**3GPP TSG-RAN WG4 Meeting #94-e****R4-2002399**

**Online, 24th February- 6th March, 2020**

|  |
| --- |
| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
|  |
|  | **38.141-1** | **CR** | **0088** | **rev** | **1** | **Current version:** |  |  |
|  |
| *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)*.* |
|  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **X** | Core Network |  |

|  |
| --- |
|  |
| ***Title:***  | CR for TS38.141-1: Introduce PUSCH performance requirements at 30% throughput testing point |
|  |  |
| ***Source to WG:*** | CATT |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_perf\_enh-Perf |  | ***Date:*** | 2020-02-14 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***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-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
|  |  |
| ***Reason for change:*** | PUSCH performance requirements at 30% throughput testing point should be added to the specification. |
|  |  |
| ***Summary of change:*** | Add PUSCH performance requirements at 30% throughput testing point. |
|  |  |
| ***Consequences if not approved:*** | PUSCH performance requirements would be incomplete. |
|  |  |
| ***Clauses affected:*** | 8.1.2.1.1, 8.2.1.5 |
|  |  |
|  | **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:*** |  |

<Start of Change 1>

### 8.1.2 Applicability rule

#### 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.

#### 8.1.2.1 Applicability of PUSCH performance requirements

##### 8.1.2.1.1 Applicability of requirements for different subcarrier spacings

Unless otherwise stated, PUSCH requirement tests shall apply only for each subcarrier spacing declared to be supported (see D.14 in table 4.6-1).

Unless otherwise stated, PUSCH requirements with 30% maximum throughput testing point shall apply only for the lowest subcarrier spacing declared to be supported (see D.14 in table 4.6-1) for each frequency range.

##### 8.1.2.1.2 Applicability of requirements for different channel bandwidths

For each subcarrier spacing declared to be supported, the tests for a specific channel bandwidth shall apply only if the BS supports it (see D.14 in table 4.6-1).

Unless otherwise stated, for each subcarrier spacing declared to be supported, the tests shall be done only for the widest supported channel bandwidth. If performance requirement is not specified for this widest supported channel bandwidth, the tests shall be done by using performance requirement for the closest channel bandwidth lower than this widest supported bandwidth; the tested PRBs shall then be centered in this widest supported channel bandwidth.

##### 8.1.2.1.3 Applicability of requirements for different configurations

Unless otherwise stated, PUSCH requirement tests shall apply only for the mapping type declared to be supported (see D.100 in table 4.6-1). If both mapping type A and type B are declared to be supported, the tests shall be done for either type A or type B; the same chosen mapping type shall then be used for all tests.

8.1.2.1.4 Applicability of requirements for uplink carrier aggregation

The tests for uplink carrier aggregation shall be carried out according to the declaration (see D.107 in table 4.6-1).

Unless otherwise stated, the tests for uplink carrier aggregation shall apply only for PUSCH with transform precoding disabled, and shall be conducted on per component carrier basis.

8.1.2.1.5 Applicability of requirements for TDD with different UL-DL patterns

Unless otherwise stated, for each subcarrier spacing declared to be supported, if BS supports multiple TDD UL-DL patterns, only one of the supported TDD UL-DL patterns shall be used for all tests.

<End of Change 1>

<Start of Change 2>

## 8.2 Performance requirements for PUSCH

### 8.2.1 Performance requirements for PUSCH with transform precoding disabled

#### 8.2.1.1 Definition and applicability

The performance requirement of PUSCH is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in annex A. The performance requirements assume HARQ re-transmissions.

Which specific test(s) are applicable to BS is based on the test applicability rules defined in clause 8.1.2.1.

#### 8.2.1.2 Minimum Requirement

The minimum requirement is in TS 38.104 [2] clause 8.2.1.

#### 8.2.1.3 Test Purpose

The test shall verify the receiver's ability to achieve throughput under multipath fading propagation conditions for a given SNR.

#### 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 testedfor 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 |
| 15 kHz | 5 | -86.5 dBm / 4.5MHz |
| 10 | -83.3 dBm / 9.36MHz |
| 20 | -80.2 dBm / 19.08MHz |
| 30 kHz | 10 | -83.6 dBm / 8.64MHz |
| 20 | -80.4 dBm / 18.36MHz |
| 40 | -77.2 dBm / 38.16MHz |
| 100 | -73.1 dBm / 98.28MHz |

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:2U30 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-symbolDM-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} |
| 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 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 8.2.1.5-14 is achieved at the BS input.

6) For each of the reference channels in table 8.2.1.5-1 to 8.2.1.5-14 applicable for the base station, measure the throughput.

#### 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 8.2.1.5-14.

Table 8.2.1.5-1: Test requirements for PUSCH, Type A, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -1.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 10.7 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 12.9 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -5.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 6.8 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 9.4 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -8.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 3.6 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 6.2 |
| 2 | 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 |
| 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 |

Table 8.2.1.5-2: Test requirements for PUSCH, Type A, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -1.9 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 10.8 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 12.8 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -5.4 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 6.9 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 9.2 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -8.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 3.7 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 6.1 |
| 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 |
| 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, Type A, 20 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -1.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 10.6 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 13.0 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -4.9 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 6.8 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 9.2 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -7.9 |
| 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 | 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 |
| 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 |

Table 8.2.1.5-4: Test requirements for PUSCH, Type A, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -1.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 10.8 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 13.4 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -5.0 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 7.0 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 9.2 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -8.0 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 3.9 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 6.1 |
| 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 |
| 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 |

Table 8.2.1.5-5: Test requirements for PUSCH, Type A, 20 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 10.8 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 13.1 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -5.4 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 7.0 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 9.2 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -8.2 |
| 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 | 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 |
| 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, Type A, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -1.9 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 10.6 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 13.0 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -5.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 6.9 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 9.1 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -8.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 3.7 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 6.0 |
| 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 |
| 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 |

Table 8.2.1.5-7: Test requirements for PUSCH, Type A, 100 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -2.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 10.8 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 13.6 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -5.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 7.1 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 9.6 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -8.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 3.8 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 6.4 |
| 2 | 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 |
| 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 |

Table 8.2.1.5-8: Test requirements for PUSCH, Type B, 5 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -1.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 10.8 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 13.1 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -5.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 6.9 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 9.5 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-8 | pos1 | -8.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-8 | pos1 | 3.6 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-8 | pos1 | 6.3 |
| 2 | 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 |
| 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 |

Table 8.2.1.5-9: Test requirements for PUSCH, Type B, 10 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -1.7 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 11.1 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 13.2 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -5.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 7.1 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 9.5 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-9 | pos1 | -8.4 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-9 | pos1 | 3.8 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-9 | pos1 | 6.4 |
| 2 | 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 |
| 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, Type B, 20 MHz channel bandwidth, 15 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -1.5 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 11.0 |
| 30 % | G-FR1-A4-8 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 12.9 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -5.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-10 | pos1 | 6.9 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-10 | pos1 | 9.4 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-10 | pos1 | -7.9 |
| 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 | 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 |
| 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 |

Table 8.2.1.5-11: Test requirements for PUSCH, Type B, 10 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -1.8 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 10.7 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 13.1 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -5.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 7.0 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 9.2 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-11 | pos1 | -8.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-11 | pos1 | 3.8 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-11 | pos1 | 6.2 |
| 2 | 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 |
| 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 |

Table 8.2.1.5-12: Test requirements for PUSCH, Type B, 20 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -2.3 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 10.7 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 13.1 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -5.4 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-12 | pos1 | 6.9 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-12 | pos1 | 9.2 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-12 | pos1 | -8.4 |
| 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 | 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 |
| 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, Type B, 40 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -1.9 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 10.6 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 13.1 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -5.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 6.8 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 9.3 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-13 | pos1 | -8.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-13 | pos1 | 3.6 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-13 | pos1 | 6.1 |
| 2 | 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 |
| 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 |

Table 8.2.1.5-14: Test requirements for PUSCH, Type B, 100 MHz channel bandwidth, 30 kHz SCS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of TX antennas | Number of RX antennas | Cyclic prefix | Propagation conditionsand correlation matrix (annex G) | Fraction of maximum throughput | FRC(annex A) | Additional DM-RS position | SNR(dB) |
| 1 | 2 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -1.9 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 10.7 |
| 30 % | G-FR1-A4-11 | pos1 | [TBD] |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 13.7 |
| 4 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -5.2 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 6.9 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 9.8 |
| 8 | Normal | TDLB100-400 Low | 70 % | G-FR1-A3-14 | pos1 | -8.1 |
| Normal | TDLC300-100 Low | 70 % | G-FR1-A4-14 | pos1 | 3.7 |
| Normal | TDLA30-10 Low | 70 % | G-FR1-A5-14 | pos1 | 6.5 |
| 2 | 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 |
| 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 |

<End of Change 2>