3.3-2. | | | |

Table 7.3.5.3-3 FR2-2 OTA reference sensitivity requirement applicable in the frequency range 52.6 – 71 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| BS channel bandwidth  (MHz) | Sub-carrier spacing  (kHz) | Reference measurement channel  (annex A.1) | OTA reference sensitivity level, EISREFSENS  (dBm) |
| 100,400 | 120 | G-FR2-A1-3 | EISREFSENS\_50M + 3+ [3.0] + ΔFR2\_REFSENS |
| 400, 800, 1600 | 480 | G-FR2-A1-6 | EISREFSENS\_50M + 9 + [3.0] + ΔFR2\_REFSENS |
| 400, 800, 1600, 2000 | 960 | G-FR2-A1-7 | EISREFSENS\_50M + 9 + [3.0] + ΔFR2\_REFSENS |
| NOTE 1: EISREFSENS is the power level of a single instance of the reference measurement channel. This requirement shall be met for each consecutive application of a single instance of the reference measurement channel mapped to disjoint frequency ranges with a width corresponding to the number of resource blocks of the reference measurement channel each, except for one instance that might overlap one other instance to cover the full *BS channel bandwidth*.  NOTE 2: The declared EISREFSENS\_50M shall be within the range specified in table 10.3.3-2. | | | |

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##### 7.5.1.5.3 Test requirements for *BS type 2-O*

The requirement shall apply at the RIB when the AoA of the incident wave of a received signal and the interfering signal are from the same direction and are within the *OTA REFSENS RoAoA.*

The wanted and interfering signals apply to each supported polarization, under the assumption o*f polarization match*.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel.

For FR2, the OTA wanted and the interfering signal are specified in table 7.5.1.5.3-1 and table 7.5.1.5.3-2 for ACS. The reference measurement channel for the OTA wanted signal is identified in clause 7.3.5.3 and is further specified in annex A.1. The characteristics of the interfering signal is further specified in TS 38.104 [2] annex D.

The OTA ACS requirement is applicable outside the Base Station RF Bandwidth. The OTA interfering signal offset is defined relative to the Base station RF Bandwidth edges.

For RIBs supporting operation in *non-contiguous spectrum* within any *operating band*, the OTA ACS requirement shall apply in addition inside any sub-block gap, in case the sub-block gap size is at least as wide as the NR interfering signal in table 7.5.1.5.3-2. The OTA interfering signal offset is defined relative to the sub-block edges inside the sub-block gap.

Table 7.5.1.5.3-1: OTA ACS requirement for *BS type 2-O*

|  |  |  |  |
| --- | --- | --- | --- |
|  | BS channel bandwidth of the | Wanted signal mean power (dBm) | Interfering signal mean |
|  | lowest/highest carrier received (MHz) | power (dBm) |
| FR2-1 | 50, 100, 200, 400 |  | EISREFSENS + 6 dB (Note 3)EISREFSENS\_50M + 27.7 + ΔFR2\_REFSENS (Note 1)  EISREFSENS\_50M + 26.7 + ΔFR2\_REFSENS (Note 2) |
| FR2-2 | 100, 400, 800, 1600, 2000 | EISREFSENS\_50M + 28.7 + ΔFR2\_REFSENS (Note 4) |
| NOTE 1: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz.  NOTE 2: Applicable to bands defined within the frequency spectrum range of 37 – 52.6 GHz.  NOTE 3: EISREFSENS is specified in TS 38.104 [2], clause 10.3.3.  NOTE 4: Applicable to bands defined within the frequency spectrum range of 52.6 – 71 GHz. | | | |

Table 7.5.1.5.3-2: OTA ACS interferer frequency offset for *BS type 2-O*

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range | *BS channel bandwidth* of the lowest/highest carrier received (MHz) | Interfering signal centre frequency offset from the lower/upper Base Station RF Bandwidth edge or sub-block edge inside a sub-block gap (MHz) | Type of interfering signal |
| FR2-1 | 50 | ±24.29 | 50 MHz DFT-s-OFDM NR |
| 100 | ±24.31 | signal, 60 kHz SCS, 64 RBs |
| 200 | ±24.29 |  |
| 400 | ±24.31 |  |
| FR2-2 | 100 | ±48.58 | 100 MHz DFT-s-OFDM NR  signal,120 kHz SCS, 64 RBs |
| 400 | ±48.58 |
| 800 | ±48.62 |
| 1600 | ±48.58 |
| 2000 | ±48.62 |

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##### 7.5.2.5.3 Test requirements for *BS type 2-O*

The requirement shall apply at the RIB when the AoA of the incident wave of a received signal and the interfering signal are from the same direction and are within the *OTA REFSENS RoAoA.*

The wanted and interfering signals apply to each supported polarization, under the assumption o*f polarization match*.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel.

For *BS type 2-O*, the OTA wanted and OTA interfering signals are provided at RIB using the parameters in table 7.5.2.5.3-1 for general OTA blocking requirements. The reference measurement channel for the OTA wanted signal is identified in clause 7.3.5.3 and is further specified in annex A.1. The characteristics of the interfering signal is further specified in TS 38.104 [2] annex D.

The OTA blocking requirements are applicable outside the *Base Station RF Bandwidth*. The interfering signal offset is defined relative to the *Base Station RF Bandwidth edges*.

For *BS type 2-O* the OTA blocking requirement shall apply in the in-band blocking frequency range, which is defined within frequency range from FUL\_low - ΔfOOB to FUL\_high + ΔfOOB, where theΔfOOB for *BS type 2-O* is defined in table 7.5.2.5.3-0.

Table 7.5.2.5.3-0: ΔfOOB offset for NR *operating bands* in FR2

|  |  |  |  |
| --- | --- | --- | --- |
| BS type | Frequency range | *Operating band* characteristics (MHz) | ΔfOOB (MHz) |
| *BS type 2-O* | FR2-1 | FUL\_high – FUL\_low ≤ 4000 | 1500 |
| FR2-2 | 4000 < FUL\_high – FUL\_low ≤14000 | 3500 |

For a RIBs supporting operation in *non-contiguous spectrum* within any *operating band*, the OTA blocking requirements apply in addition inside any sub-block gap, in case the sub-block gap size is at least as wide as twice the interfering signal minimum offset in table 7.5.2.5.3-1. The interfering signal offset is defined relative to the sub-block edges inside the sub-block gap.

Table 7.5.2.5.3-1: General OTA blocking requirement for *BS type 2-O*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Frequency range | BS channel bandwidth of the  lowest/highest carrier received (MHz) | OTA wanted signal mean power (dBm) | OTA interfering signal mean  power (dBm) | OTA interfering signal centre  frequency offset  from the lower/upper Base Station RF Bandwidth edge or sub-block edge inside a sub-block gap (MHz) | Type of OTA interfering  signal |
| FR2-1 | 50, 100, 200, 400 | EISREFSENS + 6 dB | EISREFSENS\_50M + 33 + ΔFR2\_REFSENS dB | ±75 | 50 MHz DFT-s-OFDM NR signal, 60 kHz SCS, 64 RBs |
| FR2-2 | 100, 400, 800, 1600, 2000 | EISREFSENS\_50M + 36 + ΔFR2\_REFSENS | ±150 | 100 MHz DFT-s-OFDM NR signal,  120 kHz SCS, 64 RBs |
| NOTE: EISREFSENS and EISREFSENS\_50M are given in TS 38.104 [2], clause 10.3.3. | | | | | |

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##### 7.6.4.2.3 *BS type 2-O* procedure for out-of-band blocking

1) Place BS and the test antenna(s) according to annex E.2.4.1.

2) Align the BS and test antenna(s) according to the directions to be tested.

3) Connect test antenna(s) to the measurement equipment as shown in annex E.2.4.1.

4) The test antenna(s) shall be dual (or single) polarized covering the same frequency ranges as the *BS* and 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.

5) 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* in-band and the polarization maintained for out-of-band frequencies.

6) Generate the wanted signal, according to the applicable test configuration (see clause 4.7 and 4.8) using applicable reference measurement channel to the RIB, according to annex A.1.

7) Adjust the signal generators to the type of interfering signals, levels and the frequency offsets as specified for general test requirements in table 7.6.5.2.1-1. 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.

8) The interfering signal shall be swept within the frequency range specified in table 7.6.5.2.1-1 with the step size specified in table 7.6.4.2.3-1 and table 7.6.4.2.3-2.

9) Measure the performance of the wanted signal at the receiver unit associated with the RIB, as defined in the clause 7.6.5, for the relevant carriers specified by the test configuration in clause 4.7 and 4.8.

Table 7.6.4.2.3-1: Interferer signal step size for FR2-1

|  |  |  |
| --- | --- | --- |
| Frequency range  (MHz) | Minimum supported *BS channel bandwidth* (MHz) | Measurement  step size  (MHz) |
| 30 to 6000 | 50, 100, 200, 400 | 1 |
| 6000 to 60000 | 50 | 15 |
|  | 100 | 30 |
|  | 200 | 60 |
|  | 400 | 60 |

Table 7.6.4.2.3-2: Interferer signal step size for FR2-2

|  |  |  |
| --- | --- | --- |
| Frequency range  (MHz) | Minimum supported *BS channel bandwidth* (MHz) | Measurement  step size  (MHz) |
| 30 to 6000 | 100, 400, 800, 1600, 2000 | 1 |
| 6000 to 142000 | 100 | 30 |
| 400 | 60 |
| 800 | 240 |
| 1600 | 240 |
| 2000 | 240 |

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##### 7.6.5.2.1 General requirement

For OTA wanted and OTA interfering signals provided at the RIB using the parameters in table 7.6.5.2.1-1 and table 7.6.5.2.1-2, the following requirements shall be met:

- The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel. The reference measurement channel for the OTA wanted signal is identified in clause 10.3.3 in TS 38.104 [2] for each *BS channel bandwidth* and further specified in annex A.1.

For *BS type 2-O* within FR2-1 the OTA out-of-band blocking requirement apply from 30 MHz to FUL\_low – ΔfOOB and from FUL\_high + ΔfOOB up to min(2nd harmonic of the upper frequency edge of the *operating band*, 60 GHz). The ΔfOOB for *BS type 2-O* is defined in table 7.5.2.5.3-0.

For *BS type 2-O* within FR2-2 the OTA out-of-band blocking requirement apply from 30 MHz to FUL\_low – ΔfOOB and from FUL\_high + ΔfOOB up to [142] GHz. The ΔfOOB for *BS type 2-O* is defined in table 7.5.2.5.3-0.

Table 7.6.5.2.1-1: OTA out-of-band blocking performance requirement for FR2-1

| Frequency range of interfering signal  (MHz) | Wanted signal mean power  (dBm) | Interferer RMS field-strength  (V/m) | Type of interfering signal |
| --- | --- | --- | --- |
| 30 to 12750 | EISREFSENS + 6 dB | 0.36 | CW carrier |
| 12750 to FUL\_low – ΔfOOB |  | 0.1 |  |
| FUL\_high + ΔfOOB to min(2nd harmonic of the upper frequency edge of the operating band, 60000) |  | 0.1 |  |
| NOTE: EISREFSENS is given in TS 38.104 [2], clause 10.3.3. | | | |

Table 7.6.5.2.1-2: OTA out-of-band blocking performance requirement for FR2-2

| Frequency range of interfering signal  (MHz) | Wanted signal mean power  (dBm) | Interferer RMS field-strength  (V/m) | Type of interfering signal |
| --- | --- | --- | --- |
| 30 to 12750 | EISREFSENS + 6 dB | 0.36 | CW carrier |
| 12750 to FUL\_low – ΔfOOB | 0.1 |
| FUL\_high + ΔfOOB to 2nd harmonic of the upper frequency edge of the operating band | 0.1 |
| NOTE: EISREFSENS is given in TS 38.104 [2], clause 10.3.3. | | | |

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#### 7.7.4.1 Initial conditions

Test environment: Normal; see annex B.2.

RF channels to be tested for single carrier, see clause 4.9.1:

- For FR1:

- B when testing from 30 MHz to FDL\_low - ΔfOBUE

- T when testing from FDL\_high + ΔfOBUE to 12.75 GHz (or to 5th harmonic)

- For FR2:

- B when testing from 30 MHz to FDL\_low - ΔfOBUE

- T when testing from FDL\_high + ΔfOBUE to 2nd harmonic (or to 60 GHz) for FR2-1

- T when testing from FDL\_high + ΔfOBUE to 2nd harmonic (or to 142 GHz) for FR2-2

RF bandwidth positions to be tested in single-band operation, see clause 4.9.1:

- For FR1:

- BRFBW when testing from 30 MHz to FDL\_low - ΔfOBUE

- TRFBW when testing from FDL\_high + ΔfOBUE to 12.75 GHz (or to 5th harmonic)

- For FR2:

- BRFBW when testing from 30 MHz to FDL\_low - ΔfOBUE

- TRFBW when testing from FDL\_high + ΔfOBUE to 2nd harmonic (or to 60 GHz) for FR2-1

- TRFBW when testing from FDL\_high + ΔfOBUE to 2nd harmonic (or to 142 GHz) for FR2-2

RF bandwidth positions to be tested in multi-band operation, see clause 4.9.1:

- For FR1:

- BRFBW\_T'RFBW when testing from 30 MHz to FDL\_Blow\_low - ΔfOBUE

- B'RFBW\_TRFBW when testing from FDL\_Bhigh\_high + ΔfOBUE to 12.75 GHz (or to 5th harmonic)

- BRFBW\_T'RFBW and B'RFBW\_TRFBW when testing from FDL\_Blow\_high + ΔfOBUE to FDL\_Bhigh\_low - ΔfOBUE

Directions to be tested: As the requirement is TRP the beam pattern(s) may be set up to optimise the TRP measurement procedure (see annex I) as long as the required TRP level is achieved.

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#### 7.7.5.2 Test requirement for *BS type 2-O*

The power of any receiver spurious emission shall not exceed the limits in table 7.7.5.2-1.

Table 7.7.5.2-1: Radiated Rx spurious emission limits for *BS type 2-O*

|  |  |  |  |
| --- | --- | --- | --- |
| Spurious  frequency range  (Note 4) | Limit (Note 5) | Measurement Bandwidth | Note |
| 30 MHz ↔ 1 GHz | -36 dBm | 100 kHz | Note 1 |
| 1 GHz ↔ 18 GHz | -30 dBm | 1 MHz | Note 1 |
| 18 GHz ↔ Fstep,1 | -20 dBm | 10 MHz | Note 2 |
| Fstep,1  ↔ Fstep,2 | -15 dBm | 10 MHz | Note 2 |
| Fstep,2 ↔ Fstep,3 | -10 dBm | 10 MHz | Note 2 |
| Fstep,4  ↔ Fstep,5 | -10 dBm | 10 MHz | Note 2 |
| Fstep,5  ↔ Fstep,6 | -15 dBm | 10 MHz | Note 2 |
| Fstep,6 ↔ min(2nd harmonic of the upper frequency edge of the UL operating band in GHz; 60 GHz) | -20 dBm | 10 MHz | Note 2, Note 3 |
| NOTE 1: Bandwidth as in ITU-R SM.329 [2], s4.1.  NOTE 2: Limit and bandwidth as in ERC Recommendation 74-01 [19], Annex 2.  NOTE 3: Upper frequency as in ITU-R SM.329 [2], s2.5 table 1.  NOTE 4: The step frequencies Fstep,X are defined in table 7.7.5.2-2.  NOTE 5: Additional limits may apply regionally. | | | |

Table 7.7.5.2-2: Step frequencies for defining the radiated Rx spurious emission limits   
for *BS type 2-O*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Operating band | Fstep,1 (GHz) | Fstep,2 (GHz) | Fstep,3 (GHz) | Fstep,4 (GHz) | Fstep,5 (GHz) | Fstep,6 (GHz) |
| n257 | 18 | 23.5 | 25 | 31 | 32.5 | 41.5 |
| n258 | 18 | 21 | 22.75 | 29 | 30.75 | 40.5 |
| n259 | 23.5 | 35.5 | 38 | 45 | 47.5 | 59.5 |
| n260 | 25 | 34 | 35.5 | 41.5 | 43 | 52 |
| n261 | 18 | 25.5 | 26.0 | 29.85 | 30.35 | 38.35 |
| n262 | 37.2 | 45.2 | 45.7 | 49.7 | 50.2 | 58.2 |
| n263 | 18 | 43 | 53.5 | 74.5 | 85 | 127 |

In addition, the following requirement may be applied for protection of EESS for BS operating in frequency range 24.25 – 27.5 GHz.

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#### 7.8.5.2 *BS type 2-O*

Throughputshall be ≥ 95% of the maximum throughput of the reference measurement channel, with OTA wanted signal at the assigned channel frequency and two OTA interfering signals provided at the RIB using the parameters in tables 7.8.5.2-1 and 7.8.5.2-2. All of the OTA test signals arrive from the same direction, and the requirement is valid if the signals arrive from any direction within the *FR2 OTA REFSENS RoAoA*. The reference measurement channel for the wanted signal is identified in table 7.3.5.3-1 for each *BS channel bandwidth* and further specified in annex A.1.

The subcarrier spacing for the modulated interfering signal shall be the same as the subcarrier spacing for the wanted signal except for FR2-2 with 400 MHz, 800 MHz, 1600 MHz and 2000 MHz case.

The receiver intermodulation requirement is applicable outside the Base Station RF Bandwidth. The interfering signal offset is defined relative to the Base Station RF Bandwidth edges.

Table 7.8.5.2-1: General intermodulation requirement

|  |  |  |  |
| --- | --- | --- | --- |
| *BS channel bandwidth* of the lowest/highest carrier received (MHz) | Mean power of interfering signals (dBm) | Wanted signal mean power (dBm) | Type of interfering signal |
| 50, 100, 200, 400, 800, 1600, 2000 | EISREFSENS\_50M + 25 + ΔFR2\_REFSENS dB (Note 2),  EISREFSENS\_50M + 28 + ΔFR2\_REFSENS (Note 3) | EISREFSENS + 6dB | See table 7.8.5.2-2 |
| NOTE 1: EISREFSENS and EISREFSENS\_50M are given in TS 38.104 [2], clause 10.3.3.  NOTE 2: Applicable to bands defined within the frequency spectrum range of FR2-1.  NOTE 3: Applicable to bands defined within the frequency spectrum range of FR2-2. | | | |

Table 7.8.5.2-2: Interfering signals for intermodulation requirement

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range | *BS channel bandwidth* of the lowest/highest carrier received (MHz) | Interfering signal centre frequency offset from the Base Station RF Bandwidth edge (MHz) | Type of interfering signal |
| FR2-1 | 50 | ±7.5 | CW |
|  | ±40 | 50MHz DFT-s-OFDM NR signal  (Note 1) |
| 100 | ±6.88 | CW |
|  | ±40 | 50MHz DFT-s-OFDM NR signal  (Note 1) |
| 200 | ±5.64 | CW |
|  | ±40 | 50MHz DFT-s-OFDM NR signal  (Note 1) |
| 400 | ±6.02 | CW |
|  | ±45 | 50MHz DFT-s-OFDM NR signal  (Note 1) |
| FR2-2 | 100 | ±7.5 | CW |
| ±65 | 100MHz DFT-s-OFDM NR signal  (Note 2) |
| 400 | ±6.28 | CW |
| ±70 | 100MHz DFT-s-OFDM NR signal  (Note 2) |
| 800 | [±7.3] | CW |
| [±105] | 100MHz DFT-s-OFDM NR signal  (Note 2) |
| 1600 | [±5.86] | CW |
| [±145] | 100MHz DFT-s-OFDM NR signal  (Note 2) |
| 2000 | ±7.48 | CW |
| ±210 | 100MHz DFT-s-OFDM NR signal  (Note 2) |
| NOTE 1: For the 60 kHz subcarrier spacing, the number of RB is 64. For the 120 kHz subcarrier spacing, the number of RB is 32.  NOTE 2: Number of RBs is 64 with 120 kHz subcarrier spacing. | | | |

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#### 7.9.4.2 Procedure

1) Place the BS with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex E.2.7.

2) Align the manufacturer declared coordinate system orientation of the BS with the test system.

3) Align the BS with the test antenna in the declared direction to be tested.

4) Align the BS to that the wanted signal and interferer signal is *polarization matched* with the test antenna(s).

5) Configure the beam peak direction for the transmitter according to the declared reference beam direction pair for the appropriate beam identifier.

6) For FDD operation, set the BS to transmit beam(s) of the same operational band as the *OTA REFSENS RoAoA* or OSDD being tested according to the appropriate test configuration in clauses 4.7 and 4.8.

7) Set the test signal mean power so the calibrated radiated power at the BS Antenna Array coordinate system reference point is as specified as follows:

a) Adjust the signal generator for the wanted signal as specified in:

For *BS type 1-O*, table 7.9.5.1-1 for BS of Wide Area BS class, in table 7.9.5.1-2 for BS of Local Area BS class and in table 7.9.5.1-3 for BS of Medium Range BS class on one side of the FC.

For *BS type 2-O*, tables 7.9.5.2-1, 7.9.5.2-2 and 7.9.5.2-3 on one side of the FC.

b) Adjust the signal generator for the interfering signal as specified in:

For *BS type 1-O*, table 7.9.5.1-1 for BS of Wide Area BS class, in table 7.9.5.1-2 for BS of Local Area BS class and in table 7.9.5.1-3 for BS of Medium Range BS class at opposite side of the FC and adjacent to the wanted signal.

For *BS type 2-O*, tables 7.9.5.2-1,7.9.5.2-2 and 7.9.5.2-3 at opposite side of the FC and adjacent to the wanted signal.

8) Measure throughput according to annex A.1 for each supported polarization.

9) Repeat the measurement with the wanted signal on the other side of the FC, and the interfering signal at opposite side of the FC and adjacent to the wanted signal.

10) Repeat for all the specified measurement directions and supported polarizations.

In addition, for *multi-band RIB(s)*, the following steps shall apply:

9) For *multi-band RIBs* and single band tests, repeat the steps above per involved band where single band test configurations and test models shall apply with no carrier activated in the other band.

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#### 7.9.5.1 *BS type 1-O*

The requirement shall apply at the RIBwhen the AoA of the incident wave of the received signal and the interfering signal are the same direction and are within the *minSENS RoAoA*

The wanted and interfering signals applies to each supported polarization, under the assumption of *polarization match.*

For a wanted and an interfering signal coupled to the RIB, the following requirements shall be met:

- For *BS type 1-O*, the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in annex A.1 with parameters specified in tables 7.9.5.1-1 and 7.9.5.1-1a for Wide Area BS, in tables 7.9.5.1-2 and 7.9.5.1-2a for Medium Range BS and in tables 7.9.5.1-3 and 7.9.5.1-3a for Local Area BS.

Table 7.9.5.1-1: Wide Area BS in-channel selectivity for f ≤ 6 GHz

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| BS channel bandwidth | Subcarrier spacing | Reference measurement | Wanted signal mean power (dBm) | | | Interfering signal mean | Type of interfering |
| (MHz) | (kHz) | channel  (annex A.1) | f ≤ 3.0 GHz | 3.0 GHz < f ≤ 4.2 GHz | 4.2 GHz < f ≤ 6.0 GHz | power (dBm) | signal |
| 5 | 15 | G-FR1-A1-7 | -98.9-ΔminSENS | -98.5-ΔminSENS | -98.2-ΔminSENS | -81.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 10 RBs |
| 10, 15, 20, 25, 30, 35 | 15 | G-FR1-A1-1 | -97-ΔminSENS | -96.6-ΔminSENS | -96.3-ΔminSENS | -77.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 25 RBs |
| 40, 45, 50 | 15 | G-FR1-A1-4 | -90.6-ΔminSENS | -90.2-ΔminSENS | -89.9-ΔminSENS | -71.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 100 RBs |
| 5 | 30 | G-FR1-A1-8 | -99.6-ΔminSENS | -99.2-ΔminSENS | -98.9-ΔminSENS | -81.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 5 RBs |
| 10, 15, 20, 25, 30, 35 | 30 | G-FR1-A1-2 | -97.1-ΔminSENS | -96.7-ΔminSENS | -96.4-ΔminSENS | -78.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 10 RBs |
| 40, 45, 50, 60, 70, 80, 90, 100 | 30 | G-FR1-A1-5 | -90.9-ΔminSENS | -90.5-ΔminSENS | -90.2-ΔminSENS | -71.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 50 RBs |
| 10, 15, 20, 25, 30, 35 | 60 | G-FR1-A1-9 | -96.5-ΔminSENS | -96.1-ΔminSENS | -95.8-ΔminSENS | -78.4 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 5 RBs |
| 40, 45, 50, 60, 70, 80, 90, 100 | 60 | G-FR1-A1-6 | -91-ΔminSENS | -90.6-ΔminSENS | -90.3-ΔminSENS | -71.6 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 24 RBs |
| NOTE: Wanted and interfering signal are placed adjacently around Fc, where the Fc is defined for *BS channel bandwidth* of the wanted signal according to the table 5.4.2.2-1 in TS 38.104 [2]. The aggregated wanted and interferer signal shall be centred in the BS channel bandwidth of the wanted signal. | | | | | | | |

Table 7.9.5.1-1a: Wide Area BS in-channel selectivity for 6 < f ≤ 7.125 GHz

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| BS channel bandwidth  (MHz) | Subcarrier spacing  (kHz) | Reference measurement  channel  (annex A.1) | Wanted signal mean power (dBm) | Interfering signal mean  power (dBm) | Type of interfering  signal |
| 20, 30 | 15 | G-FR1-A1-1 | -94.9 -ΔminSENS | -76.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 25 RBs |
| 40, 50 | 15 | G-FR1-A1-4 | -88.5 -ΔminSENS | -70.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 100 RBs |
| 20, 30 | 30 | G-FR1-A1-2 | -95.0 -ΔminSENS | -77.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 10 RBs |
| 40, 50, 60, 70, 80, 90, 100 | 30 | G-FR1-A1-5 | -88.8 -ΔminSENS | -70.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 50 RBs |
| 20, 30 | 60 | G-FR1-A1-9 | -94.4 -ΔminSENS | -77.4 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 5 RBs |
| 40, 50, 60, 70, 80, 90, 100 | 60 | G-FR1-A1-6 | -88.9 -ΔminSENS | -70.6 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 24 RBs |

Table 7.9.5.1-2: Medium Range BS in-channel selectivity for f ≤ 6.0 GHz

| BS channel bandwidth | Subcarrier spacing | Reference measurement | Wanted signal mean power (dBm) | | | Interfering signal mean | Type of interfering |
| --- | --- | --- | --- | --- | --- | --- | --- |
| (MHz) | (kHz) | channel  (annex A.1) | f ≤ 3.0 GHz | 3.0 GHz < f ≤ 4.2 GHz | 4.2 GHz < f ≤ 6.0 GHz | power (dBm) | signal |
| 5 | 15 | G-FR1-A1-7 | -93.9-ΔminSENS | -93.5-ΔminSENS | -93.2-ΔminSENS | -76.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 10 RBs |
| 10, 15, 20, 25, 30, 35 | 15 | G-FR1-A1-1 | -92-ΔminSENS | -91.6-ΔminSENS | -91.3-ΔminSENS | -72.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 25 RBs |
| 40, 45, 50 | 15 | G-FR1-A1-4 | -85.6-ΔminSENS | -85.2-ΔminSENS | -84.9-ΔminSENS | -66.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 100 RBs |
| 5 | 30 | G-FR1-A1-8 | -94.6-ΔminSENS | -94.2-ΔminSENS | -93.9-ΔminSENS | -76.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 5 RBs |
| 10, 15, 20, 25, 30, 35 | 30 | G-FR1-A1-2 | -92.1-ΔminSENS | -91.7-ΔminSENS | -91.4-ΔminSENS | -73.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 10 RBs |
| 40, 45, 50, 60, 70, 80, 90, 100 | 30 | G-FR1-A1-5 | -85.9-ΔminSENS | -85.5-ΔminSENS | -85.2-ΔminSENS | -66.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 50 RBs |
| 10, 15, 20, 25, 30, 35 | 60 | G-FR1-A1-9 | -91.5-ΔminSENS | -91.1-ΔminSENS | -90.8-ΔminSENS | -73.4 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 5 RBs |
| 40, 45, 50, 60, 70, 80, 90, 100 | 60 | G-FR1-A1-6 | -86-ΔminSENS | -85.6-ΔminSENS | -85.3-ΔminSENS | -66.6 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 24 RBs |
| NOTE: Wanted and interfering signal are placed adjacently around Fc, where the Fc is defined for *BS channel bandwidth* of the wanted signal according to the table 5.4.2.2-1 in TS 38.104 [2]. The aggregated wanted and interferer signal shall be centred in the BS channel bandwidth of the wanted signal. | | | | | | | |

Table 7.9.5.1-2a: Medium Range BS in-channel selectivity for 6.0 < f ≤ 7.125 GHz

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| BS channel bandwidth  (MHz) | Subcarrier spacing  (kHz) | Reference measurement  channel  (annex A.1) | Wanted signal mean power (dBm) | Interfering signal mean  power (dBm) | Type of interfering  signal |
| 20, 30 | 15 | G-FR1-A1-1 | -89.9 -ΔminSENS | -71.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 25 RBs |
| 40, 50 | 15 | G-FR1-A1-4 | -83.5 -ΔminSENS | -65.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 100 RBs |
| 20, 30 | 30 | G-FR1-A1-2 | -90.0 -ΔminSENS | -72.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 10 RBs |
| 40, 50, 60, 70, 80, 90, 100 | 30 | G-FR1-A1-5 | -83.8 -ΔminSENS | -65.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 50 RBs |
| 20, 30 | 60 | G-FR1-A1-9 | -89.4 -ΔminSENS | -72.4 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 5 RBs |
| 40, 50, 60, 70, 80, 90, 100 | 60 | G-FR1-A1-6 | -83.9 -ΔminSENS | -65.6 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 24 RBs |

Table 7.9.5.1-3: Local area BS in-channel selectivity for f ≤ 6.0 GHz

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| BS channel bandwidth | Subcarrier spacing | Reference measurement | Wanted signal mean power (dBm) | | | Interfering signal mean | Type of interfering |
| (MHz) | (kHz) | channel  (annex A.1) | f ≤ 3.0 GHz | 3.0 GHz < f ≤ 4.2 GHz | 4.2 GHz < f ≤ 6.0 GHz | power (dBm) | signal |
| 5 | 15 | G-FR1-A1-7 | -90.9-ΔminSENS | -90.5-ΔminSENS | -90.2-ΔminSENS | -73.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 10 RBs |
| 10, 15, 20, 25, 30, 35 | 15 | G-FR1-A1-1 | -89-ΔminSENS | -88.6-ΔminSENS | -88.3-ΔminSENS | -69.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 25 RBs |
| 40, 45, 50 | 15 | G-FR1-A1-4 | -82.6-ΔminSENS | -82.2-ΔminSENS | -81.9-ΔminSENS | -63.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 100 RBs |
| 5 | 30 | G-FR1-A1-8 | -91.6-ΔminSENS | -91.2-ΔminSENS | -90.9-ΔminSENS | -73.4 - ΔminSENS | DFT-s- NR signal, 30 kHz SCS, 5 RBs |
| 10, 15, 20, 25, 30, 35 | 30 | G-FR1-A1-2 | -89.1-ΔminSENS | -88.7-ΔminSENS | -88.4-ΔminSENS | -70.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 10 RBs |
| 40, 45, 50, 60, 70, 80, 90, 100 | 30 | G-FR1-A1-5 | -82.9-ΔminSENS | -82.5-ΔminSENS | -82.2-ΔminSENS | -63.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 50 RBs |
| 10, 15, 20, 25, 30, 35 | 60 | G-FR1-A1-9 | -88.5-ΔminSENS | -88.1-ΔminSENS | -87.8-ΔminSENS | -70.4 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 5 RBs |
| 40, 45, 50, 60, 70, 80, 90, 100 | 60 | G-FR1-A1-6 | -83-ΔminSENS | -82.6-ΔminSENS | -82.3-ΔminSENS | -63.6 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 24 RBs |
| NOTE: Wanted and interfering signal are placed adjacently around Fc, where the Fc is defined for *BS channel bandwidth* of the wanted signal according to the table 5.4.2.2-1 in TS 38.104 [2]. The aggregated wanted and interferer signal shall be centred in the BS channel bandwidth of the wanted signal. | | | | | | | |

Table 7.9.5.1-3a: Local area BS in-channel selectivity for 6.0 < f ≤ 7.125 GHz

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| BS channel bandwidth  (MHz) | Subcarrier spacing  (kHz) | Reference measurement  channel  (annex A.1) | Wanted signal mean power (dBm) | Interfering signal mean  power (dBm) | Type of interfering  signal |
| 20, 30 | 15 | G-FR1-A1-1 | -86.9 -ΔminSENS | -68.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 25 RBs |
| 40, 50 | 15 | G-FR1-A1-4 | -80.5 -ΔminSENS | -62.4 - ΔminSENS | DFT-s-OFDM NR signal, 15 kHz SCS, 100 RBs |
| 20, 30 | 30 | G-FR1-A1-2 | -87.0 -ΔminSENS | -69.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 10 RBs |
| 40, 50, 60, 70, 80, 90, 100 | 30 | G-FR1-A1-5 | -80.8 -ΔminSENS | -62.4 - ΔminSENS | DFT-s-OFDM NR signal, 30 kHz SCS, 50 RBs |
| 20, 30 | 60 | G-FR1-A1-9 | -86.4 -ΔminSENS | -69.4 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 5 RBs |
| 40, 50, 60, 70, 80, 90, 100 | 60 | G-FR1-A1-6 | -80.9 -ΔminSENS | -62.6 - ΔminSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 24 RBs |

#### 7.9.5.2 *BS type 2-O*

For *BS type 2-O*, the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in annex A.1 with parameters specified in tables 7.9.5.2-1, 7.9.5.2-2 and 7.9.5.2-3.

The wanted and interfering signals applies to each supported polarization, under the assumption of *polarization match.*

Table 7.9.5.2-1: OTA in-channel selectivity requirement for *BS type 2-O* applicable in the frequency range 24.25 – 43.5 GHz

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| BS channel bandwidth (MHz) | Subcarrier spacing (kHz) | Reference measurement channel  (annex A.1) | Wanted signal mean power (dBm)  (Note 2) | Interfering signal mean power (dBm)  (Note 2) | Type of interfering signal |
| 50 | 60 | G-FR2-A1-4 | EISREFSENS\_50M + 3.4 + ΔFR2\_REFSENS | EISREFSENS\_50M + 10 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 32 RBs |
| 100, 200 | 60 | G-FR2-A1-1 | EISREFSENS\_50M + 6.4 + ΔFR2\_REFSENS | EISREFSENS\_50M + 13 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 64 RBs |
| 50 | 120 | G-FR2-A1-5 | EISREFSENS\_50M + 3.4 + ΔFR2\_REFSENS | EISREFSENS\_50M + 10 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 120 kHz SCS, 16 RBs |
| 100, 200, 400 | 120 | G-FR2-A1-2 | EISREFSENS\_50M+ 6.4 + ΔFR2\_REFSENS | EISREFSENS\_50M + 13 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 120 kHz SCS, 32 RBs |
| NOTE 1: Wanted and interfering signal are placed adjacently around Fc, where the Fc is defined for *BS channel bandwidth* of the wanted signal according to the table 5.4.2.2-1 in TS 38.104 [2]. The aggregated wanted and interferer signal shall be centred in the BS channel bandwidth of the wanted signal.  NOTE 2: EISREFSENS\_50M is defined in TS38.104 [2], clause 7.3.3. | | | | | |

Table 7.9.5.2-2: OTA in-channel selectivity requirement for *BS type 2-O* applicable in the frequency range 43.5 – 48.2 GHz

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| BS channel bandwidth (MHz) | Subcarrier spacing (kHz) | Reference measurement channel  (annex A.1) | Wanted signal mean power (dBm)  (Note 2) | Interfering signal mean power (dBm)  (Note 2) | Type of interfering signal |
| 50 | 60 | G-FR2-A1-4 | EISREFSENS\_50M + [5.1] + ΔFR2\_REFSENS | EISREFSENS\_50M + 10 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 32 RBs |
| 100, 200 | 60 | G-FR2-A1-1 | EISREFSENS\_50M + [8.1] + ΔFR2\_REFSENS | EISREFSENS\_50M + 13 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 60 kHz SCS, 64 RBs |
| 50 | 120 | G-FR2-A1-5 | EISREFSENS\_50M + [5.1] + ΔFR2\_REFSENS | EISREFSENS\_50M + 10 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 120 kHz SCS, 16 RBs |
| 100, 200, 400 | 120 | G-FR2-A1-2 | EISREFSENS\_50M+ [8.1] + ΔFR2\_REFSENS | EISREFSENS\_50M + 13 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 120 kHz SCS, 32 RBs |
| NOTE 1: Wanted and interfering signal are placed adjacently around Fc, where the Fc is defined for *BS channel bandwidth* of the wanted signal according to the table 5.4.2.2-1 in TS 38.104 [2]. The aggregated wanted and interferer signal shall be centred in the BS channel bandwidth of the wanted signal.  NOTE 2: EISREFSENS\_50M is defined in TS38.104 [2], clause 7.3.3. | | | | | |

Table 7.9.5.2-3: OTA in-channel selectivity requirement for *BS type 2-O* applicable in the frequency range 52.6 – 71 GHz

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| BS channel bandwidth (MHz) | Subcarrier spacing (kHz) | Reference measurement channel | Wanted signal mean power (dBm)  (Note 2) | Interfering signal mean power (dBm)  (Note 2) | Type of interfering signal |
| 100, 400 | 120 | G-FR2-A1-2 | EISREFSENS\_50M+ 3+[4.0] + ΔFR2\_REFSENS | EISREFSENS\_50M + 13 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 120 kHz SCS,  32 RB |
| 400 | 480 | G-FR2-A1-8 | EISREFSENS\_50M+ 9+[4.0] + ΔFR2\_REFSENS | EISREFSENS\_50M + 19+ ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 480 kHz SCS,  32 RB |
| 800, 1600 | 480 | G-FR2-A1-6 | EISREFSENS\_50M+ 12+[4.0] + ΔFR2\_REFSENS | EISREFSENS\_50M + 22 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 480 kHz SCS,  54 RB |
| 400 | 960 | G-FR2-A1-9 | EISREFSENS\_50M+ 9+[4.0] + ΔFR2\_REFSENS | EISREFSENS\_50M + 19+ ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 960 kHz SCS,  16 RB |
| 800, 1600, 2000 | 960 | G-FR2-A1-7 | EISREFSENS\_50M+ 12+[4.0] + ΔFR2\_REFSENS | EISREFSENS\_50M + 22+ ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 960 kHz SCS,  27 RB |
| NOTE 1: Wanted and interfering signal are placed adjacently around Fc, where the Fc is defined for *BS channel bandwidth* of the wanted signal according to the table 5.4.2.2-1 in TS 38.104 [2]. The aggregated wanted and interferer signal shall be centred in the BS channel bandwidth of the wanted signal.  NOTE 2: EISREFSENS\_50M is defined in TS 38.104 [2], clause 7.3.3. | | | | | |

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##### 8.2.11.4.2 Procedure

1) Place the BS with its manufacturer declared coordinate system reference point in the same place as calibrated point in the test system, as shown in annex E.3.

2) Align the manufacturer declared coordinate system orientation of the BS with the test system.

3) Set the BS in the declared direction to be tested.

4) Connect the BS tester generating the wanted signal, multipath fading simulators and AWGN generators to a test antenna via a combining network in OTA test setup, as shown in annex E.3. Each of the demodulation branch signals should be transmitted on one polarization of the test antenna(s).

5) The characteristics of the wanted signal shall be configured to the corresponding UL reference measurement channel defined in annex A, and according to additional test parameters listed in table 8.2.11.4.2-1. The UCI information bit payload per slot is equal to 18 bits.

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Table 8.2.11.4.2-2: AWGN power level at the BS input

|  |  |  |  |
| --- | --- | --- | --- |
| BS type | Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| *BS type 1-O* | 15 | 20 | -80.2 - ΔOTAREFSENS dBm / 19.08 MHz |
| *BS type 1-O* | 30 | 20 | -80.4 - ΔOTAREFSENS dBm / 18.36 MHz |
| NOTE: ΔOTAREFSENS as declared in D.53 in table 4.6-1 and clause 7.1. | | | |

*------------------------------ Next modified section ------------------------------*

Table C.1-2: Derivation of test requirements (FR2 OTA transmitter tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Minimum requirement in TS 38.104 [2] | Test Tolerance (TTOTA) | Test requirement in the present document |
| 6.2 Radiated transmit power | See TS 38.104 [2], clause 9.2 | Normal conditions:  1.7 dB, 24.25GHz < f ≦ 29.5GHz  2.0 dB, 37GHz < f ≦ 43.5GHz  2.2 dB, 43.5GHz < f ≦ 48.2GHz  [3.0] dB, 52.6GHz ≤ f ≤ 71GHz  Extreme conditions:  3.1 dB, 24.25GHz < f ≦ 29.5GHz  3.3 dB, 37GHz < f ≦ 43.5GHz  3.5 dB, 43.5GHz < f ≦ 48.2GHz  [3.9] dB, 52.6GHz ≤ f ≤ 71GHz | Formula:  Upper limit + TT, Lower limit – TT |
| 6.3 OTA base station output power | See TS 38.104 [2], clause 9.3 | 2.1 dB, 24.25GHz < f ≦ 29.5GHz  2.4 dB, 37GHz < f ≦ 43,5GHz  2.6 dB, 43.5GHz < f ≦ 48.2GHz  [4.7] dB, 52.6GHz ≤ f ≤ 71GHz | Formula:  Upper limit + TT, Lower limit – TT |
| 6.4 OTA output power dynamics | See TS 38.104 [2], clause 9.4 | 0.4 dB | Formula:  Total power dynamic range – TT |
| 6.5.1 OTA transmitter OFF power | See TS 38.104 [2], clause 9.5.2 | 2.9 dB, 24.25GHz < f ≦ 29.5GHz  3.3 dB, 37GHz < f ≦ 43.5GHz  3.6 dB, 43.5GHz < f ≦ 48.2GHz  [5.6] dB, 52.6GHz ≤ f ≤ 71GHz | Formula:  Minimum Requirement + TT |
| 6.6.2 OTA frequency Error | See TS 38.104 [2], clause 9.6.1 | 12 Hz | Formula:  Frequency Error limit + TT |
| 6.6.3 OTA Modulation quality (EVM) | See TS 38.104 [2], clause 9.6.2 | 1 %  [1] %, 52.6GHz ≤ f ≤ 71GHz | Formula:  EVM limit + TT |
| 6.6.4 OTA time alignment error | See TS 38.104 [2], clause 9.6.3 | 25 ns |  |
| 6.7.2 OTA occupied bandwidth | See TS 38.104 [2], clause 9.7.2 | 0 Hz | Formula:  Minimum Requirement + TT |
| 6.7.3 OTA Adjacent Channel Leakage Power Ratio (ACLR) | See TS 38.104 [2], clause 9.7.3 | Relative:  2.3 dB, 24.25GHz < f ≦ 29.5GHz  2.6 dB, 37GHz < f ≦43.5GHz  2.8 dB, 43.5GHz < f ≦ 48.2GHz  [5.2] dB, 52.6GHz ≤ f ≤ 71GHz  Absolute:  2.7 dB, 24.25GHz < f ≦ 29.5GHz  2.7 dB, 37GHz < f ≦43.5GHz  2.9 dB, 43.5GHz < f ≦48.2GHz  [5.3] dB, 52.6GHz ≤ f ≤ 71GHz | Formula:  Relative limit - TT  Absolute limit +TT |
| 6.7.4 OTA operating band unwanted emissions | See TS 38.104 [2], clause 9.7.4 | 0 MHz ≤ Δf < 0.1\*BWcontiguous  2.7 dB, 24.25GHz < f ≦ 29.5GHz  2.7 dB, 37GHz < f ≦43.5GHz  2.9 dB, 43.5GHz < f ≦48.2GHz  [5.3] dB, 52.6GHz ≤ f ≤ 71GHz  0.1\*BWcontiguous ≤ Δf < Δfmax  0 dB  For co-existence with Earth Exploration Satellite Service 0 dB | Formula:  Minimum Requirement + TT |
| 6.7.5.2 General transmitter spurious emissions requirements  Category A | See TS 38.104 [2], clause 9.7.5.3.2 | 0 dB | Formula:  Minimum Requirement + TT |
| 6.7.5.2 General transmitter spurious emissions requirements  Category B | See TS 38.104 [2], clause 9.7.5.3.2 | 0 dB | Formula:  Minimum Requirement + TT |
| 6.7.5.4 OTA transmitter spurious emissions, additional requirements | See TS 38.104 [2], clause 9.7.5.3.3 | For co-existence with Earth Exploration Satellite Service 0 dB | Formula:  Minimum Requirement + TT |
| NOTE: TT values are applicable for normal condition unless otherwise stated. | | | |

*------------------------------ Next modified section ------------------------------*

Table C.2-2: Derivation of test requirements (FR2 OTA receiver tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Minimum requirement in TS 38.104 [2] | Test Tolerance  (TTOTA) | Test requirement in the present document |
| 7.3 OTA reference sensitivity level | See TS 38.104 [2], clause 10.3 | 2.4 dB, 24.25 GHz < f ≦ 33.4 GHz  2.4 dB, 37 GHz < f ≦ 43.5 GHz  [3.5] dB, 43.5 GHz < f ≦ 48.2 GHz  [3.0] dB, 52.6GHz ≤ f ≤ 71GHz | Formula:  EISREFSENS+ TT |
| 7.5.1 OTA adjacent channel selectivity | See TS 38.104 [2], clause 10.5.1 | 0 dB | Formula:  Wanted signal power + TT  Interferer signal power unchanged. |
| 7.5.2 In-band blocking | See TS 38.104 [2], clause 10.5.2 | 0 dB | Formula:  Wanted signal power + TT  Interferer signal power unchanged. |
| 7.6 OTA out-of-band blocking | See TS 38.104 [2], clause 10.6 | 0 dB | Formula:  Wanted signal power + TT  Interferer signal power unchanged |
| 7.7 OTA receiver spurious emissions | See TS 38.104 [2], clause 10.7 | 0 dB | Formula:  Minimum Requirement + TT |
| 7.8 OTA receiver intermodulation | See TS 38.104 [2], clause 10.8 | 0 dB | Formula:  Wanted signal power + TT  Interferer signal power unchanged. |
| 7.9 OTA in-channel selectivity | See TS 38.104 [2], clause 10.9 | 3.4 dB, 24.25 GHz < f ≦ 33.4 GHz  3.4 dB, 37 GHz < f ≦ 43.5 GHz  [5.1] dB, 43.5 GHz < f ≦ 48.2 GHz  [4.0] dB, 52.6GHz ≤ f ≤ 71GHz | Formula:  Wanted signal power + TT  Interferer signal power unchanged. |
| NOTE: TT values are applicable for normal condition unless otherwise stated. | | | |

*------------------------------ Next modified section ------------------------------*

## L.2.1 Output signal of the TX under test

The output signal of the TX under test is acquired by the measuring equipment and stored for further processsing. It is sampled at a sampling rate which is the product of the SCS and the *FFT size*, and it is named .

For FR1, *FFT size* is determined by the transmission bandwidth in TS 38.141-1 [3] table 6.5.3.5-2 for 15 kHz SCS, table 6.5.3.5-3 for 30 kHz SCS and table 6.5.3.5-4 for 60 kHz SCS.

For FR2, *FFT size* is determined by the transmission bandwidth in table 6.6.3.5.2-2 for 60 kHz SCS, table 6.6.3.5.2‑3 for 120 kHz SCS, table 6.6.3.5.2-4 for 480 kHz SCS and table 6.6.3.5.2-5 for 960 kHz SCS. In the time domain it comprises at least 10 ms for FR1 and FR2-1 and at least 80 slots for FR2-2. It is modelled as a signal with the following parameters:

- demodulated data content,

- carrier frequency,

- amplitude and phase for each subcarrier.

For the example in the annex, the *FFT size* is 4096 based on table 6.6.3.5.2-3. The sampling rate of 491.52 Msps is the product of the *FFT size* and SCS.

## L.2.2 Ideal signal

Two types of ideal signals are defined:

The first ideal signal is constructed by the measuring equipment according to the relevant TX specifications, using the following parameters:

- demodulated data content,

- nominal carrier frequency,

- nominal amplitude and phase for each subcarrier.

It is represented as a sequence of samples at the sampling rate determined from annex L.2.1 in the time domain. The structure of the signal is described in the test models.

The second ideal signal is constructed by the measuring equipment according to the relevant TX specifications, using the following parameters for FR1 and FR2:

- nominal demodulation reference signal and nominal PT-RS if present (all other modulation symbols are set to 0 V),

- nominal carrier frequency,

- nominal amplitude and phase for each applicable subcarrier,

- nominal timing.

It is represented as a sequence of samples at the sampling rate determined from annex L.2.1 in the time domain.

## L.2.3 Measurement results

The measurement results, achieved by the in-channel TX test are the following:

- Carrier frequency error.

- EVM.

- Resource element TX power.

- OFDM symbol TX power (OSTP).

Other side results are: residual amplitude- and phase response of the TX chain after equalisation.

## L.2.4 Measurement points

The resource element TX power is measured after the FFT box as described in figure L.2.4-1 for FR1 and in figure L.2.4.2. The EVM shall be measured at the point after the FFT and a zero-forcing (ZF) equalizer in the receiver, as depicted in for FR1 in figure L.2.4-1 and for FR2 in figure L.2.4-2. The FFT window of *FFT size* samples out of (*FFT size* + cyclic prefix length) samples in the time domain is selected in the "Remove CP" box.

For FR1, The *FFT size* and the cyclic prefix length are obtained from TS 38.141-1 [3] table 6.5.3.5-2 for 15 kHz SCS, table 6.5.3.5-3 for 30 kHz SCS and table 6.5.3.5-4 for 60 kHz SCS.

For FR2, *FFT size* and the cyclic prefix length is determined from table 6.6.3.5.2-2 for 60 kHz SCS, table 6.6.3.5.2‑3 for 120 kHz SCS, table 6.6.3.5.2-4 for 480 kHz SCS and table 6.6.3.5.2-5 for 960 kHz SCS.

In one subframe, there are two symbols with the length of the cyclic prefix larger than the values listed in TS 38.141-1 [3] tables 6.5.3.5-2, 6.5.3.5-3 and 6.5.3.5-4 for FR1 and tables 6.6.3.5.2-2, table 6.6.3.5.2-3, table 6.6.3.5.2-4 and table 6.6.3.5.2-5 for FR2. Table L.2.4-1 lists the slot number and the symbol number and the formula how to compute the length of cyclic prefix for those two symbols according to the sampling rate.

Table L.2.4-1: Slot number and symbol number identifying the longer CP length for normal CP

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SCS (kHz) | Frequency Range | # slots in subframe | Symbol # and slot # with longer CP | Longer CP length |
| 15 | FR1 | 1 | (symbol 0, slot 0)  (symbol 7, slot 0) | CP length + *FFT size* / 128 |
| 30 |  | 2 | (symbol 0, slot 0) (symbol 0, slot 1) | CP length + *FFT size* / 64 |
| 60 |  | 4 | (symbol 0, slot 0) (symbol 0, slot 2) | CP length + *FFT size* / 32 |
| 60 | FR2-1 | 4 | (symbol 0, slot 0) (symbol 0, slot 2) | CP length + *FFT size* / 32 |
| 120 |  | 8 | (symbol 0, slot 0) (symbol 0, slot 4) | CP length + *FFT size* / 16 |
| 120 | FR2-2 | 8 | (symbol 0, slot 0) (symbol 0, slot 4) | CP length + *FFT size* / 16 |
| 480 | 32 | (symbol 0, slot 0) (symbol 0, slot 16) | CP length + *FFT size* / 4 |
| 960 | 64 | (symbol 0, slot 0) (symbol 0, slot 32) | CP length + *FFT size* / 2 |

For the example used in the annex, the "Remove CP" box selects 4096 samples out of 4384 samples. Symbol 0 of slot 0 and slot 4 has 256 more samples in the cyclic prefix than the other symbols (the longer CP length = 544).



Figure L.2.4-1: Reference point for FR1 EVM measurements



Figure L.2.4-2: Reference point for FR2 EVM measurements

# L.3 Pre-FFT minimization process

Sample timing, carrier frequency in are varied in order to minimise the difference between and , after the amplitude ratio of and has been scaled. Best fit (minimum difference) is achieved when the RMS difference value between and is an absolute minimum.

The carrier frequency variation is the measurement result: carrier frequency error.

From the acquired samples, one value of carrier frequency error can be derived.

NOTE 1: The minimisation process, to derive the RF error can be supported by post-FFT operations. However the minimisation process defined in the pre-FFT domain comprises all acquired samples (i.e. it does not exclude the samples inbetween the FFT widths and it does not exclude the bandwidth outside the transmission bandwidth configuration).

NOTE 2: The algorithm would allow to derive carrier frequency error and sample frequency error of the TX under test separately. However there are no requirements for sample frequeny error. Hence the algorithm models the RF and the sample frequency commonly (not independently). It returns one error and does not distinuish between both.

After this process the samples are called .

# L.4 Timing of the FFT window

The FFT window length is *FFT size* samples per OFDM symbol. For FDD, there are FFTs performed where is the number of slots in a 10 ms measurement interval, and the number of symbols in a slot for normal CP is 14. For TDD, the number of FFTs performed is the number of downlink symbols in the measurement interval.

The position in time for the FFT shall be determined.

For the example used in the annex, the FFT window length is 4096 samples per OFDM symbol. 832 FFTs (i.e. 3,407,872 samples) cover less than the acquired number of samples (i.e. 3,651,584 samples in 10 ms). There are 816 symbols with 4384 samples and 16 symbols with 4640 samples.

In an ideal signal, the FFT may start at any instant within the cyclic prefix without causing an error. The TX filter, however, reduces the window. The EVM requirements shall be met within a window *W* < CP. There are three different instants for FFT:

- Centre of the reduced window, called ,

- , and

- .

The value of EVM window length *W* is obtained from the transmission bandwidth and TS 38.141-1 [3] table 6.5.3.5-2 for 15 kHz SCS, table 6.5.3.5-3 for 30 kHz SCS and table 6.5.3.5-4 for 60 kHz SCS for FR1, and table 6.6.3.5.2-2 for 60 kHz SCS, table 6.6.3.5.2-3 for 120 kHz SCS, table 6.6.3.5.2-4 for 480 kHz SCS and table 6.6.3.5.2-5 for 960 kHz SCS for FR2.

The BS shall transmit a signal according to the test models intended for EVM. The demodulation reference signal of the second ideal signal shall be used to find the centre of the FFT window.

The timing of the measured signal is determined in the pre FFT domain as follows, using and :

1. The measured signal is delay spread by the TX filter. Hence the distinct borders between the OFDM symbols and between data and CP are also spread and the timing is not obvious.

2. In the ideal signal , the timing is known.

Correlation between bullet (1) and (2) will result in a correlation peak. The meaning of the correlation peak is approximately the "impulse response" of the TX filter.

3. The meaning of "impulse response" assumes that the autocorrelation of the ideal signal is a Dirac peak and that the correlation between the ideal signal and the data in the measured signal is 0. The correlation peak, (the highest, or in case of more than one highest, the earliest) indicates the timing in the measured signal.

The number of samples, used for FFT is reduced compared to . This subset of samples is called .

From the acquired samples one timing can be derived.

The timing of the centre is determined according to the cyclic prefix length of the OFDM symbols. For normal CP, there are two values for in a 1 ms period:

- = length of cyclic prefix / 2,

- = Longer CP length - length of cyclic prefix / 2,

Where the length of cyclic prefix is obtained from TS 38.141-1 [3] table 6.5.3.5-2 for 15 kHz SCS, table 6.5.3.5-3 for 30 kHz SCS and table 6.5.3.5-4 for 60 kHz SCS for FR1, and table 6.6.3.5.2-2 for 60 kHz SCS, table 6.6.3.5.2-3 for 120 kHz SCS, table 6.6.3.5.2-4 for 480 kHz SCS and table 6.6.3.5.2-5 for 960 kHz SCS for FR2, and the longer CP length is obtained from table L.2.4-1.

As per the example values.

- within the CP of length 288 for most OFDM symbols in 1 ms,

- (= 544 – 144) within the CP of length 544 for OFDM symbol 0 of slot 0 and slot 4.

# L.5 Resource element TX power

Perform FFT on with the FFT window timing .

The result is called . The RE TX (RETP) power is then defined as:

where SCS is the subcarrier spacing in Hz.

From RETP, the OFDM symbol TX power (OSTP) is derived as follows:

Where the summation accumulates values of all *Nsym* OFDM symbols that carry PDSCH and not containing PDCCH, RS or SSB within a slot.

.

From the acquired samples values for each OSTP can be obtained and averaged where is the number of slots in a 10 ms measurement interval for FDD. For TDD, is the number of slots with downlink symbols in a 10 ms measurement interval for FR1 and FR2-1, in an 80 slots measurement interval for FR2-2 and is computed according to the values in table 4.9.2.2-1.

For the example used in the annex, and .

# L.6 Post-FFT equalisation

Perform FFTs on , one for each OFDM symbol within 10 ms for FR1 and FR2-1, and 80 slots measurement interval for FR2-2 measurement interval with the FFT window timing to produce an array of samples, in the time axis *t* by *FFT size* in the frequency axis *f*.

For the example in the annex, 1120 FFTs are performed on . The result is an array of samples, 1120 in the time axis by 4096 in the frequency axis.

The equalizer coefficients and are determined as follows:

1. Calculate the complex ratios (amplitude and phase) of the post-FFT acquired signal and the post-FFT ideal signal , for each demodulation reference signal, over 10 ms measurement interval for FR1 and FR2-1, and 80 slots measurement interval for FR2-2. This process creates a set of complex ratios:

2. Perform time averaging at each demodulation reference signal subcarrier of the complex ratios, the time-averaging length is 10 ms measurement interval for FR1 and FR2-1, and 80 slots measurement interval for FR2-2. Prior to the averaging of the phases an unwrap operation must be performed according to the following definition:

- The unwrap operation corrects the radian phase angles of by adding multiples of 2 \* π when absolute phase jumps between consecutive time instances are greater then or equal to the jump tolerance of π radians.

- This process creates an average amplitude and phase for each demodulation reference signal subcarrier (i.e. every second subcarrier).

Where *N* is the number of demodulation reference signal time-domain locations from for each demodulation reference signal subcarrier *f*.

3. The equalizer coefficients for amplitude and phase and at the demodulation reference signal subcarriers are obtained by computing the moving average in the frequency domain of the time-averaged demodulation reference signal subcarriers. The moving average window size is 19 and averaging is over the DM-RS subcarriers in the allocated RBs. For DM-RS subcarriers at or near the edge of the channel, or when the number of available DM-RS subcarriers within a set of contiguously allocated RBs is smaller than the moving average window size, the window size is reduced accordingly as per figure L.6-1.

4. Perform linear interpolation from the equalizer coefficients and to compute coefficients , for each subcarrier.



Figure L.6-1: Reference subcarrier smoothing in the frequency domain

a) In case of FR2 EVM, to account for the common phase error (CPE) experienced in millimetre wave frequencies, , in the estimated coefficients contain phase rotation due to the CPE, , in addition to the phase of the equalizer coefficient , that is:

For OFDM symbols where PT-RS does not exist, can be estimated by performing linear interpolation from neighboring symbols where PT-RS is present.

In order to separate component of the CPE,, contained in, , estimation and compensation of the CPE needs to follow. is the common phase error (CPE), that rotates all the subcarriers of the OFDM symbol at time .

Estimate of the CPE, , at OFDM symbol time, , can then be obtained from using the PT-RS employing the expression:

In the above equation, is the set of subcarriers where PT-RS are mapped, where is the set of OFDM symbols where PT-RS are mapped while and are is the post-FFT acquired signal and the ideal PT-RS signal respectively. That is, estimate of the CPE at a given OFDM symbol is obtained from frequency correlation of the complex ratios at the PT-RS positions with the conjugate of the estimated equalizer complex coefficients. The estimated CPE can be subtracted from to remove influence of the CPE, and obtain estimate of the complex coefficient's phase:

(t)

# L.7 EVM

## L.7.0 General

For EVM create two sets of , according to the timing and , using the equalizer coefficients from L.6.

The equivalent ideal samples are calculated from (annex L.2.2) and are called .

The EVM is the difference between the ideal signal and the equalized measured signal.

Where:

- *T* is the set of symbols with the considered modulation scheme being active within the slot,

- is the set of subcarriers within the resource blocks with the considered modulation scheme being active in symbol *t*,

- is the ideal signal reconstructed by the measurement equipment in accordance with relevant test models,

-  is the equalized signal under test.

NOTE: Although the basic unit of measurement is one slot, the equalizer is calculated over the entire 10 ms measurement interval for FR1 and FR2-1, and over the entire 80 slots measurement interval for FR2-2 to reduce the impact of noise in the reference signals.

## L.7.1 Averaged EVM (FDD)

EVM is averaged over all allocated downlink resource blocks with the considered modulation scheme in the frequency domain, and a minimum of downlink slots where is the number of slots in a 10 ms measurement interval.

The averaging in the time domain equals the slot duration of the 10 ms measurement interval from the equalizer estimation step.

Where is the number of resource blocks with the considered modulation scheme in subframe *i*.

The EVM requirements shall be tested against the maximum of the RMS average at the window *W* extremities of the EVM measurements:

Thus is calculated using in the expressions above and is calculated using in the calculation where (*l* and *h*, low and high; where low is the timing and high is the timing ).

Thus:

The resulting is compared against the limit.

## L.7.2 Averaged EVM (TDD) for FR1 and FR2-1

Let be the number of slots with downlink symbols within a 10 ms measurement interval. For TDD, the averaging in the time domain can be calculated from slots of different 10 ms measurement intervals and should have a minimum of slots averaging length where is the number of slots in a 10 ms measurement interval.

is derived by: Square the EVM results in each 10 ms measurement interval. Sum the squares, divide the sum by the number of EVM relevant locations, square-root the quotient (RMS).

Where is the number of resource blocks with the considered modulation scheme in slot *i*.

The is calculated, using the maximum of at the window *W* extremities. Thus is calculated using and is calculated using (*l* and *h*, low and high; where low is the timing and and high is the timing ).

In order to unite at least slots, consider the minimum integer number of 10 ms measurement intervals, where is determined by

And for FR1, for 15 kHz SCS, for 30 kHz SCS and for 60 kHz SCS normal CP. For FR2, for 60 kHz SCS and for 120 kHz SCS.

Unite by RMS.

The resulting is compared against the limit.

## L.7.3 Averaged EVM (TDD) for FR2-2

Let be the number of slots with downlink symbols within a 80 slots measurement interval. For TDD, the averaging in the time domain can be calculated from slots of different measurement intervals and should have a minimum of 80 slots averaging length for FR2-2.

is derived by: Square the EVM results in each one measurement interval. Sum the squares, divide the sum by the number of EVM relevant locations, square-root the quotient (RMS).

Where is the number of resource blocks with the considered modulation scheme in slot *i*.

The is calculated, using the maximum of at the window *W* extremities. Thus is calculated using and is calculated using (*l* and *h*, low and high; where low is the timing and and high is the timing ).

In order to unite at least 80 slots, consider the minimum integer number of 80 slots measurement intervals, where is determined by

Unite by RMS.

The resulting is compared against the limit.

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