3GPP TSG-RAN WG4 Meeting # 101-e draft R4-2120820

Electronic Meeting, November 01-12, 2021

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.141-2** | **CR** | **-** | **rev** | **-** | **Current version:** | **16.9.0** |  |
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| *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 for TS 38.141-2 Maintenance RF part (Rel-16, CAT A) |
|  |  |
| ***Source to WG:*** | MCC, Huawei  |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | TEI15, NR\_newRAT-Perf |  | ***Date:*** | 2021-11-16 |
|  |  |  |  |  |
| ***Category:*** | **A** |  | ***Release:*** | Rel-16 |
|  | *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 canbe 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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | This big CR merges endorsed draft CRs. The reason for change in each endorsed draft CR is copied below:* R4-2117216 (Draft CR to TS 38.141-2: Correction on tables for Band 23 co-location requirements): Entries for Band 23 were deleted from table for coexistence spurious emission limits but kept in table for co-location requirements. This would create ambiguity on Band 23 co-location requirements.
* R4-2117895 (General rule for resolution bandwidth 38.141-2 R16): The resolution bandwidth can be smaller than the measurement bandwidth is not clarified in TS 38.141-2, while it does in other specifications such as TS 38.141-1.
* R4-2118093 (Draft CR to 38.141-2: BS OBUE Cat B requirements clarification): Describtion on how to derive the “cumulative sum” for FR2 OBUE cat B requirements when measurement banwidthes are different exists in a NOTE. However, measurement bandwidthes are same for all the frequency offset resions of the requirement. It means the description is never valid.
* R4-2118465 (draftCR to 38.141-2: Addition of Plane Wave Synthesizer in OTA measurement system set-up): The annex E on OTA measurement system set-up does not include Plane Wave Synthesizer wthin the OTA chamber descriptions for co-location cases.
* R4-2118734 (Draft CR to TS 38.141-2: NRTC2 correction): In RAN4#99-e corrections to 36.141 and 38.141-1 on ETC2 and NRTC2 were agreed. These test configurations are used to test contiguous CA occupied bandwidth only. In case a eNB supports a wide variety of different channel bandwidths and also carrier aggregation with multiple carriers, the tested carrier aggregation channel bandwidth combinations can very high. This is excessive and not necessary to sufficiently verify meeting the requirements. In this CR the same correction is made also to TS 38.141-2 for the corresponding test configuration NRTC2.
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| ***Summary of change:*** | The summary of change in each endorsed draft CR is copied below:* R4-2117216: Delete the entries for Band 23 from table for co-location requirements.
* R4-2117895: The general rule for resolution bandwidth is added.
* R4-2118093: Deleted the unnecessary text in NOTE1 in table 6.7.4.5.1.2-1.
* R4-2118465: PWS chamber added to the corresponding annex E clauses on any suitable OTA chamber.
* R4-2118734: Instead of testing all carrier bandwidth combinations with different sum of channel bandwidth, only smallest and largest sum of channel bandwidth is tested.
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|  |  |
| ***Consequences if not approved:*** | The consequences if not approved in each endorsed draft CR is copied below:* R4-2117216: Ambiguity remains and would lead to different interpretations.
* R4-2117895: The general rule for setting resolution bandwidth is missing.
* R4-2118093: Unnecessary text may be interpreted wrongly.
* R4-2118465: Incomplete description of OTA measurement systems.
* R4-2118734: Excessive testing of CA occupied bandwidth, misalignment of 3GPP specifications.
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|  |  |
| ***Clauses affected:*** | 4.7.2.3.1, 6.7.4.4.2, 6.7.4.5.1.2, 6.7.5.5.5.1, E.1.4, E.1.5, and E.2.4.2 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 38.104 |
| ***affected:*** | **X** |  |  Test specifications | TS 38.141-1 |
| ***(show related CRs)*** |  | **x** |  O&M Specifications |  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

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

##### 4.7.2.3.1 NRTC2 generation

NRTC2 shall be constructed on a per band basis using the following method:

- Of all component carrier combinations supported by the beam, those which have smallest or largest sum of channel bandwidths of component carrier, shall be tested. Of all component carrier combinations which have smallest or largest sum of channel bandwidth of component carriers supported by the BS, only one combination having largest sum and one combination having smallest sum shall be tested irrespective of the number of component carriers.

- Of all component carrier combinations which have same sum of channel bandwidths of component carrier, select those with the narrowest carrier with the smallest supported subcarrier spacing declared per *operating band* (D.7) at the lower *Base Station RF Bandwidth edge*.

- Of the combinations selected in the previous step, select one with the narrowest carrier with the smallest supported subcarrier spacing declared per *operating band* (D.7) at the upper *Base Station RF Bandwidth edge*.

- If there are multiple combinations fulfilling previous steps, select the one with the smallest number of component carrier.

- If there are multiple combinations fulfilling previous steps, select the one with the widest carrier with the smallest supported subcarrier spacing declared per *operating band* (D.7) being adjacent to the lowest carrier.

- If there are multiple combinations fulfilling previous steps, select the one with the widest carrier with the smallest supported subcarrier spacing declared per *operating band* (D.7) being adjacent to the highest carrier.

- If there are multiple combinations fulfilling previous steps, select the one with the widest carrier with the smallest supported subcarrier spacing declared per *operating band* (D.7) being adjacent to the carrier which has been selected in the previous step.

- If there are multiple combinations fulfilling previous steps, repeat the previous step until there is only one combination left.

- The nominal channel spacing defined in TS 38.104 [2] clause 5.4.1 shall apply.

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

##### 6.7.4.4.2 Procedure

The following procedure for measuring TRP is based on the directional power measurements as described in annex I. An alternative method to measure TRP is to use a characterized and calibrated reverberation chamber if so follow steps 1, 3, 4, 6 and 9.

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) The measurement devices characteristics shall be:

 - measurement filter bandwidth: defined in clause 6.7.4.5.

 - detection mode: true RMS voltage or true power averaging.

As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity, efficiency and avoiding e.g. carrier leakage, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

4) For single carrier operation, set the BS to transmit according to the applicable test configuration in clause 4.8 using the corresponding test model(s) in clause 4.9.2 at manufacturers declared *rated carrier output power* (Prated,c,TRP).

 For a BS declared to be capable of multi-carrier and/or CA operation, use the applicable test signal configuration and corresponding power setting specified in clause 4.7.2 and 4.8 using the corresponding test model(s) in clause 4.9.2 on all carriers configured.

5) Orient the positioner (and BS) in order that the direction to be tested aligns with the test antenna such that measurements to determine TRP can be performed (see annex I).

6) Sweep the centre frequency of the measurement filter in contiguous steps and measure emission power within the specified frequency ranges with the specified measurement bandwidth.

7) Repeat step 5-6 for all directions in the appropriated TRP measurement grid needed for TRPEstimate (see annex I).

8) Calculate TRPEstimate using the measurements made in step 6.

9) For *BS type 1-O* and *multi-band RIB* 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.

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

Table 6.7.4.5.1.2-1: Wide Area BS operating band unwanted emission limits
(NR bands ≤ 1 GHz) for Category B

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter ‑3dB point, Δf | Frequency offset of measurement filter centre frequency, f\_offset | Test requirement (Note 1, 2, 4) | Measurement bandwidth |
| 0 MHz ≤ Δf < 5 MHz | 0.05 MHz ≤ f\_offset < 5.05 MHz | 3.8 dBm-7/5(f\_offset/MHz-0.05)dB | 100 kHz  |
| 5 MHz ≤ Δf <min(10 MHz, Δfmax) | 5.05 MHz ≤ f\_offset <min(10.05 MHz, f\_offsetmax) | -3.2 dBm | 100 kHz  |
| 10 MHz ≤ Δf ≤ Δfmax | 10.05 MHz ≤ f\_offset < f\_offsetmax  | -7 dBm (Note 3) | 100 kHz  |
| NOTE 1: For a BS supporting non-contiguous spectrum operation within any *operating band*, the emission limits within sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub blocks on each side of the sub block gap. Exception is f ≥ 10MHz from both adjacent sub blocks on each side of the sub-block gap, where the emission limits within sub-block gaps shall be ‑7 dBm/ 100 kHz.NOTE 2: For a *multi-band RIB* with Inter RF Bandwidth gap < 2\*ΔfOBUE the emission limits within the Inter RF Bandwidth gaps is calculated as a cumulative sum of contributions from adjacent sub-blocks or RF Bandwidth on each side of the Inter RF Bandwidth gap, where the contribution from the far-end sub-block or RF Bandwidth shall be scaled according to the measurement bandwidth of the near-end sub-block or RF Bandwidth.NOTE 3: The requirement is not applicable when Δfmax < 10 MHz.NOTE 4: The test requirement is derived from the basic limit a scaling factor of 9 dB and any applicable TT.NOTE 5: Void |

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

Table 6.7.5.5.5.1-1: *BS type 1-O* OTA spurious emissions limits for BS co-located with another BS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type of co-located BS | Frequency range for co-location | Test limit | Measurement bandwidth | Note |
|  | requirement | WA BS | MR BS | LA BS |  |  |
| GSM900 | 876-915 MHz | -115.9 dBm | -108.9 dBm | -87.9 dBm | 100 kHz |  |
| DCS1800 | 1710 – 1785 MHz | -115.9 dBm | -108.9 dBm | -97.9 dBm | 100 kHz |  |
| PCS1900 | 1850 – 1910 MHz | -115.9 dBm | -108.9 dBm | -97.9 dBm | 100 kHz |  |
| GSM850 or CDMA850 | 824 – 849 MHz | -115.9 dBm | -108.9 dBm | -87.9 dBm | 100 kHz |  |
| UTRA FDD Band I or E-UTRA Band 1 or NR Band n1 | 1920 – 1980 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band II or E-UTRA Band 2 or NR Band n2 | 1850 – 1910 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band III or E-UTRA Band 3 or NR Band n3 | 1710 – 1785 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band IV or E-UTRA Band 4 | 1710 – 1755 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band V or E-UTRA Band 5 or NR Band n5 | 824 – 849 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band VI, XIX or E-UTRA Band 6, 19 | 830 – 845 MHz  | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band VII or E-UTRA Band 7 or NR Band n7 | 2500 – 2570 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band VIII or E-UTRA Band 8 or NR Band n8 | 880 – 915 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band IX or E-UTRA Band 9 | 1749.9 – 1784.9 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band X or E-UTRA Band 10 | 1710 – 1770 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band XI or E-UTRA Band 11 | 1427.9 – 1447.9 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz | This is not applicable to BS operating in Band n50 or n75 |
| UTRA FDD Band XII orE-UTRA Band 12 | 699 – 716 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band XIII orE-UTRA Band 13 | 777 – 787 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band XIV orE-UTRA Band 14 | 788 – 798 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 17 | 704 – 716 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 18 | 815 – 830 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band XX or E-UTRA Band 20 or NR Band n20 | 832 – 862 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band XXI or E-UTRA Band 21 | 1447.9 – 1462.9 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz | This is not applicable to BS operating in Band n50 or n75 |
| UTRA FDD Band XXII or E-UTRA Band 22 | 3410 – 3490 MHz | -113.7 dBm | -108.7 dBm | -105.7 dBm | 100 kHz | This is not applicable to BS operating in Band n77 or n78 |
|  |  |  |  |  |  |  |
| E-UTRA Band 24 | 1626.5 – 1660.5 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band XXV orE-UTRA Band 25 | 1850 – 1915 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA FDD Band XXVI orE-UTRA Band 26 | 814 – 849 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 27 | 807 – 824 MHz  | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 28 or NR Band n28 | 703 – 748 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 30 | 2305 – 2315 MHz  | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 31 | 452.5 -457.5 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA TDD Band a) or E-UTRA Band 33 | 1900 – 1920 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA TDD Band a) or E-UTRA Band 34 | 2010 – 2025 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA TDD Band b) or E-UTRA Band 35 | 1850 – 1910 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA TDD Band b) or E-UTRA Band 36 | 1930 – 1990 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz | This is not applicable to BS operating in Band n2 |
| UTRA TDD Band c) or E-UTRA Band 37 | 1910 – 1930 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA TDD Band d) or E-UTRA Band 38 or NR Band n38 | 2570 – 2620 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz | This is not applicable to BS operating in Band n38.  |
| UTRA TDD Band f) or E-UTRA Band 39 | 1880 – 1920 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| UTRA TDD Band e) or E-UTRA Band 40 | 2300 – 2400MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 41 or NR Band n41 | 2496 – 2690 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz | This is not applicable to BS operating in Band n41 |
| E-UTRA Band 42 | 3400 – 3600 MHz | -113.7 dBm | -108.7 dBm | -105.7 dBm | 100 kHz | This is not applicable to BS operating in Band n77 or n78 |
| E-UTRA Band 43 | 3600 – 3800 MHz | -113.7 dBm | -108.7 dBm | -105.7 dBm | 100 kHz | This is not applicable to BS operating in Band n77 or n78 |
| E-UTRA Band 44 | 703 – 803 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz | This is not applicable to BS operating in Band n28 |
| E-UTRA Band 45 | 1447 – 1467 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 46 | 5150 – 5925 MHz | N/A | -108.6 dBm | -105.6 dBm | 100 kHz |  |
| E-UTRA Band 48 | 3550 – 3700 MHz | -113.7 dBm | -108.7 dBm | -105.7 dBm | 100 kHz | This is not applicable to BS operating in Band n77 or n78 |
| E-UTRA Band 50 or NR Band n50 | 1432 – 1517 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz | This is not applicable to BS operating in Band n74 or n75 |
| E-UTRA Band 51 or NR Band n51 | 1427 – 1432 MHz | N/A | N/A | -105.9 dBm | 100 kHz | This is not applicable to BS operating in Band n50, n75 or n76 |
| E-UTRA Band 65 | 1920 – 2010 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 66 or NR Band n66 | 1710 – 1780 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 68 | 698 – 728 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 70 or NR Band n70 | 1695 – 1710 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 71 or NR Band n71 | 663 – 698 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 72 | 451 – 456 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 74 or NR Band n74 | 1427 – 1470 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz | This is not applicable to BS operating in Band n50 |
| NR Band n77 | 3.3 – 4.2 GHz | -113.7 dBm | -108.7 dBm | -105.7 dBm | 100 kHz | This is not applicable to BS operating in Band n77 or n78 |
| NR Band n78 | 3.3 – 3.8 GHz | -113.7 dBm | -108.7 dBm | -105.7 dBm | 100 kHz | This is not applicable to BS operating in Band n77 or n78 |
| NR Band n79 | 4.4 – 5.0 GHz | -113.6 dBm | -108.6 dBm | -105.6 dBm | 100 kHz |  |
| NR Band n80  | 1710 – 1785 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| NR Band n81 | 880 – 915 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| NR Band n82 | 832 – 862 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| NR Band n83 | 703 – 748 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| NR Band n84 | 1920 – 1980 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| E-UTRA Band 85 | 698 - 716 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |
| NR Band n86 | 1710 – 1780 MHz | -113.9 dBm | -108.9 dBm | -105.9 dBm | 100 kHz |  |

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

## E.1.4 OTA co-location emissions, OTA transmit ON/OFF power (*BS type 1-O*)



Figure E.1.4-1: Measurement set up for OTA co-location emissions, OTA transmit ON/OFF power (*BS type 1-O*)

The OTA chamber shown in figure E.1.4-1 is intended to be generic and can be replaced with any suitable OTA chamber (Far field anechoic chamber, CATR, Near field chamber, PWS (NOTE), etc.)

NOTE: The maximum rated Power Density (PD) per section of the PWS area (e.g. dBm/cm2) might be restricted depending on the implementation. This Power Density at a specific reference plane can be calculated for each transmitter as a function of the total radiated power, the test distance and the radiation pattern of the transmitter.

## E.1.5 OTA transmitter intermodulation



Figure E.1.5-1: Measurement set up for OTA transmitter intermodulation

The OTA chamber shown in figure E.1.5-1 is intended to be generic and can be replaced with any suitable OTA chamber (Far field anechoic chamber, CATR, PWS (NOTE), etc.). When injecting the interferer signal into the CLTA ports, a splitter might be needed. For testing emission far out-of-band an additional test antenna might be needed.

NOTE: The maximum rated Power Density (PD) per section of the PWS area (e.g. dBm/cm2) might be restricted depending on the implementation. This Power Density at a specific reference plane can be calculated for each transmitter as a function of the total radiated power, the test distance and the radiation pattern of the transmitter.

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

### E.2.4.2 OTA co-location blocking



Figure E.2.4.2-1: Measurement set up for OTA co-location blocking

The OTA chamber shown in figure E.2.4.2-1 is intended to be generic and can be replaced with any suitable OTA chamber (Far field anechoic chamber, CATR, PWS (NOTE), etc.). For testing blocking far out-of-band several CLTAs might be needed.

NOTE: The maximum rated Power Density (PD) per section of the PWS area (e.g. dBm/cm2) might be restricted depending on the implementation. This Power Density at a specific reference plane can be calculated for each transmitter as a function of the total radiated power, the test distance and the radiation pattern of the transmitter.

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