**3GPP TSG-RAN WG4 Meeting # 108bis *R4-2321121***

**Chicago, US, November 13 – 17, 2023**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **TS 38.141-1** | **CR** | Draft big CR | **rev** |  | **Current version:** | 18.3.0 |  |
|  | | | | | | | | |
| *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:*** | Draft BigCR on 38.141-1 \_RF\_FR1\_enh2\_Demod\_4Tx | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, HiSilcon | | | | | | | | | |
| ***Source to TSG:*** | RAN4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_ENDC\_RF\_FR1\_enh2-Perf | | | | |  | ***Date:*** | | | 2023-11-21 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *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:*** | | According to chairman’s assignment, Huawei is resonsible for bigCR preparation for 4Tx demodulation requirements. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Combine all following draft CRs:  R4-2313881 Revised R4-2312213 Draft CR on applicability rule for PUSCH UL 4Tx requirement in TS 38.141-1\_V2 (Samsung, Cybercore)  [R4-2321121](ftp://10.10.10.10/ftp/tsg_ran/WG4_Radio/TSGR4_109/Inbox/R4-2321119.zip) Draft CR to TS 38.141-1 for supporting of 4Tx in R18. (ZTE)  R4-2315985 Draft CR on 38.141-1 Introduction of FRC for 4Tx performance requirements (Huawei,HiSilicon)  R4-2321135 Correction on draft BigCR to 38.141-1 NR\_ENDC\_RF\_FR1\_enh2-Perf 4Tx demod (Keysight Technologies UK Ltd, NEC) | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The 4Tx performance requirements will be missing | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 4.1.2.4, 8.1.2.0, 8.2.1.4, 8.2.1.5, A.3, A.9, A10, A11, C.3 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

#### 4.1.2.4 Measurement of performance requirements

* Table 4.1.2.4-1: Maximum Test System Uncertainty for performance requirements

| Clause | Maximum Test System Uncertainty | Derivation of Test System Uncertainty |
| --- | --- | --- |
| * 8 PUSCH, PUCCH, PRACH with single antenna port and fading channel | * ± 0.6 dB | * Overall system uncertainty for fading conditions comprises two quantities: * 1. Signal-to-noise ratio uncertainty * 2. Fading profile power uncertainty * Items 1 and 2 are assumed to be uncorrelated so can be root sum squared: * Test System uncertainty = [SQRT (Signal-to-noise ratio uncertainty 2 + Fading profile power uncertainty 2)] * Signal-to-noise ratio uncertainty ±0.3 dB * Fading profile power uncertainty ±0.5 dB |
| * 8 PUSCH, PRACH with single antenna port and AWGN | * ± 0.3 dB | * Signal-to-noise ratio uncertainty ±0.3 dB |
| * 8 PUSCH with two antenna port and fading channel | * ± 0.8 dB | * Overall system uncertainty for fading conditions comprises two quantities: * 1. Signal-to-noise ratio uncertainty * 2. Fading profile power uncertainty * Items 1 and 2 are assumed to be uncorrelated so can be root sum squared: * Test System uncertainty = [SQRT (Signal-to-noise ratio uncertainty 2 + Fading profile power uncertainty 2)] * Signal-to-noise ratio uncertainty ±0.3 dB * Fading profile power uncertainty ±0.7 dB for MIMO |
| * 8 PUSCH with four antenna port and fading channel | * ± 1.0 dB | * Overall system uncertainty for fading conditions comprises two quantities: * 1. Signal-to-noise ratio uncertainty * 2. Fading profile power uncertainty * Items 1 and 2 are assumed to be uncorrelated so can be root sum squared: * Test System uncertainty = [SQRT (Signal-to-noise ratio uncertainty 2 + Fading profile power uncertainty 2)] * Signal-to-noise ratio uncertainty ±0.3 dB * Fading profile power uncertainty 1.0 dB for MIMO |

#### 8.1.2.0 General

Unless otherwise stated, for a BS supporting more than 8 antenna connectors (for *BS type 1-C*) or *TAB connectors* (for *BS type 1-H*) (see D.37 in table 4.6-1), the performance requirement tests for 8 RX antennas shall apply, and the specific connectors used for testing are based on manufacturer declaration.

Unless otherwise stated, for a BS supporting different numbers of antenna connectors (for *BS type 1-C*) or *TAB connectors* (for *BS type 1-H*) (see D.37 in table 4.6-1), the tests with low MIMO correlation level shall apply only for the lowest and highest numbers of supported connectors, and the specific connectors used for testing are based on manufacturer declaration.

Unless otherwise stated, for a BS supporting different numbers of antenna connectors (for *BS type 1-C*) or TAB *connectors* (for *BS type 1-H*) (see D.37 in table 4.6-1), the 4 Tx antenna tests with low MIMO correlation level shall apply only for the highest numbers of supported connectors which is larger or equal to 4, and the specific connectors used for testing are based on manufacturer declaration.

<End of Change 1>

#### 8.2.1.4 Method of test

##### 8.2.1.4.1 Initial Conditions

Test environment: Normal, see annex B.2.

RF channels to be tested for single carrier: M; see clause 4.9.1.

RF channels to be tested for carrier aggregation: MBW Channel CA; see clause 4.9.1.

##### 8.2.1.4.2 Procedure

1) Connect the BS tester generating the wanted signal, multipath fading simulators and AWGN generators to all BS antenna connectors for diversity reception via a combining network as shown in annex D.5 and D.6 for *BS type 1-C* and *type 1-H* respectively.

2) Adjust the AWGN generator, according to the channel bandwidth, defined in table 8.2.1.4.2-1.

* Table 8.2.1.4.2-1: AWGN power level at the BS input

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
|  | 5 | -86.5 dBm / 4.5MHz |
| 15 kHz | 10 | -83.3 dBm / 9.36MHz |
|  | 20 | -80.2 dBm / 19.08MHz |
|  | 10 | -83.6 dBm / 8.64MHz |
| 30 kHz | 20 | -80.4 dBm / 18.36MHz |
|  | 40 | -77.2 dBm / 38.16MHz |
|  | 100 | -73.1 dBm / 98.28MHz |
| NOTE: The AWGN power level contains an AWGN offset of 16dB by default. If needed for test purposes, the AWGN level can be reduced from the default by any value in the range 0dB to 16dB. Changing the AWGN level does not impact the validity of the test, as it reduces the effective base band SNR level. | | |

3) The characteristics of the wanted signal shall be configured according to the corresponding UL reference measurement channel defined in annex A and the test parameters in table 8.2.1.4.2-2.

* Table 8.2.1.4.2-2: Test parameters for testing PUSCH

|  |  |  |
| --- | --- | --- |
| Parameter | | Value |
| * Transform precoding | | Disabled |
| * Default TDD UL-DL pattern (Note 1) | | 15 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U |
| * HARQ | * Maximum number of HARQ transmissions | 4 |
|  | * RV sequence | 0, 2, 3, 1 |
| * DM-RS | * DM-RS configuration type | 1 |
|  | * DM-RS duration | single-symbol DM-RS |
|  | * Additional DM-RS position | pos1 |
|  | * Number of DM-RS CDM group(s) without data | 2 |
|  | * Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB |
|  | * DM-RS port(s) | {0}, {0, 1}, {0, 1, 2, 3} |
|  | * DM-RS sequence generation | NID0=0, nSCID =0 |
| * Time domain resource assignment | * PUSCH mapping type | A, B |
|  | * Start symbol | 0 |
|  | * Allocation length | 14 |
| * Frequency domain resource assignment | * RB assignment | Full applicable test bandwidth |
|  | * Frequency hopping | Disabled |
| * TPMI index for 2Tx two layer or 4Tx four layer spatial multiplexing transmission | | 0 |
| * Code block group based PUSCH transmission | | Disabled |
| NOTE 1: The same requirements are applicable to FDD and TDD with different UL-DL patterns. | | |

4) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.

5) Adjust the equipment so that required SNR specified in table 8.2.1.5-1 to 8.2.1.5-20 is achieved at the BS input.

6) For each of the reference channels in table 8.2.1.5-1 to 8.2.1.5-20 applicable for the base station, measure the throughput.

*<unchanged part omitted>*

*<end of the change 1>*

*<start of the change 2>*

#### 8.2.1.5 Test Requirement

The throughput measured according to clause 8.2.1.4.2 shall not be below the limits for the SNR levels specified in table 8.2.1.5-1 to 8.2.1.5-18.

* Table 8.2.1.5-1: Test requirements for PUSCH with 70% of maximum throughput, Type A, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -1.7 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 10.7 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 12.9 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-1 | pos1 | 19.7 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -5.2 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 6.8 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 9.4 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-1 | pos1 | 16.1 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -8.1 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 3.6 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 6.2 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-1 | pos1 | 13.0 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | 1.8 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 19.0 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | -1.5 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 11.8 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | -4.5 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 7.6 |
|  | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-39 | pos1 | 2.7 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A7-1 | pos1 | 15.6 |
| 4 |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-1 | pos1 | 20.2 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-39 | pos1 | -0.5 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A7-1 | pos1 | 9.0 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-1 | pos1 | 12.6 |

* Table 8.2.1.5-2: Test requirements for PUSCH with 70% of maximum throughput, Type A, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -1.9 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 10.8 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 12.8 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-2 | pos1 | 20.1 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -5.4 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 6.9 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 9.2 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-2 | pos1 | 16.5 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -8.1 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 3.7 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 6.1 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-2 | pos1 | 13.2 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | 2.5 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 19.1 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | -1.2 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 12.0 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | -4.7 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 7.6 |

* Table 8.2.1.5-3: Test requirements for PUSCH with 70% of maximum throughput, Type A, 20 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -1.5 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 10.6 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 13.0 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -4.9 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 6.8 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 9.2 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -7.9 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 3.6 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 6.1 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | 2.9 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 19.1 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | -1.0 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 11.9 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | -4.5 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 7.7 |
| 4 | 4 | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-2 | pos1 | 21.1 |
|  | 8 | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-2 | pos1 | 12.9 |

* Table 8.2.1.5-4: Test requirements for PUSCH with 70% of maximum throughput, Type A, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -1.7 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 10.8 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 13.4 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-3 | pos1 | 19.9 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -5.0 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 7.0 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 9.2 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-3 | pos1 | 16.2 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -8.0 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 3.9 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 6.1 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-3 | pos1 | 13.2 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | 2.1 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 19.2 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | -1.4 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 12.0 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | -4.4 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 7.8 |
|  | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-41 | pos1 | 2.6 |
|  |  | Normal | TLDC300-100 Low | 70 % | G-FR1-A7-3 | pos1 | 15.9 |
| 4 |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-4 | pos1 | 20.2 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-41 | pos1 | -0.6 |
|  |  | Normal | TLDC300-100 Low | 70 % | G-FR1-A7-3 | pos1 | 9.2 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-4 | pos1 | 12.6 |

* Table 8.2.1.5-5: Test requirements for PUSCH with 70% of maximum throughput, Type A, 20 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -2.3 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 10.8 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 13.1 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -5.4 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 7.0 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 9.2 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -8.2 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 3.8 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 6.1 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | 2.1 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 18.9 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | -1.4 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 12.1 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | -4.5 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 7.7 |

* Table 8.2.1.5-6: Test requirements for PUSCH with 70% of maximum throughput, Type A, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -1.9 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 10.6 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 13.0 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-4 | pos1 | 20.5 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -5.2 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 6.9 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 9.1 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-4 | pos1 | 16.7 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -8.1 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 3.7 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 6.0 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-4 | pos1 | 13.2 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | 2.1 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 20.3 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | -1.5 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 12.1 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | -4.4 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 7.7 |
| 4 | 4 | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-5 | pos1 | 20.6 |
|  | 8 | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-5 | pos1 | 12.8 |

* Table 8.2.1.5-7: Test requirements for PUSCH with 70% of maximum throughput, Type A, 100 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -2.2 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 10.8 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 13.6 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-5 | pos1 | 21.7 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -5.2 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 7.1 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 9.6 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-5 | pos1 | 17.3 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -8.1 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 3.8 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 6.4 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-5 | pos1 | 13.7 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | 2.2 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 20.0 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | -1.4 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 12.4 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | -4.4 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 7.9 |
|  | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-42 | pos1 | 3.0 |
|  |  | Normal | TLDC300-100 Low | 70 % | G-FR1-A7-4 | pos1 | 16.8 |
| 4 |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-6 | pos1 | 21.6 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-42 | pos1 | -0.4 |
|  |  | Normal | TLDC300-100 Low | 70 % | G-FR1-A7-4 | pos1 | 9.5 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-6 | pos1 | 13.2 |

* Table 8.2.1.5-8: Test requirements for PUSCH with 70% of maximum throughput, Type B, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -1.7 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 10.8 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 13.1 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-1 | pos1 | 19.7 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -5.1 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 6.9 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 9.5 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-1 | pos1 | 16.1 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -8.1 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 3.6 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 6.3 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-1 | pos1 | 12.9 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | 2.3 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 19.1 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | -1.5 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 11.9 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-22 | pos1 | -4.6 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-22 | pos1 | 7.6 |
|  | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-39 | pos1 | 2.9 |
|  |  | Normal | TLDC300-100 Low | 70 % | G-FR1-A7-1 | pos1 | 15.7 |
| 4 |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-1 | pos1 | 20.2 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-39 | pos1 | -0.4 |
|  |  | Normal | TLDC300-100 Low | 70 % | G-FR1-A7-1 | pos1 | 9.2 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-1 | pos1 | 12.6 |

* Table 8.2.1.5-9: Test requirements for PUSCH with 70% of maximum throughput, Type B, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -1.7 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 11.1 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 13.2 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-2 | pos1 | 20.1 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -5.1 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 7.1 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 9.5 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-2 | pos1 | 16.5 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -8.4 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 3.8 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 6.4 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-2 | pos1 | 13.1 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | 2.8 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 19.5 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | -1.5 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 12.1 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-23 | pos1 | -4.4 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-23 | pos1 | 7.8 |

* Table 8.2.1.5-10: Test requirements for PUSCH with 70% of maximum throughput, Type B, 20 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -1.5 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 11.0 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 12.9 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -5.1 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 6.9 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 9.4 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -7.9 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 3.7 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 6.3 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | 2.4 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 18.9 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | -1.2 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 12.0 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-24 | pos1 | -4.5 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-24 | pos1 | 7.7 |
| 4 | 4 | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-2 | pos1 | 21.1 |
|  | 8 | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-2 | pos1 | 12.9 |

* Table 8.2.1.5-11: Test requirements for PUSCH with 70% of maximum throughput, Type B, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -1.8 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 10.7 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 13.1 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-3 | pos1 | 19.8 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -5.1 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 7.0 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 9.2 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-3 | pos1 | 16.3 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -8.2 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 3.8 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 6.2 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-3 | pos1 | 13.0 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | 1.9 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 19.3 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | -1.7 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 12.1 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-25 | pos1 | -4.8 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-25 | pos1 | 7.8 |
|  | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-41 | pos1 | 2.7 |
|  |  | Normal | TLDC300-100 Low | 70 % | G-FR1-A7-3 | pos1 | 16.0 |
| 4 |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-4 | pos1 | 20.2 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-41 | pos1 | -0.6 |
|  |  | Normal | TLDC300-100 Low | 70 % | G-FR1-A7-3 | pos1 | 9.3 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-4 | pos1 | 12.4 |

* Table 8.2.1.5-12: Test requirements for PUSCH with 70% of maximum throughput, Type B, 20 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -2.3 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 10.7 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 13.1 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -5.4 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 6.9 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 9.2 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -8.4 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 3.7 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 6.2 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | 2.1 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 19.0 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | -1.5 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 12.0 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-26 | pos1 | -4.6 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-26 | pos1 | 7.8 |

* Table 8.2.1.5-13: Test requirements for PUSCH with 70% of maximum throughput, Type B, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -1.9 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 10.6 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 13.1 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-4 | pos1 | 20.5 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -5.2 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 6.8 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 9.3 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-4 | pos1 | 16.6 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -8.2 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 3.6 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 6.1 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-4 | pos1 | 13.3 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | 2.5 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 19.5 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | -1.3 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 12.0 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-27 | pos1 | -4.4 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-27 | pos1 | 7.7 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-5 | pos1 | 20.7 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-5 | pos1 | 12.9 |

* Table 8.2.1.5-14: Test requirements for PUSCH with 70% of maximum throughput, Type B, 100 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -1.9 |
|  | 2 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 10.7 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 13.7 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-5 | pos1 | 21.7 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -5.2 |
| 1 | 4 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 6.9 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 9.8 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-5 | pos1 | 17.5 |
|  |  | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -8.1 |
|  | 8 | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 3.7 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 6.5 |
|  |  | Normal | TDLA30-10 Low | 70% | G-FR1-A8-5 | pos1 | 13.8 |
|  | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | 2.4 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 20.1 |
| 2 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | -1.4 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 12.4 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-28 | pos1 | -4.5 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A4-28 | pos1 | 7.9 |
|  | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-42 | pos1 | 3.1 |
|  |  | Normal | TLDC300-100 Low | 70 % | G-FR1-A7-4 | pos1 | 16.9 |
| 4 |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-6 | pos1 | 21.7 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-42 | pos1 | -0.3 |
|  |  | Normal | TLDC300-100 Low | 70 % | G-FR1-A7-4 | pos1 | 9.6 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-6 | pos1 | 13.3 |

* Table 8.2.1.5-15: Test requirements for PUSCH with 30% of maximum throughput, Type A, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLC300-100 Low | 30 % | G-FR1-A4-8 | pos1 | 3.5 |

* Table 8.2.1.5-16: Test requirements for PUSCH with 30% of maximum throughput, Type A, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLC300-100 Low | 30 % | G-FR1-A4-11 | pos1 | 3.4 |

* Table 8.2.1.5-17: Test requirements for PUSCH with 30% of maximum throughput, Type B, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLC300-100 Low | 30 % | G-FR1-A4-8 | pos1 | 3.4 |

* Table 8.2.1.5-18: Test requirements for PUSCH with 30% of maximum throughput, Type B, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 1 | 2 | Normal | TDLC300-100 Low | 30 % | G-FR1-A4-11 | pos1 | 3.5 |

* Table 8.2.1.5-19: Test requirements for PUSCH with 70% of maximum throughput, Type A, 50 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 4 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-40 | pos1 | 3.1 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A7-2 | pos1 | 16.0 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-3 | pos1 | 22.2 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-40 | pos1 | -0.3 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A7-2 | pos1 | 9.3 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-3 | pos1 | 13.4 |

* Table 8.2.1.5-20: Test requirements for PUSCH with 70% of maximum throughput, Type B, 50 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditions and correlation matrix (annex G) | Fraction of maximum throughput | FRC (annex A) | Additional DM-RS position | SNR  (dB) |
| 4 | 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-40 | pos1 | 3.4 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A7-2 | pos1 | 16.1 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-3 | pos1 | 22.2 |
|  | 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-40 | pos1 | -0.2 |
|  |  | Normal | TDLC300-100 Low | 70 % | G-FR1-A7-2 | pos1 | 9.3 |
|  |  | Normal | TDLA30-10 Low | 70 % | G-FR1-A11-3 | pos1 | 13.4 |

*<unchanged part omitted>*

*<end of the change 2>*

*<start of the change 1>*

# A.3 Fixed Reference Channels for performance requirements (QPSK, R=193/1024)

The parameters for the reference measurement channels are specified in table A.3-2, table A.3-2A, table A.3-4,table A.3-6 and table A.3-8 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.3-2 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.3-2A for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos2 and 1 transmission layer.

- FRC parameters are specified in table A.3-4 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 2 transmission layers.

- FRC parameters are specified in table A.3-6 for FR1 PUSCH with transform precoding enabled, additional DM-RS position = pos1 and 1 transmission layer.

- FRC parameters are specified in table A.3-8 for FR1 PUSCH with transform precoding enabled, additional DM-RS position = pos1 and 4 transmission layer.

The parameters for the reference measurement channels are specified in table A.3-7 for FR1 PUSCH performance requirements for TBoMS:

- FRC parameters are specified in table A.3-7 for FR1 PUSCH with transform precoding disabled, *Additional DM-RS position = pos1* and 1 transmission layer.

*<Unchanged sikpped>*

* Table A.3-8: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, Additional DM-RS position = pos1 and 4 transmission layer (QPSK, R=193/1024)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A3-39 | G-FR1-A3-40 | G-FR1-A3-41 | G-FR1-A3-42 |
| Subcarrier spacing (kHz) | 15 | 15 | 30 | 30 |
| Allocated resource blocks | 25 | 270 | 24 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 |
| Modulation | QPSK | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 193/1024 | 193/1024 | 193/1024 | 193/1024 |
| Payload size (bits) | 5384 | 58472 | 5256 | 59496 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 2 | 16 | 2 | 16 |
| Code block size including CRC (bits) (Note 2) | 2728 | 3680 | 2664 | 3744 |
| Total number of bits per slot | 28800 | 311040 | 27648 | 314496 |
| Total symbols per slot | 14400 | 155520 | 13824 | 157248 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos1, *l0* = 2 and *l* = 11 for PUSCH mapping type A, *l0* = 0 and *l* = 10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [17].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [16]. | | | | |

*<Unchanged sikpped>*

# A.9 Fixed Reference Channels for performance requirements (16QAM, R=434/1024)

Note: Different FRC numbers are assigned in TS 38.104 [2] and TS 38.141-2 [3] for the FRCs in this annex

The parameters for the reference measurement channels are specified in table A.9A-1 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.9-1 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 4 transmission layer.

* Table A.9-1: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, Additional DM-RS position = pos1 and 4 transmission layer (16QAM, R=434/1024)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A9-1 | G-FR1-A9-2 | G-FR1-A9-3 | G-FR1-A9-4 |
| Subcarrier spacing (kHz) | 15 | 15 | 30 | 30 |
| Allocated resource blocks | 25 | 270 | 24 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 |
| Modulation | 16QAM | 16QAM | 16QAM | 16QAM |
| Code rate (Note 2) | 434/1024 | 434/1024 | 434/1024 | 434/1024 |
| Payload size (bits) | 24576 | 262376 | 23568 | 270576 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 3 | 32 | 3 | 33 |
| Code block size including CRC (bits) (Note 2) | 8224 | 8224 | 7888 | 8224 |
| Total number of bits per slot | 57600 | 622080 | 55296 | 628992 |
| Total symbols per slot | 14400 | 155520 | 13824 | 157248 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos1, *l0* = 2 and *l* = 11 for PUSCH mapping type A, *l0* = 0 and *l* = 10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [17].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [16]. | | | | |

*<Unchanged sikpped>*

# A.10 Fixed Reference Channels for performance requirements (64QAM, R=517/1024)

NOTE: Fixed Reference Channels defined in table A.10-1, A.10-2, A.10-3, A.10-4, A.10-5 and A.10-6 in TS38.104 [2] and TS38.141-2 [3] is not used in this specification.

# A.11 Fixed Reference Channels for performance requirements (64QAM, R=438/1024)

The parameters for the reference measurement channels are specified in table A.11A-1 for FR1 PUSCH performance requirements:

- FRC parameters are specified in table A.11-1 for FR1 PUSCH with transform precoding disabled, additional DM-RS position = pos1 and 4 transmission layer.

* Table A.11-1: FRC parameters for FR1 PUSCH performance requirements, transform precoding disabled, Additional DM-RS position = pos1 and 4 transmission layer (64QAM, R=438/1024)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Reference channel | G-FR1-A11-1 | G-FR1-A11-2 | G-FR1-A11-3 | G-FR1-A11-4 | G-FR1-A11-5 | G-FR1-A11-6 |
| Subcarrier spacing (kHz) | 15 | 15 | 15 | 30 | 30 | 30 |
| Allocated resource blocks | 25 | 106 | 270 | 24 | 106 | 273 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM | 64QAM |
| Code rate (Note 2) | 438/1024 | 438/1024 | 438/1024 | 438/1024 | 438/1024 | 438/1024 |
| Payload size (bits) | 36896 | 155776 | 401640 | 35856 | 155776 | 401640 |
| Transport block CRC (bits) | 24 | 24 | 24 | 24 | 24 | 24 |
| Code block CRC size (bits) | 24 | 24 | 24 | 24 | 24 | 24 |
| Number of code blocks - C | 5 | 19 | 48 | 5 | 19 | 48 |
| Code block size including CRC (bits) (Note 2) | 7408 | 8224 | 8392 | 7200 | 8224 | 8392 |
| Total number of bits per slot | 86400 | 366336 | 933120 | 82944 | 366336 | 943488 |
| Total symbols per slot | 14400 | 61056 | 155520 | 13824 | 61056 | 157248 |
| NOTE 1: DM-RS configuration type = 1 with DM-RS duration = single-symbol DM-RS and the number of DM-RS CDM groups without data is 2, additional DM-RS position = pos1, *l0* = 2 and *l* = 11 for PUSCH mapping type A, *l0* = 0 and *l* = 10 for PUSCH mapping type B as per table 6.4.1.1.3-3 of TS 38.211 [17].  NOTE 2: Code block size including CRC (bits) equals to *K'* in clause 5.2.2 of TS 38.212 [16]. | | | | | | |

Annex C (informative):  
Test tolerances and derivation of test requirements

# C.3 Measurement of performance requirements

* Table C.3-1: Derivation of Test Requirements (Performance tests)

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Minimum Requirement in TS 38.104 [2] | Test Tolerance (TT) | Test requirement in the present document |
| * 8.2.1 Performance requirements for PUSCH with transform precoding disabled | * SNRs as specified | * 0.6 dB for 1Tx cases * 0.8 dB for 2Tx cases * 1.0 dB for 4Tx cases | * Formula: SNR + TT * T-put limit unchanged |

## D.5.2 Performance requirements for PUSCH transmission on two antenna ports in multipath fading conditions

## D.5.2A Performance requirements for PUSCH transmission on four antenna ports in multipath fading conditions

## D.6.2 Performance requirements for PUSCH transmission on two antenna ports in multipath fading conditions

## D.6.2A Performance requirements for PUSCH transmission on four antenna ports in multipath fading conditions