## 6.3A Output power dynamics for CA

### 6.3A.1 Minimum output power for CA

#### 6.3A.1.0 Minimum conformance requirements

6.3A.1.0.1 Minimum output power for intra-band contiguous CA

For intra-band contiguous carrier aggregation, the minimum output power is defined per carrier and the requirement is specified in clause 6.3.1.

6.3A.1.0.2 Minimum output power for intra-band non-contiguous CA

For intra-band non-contiguous carrier aggregation, the minimum output power is defined per carrier and the requirement is specified in clause 6.3.1.

6.3A.1.0.3 Minimum output power for inter-band CA

For inter-band carrier aggregation with one uplink carrier assigned to one NR band, the minimum output power requirements in clause 6.3.1 apply.

For inter-band carrier aggregation with two uplink contiguous carrier assigned to one NR band, the minimum output power requirements in subclause 6.3A.1.0.1 apply for those carriers. For inter-band carrier aggregation with uplink assigned to two NR bands, the minimum output power is defined per carrier and the requirement is specified in clause 6.3.1.

For inter-band carrier aggregation with two uplink non-contiguous carrier assigned to one NR band, the minimum output power requirements in subclause 6.3A.1.0.2 apply for those carriers.

For inter-band carrier aggregation with uplink assigned to two NR bands, the minimum output power is defined per carrier and the requirement is specified in clause 6.3.1.

For combinations of intra-band and inter-band carrier aggregation with three uplink component carriers (up to two contiguously aggregated carriers per operating band), the minimum output power requirements specified in subclause 6.3.1 apply for the NR band supporting one component carrier, and for the NR band supporting two contiguous component carriers the requirements specified in subclause 6.3A.1.0.1 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3A.1.

#### 6.3A.1.1 Minimum output power for CA (2UL CA)

6.3A.1.1.1 Test purpose

To verify the UE's ability to transmit with a broadband output power for 2UL CA below the value specified in the test requirement when the power is set to a minimum value.

6.3A.1.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support 2UL CA.

6.3A.1.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3A.1.0.

6.3A.1.1.4 Test description

6.3A.1.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configurations specified in 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in table 6.3A.1.1.4.1-1 or 6.3A.1.1.4.1-2. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3A.1.1.4.1-1: Test Configuration Table for inter-band CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range for PCC and SCC  High range for PCC and SCC | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation (NOTE 1) | |
|  |  |  | PCC | SCC |
| 1 | N/A for this test | DFT-s-OFDM QPSK | Outer Full | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.3.1-1 and SCS is specified in Table 5.3.5-1 for each NR band. | | | | |

Table 6.3A.1.1.4.1-2: Test Configuration Table for intra-band contiguous CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range  High range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation (NOTE 1) | |
|  |  |  | PCC | SCC |
| 1 | N/A for this test | DFT-s-OFDM QPSK | Outer Full | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in 6.1A-1a  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.3.1-1 and SCS is specified in Table 5.3.5-1 for each NR band. | | | | |

Table 6.3A.1.1.4.1-3: Test Configuration Table for intra-band non-contiguous CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range and High range test frequencies as specified in tables for non-contiguous CA configuration with UL CA | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation (NOTE 1) | |
|  |  |  | PCC | SCC |
| 1 | N/A for this test | DFT-s-OFDM QPSK | Outer Full | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in 6.1-1  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.3.1-1 and SCS is specified in Table 5.3.5-1 for each NR band. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.3 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Tables 6.3A.1.1.4.1-1, 6.3A.1.1.4.1-2 and 6.3A.1.1.4.1-3.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3A.1.1.4.3.

6.3A.1.1.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [5] clause5.5.1. Message contents are defined in clause 6.3A.1.1.4.3.

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

4. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.1.1.4.1-1 or 6.3A.1.1.4.1-2 or 6.3A.1.1.4.1-3 on both PCC and SCC. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

5. Send continuously uplink power control "down" commands for both carriers in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step to ensure that the UE transmits at its minimum output power.

6. Measure the mean power of the UE for each component carrier in the associated measurement channel bandwidth specified in Table 6.3A.1.1.5-1 for the specific channel bandwidth under test. The period of measurement shall be at least the continuous duration of 1ms in all active uplink slots and in the uplink symbols. For TDD, only slots consisting of only UL symbols are under test.

6.3A.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with following exception.

Table 6.3A.1.1.4.3-1: *PUSCH-Config*

|  |
| --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-118 with condition TRANSFORM\_PRECODER\_ENABLED |

6.3A.1.1.5 Test requirement

The minimum output power of each component carrier, derived in step 6 shall not exceed the values specified in Table 6.3A.1.1.5-1.

Table 6.3A.1.1.5-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -40+TT | 4.515 |
| 10 | -40+TT | 9.375 |
| 15 | -40+TT | 14.235 |
| 20 | -40+TT | 19.095 |
| 25 | -39+TT | 23.955 |
| 30 | -38.2+TT | 28.815 |
| 35 | -37.6+TT | 33.855 |
| 40 | -37+TT | 38.895 |
| 45 | -36.5+TT | 43.575 |
| 50 | -36+TT | 48.615 |
| 60 | -35.2+TT | 58.35 |
| 70 | -34.6+TT | 68.07 |
| 80 | -34+TT | 78.15 |
| 90 | -33.5+TT | 88.23 |
| 100 | -33+TT | 98.31 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3A.1.1.5-2 | | |

Table 6.3A.1.1.5-2: Test Tolerance (Minimum output power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.0 | 1.3 |
| 40MHz < BW ≤ 100MHz | 1.3 | 1.3 |

### 6.3A.2 Transmit OFF power for CA

#### 6.3A.2.0 Minimum conformance requirements

6.3A.2.0.1 Transmit OFF power for intra-band contiguous CA

For intra-band contiguous carrier aggregation, the Transmit OFF power specified in clause 6.3.2 is applicable for each component carrier when the transmitter is OFF on all component carriers. The transmitter is considered to be OFF when the UE is not allowed to transmit on any of its ports.

6.3A.2.0.2 Transmit OFF power for intra-band non-contiguous CA

For intra-band non-contiguous carrier aggregation, the Transmit OFF power specified in clause 6.3.2 is applicable for each component carrier when the transmitter is OFF on all component carriers. The transmitter is considered to be OFF when the UE is not allowed to transmit on any of its ports.

6.3A.2.0.3 Transmit OFF power for inter-band CA

For inter-band carrier aggregation with one uplink carrier assigned to one NR band, the Transmit OFF power requirements in subclause 6.3.2 apply.

For inter-band carrier aggregation with two contiguous carriers assigned to one NR band, the Transmit OFF power requirements in subclause 6.3A.2.0.1 apply for those carriers.

For inter-band carrier aggregation with two uplink non-contiguous carrier assigned to one NR band, the Transmit OFF power requirements in subclause 6.3A.2.0.2 apply for those carriers.

For inter-band carrier aggregation with uplink assigned to two NR bands, the Transmit OFF power specified in clause 6.3.2 is applicable for each component carrier when the transmitter is OFF on all component carriers. The transmitter is considered to be OFF when the UE is not allowed to transmit on any of its ports.

For combinations of intra-band and inter-band carrier aggregation with three uplink component carriers (up to two contiguously aggregated carriers per operating band), the Transmit OFF power requirements specified in subclause 6.3.2 apply for the NR band supporting one component carrier, and for the NR band supporting two contiguous component carriers the requirements specified in subclause 6.3A.2.0.1 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3A.2

#### 6.3A.2.1 Transmit OFF power for CA (2UL CA)

6.3A.2.1.1 Test purpose

To verify that the UE Transmit OFF power for 2UL CA is lower than the value specified in the test requirement.

6.3A.2.1.2 Test applicability

The requirements of 6.3A.2.1 apply in test cases 6.3A.3.1 Transmit ON/OFF time mask for CA (2UL CA) to all types of NR UE release 15 and forward that support 2UL CA. Therefore, no test case description and requirements are specified.

6.3A.2.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3A.2.0.

6.3A.2.1.4 Test description

This test is covered by clause 6.3A.3.1 Transmit ON/OFF time mask for 2UL CA.

6.3A.2.1.5 Test requirement

The requirement for the Transmit OFF power of each component carrier shall not exceed the values specified in Table 6.3A.2.1.5-1.

Table 6.3A.2.1.5-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -50+TT | 4.515 |
| 10 | -50+TT | 9.375 |
| 15 | -50+TT | 14.235 |
| 20 | -50+TT | 19.095 |
| 25 | -50+TT | 23.955 |
| 30 | -50+TT | 28.815 |
| 35 | -50+TT | 33.855 |
| 40 | -50+TT | 38.895 |
| 45 | -50+TT | 43.575 |
| 50 | -50+TT | 48.615 |
| 60 | -50+TT | 58.35 |
| 70 | -50+TT | 68.07 |
| 80 | -50+TT | 78.15 |
| 90 | -50+TT | 88.23 |
| 100 | -50+TT | 98.31 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3A.2.1.5-2 | | |

Table 6.3A.2.1.5-2: Test Tolerance (Transmit OFF power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | FFS | FFS |
| 40MHz < BW ≤ 100MHz | FFS | FFS |

### 6.3A.3 Transmit ON/OFF time mask for CA

#### 6.3A.3.0 Minimum conformance requirements

##### 6.3A.3.0.1 Transmit ON/OFF time mask for intra-band contiguous CA

For intra-band contiguous carrier aggregation, the general output power ON/OFF time mask specified in clause 6.3.3.1 is applicable for each component carrier during the ON power period and the transient periods. The OFF period as specified in clause 6.3.3.1 shall only be applicable for each component carrier when all the component carriers are OFF.

##### 6.3A.3.0.2 Transmit ON/OFF time mask for intra-band non-contiguous CA

For intra-band non-contiguous carrier aggregation, the general output power ON/OFF time mask specified in clause 6.3.3.2 is applicable for each component carrier during the ON power period and the transient periods. The OFF period as specified in clause 6.3.3.2 shall only be applicable for each component carrier when all the component carriers are OFF.

##### 6.3A.3.0.3 Transmit ON/OFF time mask for inter-band CA

6.3A.3.0.3.1 General

For inter-band carrier aggregation with one uplink carrier assigned to one NR band, the Transmit ON/OFF time mask requirements in subclause 6.3.3 apply.

For inter-band carrier aggregation with two contiguous carriers assigned to one NR band, the Transmit ON/OFF time mask requirements in subclause 6.3A.3.0.1 apply for those carriers.

For inter-band carrier aggregation with two uplink non-contiguous carrier assigned to one NR band, the Transmit ON/OFF time mask requirements in subclause 6.3A.3.0.2 apply for those carriers.

For inter-band carrier aggregation with uplink assigned to two NR bands, the general output power ON/OFF time mask specified in clause 6.3.3.1 is applicable for each component carrier during the ON power period and the transient periods. The OFF period as specified in clause 6.3.3.1 shall only be applicable for each component carrier when all the component carriers are OFF.

For combinations of intra-band and inter-band carrier aggregation with three uplink component carriers (up to two contiguously aggregated carriers per operating band), the Transmit ON/OFF time mask requirements specified in subclause 6.3.3.1 apply for the NR band supporting one component carrier, and for the NR band supporting two contiguous component carriers the requirements specified in subclause 6.3A.3.0.1 apply.

6.3A.3.0.3.2 Time mask for switching between two uplink carriers

In addition to the requirements in 6.3A.3.0.3.1 and the maximum output power requirement specified in Table 6.2A.1.0.3-1 with uplink assigned to two NR bands, the switching time mask specified in this clause is applicable for an uplink band pair of an inter-band UL CA configuration when the capability *uplinkTxSwitchingPeriod* is present, and is only applicable for uplink switching mechanisms specified in clause 6.1.6 of TS 38.214 [12], where NR UL carrier 1 is capable of one transmit antenna connector and NR UL carrier 2 is capable of two transmit antenna connectors with 3dB boosting on the maximum output power when the capability *uplinkTxSwitchingPowerBoosting* is present and the IE *uplinkTxSwitchingPowerBoosting* is enabled, and the two uplink carriers are in different bands with different carrier frequencies. The UE shall support the switch between single layer transmission with one antenna port and two-layer transmission with two antenna ports on the two uplink carriers following the scheduling commands and rank adaptation, i.e., both single layer and two-layer transmission with 2 antenna ports, and single layer transmission with 1 antenna port shall be supported on NR UL carrier 2.

The switching periods described in Figure 6.3A.3.0.3.2-1a and Figure 6.3A.3.0.3.2-1b are located in either NR carrier 1 or carrier 2 as indicated in RRC signalling *uplinkTxSwitchingPeriodLocation* [6], and the length of uplink switching period *X* is less than the value indicated by UE capability *uplinkTxSwitchingPeriod*.

When switching from one carrier to another, if there is no uplink transmission scheduled or configured on the switch-from carrier for at least the duration of the switching period (X µs) before the point in time the UE is scheduled or configured to start the transmission on the switch-to carrier, the switching period is fully contained in the time period between the end of the transmission on the switch-from carrier and the start of the transmission on the switch-to carrier. In addition, the RRC signalling *uplinkTxSwitchingPeriodLocation* does not take effect in this case.

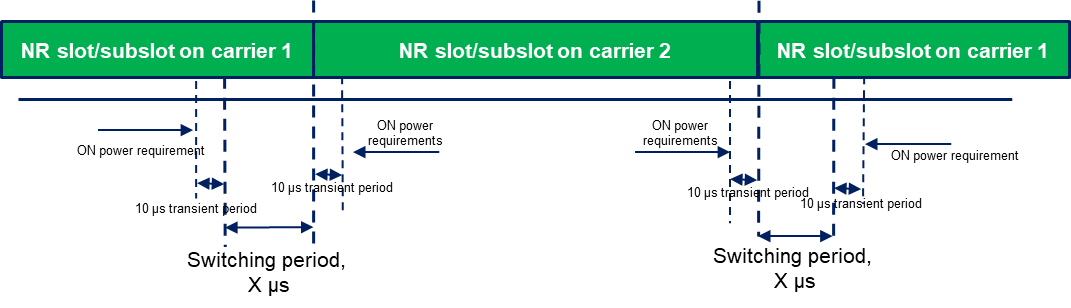


Figure 6.3A.3.0.3.2-1a: Time mask for switching between UL carrier 1 and UL Carrier 2, where the switching period is located in carrier 1

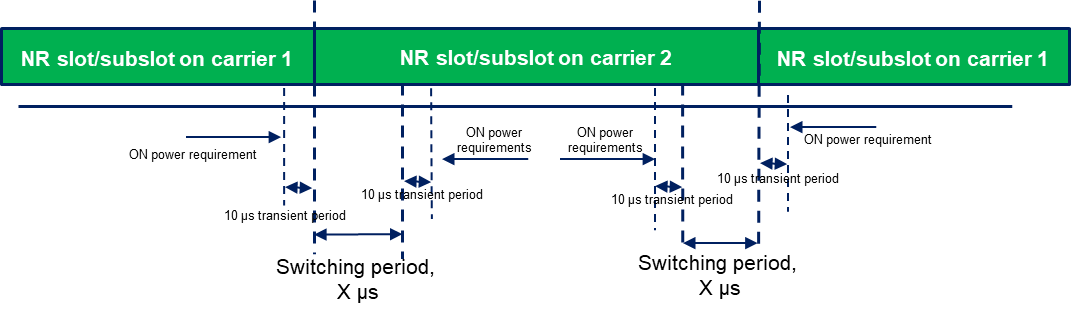


Figure 6.3A.3.0.3.2-1b: Time mask for switching between UL carrier 1 and UL Carrier 2, where the switching period is located in carrier 2

The requirements apply for the case of co-located and synchronized network deployment for the two uplink carriers.

The requirements apply for the case of single TAG for the two uplink carriers, i.e., the same uplink timing for the two carriers as described in clause 4.2 of TS 38.213 [9].

The time mask is applicable to uplink transmissions when configured with *switchedUL* or *dualUL*.

6.3A.3.0.3.3 Time mask for switching between two uplink carriers with two transmit antenna connectors

In addition to the requirements in 6.3A.3.0.3.1 and the maximum output power requirement specified in Table 6.2A.1.0.3-1 with uplink assigned to two NR bands, the switching time mask specified in this clause is applicable for an uplink band pair of a inter-band UL CA configuration when the capability *uplinkTxSwitchingPeriod2T2T* is present, and is only applicable for uplink switching mechanisms specified in clause 6.1.6 of TS 38.214 [12], where NR UL carrier 1 is capable of two transmit antenna connectors and NR UL carrier 2 is capable of two transmit antenna connectors, and the two uplink carriers are in different bands with different carrier frequencies. The UE shall support the switch between two-layer transmission with two antenna ports and two-layer transmission with two antenna ports on the two uplink carriers following the scheduling commands and rank adaptation, i.e., both single layer and two-layer transmission with 2 antenna ports, and single layer transmission with 1 antenna port shall be supported on NR UL carrier 1 and carrier 2.

The switching periods described in Figure 6.3A.3.0.3.3-1a and Figure 6.3A.3.0.3.3-1b are located in either NR carrier 1 or carrier 2 as indicated in RRC signalling *uplinkTxSwitchingPeriodLocation* [6], and the length of uplink switching period *X* is less than the value indicated by UE capability *uplinkTxSwitchingPeriod2T2T*.

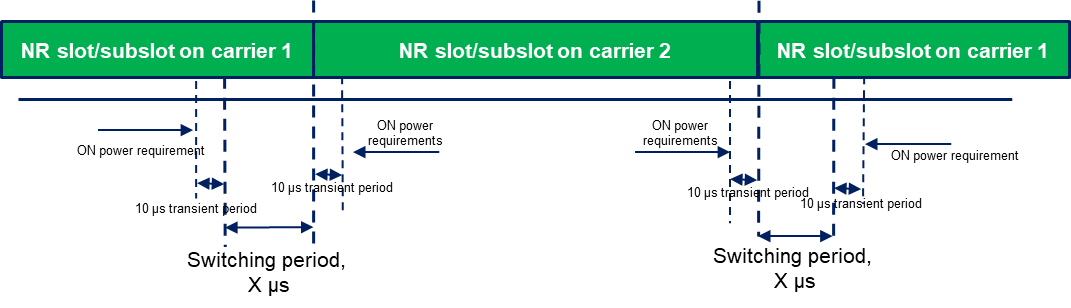


Figure 6.3A.3.0.3.3-1a: Time mask for switching between UL carrier 1 and UL Carrier 2, where the switching period is located in carrier 1

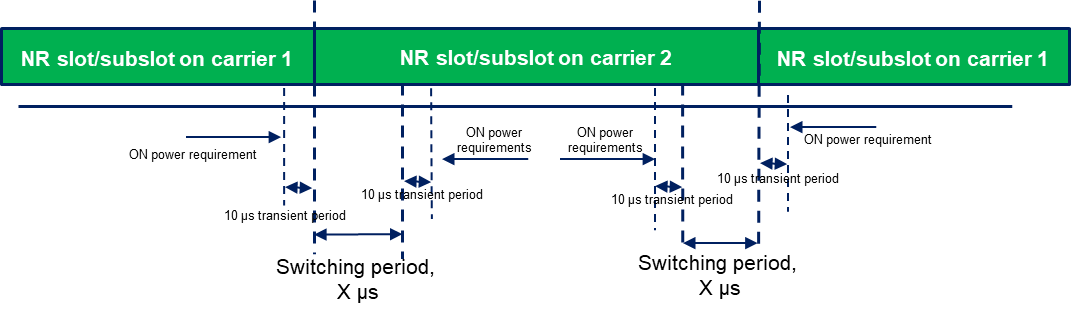


Figure 6.3A.3.0.3.3-1b: Time mask for switching between UL carrier 1 and UL Carrier 2, where the switching period is located in carrier 2

The requirements apply for the case of co-located and synchronized network deployment for the two uplink carriers.

The requirements apply for the case of single TAG for the two uplink carriers, i.e., the same uplink timing for the two carriers as described in clause 4.2 of TS 38.213 [9].

The time mask is applicable to uplink transmissions when configured with *switchedUL* or *dualUL*.

6.3A.3.0.3.4 Time mask for switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors

In addition to the requirements in 6.3A.3.0.3.1 and the maximum output power requirement specified in Table 6.2A.1.0.3-1 with uplink assigned to two NR bands, the switching time mask specified in this clause is applicable for an uplink band pair of an inter-band UL CA configuration when the capability *uplinkTxSwitchingPeriod* is present, and is only applicable for uplink switching mechanisms specified in clause 6.1.6 of TS 38.214 [12], where NR UL carrier 1 in band A is capable of one transmit antenna connector, NR UL carrier 2 and carrier 3 in band B are capable of two transmit antenna connectors. NR UL carrier 2 and carrier 3 are two contiguous aggregated carriers, and band A and band B are different bands with different carrier frequencies. The UE shall support the switch between single layer transmission with one antenna port and two-layer transmission with two antenna ports on the two uplink bands following the scheduling commands and rank adaptation, i.e., both single layer and two-layer transmission with 2 antenna ports, and single layer transmission with 1 antenna port shall be supported on NR UL carrier 2 and carrier 3 in band B.

The switching periods described in Figure 6.3A.3.0.3.4-1a and Figure 6.3A.3.0.3.4-1b are located in either NR band A or band B as indicated in RRC signalling *uplinkTxSwitchingPeriodLocation* [6], and the length of uplink switching period *X* is less than the value indicated by UE capability *uplinkTxSwitchingPeriod* .

When switching from one carrier to another, if there is no uplink transmission scheduled or configured on the switch-from carrier for at least the duration of the switching period (X µs) before the point in time the UE is scheduled or configured to start the transmission on the switch-to carrier, the switching period is fully contained in the time period between the end of the transmission on the switch-from carrier and the start of the transmission on the switch-to carrier. In addition, the RRC signalling *uplinkTxSwitchingPeriodLocation* is ignored by the UE and does not take effect in this case.

A screen shot of a computer

Description automatically generated

Figure 6.3A.3.0.3.4-1a: Time mask for switching between one carrier in band A and two contiguous carriers in band B, where the switching period is located in band A

A screen shot of a video game

Description automatically generated

Figure 6.3A.3.0.3.4-1b: Time mask for switching between one carrier in band A and two contiguous carriers in band B, where the switching period is located in band B

The following applies for the uplink switching cases specified in clause 6.1.6.2 of [12] with *uplinkTxSwitchingOption* set to either *switchedUL* or *dualUL* when the configuration of the location of the switching period by *uplinkTxSwitchingPeriodLocation* is ignored by the UE:

- if an uplink switching is triggered for an uplink transmission starting at *T0* based on higher layer configuration(s) or DCI(s) received before *T0* − *Toffset* as specified in [12] and the UE is not configured or scheduled with uplink transmissions for a duration of at least the uplink switching gap indicated by *uplinkTxSwitchingPeriod*on any of the carriers before *T0*, transient periods of 10 s are located at the end of the last symbol(s) configured or scheduled on the carriers before *T0* and at the start of the first symbol(s) configured or scheduled at *T0* on the switched-to carrier.

The requirements apply for the case of both non-co-located and co-located and synchronized network deployment for the three uplink carriers.

The time mask is applicable to uplink transmissions when configured with *switchedUL* or *dualUL*.

6.3A.3.0.3.5 Time mask for switching between two uplink bands with two transmit antenna connectors

In addition to the requirements in 6.3A.3.0.3.1 and the maximum output power requirement specified in Table 6.2A.1.0.3-1 with uplink assigned to two NR bands, the switching time mask specified in this clause is applicable for an uplink band pair of an inter-band UL CA configuration when the capability *uplinkTxSwitchingPeriod2T2T* is present, and is only applicable for uplink switching mechanisms specified in clause 6.1.6 of TS 38.214 [12], where NR UL carrier 1 in band A is capable of two transmit antenna connectors, NR UL carrier 2 and carrier 3 in band B are capable of two transmit antenna connectors. NR UL carrier 2 and carrier 3 are two contiguous aggregated carriers, and band A and band B are different bands with different carrier frequencies. The UE shall support the switch between two-layer transmission with two antenna ports and two-layer transmission with two antenna ports on the two uplink bands following the scheduling commands and rank adaptation, i.e., both single layer and two-layer transmission with 2 antenna ports, and single layer transmission with 1 antenna port shall be supported on NR UL carrier 1, carrier 2 and carrier 3 in the two bands.

The switching periods described in Figure 6.3A.3.0.3.5-1a and Figure 6.3A.3.0.3.5-1b are located in either NR band A or band B as indicated in RRC signalling *uplinkTxSwitchingPeriodLocation* [6], and the length of uplink switching period *X* is less than the value indicated by UE capability *uplinkTxSwitchingPeriod2T2T*.

When switching from one carrier to another, if there is no uplink transmission scheduled or configured on the switch-from carrier for at least the duration of the switching period (X µs) before the point in time the UE is scheduled or configured to start the transmission on the switch-to carrier, the switching period is fully contained in the time period between the end of the transmission on the switch-from carrier and the start of the transmission on the switch-to carrier. In addition, the RRC signalling *uplinkTxSwitchingPeriodLocation* is ignored by the UE and does not take effect in this case.

A screen shot of a computer

Description automatically generated

Figure 6.3A.3.0.3.5-1a: Time mask for switching between one carrier in band A and two contiguous carriers in band B, where the switching period is located in band A

A screen shot of a video game

Description automatically generated

Figure 6.3A.3.0.3.5-1b: Time mask for switching between one carrier in band A and two contiguous carriers in band B, where the switching period is located in band B

The following applies for the uplink switching cases specified in clause 6.1.6.2 of [12] with *uplinkTxSwitchingOption* set to either *switchedUL* or *dualUL* when the configuration of the location of the switching period by *uplinkTxSwitchingPeriodLocation* is ignored by the UE:

- if an uplink switching is triggered for an uplink transmission starting at *T0* based on higher layer configuration(s) or DCI(s) received before *T0* − *Toffset* as specified in [12] and the UE is not configured or scheduled with uplink transmissions for a duration of at least the uplink switching gap indicated by *uplinkTxSwitchingPeriod2T2T*on any of the carriers before *T0*, transient periods of 10 s are located at the end of the last symbol(s) configured or scheduled on the carriers before *T0* and at the start of the first symbol(s) configured or scheduled at *T0* on the switched-to carrier.

The requirements apply for the case of both non-co-located and co-located and synchronized network deployment for the three uplink carriers.

The time mask is applicable to uplink transmissions when configured with *switchedUL* or *dualUL*.The normative reference for this requirement is TS 38.101-1 [2] clause 6.3A.3.

#### 6.3A.3.1 Transmit ON/OFF time mask for CA (2UL CA)

6.3A.3.1.1 Test purpose

To verify that the general ON/OFF time mask for CA (2UL CA) meets the requirements given in 6.3A.3.1.5

The transmit power time mask for transmit ON/OFF defines the transient period(s) allowed between transmit OFF power and transmit ON power symbols for CA.

Transmission of the wrong power increases interference to other channels, or increases transmission errors in the uplink channel.

6.3A.3.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support 2UL CA.

6.3A.3.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3A.3.0.

6.3A.3.1.4 Test description

6.3A.3.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configuration specified in 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in table 6.3A.3.1.4.1-1 or 6.3A.3.1.4.1-2. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3A.3.1.4.1-1: Test Configuration Table for inter-band CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1 | | Low range for PCC and SCC  High range for PCC and SCC | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest, Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation (NOTE 1) | |
|  |  |  | PCC | SCC |
| 1 | N/A for this test | DFT-s-OFDM QPSK | Inner Full | Inner Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.3.1-1 and SCS is specified in Table 5.3.5-1 for each NR band.. | | | | |

Table 6.3A.3.1.4.1-2: Test Configuration Table for intra-band contiguous CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1.1.4 for intra band contiguous CA in FR1 | | Low range  High range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest, Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation (NOTE 1) | |
|  |  |  | PCC | SCC |
| 1 | N/A for this test | DFT-s-OFDM QPSK | Inner Full | Inner Full |
| NOTE 1: The specific configuration of each RB allocation is defined in 6.1A-1a NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.3.1-1 and SCS is specified in Table 5.3.5-1 for each NR band. | | | | |

Table 6.3A.3.1.4.1-3: Test Configuration Table for intra-band non-contiguous CA when UE supporting IE *dualPA-Architecture*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1.1.5 for intra band non-contiguous CA in FR1 | | Low range and High range test frequencies as specified in tables for non-contiguous CA configuration with UL CA | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest, Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation (NOTE 1) | |
|  |  |  | PCC | SCC |
| 1 | N/A for this test | DFT-s-OFDM QPSK | SCS 15kHz: 45@0  SCS 30kHz: 24@0  SCS 60kHz: 12@0 | SCS 15kHz: 45@0  SCS 30kHz: 24@0  SCS 60kHz: 12@0 |
| NOTE 1: The specific configuration of each RB allocation is defined in 6.1A-1a  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths and SCS are specified in Table 5.5A.3-1. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.3 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Tables 6.3A.3.1.4.1-1 to 6.3A.3.1.4.1-3a as appropriate.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3A.3.1.4.3.

6.3A.3.1.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3A.3.1.4.3.

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

4. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.1.4.1-1 or 6.3A.3.1.4.1-2 on both PCC and SCC. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The UL assignment is such that the UE transmits on slots 8 for 15kHz SCS, on slots 16 and 17 for 30kHz SCS and on slots 32 through 35 for 60kHz SCS.

5. Send continuously uplink power control "up" commands for both carriers in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

6. On power sub test:

6.1. Measure the sum of mean output power over all component carriers in the CA configuration of the UE PUSCH transmission during one slot of the radio access mode. For FDD band in inter-band CA with both TDD band and FDD band, only slots overlapping with only UL symbols in TDD are under test.

7. OFF power sub test:

7.1. Measure the UE transmission OFF power for each component carrier during the slot prior to the PUSCH transmission, excluding a transient period of 10 µs in the end of the slot.

7.2. Measure the UE transmission OFF power of each component carrier during the slot following the PUSCH transmission, excluding a transient period of 10 µs at the beginning of the slot.

6.3A.3.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with following exceptions.

Table 6.3A.3.1.4.3-1: PUSCH-ConfigCommon

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-90 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-ConfigCommon ::= SEQUENCE { |  |  |  |
| p0-NominalWithGrant | -100 |  |  |
| } |  |  |  |

Table 6.3A.3.1.4.3-2: TDD-UL-DL-Config

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms10 |  | FR1 |
| nrofDownlinkSlots | 6 |  | FR1\_15kHz |
|  | 13 |  | FR1\_30kHz |
|  | 27 |  | FR1\_60kHz |
| nrofDownlinkSymbols | 10 |  | FR1\_15kHz |
|  | 6 |  | FR1\_30kHz |
|  | 12 |  | FR1\_60kHz |
| nrofUplinkSlots | 3 |  | FR1\_15kHz |
|  | 6 |  | FR1\_30kHz |
|  | 12 |  | FR1\_60kHz |
| nrofUplinkSymbols | 4 |  | FR1\_30kHz |
|  | 2 |  | FR1\_15kHz, |
|  | 8 |  | FR1\_60kHz |
|  |  |  |  |
| } |  |  |  |
| pattern2 | Not present |  |  |
| } |  |  |  |

Table 6.3A.3.1.4.3-3: PUSCH-TimeDomainResourceAllocationList

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-122 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF { | 2 entries |  |  |
| PUSCH-TimeDomainResourceAllocation[1] SEQUENCE { |  |  |  |
| k2 | 4 |  | FR1\_15kHz,FR1\_30kHz |
| 6 |  | FR1\_60kHz |
| mappingType | typeA |  |  |
| startSymbolAndLength | 27 | Start symbol(S)=0, Length(L)=14 |  |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation[2] SEQUENCE { |  | addressed by Msg3 PUSCH time resource allocation field of the Random Access Response acc. to TS 38.213 [22] Table 8.2-1. |  |
| k2 | 2 | K2+ Δ=4 acc. to TS 38.214 [21] Table 6.1.2.1.1-5  (NOTE 1) | FR1\_15kHz |
| 6 | K2+ Δ=9 acc. to TS 38.214 [21] Table 6.1.2.1.1-5  (NOTE 1) | FR1\_30kHz |
| mappingType | typeA |  |  |
| startSymbolAndLength | 27 | Start symbol(S)=0, Length(L)=14 |  |
| } |  |  |  |
| } |  |  |  |
| NOTE 1: Values are chosen so that first slot of a TDD-UL-DL slot configuration period can be used for the Random Access Response and the last slot (of the same or another period) for the corresponding Msg3. | | | |

|  |  |
| --- | --- |
| Condition | Explanation |
| FR1\_15kHz | FR1 is used under the test. SCS is set to 15kHz. |
| FR1\_30kHz | FR1 is used under the test. SCS is set to 30kHz. |
| FR1\_60kHz | FR1 is used under the test. SCS is set to 60kHz. |

Table 6.3A.3.1.4.3-4: ServingCellConfigCommon

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1[5], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| ss-PBCH-BlockPower | 18 |  | SCS\_15kHz |
|  | 21 |  | SCS\_30kHz |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| SCS\_15kHz | SCS=15kHz for SS/PBCH block |
| SCS\_30kHz | SCS=30kHz for SS/PBCH block |

Table 6.3A.3.1.4.3-5: *PUSCH-Config*

|  |
| --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-118 with condition TRANSFORM\_PRECODER\_ENABLED |

Table 6.3A.3.1.4.3-6: FrequencyInfoUL-SIB

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-62 FrequencyInfoUL-SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 20 |  | Inter-band CA |
|  | 19 |  | intra-band contiguous for CA\_n48B |
|  | 18 |  | intra-band contiguous for CA\_n41C |
|  | 17 |  | intra-band contiguous for CA\_n77C |
|  | [16] |  | intra-band non-contiguous 2 UL CA PC3 (MPRIM3 to meet -13dBm/MHz) |
|  | [8] |  | intra-band non-contiguous 2 UL CA PC3 (MPRIM3 to meet -30dBm/MHz) |

6.3A.3.1.5 Test requirement

The requirement for the transmit ON power and Transmit OFF power for CA measured in steps 5, 6 and 7 of the test procedure shall not exceed the values specified in Table 6.3A.3.1.5-1.

Table 6.3A.3.1.5-1: General ON/OFF time mask

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Channel bandwidth / minimum output power / measurement bandwidth | | | | | | | | | | | | | | |
|  | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 35  MHz | 40  MHz | 45  MHz | 50  MHz | 60  MHz | 70  MHz | 80  MHz | 90  MHz | 100  MHz |
| Transmit OFF power | ≤ -50+TT dBm | | | | | | | | | | | | | | |
| Transmission OFF Measurement bandwidth | 4.515 | 9.375 | 14.235 | 19.095 | 23.955 | 28.815 | 33.855 | 38.895 | 43.575 | 48.615 | 58.35 | 68.07 | 78.15 | 88.23 | 98.31 |
| Transmit ON power | For inter-band CA configurations, The test requirement of transmit on power of 2UL CA is the same as Test ID 9of Table 6.2A.2.1.5-1 as appropriate.  For intra-band contiguous CA configurations, The test requirement of transmit on power of 2UL CA is the same as Test ID 3 of Table 6.2A.2.1.5-1a, Table 6.2A.2.1.5-1b and 6.2A.2.1.5-1c as appropriate.  For intra-band non-contiguous CA configurations, The test requirement of transmit on power of 2UL CA is the same as Test ID 4 of Table 6.2A.2.1.5-1e, Test ID 3 of 6.2A.2.1.5-1f as appropriate. | | | | | | | | | | | | | | |
| NOTE 1: TT for each frequency and channel bandwidth of OFF power is specified in Table 6.3A.3.1.5-2.  NOTE 2: TT or each frequency and channel bandwidth of Transmit ON power is specified in Table 6.2A.2.1.5-3 | | | | | | | | | | | | | | | |

Table 6.3A.3.1.5-2: Test Tolerance for OFF power

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 1.5 | 1.8 |
| 40MHz < BW ≤ 100MHz | 1.7 | 1.8 |

#### 6.3A.3.1\_1 Void

#### 6.3A.3.2 Time mask for switching between two uplink carriers

Editor’s Note: The improvement for test procedure is FFS

6.3A.3.2.1 Test purpose

To verify that the time mask for switching between two uplink carriers meets the requirements given in 6.3A.3.0.3.2.

The time mask for switching between two uplink carriers defines the transient period(s) allowed between two uplink carriers for an uplink band pair of an inter-band UL CA configuration when the capability *uplinkTxSwitchingPeriod* is present.

6.3A.3.2.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support 2UL inter-band CA and dynamic UL Tx switching.

6.3A.3.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3A.3.0.3.2.

6.3A.3.2.4 Test description

6.3A.3.2.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configuration specified in 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in table 6.3A.3.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3A.3.2.4.1-1: Test Configuration Table for inter-band CA Uplink switching

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1.1.3 for inter band CA in FR1 | | Mid range for PCC and SCC | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation (NOTE 2) | |
|  |  |  | PCC | SCC |
| 1 | N/A for this test | CP-OFDM QPSK | Inner Full | Inner Full |
| NOTE 1: PCC is the component carrier capable of one transmit antenna connector, and is configured as Carrier 1. SCC is the component carrier capable of two transmit antenna connectors, and is configured as Carrier 2.  NOTE 2: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 3: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.3.1-1 and SCS is specified in Table 5.3.5-1 for each NR band. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3A.3.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3A.3.2.4.3.

6.3A.3.2.4.2 Test procedure

1. Sub test 1: Switching period located in Carrier 1

1.1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

1.2. The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3A.3.2.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier1 and FALSE on carrier 2.

1.3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

1.3a. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.2.4.1-1 on PCC only. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX,c level on PCC.

1.3b. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.2.4.1-1 on SCC only. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX,c level on SCC.

1.4. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.2.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

1.5. The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.2.4.1-1 on carrier 2 starting on slot n and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.6. Measure the output power of UE PUSCH transmission for carrier 1 during slot n-1 excluding a transient period of 10 µs and a Switching period X µs in the end of slot n-1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod*.

1.7. Measure the sum of output power of UE PUSCH transmission on carrier 2 over all antenna connectors during slot n and slot m excluding a transient period of 10 µs in the beginning of slot n and in the end of slot m

1.8. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.2.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

1.9. Measure the output power of UE PUSCH transmission for carrier 1 during slot m+1 excluding a switching period X and a transient period of 10 µs in the beginning of slot m+1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod*.

2. Sub test 2: Switching period located in Carrier 2

2.1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2.2. The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3A.3.2.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier 2 and FALSE on carrier 1.

2.3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

2.3a. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.2.4.1-1 on PCC only. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX,c level on PCC.

2.3b. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.2.4.1-1 on SCC only. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX,c level on SCC.

2.4. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.2.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2.5.The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.2.4.1-1 on carrier 2 on slot n (n ≥1) and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.6. Measure the output power of UE PUSCH transmission for carrier 1 during slot n-1, for carrier 1 excluding a transient period of 10 µs in the end of slot n-1.

2.7. Measure the sum of output power of UE PUSCH transmission on carrier 2 over all antenna connectors during during slot n and slot m excluding a switching period X and a transient period of 10 µs in the beginning of slot n and in the end of slot m. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod.*

2.8. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.2.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC

2.9. Measure the output power of UE PUSCH transmission for carrier 1 during slot m+1 excluding a transient period of 10 µs in the beginning of slot m+1.

6.3A.3.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with following exceptions.

Table 6.3A.3.2.4.3-1: CellGroupConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| uplinkTxSwitchingOption-r16 | switchedUL |  | switchedUL OR Both |
|  | dualUL |  | dualUL |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| switchedUL | UE indicated supporting of switchedUL in uplinkTxSwitching-OptionSupport-r16 |
| dualUL | UE indicated supporting of dualUL in uplinkTxSwitching-OptionSupport-r16 |
| Both | UE indicated supporting of both in uplinkTxSwitching-OptionSupport-r16 |

Table 6.3A.3.2.4.3-2: Void

Table 6.3A.3.2.4.3-3: ServingCellConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1[5], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| uplinkTxSwitching-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| uplinkTxSwitchingPeriodLocation-r16 | TRUE |  | PL |
|  | FALSE |  | noPL |
| uplinkTxSwitchingCarrier-r16 | carrier1 |  | 1TxCC |
|  | carrier2 |  | 2TxCC |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| PL | The location of UL Tx switching period is configured in this carrier |
| noPL | The location of UL Tx switching period is not configured in this carrier |
| 1TxCC | The carrier is capable of one transmit antenna connector |
| 2TxCC | The carrier is capable of two transmit antenna connectors |

Table 6.3A.3.2.4.3-4: Void

Table 6.3A.3.2.4.3-5: Void

Table 6.3A.3.2.4.3-6: FrequencyInfoUL-SIB for inter-band CA

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-62 FrequencyInfoUL-SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 23 |  |  |

Table 6.3A.3.2.4.3-7: FrequencyInfoUL for inter-band CA

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-61 FrequencyInfoUL | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 23 |  |  |

6.3A.3.2.5 Test requirement

The requirement for the power of carrier 1 measured in step 1.6, 1.9, 2.6, 2.9 of the test procedure and the power of carrier 2 measured in step 1.7 and 2.7 shall not exceed the values specified in table 6.3A.3.2.5-1.

Table 6.3A.3.2.5-1: Time mask for switching between two uplink carriers (On power)

|  |  |
| --- | --- |
|  | Measured output power |
| Transmit ON power | PCC: Same as Test ID 23 of Table 6.2.2.5-1 to Table 6.2.2.5-3 as appropriate  SCC: Same as Test ID 1 of Table 6.2D.2.5-1 as appropriate |
| NOTE1: TT or each frequency and channel bandwidth of Transmit ON power is specified in Table 6.2A.2.1.5-3 | |

Table 6.3A.3.2.5-2: Void

#### 6.3A.3.3 Time mask for switching between two uplink carriers with two transmit antenna connectors

6.3A.3.3.1 Test purpose

To verify that the time mask for switching between two uplink carriers meets the requirements given in 6.3A.3.0.3.3.

The time mask for switching between two uplink carriers with two transmit antenna connectors defines the transient period(s) allowed between two uplink carriers for an uplink band pair of an inter-band UL CA configuration when the capability *uplinkTxSwitchingPeriod2T2T* is present.

6.3A.3.3.2 Test applicability

This test case applies to all types of NR UE release 17 and forward that support 2UL inter-band CA and dynamic UL 2Tx-2Tx switching.

6.3A.3.3.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3A.3.0.3.3.

6.3A.3.3.4 Test description

6.3A.3.3.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configuration specified in 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in table 6.3A.3.3.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3A.3.3.4.1-1: Test Configuration Table for inter-band CA Uplink switching

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1.1.3 for inter band CA in FR1 | | Mid range for PCC and SCC | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Highest NRB\_agg | | |
| Test SCS as specified in Table 5.5A.3-1 | | Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation (NOTE 2) | |
|  |  |  | PCC | SCC |
| 1 | N/A for this test | CP-OFDM QPSK | Inner Full | Inner Full |
| NOTE 1: PCC is the component carrier with lower center frequency between two component carriers. PCC is configured as Carrier 1 and SCC is configured as Carrier2.  NOTE 2: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 3: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths and SCS are specified in Table 5.5A.3-1. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3A.3.3.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3A.3.3.4.3.

6.3A.3.3.4.2 Test procedure

1. Sub test 1: Switching period located in Carrier 1

1.1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

1.2. The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3A.3.3.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier1 and FALSE on carrier 2.

1.3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

1.3a. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.3.4.1-1 on PCC only. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX,c level on PCC.

1.3b. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.3.4.1-1 on SCC only. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX,c level on SCC.1.4. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.3.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.5. The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.3.4.1-1 on carrier 2 starting on slot n and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.6. Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot n-1 excluding a transient period of 10 µs and a Switching period X µs in the end of slot n-1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod2T2T-r17*.

1.7. Measure the sum of output power of UE PUSCH transmission on carrier 2 over all antenna connectors during slot n and slot m excluding a transient period of 10 µs in the beginning of slot n and in the end of slot m

1.8. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.3.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.9. Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot m+1 excluding a switching period X and a transient period of 10 µs in the beginning of slot m+1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod2T2T-r17*.

2. Sub test 2: Switching period located in Carrier 2

2.1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2.2. The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3A.3.3.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier 2 and FALSE on carrier 1.

2.3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

2.3a. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.3.4.1-1 on PCC only. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX,c level on PCC.

2.3b. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.3.4.1-1 on SCC only. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX,c level on SCC.

2.4. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.3.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.5.The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.3.4.1-1 on carrier 2 on slot n (n ≥1) and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.6. Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot n-1, for carrier 1 excluding a transient period of 10 µs in the end of slot n-1.

2.7. Measure the sum of output power of UE PUSCH transmission on carrier 2 over all antenna connectors during during slot n and slot m excluding a switching period X and a transient period of 10 µs in the beginning of slot n and in the end of slot m. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod2T2T-r17.*

2.8. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.3.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.9. Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot m+1 excluding a transient period of 10 µs in the beginning of slot m+1.

6.3A.3.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 ensuring Table 4.6.3-182 with the condition 2TX\_UL\_MIMO, with the following exceptions.

Table 6.3A.3.3.4.3-1: CellGroupConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| uplinkTxSwitchingOption-r16 | switchedUL |  | switchedUL OR Both |
|  | dualUL |  | dualUL |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| switchedUL | UE indicated supporting of switchedUL in uplinkTxSwitching-OptionSupport-r16 |
| dualUL | UE indicated supporting of dualUL in uplinkTxSwitching-OptionSupport-r16 |
| Both | UE indicated supporting of both in uplinkTxSwitching-OptionSupport-r16 |

Table 6.3A.3.3.4.3-2: ServingCellConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1[5], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| uplinkTxSwitching-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| uplinkTxSwitchingPeriodLocation-r16 | TRUE |  | PL |
|  | FALSE |  | noPL |
| uplinkTxSwitchingCarrier-r16 | carrier1 |  | PCC |
|  | carrier2 |  | SCC |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| PL | The location of UL Tx switching period is configured in this carrier |
| noPL | The location of UL Tx switching period is not configured in this carrier |

Table 6.3A.3.3.4.3-3: FrequencyInfoUL-SIB for inter-band CA

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-62 FrequencyInfoUL-SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 23 |  |  |

Table 6.3A.3.3.4.3-4: FrequencyInfoUL for inter-band CA

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-61 FrequencyInfoUL | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 23 |  |  |

6.3A.3.3.5 Test requirement

The requirement for the power of carrier 1 measured in step 1.6, 1.9, 2.6, 2.9 of the test procedure and the power of carrier 2 measured in step 1.7 and 2.7 shall not exceed the values specified in table 6.3A.3.3.5-1.

Table 6.3A.3.3.5-1: Time mask for 2Tx-2Tx switching between two uplink carriers (On power)

|  |  |
| --- | --- |
|  | Measured output power |
| Transmit ON power | Same as Test ID 1 of Table 6.2D.2.5-1 as appropriate |
| NOTE1: TT or each frequency and channel bandwidth of Transmit ON power is specified in Table 6.2A.2.1.5-3 | |

#### 6.3A.3.4 Time mask for switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors (3UL CA)

6.3A.3.4.1 Test purpose

To verify that the time mask for switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors meets the requirements given in 6.3A.3.0.3.4.

The time mask for switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors defines the transient period(s) allowed when the capability *uplinkTxSwitchingPeriod* is present.

6.3A.3.4.2 Test applicability

This test case applies to all types of NR UE release 17 and forward that support 3UL inter-band CA with intra-band contiguous CA and dynamic UL 1Tx-2Tx switching.

6.3A.3.4.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3A.3.0.3.4.

6.3A.3.4.4 Test description

6.3A.3.4.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configuration specified in 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in table 6.3A.3.4.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3A.3.4.4.1-1: Test Configuration Table for inter-band CA with intra-band contiguous CA Uplink switching

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1.1.3 for inter band CA in FR1 | | Mid range for PCC and SCCs | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Highest NRB on PCC and Highest NRB\_agg on SCCs | | |
| Test SCS as specified in Table 5.5A.3-1 | | Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation | |
|  |  |  | PCC (NOTE 2) | SCCs (NOTE 3) |
| 1 | N/A for this test | CP-OFDM QPSK | Inner Full | Inner Full |
| NOTE 1: PCC is the component carrier on the band with single carrier configured and SCCs are the contiguous aggregated component carriers on another band. PCC is configured as Carrier 1 and both SCCs are configured as Carrier2.  NOTE 2: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 3: The specific configuration of each RB allocation is defined in Table 6.1A-1a.  NOTE 4: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths and SCS are specified in Table 5.5A.3-1. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.6 for TE diagram and section A.3.2.3.11 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3A.3.4.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3A.3.4.4.3.

6.3A.3.4.4.2 Test procedure

In this test case, one component carrier (PCC) is configured in band A and two contiguous aggregated carriers (SCCs) are configured in band B. The carrier in band A is configured as Carrier 1, and both carriers in band B is configured as Carrer 2.

1. Sub test 1: Switching period located in Carrier 1

1.1. Configure SCCs according to Annex C.0, C.1, C.2 for all downlink physical channels.

1.2. The SS shall configure SCCs as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3A.3.4.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier1 and FALSE on carrier 2.

1.3. SS activates SCCs by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

1.3a. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.4.4.1-1 on PCC only. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX,c level on PCC.

1.3b. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.4.4.1-1 on both SCCs. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX level on the SCCs.

1.4. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.4.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

1.5. The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.4.4.1-1 on carrier 2 (SCCs) on slot n and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.6. Measure the output power of UE PUSCH transmission for carrier 1 during slot n-1 excluding a transient period of 10 µs and a Switching period X µs in the end of slot n-1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod*.

1.7. Measure the sum of output power of UE PUSCH transmission on carrier 2 (SCCs) over all antenna connectors and both component carriers during slot n and slot m excluding a transient period of 10 µs in the beginning of slot n and in the end of slot m.

1.8. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.4.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

1.9. Measure the output power of UE PUSCH transmission for carrier 1 during slot m+1 excluding a switching period X and a transient period of 10 µs in the beginning of slot m+1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod2T2T-r17*.

2. Sub test 2: Switching period located in Carrier 2

2.1. Configure SCCs according to Annex C.0, C.1, C.2 for all downlink physical channels.

2.2. The SS shall configure SCCs as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3A.3.4.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier 2 and FALSE on carrier 1.

2.3. SS activates SCCs by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

2.3a. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.4.4.1-1 on PCC only. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX,c level on PCC.

2.3b. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.4.4.1-1 on both SCCs. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX level on SCCs.

2.4. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.4.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2.5.The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.4.4.1-1 on carrier 2 (SCCs) on slot n (n ≥1) and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.6. Measure the output power of UE PUSCH transmission for carrier 1 during slot n-1, for carrier 1 excluding a transient period of 10 µs in the end of slot n-1.

2.7. Measure the sum of output power of UE PUSCH transmission on carrier 2 (SCCs) over all antenna connectors and both component carrier s during slot n and slot m excluding a switching period X and a transient period of 10 µs in the beginning of slot n and in the end of slot m. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod.*

2.8. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.4.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2.9. Measure the output power of UE PUSCH transmission for carrier 1 during slot m+1 excluding a transient period of 10 µs in the beginning of slot m+1.

6.3A.3.4.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 ensuring Table 4.6.3-182 with the condition 2TX\_UL\_MIMO, with the following exceptions.

Table 6.3A.3.4.4.3-1: CellGroupConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| uplinkTxSwitchingOption-r16 | switchedUL |  | switchedUL OR Both |
|  | dualUL |  | dualUL |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| switchedUL | UE indicated supporting of switchedUL in uplinkTxSwitching-OptionSupport-r16 |
| dualUL | UE indicated supporting of dualUL in uplinkTxSwitching-OptionSupport-r16 |
| Both | UE indicated supporting of both in uplinkTxSwitching-OptionSupport-r16 |

Table 6.3A.3.4.4.3-2: ServingCellConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1[5], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| uplinkTxSwitching-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| uplinkTxSwitchingPeriodLocation-r16 | TRUE |  | PL |
|  | FALSE |  | noPL |
| uplinkTxSwitchingCarrier-r16 | carrier1 |  | PCC |
|  | carrier2 |  | SCC |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| PL | The location of UL Tx switching period is configured in this carrier |
| noPL | The location of UL Tx switching period is not configured in this carrier |

Table 6.3A.3.4.4.3-3: FrequencyInfoUL-SIB for PCC

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-62 FrequencyInfoUL-SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 23 |  |  |

Table 6.3A.3.4.4.3-4: FrequencyInfoUL for SCCs

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-61 FrequencyInfoUL | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 20 |  |  |

6.3A.3.4.5 Test requirement

The requirement for the power of carrier 1 measured in step 1.6, 1.9, 2.6, 2.9 of the test procedure and the power of carrier 2 measured in step 1.7 and 2.7 shall not exceed the values specified in table 6.3A.3.4.5-1.

Table 6.3A.3.4.5-1: Time mask for 1Tx-2Tx switching between two bands (On power)

|  |  |
| --- | --- |
|  | Measured output power |
| Transmit ON power | PCC: Same as Test ID 23 of Table 6.2.2.5-1 to Table 6.2.2.5-3 as appropriate  SCCs: Same as Test ID 1 of Table 6.2H.1.2.5-1 or 6.2H.1.2.5-2 as appropriate |
| NOTE1: TT or each frequency and channel bandwidth of Transmit ON power is specified in Table 6.2A.2.1.5-3 | |

#### 6.3A.3.5 Time mask for switching between two uplink bands with two transmit antenna connectors (3UL CA)

6.3A.3.5.1 Test purpose

To verify that the time mask for switching between two uplink bands with two transmitter connectors meets the requirements given in 6.3A.3.0.3.5.

The time mask for switching between NR UL carrier 1 in band A, which capable of two transmit antenna connectors, and NR UL carrier 2 and carrier 3 in band B, which are capable of two transmit antenna connectors defines the transient period(s) allowed when the capability *uplinkTxSwitchingPeriod2T2T* is present.

6.3A.3.5.2 Test applicability

This test case applies to all types of NR UE release 17 and forward that support 3UL inter-band CA with intra-band contiguous CA and dynamic UL 2Tx-2Tx switching.

6.3A.3.5.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3A.3.0.3.5.

6.3A.3.5.4 Test description

6.3A.3.5.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configuration specified in 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in table 6.3A.3.5.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3A.3.5.4.1-1: Test Configuration Table for inter-band CA with intra-band contiguous CA 2Tx-2Tx Uplink switching

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1.1.3 for inter band CA in FR1 | | Mid range for PCC and SCCs | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Highest NRB on PCC and Highest NRB\_agg on SCCs | | |
| Test SCS as specified in Table 5.5A.3-1 | | Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation | |
|  |  |  | PCC (NOTE 2) | SCCs (NOTE 3) |
| 1 | N/A for this test | CP-OFDM QPSK | Inner Full | Inner Full |
| NOTE 1: PCC is the component carrier on the band with single carrier configured and SCCs are the contiguous aggregated component carriers on another band. PCC is configured as Carrier 1 and both SCCs are configured as Carrier2.  NOTE 2: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 3: The specific configuration of each RB allocation is defined in Table 6.1A-1a.  NOTE 4: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths and SCS are specified in Table 5.5A.3-1. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.6 for TE diagram and section A.3.2.3.11 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3A.3.5.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3A.3.5.4.3.

6.3A.3.5.4.2 Test procedure

In this test case, one component carrier (PCC) is configured in band A and two contiguous aggregated carriers (SCCs) are configured in band B. The carrier in band A is configured as Carrier 1, and both carriers in band B is configured as Carrer 2.

1. Sub test 1: Switching period located in Carrier 1

1.1. Configure SCCs according to Annex C.0, C.1, C.2 for all downlink physical channels.

1.2. The SS shall configure SCCs as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3A.3.5.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier1 and FALSE on carrier 2.

1.3. SS activates SCCs by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

1.3a. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.5.4.1-1 on PCC only. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX,c level on PCC.

1.3b. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.5.4.1-1 on both SCCs. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX level on the SCCs.

1.4. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.5.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.5. The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.5.4.1-1 on carrier 2 (SCCs) on slot n and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.6. Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot n-1 excluding a transient period of 10 µs and a Switching period X µs in the end of slot n-1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod2T2T*.

1.7. Measure the sum of output power of UE PUSCH transmission on carrier 2 (SCCs) over all antenna connectors and both component carriers during slot n and slot m excluding a transient period of 10 µs in the beginning of slot n and in the end of slot m.

1.8. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.5.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.9. Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot m+1 excluding a switching period X and a transient period of 10 µs in the beginning of slot m+1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod2T2T-r17*.

2. Sub test 2: Switching period located in Carrier 2

2.1. Configure SCCs according to Annex C.0, C.1, C.2 for all downlink physical channels.

2.2. The SS shall configure SCCs as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3A.3.5.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier 2 and FALSE on carrier 1.

2.3. SS activates SCCs by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

2.3a. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.5.4.1-1 on PCC only. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX,c level on PCC.

2.3b. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.5.4.1-1 on both SCCs. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PCMAX level on SCCs.

2.4. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.5.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.5.The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.5.4.1-1 on carrier 2 (SCCs) on slot n (n ≥1) and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.6. Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot n-1, for carrier 1 excluding a transient period of 10 µs in the end of slot n-1.

2.7. Measure the sum of output power of UE PUSCH transmission on carrier 2 (SCCs) over all antenna connectors and both component carrier s during slot n and slot m excluding a switching period X and a transient period of 10 µs in the beginning of slot n and in the end of slot m. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod2T2T.*

2.8. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.3.5.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.9. Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot m+1 excluding a transient period of 10 µs in the beginning of slot m+1.

6.3A.3.5.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 ensuring Table 4.6.3-182 with the condition 2TX\_UL\_MIMO, with the following exceptions.

Table 6.3A.3.5.4.3-1: CellGroupConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| uplinkTxSwitchingOption-r16 | switchedUL |  | switchedUL OR Both |
|  | dualUL |  | dualUL |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| switchedUL | UE indicated supporting of switchedUL in uplinkTxSwitching-OptionSupport-r16 |
| dualUL | UE indicated supporting of dualUL in uplinkTxSwitching-OptionSupport-r16 |
| Both | UE indicated supporting of both in uplinkTxSwitching-OptionSupport-r16 |

Table 6.3A.3.5.4.3-2: ServingCellConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1[5], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| uplinkTxSwitching-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| uplinkTxSwitchingPeriodLocation-r16 | TRUE |  | PL |
|  | FALSE |  | noPL |
| uplinkTxSwitchingCarrier-r16 | carrier1 |  | PCC |
|  | carrier2 |  | SCC |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| PL | The location of UL Tx switching period is configured in this carrier |
| noPL | The location of UL Tx switching period is not configured in this carrier |

Table 6.3A.3.5.4.3-3: FrequencyInfoUL-SIB for PCC

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-62 FrequencyInfoUL-SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 23 |  |  |

Table 6.3A.3.5.4.3-4: FrequencyInfoUL for SCCs

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-61 FrequencyInfoUL | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 20 |  |  |

6.3A.3.5.5 Test requirement

The requirement for the power of carrier 1 measured in step 1.6, 1.9, 2.6, 2.9 of the test procedures and the power of carrier 2 measured in step 1.7 and 2.7 shall not exceed the values specified in table 6.3A.3.5.5-1.

Table 6.3A.3.5.5-1: Time mask for 2Tx-2Tx switching between two bands (On power)

|  |  |
| --- | --- |
|  | Measured output power |
| Transmit ON power | PCC: Same as Test ID 1 of Table 6.2D.2.5-1 as appropriate  SCCs: Same as Test ID 1 of Table 6.2H.1.2.5-1 or 6.2H.1.2.5-2 as appropriate |
| NOTE1: TT or each frequency and channel bandwidth of Transmit ON power is specified in Table 6.2A.2.1.5-3 | |

### 6.3A.4 Power control for CA

#### 6.3A.4.1 Absolute power tolerance for CA

##### 6.3A.4.1.0 Minimum conformance requirements

The absolute power tolerance is the ability of the UE transmitter to set its initial output power to a specific value for the first sub-frame at the start of a contiguous transmission or non-contiguous transmission with a transmission gap on each active component carriers larger than 20ms. The requirement can be tested by time aligning any transmission gaps on the component carriers.

For intra-band contiguous carrier aggregation the absolute power control tolerance per component carrier is given in Table 6.3.4.2.3-1.

For intra-band non-contiguous carrier aggregation the absolute power control tolerance per component carrier is given in Table 6.3.4.2.3-1.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3A.4.

##### 6.3A.4.1.1 Absolute power tolerance for CA (2UL CA)

Editor’s Note:

This test case in incomplete when signalling is absent for dualPA-Architecture IE due to lack of core requirements.

6.3A.4.1.1.1 Test purpose

To verify the ability of the UE transmitter for 2UL CA to set its initial output power to a specific value at the start of a contiguous transmission or non-contiguous transmission on each active component carrier with a long transmission gap, i.e. transmission gap is larger than 20ms.

6.3A.4.1.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support intra-band contiguous and non-contiguous 2UL CA.

6.3A.4.1.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3A.4.1.0.

6.3A.4.1.1.4 Test description

6.3A.4.1.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configurations specified in 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in table 6.3A.4.1.1.4.1-1 for intra-band contiguous CA and table 6.3A.4.1.1.4.1-2 for intra-band non-contiguous CA. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3A.4.1.1.4.1-1: Test Configuration Table for intra-band contiguous CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Mid range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest, Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation (NOTE 1) | |
|  |  |  | PCC | SCC |
| 1 | N/A for this test | CP-OFDM QPSK | Outer\_Full | Outer\_Full |
| NOTE 1: The specific configuration of each RB allocation is defined in 6.1A-1a for contiguous RB allocation.  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths and SCS are specified in Table 5.5A.1-1.  NOTE 3: If the UE supports multiple CC Combinations in the CA Configuration with the same NRB\_agg, only the combination with the highest NRB\_PCC is tested. | | | | |

Table 6.3A.4.1.1.4.1-2: Test Configuration Table for intra-band non-contiguous CA

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | | | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | | | Normal | | | | | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | | Low range and High range test frequencies as specified in tables for non-contiguous CA configuration with UL CA | | | | | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | | Refer to “PCC NRB”and “SCC NRB ” columns | | | | | | |
| Test SCS as specified in Table 5.3.5-1 | | | | | Lowest, Highest | | | | | | |
| Test Parameters | | | | | | | | | | | |
| ID | CA config / CBW | | | | | | | DL config | UL config | | |
| PCC | | SCC | |  |  |  | CC MOD | RB allocation (NOTE 1) | |
| Band | Range | Band | Range | PCC NRB | Wgap | SCC NRB | PCC | SCC |
| 2 | nX | CC1 | nX | CC2 | Highest NRB | Max (NOTE 4) | Highest NRB | N/A | CP-OFDM QPSK | Outer\_Full | Outer\_Full |
| NOTE 1: The RB allocation is defined in table 6.1-1 for each CC.  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths and SCS are specified in Table 5.5A.2-1.  NOTE 3: If the UE supports multiple CC Combinations in the CA Configuration with the same NRB\_agg, only the combination with the highest NRB\_PCC is tested.  NOTE 4: The Wgap is defined to be widest possible on band based on the PCC and SCC configuration | | | | | | | | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.3 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3A.1.1.4.1-1 and Table 6.3A.1.1.4.1-2 as appropriate.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3A.4.1.1.4.3. Note that PDCCH DCI format 0\_1 sent after resetting uplink power with RRC Connection Reconfiguration, should have TPC command 0dB.

6.3A.4.1.1.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [5] clause5.5.1. Message contents are defined in clause 6.3A.4.1.1.4.3. Any PDCCH DCI format 0\_1 sent to the UE during the configuration should have TPC command 0dB.

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

4. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 with TPC command 0dB for C\_RNTI to schedule the UL RMC according to Table 6.3A.4.1.1.4.1-1 on both PCC and SCC. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

5. Measure the initial output power of the first subframe of UE PUSCH first transmission for each component carrier.

6. Repeat for the two test points as indicated in section 6.3A.4.1.1.4.3. The timing of the execution between the two test points shall be larger than 20ms.

6.3A.4.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the following exceptions:

Table 6.3A.4.1.1.4.3-0: ServingCellConfigCommon

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1[5], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| ss-PBCH-BlockPower | 18 |  | SCS\_15kHz |
|  | 21 |  | SCS\_30kHz |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| SCS\_15kHz | SCS=15kHz for SS/PBCH block |
| SCS\_30kHz | SCS=30kHz for SS/PBCH block |

Table 6.3A.4.1.1.4.3-1: UplinkPowerControlCommon: Test point 1

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] subclause 4.6.3 Table 4.6.3-119 PUSCH-ConfigCommon | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-ConfigCommon::= SEQUENCE { |  |  |  |
| p0-NominalWithGrant | -114 | Test point 1 to verify a UE relative low initial power transmission |  |
| } |  |  |  |

Table 6.3A.4.1.1.4.3-2: UplinkPowerControlCommon: Test point 2

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] subclause 4.6.3 Table 4.6.3-119 PUSCH-ConfigCommon | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-ConfigCommon::= SEQUENCE { |  |  |  |
| p0-NominalWithGrant | -108 | Test point 2 to verify a UE relative high initial power transmission |  |
| } |  |  |  |

6.3A.4.1.1.5 Test requirement

For intra-band contiguous CA, the absolute power control tolerance per component carrier measured in step (5) of the test procedure is not to exceed the values specified in Table 6.3A.4.1.1.5-1 and 6.3A.4.1.1.5-2.

Table 6.3A.4.1.1.5-1: Absolute power tolerance: test point 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | Channel bandwidth / expected output power (dBm) | | | | | | | | | | | | |
| 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz | 60  MHz | 70  MHz | 80  MHz | 90  MHz | 100  MHz |
| Expected Measured power | SCS15 | -17.6 | -14.4 | -12.6 | -11.3 | -10.4 | -9.6 | -8.3 | -7.3 | N/A | N/A | N/A | N/A | N/A |
| SCS30 | -18.2 | -14.8 | -12.8 | -11.5 | -10.5 | -9.7 | -8.3 | -7.4 | -6.5 | -5.8 | -5.2 | -4.7 | -4.2 |
| SCS60 |  | -15.2 | -13.0 | -11.8 | -10.7 | -9.8 | -8.5 | -7.5 | -6.6 | -5.9 | -5.3 | -4.8 | -4.3 |
| Power tolerance | | ± (9+TT)dB | | | | | | | | | | | | |
| Note 1: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3A.4.1.1.5-3. | | | | | | | | | | | | | | |

Table 6.3A.4.1.1.5-2: Absolute power tolerance: test point 2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | Channel bandwidth / expected output power (dBm) | | | | | | | | | | | | |
|  | | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz | 60  MHz | 70  MHz | 80  MHz | 90  MHz | 100  MHz |
| Expected Measured power | SCS15 | -11.6 | -7.6 | -6.6 | -5.3 | -4.4 | -3.6 | -2.3 | -1.3 | N/A | N/A | N/A | N/A | N/A |
| SCS30 | -12.2 | -8.8 | -6.8 | -5.5 | -4.5 | -3.7 | -2.3 | -1.4 | -0.5 | 0.2 | 0.8 | 1.3 | 1.8 |
| SCS60 | N/A | -9.2 | -7 | -5.8 | -4.7 | -3.8 | -2.5 | -1.5 | -0.6 | 0.1 | 0.7 | 1.2 | 1.7 |
| Power tolerance | | ± (9+TT)dB | | | | | | | | | | | | |
| Note 1: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3A.4.1.1.5-3. | | | | | | | | | | | | | | |

Table 6.3A.4.1.1.5-3: Test Tolerance

|  |  |  |  |
| --- | --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 4.2GHz | 4.2GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.0 dB | 1.4 dB | 1.4 dB |
| 40MHz < BW ≤ 100MHz | 1.4 dB | 1.4 dB | 1.4 dB |

#### 6.3A.4.2 Relative power tolerance for CA

##### 6.3A.4.2.0 Minimum conformance requirements

For intra-band contiguous and non-contiguous carrier aggregation, the requirements apply when the power of the target and reference sub-frames on each component carrier exceed the minimum output power as defined in subclause 6.3A.1.0 and the total power is limited by PUMAX as defined in subclause 6.2A.4.0. The UE shall meet the following requirements for transmission on both assigned component carriers when the average transmit power per PRB is aligned across both assigned carriers in the reference sub-frame:

a) for all possible combinations of PUSCH and PUCCH transitions per component carrier, the corresponding requirements given in Table 6.3.4.3.3-1;

b) for SRS transitions on each component carrier, the requirements for combinations of PUSCH/PUCCH and SRS transitions given in Table 6.3.4.3.3-1 with simultaneous SRS of constant SRS bandwidth allocated in the target and reference subframes;

c) for RACH on the primary component carrier, the requirements given in Table 6.3.4.3.3-1 for PRACH.

For a) and b) above, the power step P between the reference and target subframes shall be set by a TPC command and/or an uplink scheduling grant transmitted by means of an appropriate DCI Format.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3A.4.

##### 6.3A.4.2.1 Relative power tolerance for CA (2UL CA)

Editor’s Note: This test case is incomplete for UL intra-band non-contiguous CA because MPR and PCMAX\_L are not evaluated.

6.3A.4.2.1.1 Test purpose

To verify the ability of the UE transmitter to set its output power of each component carrier in a target sub-frame(1ms) relatively to the power of the most recently transmitted reference sub-frame if the transmission gap between these sub-frames is less than or equal to 20ms.

6.3A.4.2.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support intra-band contiguous 2UL CA.

6.3A.4.2.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3A.4.2.0.

6.3A.4.2.1.4 Test description

6.3A.4.2.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configurations specified in 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in table 6.3A.4.2.1.4.1-1 and table 6.3A.4.2.1.4.1-2. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3A.4.2.1.4.1-1: Test Configuration Table for intra-band contiguous CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Mid range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest, Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocations (Note 3)  (LCRB @ RBstart) | |
|  |  |  | PCC | SCC |
| 1 | N/A for this test | DFT-s-OFDM QPSK | 5@(NRB-5)  5@(NRB-5)  1@(NRB-1)  8@(NRB-8) | 1@0  8@0  1@0  8@0 |
| NOTE 1: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths and SCS are specified in Table 5.5A.1-1.  NOTE 2: If the UE supports multiple CC Combinations in the CA Configuration with the same NRB\_agg, only the combination with the highest NRB\_PCC is tested.  NOTE 3: The UL allocation is changed as part of the test procedure. The Test Configuration Table entries list the combinations used, with the sequence of usage as determined by the test procedure for each sub-test. | | | | |

Table 6.3A.4.2.1.4.1-2: Test Configuration Table for intra-band non-contiguous CA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | | Low range and High range test frequencies as specified in tables for non-contiguous CA configuration with UL CA | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | | | | Lowest, Highest | | |
| Test Parameters | | | | | | | |
| Test ID | Range | | | DL Config | Uplink Configuration | | |
| Modulation for all CCs | RB allocations (Note 3)  (LCRB @ RBstart) | |
| PCC | Wgap | SCC |  |  | PCC | SCC |
| 1 | CC1 | Max Wgap | CC2 | N/A | DFT-s-OFDM QPSK | 5@0  5@0  1@0  8@0 | 1@0  8@0  1@0  8@0 |
| NOTE 1: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths and SCS are specified in Table 5.5A.2-1.  NOTE 2: If the UE supports multiple CC Combinations in the CA Configuration with the same NRB\_agg, only the combination with the highest NRB\_PCC is tested.  NOTE 3: The UL allocation is changed as part of the test procedure. The Test Configuration Table entries list the combinations used, with the sequence of usage as determined by the test procedure for each sub-test. | | | | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.3 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3A.4.2.1.4.1-1 and Table 6.3A.4.2.1.4.1-2 as appropriate.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3A.4.2.1.4.3.

6.3A.4.2.1.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [5] clause5.5.1. Message contents are defined in clause 6.3A.4.2.1.4.3.

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133, clause 9.3).

4. The procedure is separated in various subtests to verify different aspects of relative power control. The power changes of the subtests are shown by diagrams in the Test Procedure. In this test case, the term PCMAX\_L – MAX{TL, TLOW(PCMAX\_L) } defined in TS 38.101 [2] clause 6.2.4A is used, to ensure the UE is not tested outside its power capability.

5. Sub test: SCC power increase

5.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.4.2.1.4.1-1 for intra-band contiguous CA and Table 6.3A.4.2.1.4.1-2 for intra-band non-contiguous CA on both PCC and SCC. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send the appropriate TPC commands for PUSCH on each component carrier to the UE to ensure that the UE transmits PUSCH on the PCC and on the SCC with powers nearest to PCCRefSet, 0 and SCCRefSet, 0 respectively, as defined in Table 6.3A.4.2.1.4.2-1. The powers and allocations are chosen so the average transmit power per PRB is aligned across both assigned carriers in the reference sub-frame. Measure PCCRefMeas, 0 and SCCRefMeas, 0 in the Reference subframe, and after the SCC allocation is increased, measure PCCTargetMeas, 0 and SCCTargetMeas, 0 in the Target subframe.

Table 6.3A.4.2.1.4.2-1: Power settings and RB allocations for SCC power increase, step n=0

|  |  |  |  |
| --- | --- | --- | --- |
| PCC | | SCC | |
| Parameter | Value | Parameter | Value |
| Reference subframe | | | |
| PCCRefSet, 0, dBm/NRB alloc | (SCCRefSet, 0) +7 | SCCRefSet, 0, dBm/NRB alloc | -17 |
| PCC allocation, NRB alloc | 5 | SCC allocation, NRB alloc | 1 |
| Measured power,  dBm/NRB alloc | PCCRefMeas, 0 | Measured power,  dBm/NRB alloc | SCCRefMeas, 0 |
| Target subframe | | | |
| PCCTargetSet, 0, dBm/NRB alloc | (SCCRefSet, 0) +7 | SCCTargetSet, 0, dBm/NRB alloc | (SCCRefSet, 0) +9 |
| PCC allocation, NRB alloc | 5 | SCC allocation, NRB alloc | 8 |
| Measured power,  dBm/NRB alloc | PCCTargetMeas, 0 | Measured power,  dBm/NRB alloc | SCCTargetMeas, 0 |

5.2. Calculate the Total uplink power across both CCs in dBm as 10log10((PCCTargetMeas, n in mW) + (SCCTargetMeas, n in mW)). If (PCMAX\_L – MAX{TL, TLOW(PCMAX\_L) } - Total uplink power) > 1dB, continue to step 5.3. Otherwise, go to step 5.6.

5.3. For the PCC, calculate the change in power as (PCCTargetMeas, n - PCCRefMeas, n) and compare to the PCC Test requirement specified in Table 6.3A.4.2.1.5-1. If the result meets the Test requirement, continue to step 5.4. Otherwise, fail the UE for this subtest.

5.4. For the SCC, calculate the change in power as (SCCTargetMeas, n - SCCRefMeas, n) and compare to the SCC Test requirement specified in Table 6.3A.4.2.1.5-1. If the result meets the Test requirement, continue to step 5.5. Otherwise, fail the UE for this subtest.

5.5. Send the appropriate TPC commands for PUSCH on each component carrier to the UE to ensure that the UE transmits PUSCH on the PCC and on the SCC with powers nearest to PCCRefSet, n+1 and SCCRefSet, n+1 respectively, as defined in Table 6.3A.4.2.1.4.2-2. Measure PCCRefMeas, n and SCCRefMeas, n.in the Reference subframe, and after the SCC allocation is increased, measure PCCTargetMeas, n and SCCTargetMeas, n.in the Target subframe. Repeat steps 5.2 to 5.4.

Table 6.3A.4.2.1.4.2-2: Power settings and RB allocations for SCC power increase, step n+1

|  |  |  |  |
| --- | --- | --- | --- |
| PCC | | SCC | |
| Parameter | Value | Parameter | Value |
| Reference subframe | | | |
| PCCRefSet, n+1, dBm/NRB alloc | (SCCRefSet, n+1) +7 | SCCRefSet, n+1, dBm/NRB alloc | SCCTargetMeas, n  +2dB) |
| PCC allocation, NRB alloc | 5 | SCC allocation, NRB alloc | 1 |
| Measured power,  dBm/NRB alloc | PCCRefMeas, n+1 | Measured power,  dBm/NRB alloc | SCCRefMeas, n+1 |
| Target subframe | | | |
| PCCTargetSet, n+1, dBm/NRB alloc | (SCCRefSet, n+1) +7 | SCCTargetSet, n+1, dBm/NRB alloc | (SCCRefSet, n+1) +9 |
| PCC allocation, NRB alloc | 5 | SCC allocation, NRB alloc | 8 |
| Measured power,  dBm/NRB alloc | PCCTargetMeas, n+1 | Measured power,  dBm/NRB alloc | SCCTargetMeas, n+1 |

5.6. If the requirements specified in Table 6.3A.4.2.1.5-1 are all met, pass the UE for this subtest.

6. Sub test: SCC power decrease

6.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.4.2.1.4.1-1 for intra-band contiguous CA and Table 6.3A.4.2.1.4.1-2 for intra-band non-contiguous CA on both PCC and SCC. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send the appropriate TPC commands for PUSCH on each component carrier to the UE to ensure that the UE transmits PUSCH on the PCC and on the SCC with powers nearest to PCCRefSet, 0 and SCCRefSet, 0 respectively, as defined in Table 6.3A.4.2.1.4.2-3.The powers and allocations are chosen so the average transmit power per PRB is aligned across both assigned carriers in the reference sub-frame. Measure PCCRefMeas, 0 and SCCRefMeas, 0 in the Reference subframe, and after the SCC allocation is decreased, measure PCCTargetMeas, 0 and SCCTargetMeas, 0 in the Target subframe.

Table 6.3A.4.2.1.4.2-3: Power settings and RB allocations for SCC power decrease, step n=0

|  |  |  |  |
| --- | --- | --- | --- |
| PCC | | SCC | |
| Parameter | Value | Parameter | Value |
| Reference subframe | | | |
| PCCRefSet, 0, dBm/NRB alloc | (SCCRefSet, 0) -2 | SCCRefSet, 0, dBm/NRB alloc | PCMAX\_L – MAX{TL, TLOW(PCMAX\_L) } -5 |
| PCC allocation, NRB alloc | 5 | SCC allocation, NRB alloc | 8 |
| Measured power,  dBm/NRB alloc | PCCRefMeas, 0 | Measured power,  dBm/NRB alloc | SCCRefMeas, 0 |
| Target subframe | | | |
| PCCTargetSet, 0, dBm/NRB alloc | (SCCRefSet, 0) -2 | SCCTargetSet, 0, dBm/NRB alloc | (SCCRefSet, 0) -9 |
| PCC allocation, NRB alloc | 5 | SCC allocation, NRB alloc | 1 |
| Measured power,  dBm/NRB alloc | PCCTargetMeas, 0 | Measured power,  dBm/NRB alloc | SCCTargetMeas, 0 |

6.2. If the uplink (power for each CC – (-20dBm)) is > 1dB, continue to step 6.3. Otherwise, go to step 6.6.

6.3. For the PCC, calculate the change in power as (PCCTargetMeas, n - PCCRefMeas, n) and compare to the PCC Test requirement specified in Table 6.3A.4.2.1.5-2. If the result meets the Test requirement, continue to step 6.4. Otherwise, fail the UE for this subtest.

6.4. For the SCC, calculate the change in power as (SCCTargetMeas, n - SCCRefMeas, n) and compare to the SCC Test requirement specified in Table 6.3A.4.2.1.5-2. If the result meets the Test requirement, continue to step 6.5. Otherwise, fail the UE for this subtest.

6.5. Send the appropriate TPC commands for PUSCH on each component carrier to the UE to ensure that the UE transmits PUSCH on the PCC and on the SCC with powers nearest to PCCRefSet, n+1 and SCCRefSet, n+1 respectively, as defined in Table 6.3A.4.2.1.4.2-4. Measure PCCRefMeas, n and SCCRefMeas, n.in the Reference subframe, and after the SCC allocation is decreased, measure PCCTargetMeas, n and SCCTargetMeas, n.in the Target subframe. Repeat steps 6.2 to 6.4.

Table 6.3A.4.2.1.4.2-4: Power settings and RB allocations for SCC power decrease, step n+1

|  |  |  |  |
| --- | --- | --- | --- |
| PCC | | SCC | |
| Parameter | Value | Parameter | Value |
| Reference subframe | | | |
| PCCRefSet, n+1, dBm/NRB alloc | (SCCRefSet, n+1) -2 | SCCRefSet, n+1, dBm/NRB alloc | SCCTargetMeas, n  -2dB |
| PCC allocation, NRB alloc | 5 | SCC allocation, NRB alloc | 8 |
| Measured power,  dBm/NRB alloc | PCCRefMeas, n+1 | Measured power,  dBm/NRB alloc | SCCRefMeas, n+1 |
| Target subframe | | | |
| PCCTargetSet, n+1, dBm/NRB alloc | (SCCRefSet, n+1) -2 | SCCTargetSet, n+1, dBm/NRB alloc | (SCCRefSet, n+1) -9 |
| PCC allocation, NRB alloc | 5 | SCC allocation, NRB alloc | 1 |
| Measured power,  dBm/NRB alloc | PCCTargetMeas, n+1 | Measured power,  dBm/NRB alloc | SCCTargetMeas, n+1 |

6.6. If the requirements specified in Table 6.3A.4.2.1.5-2 are all met, pass the UE for this subtest.

7. Sub test: PCC and SCC power increase together

7.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.4.2.1.4.1-1 for intra-band contiguous CA and Table 6.3A.4.2.1.4.1-2 for intra-band non-contiguous CA on both PCC and SCC. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send the appropriate TPC commands for PUSCH on each component carrier to the UE to ensure that the UE transmits PUSCH on the PCC and on the SCC with powers nearest to PCCRefSet, 0 and SCCRefSet, 0 respectively, as defined in Table 6.3A.4.2.1.4.2-5. The powers and allocations are chosen so the average transmit power per PRB is aligned across both assigned carriers in the reference sub-frame. Measure PCCRefMeas, 0 and SCCRefMeas, 0 in the Reference subframe, and after the PCC and SCC allocation are increased, measure PCCTargetMeas, 0 and SCCTargetMeas, 0 in the Target subframe.

Table 6.3A.4.2.1.4.2-5: Power settings and RB allocations for PCC and SCC power increase, step n=0

|  |  |  |  |
| --- | --- | --- | --- |
| PCC | | SCC | |
| Parameter | Value | Parameter | Value |
| Reference subframe | | | |
| PCCRefSet, 0, dBm/NRB alloc | -17 | SCCRefSet, 0, dBm/NRB alloc | -17 |
| PCC allocation, NRB alloc | 1 | SCC allocation, NRB alloc | 1 |
| Measured power,  dBm/NRB alloc | PCCRefMeas, 0 | Measured power,  dBm/NRB alloc | SCCRefMeas, 0 |
| Target subframe | | | |
| PCCTargetSet, 0, dBm/NRB alloc | (PCCRefSet, 0) +9 | SCCTargetSet, 0, dBm/NRB alloc | (SCCRefSet, 0) +9 |
| PCC allocation, NRB alloc | 8 | SCC allocation, NRB alloc | 8 |
| Measured power,  dBm/NRB alloc | PCCTargetMeas, 0 | Measured power,  dBm/NRB alloc | SCCTargetMeas, 0 |

7.2. Calculate the Total uplink power across both CCs in dBm as 10log10((PCCTargetMeas, n in mW) + (SCCTargetMeas, n in mW)). If (PCMAX\_L – MAX{TL, TLOW(PCMAX\_L) } - Total uplink power) > 1dB, continue to step 7.3. Otherwise, go to step 7.6.

7.3. For the PCC, calculate the change in power as (PCCTargetMeas, n - PCCRefMeas, n) and compare to the PCC Test requirement specified in Table 6.3A.4.2.1.5-3. If the result meets the Test requirement, continue to step 7.4. Otherwise, fail the UE for this subtest.

7.4. For the SCC, calculate the change in power as (SCCTargetMeas, n - SCCRefMeas, n) and compare to the SCC Test requirement specified in Table 6.3A.4.2.1.5-3. If the result meets the Test requirement, continue to step 7.5. Otherwise, fail the UE for this subtest.

7.5. Send the appropriate TPC commands for PUSCH on each component carrier to the UE to ensure that the UE transmits PUSCH on the PCC and on the SCC with powers nearest to PCCRefSet, n+1 and SCCRefSet, n+1 respectively, as defined in Table 6.3A.4.2.1.4.2-6. Measure PCCRefMeas, n and SCCRefMeas, n.in the Reference subframe, and after the PCC and SCC allocation are increased, measure PCCTargetMeas, n and SCCTargetMeas, n.in the Target subframe. Repeat steps 7.2 to 7.4.

Table 6.3A.4.2.1.4.2-6: Power settings and RB allocations for PCC and SCC power increase, step n+1

|  |  |  |  |
| --- | --- | --- | --- |
| PCC | | SCC | |
| Parameter | Value | Parameter | Value |
| Reference subframe | | | |
| PCCRefSet, n+1, dBm/NRB alloc | (Max (PCCTargetMeas, n, SCCTargetMeas, n))  +2dB | SCCRefSet, n+1, dBm/NRB alloc | (Max (PCCTargetMeas, n, SCCTargetMeas, n))  +2dB |
| PCC allocation, NRB alloc | 1 | SCC allocation, NRB alloc | 1 |
| Measured power,  dBm/NRB alloc | PCCRefMeas, n+1 | Measured power,  dBm/NRB alloc | SCCRefMeas, n+1 |
| Target subframe | | | |
| PCCTargetSet, n+1, dBm/NRB alloc | (SCCRefSet, n+1) +9 | SCCTargetSet, n+1, dBm/NRB alloc | (SCCRefSet, n+1) +9 |
| PCC allocation, NRB alloc | 8 | SCC allocation, NRB alloc | 8 |
| Measured power,  dBm/NRB alloc | PCCTargetMeas, n+1 | Measured power,  dBm/NRB alloc | SCCTargetMeas, n+1 |

7.6. If the requirements specified in Table 6.3A.4.2.1.5-3 are all met, pass the UE for this subtest.

8. Sub test: PCC and SCC power decrease together

8.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3A.4.2.1.4.1-1 for intra-band contiguous CA and Table 6.3A.4.2.1.4.1-2 for intra-band non-contiguous CA on both PCC and SCC. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send the appropriate TPC commands for PUSCH on each component carrier to the UE to ensure that the UE transmits PUSCH on the PCC and on the SCC with powers nearest to PCCRefSet, 0 and SCCRefSet, 0 respectively, as defined in Table 6.3A.4.2.1.4.2-7. The powers and allocations are chosen so the average transmit power per PRB is aligned across both assigned carriers in the reference sub-frame. Measure PCCRefMeas, 0 and SCCRefMeas, 0 in the Reference subframe, and after the PCC and SCC allocation are decreased, measure PCCTargetMeas, 0 and SCCTargetMeas, 0 in the Target subframe.

Table 6.3A.4.2.1.4.2-7: Power settings and RB allocations for PCC and SCC power decrease, step n=0

|  |  |  |  |
| --- | --- | --- | --- |
| PCC | | SCC | |
| Parameter | Value | Parameter | Value |
| Reference subframe | | | |
| PCCRefSet, 0, dBm/NRB alloc | PCMAX\_L – MAX{TL, TLOW(PCMAX\_L) } -6 | SCCRefSet, 0, dBm/NRB alloc | PCMAX\_L – MAX{TL, TLOW(PCMAX\_L) } -6 |
| PCC allocation, NRB alloc | 8 | SCC allocation, NRB alloc | 8 |
| Measured power,  dBm/NRB alloc | PCCRefMeas, 0 | Measured power,  dBm/NRB alloc | SCCRefMeas, 0 |
| Target subframe | | | |
| PCCTargetSet, 0, dBm/NRB alloc | (PCCRefSet, 0) -9 | SCCTargetSet, 0, dBm/NRB alloc | (SCCRefSet, 0) -9 |
| PCC allocation, NRB alloc | 1 | SCC allocation, NRB alloc | 1 |
| Measured power,  dBm/NRB alloc | PCCTargetMeas, 0 | Measured power,  dBm/NRB alloc | SCCTargetMeas, 0 |

8.2. If the uplink (power for each CC – (-20dBm)) is > 1dB, continue to step 8.3. Otherwise, go to step 8.6.

8.3. For the PCC, calculate the change in power as (PCCTargetMeas, n - PCCRefMeas, n) and compare to the PCC Test requirement specified in Table 6.3A.4.2.1.5-4. If the result meets the Test requirement, continue to step 8.4. Otherwise, fail the UE for this subtest.

8.4. For the SCC, calculate the change in power as (SCCTargetMeas, n - SCCRefMeas, n) and compare to the SCC Test requirement specified in Table 6.3A.4.2.1.5-4. If the result meets the Test requirement, continue to step 8.5. Otherwise, fail the UE for this subtest.

8.5. Send the appropriate TPC commands for PUSCH on each component carrier to the UE to ensure that the UE transmits PUSCH on the PCC and on the SCC with powers nearest to PCCRefSet, n+1 and SCCRefSet, n+1 respectively, as defined in Table 6.3A.4.2.1.4.2-8. Measure PCCRefMeas, n and SCCRefMeas, n.in the Reference subframe, and after the PCC and SCC allocation are decreased**,** measure PCCTargetMeas, n and SCCTargetMeas, n.in the Target subframe. Repeat steps 8.2 to 8.4.

Table 6.3A.4.2.1.4.2-8: Power settings and RB allocations for PCC and SCC power decrease, step n+1

|  |  |  |  |
| --- | --- | --- | --- |
| PCC | | SCC | |
| Parameter | Value | Parameter | Value |
| Reference subframe | | | |
| PCCRefSet, n+1, dBm/NRB alloc | (Min (PCCTargetMeas, n, SCCTargetMeas, n))  -2dB | SCCRefSet, n+1, dBm/NRB alloc | (Min (PCCTargetMeas, n, SCCTargetMeas, n))  -2dB |
| PCC allocation, NRB alloc | 8 | SCC allocation, NRB alloc | 8 |
| Measured power,  dBm/NRB alloc | PCCRefMeas, n+1 | Measured power,  dBm/NRB alloc | SCCRefMeas, n+1 |
| Target subframe | | | |
| PCCTargetSet, n+1, dBm/NRB alloc | (SCCRefSet, n+1) -9 | SCCTargetSet, n+1, dBm/NRB alloc | (SCCRefSet, n+1) -9 |
| PCC allocation, NRB alloc | 1 | SCC allocation, NRB alloc | 1 |
| Measured power,  dBm/NRB alloc | PCCTargetMeas, n+1 | Measured power,  dBm/NRB alloc | SCCTargetMeas, n+1 |

8.6. If the requirements specified in Table 6.3A.4.2.1.5-4 are all met, pass the UE for this subtest.

6.3A.4.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the following exception:

Table 6.3A.4.2.1.4.3-1: *PUSCH-Config*

|  |
| --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-118 with condition TRANSFORM\_PRECODER\_ENABLED |

6.3A.4.2.1.5 Test requirement

For intra-band contiguous carrier aggregation bandwidth class C and intra-band non-contiguous CA, the relative power control tolerance per component carrier measured in steps 5, 6, 7 and 8 of the test procedures should satisfy the applicable test requirements specified in Tables 6.3A.4.2.1.5-1 to 6.3A.4.2.1.5-5.

Table 6.3A.4.2.1.5-1: Test requirements for SCC power increase

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Condition | Unit | Minimum | Maximum |
| (PCCTargetMeas, n - PCCRefMeas, n) | Normal | dB | -0.7-TT | 0.7+TT |
| (SCCTargetMeas, n - SCCRefMeas, n) | Normal | dB | 5.5-TT | 12.5+TT |

Table 6.3A.4.2.1.5-2: Test requirements for SCC power decrease

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Condition | Unit | Minimum | Maximum |
| (PCCTargetMeas, n - PCCRefMeas, n) | Normal | dB | -0.7-TT | 0.7+TT |
| (SCCTargetMeas, n - SCCRefMeas, n) | Normal | dB | -12.5-TT | -5.5+TT |

Table 6.3A.4.2.1.5-3: Test requirements for PCC and SCC power increase together

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Condition | Unit | Minimum | Maximum |
| (PCCTargetMeas, n - PCCRefMeas, n) | Normal | dB | 5.5-TT | 12.5+TT |
| (SCCTargetMeas, n - SCCRefMeas, n) | Normal | dB | 5.5-TT | 12.5+TT |

Table 6.3A.4.2.1.5-4: Test requirements for PCC and SCC power decrease together

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Condition | Unit | Minimum | Maximum |
| (PCCTargetMeas, n - PCCRefMeas, n) | Normal | dB | -12.5-TT | -5.5+TT |
| (SCCTargetMeas, n - SCCRefMeas, n) | Normal | dB | -12.5-TT | -5.5+TT |

Table 6.3A.4.2.1.5-5: Test Tolerance

|  |  |
| --- | --- |
|  | f ≤ 6.0GHz |
| BW ≤ 100MHz | 0.7 dB |

#### 6.3A.4.3 Aggregate power tolerance for CA

##### 6.3A.4.3.0 Minimum conformance requirements

For intra-band contiguous and non-contiguous carrier aggregation, the aggregate power tolerance per component carrier is given in Table 6.3.4.4.3-1. The average power per PRB shall be aligned across both assigned carriers before the start of the test. The requirement can be tested with the transmission gaps time aligned between component carriers.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3A.4.

##### 6.3A.4.3.1 Aggregate power tolerance for CA (2UL CA)

Editor’s Note: This test case in incomplete when signalling is absent for dualPA-Architecture IE due to lack of core requirements.

6.3A.4.3.1.1 Test purpose

To verify the ability of the UE transmitter to maintain its power during non-contiguous transmissions within 21ms in response to 0 dB commands with respect to the first UE transmission and all other power control parameters as specified in 38.213 kept constant on all active component carriers.

6.3A.4.3.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support intra-band contiguous 2UL CA.

6.3A.4.3.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3A.4.3.0.

6.3A.4.3.1.4 Test description

6.3A.4.3.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configurations specified in 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in table 6.3A.4.3.1.4.1-2 and 6.3A.4.3.1.4.1-3. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH before measurement is specified in Annex C.2.

Table 6.3A.4.3.1.4.1-1: Void

Table 6.3A.4.3.1.4.1-2: Test Configuration Table for intra-band contiguous CA: PUSCH sub-test

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Mid range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest, Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation (NOTE 1) | |
|  |  |  | PCC | SCC |
| 1 | N/A for this test | CP-OFDM QPSK | Outer Full | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in 6.1A-1a for contiguous RB alloc.  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths and SCS are specified in Table 5.5A.1-1.  NOTE 3: If the UE supports multiple CC Combinations in the CA Configuration with the same NRB\_agg, only the combination with the highest NRB\_PCC is tested. | | | | |

Table 6.3A.4.3.1.4.1-3: Test Configuration Table for intra-band non-contiguous CA

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | | | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | | | Normal | | | | | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | | Low range and High range test frequencies as specified in tables for non-contiguous CA configuration with UL CA | | | | | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | | Refer to PCC NRB”and “SCC NRB ” columns | | | | | | |
| Test SCS as specified in Table 5.3.5-1 | | | | | Lowest, Highest | | | | | | |
| Test Parameters | | | | | | | | | | | |
| ID | CA config / CBW | | | | | | | DL config | UL config | | |
| PCC | | SCC | |  |  |  | CC MOD | RB allocation (NOTE 1) | |
| Band | Range | Band | Range | PCC NRB | Wgap | SCC NRB | PCC | SCC |
| 1 | nX | CC1 | nX | CC2 | Lowest NRB\_agg | Max (NOTE 4) | Lowest NRB\_agg | N/A | CP-OFDM QPSK | Outer\_Full | Outer\_Full |
| 2 | nX | CC1 | nX | CC2 | Highest NRB\_agg | Max (NOTE 4) | Highest NRB\_agg | Outer\_Full | Outer\_Full |
| NOTE 1: RB allocation is defined in table 6.1-1 for each CC.  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths and SCS are specified in Table 5.5A.2-1.  NOTE 3: If the UE supports multiple CC Combinations in the CA Configuration with the same NRB\_agg, only the combination with the highest NRB\_PCC is tested.  NOTE 4: The Wgap is defined to be widest possible on band based on the PCC and SCC configuration | | | | | | | | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.3 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3A.3.1.4.1-1 for intra-band contiguous CA and Table 6.3A.3.1.4.1-3 for intra-band non-contiguous CA.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3A.4.3.1.4.3.

6.3A.4.3.1.4.2 Test procedure

For intra-band contiguous UL CA:

The procedure is separated in two subtests to verify PUCCH and PUSCH aggregate power control tolerance respectively. The uplink transmission patterns for each component carrier are described in figure 6.3A.4.3.1.4.2-1.



Figure 6.3A.4.3.1.4.2-1 Test uplink transmission

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [5] clause5.5.1. Message contents are defined in clause 6.3A.4.3.1.4.3. Any PDCCH DCI format 0\_1 sent to the UE during the configuration should have TPC command 0dB.

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3)

4. PUSCH sub test:

4.1. The SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the PUSCH according to Table 6.3A.4.3.1.4.1-1 on PCC and SCC. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send uplink power control commands for PUSCH to the UE using 1dB power step size to ensure that the UE output power on PCC and SCC measured by the test system is within the Uplink power control window, defined as – (Uplink power control window size / 2) dB to + (Uplink power control window size / 2) dB of the target power level + 0 dBm, where:

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for PUSCH with 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.4.

4.2. Every 5 sub-frames (5ms) schedule the UE's PUSCH data transmission for 1 sub-frame(1ms), and transmit 0 dB TPC command for PUSCH via the PDCCH to make the UE transmit PUSCH. The uplink transmission patterns are described in figure 6.3A.4.3.1.4.2-1,

4.3. Measure the power on both PCC and SCC of 5 consecutive PUSCH transmissions to verify the UE transmitted PUSCH power is maintained within 21ms transmissions on each component carrier.

For intra-band non-contiguous UL CA:

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.
2. The SS shall configure SCC as per TS 38.508-1 [5] clause5.5.1. Message contents are defined in clause 6.3A.4.3.1.4.3. Any PDCCH DCI format 0\_1 sent to the UE during the configuration should have TPC command 0dB.
3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3)
4. The SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the PUSCH according to Table 6.3A.4.3.1.4.1-3 on PCC and SCC. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send uplink power control commands for PUSCH to the UE using 1dB power step size to ensure that the UE output power on PCC and SCC measured by the test system is within the Uplink power control window, defined as – (Uplink power control window size / 2) dB to + (Uplink power control window size / 2) dB of the target power level + 0 dBm, where:
5. Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for PUSCH with 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.4.

1. Every 5 sub-frames (5ms) schedule the UE's PUSCH data transmission for 1 sub-frame(1ms), and transmit 0 dB TPC command for PUSCH via the PDCCH to make the UE transmit PUSCH. The uplink transmission patterns are described in figure 6.3A.4.3.1.4.2-1.
2. Measure the power on both PCC and SCC of 5 consecutive PUSCH transmissions to verify the UE transmitted PUSCH power is maintained within 21ms transmissions on each component carrier.

6.3A.4.3.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the following exceptions:

Table 6.3A.4.3.1.4.3-1: Void

6.3A.4.3.1.5 Test requirement

For intra-band contiguous CA, the aggregate power control tolerance per component carrier measured in step (4.3) and step (5.3) of the test procedure is not to exceed the values specified in Table 6.3A.4.3.1.5-1.

For intra-band non-contiguous CA, the aggregate power control tolerance per component carrier measured in step 7 of the test procedure is not to exceed the values specified in Table 6.3A.4.3.1.5-1.

Table 6.3A.4.3.1.5-1: Aggregate power tolerance for CA

|  |  |  |
| --- | --- | --- |
| TPC command | UL channel | Test requirement measured power |
| 0 dB | PUSCH on PCC and SCC | Given 5 power measurements in the pattern, the 2nd, and later measurements shall be within ± (3.5 + TT) dB of the 1st measurement. |
| Note 1: For SCS 30kHz 1 sub-frame corresponds to 2 slots and for SCS 60kHz 1 sub-frame corresponds to 4 slots, so 2 TPC commands will be sent for a single measurement period.  Note 2: TT = 0.7dB. | | |

## 6.3B Output power dynamics for NR-DC

For inter-band NR-DC with one uplink carrier assigned per NR band, the output power dynamics for the corresponding inter-band CA configuration as specified in subclause 6.3A applies.

Note: For NR-DC testing, replace CA by NR-DC, PCC by PCell, and SCC by PSCell in clause 6.3A.

### 6.3B.1 Minimum output power for NR-DC

For inter-band dual connectivity, the minimum output power for the corresponding inter-band CA configuration as specified in clause 6.3A.1 applies.

Note: For NR-DC testing, replace CA by NR-DC, PCC by PCell, and SCC by PSCell in clause 6.3A.1.

### 6.3B.2 Transmit OFF power for NR-DC

For inter-band dual connectivity, the transmit OFF power for the corresponding inter-band CA configuration as specified in clause 6.3A.2 applies.

Note: For NR-DC testing, replace CA by NR-DC, PCC by PCell, and SCC by PSCell in clause 6.3A.2.

### 6.3B.3 Transmit ON/OFF time mask for NR-DC

For inter-band dual connectivity, the transmit ON/OFF time mask for the corresponding inter-band CA configuration as specified in clause 6.3A.3 applies.

Note: For NR-DC testing, replace CA by NR-DC, PCC by PCell, and SCC by PSCell in clause 6.3A.3.

## 6.3C Output power dynamics for SUL

### 6.3C.1 Minimum output power for SUL

6.3C.1.1 Test purpose

Same test purpose as in clause 6.3.1.1

6.3C.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support SUL operating on the SUL bands.

6.3C.1.3 Minimum conformance requirements

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3 and 6.3.1.

6.3C.1.4 Test description

Same test description as specified in clause 6.3.1.4 with following exceptions:

Instead of table 5.3.5-1 🡪 use Table 5.5C-1.

Instead of table 6.3.1.4.1-1 🡪 use Table 6.3C.1.4-1

Table 6.3C.1.4-1: Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low, Mid, High range for SUL carrier  Mid-range for Non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | SUL Configuration | |
|  | N/A | N/A | | Modulation | RB allocation (NOTE 2) |
| 1 |  |  | | DFT-s-OFDM QPSK | Outer Full |
| NOTE 1: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 2: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports Pi/2 BPSK in FR1.  NOTE 4: For NR band n83, 30MHz test channel bandwidth is tested with Low range and High range test frequencies. | | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.4 for TE diagram and section A.3.2 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, additionally the following exception shown in Table 6.3C.1.4-2 is considered.

Table 6.3C.1.4-2: *PUSCH-Config*

|  |
| --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-118 with condition TRANSFORM\_PRECODER\_ENABLED |

Table 6.3C.1.4-3: Void

6.3C.1.5 Test requirement

The minimum output power, derived in step 3 shall not exceed the values specified in Table 6.3C.1.5-1.

Table 6.3C.1.5-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -40+TT | 4.515 |
| 10 | -40+TT | 9.375 |
| 15 | -40+TT | 14.235 |
| 20 | -40+TT | 19.095 |
| 25 | -39+TT | 23.955 |
| 30 | -38.2+TT | 28.815 |
| 40 | -37+TT | 38.895 |
| 50 | -36+TT | 48.615 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3C.1.5-2 | | |

Table 6.3C.1.5-2: Test Tolerance (Minimum output power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.0 dB | 1.3 dB |
| 40MHz < BW ≤ 100MHz | 1.3 dB | 1.3 dB |

### 6.3C.2 Transmit OFF power for SUL

6.3C.2.1 Test purpose

Same test purpose as in clause 6.3.2.1

6.3C.2.2 Test applicability

The requirements of this test apply in test cases 6.3C.3 Transmit ON/OFF time mask for SUL to all types of NR UE release 15 and forward that support SUL operating on the SUL bands.

6.3C.2.3 Minimum conformance requirements

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3 and 6.3.2.

6.3C.2.4 Test description

This test is covered by clause 6.3C.3 Transmit ON/OFF time mask for SUL.

6.3C.2.5 Test requirement

The requirement for the Transmit OFF power for SUL shall not exceed the values specified in Table 6.3C.2.5-1.

Table 6.3C.2.5-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -50+TT | 4.515 |
| 10 | -50+TT | 9.375 |
| 15 | -50+TT | 14.235 |
| 20 | -50+TT | 19.095 |
| 25 | -50+TT | 23.955 |
| 30 | -50+TT | 28.815 |
| 40 | -50+TT | 38.895 |
| 50 | -50+TT | 48.615 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3C.2.5-2 | | |

Table 6.3C.2.5-2: Test Tolerance (Transmit OFF power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.5 dB | 1.8 dB |

### 6.3C.3 Transmit ON/OFF time mask for SUL

#### 6.3C.3.0 Minimum conformance requirements

##### 6.3C.3.0.1 General ON/OFF time mask for SUL

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3 and 6.3.3.2

##### 6.3C.3.0.2 Time mask for switching between two uplink carriers

The switching time mask specified in this clause is applicable for an uplink band pair of a SUL configuration when the capability *uplinkTxSwitchingPeriod* is present, is only applicable for uplink switching mechanisms specified in clause 6.16 of TS 38.214 [10], where NR SUL carrier 1 is capable of one transmit antenna connector and NR UL carrier 2 is capable of two transmit antenna connectors, and the two uplink carriers are in different bands with different carrier frequencies. The UE shall support the switch between single layer transmission with one antenna port and two-layer transmission with two antenna ports on the two uplink carriers following the scheduling commands and rank adaptation, i.e., both single layer and two-layer transmission with 2 antenna ports, and single layer transmission with 1 antenna port shall be supported on NR UL carrier 2.

The switching periods described in Figure 6.3C.3.1-1a and Figure 6.3C.3.1-1b are located in either NR carrier 1 or carrier 2 as indicated in RRC signalling *uplinkTxSwitchingPeriodLocation* [7], and the length of uplink switching period *X* is less than the value indicated by UE capability *uplinkTxSwitchingPeriod*.

When switching from one carrier to another, if there is no uplink transmission scheduled or configured on the switch-from carrier for at least the duration of the switching period (X µs) before the point in time the UE is scheduled or configured to start the transmission on the switch-to carrier, the switching period is fully contained in the time period between the end of the transmission on the switch-from carrier and the start of the transmission on the switch-to carrier. In addition, the RRC signalling *uplinkTxSwitchingPeriodLocation* does not take effect in this case.

Graphical user interface, text, application

Description automatically generated

Figure 6.3C.3.0.2-1a: Time mask for switching between SUL carrier 1 and UL Carrier 2, where the switching period is located in carrier 1

Graphical user interface

Description automatically generated

Figure 6.3C.3.0.2-1b: Time mask for switching between SUL carrier 1 and UL Carrier 2, where the switching period is located in carrier 2

The requirements apply for the case of co-located and synchronized network deployment for the two uplink carriers.

The requirements apply for the case of single TAG for the two uplink carriers, i.e., the same uplink timing for the two carriers as described in clause 4.2 of TS 38.213 [8].

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3 and 6.3C.3.2.

##### 6.3C.3.0.3 Time mask for switching between two uplink carriers with two transmit antenna connectors

The switching time mask specified in this clause is applicable for an uplink band pair of a SUL configuration when the capability *uplinkTxSwitchingPeriod2T2T* is present, is only applicable for uplink switching mechanisms specified in clause 6.1.6 of TS 38.214 [12], where NR SUL carrier 1 is capable of two transmit antenna connectors and NR UL carrier 2 is capable of two transmit antenna connectors, and the two uplink carriers are in different bands with different carrier frequencies. The UE shall support the switch between two-layer transmission with two antenna ports and two-layer transmission with two antenna ports on the two uplink carriers following the scheduling commands and rank adaptation, i.e., both single layer and two-layer transmission with 2 antenna ports, and single layer transmission with 1 antenna port shall be supported on NR UL carrier 1 and carrier 2.

The switching periods described in Figure 6.3C.3.0.3-1a and Figure 6.3C.3.0.3-1b are located in either NR carrier 1 or carrier 2 as indicated in RRC signalling *uplinkTxSwitchingPeriodLocation* [7], and the length of uplink switching period *X* is less than the value indicated by UE capability *uplinkTxSwitchingPeriod2T2T*.

When switching from one carrier to another, if there is no uplink transmission scheduled or configured on the switch-from carrier for at least the duration of the switching period (X µs) before the point in time the UE is scheduled or configured to start the transmission on the switch-to carrier, the switching period is fully contained in the time period between the end of the transmission on the switch-from carrier and the start of the transmission on the switch-to carrier. In addition, the RRC signalling *uplinkTxSwitchingPeriodLocation* is ignored by the UE and does not take effect in this case.

A screen shot of a computer

Description automatically generated

Figure 6.3C.3.0.3-1a: Time mask for switching between SUL carrier 1 and UL Carrier 2, where the switching period is located in carrier 1

A screen shot of a video game

Description automatically generated

Figure 6.3C.3.0.3-1b: Time mask for switching between SUL carrier 1 and UL Carrier 2, where the switching period is located in carrier 2

The following applies for the uplink switching case specified in clause 6.1.6.3 of [12] when the configuration of the location of the switching period by *uplinkTxSwitchingPeriodLocation* is ignored by the UE:

- if an uplink switching is triggered for an uplink transmission starting at *T0* based on higher layer configuration(s) or DCI(s) received before *T0* − *Toffset* as specified in [12] and the UE is not configured or scheduled with uplink transmissions for a duration of at least the uplink switching gap indicated by *uplinkTxSwitchingPeriod2T2T* on any of the carriers before *T0*, transient periods of 10 s are located at the end of the last symbol(s) configured or scheduled on the carriers before *T0* and at the start of the first symbol(s) configured or scheduled at *T0* on the switched-to carrier.

The requirements apply for the case of co-located and synchronized network deployment for the two uplink carriers.

The requirements apply for the case of single TAG for the two uplink carriers, i.e., the same uplink timing for the two carriers as described in clause 4.2 of TS 38.213 [9].

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3 and 6.3C.3.3.

##### 6.3C.3.0.4 Time mask for switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors

The switching time mask specified in this clause is applicable for an uplink band pair of a SUL configuration when the capability *uplinkTxSwitchingPeriod* is present, is only applicable for uplink switching mechanisms specified in clause 6.1.6 of TS 38.214 [12], where NR SUL carrier 1 in band A is capable of one transmit antenna connector and NR UL carrier 2 and carrier 3 in band B are capable of two transmit antenna connectors. NR UL carrier 2 and carrier 3 are two contiguous aggregated carriers, and band A and band B are different bands with different carrier frequencies. The UE shall support the switch between single layer transmission with one antenna port and two-layer transmission with two antenna ports on the two uplink bands following the scheduling commands and rank adaptation, i.e., both single layer and two-layer transmission with 2 antenna ports, and single layer transmission with 1 antenna port shall be supported on NR UL carrier 2 and carrier 3 in band B.

The switching periods described in Figure 6.3C.3.0.4-1a and Figure 6.3C.3.0.4-1b are located in either NR band A or band B as indicated in RRC signalling *uplinkTxSwitchingPeriodLocation* [7], and the length of uplink switching period *X* is less than the value indicated by UE capability *uplinkTxSwitchingPeriod*.

When switching from one carrier to another, if there is no uplink transmission scheduled or configured on the switch-from carrier for at least the duration of the switching period (X µs) before the point in time the UE is scheduled or configured to start the transmission on the switch-to carrier, the switching period is fully contained in the time period between the end of the transmission on the switch-from carrier and the start of the transmission on the switch-to carrier. In addition, the RRC signalling *uplinkTxSwitchingPeriodLocation* is ignored by the UE and does not take effect in this case.

A screen shot of a computer

Description automatically generated

Figure 6.3C.3.0.4-1a: Time mask for switching between one carrier in band A and two contiguous carriers in band B, where the switching period is located in band A

A screen shot of a video game

Description automatically generated

Figure 6.3C.3.0.4-1b: Time mask for switching between one carrier in band A and two contiguous carriers in band B, where the switching period is located in band B

The following applies for the uplink switching case specified in clause 6.1.6.3 of [12] when the configuration of the location of the switching period by *uplinkTxSwitchingPeriodLocation* is ignored by the UE:

- if an uplink switching is triggered for an uplink transmission starting at *T0* based on higher layer configuration(s) or DCI(s) received before *T0* − *Toffset* as specified in [12] and the UE is not configured or scheduled with uplink transmissions for a duration of at least the uplink switching gap indicated by *uplinkTxSwitchingPeriod* on any of the carriers before *T0*, transient periods of 10 s are located at the end of the last symbol(s) configured or scheduled on the carriers before *T0* and at the start of the first symbol(s) configured or scheduled at *T0* on the switched-to carrier.

The requirements apply for the case of co-located and synchronized network deployment for the three uplink carriers.

The requirements apply for the case of single TAG for the three uplink carriers, i.e., the same uplink timing for the three carriers as described in clause 4.2 of TS 38.213 [9].

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3 and 6.3C.3.3.

##### 6.3C.3.0.5 Time mask for switching between two uplink carriers

The switching time mask specified in this clause is applicable for an uplink band pair of a SUL configuration when the capability *uplinkTxSwitchingPeriod2T2T* is present, is only applicable for uplink switching mechanisms specified in clause 6.1.6 of TS 38.214 [12], where NR SUL carrier 1 in band A is capable of two transmit antenna connectors and NR UL carrier 2 and carrier 3 in band B are capable of two transmit antenna connectors. NR UL carrier 2 and carrier 3 are two contiguous aggregated carriers, and band A and band B are different bands with different carrier frequencies. The UE shall support the switch between two-layer transmission with two antenna ports and two-layer transmission with two antenna ports on the two uplink bands following the scheduling commands and rank adaptation, i.e., both single layer and two-layer transmission with 2 antenna ports, and single layer transmission with 1 antenna port shall be supported on NR UL carrier 1, carrier 2 and carrier 3 in the two bands.

The switching periods described in Figure 6.3C.3.4-1a and Figure 6.3C.3.4-1b are located in either NR band A or band B as indicated in RRC signalling *uplinkTxSwitchingPeriodLocation* [7], and the length of uplink switching period *X* is less than the value indicated by UE capability *uplinkTxSwitchingPeriod2T2T*.

When switching from one carrier to another, if there is no uplink transmission scheduled or configured on the switch-from carrier for at least the duration of the switching period (X µs) before the point in time the UE is scheduled or configured to start the transmission on the switch-to carrier, the switching period is fully contained in the time period between the end of the transmission on the switch-from carrier and the start of the transmission on the switch-to carrier. In addition, the RRC signalling *uplinkTxSwitchingPeriodLocation* is ignored by the UE and does not take effect in this case.

A screen shot of a computer

Description automatically generated

Figure 6.3C.3.0.5-1a: Time mask for switching between one carrier in band A and two contiguous carriers in band B, where the switching period is located in band A

A screen shot of a video game

Description automatically generated

Figure 6.3C.3.0.5-1b: Time mask for switching between one carrier in band A and two contiguous carriers in band B, where the switching period is located in band B

The following applies for the uplink switching case specified in clause 6.1.6.3 of [12] when the configuration of the location of the switching period by *uplinkTxSwitchingPeriodLocation* is ignored by the UE:

- if an uplink switching is triggered for an uplink transmission starting at *T0* based on higher layer configuration(s) or DCI(s) received before *T0* − *Toffset* as specified in [12] and the UE is not configured or scheduled with uplink transmissions for a duration of at least the uplink switching gap indicated by *uplinkTxSwitchingPeriod2T2T* on any of the carriers before *T0*, transient periods of 10 s are located at the end of the last symbol(s) configured or scheduled on the carriers before *T0* and at the start of the first symbol(s) configured or scheduled at *T0* on the switched-to carrier.

The requirements apply for the case of co-located and synchronized network deployment for the three uplink carriers.

The requirements apply for the case of single TAG for the three uplink carriers, i.e., the same uplink timing for the three carriers as described in clause 4.2 of TS 38.213 [9].

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3 and 6.3C.3.4.

#### 6.3C.3.1 General transmit ON/OFF time mask for SUL

6.3C.3.1.1 Test purpose

Same test purpose as in clause 6.3.3.2.1

6.3C.3.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support SUL operating on the SUL bands.

6.3C.3.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3C.3.0.1.

6.3C.3.1.4 Test description

Same test description as specified in clause 6.3.3.2.4 with following exceptions:

Instead of table 5.3.5-1 🡪 use Table 5.5C-1.

Instead of table 6.3.3.2.4.1-1 🡪 use Table 6.3C.3.1.4-1

Table 6.3C.3.1.4-1: Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low, Mid, High range for SUL carrier  Mid-range for Non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | SUL Configuration | |
|  | N/A | N/A | | Modulation | RB allocation (NOTE 2) |
| 1 |  |  | | DFT-s-OFDM QPSK | Inner Full |
| NOTE 1: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 2: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 3: For NR band n83, 30MHz test channel bandwidth is tested with Low range and High range test frequencies. | | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.4 for TE diagram and section A.3.2 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL.

Table 6.3C.3.1.4-2: Void

6.3C.3.1.5 Test requirement

The requirement for the power measured in steps 2, 3 and 4 of the test procedure shall not exceed the values specified in Table 6.3C.3.1.5-1.

Table 6.3C.3.1.5-1: General ON/OFF time mask

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Channel bandwidth / minimum output power / measurement bandwidth | | | | | | |
|  | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz |
| Transmit OFF power | ≤ -50+TT dBm | | | | | | |
| Transmission OFF Measurement bandwidth | 4.515 | 9.375 | 14.235 | 19.095 | 23.955 | 28.815 | 38.895 |
| Transmitted ON Power | Same as Table 6.2.1.5-1 | | | | | | |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3C.3.5-2 and Table 6.2.1.5-3. | | | | | | | |

Table 6.3C.3.1.5-2: Test Tolerance for OFF power

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 1.5 dB | 1.8 dB |
| 40MHz < BW ≤ 100MHz | 1.7 dB | 1.8 dB |

Table 6.3C.3.1.5-3: Void

#### 6.3C.3.2 General transmit ON/OFF time mask for switching between two uplink carriers

6.3C.3.2.1 Test purpose

To verify that the time mask for switching between two uplink carriers meets the requirements given in 6.3C.3.0.2.

The time mask for switching between two uplink carriers defines the transient period(s) allowed between two uplink carriers for an uplink band pair of an SUL configuration when the capability uplinkTxSwitchingPeriod is present

6.3C.3.2.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support SUL configuration and dynamic UL Tx switching.

6.3C.3.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3C.3.0.2.

6.3C.3.2.4 Test description

6.3C.3.2.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR SUL configuration specified in 5.5C. All of these configurations shall be tested with applicable test parameters for each SUL configuration, and are shown in table 6.3C.3.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3C.3.2.4.1-1: Test Configuration Table for SUL Tx switching

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | Mid range for both carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | Highest for SUL carrier and Non-SUL carrier | | |
| Test SCS as specified in Table 5.3.5-1 | | | | 15kHz for SUL carrier, lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | | SUL Configuration | |
| 1 | N/A | Modulation | RB allocation (NOTE 2) | | Modulation | RB allocation (NOTE 2) |
|  |  | DFT-s-OFDM QPSK | Inner Full | | DFT-s-OFDM QPSK | Inner Full |
| NOTE 1: SUL carrier is configured as Carrier 1 and Non-SUL carrier is configured as Carrier2.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 3: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 4: For NR band n83, 30MHz test channel bandwidth is tested with Low range test frequency. | | | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.4 for TE diagram and section A.3.2 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

6.3C.3.2.4.2 Test procedure

1. Sub test 1: Switching period located in Carrier 1 (SUL carrier)

1.1 SS send an NR RRCReconfiguration message according to 6.3C.3.2.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier1 and FALSE on carrier 2.1.2 SS send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

1.3 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.2.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

1.4 The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.2.4.1-1 on carrier 2 starting on slot n and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.5 Measure the output power of UE PUSCH transmission for carrier 1 during slot n-1 excluding a transient period of 10 µs and a Switching period X µs in the end of slot n-1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod*.

1.6 Measure the sum of output power of UE PUSCH transmission on carrier 2 over all antenna connectors during slot n and slot m excluding a transient period of 10 µs in the beginning of slot n and in the end of slot m.

1.7 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.2.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

1.8 Measure the output power of UE PUSCH transmission for carrier 1 during slot m+1 excluding a switching period X and a transient period of 10 µs in the beginning of slot m+1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod*.

2. Sub test 2: Switching period located in Carrier 2 (Non-SUL carrier)

2.1 SS send an NR RRCReconfiguration message according to 6.3C.3.2.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured FALSE on carrier1 and TRUE on carrier 2.

2.2 SS send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

2.3 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.2.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2.4 The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.2.4.1-1 on carrier 2 starting on slot n and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.5 Measure the output power of UE PUSCH transmission for carrier 1 during slot n-1 excluding a transient period of 10 µs in the end of slot n-1.

2.6 Measure the sum of output power of UE PUSCH transmission on carrier 2 over all antenna connectors during slot n and slot m excluding a transient period of 10 µs and a Switching period X µs in the beginning of slot n and in the end of slot m. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod*.

2.7 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.2.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2.8 Measure the output power of UE PUSCH transmission for carrier 1 during slot m+1 excluding a transient period of 10 µs in the beginning of slot m+1.

6.3C.3.2.4.3 Message contents

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, and following exceptions:

Table 6.3C.3.2.4.3-2: ServingCellConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1[5], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| uplinkTxSwitching-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| uplinkTxSwitchingPeriodLocation-r16 | TRUE |  | PL |
|  | FALSE |  | noPL |
| uplinkTxSwitchingCarrier-r16 | carrier1 |  | 1TxCC |
|  | carrier2 |  | 2TxCC |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| PL | The location of UL Tx switching period is configured in this carrier |
| noPL | The location of UL Tx switching period is not configured in this carrier |
| 1TxCC | The carrier is capable of one transmit antenna connector |
| 2TxCC | The carrier is capable of two transmit antenna connectors |

Table 6.3C.3.2.4.3-4: *PUSCH-Config*

|  |
| --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-118 with condition TRANSFORM\_PRECODER\_ENABLED |

Table 6.3C.3.2.4.3-5: P-Max

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-62 FrequencyInfoUL-SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 23 |  |  |

6.3C.3.2.4.3 Test requirement

The requirement for the power of carrier 1 measured in step 1.5, 1.8, 2.5, 2.8 of the test procedure and the power of carrier 2 measured in step 1.6 and 2.6 shall not exceed the values specified in table 6.3C.3.2.4.3-1.

Table 6.3C.3.2.4.3-1: General SUL Time mask for switching between two uplink carriers (On power)

|  |  |
| --- | --- |
|  | Measured output power |
| Transmit ON power | Same as table 6.2.1.5-1 for NUL carrier and table 6.2C.3.5-1 for SUL carrier |
| NOTE 1: TT or each frequency and channel bandwidth of Transmit ON power is specified in Table 6.2.1.5-3 | |

#### 6.3C.3.3 General transmit ON/OFF time mask for switching between two uplink carriers with two transmit antenna connectors

6.3C.3.3.1 Test purpose

To verify that the time mask for switching between two uplink carriers with two transmit antenna connectors meets the requirements given in 6.3C.3.0.3.

The time mask for switching between two uplink carriers with two transmit antenna connectors defines the transient period(s) allowed between an uplink band pair of an SUL configuration when the capability uplinkTxSwitchingPeriod2T2T is present

6.3C.3.3.2 Test applicability

This test case applies to all types of NR UE release 17 and forward that support SUL configuration and dynamic UL 2Tx-2Tx switching.

6.3C.3.3.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3C.3.0.3.

6.3C.3.3.4 Test description

6.3C.3.3.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR SUL configuration specified in 5.5C. All of these configurations shall be tested with applicable test parameters for each SUL configuration, and are shown in table 6.3C.3.3.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3C.3.3.4.1-1: Test Configuration Table for SUL Tx switching

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | Mid range for both carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | Highest for SUL carrier and Non-SUL carrier | | |
| Test SCS as specified in Table 5.3.5-1 | | | | 15kHz for SUL carrier, lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | | SUL Configuration | |
| 1 | N/A | **Modulation** | **RB allocation (NOTE 3)** | | Modulation | RB allocation (NOTE 3) |
|  |  | CP-OFDM QPSK | Inner Full | | CP-OFDM QPSK | Inner Full |
| NOTE 1: SUL carrier is configured as Carrier 1 and Non-SUL carrier is configured as Carrier2.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 3: The specific configuration of each RB allocation is defined in Table 6.1-1. | | | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.6 for TE diagram and section A.3.2.3.11 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

6.3C.3.3.4.2 Test procedure

1. Sub test 1: Switching period located in Carrier 1 (SUL carrier)

1.1 SS send an NR RRCReconfiguration message according to 6.3C.3.3.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier1 and FALSE on carrier 2.

1.2 SS send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

1.3 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.3.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.4 The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.3.4.1-1 on carrier 2 starting on slot n and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.5 Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot n-1 excluding a transient period of 10 µs and a Switching period X µs in the end of slot n-1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod2T2T*.

1.6 Measure the sum of output power of UE PUSCH transmission on carrier 2 over all antenna connectors during slot n and slot m excluding a transient period of 10 µs in the beginning of slot n and in the end of slot m.

1.7 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.3.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.8 Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot m+1 excluding a switching period X and a transient period of 10 µs in the beginning of slot m+1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod2T2T*.

2. Sub test 2: Switching period located in Carrier 2 (Non-SUL carrier)

2.1 SS send an NR RRCReconfiguration message according to 6.3C.3.3.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured FALSE on carrier1 and TRUE on carrier 2.

2.2 SS send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

2.3 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.3.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.4 The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.3.4.1-1 on carrier 2 starting on slot n and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.5 Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot n-1 excluding a transient period of 10 µs in the end of slot n-1.

2.6 Measure the sum of output power of UE PUSCH transmission on carrier 2 over all antenna connectors during slot n and slot m excluding a transient period of 10 µs and a Switching period X µs in the beginning of slot n and in the end of slot m. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod2T2T*.

2.7 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.3.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.8 Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot m+1 excluding a transient period of 10 µs in the beginning of slot m+1.

6.3C.3.3.4.3 Message contents

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, and following exceptions:

Table 6.3C.3.3.4.3-1: ServingCellConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1[5], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| uplinkTxSwitching-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| uplinkTxSwitchingPeriodLocation-r16 | TRUE |  | PL |
|  | FALSE |  | noPL |
| uplinkTxSwitchingCarrier-r16 | carrier1 |  | 1TxCC |
|  | carrier2 |  | 2TxCC |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| PL | The location of UL Tx switching period is configured in this carrier |
| noPL | The location of UL Tx switching period is not configured in this carrier |
| 1TxCC | The carrier is capable of one transmit antenna connector |
| 2TxCC | The carrier is capable of two transmit antenna connectors |

Table 6.3C.3.3.4.3-2: P-Max

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-62 FrequencyInfoUL-SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 23 |  |  |

6.3C.3.3.4.3 Test requirement

The requirement for the power of carrier 1 measured in step 1.5, 1.8, 2.5, 2.8 of the test procedures and the power of carrier 2 measured in step 1.6 and 2.6 shall not exceed the values specified in table 6.3C.3.3.4.3-1.

Table 6.3C.3.3.4.3-1: General SUL Time mask for switching between two uplink carriers (On power)

|  |  |
| --- | --- |
|  | Measured output power |
| Transmit ON power | NUL: Same as Test ID 1 of Table 6.2D.2.5-1  SUL: Same as Test ID 1 of Table 6.2D.2\_1.5-1~6.2D.2\_1.5-2 |
| NOTE 1: TT or each frequency and channel bandwidth of Transmit ON power is specified in Table 6.2.1.5-3 | |

#### 6.3C.3.4 General transmit ON/OFF time mask for switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors

6.3C.3.4.1 Test purpose

To verify that the time mask for switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors meets the requirements given in 6.3C.3.0.4 when the capability uplinkTxSwitchingPeriod is present.

6.3C.3.4.2 Test applicability

This test case applies to all types of NR UE release 17 and forward that support SUL configuration with intra-band contiguous CA and dynamic UL 1Tx-2Tx switching.

6.3C.3.4.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3C.3.0.4.

6.3C.3.4.4 Test description

6.3C.3.4.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR SUL configuration specified in 5.5C. All of these configurations shall be tested with applicable test parameters for each SUL configuration, and are shown in table 6.3C.3.4.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3C.3.4.4.1-1: Test Configuration Table for SUL Tx switching

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | Mid range for SUL carrier  Mid range for Non-SUL aggregate carriers | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | Highest for SUL carrier  Highest NRB\_agg for Non-SUL aggregate carriers | | |
| Test SCS as specified in Table 5.3.5-1 | | | | 15kHz for SUL carrier, lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | | SUL Configuration | |
| 1 | N/A | **Modulation** | **RB allocation (NOTE 3)** | | Modulation | RB allocation (NOTE 3) |
|  |  | CP-OFDM QPSK | Inner Full | | CP-OFDM QPSK | Inner Full |
| NOTE 1: SUL carrier is configured as Carrier 1 and Non-SUL carrier is configured as Carrier2.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 3: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 4: The specific configuration of each RB allocation is defined in Table 6.1A-1a. | | | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.6 for TE diagram and section A.3.2.3.11 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

6.3C.3.4.4.2 Test procedure

In this test case, one SUL carrier and two contiguous aggregated non-SUL carriers are configured. The SUL carrier is configured as Carrier 1, and both non-SUL carriers are configured as Carrer 2.

1. Sub test 1: Switching period located in Carrier 1 (SUL carrier)

1.1 Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

1.2 The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3A.3.4.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier1 and FALSE on carrier 2.

1.3 SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

1.4 SS send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

1.5 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.4.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

1.6 The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.4.4.1-1 on carrier 2 starting on slot n and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.7 Measure the output power of UE PUSCH transmission for carrier 1 during slot n-1 excluding a transient period of 10 µs and a Switching period X µs in the end of slot n-1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod*.

1.8 Measure the sum of output power of UE PUSCH transmission on carrier 2 over all antenna connectors and both component carriers during slot n and slot m excluding a transient period of 10 µs in the beginning of slot n and in the end of slot m.

1.9 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.4.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

1.10 Measure the output power of UE PUSCH transmission for carrier 1 during slot m+1 excluding a switching period X and a transient period of 10 µs in the beginning of slot m+1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod*.

2. Sub test 2: Switching period located in Carrier 2 (Non-SUL carriers)

2.1 Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2.2 The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3A.3.4.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier1 and FALSE on carrier 2.

2.3 SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

2.4 SS send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

2.5 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.4.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2.6 The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.4.4.1-1 on carrier 2 starting on slot n and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.7 Measure the output power of UE PUSCH transmission for carrier 1 during slot n-1 excluding a transient period of 10 µs in the end of slot n-1.

2.8 Measure the sum of output power of UE PUSCH transmission on carrier 2 over all antenna connectors and both component carriers during slot n and slot m excluding a transient period of 10 µs and a Switching period X µs in the beginning of slot n and in the end of slot m. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod*.

2.9 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.4.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2.10 Measure the output power of UE PUSCH transmission for carrier 1 during slot m+1 excluding a transient period of 10 µs in the beginning of slot m+1.

6.3C.3.4.4.3 Message contents

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, and following exceptions:

Table 6.3C.3.4.4.3-1: ServingCellConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1[5], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| uplinkTxSwitching-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| uplinkTxSwitchingPeriodLocation-r16 | TRUE |  | PL |
|  | FALSE |  | noPL |
| uplinkTxSwitchingCarrier-r16 | carrier1 |  | 1TxCC |
|  | carrier2 |  | 2TxCC |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| PL | The location of UL Tx switching period is configured in this carrier |
| noPL | The location of UL Tx switching period is not configured in this carrier |
| 1TxCC | The carrier is capable of one transmit antenna connector |
| 2TxCC | The carrier is capable of two transmit antenna connectors |

Table 6.3C.3.4.4.3-2: P-Max

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-62 FrequencyInfoUL-SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 23 |  |  |

6.3C.3.4.4.3 Test requirement

The requirement for the power of carrier 1 measured in step 1.7, 1.10, 2.7, 2.10 of the test procedures and the power of carrier 2 measured in step 1.8 and 2.8 shall not exceed the values specified in table 6.3C.3.4.4.3-1.

Table 6.3C.3.4.4.3-1: SUL Time mask for 2Tx-2Tx switching between two bands (On power)

|  |  |
| --- | --- |
|  | Measured output power |
| Transmit ON power | NUL: Same as Test ID 1 of Table 6.2H.1.2.5-1 or 6.2H.1.2.5-2  SUL: Same as Test ID 19 of Table 6.2C.4.5-1 to Table 6.2C.4.5-4 |
| NOTE 1: TT or each frequency and channel bandwidth of Transmit ON power is specified in Table 6.2.1.5-3 | |

#### 6.3C.3.5 General transmit ON/OFF time mask for switching between two uplink bands with two transmit antenna connectors

6.3C.3.5.1 Test purpose

To verify that the time mask for switching between one uplink band with two transmit antenna connectors and one uplink band with two transmit antenna connectors meets the requirements given in 6.3C.3.0.4 when the capability *uplinkTxSwitchingPeriod2T2T* is present.

6.3C.3.5.2 Test applicability

This test case applies to all types of NR UE release 17 and forward that support SUL configuration with intra-band contiguous CA and dynamic UL 2Tx-2Tx switching.

6.3C.3.5.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3C.3.0.5.

6.3C.3.5.4 Test description

6.3C.3.5.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR SUL configuration specified in 5.5C. All of these configurations shall be tested with applicable test parameters for each SUL configuration, and are shown in table 6.3C.3.5.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3C.3.5.4.1-1: Test Configuration Table for SUL 2Tx-2Tx switching

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | Mid range for SUL carrier  Mid range for Non-SUL aggregate carriers | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | Highest for SUL carrier  Highest NRB\_agg for Non-SUL aggregate carriers | | |
| Test SCS as specified in Table 5.3.5-1 | | | | 15kHz for SUL carrier, lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | | SUL Configuration | |
| 1 | N/A | **Modulation** | **RB allocation (NOTE 3)** | | Modulation | RB allocation (NOTE 3) |
|  |  | CP-OFDM QPSK | Inner Full | | CP-OFDM QPSK | Inner Full |
| NOTE 1: SUL carrier is configured as Carrier 1 and Non-SUL carrier is configured as Carrier2.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 3: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 4: The specific configuration of each RB allocation is defined in Table 6.1A-1a. | | | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.6 for TE diagram and section A.3.2.3.11 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

6.3C.3.5.4.2 Test procedure

In this test case, one SUL carrier and two contiguous aggregated non-SUL carriers are configured. The SUL carrier is configured as Carrier 1, and both non-SUL carriers are configured as Carrer 2.

1. Sub test 1: Switching period located in Carrier 1 (SUL carrier)

1.1 Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

1.2 The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3A.3.4.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier1 and FALSE on carrier 2.

1.3 SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

1.4 SS send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

1.5 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.5.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.6 The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.5.4.1-1 on carrier 2 starting on slot n and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.7 Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot n-1 excluding a transient period of 10 µs and a Switching period X µs in the end of slot n-1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod2T2T*.

1.8 Measure the sum of output power of UE PUSCH transmission on carrier 2 over all antenna connectors and both component carriers during slot n and slot m excluding a transient period of 10 µs in the beginning of slot n and in the end of slot m.

1.9 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.5.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.10 Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot m+1 excluding a switching period X and a transient period of 10 µs in the beginning of slot m+1. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod2T2T*.

2. Sub test 2: Switching period located in Carrier 2 (Non-SUL carriers)

2.1 Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2.2 The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3A.3.4.4.3 with *uplinkTxSwitchingPeriodLocation-r16* configured TRUE on carrier1 and FALSE on carrier 2.

2.3 SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133 [19], clause 9.3).

2.4 SS send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

2.5 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.5.4.1-1 on carrier 1 on slot n-1, where slot n is an uplink slot for carrier 2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.6 The SS sends uplink scheduling information via DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.5.4.1-1 on carrier 2 starting on slot n and slot m, with both slot n and slot m being uplink slots for carrier 2 and m ≥ n+20 when SCS=15kHz (m ≥ n+40 when SCS=30 kHz, m ≥ n+80 when SCS=60 kHz). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.7 Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot n-1 excluding a transient period of 10 µs in the end of slot n-1.

2.8 Measure the sum of output power of UE PUSCH transmission on carrier 2 over all antenna connectors and both component carriers during slot n and slot m excluding a transient period of 10 µs and a Switching period X µs in the beginning of slot n and in the end of slot m. The length of uplink switching period X is indicated by UE capability *uplinkTxSwitchingPeriod*.

2.9 SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3C.3.5.4.1-1 on carrier 1 on slot m+1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2.10 Measure the sum of output power of UE PUSCH transmission for carrier 1 over all antenna connectors during slot m+1 excluding a transient period of 10 µs in the beginning of slot m+1.

6.3C.3.5.4.3 Message contents

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, and following exceptions:

Table 6.3C.3.5.4.3-1: ServingCellConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1[5], Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfig ::= SEQUENCE { |  |  |  |
| uplinkConfig SEQUENCE { |  |  |  |
| uplinkTxSwitching-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| uplinkTxSwitchingPeriodLocation-r16 | TRUE |  | PL |
|  | FALSE |  | noPL |
| uplinkTxSwitchingCarrier-r16 | carrier1 |  | 1TxCC |
|  | carrier2 |  | 2TxCC |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| PL | The location of UL Tx switching period is configured in this carrier |
| noPL | The location of UL Tx switching period is not configured in this carrier |
| 1TxCC | The carrier is capable of one transmit antenna connector |
| 2TxCC | The carrier is capable of two transmit antenna connectors |

Table 6.3C.3.5.4.3-2: P-Max

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-62 FrequencyInfoUL-SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 23 |  |  |

6.3C.3.5.4.3 Test requirement

The requirement for the power of carrier 1 measured in step 1.7, 1.10, 2.7, 2.10 of the test procedures and the power of carrier 2 measured in step 1.8 and 2.8 shall not exceed the values specified in table 6.3C.3.5.4.3-1.

Table 6.3C.3.5.4.3-1: SUL Time mask for 1Tx-2Tx switching between two bands (On power)

|  |  |
| --- | --- |
|  | Measured output power |
| Transmit ON power | NUL: Same as Test ID 1 of Table 6.2H.1.2.5-1 or 6.2H.1.2.5-2  SUL: Same as Test ID 1 of Table 6.2D.2\_1.5-1~6.2D.2\_1.5-2 |
| NOTE 1: TT or each frequency and channel bandwidth of Transmit ON power is specified in Table 6.2.1.5-3 | |

### 6.3C.4 Power control for SUL

#### 6.3C.4.1 Absolute power tolerance for SUL

6.3C.4.1.1 Test purpose

Same test purpose as in clause 6.3.4.2.1

6.3C.4.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support SUL operating on the SUL bands.

6.3C.4.1.3 Minimum conformance requirements

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3 and 6.3.4.2.

6.3C.4.1.4 Test description

Same test description as specified in clause 6.3.4.2.4 with following exceptions:

Instead of table 5.3.5-1 🡪 use Table 5.5C-1.

Instead of table 6.3.4.2.4.1-1 🡪 use Table 6.3C.4.1.4-1

Table 6.3C.4.1.4-1: Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid-range for SUL and Non-SUL carrier | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | SUL Configuration | |
|  |  |  | Modulation | RB allocation (NOTE 2) |
| 1 | N/A | N/A | CP-OFDM QPSK | Outer\_Full |
| NOTE 1: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 2: The specific configuration of each RF allocation is defined in Table 6.1-1.  NOTE 3: For NR band n83, 30MHz test channel bandwidth is tested with Low range test frequency. | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.4 for TE diagram and section A.3.2 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL.

Table 6.3C.4.1.4-2: Void

6.3C.4.1.5 Test requirement

The requirement for the power measured in step (2) of the test procedure is not to exceed the values specified in Table 6.3C.4.1.5-1 and 6.3C.4.1.5-2.

Table 6.3C.4.1.5-1: Absolute power tolerance: test point 1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Channel bandwidth / expected output power (dBm) | | | | | | | |
| 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz |
| Expected Measured power | -17.6 | -14.4 | -12.6 | -11.3 | -10.4 | -9.6 | -8.3 | -7.3 |
| Power tolerance | ± (9+TT)dB | | | | | | | |
| Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3C.1.3  Note 2: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3C.4.1.5-3. | | | | | | | | |

Table 6.3C.4.1.5-2: Absolute power tolerance: test point 2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Channel bandwidth / expected output power (dBm) | | | | | | | |
| 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz |
| Expected Measured power | -3.6 | 0.4 | 1.4 | 2.7 | 3.6 | 4.4 | 5.7 | 6.7 |
| Power tolerance | ± (9+TT)dB | | | | | | | |
| Note 1: The higher power limit shall not exceed the maximum output power requirements defined in sub-clause 6.2C.3.3  Note 2: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3C.4.1.5-3. | | | | | | | | |

Table 6.3C.4.1.5-3: Test Tolerance

|  |  |  |  |
| --- | --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 4.2GHz | 4.2GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.0 dB | 1.4 dB | 1.4 dB |

#### 6.3C.4.2 Relative power tolerance for SUL

6.3C.4.2.1 Test purpose

Same test purpose as in clause 6.3.4.3.1

6.3C.4.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support SUL operating on the SUL bands.

6.3C.4.2.3 Minimum conformance requirements

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3 and 6.3.4.3.

6.3C.4.2.4 Test description

Same test description as specified in clause 6.3.4.3.4 with following exceptions:

Instead of table 5.3.5-1 🡪 use Table 5.5C-1.

Instead of table 6.3.4.3.4.1-1 🡪 use Table 6.3C.4.2.4-1

Table 6.3C.4.2.4-1: Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low range for SUL carrier  Mid-range for Non-SUL carrier | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | |
| Test SCS as specified in table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | |
| Test Parameters | | | | |
| Ch BW | Downlink Configuration | Uplink Configuration | SUL Configuration | |
|  |  |  | Modulation | RB allocation (NOTE 1) |
| 5MHz | N/A | | DFT-s-OFDM QPSK | See Table 6.3C.4.2.5-1  See Table 6.3C.4.2.5-2  See Table 6.3C.4.2.5-5 |
| 10MHz |  | | DFT-s-OFDM QPSK | See Table 6.3C.4.2.5-3  See Table 6.3C.4.2.5-4  See Table 6.3C.4.2.5-5 |
| 15MHz |  | | DFT-s-OFDM QPSK | See Table 6.3C.4.2.5-3  See Table 6.3C.4.2.5-4  See Table 6.3C.4.2.5-5 |
| 20MHz |  | | DFT-s-OFDM QPSK | See Table 6.3C.4.2.5-3  See Table 6.3C.4.2.5-4  See Table 6.3C.4.2.5-5 |
| 25MHz |  | | DFT-s-OFDM QPSK | See Table 6.3C.4.2.5-3  See Table 6.3C.4.2.5-4  See Table 6.3C.4.2.5-5 |
| 30MHz |  | | DFT-s-OFDM QPSK | See Table 6.3C.4.2.5-3  See Table 6.3C.4.2.5-4  See Table 6.3C.4.2.5-5 |
| 40MHz |  | | DFT-s-OFDM QPSK | See Table 6.3C.4.2.5-3  See Table 6.3C.4.2.5-4  See Table 6.3C.4.2.5-5 |
| 50MHz |  | | DFT-s-OFDM QPSK | See Table 6.3C.4.2.5-3  See Table 6.3C.4.2.5-4  See Table 6.3C.4.2.5-5 |
| NOTE 1: The starting resource block shall be RB# 0  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1. | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.4 for TE diagram and section A.3.2 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL.

Table 6.3C.4.2.4-2: Void

6.3C.4.2.5 Test requirement

Each UE power step measured in the test procedure 6.3.4.3.4.2 should satisfy the test requirements specified in Table 6.3C.4.2.5-1 thru 6.3C.4.2.5-5.

To account for RF Power amplifier mode changes 2 exceptions are allowed for each of ramping up and ramping down test patterns. For these exceptions the power tolerance limit is a maximum of ± (6.0 + TT) dB. If there is an exception in the power step caused by the RB change for all test patterns (A, B, C) then fail the UE.

Table 6.3C.4.2.5-1: Test Requirements Relative Power Tolerance for Transmission, channel BW 5MHz, ramp up sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Up) | Power step size range (Up) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Sub-frames before RB change | Fixed = 1 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Sub-frames before RB change | Fixed = 1 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 1RB to 15 RBs | TPC=+1dB | 12.76 | 10dB ≤ ΔP < 15dB | 12.76 +/- (4 + TT) |
|  |  | Sub-frames after RB change | Fixed = 15 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Sub-frames Pattern B the position of RB uplink allocation change is after 20 active uplink Sub-frames Pattern C the position of RB uplink allocation change is after 30 active uplink Sub-frames  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3C.1. | | | | | | | |

Table 6.3C.4.2.5-2: Test Requirements Relative Power Tolerance for Transmission, channel BW 5MHz, ramp down sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Down) | Power step size range (Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Sub-frames before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 |  | Sub-frames before RB change | Fixed = 15 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 15 RBs to 1 RB | TPC=-1dB | 12.76 | 10dB ≤ ΔP < 15dB | 12.76 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Sub-frames Pattern B the position of RB uplink allocation change is after 20 active uplink Sub-frames Pattern C the position of RB uplink allocation change is after 30 active uplink Sub-frames  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3C.1. | | | | | | | |

Table 6.3C.4.2.5-3: Test Requirements Relative Power Tolerance for Transmission, channel BW 10MHz, 15MHz, 20MHz, 25MHz, 30MHz, 40MHz, 50MHz ramp up sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Up) | Power step size range (Up) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 | 2 | RB change | 1RB to 20 RBs | TPC=+1dB | 14.01 | 10dB ≤ ΔP < 15dB | 14.01 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 20 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/-0.7 + TT |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 3 | RB change | 1RB to 50 RBs | TPC=+1dB | 17.99 | 15dB ≤ ΔP | 17.99 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 50 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3C.1. | | | | | | | |

Table 6.3C.4.2.5-4: Test Requirements Relative Power Tolerance for Transmission, channel BW 10MHz, 15MHz, 20MHz, 25MHz, 30MHz, 40MHz, 50MHz ramp down sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Down) | Power step size range (Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1RBs | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 20 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 | 2 | RB change | 20 RBs to 1 RB | TPC=-1dB | 14.01 | 10dB ≤ ΔP < 15dB | 14.01 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 50 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 3 | RB change | 50 RBs to 1 RB | TPC=-1dB | 17.99 | 15dB ≤ ΔP | 17.99 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3C.1. | | | | | | | |

Table 6.3C.4.2.5-5: Test Requirements Relative Power Tolerance for Transmission, alternating sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| BW | Test SCS [kHz] | Sub-test ID | Uplink RB allocation | TPC command | Expected power step size (Up or Down) | Power step size range (Up or Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
| 5 | 15 | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  |  | 3 | Alternating 1 and 15 | TPC=0dB | 11.76 | 10dB ≤ ΔP < 15dB | 11.76 +/- (4 + TT) |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
| 10,15,20, 25,30,40 |  | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  | 15 | 3 | Alternating 1 and 20 | TPC=0dB | 13.01 | 10dB ≤ ΔP < 15dB | 13.01 +/- (4 + TT) |
|  |  | 4 | Alternating 1 and 50 | TPC=0dB | 16.99 | 15dB ≤ ΔP | 16.99 +/- (5 + TT) |
| Note 1: The starting resource block shall be RB# 0.  Note 2: TT=0.7dB  Note 3: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3C.1. | | | | | | | |

#### 6.3C.4.3 Aggregate power tolerance for SUL

6.3C.4.3.1 Test purpose

Same test purpose as in clause 6.3.4.3.1

6.3C.4.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support SUL operating on the SUL bands.

6.3C.4.3.3 Minimum conformance requirements

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3 and 6.3.4.4.

6.3C.4.3.4 Test description

Same test description as specified in clause 6.3.4.4.4 with following exceptions:

Instead of table 5.3.5-1 🡪 use Table 5.5C-1.

Instead of table 6.3.4.4.4.1-1 🡪 use Table 6.3C.4.3.4-1

Instead of table 6.3.4.4.4.1-2 🡪 use Table 6.3C.4.3.4-2

Table 6.3C.4.3.4-1: Test Configuration Table: PUCCH sub-test

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid range for SUL and Non-SUL carrier |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier |
| Test Parameters for Channel Bandwidths | | | |
| Test ID | Downlink Configuration | Uplink Configuration | SUL Configuration |
|  |  |  | PUCCH format = Format 1  Length in OFDM symbols = 14 |
| 1 | CP-OFDM QPSK  Full RB allocation (NOTE 1) | N/A |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2.  NOTE 2: For NR band n83, 30MHz test channel bandwidth is tested with Low range test frequency. | | | |

Table 6.3C.4.3.4-2: Test Configuration Table: PUSCH sub-test

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid range for SUL and Non-SUL carrier | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | |
| Test Parameters for Channel Bandwidths | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | SUL Configuration | |
|  |  |  | Modulation | RB allocation (NOTE 1) |
| 1 | N/A | N/A | CP-OFDM QPSK | Outer\_Full |
| NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 3: For NR band n83, 30MHz test channel bandwidth is tested with Low range test frequency. | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.4 for TE diagram and section A.3.2 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL.

Table 6.3C.4.3.4-2: Void

6.3C.4.3.5 Test requirement

The requirement for the power measurements made in step (1.3) and (2.3) of the test procedure shall not exceed the values specified in Table 6.3C.4.3.5-1. The power measurement period shall be 1 sub-frame(1ms).

Table 6.3C.4.3.5-1: Power control tolerance

|  |  |  |
| --- | --- | --- |
| TPC command | UL channel | Test requirement measured power |
| 0 dB | PUCCH | Given 5 power measurements in the pattern, the 2nd, and later measurements shall be within ± (2.5 + TT) dB of the 1st measurement. |
| 0 dB | PUSCH | Given 5 power measurements in the pattern, the 2nd, and later measurements shall be within ± (3.5 + TT) dB of the 1st measurement. |
| Note 1: TT=0.7dB. | | |

## 6.3D Output power dynamics for UL MIMO

### 6.3D.1 Minimum output power for UL MIMO

6.3D.1.1 Test purpose

To verify the UE's ability to transmit with a UL MIMO broadband output power below the value specified in the test requirement when the power is set to a minimum value.

6.3D.1.2 Test applicability

This test case applies to all types of NR Power Class 1.5, Power Class 2 and Power Class 3UE release 15 and forward that support 2-layer codebook based UL MIMO.

6.3D.1.3 Minimum conformance requirements

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the minimum output power is defined as the sum of the mean power at each UE antenna connector in one sub-frame (1ms). The minimum output power shall not exceed the values specified in Table 6.3D.1.3-1.

Table 6.3D.1.3-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -40 | 4.515 |
| 10 | -40 | 9.375 |
| 15 | -40 | 14.235 |
| 20 | -40 | 19.095 |
| 25 | -39 | 23.955 |
| 30 | -38.2 | 28.815 |
| 35 | -37.6 | 33.855 |
| 40 | -37 | 38.895 |
| 45 | -36.5 | 43.575 |
| 50 | -36 | 48.615 |
| 60 | -35.2 | 58.35 |
| 70 | -34.6 | 68.07 |
| 80 | -34 | 78.15 |
| 90 | -33.5 | 88.23 |
| 100 | -33 | 98.31 |

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3D.1.

6.3D.1.4 Test description

6.3D.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.3D.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3D.1.4.1-1: Test Configuration Table

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Highest | |
| Test Parameters for Channel Bandwidths | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A for minimum output power | Modulation | RB allocation (NOTE 1) |
| 1 | test case | CP-OFDM QPSK | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3D.1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3D.1.4.3.

6.3D.1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3D.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2. Send continuously uplink power control "down" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step to ensure that the UE transmits at its minimum output power.

3. Measure the sum of mean power of the UE at each UE antenna connector in the associated measurement channel bandwidth specified in Table 6.3D.1.5-1 for the specific channel bandwidth under test. The period of measurement shall be at least the continuous duration of 1ms over all active uplink slots and in the uplink symbols. For TDD, only slots consisting of only UL symbols are under test.

6.3D.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX\_UL\_MIMO.

6.3D.1.5 Test requirement

The minimum output power, derived in step 3 shall not exceed the values specified in Table 6.3D.1.5-1.

Table 6.3D.1.5-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -40+TT | 4.515 |
| 10 | -40+TT | 9.375 |
| 15 | -40+TT | 14.235 |
| 20 | -40+TT | 19.095 |
| 25 | -39+TT | 23.955 |
| 30 | -38.2+TT | 28.815 |
| 35 | -37.6+TT | 33.855 |
| 40 | -37+TT | 38.895 |
| 45 | -36.5+TT | 43.575 |
| 50 | -36+TT | 48.615 |
| 60 | -35.2+TT | 58.35 |
| 70 | -34.6+TT | 68.07+TT |
| 80 | -34+TT | 78.15 |
| 90 | -33.5+TT | 88.23 |
| 100 | -33+TT | 98.31 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3D.1.5-2 | | |

Table 6.3D.1.5-2: Test Tolerance (Minimum output power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.0 dB | 1.3 dB |
| 40MHz < BW ≤ 100MHz | 1.3 dB | 1.3 dB |

### 6.3D.1\_1 Minimum output power for SUL with UL MIMO

6.3D.1\_1.1 Test purpose

Same test purpose as in clause 6.3D.1.1.

6.3D.1\_1.2 Test applicability

This test applies to all types of NR UE release 17 and forward that support SUL and UL MIMO operating on the SUL bands.

6.3D.1\_1.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.3D.1.3.

6.3D.1\_1.4 Test description

6.3D.1\_1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.3D.1\_1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3D.1\_1.4.1-1: Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low range, Mid range, High range for SUL carrier  Mid range for non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.5C-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | UL Configuration | | SUL Configuration | |
|  | N/A | N/A | | Modulation | RB allocation (NOTE 2) |
| 1 |  |  | | CP-OFDM QPSK | Outer Full |
| NOTE 1: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 2: The specific configuration of each RB allocation is defined in Table 6.1-1. | | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.5 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2 and G.3.0 with consideration of supplementary uplink physical channels.

4. The UL Reference Measurement Channel is set according to Table 6.3D.1\_1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3D.1\_1.4.3.

6.3D.1\_1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3D.1\_1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2. Send continuously uplink power control "down" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step to ensure that the UE transmits at its minimum output power.

3. Measure the sum of mean power of the UE at each UE antenna connector in the associated measurement channel bandwidth specified in Table 6.3D.1\_1.5-1 for the specific channel bandwidth under test. The period of measurement shall be at least the continuous duration of 1ms over all active uplink slots and in the uplink symbols.

6.3D.1\_1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, and Table 4.6.3-182 with the condition 2TX\_UL\_MIMO.

6.3D.1\_1.5 Test requirement

The minimum output power, derived in step 3 shall not exceed the values specified in Table 6.3D.1\_1.5-1.

Table 6.3D.1\_1.5-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -40+TT | 4.515 |
| 10 | -40+TT | 9.375 |
| 15 | -40+TT | 14.235 |
| 20 | -40+TT | 19.095 |
| 25 | -39+TT | 23.955 |
| 30 | -38.2+TT | 28.815 |
| 35 | -37.6+TT | 33.855 |
| 40 | -37+TT | 38.895 |
| 45 | -36.5+TT | 43.575 |
| 50 | -36+TT | 48.615 |
| 60 | -35.2+TT | 58.35 |
| 70 | -34.6+TT | 68.07+TT |
| 80 | -34+TT | 78.15 |
| 90 | -33.5+TT | 88.23 |
| 100 | -33+TT | 98.31 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3D.1\_1.5-2 | | |

Table 6.3D.1\_1.5-2: Test Tolerance (Minimum output power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.0 dB | 1.3 dB |
| 40MHz < BW ≤ 100MHz | 1.3 dB | 1.3 dB |

### 6.3D.2 Transmit OFF power for UL MIMO

6.3D.2.1 Test purpose

To verify that the UE transmit OFF power for UL MIMO is lower than the value specified in the test requirement.

An excess Transmit OFF power potentially increases the Rise Over Thermal (RoT) and therefore reduces the cell coverage area for other UEs.

6.3D.2.2 Test applicability

The requirements of this test apply in test cases 6.3D.3 Transmit ON/OFF time mask for UL MIMO to all types of NR Power Class 1.5, Power Class 2 and Power Class 3 UE release 15 and forward that support 2-layer codebook based UL MIMO.

6.3D.2.3 Minimum conformance requirements

The transmit OFF power is defined as the mean power at each transmit connector in a duration of at least one sub-frame (1ms) excluding any transient periods.

The transmit OFF power at each transmit connector shall not exceed the values specified in Table 6.3D.2.3-1.

Table 6.3D.2.3-1: Transmit OFF power

|  |  |  |  |
| --- | --- | --- | --- |
| Channel bandwidth | (MHz) | 5,10,15,20,25,30,35,40,45,50 | 60,70,80,90,100 |
| REF\_SCS | (kHz) | 15 | 30 |
| Transmit OFF power | (dBm) | -50 | |
| Measurement bandwidth | (MHz) | MBW=REF\_SCS\*(12\*NRB+1)/1000 | |

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3D.2.

6.3D.2.4 Test description

This test is covered by clause 6.3D.3 Transmit ON/OFF time mask for UL MIMO.

6.3D.2.5 Test requirement

The requirement for the transmit OFF power at each transmit antenna connector shall not exceed the values specified in Table 6.3D.2.5-1.

Table 6.3D.2.5-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -50+TT | 4.515 |
| 10 | -50+TT | 9.375 |
| 15 | -50+TT | 14.235 |
| 20 | -50+TT | 19.095 |
| 25 | -50+TT | 23.955 |
| 30 | -50+TT | 28.815 |
| 35 | -50+TT | 33.855 |
| 40 | -50+TT | 38.895 |
| 45 | -50+TT | 43.575 |
| 50 | -50+TT | 48.615 |
| 60 | -50+TT | 58.35 |
| 70 | -50+TT | 68.07 |
| 80 | -50+TT | 78.15 |
| 90 | -50+TT | 88.23 |
| 100 | -50+TT | 98.31 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3D.2.5-2 | | |

Table 6.3D.2.5-2: Test Tolerance (Transmit OFF power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 1.5 dB | 1.8 dB |
| 40MHz < BW ≤ 100MHz | 1.7 dB | 1.8 dB |

### 6.3D.2\_1 Transmit OFF power for SUL with UL MIMO

6.3D.2\_1.1 Test purpose

Same test purpose as in clause 6.3D.2.1.

6.3D.2\_1.2 Test applicability

This test applies to all types of NR UE release 17 and forward that support SUL and UL MIMO operating on the SUL bands.

6.3D.2\_1.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.3D.2.3.

6.3D.2\_1.4 Test description

This test is covered by clause 6.3D.3\_1 Transmit ON/OFF time mask for SUL with UL MIMO.

6.3D.2\_1.5 Test requirement

The requirement for the transmit OFF power at each transmit antenna connector shall not exceed the values specified in Table 6.3D.2\_1.5-1.

Table 6.3D.2\_1.5-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -50+TT | 4.515 |
| 10 | -50+TT | 9.375 |
| 15 | -50+TT | 14.235 |
| 20 | -50+TT | 19.095 |
| 25 | -50+TT | 23.955 |
| 30 | -50+TT | 28.815 |
| 35 | -50+TT | 33.855 |
| 40 | -50+TT | 38.895 |
| 45 | -50+TT | 43.575 |
| 50 | -50+TT | 48.615 |
| 60 | -50+TT | 58.35 |
| 70 | -50+TT | 68.07 |
| 80 | -50+TT | 78.15 |
| 90 | -50+TT | 88.23 |
| 100 | -50+TT | 98.31 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3D.2\_1.5-2 | | |

Table 6.3D.2\_1.5-2: Test Tolerance (Transmit OFF power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 1.5 dB | 1.8 dB |
| 40MHz < BW ≤ 100MHz | 1.7 dB | 1.8 dB |

### 6.3D.3 Transmit ON/OFF time mask for UL MIMO

6.3D.3.1 Test purpose

To verify that the general ON/OFF time mask for UL MIMO meets the requirements given in 6.3D.3.5

The transmit power time mask for transmit ON/OFF defines the transient period(s) allowed between transmit OFF power as defined in sub-clause 6.3D.2 and transmit ON power symbols (transmit ON/OFF)

Transmission of the wrong power increases interference to other channels, or increases transmission errors in the uplink channel.

6.3D.3.2 Test applicability

This test case applies to all types of NR Power Class 1.5, Power Class 2 and Power Class 3 UE release 15 and forward that support 2-layer codebook based UL MIMO.

6.3D.3.3 Minimum conformance requirements

For UE supporting UL MIMO, the ON/OFF time mask requirements in subclause 6.3.3.2.3 apply to each transmit antenna connector.

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the general ON/OFF time mask requirements specified in subclause 6.3.3.2.3 apply to each transmit antenna connector with the UL MIMO configurations specified in Table 6.3D.3.3-1.

Table 6.3D.3.3-1: UL MIMO configuration in closed-loop spatial multiplexing scheme

|  |  |  |
| --- | --- | --- |
| Transmission scheme | DCI format | Codebook Index |
| Codebook based uplink | DCI format 0\_1 | Codebook index 0 |

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3D.3

6.3D.3.4 Test description

6.3D.3.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, and are shown in table 6.3D.3.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3D.3.4.1-1: Test Configuration Table

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest, Highest | |
| Test Parameters for Channel Bandwidths | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A for minimum output power | Modulation | RB allocation (NOTE 1) |
| 1 | test case | CP-OFDM QPSK | Inner Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3D.3.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3D.3.4.3.

6.3D.3.4.2 Test procedure

1. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3D.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The UL assignment is such that the UE transmits on slots 8 for15kHz SCS, on slots 8 and 18 for 30kHz SCS and on slots 17 and 37 for 60kHz SCS. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

3. On power sub test:

3.1. Measure the sum output power at two transmit antenna connectors of the UE PUSCH transmission during one slot.

4. OFF power sub test:

4.1. Measure the UE transmission OFF power at each antenna connectors during the slot prior to the PUSCH transmission, excluding a transient period of 10 µs at the end of the slot.

4.2. Measure the UE transmission OFF power at each antenna connectors during the slot following the PUSCH transmission, excluding a transient period of 10 µs at the beginning of the slot.

6.3D.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX\_UL\_MIMO and following exceptions.

Table 6.3D.3.4.3-1: Void

Table 6.3D.3.4.3-2: TDD-UL-DL-Config

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 |
|  | ms10 |  | FR1\_15kHz |
| nrofDownlinkSlots | 6 |  | FR1\_15kHz |
|  | 6 |  | FR1\_30kHz |
|  | 14 |  | FR1\_60kHz |
| nrofDownlinkSymbols | 10 |  | FR1\_15kHz |
|  | 6 |  | FR1\_30kHz |
|  | 12 |  | FR1\_60kHz |
| nrofUplinkSlots | 3 |  | FR1\_15kHz,FR1\_30kHz |
|  | 4 |  | FR1\_60kHz |
| nrofUplinkSymbols | 4 |  | FR1\_30kHz |
|  | 2 |  | FR1\_15kHz, |
|  | 8 |  | FR1\_60kHz |
|  |  |  |  |
| } |  |  |  |
| pattern2 | Not present |  |  |
| } |  |  |  |

Table 6.3D.3.4.3-3: PUSCH-TimeDomainResourceAllocationList

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-122 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF { | 2 entries |  |  |
| PUSCH-TimeDomainResourceAllocation[1] SEQUENCE { |  |  |  |
| k2 | 4 |  | FR1\_15kHz,FR1\_30kHz |
| 6 |  | FR1\_60kHz |
| mappingType | typeA |  |  |
| startSymbolAndLength | 27 | Start symbol(S)=0, Length(L)=14 |  |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation[2] SEQUENCE { |  | addressed by Msg3 PUSCH time resource allocation field of the Random Access Response acc. to TS 38.213 [22] Table 8.2-1. |  |
| k2 | 2 | K2+ Δ=4 acc. to TS 38.214 [21] Table 6.1.2.1.1-5  (NOTE 1) | FR1\_15kHz |
| 6 | K2+ Δ=9 acc. to TS 38.214 [21] Table 6.1.2.1.1-5  (NOTE 1) | FR1\_30kHz |
| mappingType | typeA |  |  |
| startSymbolAndLength | 27 | Start symbol(S)=0, Length(L)=14 |  |
| } |  |  |  |
| } |  |  |  |
| NOTE 1: Values are chosen so that first slot of a TDD-UL-DL slot configuration period can be used for the Random Access Response and the last slot (of the same or another period) for the corresponding Msg3. | | | |

|  |  |
| --- | --- |
| Condition | Explanation |
| FR1\_15kHz | FR1 is used under the test. SCS is set to 15kHz. |
| FR1\_30kHz | FR1 is used under the test. SCS is set to 30kHz. |
| FR1\_60kHz | FR1 is used under the test. SCS is set to 60kHz. |

Table 6.3D.3.4.3-4: Void

Table 6.3D.3.4.3-5: *P-Max*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-89 | | | |
| Information Element | Value/remark | Comment | Condition |
| P-Max | 23 |  | Power class 2 or power class 1.5 |

6.3D.3.5 Test requirement

The requirement for the power measured in steps 2, 3 and 4 of the test procedure shall not exceed the values specified in Table 6.3D.3.5-1.

Table 6.3D.3.5-1: General ON/OFF time mask

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 35  MHz | 40  MHz | 45  MHz | 50  MHz | 60  MHz | 70  MHz | 80  MHz | 90  MHz | 100  MHz |
| Transmit OFF power | ≤ -50+TT dBm | | | | | | | | | | | | | | |
| Transmission OFF Measurement bandwidth | 4.515 | 9.375 | 14.235 | 19.095 | 23.955 | 28.815 | 33.855 | 38.895 | 43.575 | 48.615 | 58.35 | 68.07 | 78.15 | 88.23 | 98.31 |
| Transmit ON power | Same as test ID 1 in Table 6.2D.2.5-1 | | | | | | | | | | | | | | |
| NOTE 1: TT for each frequency and channel bandwidth of OFF power is specified in Table 6.3D.3.2.5-2  NOTE 2: TT for each frequency and channel bandwidth of ON power is specified in Table 6.2D.1.5-2 | | | | | | | | | | | | | | | |

Table 6.3D.3.5-2: Test Tolerance for OFF power

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 1.5 dB | 1.8 dB |
| 40MHz < BW ≤ 100MHz | 1.7 dB | 1.8 dB |

Table 6.3D.3.5-3: Void

### 6.3D.3\_1 Transmit ON/OFF time mask for SUL with UL MIMO

6.3D.3\_1.1 Test purpose

Same test purpose as in clause 6.3D.3.1.

6.3D.3\_1.2 Test applicability

This test applies to all types of NR UE release 17 and forward that support SUL and UL MIMO operating on the SUL bands.

6.3D.3\_1.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.3D.3.3.

6.3D.3\_1.4 Test description

6.3D.3\_1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.3D.3\_1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3D.3\_1.4.1-1: Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low range, Mid range, High range for SUL carrier  Mid range for Non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.5C-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | UL Configuration | | SUL Configuration | |
|  | N/A | N/A | | Modulation | RB allocation (NOTE 2) |
| 1 |  |  | | CP-OFDM QPSK | Inner Full |
| NOTE 1: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 2: The specific configuration of each RB allocation is defined in Table 6.1-1. | | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.5 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2 and G.3.0 with consideration of supplementary uplink physical channels.

4. The UL Reference Measurement Channel is set according to Table 6.3D.3\_1.4.1-1

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3D.3\_1.4.3.

6.3D.3\_1.4.2 Test procedure

1. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3D.3\_1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The UL assignment is such that the UE transmits on slots 8 for15kHz SCS, on slots 8 and 18 for 30kHz SCS and on slots 17 and 37 for 60kHz SCS. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

3. On power sub test:

3.1. Measure the sum output power at two transmit antenna connectors of the UE PUSCH transmission during one slot.

4. OFF power sub test:

4.1. Measure the UE transmission OFF power at each antenna connectors during the slot prior to the PUSCH transmission, excluding a transient period of 10 µs at the end of the slot.

4.2. Measure the UE transmission OFF power at each antenna connectors during the slot following the PUSCH transmission, excluding a transient period of 10 µs at the beginning of the slot.

6.3D.3\_1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, and Table 4.6.3-182 with the condition 2TX\_UL\_MIMO and following exception.

Table 6.3D.3\_1.4.3-1: TDD-UL-DL-Config

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 |
|  | ms10 |  | FR1\_15kHz |
| nrofDownlinkSlots | 6 |  | FR1\_15kHz |
|  | 6 |  | FR1\_30kHz |
|  | 14 |  | FR1\_60kHz |
| nrofDownlinkSymbols | 10 |  | FR1\_15kHz |
|  | 6 |  | FR1\_30kHz |
|  | 12 |  | FR1\_60kHz |
| nrofUplinkSlots | 3 |  | FR1\_15kHz,FR1\_30kHz |
|  | 4 |  | FR1\_60kHz |
| nrofUplinkSymbols | 4 |  | FR1\_30kHz |
|  | 2 |  | FR1\_15kHz, |
|  | 8 |  | FR1\_60kHz |
|  |  |  |  |
| } |  |  |  |
| pattern2 | Not present |  |  |
| } |  |  |  |

Table 6.3D.3\_1.4.3-2: PUSCH-TimeDomainResourceAllocationList

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-122 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF { | 2 entries |  |  |
| PUSCH-TimeDomainResourceAllocation[1] SEQUENCE { |  |  |  |
| k2 | 4 |  | FR1\_15kHz,FR1\_30kHz |
| 6 |  | FR1\_60kHz |
| mappingType | typeA |  |  |
| startSymbolAndLength | 27 | Start symbol(S)=0, Length(L)=14 |  |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation[2] SEQUENCE { |  | addressed by Msg3 PUSCH time resource allocation field of the Random Access Response acc. to TS 38.213 [22] Table 8.2-1. |  |
| k2 | 2 | K2+ Δ=4 acc. to TS 38.214 [21] Table 6.1.2.1.1-5  (NOTE 1) | FR1\_15kHz |
| 6 | K2+ Δ=9 acc. to TS 38.214 [21] Table 6.1.2.1.1-5  (NOTE 1) | FR1\_30kHz |
| mappingType | typeA |  |  |
| startSymbolAndLength | 27 | Start symbol(S)=0, Length(L)=14 |  |
| } |  |  |  |
| } |  |  |  |
| NOTE 1: Values are chosen so that first slot of a TDD-UL-DL slot configuration period can be used for the Random Access Response and the last slot (of the same or another period) for the corresponding Msg3. | | | |

|  |  |
| --- | --- |
| Condition | Explanation |
| FR1\_15kHz | FR1 is used under the test. SCS is set to 15kHz. |
| FR1\_30kHz | FR1 is used under the test. SCS is set to 30kHz. |
| FR1\_60kHz | FR1 is used under the test. SCS is set to 60kHz. |

Table 6.3D.3\_1.4.3-3: *P-Max*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-89 | | | |
| Information Element | Value/remark | Comment | Condition |
| P-Max | 23 |  |  |

6.3D.3\_1.5 Test requirement

The requirement for the power measured in steps 2, 3 and 4 of the test procedure shall not exceed the values specified in Table 6.3D.3.5-1.

Table 6.3D.3\_1.5-1: General ON/OFF time mask

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Channel bandwidth / minimum output power / measurement bandwidth | | | | | | | | | | | | | | |
| 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 35  MHz | 40  MHz | 45  MHz | 50  MHz | 60  MHz | 70  MHz | 80  MHz | 90  MHz | 100  MHz |
| Transmit OFF power | ≤ -50+TT dBm | | | | | | | | | | | | | | |
| Transmission OFF Measurement bandwidth | 4.515 | 9.375 | 14.235 | 19.095 | 23.955 | 28.815 | 33.855 | 38.895 | 43.575 | 48.615 | 58.35 | 68.07 | 78.15 | 88.23 | 98.31 |
| Transmit ON power | Same as test ID 1 in Table 6.2D.2.5-1 | | | | | | | | | | | | | | |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3D.3\_1.5-2 | | | | | | | | | | | | | | | |

Table 6.3D.3\_1.5-2: Test Tolerance for OFF power

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 1.5 dB | 1.8 dB |
| 40MHz < BW ≤ 100MHz | 1.7 dB | 1.8 dB |

### 6.3D.4 Power control for UL MIMO

#### 6.3D.4.1 Absolute power tolerance for UL MIMO

6.3D.4.1.1 Test purpose

To verify the ability of the UE transmitter for UL MIMO to set its initial output power to a specific value at the start of a contiguous transmission or non-contiguous transmission with a long transmission gap, i.e. transmission gap is larger than 20ms.

6.3D.4.1.2 Test applicability

This test case applies to all types of NR Power Class 1.5, Power Class 2 and Power Class 3 UE release 15 and forward that support 2-layer codebook based UL MIMO.

6.3D.4.1.3 Minimum conformance requirements

For UE supporting UL MIMO, the power control tolerance applies to the sum of output power at each transmit antenna connector.

The power control requirements specified in subclause 6.3.4.2 apply to UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme. The requirements shall be met with UL MIMO configurations described in Table 6.3D.4.1.3-1

Table 6.3D.4.1.3-1: UL MIMO configuration in closed-loop spatial multiplexing scheme

|  |  |  |
| --- | --- | --- |
| Transmission scheme | DCI format | Codebook Index |
| Codebook based uplink | DCI format 0\_1 | Codebook index 0 |

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3D.4.

6.3D.4.1.4 Test description

6.3D.4.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.3D.4.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3D.4.1.4.1-1: Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | | Lowest, Highest | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | | Uplink Configuration | |
|  | Modulation | RB Allocation | Modulation | RB allocation (NOTE 1) |
| 1 | N/A for Absolute power tolerance test case | | CP-OFDM QPSK | Outer\_Full |
| NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3D.4.1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3D.4.1.4.3. Note that PDCCH DCI format 0\_1 sent after resetting uplink power with RRC Connection Reconfiguration, should have TPC command 0dB.

6.3D.4.1.4.2 Test procedure

Same test procedure as clause 6.3.4.2.4.2 with following exceptions.

The power of UE PUSCH first transmissions should be measured as the sum power at each antenna connector.

6.3D.4.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX\_UL\_MIMO and following exceptions.

Table 6.3D.4.1.4.3-1: UplinkPowerControlCommon: Test point 1

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] subclause 4.6.3 Table 4.6.3-119 PUSCH-ConfigCommon | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-ConfigCommon::= SEQUENCE { |  |  |  |
| p0-NominalWithGrant | -114 | Test point 1 to verify a UE relative low initial power transmission |  |
| } |  |  |  |

Table 6.3D.4.1.4.3-2: UplinkPowerControlCommon: Test point 2

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] subclause 4.6.3 Table 4.6.3-119 PUSCH-ConfigCommon | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-ConfigCommon::= SEQUENCE { |  |  |  |
| p0-NominalWithGrant | -100 | Test point 2 to verify a UE relative high initial power transmission |  |
| } |  |  |  |

Table 6.3D.4.1.4.3-3: ServingCellConfigCommon

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1[5], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| ss-PBCH-BlockPower | 18 |  | SCS\_15kHz |
|  | 21 |  | SCS\_30kHz |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| SCS\_15kHz | SCS=15kHz for SS/PBCH block |
| SCS\_30kHz | SCS=30kHz for SS/PBCH block |

6.3D.4.1.5 Test requirement

The requirement for the power measured in step (2) of the test procedure is not to exceed the values specified in Table 6.3D.4.1.5-1 and 6.3D.4.1.5-2.

Table 6.3D.4.1.5-1: Absolute power tolerance: test point 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | Channel bandwidth / expected output power (dBm) | | | | | | | | | | | | | | |
| 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 35  MHz | 40 MHz | 45 MHz | 50 MHz | 60 MHz | 70 MHz | 80 MHz | 90 MHz | 100 MHz |
| Expected Measured power | SCS15 | -17.6 | -14.4 | -12.6 | -11.3 | -10.4 | -9.6 | -8.9 | -8.3 | -7.8 | -7.3 | N/A | N/A | N/A | N/A | N/A |
| SCS30 | -18.2 | -14.8 | -12.8 | -11.5 | -10.5 | -9.7 | -9 | -8.3 | -7.9 | -7.4 | -6.5 | -5.8 | -5.2 | -4.7 | -4.2 |
| SCS60 |  | -15.2 | -13 | -11.8 | -10.7 | -9.8 | -9.1 | -8.5 | -8 | -7.5 | -6.6 | -5.9 | -5.3 | -4.8 | -4.3 |
| Power tolerance | | ± (9+TT)dB | | | | | | | | | | | | | | |
| Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3.2.3  Note 2: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3.4.2.5-3. | | | | | | | | | | | | | | | | |

Table 6.3D.4.1.5-2: Absolute power tolerance: test point 2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | Channel bandwidth / expected output power (dBm) | | | | | | | | | | | | | | |
| 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 35  MHz | 40 MHz | 45 MHz | 50 MHz | 60 MHz | 70 MHz | 80 MHz | 90 MHz | 100 MHz |
| Expected Measured power | SCS15 | -3.6 | 0.4 | 1.4 | 2.7 | 3.6 | 4.4 | 5.1 | 5.7 | 6.2 | 6.7 | N/A | N/A | N/A | N/A | N/A |
| SCS30 | -4.2 | -0.8 | 1.2 | 2.5 | 3.5 | 4.3 | 5 | 5.7 | 6.2 | 6.6 | 7.5 | 8.2 | 8.8 | 9.3 | 9.8 |
| SCS60 | N/A | -1.2 | 1 | 2.2 | 3.3 | 4.2 | 4.9 | 5.5 | 6 | 6.5 | 7.4 | 8.1 | 8.7 | 9.2 | 9.7 |
| Power tolerance | | ± (9+TT)dB | | | | | | | | | | | | | | |
| Note 1: The higher power limit shall not exceed the maximum output power requirements defined in sub-clause 6.2.1.3  Note 2: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3.4.2.5-3. | | | | | | | | | | | | | | | | |

Table 6.3D.4.1.5-3: Test Tolerance

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.0 dB | 1.4 dB |
| 40MHz < BW ≤ 100MHz | 1.4 dB | 1.4 dB |

#### 6.3D.4.1\_1 Absolute power tolerance for SUL with UL MIMO

6.3D.4.1\_1.1 Test purpose

Same as test purpose in clause 6.3D.4.1.1.

6.3D.4.1\_1.2 Test applicability

This test applies to all types of NR UE release 17 and forward that support SUL and UL MIMO operating on the SUL bands.

6.3D.4.1\_1.3 Minimum conformance requirements

For UE supporting UL MIMO, the power control tolerance applies to the sum of output powers from both transmit antenna connector.

The power control requirements specified in clause 6.3.4 apply to UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme. The requirements shall be met with UL MIMO configurations described in clause 6.2D.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook-based transmission, the requirements in clause 6.3.4 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3D.4.

6.3D.4.1\_1.4 Test description

6.3D.4.1\_1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing and are shown in table 6.3D.4.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3D.4.1\_1.4.1-1: Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid-range for SUL and Non-SUL carrier | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | SUL Configuration | |
|  |  |  | Modulation | RB allocation (NOTE 2) |
| 1 | N/A | N/A | CP-OFDM QPSK | Outer\_Full |
| NOTE 1: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 2: The specific configuration of each RF allocation is defined in Table 6.1-1. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.5 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3D.4.1\_1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3D.4.1\_1.4.3. Note that PDCCH DCI format 0\_1 sent after resetting uplink power with RRC Connection Reconfiguration, should have TPC command 0dB.

6.3D.4.1\_1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 with TPC command 0dB for C\_RNTI to schedule the UL RMC according to Table 6.3D.4.1\_1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Measure the sum of initial output power from both transmit antenna connector of the first sub-frame (1ms) of UE PUSCH first transmission.

3. Repeat for the two test points as indicated in section 6.3D.4.1\_1.4.3. The timing of the execution between the two test points shall be larger than 20ms.

6.3D.4.1\_1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, and Table 4.6.3-182 with the condition 2TX\_UL\_MIMO and following exception.

Table 6.3D.4.1\_1.4.3-1: UplinkPowerControlCommon: Test point 1

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] subclause 4.6.3 Table 4.6.3-119 PUSCH-ConfigCommon | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-ConfigCommon::= SEQUENCE { |  |  |  |
| p0-NominalWithGrant | -114 | Test point 1 to verify a UE relative low initial power transmission |  |
| } |  |  |  |

Table 6.3D.4.1\_1.4.3-2: UplinkPowerControlCommon: Test point 2

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] subclause 4.6.3 Table 4.6.3-119 PUSCH-ConfigCommon | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-ConfigCommon::= SEQUENCE { |  |  |  |
| p0-NominalWithGrant | -100 | Test point 2 to verify a UE relative high initial power transmission |  |
| } |  |  |  |

Table 6.3D.4.1\_1.4.3-3: ServingCellConfigCommon

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1[5], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| ss-PBCH-BlockPower | 18 |  | SCS\_15kHz |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| SCS\_15kHz | SCS=15kHz for SS/PBCH block |

6.3D.4.1\_1.5 Test requirement

The requirement for the power measured in step (2) of the test procedure is not to exceed the values specified in Table 6.3D.4.1\_1.5-1 and 6.3D.4.1\_1.5-2.

Table 6.3D.4.1\_1.5-1: Absolute power tolerance: test point 1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Channel bandwidth / expected output power (dBm) | | | | | | | |
| 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz |
| Expected Measured power | -17.6 | -14.4 | -12.6 | -11.3 | -10.4 | -9.6 | -8.3 | -7.3 |
| Power tolerance | ± (9+TT)dB | | | | | | | |
| Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3.2.3  Note 2: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3D.4.1\_1.5-3. | | | | | | | | |

Table 6.3D.4.1\_1.5-2: Absolute power tolerance: test point 2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Channel bandwidth / expected output power (dBm) | | | | | | | |
| 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz |
| Expected Measured power | -3.6 | 0.4 | 1.4 | 2.7 | 3.6 | 4.4 | 5.7 | 6.7 |
| Power tolerance | ± (9+TT)dB | | | | | | | |
| Note 1: The higher power limit shall not exceed the maximum output power requirements defined in sub-clause 6.2D.1\_1.3  Note 2: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3D.4.1\_1.5-3. | | | | | | | | |

Table 6.3D.4.1\_1.5-3: Test Tolerance

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.0 dB | 1.4 dB |
| 40MHz < BW ≤ 100MHz | 1.4 dB | 1.4 dB |

#### 6.3D.4.2 Relative power tolerance for UL MIMO

6.3D.4.2.1 Test purpose

To verify the ability of the UE transmitter to set its output power in a target sub-frame relatively to the power of the most recently transmitted reference sub-frame if the transmission gap between these sub-frames is ≤ 20ms.

6.3D.4.2.2 Test applicability

This test case applies to all types of NR Power Class 1.5, Power Class 2 and Power Class 3 UE release 15 and forward that support 2-layer codebook based UL MIMO.

6.3D.4.2.3 Minimum conformance requirements

For UE supporting UL MIMO, the power control tolerance applies to the sum of output power at each transmit antenna connector.

The power control requirements specified in subclause 6.3.4.3 apply to UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme. The requirements shall be met with UL MIMO configurations described in clause 6.2D.1.3.

Table 6.3D.4.2.3-1: Void

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3D.4

6.3D.4.2.4 Test description

6.3D.4.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.3D.4.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3D.4.2.4.1-1: Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest | |
| Test SCS as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Highest | |
| Test Parameters | | | | |
| Ch BW | Downlink Configuration | | Uplink Configuration | |
|  | Modulation | RB Allocation | Modulation | RB allocation (NOTE 1) |
| 5MHz | N/A for Relative power tolerance test case | | CP-OFDM QPSK | See Table 6.3D.4.2.5-1  See Table 6.3D.4.2.5-2  See Table 6.3D.4.2.5-7 |
| 10MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2.5-3  See Table 6.3D.4.2.5-4  See Table 6.3D.4.2.5-7 |
| 15MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2.5-3  See Table 6.3D.4.2.5-4  See Table 6.3D.4.2.5-7 |
| 20MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2.5-3  See Table 6.3D.4.2.5-4  See Table 6.3D.4.2.5-7 |
| 25MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2.5-3  See Table 6.3D.4.2.5-4  See Table 6.3D.4.2.5-7 |
| 30MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2.5-3  See Table 6.3D.4.2.5-4  See Table 6.3D.4.2.5-7 |
| 35MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2.5-3  See Table 6.3D.4.2.5-4  See Table 6.3D.4.2.5-7 |
| 40MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2.5-3  See Table 6.3D.4.2.5-4  See Table 6.3D.4.2.5-7 |
| 45MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2.5-3  See Table 6.3D.4.2.5-4  See Table 6.3D.4.2.5-7 |
| 50MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2.5-3  See Table 6.3D.4.2.5-4  See Table 6.3D.4.2.5-7 |
| 60MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2.5-5  See Table 6.3D.4.2.5-6  See Table 6.3D.4.2.5-7 |
| 70MHz |  | | CP-OFDM QPSK | See Table 6.3.4.3.5-5  See Table 6.3.4.3.5-6  See Table 6.3.4.3.5-7 |
| 80MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2.5-5  See Table 6.3D.4.2.5-6  See Table 6.3D.4.2.5-7 |
| 90MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2.5-5  See Table 6.3D.4.2.5-6  See Table 6.3D.4.2.5-7 |
| 100MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2.5-5  See Table 6.3D.4.2.5-6  See Table 6.3D.4.2.5-7 |
| Note 1: The starting resource block shall be RB# 0 | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3D.4.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3D.4.2.4.3.

6.3D.4.2.4.2 Test procedure

Same test procedure as clause 6.3.4.3.4.2 with following exceptions.

The power of PUSCH transmissions should be measured as the sum power at each antenna connector.

Instead of table 6.3.4.3.4.1-1 🡪 use Table 6.3D.4.2.4.1-1

Step 1.1 in ramping up pattern sub test should be changed into following description:

1.1 SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3D.4.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send the appropriate TPC commands for PUSCH to the UE to ensure that the UE transmits PUSCH at -31.8 dBm +/- 2.7 dB.

6.3D.4.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX\_UL\_MIMO.

6.3D.4.2.5 Test requirement

Each UE power step measured in the test procedure 6.3D.4.2.4.2 should satisfy the test requirements specified in Table 6.3D.4.2.5-1 thru 6.3D.4.2.5-7.

To account for RF Power amplifier mode changes 2 exceptions are allowed for each of ramping up and ramping down test patterns. For these exceptions the power tolerance limit is a maximum of ± (6.0 + TT) dB. If there is an exception in the power step caused by the RB change for all test patterns (A, B, C) then fail the UE.

Table 6.3D.4.2.5-1: Test Requirements Relative Power Tolerance for Transmission, channel BW 5MHz, ramp up sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Up) | Power step size range (Up) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Sub-frames before RB change | Fixed = 1 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Sub-frames before RB change | Fixed = 1 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 1RB to 15 RBs | TPC=+1dB | 12.76 | 10dB ≤ ΔP < 15dB | 12.76 +/- (4 + TT) |
|  |  | Sub-frames after RB change | Fixed = 15 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Sub-frames before RB change | Fixed = 1 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 30 |  | Sub-frames before RB change | Fixed = 1 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 1RB to 10 RBs | TPC=+1dB | 11.00 | 10dB ≤ ΔP < 15dB | 11.00 +/- (4 + TT) |
|  |  | Sub-frames after RB change | Fixed = 10 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Sub-frames Pattern B the position of RB uplink allocation change is after 20 active uplink Sub-frames Pattern C the position of RB uplink allocation change is after 30 active uplink Sub-frames  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3.1. | | | | | | | |

Table 6.3D.4.2.5-2: Test Requirements Relative Power Tolerance for Transmission, channel BW 5MHz, ramp down sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Down) | Power step size range (Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Sub-frames before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 |  | Sub-frames before RB change | Fixed = 15 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 15 RBs to 1 RB | TPC=-1dB | 12.76 | 10dB ≤ ΔP < 15dB | 12.76 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Sub-frames before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 30 |  | Sub-frames before RB change | Fixed = 10 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 10 RBs to 1 RB | TPC=-1dB | 11.00 | 10dB ≤ ΔP < 15dB | 11.00 +/- (4 + TT) |
|  |  | Sub-frames after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Sub-frames Pattern B the position of RB uplink allocation change is after 20 active uplink Sub-frames Pattern C the position of RB uplink allocation change is after 30 active uplink Sub-frames  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3.1. | | | | | | | |

Table 6.3D.4.2.5-3: Test Requirements Relative Power Tolerance for Transmission, channel BW 10MHz, 15MHz, 20MHz, 25MHz, 30MHz, 35MHz, 40MHz, 45MHz, 50MHz ramp up sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Up) | Power step size range (Up) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 | 2 | RB change | 1RB to 20 RBs | TPC=+1dB | 14.01 | 10dB ≤ ΔP < 15dB | 14.01 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 20 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 3 | RB change | 1RB to 50 RBs | TPC=+1dB | 17.99 | 15dB ≤ ΔP | 17.99 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 50 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 30 |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 1RB to 24 RBs | TPC=+1dB | 14.80 | 10dB ≤ ΔP < 15dB | 14.80+/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 24 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 60 |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 1RB to 10 RBs | TPC=+1dB | 11.00 | 10dB ≤ ΔP < 15dB | 11.00 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 10 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3.1. | | | | | | | |

Table 6.3D.4.2.5-4: Test Requirements Relative Power Tolerance for Transmission, channel BW 10MHz, 15MHz, 20MHz, 25MHz, 30MHz, 35MHz, 40MHz, 45MHz, 50MHz ramp down sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Down) | Power step size range (Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1RBs | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 20 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 | 2 | RB change | 20 RBs to 1 RB | TPC=-1dB | 14.01 | 10dB ≤ ΔP < 15dB | 14.01 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 50 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 3 | RB change | 50 RBs to 1 RB | TPC=-1dB | 17.99 | 15dB ≤ ΔP | 17.99 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 30 |  | Subframes before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 24 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 24 RBs to 1 RB | TPC=-1dB | 14.80 | 10dB ≤ ΔP < 15dB | 14.80 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 60 |  | Subframes before RB change | Fixed = 10 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 10 RBs to 1 RB | TPC=-1dB | 11.00 | 10dB ≤ ΔP < 15dB | 11.00 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3.1. | | | | | | | |

Table 6.3D.4.2.5-5: Test Requirements Relative Power Tolerance for Transmission, channel BW 60MHz, 70MHz, 80MHz, 90MHz, 100MHz ramp up sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Up) | Power step size range (Up) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 30 | 2 | RB change | 1RB to 24 RBs | TPC=+1dB | 14.80 | 10dB ≤ ΔP < 15dB | 14.80 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 24 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 3 | RB change | 1RB to 81 RBs | TPC=+1dB | 20.08 | 15dB < ΔP | 20.08 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 81 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 60 |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 1RB to 75 RBs | TPC=+1dB | 19.75 | 15dB < ΔP | 19.75 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 75 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3.1. | | | | | | | |

Table 6.3D.4.2.5-6: Test Requirements Relative Power Tolerance for Transmission, channel BW 60MHz, 70MHz, 80MHz, 90MHz, 100MHz ramp down sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Down) | Power step size range (Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 24 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 30 | 2 | RB change | 24 RBs to 1 RB | TPC=-1dB | 14.80 | 10dB ≤ ΔP < 15dB | 14.80 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 81 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 3 | RB change | 81 RBs to 1 RB | TPC=-1dB | 20.08 | 15dB < ΔP | 20.08 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 60 |  | Subframes before RB change | Fixed = 75 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 75 RBs to 1 RB | TPC=-1dB | 19.75 | 15dB < ΔP | 19.75 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3.1. | | | | | | | |

Table 6.3D.4.2.5-7: Test Requirements Relative Power Tolerance for Transmission, alternating sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| BW | Test SCS [kHz] | Sub-test ID | Uplink RB allocation | TPC command | Expected power step size (Up or Down) | Power step size range (Up or Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
|  | 15 | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
| 5 |  | 3 | Alternating 1 and 15 | TPC=0dB | 11.76 | 10dB ≤ ΔP < 15dB | 11.76 +/- (4 + TT) |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
|  | 30 | 2 | Alternating 1 and 10 | TPC=0dB | 10.00 | 10dB ≤ ΔP < 15dB | 10.00 +/- (4 + TT) |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
|  |  | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  | 15 | 3 | Alternating 1 and 20 | TPC=0dB | 13.01 | 10dB ≤ ΔP < 15dB | 13.01 +/- (4 + TT) |
|  |  | 4 | Alternating 1 and 50 | TPC=0dB | 16.99 | 15dB ≤ ΔP | 16.99 +/- (5 + TT) |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
| 10,15,20, 25,30,35, 40,45,50 | 30 | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  |  | 3 | Alternating 1 and 24 | TPC=0dB | 13.80 | 10dB ≤ ΔP < 15dB | 13.80 +/- (4 + TT) |
|  |  | 1 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  | 60 | 2 | Alternating 1 and 10 | TPC=0dB | 10.00 | 10dB ≤ ΔP < 15dB | 10.00 +/- (4 + TT) |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
|  | 30 | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  |  | 3 | Alternating 1 and 81 | TPC=0dB | 19.08 | 15dB < ΔP | 19.08 +/- (5 + TT) |
| 60,70,80,90,100 |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
|  | 60 | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  |  | 3 | Alternating 1 and 75 | TPC=0dB | 18.75 | 15dB < ΔP | 18.75 +/- (5 + TT) |
| Note 1: The starting resource block shall be RB# 0.  Note 2: TT=0.7dB  Note 3: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3.1. | | | | | | | |

#### 6.3D.4.2\_1 Relative power tolerance for SUL with UL MIMO

6.3D.4.2\_1.1 Test purpose

Same as test purpose in clause 6.3D.4.2.1.

6.3D.4.2\_1.2 Test applicability

This test applies to all types of NR UE release 17 and forward that support SUL and UL MIMO operating on the SUL bands.

6.3D.4.2\_1.3 Minimum conformance requirements

For UE supporting UL MIMO, the power control tolerance applies to the sum of output power at each transmit antenna connector.

The power control requirements specified in subclause 6.3.4.3 apply to UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme. The requirements shall be met with UL MIMO configurations described in clause 6.2D.1\_1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook-based transmission, the requirements in clause 6.3.4 apply.

Table 6.3D.4.2\_1.3-1: UL MIMO configuration in closed-loop spatial multiplexing scheme

|  |  |  |
| --- | --- | --- |
| Transmission scheme | DCI format | Codebook Index |
| Codebook based uplink | DCI format 0\_1 | Codebook index 0 |

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3D.4

6.3D.4.2\_1.4 Test description

6.3D.4.2\_1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.3D.4.2\_1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3D.4.2\_1.4.1-1: Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low range for SUL carrier  Mid-range for Non-SUL carrier | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | |
| Test SCS as specified in table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | |
| Test Parameters | | | | |
| Ch BW | Downlink Configuration | Uplink Configuration | SUL Configuration | |
|  |  |  | Modulation | RB allocation (NOTE 1) |
| 5MHz | N/A | | CP-OFDM QPSK | See Table 6.3D.4.2\_1.5-1  See Table 6.3D.4.2\_1.5-2  See Table 6.3D.4.2\_1.5-5 |
| 10MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2\_1.5-3  See Table 6.3D.4.2\_1.5-4  See Table 6.3D.4.2\_1.5-5 |
| 15MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2\_1.5-3  See Table 6.3D.4.2\_1.5-4  See Table 6.3D.4.2\_1.5-5 |
| 20MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2\_1.5-3  See Table 6.3D.4.2\_1.5-4  See Table 6.3D.4.2\_1.5-5 |
| 25MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2\_1.5-3  See Table 6.3D.4.2\_1.5-4  See Table 6.3D.4.2\_1.5-5 |
| 30MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2\_1.5-3  See Table 6.3D.4.2\_1.5-4  See Table 6.3D.4.2\_1.5-5 |
| 40MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2\_1.5-3  See Table 6.3D.4.2\_1.5-4  See Table 6.3D.4.2\_1.5-5 |
| 50MHz |  | | CP-OFDM QPSK | See Table 6.3D.4.2\_1.5-3  See Table 6.3D.4.2\_1.5-4  See Table 6.3D.4.2\_1.5-5 |
| NOTE 1: The starting resource block shall be RB# 0  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.5 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3D.4.2\_1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3D.4.1\_1.4.3. Note that PDCCH DCI format 0\_1 sent after resetting uplink power with RRC Connection Reconfiguration, should have TPC command 0dB.

6.3D.4.2\_1.4.2 Test procedure

Same test procedure as clause 6.3.4.3.4.2 with following exceptions.

The power of PUSCH transmissions should be measured as the sum power at each antenna connector.

Step 1.1 in ramping up pattern sub test should be changed into following description:

1.1 SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to 6.3D.4.2\_1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send the appropriate TPC commands for PUSCH to the UE to ensure that the UE transmits PUSCH at -31.8 dBm +/- 2.7 dB.

6.3D.4.2\_1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, and Table 4.6.3-182 with the condition 2TX\_UL\_MIMO.

6.3D.4.2\_1.5 Test requirement

Each UE power step measured in the test procedure 6.3D.4.2\_1.4.2 should satisfy the test requirements specified in Table 6.3D.4.2\_1.5-1 to Table 6.3D.4.2\_1.5-5.

To account for RF Power amplifier mode changes 2 exceptions are allowed for each of ramping up and ramping down test patterns. For these exceptions the power tolerance limit is a maximum of ± (6.0 + TT) dB. If there is an exception in the power step caused by the RB change for all test patterns (A, B, C) then fail the UE.

Table 6.3D.4.2\_1.5-1: Test Requirements Relative Power Tolerance for Transmission, channel BW 5MHz, ramp up sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Up) | Power step size range (Up) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Sub-frames before RB change | Fixed = 1 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Sub-frames before RB change | Fixed = 1 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 1RB to 15 RBs | TPC=+1dB | 12.76 | 10dB ≤ ΔP < 15dB | 12.76 +/- (4 + TT) |
|  |  | Sub-frames after RB change | Fixed = 15 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Sub-frames Pattern B the position of RB uplink allocation change is after 20 active uplink Sub-frames Pattern C the position of RB uplink allocation change is after 30 active uplink Sub-frames  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3D.1\_1. | | | | | | | |

Table 6.3D.4.2\_1.5-2: Test Requirements Relative Power Tolerance for Transmission, channel BW 5MHz, ramp down sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Down) | Power step size range (Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Sub-frames before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 |  | Sub-frames before RB change | Fixed = 15 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 15 RBs to 1 RB | TPC=-1dB | 12.76 | 10dB ≤ ΔP < 15dB | 12.76 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Sub-frames Pattern B the position of RB uplink allocation change is after 20 active uplink Sub-frames Pattern C the position of RB uplink allocation change is after 30 active uplink Sub-frames  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3D.1\_1. | | | | | | | |

Table 6.3D.4.2\_1.5-3: Test Requirements Relative Power Tolerance for Transmission, channel BW 10MHz, 15MHz, 20MHz, 25MHz, 30MHz, 40MHz, 50MHz ramp up sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Up) | Power step size range (Up) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 | 2 | RB change | 1RB to 20 RBs | TPC=+1dB | 14.01 | 10dB ≤ ΔP < 15dB | 14.01 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 20 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/-0.7 + TT |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 3 | RB change | 1RB to 50 RBs | TPC=+1dB | 17.99 | 15dB ≤ ΔP | 17.99 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 50 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3D.1\_1. | | | | | | | |

Table 6.3D.4.2\_1.5-4: Test Requirements Relative Power Tolerance for Transmission, channel BW 10MHz, 15MHz, 20MHz, 25MHz, 30MHz, 40MHz, 50MHz ramp down sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Down) | Power step size range (Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1RBs | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 20 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 | 2 | RB change | 20 RBs to 1 RB | TPC=-1dB | 14.01 | 10dB ≤ ΔP < 15dB | 14.01 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 50 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 3 | RB change | 50 RBs to 1 RB | TPC=-1dB | 17.99 | 15dB ≤ ΔP | 17.99 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3D.1\_1. | | | | | | | |

Table 6.3D.4.2\_1.5-5: Test Requirements Relative Power Tolerance for Transmission, alternating sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| BW | Test SCS [kHz] | Sub-test ID | Uplink RB allocation | TPC command | Expected power step size (Up or Down) | Power step size range (Up or Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
| 5 | 15 | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  |  | 3 | Alternating 1 and 15 | TPC=0dB | 11.76 | 10dB ≤ ΔP < 15dB | 11.76 +/- (4 + TT) |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
| 10,15,20, 25,30,40,50 |  | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  | 15 | 3 | Alternating 1 and 20 | TPC=0dB | 13.01 | 10dB ≤ ΔP < 15dB | 13.01 +/- (4 + TT) |
|  |  | 4 | Alternating 1 and 50 | TPC=0dB | 16.99 | 15dB ≤ ΔP | 16.99 +/- (5 + TT) |
| Note 1: The starting resource block shall be RB# 0.  Note 2: TT=0.7dB  Note 3: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3D.1\_1. | | | | | | | |

#### 6.3D.4.3 Aggregate power tolerance for UL MIMO

6.3D.4.3.1 Test purpose

To verify the ability of the UE with UL MIMO to maintain its power during non-contiguous transmissions within 21ms in response to 0 dB commands with respect to the first UE transmission and all other power control parameters as specified in 38.213 kept constant.

6.3D.4.3.2 Test applicability

This test case applies to all types of NR Power Class 1.5, Power Class 2 and Power Class 3 UE release 15 and forward that support 2-layer codebook based UL MIMO.

6.3D.4.3.3 Minimum conformance requirements

For UE supporting UL MIMO, the power control tolerance applies to the sum of output power at each transmit antenna connector.

The power control requirements specified in subclause 6.3.4.4 apply to UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme. The requirements shall be met with UL MIMO configurations described in Table 6.3D.4.3.3-1

Table 6.3D.4.3.3-1: UL MIMO configuration in closed-loop spatial multiplexing scheme

|  |  |  |
| --- | --- | --- |
| Transmission scheme | DCI format | Codebook Index |
| Codebook based uplink | DCI format 0\_1 | Codebook index 0 |

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3D.4

6.3D.4.3.4 Test description

6.3D.4.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.3D.4.3.4.1-1 and table 6.3D.4.3.4.1-2. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3D.4.3.4.1-1: Test Configuration Table: PUCCH sub-test

|  |  |  |
| --- | --- | --- |
| Initial Conditions | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Mid range |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest |
| Test SCS as specified in Table 5.3.5-1 | | Lowest, Highest |
| Test Parameters for Channel Bandwidths | | |
| Test ID | Downlink Configuration | Uplink Configuration |
|  | CP-OFDM QPSK  Full RB allocation (NOTE 1) | PUCCH format = Format 1  Length in OFDM symbols = 14 |
| 1 |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2. | | |

Table 6.3D.4.3.4.1-2: Test Configuration Table: PUSCH sub-test

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Mid range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest, Highest | |
| Test Parameters for Channel Bandwidths | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A for aggregate power tolerance testcase | Modulation | RB allocation (NOTE 1) |
| 1 | CP-OFDM QPSK | Outer\_Full |
| NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL and DL Reference Measurement channels are set according to Table 6.3D.4.3.4.1-1 (PUCCH sub-test) and Table 6.3D.4.3.4.1-2 (PUSCH sub-test)

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3D.4.3.4.3.

6.3D.4.3.4.2 Test procedure

Same test procedure as clause 6.3.4.4.4.2 with following exceptions.

The power of PUCCH /PUSCH transmissions should be measured as the sum power at each antenna connector.

6.3D.4.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX\_UL\_MIMO.

6.3D.4.3.5 Test requirement

The requirement for the power measurements made in step (1.3) and (2.3) of the test procedure shall not exceed the values specified in Table 6.3D.4.3.5-1. The power measurement period shall be 1 sub-frame.

Table 6.3D.4.3.5-1: Power control tolerance

|  |  |  |
| --- | --- | --- |
| TPC commands | UL channel | Test requirement measured power |
| 0 dB | PUCCH | Given 5 power measurements in the pattern, the 2nd, and later measurements shall be within ± (2.5dB + TT) of the 1st measurement. |
| 0 dB | PUSCH | Given 5 power measurements in the pattern, the 2nd, and later measurements shall be within ± (3.5dB + TT) of the 1st measurement. |
| Note 1: For SCS 30kHz 1 sub-frame corresponds to 2 slots, so 2 TPC commands will be sent for a single measurement period. For SCS 60kHz 1 sub-frame corresponds to 4 slot, so 4 TPC commands will be sent for a single measurement period. | | |

#### 6.3D.4.3\_1 Aggregate power tolerance for SUL with UL MIMO

6.3D.4.3\_1.1 Test purpose

Same as test purpose in clause 6.3D.4.3.1

6.3D.4.3\_1.2 Test applicability

This test applies to all types of NR UE release 17 and forward that support SUL and UL MIMO operating on the SUL bands.

6.3D.4.3\_1.3 Minimum conformance requirements

For UE supporting UL MIMO, the power control tolerance applies to the sum of output powers from both transmit antenna connector.

The power control requirements specified in clause 6.3.4 apply to UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme. The requirements shall be met with UL MIMO configurations described in clause 6.2D.1\_1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.3.4 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3D.4.

6.3D.4.3\_1.4 Test description

6.3D.4.3\_1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing and are shown in table 6.3D.4.3\_1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3D.4.3\_1.4.1-1: Test Configuration Table: PUCCH sub-test

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid range for SUL and Non-SUL carrier |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier |
| Test Parameters for Channel Bandwidths | | | |
| Test ID | Downlink Configuration | Uplink Configuration | SUL Configuration |
|  |  |  | PUCCH format = Format 1  Length in OFDM symbols = 14 |
| 1 | CP-OFDM QPSK  Full RB allocation (NOTE 1) | N/A |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2. | | | |

Table 6.3D.4.3\_1.4.1-2: Test Configuration Table: PUSCH sub-test

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid range for SUL and Non-SUL carrier | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | |
| Test Parameters for Channel Bandwidths | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | SUL Configuration | |
|  |  |  | Modulation | RB allocation (NOTE 1) |
| 1 | N/A | N/A | CP-OFDM QPSK | Outer\_Full |
| NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.5 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL and DL Reference Measurement channels are set according to Table 6.3D.4.3\_1.4.1-1 (PUCCH sub-test) and Table 6.3D.4.3\_1.4.1-2 (PUSCH sub-test)

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3D.4.3.4.3.

6.3D.4.3\_1.4.2 Test procedure

Same test procedure as clause 6.3.4.4.4.2 with following exceptions.

The power of PDCCH /PUSCH transmissions should be measured as the sum power at each antenna connector.

6.3D.4.3\_1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, and Table 4.6.3-182 with the condition 2TX\_UL\_MIMO.

6.3D.4.3\_1.5 Test requirement

The requirement for the power measurements made in step (1.3) and (2.3) of the test procedure shall not exceed the values specified in Table 6.3D.4.3\_1.5-1. The power measurement period shall be 1 sub-frame(1ms).

Table 6.3D.4.3\_1.5-1: Power control tolerance

|  |  |  |
| --- | --- | --- |
| TPC command | UL channel | Test requirement measured power |
| 0 dB | PUCCH | Given 5 power measurements in the pattern, the 2nd, and later measurements shall be within ± (2.5 + TT) dB of the 1st measurement. |
| 0 dB | PUSCH | Given 5 power measurements in the pattern, the 2nd, and later measurements shall be within ± (3.5 + TT) dB of the 1st measurement. |
| Note 1: TT=0.7dB. | | |

## 6.3E Output power dynamics for V2X

### 6.3E.1 Minimum output power for V2X

#### 6.3E.1.0 Minimum conformance requirements

6.3E.1.0.1 General

When UE is configured for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions for NR V2X operating bands in Table 5.2E-1, the minimum output power is specified in Table 6.3E.1.0.1-1. The minimum output power is defined as the mean power in at least one sub-frame 1 ms.

Table 6.3E.1.0.1-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 10 | -30 | 9.375 |
| 20 | -30 | 19.095 |
| 30 | -28.2 | 28.815 |
| 40 | -27 | 38.895 |

For NR V2X UE with two transmit antenna connectors, the minimum output power is defined as the sum of the mean power at each transmit connector in one sub-frame (1 ms). The minimum output power shall not exceed the values specified for single carrier.

If the UE transmits on one antenna connector at a time, the requirements specified for single carrier shall apply to the active antenna connector.

6.3E.1.0.2 Minimum output power for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 6.3.1.3 shall apply for the uplink in licensed band and the requirements specified in subclause 6.3E.1.0 shall apply for the sidelink in licensed band or Band n47.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3E.1

#### 6.3E.1.1 Minimum output power for V2X / non-concurrent operation

6.3E.1.1.1 Test purpose

Same test purpose as in 6.3.1.1.

6.3E.1.1.2 Test applicability

This test case applies to all types of UE release 16 and forward that support NR V2X sidelink communication.

6.3E.1.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3E.1.0.

6.3E.1.1.4 Test description

6.3E.1.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.2E.1-1 and table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.3E.1.1.4.1-1. The details of the V2X reference measurement channels (RMCs) are specified in Annex A.7.5 and the GNSS configuration in TS 38.508-1 [5] subclause 4.11.

Table 6.3E.1.1.4.1-1: Test Configuration Table for minimum output power

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1.8 | | | Low range, High range | |
| Test Channel Bandwidths as specified TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | | Lowest, Highest | |
| Test Parameters for Channel Bandwidths | | | | |
| Test ID | Freq | V2X Configuration to Transmit | | |
|  |  | Modulation | | PSCCH and PSSCH RB allocation  (Note 1) |
| 1 | Default | QPSK | | Outer\_Full |
| 3 | Default | 16QAM | | Outer\_Full |
| 5 | Default | 64QAM | | Outer\_Full |
| 6 | Default | 256QAM | | Outer\_Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1E-1. | | | | |

1. Connect the SS and GNSS simulator to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.9.1 for TE diagram and section A.3.2.7 for UE diagram.

2. The parameter settings for the NR sidelink transmission over PC5 are pre-configured according to TS 38.508-1 [5] subclause 4.10. Message content exceptions are defined in clause 6.3E.1.1.4.3.

3. The V2X Reference Measurement Channel is set according to Table 6.3E.1.1.4.1-1.

4. The GNSS simulator is configured for Scenario #1: static in Ge ographical area #1, as defined in TS38.508-1 [5] Table 4.11.2-2. Geographical area #1 is also pre-configured in the UE.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state Out\_of\_Coverage with generic procedure parameters Sidelink *On*, Test Loop Function *On* with UE test loop mode E closed for *Transmit Mode* according to TS 38.508-1 [5] clause 4.5.

6.3E.1.1.4.2 Test procedure

1. The UE starts to perform the NR sidelink communication according to *SL-PreconfigurationNR*. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the NR sidelink RMC.

2. Measure the mean power of the UE in the channel bandwidth according to the test configuration from Table 6.3E.1.1.4.1-1. The period of measurement shall be at least continuous duration of one active sub-frame (1ms) excluding guard symbols.

6.3E.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.10 with the following exceptions.

Table 6.3E.1.1.4.3-1: *SL-ResourcePool*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.6-25 | | | |
| Information Element | Value/remark | Comment | Condition |
| SL-ResourcePool-r16 ::= SEQUENCE { |  |  |  |
| sl-PSCCH-Config-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| sl-TimeResourcePSCCH-r16 | As defined in Table 6.1E-2 |  |  |
| sl-FreqResourcePSCCH-r16 | As defined in Table 6.1E-2 |  |  |
| } |  |  |  |
| } |  |  |  |
| sl-SubchannelSize-r16 | As defined in Table 6.1E-2 |  |  |
| sl-StartRB-Subchannel-r16 | As defined in Table 6.1E-2 |  |  |
| sl-NumSubchannel-r16 | As defined in Table 6.1E-2 |  |  |
| } |  |  |  |

Table 6.3E.1.1.4.3-2: *SL-TxPower*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.6-33 | | | |
| Information Element | Value/remark | Comment | Condition |
| SL-TxPower-r16 ::= CHOICE { |  |  |  |
| txPower | -30 |  |  |
| } |  |  |  |

6.3E.1.1.5 Test requirement

The minimum output power, derived in step 2 shall not exceed the values specified in Table 6.3E.1.1.5-1.

Table 6.3E.1.1.5-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 10 | -30+TT | 9.375 |
| 20 | -30+TT | 19.095 |
| 30 | -28.2+TT | 28.815 |
| 40 | -27+TT | 38.895 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3.1.5-2 | | |

Table 6.3E.1.1.5-2: Test Tolerance (Minimum output power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.0 dB | 1.3 dB |

#### 6.3E.1.1D Minimum output power for V2X / non-concurrent operation / SL-MIMO

Editor’s Note: The test case is not completed due to the following aspects are not yet determined:

- Uplink RMC is TBD in RAN4

- Preconfiguration is not complete in 38.508-1

- Test state and generic procedure are TBD in 38.508-1

- Measurement period of PSFCH and PSBCH is FFS.

- Connection diagram for SL-MIMO is TBD

6.3E.1.1D.1 Test purpose

Same test purpose as in 6.3E.1.1.

6.3E.1.1D.2 Test applicability

This test case applies to all types of UE release 16 and forward that support NR V2X sidelink communication and SL-MIMO.

6.3E.1.1D.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3E.1.0.

6.3E.1.1D.4 Test description

6.3E.1.1D.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.2E.1-1 and table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.3E.1.1D.4.1-1. The details of the V2X reference measurement channels (RMCs) are specified in Annexes TBD and the GNSS configuration in TS 38.508-1 [5] subclause 4.11.

Table 6.3E.1.1D.4.1-1: Test Configuration Table for minimum output power for SL-MIMO

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1.8 | | | Low range, High range | |
| Test Channel Bandwidths as specified TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | | Lowest, Highest | |
| Test Parameters for Channel Bandwidths | | | | |
| Test ID | Freq | V2X Configuration to Transmit | | |
|  |  | Modulation | | PSCCH and PSSCH RB allocation  (Note 1) |
| 1 | Default | QPSK | | Outer\_Full |
| 2 | Default | 16QAM | | Outer\_Full |
| 3 | Default | 64QAM | | Outer\_Full |
| 4 | Default | 256QAM | | Outer\_Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1E-1. | | | | |

1. Connect the SS and GNSS simulator to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure TBD for TE diagram and section TBD for UE diagram.

2. The parameter settings for the NR sidelink transmission over PC5 are pre-configured according to TS 38.508-1 [5] subclause 4.10. Message content exceptions are defined in clause 6.3E.1.1D.4.3.

3. The V2X Reference Measurement Channel is set according to Table 6.3E.1.1D.4.1-1.

4. The GNSS simulator is configured for Scenario #1: static in Geographical area #1, as defined in TS38.508-1 [5] Table 4.11.2-2. Geographical area #1 is also pre-configured in the UE.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state 4-A as defined in TS 38.508-1 [4], subclause 4.4A using generic procedure parameter Sidelink (*On*), Cast Type (*Unicast*), GNSS Sync (*On*) and *Transmit Mode with SL-MIMO.*

6.3E.1.1D.4.2 Test procedure

1. The UE starts to perform the NR sidelink communication according to *SL-PreconfigurationNR* with 2-layer MIMO codebook TPMI 0. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the NR sidelink RMC.

2. Measure the sum of mean power of the UE at each transmit antenna connector in the channel bandwidth according to the test configuration from Table 6.3E.1.1D.4.1-1. The period of measurement shall be at least continuous duration of one active sub-frame (1ms) excluding guard symbols.

6.3E.1.1D.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.10 with the following exceptions.

Table 6.3E.1.1D.4.3-1: *SL-ResourcePool*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.6-25 | | | |
| Information Element | Value/remark | Comment | Condition |
| SL-ResourcePool-r16 ::= SEQUENCE { |  |  |  |
| sl-PSCCH-Config-r16 CHOICE { |  |  |  |
| setup SEQUENCE { |  |  |  |
| sl-TimeResourcePSCCH-r16 | As defined in Table 6.1E-2 |  |  |
| sl-FreqResourcePSCCH-r16 | As defined in Table 6.1E-2 |  |  |
| } |  |  |  |
| } |  |  |  |
| sl-SubchannelSize-r16 | As defined in Table 6.1E-2 |  |  |
| sl-StartRB-Subchannel-r16 | As defined in Table 6.1E-2 |  |  |
| sl-NumSubchannel-r16 | As defined in Table 6.1E-2 |  |  |
| } |  |  |  |

Table 6.3E.1.1D.4.3-2: *SL-TxPower*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.6-33 | | | |
| Information Element | Value/remark | Comment | Condition |
| SL-TxPower-r16 ::= CHOICE { |  |  |  |
| txPower | -30 |  |  |
| } |  |  |  |

6.3E.1.1D.5 Test requirement

The minimum output power, derived in step 2 shall not exceed the values specified in Table 6.3E.1.1D.5-1.

Table 6.3E.1.1D.5-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 10 | -30+TT | 9.375 |
| 20 | -30+TT | 19.095 |
| 30 | -28.2+TT | 28.815 |
| 40 | -27+TT | 38.895 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3E.1.1D.5-2 | | |

Table 6.3E.1.1D.5-2: Test Tolerance (UE maximum output power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 4.2GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | FFS | FFS |

### 6.3E.2 Transmit OFF power for V2X

#### 6.3E.2.0 Minimum conformance requirements

6.3E.2.0.1 General

When UE is configured for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions for NR V2X operating bands in Table 5.2E.1-1, the requirements specified in Table 6.3E.2.0.1-1 apply.

Table 6.3E.2.0.1-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 10 | -50 | 9.375 |
| 20 | -50 | 19.095 |
| 30 | -50 | 28.815 |
| 40 | -50 | 38.895 |

For NR V2X UE supporting SL MIMO, the transmit OFF power at each transmit antenna connector shall not exceed the values specified in Table 6.3E.2.0.1-1 for single carrier. Transmit off power is defined as the mean power in at least one sub-frame 1 ms.

6.3E.2.0.2 Transmit OFF power for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in clause 6.3.2 shall apply for the uplink in licensed band and the requirements specified in Table 6.3E.2.0.1-1 shall apply for the sidelink in licensed band or Band n47.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3E.2.

#### 6.3E.2.1 Transmit OFF power for V2X / non-concurrent operation

Editor’s Note: This test is incomplete. The following aspects are not yet determined:

- 6.3E.3.2.1 General time mask for V2X / non-concurrent operation is FFS.

6.3E.2.1.1 Test purpose

To verify that the UE transmit OFF power is lower than the value specified in the test requirement.

An excess Transmit OFF power potentially increases the Rise Over Thermal (RoT) and therefore reduces the cell coverage area for other UEs.

6.3E.2.1.2 Test applicability

The requirements of this test apply in test case 6.3E.3.2.1 General time mask for V2X / non-concurrent operation to all types of NR UE release 16 and forward that support NR V2X sidelink communication.

6.3E.2.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3E.2.0.

6.3E.2.1.4 Test description

This test is covered by clause 6.3E.3.2.1 General time mask for V2X / non-concurrent operation.

6.3E.2.1.5 Test requirement

The requirement for the Transmit OFF power shall not exceed the values specified in Table 6.3E.2.1.5-1.

Table 6.3E.2.1.5-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 10 | -50+TT | 9.375 |
| 20 | -50+TT | 19.095 |
| 30 | -50+TT | 28.815 |
| 40 | -50+TT | 38.895 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3E.2.1.5-2 | | |

Table 6.3E.2.1.5-2: Test Tolerance (Transmit OFF power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.5 dB | 1.8 dB |

#### 6.3E.2.1D Transmit OFF power for V2X / non-concurrent operation / SL-MIMO

Editor’s Note: This test is incomplete. The following aspects are not yet determined:

- 6.3E.3.2.1D General time mask for V2X / non-concurrent operation / SL-MIMO is FFS.

6.3E.2.1D.1 Test purpose

To verify that the UE transmit OFF power is lower than the value specified in the test requirement.

An excess Transmit OFF power potentially increases the Rise Over Thermal (RoT) and therefore reduces the cell coverage area for other UEs.

6.3E.2.1D.2 Test applicability

The requirements of this test apply in test case 6.3E.3.2.1D General time mask for V2X / non-concurrent operation / SL-MIMO to all types of NR UE release 16 and forward that support NR V2X sidelink communication and SL-MIMO.

6.3E.2.1D.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3E.2.0.

6.3E.2.1D.4 Test description

This test is covered by clause 6.3E.3.2.1D General time mask for V2X / non-concurrent operation / SL-MIMO.

6.3E.2.1D.5 Test requirement

The requirement for the Transmit OFF power shall not exceed the values specified in Table 6.3E.2.1D.5-1.

Table 6.3E.2.1D.5-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 10 | -50+TT | 9.375 |
| 20 | -50+TT | 19.095 |
| 30 | -50+TT | 28.815 |
| 40 | -50+TT | 38.895 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3E.2.1D.5-2 | | |

Table 6.3E.2.1D.5-2: Test Tolerance (Transmit OFF power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.5 dB | 1.8 dB |

#### 6.3E.2.2 Transmit OFF power for V2X / con-current operation

Editor’s Note: This test is incomplete. The following aspects are not yet determined:

- 6.3E.3.2.2 General time mask for V2X / con-current operation is FFS.

6.3E.2.2.1 Test purpose

To verify that the UE transmit OFF power is lower than the value specified in the test requirement.

An excess Transmit OFF power potentially increases the Rise Over Thermal (RoT) and therefore reduces the cell coverage area for other UEs.

6.3E.2.2.2 Test applicability

The requirements of this test apply in test case 6.3E.3.2.2 General time mask for V2X / con-current operation to all types of NR UE release 16 and forward that support NR V2X sidelink communication.

6.3E.2.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3E.2.0.

6.3E.2.2.4 Test description

This test is covered by clause 6.3E.3.2.2 General time mask for V2X / con-current operation.

6.3E.2.2.5 Test requirement

The requirement for the Transmit OFF power shall not exceed the values specified in Table 6.3E.2.2.5-1.

Table 6.3E.2.2.5-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 10 | -50+TT | 9.375 |
| 20 | -50+TT | 19.095 |
| 30 | -50+TT | 28.815 |
| 40 | -50+TT | 38.895 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3E.2.2.5-2 | | |

Table 6.3E.2.2.5-2: Test Tolerance (Transmit OFF power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.5 dB | 1.8 dB |

## 6.3F Output power dynamics for shared spectrum channel access

### 6.3F.1 Minimum output power

Editor’s Note: This test is incomplete. The following aspects are not yet determined:

- Test configuration table is FFS

- MU and TT for >6GHz (band n96) are working assumption based on analysis of single TE vendor. Values will be revisited once analysis from other TE vendors is available.

- Test state and generic procedure are TBD in 38.508-1

6.3F.1.1 Test purpose

To verify the UE's ability to transmit with a broadband output power below the value specified in the test requirement when the power is set to a minimum value.

6.3F.1.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR standalone shared spectrum channel access.

6.3F.1.3 Minimum conformance requirements

The minimum controlled output power of the UE is defined as the power in the channel bandwidth for all transmit bandwidth configurations (resource blocks), when the power is set to a minimum value.

The minimum output power is defined as the mean power in at least one sub-frame 1 ms. The minimum output power shall not exceed the values specified in Table 6.3F.1.3-1.

Table 6.3F.1.3-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -40 | 4.515 |
| 10 | -40 | 9.375 |
| 15 | -40 | 14.235 |
| 20 | -40 | 19.095 |
| 25 | -39 | 23.955 |
| 30 | -38.2 | 28.815 |
| 40 | -37 | 38.895 |
| 45 | -36.5 | 43.575 |
| 50 | -36 | 48.615 |
| 60 | -35.2 | 58.35 |
| 70 | -34.6 | 68.07 |
| 80 | -34 | 78.15 |
| 90 | -33.5 | 88.23 |
| 100 | -33 | 98.31 |

The normative reference for requirement is TS 38.101-1 [2] clause 6.3F.1 and 6.3.1.

6.3F.1.4 Test description

6.3F.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.3F.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3F.1.4.1-1: Test Configuration Table

FFS

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3F.1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3F.1.4.3.

6.3F.1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3F.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send continuously uplink power control "down" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step to ensure that the UE transmits at its minimum output power.

3. Measure the mean power of the UE in the associated measurement channel bandwidth specified in Table 6.3F.1.5-1 for the specific channel bandwidth under test. The period of measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD symbols with transient periods are not under test.

6.3F.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with following exception.

Table 6.3F.1.4.3-1: *PUSCH-Config*

|  |
| --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-118 with condition TRANSFORM\_PRECODER\_ENABLED |

6.3F.1.5 Test requirement

The minimum output power, derived in step 3 shall not exceed the values specified in Table 6.3F.1.5-1.

Table 6.3F.1.5-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -40+TT | 4.515 |
| 10 | -40+TT | 9.375 |
| 15 | -40+TT | 14.235 |
| 20 | -40+TT | 19.095 |
| 25 | -39+TT | 23.955 |
| 30 | -38.2+TT | 28.815 |
| 40 | -37+TT | 38.895 |
| 45 | -36.5+TT | 43.575 |
| 50 | -36+TT | 48.615 |
| 60 | -35.2+TT | 58.35 |
| 70 | -34.6+TT | 68.07 |
| 80 | -34+TT | 78.15 |
| 90 | -33.5+TT | 88.23 |
| 100 | -33+TT | 98.31 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3F.1.5-2 | | |

Table 6.3F.1.5-2: Test Tolerance (Minimum output power)

|  |  |  |
| --- | --- | --- |
|  | 4.2GHz < f ≤ 5.925GHz | 5.925GHz < f ≤ 7.125GHz |
| BW ≤ 40MHz | 1.3 dB | 1.3 dB |
| 40MHz < BW ≤ 100MHz | 1.3 dB | 1.3 dB |

### 6.3F.2 Transmit OFF power for shared spectrum channel access

6.3F.2.1 Test purpose

To verify that the UE transmit OFF power is lower than the value specified in the test requirement.

An excess Transmit OFF power potentially increases the Rise Over Thermal (RoT) and therefore reduces the cell coverage area for other UEs.

6.3F.2.2 Test applicability

The requirements of this test apply in test case 6.3F.3 Transmit ON/OFF time mask for shared spectrum channel access to all types of NR UE release 16 and forward that support NR standalone shared spectrum channel access.

6.3F.2.3 Minimum conformance requirements

Transmit OFF power is defined as the mean power in the channel bandwidth when the transmitter is OFF. The transmitter is considered OFF when the UE is not allowed to transmit on any of its ports.

The Transmit OFF power is defined as the mean power in a duration of at least one sub-frame (1ms) excluding any transient periods. The Transmit OFF power shall not exceed the values specified in Table 6.3F.2.3-1.

Table 6.3F.2.3-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -50 | 4.515 |
| 10 | -50 | 9.375 |
| 15 | -50 | 14.235 |
| 20 | -50 | 19.095 |
| 25 | -50 | 23.955 |
| 30 | -50 | 28.815 |
| 40 | -50 | 38.895 |
| 50 | -50 | 48.615 |
| 60 | -50 | 58.35 |
| 70 | -50 | 68.07 |
| 80 | -50 | 78.15 |
| 90 | -50 | 88.23 |
| 100 | -50 | 98.31 |

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3F.2 and 6.3.2.

6.3F.2.4 Test description

This test is covered by clause 6.3F.3 Transmit ON/OFF time mask.

6.3F.2.5 Test requirement

The requirement for the Transmit OFF power shall not exceed the values specified in Table 6.3F.2.5-1.

Table 6.3F.2.5-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 10 | -50+TT | 9.375 |
| 20 | -50+TT | 19.095 |
| 40 | -50+TT | 38.895 |
| 60 | -50+TT | 58.35 |
| 80 | -50+TT | 78.15 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3F.2.5-2 | | |

Table 6.3F.2.5-2: Test Tolerance (Transmit OFF power)

|  |  |  |
| --- | --- | --- |
|  | 4.2GHz < f ≤ 5.925GHz | 5.925GHz < f ≤ 7.125GHz |
| BW ≤ 40MHz | 1.8 dB | 1.8 dB |
| 40MHz < BW ≤ 100MHz | 1.8 dB | 1.8 dB |

### 6.3F.3 Transmit ON/OFF time mask for shared spectrum channel access

#### 6.3F.3.1 General

The transmit power time mask defines the transient period(s) allowed between transmit OFF power as defined in clause 6.3F.2 and transmit ON power symbols (transmit ON/OFF). The transmit power ON/OFF time mask specified in clause 6.3F.3.2 supersedes the ON/OFF masks specified in clause 6.3.3; however, between continuous ON-power transmissions the requirements in clause 6.3.3 apply. Unless otherwise stated the requirements in clause 6.5F apply also in transient periods.

#### 6.3F.3.2 General ON/OFF time mask

Editor’s Note: This test is incomplete. The following aspects are not yet determined:

- Test points are TBD

- MU and TT for >6GHz (band n96) are working assumption based on analysis of single TE vendor. Values will be revisited once analysis from other TE vendors is available.

- RMC in Annex A.

- Test coverage for UL-MIMO

- Message exceptions

- Test state and generic procedure are TBD in 38.508-1

6.3F.3.2.1 Test purpose

To verify that the general ON/OFF time mask meets the requirements given in 6.3F.3.2.5.

The transmit power time mask for transmit ON/OFF defines the transient period(s) allowed between transmit OFF power as defined in sub-clause 6.3F.2 and transmit ON power symbols (transmit ON/OFF)

Transmission of the wrong power increases interference to other channels, or increases transmission errors in the uplink channel.

6.3F.3.2.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR standalone shared spectrum channel access.

6.3F.3.2.3 Minimum conformance requirements

The general ON/OFF time mask defines the observation period between transmit OFF and ON power and between transmit ON and OFF power for each SCS as illustrated below in Figure 6.3F.3.2.3-1. ON/OFF scenarios include: contiguous, and non-contiguous transmission, etc.

The OFF power measurement period is defined in a duration of at least one slot excluding any transient periods. The ON power is defined as the mean power over the duration of at least one slot excluding any transient period and non-transmitted symbols. The leading transient period starts 5us before the beginning of the first symbol of transmission and extends 10us into the transmission including the CP extension if applicable. The trailing transient period starts 5us before the end of transmission and extends 5us beyond the end of transmission.

Figure 6.3F.3.2.3-1: General ON/OFF time mask for shared spectrum channel access

CP-E

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3F.3.2.

6.3F.3.2.4 Test description

6.3F.3.2.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, and are shown in table 6.3F.3.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3F.3.2.4.1-1: Test Configuration Table

FFS

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3F.3.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3F.3.2.4.3.

6.3F.3.2.4.2 Test procedure

1. SS sends uplink scheduling information via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3F.3.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The UL assignment is such that the UE transmits on slots TBD.

2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

3. ON power sub test:

3.1. Measure the output power of the UE PUSCH transmission during one slot, excluding a transient period of 10 µs in the beginning of the slot and 5 µs in the end of the slot.

4. OFF power sub test:

4.1. Measure the UE transmission OFF power during the slot prior to the PUSCH transmission, excluding a transient period of 5 µs in the end of the slot.

4.2. Measure the UE transmission OFF power during the slot following the PUSCH transmission, excluding a transient period of 5 µs at the beginning of the slot.

6.3F.3.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with following exceptions.

FFS

6.3F.3.2.5 Test requirement

The requirement for the power measured in steps 2, 3 and 4 of the test procedure shall not exceed the values specified in Table 6.3F.3.2.5-1.

Table 6.3F.3.2.5-1: General ON/OFF time mask

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Channel bandwidth / minimum output power / measurement bandwidth | | | | |
|  | 10  MHz | 20  MHz | 40  MHz | 60  MHz | 80  MHz |
| Transmit OFF power | ≤ -50+TT dBm | | | | |
| Transmission OFF Measurement bandwidth | 9.375 | 19.095 | 38.895 | 58.35 | 78.15 |
| Transmit ON power | TBD | | | | |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3F.3.2.5-2 | | | | | |

Table 6.3F.3.2.5-2: Test Tolerance for OFF power

|  |  |  |
| --- | --- | --- |
|  | 4.2GHz < f ≤ 5.925GHz | 5.925GHz < f ≤ 7.125GHz |
| BW ≤ 40MHz | 1.8 dB | 1.8 dB |
| 40MHz < BW ≤ 100MHz | 1.8 dB | 1.8 dB |

Table 6.3F.3.2.5-3: Test Tolerance for ON power

|  |  |  |
| --- | --- | --- |
|  | 4.2GHz < f ≤ 5.925GHz | 5.925GHz < f ≤ 7.125GHz |
| BW ≤ 40MHz | 1.8 dB | 1.8 dB |
| 40MHz < BW ≤ 100MHz | 1.8 dB | 1.8 dB |

### 6.3F.4 Power control for shared spectrum access

#### 6.3F.4.1 General

The requirements on power control accuracy apply under normal conditions.

#### 6.3F.4.2 Absolute power tolerance for shared spectrum access

Editor’s Note: This test is incomplete. The following aspects are not yet determined:

- MU and TT for >6GHz (band n96) are working assumption based on analysis of single TE vendor. Values will be revisited once analysis from other TE vendors is available.

- Test coverage for UL-MIMO

- Message exceptions

- Test state and generic procedure are TBD in 38.508-1

6.3F.4.2.1 Test purpose

To verify the ability of the UE transmitter to set its initial output power to a specific value at the start of a contiguous transmission or non-contiguous transmission with a long transmission gap, i.e. transmission gap is larger than 20ms.

6.3F.4.2.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR standalone shared spectrum channel access.

6.3F.4.2.3 Minimum conformance requirements

The absolute power tolerance requirements of clause 6.3.4.2.3 apply at the start of a contiguous transmission or non-contiguous transmission with a transmission gap larger than 40 ms.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3F.4.2

6.3F.4.2.4 Test description

6.3F.4.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in clause 6.2D.3.4.1 for NS\_03, NS\_03U, NS\_04 and NS\_35. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3F.4.2.4.1-1: Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | | Lowest, Highest | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | | Uplink Configuration | |
|  | Modulation | RB allocation | Modulation | RB allocation (NOTE 1) |
| 1 | N/A | | CP-OFDM QPSK | Full |
| NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1F-1. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3F.4.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3F.4.2.4.3. Note that PDCCH DCI format 0\_1 sent after resetting uplink power with RRC Connection Reconfiguration, should have TPC command 0dB.

6.3F.4.2.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 with TPC command 0dB for C\_RNTI to schedule the UL RMC according to Table 6.3F.4.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Measure the initial output power of the first sub-frame (1ms) of UE PUSCH first transmission.

3. Repeat for the two test points as indicated in section 6.3F.4.2.4.3. The timing of the execution between the two test points shall be larger than 40ms.

6.3F.4.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the following exceptions:

Table 6.3F.4.2.4.3-1: UplinkPowerControlCommon: Test point 1

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] subclause 4.6.3 Table 4.6.3-119 PUSCH-ConfigCommon | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-ConfigCommon::= SEQUENCE { |  |  |  |
| p0-NominalWithGrant | -114 | Test point 1 to verify a UE relative low initial power transmission |  |
| } |  |  |  |

Table 6.3F.4.2.4.3-2: UplinkPowerControlCommon: Test point 2

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] subclause 4.6.3 Table 4.6.3-119 PUSCH-ConfigCommon | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-ConfigCommon::= SEQUENCE { |  |  |  |
| p0-NominalWithGrant | -100 | Test point 2 to verify a UE relative high initial power transmission |  |
| } |  |  |  |

Table 6.3F.4.2.4.3-3: ServingCellConfigCommon

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: 38.508-1[5], Table 4.6.3-168 | | | |
| Information Element | Value/remark | Comment | Condition |
| ServingCellConfigCommon ::= SEQUENCE { |  |  |  |
| ss-PBCH-BlockPower | 18 |  | SCS\_15kHz |
|  | 21 |  | SCS\_30kHz |
| } |  |  |  |

|  |  |
| --- | --- |
| Condition | Explanation |
| SCS\_15kHz | SCS=15kHz for SS/PBCH block |
| SCS\_30kHz | SCS=30kHz for SS/PBCH block |

6.3F.4.2.5 Test requirement

The requirement for the power measured in step (2) of the test procedure is not to exceed the values specified in Table 6.3F.4.2.5-1 and 6.3F.4.2.5-2.

Table 6.3F.4.2.5-1: Absolute power tolerance: test point 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | 20 MHz | 40 MHz | 60 MHz | 80 MHz |
| Expected Measured power | SCS15 | -11.3 | -8.3 | N/A | N/A |
| SCS30 | -11.5 | -8.3 | -6.5 | -5.2 |
| Power tolerance | | ± (9+TT) dB | | | |
| Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3F.2.3  Note 2: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3F.4.2.5-3. | | | | | |

Table 6.3F.4.2.5-2: Absolute power tolerance: test point 2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | 20 MHz | 40 MHz | 60 MHz | 80 MHz |
| Expected Measured power | SCS15 | 2.7 | 5.7 | N/A | N/A |
| SCS30 | 2.5 | 5.7 | 7.5 | 8.8 |
| Power tolerance | | ± (9+TT) dB | | | |
| Note 1: The higher power limit shall not exceed the maximum output power requirements defined in sub-clause 6.2F.1.3  Note 2: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3F.4.2.5-3. | | | | | |

Table 6.3F.4.2.5-3: Test Tolerance

|  |  |
| --- | --- |
|  | 4.2GHz < f ≤ 7.125GHz |
| BW ≤ 100MHz | 1.4 dB |

#### 6.3F.4.3 Relative power tolerance for shared spectrum channel access

Editor’s Note: This test is incomplete. The following aspects are not yet determined:

- MU and TT for >6GHz (band n96) are working assumption based on analysis of single TE vendor. Values will be revisited once analysis from other TE vendors is available.

- Test coverage for UL-MIMO

- Message exceptions

- Test state and generic procedure are TBD in 38.508-1

6.3F.4.3.1 Test purpose

To verify the ability of the UE transmitter to set its output power in a target sub-frame(1ms) relatively to the power of the most recently transmitted reference sub-frame if the transmission gap between these sub-frames is less than or equal to 20ms.

6.3F.4.3.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR standalone shared spectrum channel access.

6.3F.4.3.3 Minimum conformance requirement

The relative power tolerance requirements of clause 6.3.4.3.3 apply if the transmission gap between the target sub-frame and the reference sub-frame is less than or equal to 40 ms.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3F.4.3.

6.3F.4.3.4 Test description

6.3F.4.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.3F.4.3.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3F.4.3.4.1-1: Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest | |
| Test SCS as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Highest | |
| Test Parameters | | | | |
| Ch BW | Downlink Configuration | | Uplink Configuration | |
|  | Modulation | RB Allocation | Modulation | RB allocation |
| 20, 40, 60, 80MHz | N/A | | CP-OFDM QPSK | See Table 6.3F.4.3.5-1  See Table 6.3F.4.3.5-2  See Table 6.3F.4.3.5-3 |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3F.4.3.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5 Message contents are defined in clause 6.3F.4.3.4.3.

6.3F.4.3.4.2 Test procedure

The procedure is separated in various subtests to verify different aspects of relative power control. The power patterns of the subtests are described in figure 6.3F.4.3.4.2-1 thru figure 6.3F.4.3.4.2-5.



Figure 6.3F.4.3.4.2-1: FDD ramping up test power patterns



Figure 6.3F.4.3.4.2-2: FDD ramping down test power patterns



Figure 6.3F.4.3.4.2-3: TDD ramping up test power patterns



Figure 6.3F.4.3.4.2-4: TDD ramping down test power patterns

Figure 6.3F.4.3.4.2-5: Alternating Test Power patterns

1. Sub test: ramping up pattern

1.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3F.4.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level -33 dBm, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3F.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

1.2. Schedule the UE's PUSCH data transmission as described in Figure 6.3F.4.3.4.2-1 (FDD pattern A: sub-test is divided in 4 arbitrary radio frames with 10 active uplink sub-frames per radio frame) and Figure 6.3F.4.3.4.2-3 (TDD pattern A: sub-test is divided in 20 arbitrary radio frames with 2 active uplink sub-frames per radio frame). Uplink RB allocation as defined in table 6.3F.4.3.5-1/6.3F.4.3.5-3/ 6.3F.4.3.5-5 depending on channel bandwidth. On the PDCCH format 0\_1 for the scheduling of the PUSCH the SS will transmit a +1dB TPC command for every first slot in a sub-frame. Note that the measurement need not be done continuously, provided that interruptions are whole numbers of frames, and TPC commands of 0dB are sent during the interruption.

1.3. Measure the power of PUSCH transmissions to verify the UE relative power control meet test requirements 6.3F.4.3.5. For power transients between sub-frames, transient periods of 20us between sub-frames are excluded.

1.4. Repeat the subtest different pattern B, C to move the RB allocation change at different points in the pattern as described in Table 6.3F.4.3.5-1/6.3F.4.3.5-3/ 6.3F.4.3.5-5 to force bigger UE power steps at various points in the power range.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F, clause F.4.2.

2. Sub test: ramping down pattern

2.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3F.4.3.4.1-1. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as -(MU + Uplink power control window size) to -MU dB of the target power level 20.7 dBm, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size is same as defined in step 1.1.

2.2. Schedule the UE's PUSCH data transmission as described in Figure 6.3F.4.3.4.2-2 (FDD pattern A: sub-test is divided in 4 arbitrary radio frames with 10 active uplink slots per radio frame) and Figure 6.3F.4.3.4.2-4 (TDD pattern A: sub-test is divided in 20 arbitrary radio frames with 2 active uplink sub-frames per radio frame). Uplink RB allocation as defined in table 6.3F.4.3.5-2/6.3F.4.3.5-4/ 6.3F.4.3.5-6 depending on channel bandwidth. On the PDCCH format 0\_1 for the scheduling of the PUSCH the SS will transmit a -1dB TPC command for every first slot in a sub-frame. Note that the measurement need not be done continuously, provided that interruptions are whole numbers of frames, and TPC commands of 0dB are sent during the interruption.

2.3. Measure the power of PUSCH transmissions to verify the UE relative power control meet test requirements 6.3.4.4.5. For power transients between sub-frames, transient periods of 20us between sub-frames are excluded.

2.4. Repeat the subtest different pattern B, C to move the RB allocation change at different points in the pattern as described in Table 6.3F.4.3.5-2/6.3F.4.3.5-4/ 6.3F.4.3.5-6 to force bigger UE power steps at various points in the power range.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no greater than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F, clause F.4.3.

3. Sub test: alternating pattern

3.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3F.4.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send uplink power control commands for PUSCH to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as – (Uplink power control window size / 2) dB to + (Uplink power control window size / 2) dB of the target power level -10 dBm, where:

- Uplink power control window size is same as defined in step 1.1.

3.2. Schedule the UE's PUSCH data transmission as described in Figure 6.3.5.2.4.2-5 for 10 sub-frames an uplink RB allocation alternating pattern as defined in table 6.3F.4.3.5-7 while transmitting 0dB TPC command for PUSCH via the PDCCH.

3.3. Measure the power of PUSCH transmissions to verify the UE relative power control meet test requirements specified in clause 6.3F.4.3.5. For power transients between sub-frames, transient periods of 20us between sub-frames are excluded.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.4.

6.3F.4.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6.

6.3F.4.3.5 Test requirement

Each UE power step measured in the test procedure 6.3F.4.3.4.2 should satisfy the test requirements specified in Table 6.3F.4.3.5-1 thru 6.3F.4.3.5-7.

To account for RF Power amplifier mode changes 2 exceptions are allowed for each of ramping up and ramping down test patterns. For these exceptions the power tolerance limit is a maximum of ± (6.0 + TT) dB. If there is an exception in the power step caused by the RB change for all test patterns (A, B, C) then fail the UE.

Table 6.3F.4.3.5-1: Test Requirements Relative Power Tolerance for Transmission, ramp up sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| BW  [MHz] | Test SCS [kHz] | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Up) | Power step size range (Up) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | Fixed = 11RBs | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 15 | RB change | 11RBs to 106 RBs | TPC=+1dB | 10.84 | 10dB ≤ ΔP < 15dB | 10.84 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 106 RBs | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 20 |  | Subframes before RB change | Fixed = 11RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 30 | RB change | 11RB to 51 RBs | TPC=+1dB | 7.66 | 4dB ≤ ΔP < 10dB | 7.66 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 51RBs | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 22RBs | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 15 | RB change | 22RBs to 216RBs | TPC=+1dB | 10.92 | 10dB ≤ ΔP < 15dB | 10.92 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 216RBs | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 40 |  | Subframes before RB change | Fixed = 22RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 30 | RB change | 22RB to 106 RBs | TPC=+1dB | 7.83 | 4dB ≤ ΔP < 10dB | 7.83 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 106RBs | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 33RBs | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 60 | 30 | RB change | 33RBs to 162RBs | TPC=+1dB | 7.91 | 4dB ≤ ΔP < 10dB | 7.91 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 162RBs | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 44RBs | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 80 | 30 | RB change | 44PBs to 217RBs | TPC=+1dB | 7.93 | 4dB ≤ ΔP < 10dB | 7.93 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 217RBs | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: Allocation as per Table 6.1F-1.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3F.1. | | | | | | | |

Table 6.3F.4.3.5-2: Test Requirements Relative Power Tolerance for Transmission, ramp down sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| BW  [MHz] | Test SCS [kHz] | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Up) | Power step size range (Up) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | Fixed = 106RBs | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 15 | RB change | 106RBs to 11 RBs | TPC=-1dB | 10.84 | 10dB ≤ ΔP < 15dB | 10.84 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 11 RBs | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 20 |  | Subframes before RB change | Fixed = 51RB | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 30 | RB change | 51RB to 11RBs | TPC=-1dB | 7.66 | 4dB ≤ ΔP < 10dB | 7.66 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 11RBs | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 216RBs | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 15 | RB change | 216RBs to 22RBs | TPC=-1dB | 10.92 | 10dB ≤ ΔP < 15dB | 10.92 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 22RBs | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 40 |  | Subframes before RB change | Fixed = 106RB | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 30 | RB change | 106RB to 22 RBs | TPC=-1dB | 7.83 | 4dB ≤ ΔP < 10dB | 7.83 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 22RBs | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 162RBs | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 60 | 30 | RB change | 162RBs to 33RBs | TPC=-1dB | 7.91 | 4dB ≤ ΔP < 10dB | 7.91 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 33RBs | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 217RBs | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 80 | 30 | RB change | 217PBs to 44RBs | TPC=-1dB | 7.93 | 4dB ≤ ΔP < 10dB | 7.93 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 44RBs | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: Allocation as per Table 6.1F-1.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3F.1. | | | | | | | |

Table 6.3F.4.3.5-3: Test Requirements Relative Power Tolerance for Transmission, alternating sub-test

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| BW | Test SCS [kHz] | Uplink RB allocation | TPC command | Expected power step size (Up or Down) | Power step size range (Up or Down) | PUSCH |
|  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  | 15 | Alternating 11 and 106 | TPC=0dB | 9.84 | 4dB ≤ ΔP < 10dB | 9.84 +/- (3.5 + TT) |
| 20 | 30 | Alternating 11 and 51 | TPC=0dB | 6.66 | 4dB ≤ ΔP < 10dB | 6.66 +/- (3.5 + TT) |
|  | 15 | Alternating 22 and 216 | TPC=0dB | 9.92 | 4dB ≤ ΔP < 10dB | 9.92 +/- (3.5 + TT) |
| 40 | 30 | Alternating 22 and 106 | TPC=0dB | 6.83 | 4dB ≤ ΔP < 10dB | 6.83 +/- (3.5 + TT) |
| 60 | 30 | Alternating 33 and 162 | TPC=0dB | 6.91 | 4dB ≤ ΔP < 10dB | 6.91 +/- (3.5 + TT) |
| 80 | 30 | Alternating 44 and 217 | TPC=0dB | 6.93 | 4dB ≤ ΔP < 10dB | 6.93 +/- (3.5 + TT) |
| Note 1: Allocation as per Table 6.1F-1.  Note 2: TT=0.7dB  Note 3: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3F.1. | | | | | | |

## 6.3G Output power dynamics for Tx Diversity

### 6.3G.1 Minimum output power for Tx Diversity

6.3G.1.1 Test purpose

Same test purpose as in 6.3.1.1.

6.3G.1.2 Test applicability

This test case applies to all types of NR Power Class 1.5 UE, Power Class 2 and Power Class 3 UE release 15 and forward that support Tx diversity.

6.3G.1.3 Minimum conformance requirements

For UE supporting Tx diversity, the minimum output power is defined as the sum of the mean power at each transmit connector in one sub-frame (1 ms). The minimum output power shall not exceed the values specified in Table 6.3.1.3-1.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3G.1.

6.3G.1.4 Test description

Same test description as specified in clause 6.3.1.4 with following exceptions:

Step 3 of Test procedure as in 6.3.1.4.2 is replaced by:

3. Measure the sum of mean power at each antenna connector in the associated measurement channel bandwidth specified in Table 6.3G.1.5-1 for the specific channel bandwidth under test. The period of measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD symbols with transient periods are not under test.

6.3G.1.5 Test requirement

The minimum output power, derived in step 3 shall not exceed the values specified in Table 6.3G.1.5-1.

|  |  |  |
| --- | --- | --- |
| Table 6.3G.1.5-1: Minimum output powerChannel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -40+TT | 4.515 |
| 10 | -40+TT | 9.375 |
| 15 | -40+TT | 14.235 |
| 20 | -40+TT | 19.095 |
| 25 | -39+TT | 23.955 |
| 30 | -38.2+TT | 28.815 |
| 40 | -37+TT | 38.895 |
| 45 | -36.5+TT | 43.575 |
| 50 | -36+TT | 48.615 |
| 60 | -35.2+TT | 58.35 |
| 70 | -34.6+TT | 68.07 |
| 80 | -34+TT | 78.15 |
| 90 | -33.5+TT | 88.23 |
| 100 | -33+TT | 98.31 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3G.1.5-2 | | |

Table 6.3G.1.5-2: Test Tolerance (Minimum output power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.0 dB | 1.3 dB |
| 40MHz < BW ≤ 100MHz | 1.3 dB | 1.3 dB |

### 6.3G.2 Transmit OFF power for Tx Diversity

6.3G.2.1 Test purpose

Same test purpose as in 6.3.2.1.

6.3G.2.2 Test applicability

The requirements of this test apply in test cases 6.3G.3 Transmit ON/OFF time mask for Tx Diversity to all types of NR Power Class 1.5 UE, Power Class 2 and Power Class 3 UE release 15 and forward support Tx diversity.

6.3G.2.3 Minimum conformance requirements

For UE supporting Tx diversity, the transmit OFF power is defined as the mean power at each transmit antenna connector in a duration of at least one sub-frame (1 ms) excluding any transient periods.

The transmit OFF power at each transmit antenna connector shall not exceed the values specified in Table 6.3.2.3-1.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3G.2.

6.3G.2.4 Test description

This test is covered by clause 6.3G.3 Transmit ON/OFF time mask.

6.3G.2.5 Test requirement

For each transmit antenna connector, the requirement for the Transmit OFF power shall not exceed the values specified in Table 6.3G.2.5-1.

|  |  |  |
| --- | --- | --- |
| Table 6.3G.2.5-1: Transmit OFF powerChannel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -50+TT | 4.515 |
| 10 | -50+TT | 9.375 |
| 15 | -50+TT | 14.235 |
| 20 | -50+TT | 19.095 |
| 25 | -50+TT | 23.955 |
| 30 | -50+TT | 28.815 |
| 40 | -50+TT | 38.895 |
| 45 | -50+TT | 43.575 |
| 50 | -50+TT | 48.615 |
| 60 | -50+TT | 58.35 |
| 70 | -50+TT | 68.07 |
| 80 | -50+TT | 78.15 |
| 90 | -50+TT | 88.23 |
| 100 | -50+TT | 98.31 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3G.2.5-2 | | |

Table 6.3G.2.5-2: Test Tolerance (Transmit OFF power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.5 dB | 1.8 dB |
| 40MHz < BW ≤ 100MHz | 1.7 dB | 1.8 dB |

### 6.3G.3 Transmit ON/OFF time mask for Tx Diversity

#### 6.3G.3.1 General ON/OFF time mask for Tx Diversity

6.3G.3.1.1 Test purpose

Same test purpose as in 6.3.3.2.1.

6.3G.3.1.2 Test applicability

This test case applies to all types of NR Power Class 1.5 UE, Power Class 2 and Power Class 3 UE release 15 and forward that support Tx diversity.

6.3G.3.1.3 Minimum conformance requirements

For UE supporting Tx diversity, the general ON/OFF time mask requirements in clause 6.3.3.2.3 apply at each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3G.3.

6.3G.3.1.4 Test description

Same test description as in clause 6.3.3.2.4 with following exceptions:

- The ON power is measured as sum of both transmit antenna connectors.

- The OFF power is measured at each transmit antenna connector.

6.3G.3.1.5 Test requirement

The measured ON power and OFF power shall not exceed the values specified in Table 6.3G.3.1.5-1.

Table 6.3G.3.1.5-1: General ON/OFF time mask

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Channel bandwidth / minimum output power / measurement bandwidth | | | | | | | | | | | | | |
| 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 45  MHz | 50  MHz | 60  MHz | 70  MHz | 80  MHz | 90  MHz | 100  MHz |
| Transmit OFF power | ≤ -50+TT dBm | | | | | | | | | | | | | |
| Transmission OFF Measurement bandwidth | 4.515 | 9.375 | 14.235 | 19.095 | 23.955 | 28.815 | 38.895 | 43.575 | 48.615 | 58.35 | 68.07 | 78.15 | 88.23 | 98.31 |
| Transmit ON power | Same as Test ID 9 of Tables 6.2G.2.5-5 to 6.2G.2.5-8 | | | | | | | | | | | | | |
| NOTE 1: TT of OFF power for each frequency and channel bandwidth is specified in Table 6.3G.3.1.5-2  NOTE 2: TT of ON power for each frequency and channel bandwidth is specified in the referred ON power test requirement tables. | | | | | | | | | | | | | | |

Table 6.3G.3.1.5-2: Test Tolerance for OFF power

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 1.5 dB | 1.8 dB |
| 40MHz < BW ≤ 100MHz | 1.7 dB | 1.8 dB |

Table 6.3G.3.1.5-3: Void

#### 6.3G.3.2 PRACH time mask for Tx Diversity

6.3G.3.2.1 Test purpose

Same test purpose as in 6.3.3.4.1.

6.3G.3.2.2 Test applicability

This test case applies to all types of NR Power Class 1.5 UE, Power Class 2 and Power Class 3 UE release 15 and forward that support Tx diversity.

6.3G.3.2.3 Minimum conformance requirements

For UE supporting Tx diversity, the PRACH time mask requirements in clause 6.3.3.4.3 apply at each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3G.3.

6.3G.3.2.4 Test description

Same test description as in clause 6.3.3.4.4 with following exceptions:

- The ON power is measured as sum of both transmit antenna connectors.

- The OFF power is measured at each transmit antenna connector.

6.3G.3.2.5 Test requirement

The measured ON power and OFF power shall not exceed the values specified in Table 6.3G.3.2.5-1.

Table 6.3G.3.2.5-1: PRACH time mask

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Channel bandwidth / minimum output power / measurement bandwidth | | | | | | | | | | | | |
|  | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz | 60  MHz | 70  MHz | 80  MHz | 90  MHz | 100  MHz |
| Transmit OFF power | ≤ -50+TT dBm | | | | | | | | | | | | |
| Transmission OFF Measurement bandwidth | 4.515 | 9.375 | 14.235 | 19.095 | 23.955 | 28.815 | 38.895 | 48.615 | 58.35 | 68.07 | 78.15 | 88.23 | 98.31 |
| Expected PRACH Transmission ON Measured Power for PRACH Format 0 and PRACH Format A3 for SCS 30kHz | -1 dBm | -1 dBm | -1 dBm | -1 dBm | -1 dBm | -1 dBm | -1 dBm | -1 dBm | -1 dBm | -1 dBm | -1 dBm | -1 dBm | -1 dBm |
| Expected PRACH Transmission ON Measured Power for PRACH Format A3 for SCS 15kHz and SCS 60kHz | -2 dBm | -2 dBm | -2 dBm | -2 dBm | -2 dBm | -2 dBm | -2 dBm | -2 dBm | -2 dBm | -2 dBm | -2 dBm | -2 dBm | -2 dBm |
| ON Power Tolerance | ± (9+TT)dB | | | | | | | | | | | | |
| NOTE 1: TT of OFF power for each frequency and channel bandwidth is specified in Table 6.3G.3.2.5-2  NOTE 2: TT of ON power for each frequency and channel bandwidth is specified in Table 6.3.3.4.5-2 | | | | | | | | | | | | | |

Table 6.3G.3.2.5-2: Test Tolerance (Transmit OFF power and PRACH time mask)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.5 dB | 1.8 dB |
| 40MHz < BW ≤ 100MHz | 1.7 dB | 1.8 dB |

#### 6.3G.3.3 SRS time mask for Tx Diversity

6.3G.3.3.1 Test purpose

Same test purpose as in 6.3.3.6.1.

6.3G.3.3.2 Test applicability

This test case applies to all types of NR Power Class 1.5 UE, Power Class 2 and Power Class 3 UE release 15 and forward that support Tx diversity.

6.3G.3.3.3 Minimum conformance requirements

For UE supporting Tx diversity, the SRS time mask requirements in clause 6.3.3.6.3 apply at each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3G.3.

6.3G.3.3.4 Test description

Same test description as in clause 6.3.3.6.4 with following exceptions:

- The ON power is measured as sum of both transmit antenna connectors.

- The OFF power is measured at each transmit antenna connector.

6.3G.3.3.5 Test requirement

The measured ON power and OFF power shall not exceed the values specified in Table 6.3G.3.3.5-1.

Table 6.3G.3.3.5-1: SRS time mask

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Channel bandwidth / minimum output power / measurement bandwidth | | | | | | | | | | | | |
|  | | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz | 60  MHz | 70  MHz | 80  MHz | 90  MHz | 100  MHz |
| Transmit OFF power | | ≤ -50+TT dBm | | | | | | | | | | | | |
| Transmission OFF Measurement bandwidth | | 4.515 | 9.375 | 14.235 | 19.095 | 23.955 | 28.815 | 38.895 | 48.615 | 58.35 | 68.07 | 78.15 | 88.23 | 98.31 |
| Transmit ON power | | Same as Table 6.2G.1.5-4 | | | | | | | | | | | | |
| NOTE 1: TT of OFF power for each frequency and channel bandwidth is specified in Table 6.3G.3.3.5-2 | | | | | | | | | | | | | | |

Table 6.3G.3.3.5-2: Test Tolerance (Transmit OFF power and SRS time mask)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 1.5 dB | 1.8 dB |
| 40MHz < BW ≤ 100MHz | 1.7 dB | 1.8 dB |

### 6.3G.4 Power control for Tx Diversity

#### 6.3G.4.1 Absolute power tolerance for Tx Diversity

6.3G.4.1.1 Test purpose

Same test purpose as in 6.3.4.2.1.

6.3G.4.1.2 Test applicability

This test case applies to all types of NR Power Class 1.5 UE, Power Class 2 and Power Class 3 UE release 15 and forward that support Tx diversity.

6.3G.4.1.3 Minimum conformance requirements

For UE supporting Tx diversity, the power control tolerance applies to the sum of output power at each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3G.4

6.3G.4.1.4 Test description

Same test description as in clause 6.3.4.2.4 with following exceptions:

- The UE’s transmit power is measured as sum of both transmit antenna connectors.

6.3G.4.1.5 Test requirement

The requirement for the power measured in step (2) of the test procedure is not to exceed the values specified in Table 6.3G.4.1.5-1 and 6.3G.4.1.5-2.

Table 6.3G.4.1.5-1: Absolute power tolerance: test point 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | Channel bandwidth / expected output power (dBm) | | | | | | | | | | | | | |
| 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 45 MHz | 50 MHz | 60 MHz | 70 MHz | 80 MHz | 90 MHz | 100 MHz |
| Expected Measured power | SCS15 | -17.6 | -14.4 | -12.6 | -11.3 | -10.4 | -9.6 | -8.3 | -7.8 | -7.3 | N/A | N/A | N/A | N/A | N/A |
| SCS30 | -18.2 | -14.8 | -12.8 | -11.5 | -10.5 | -9.7 | -8.3 | -7.9 | -7.4 | -6.5 | -5.8 | -5.2 | -4.7 | -4.2 |
| SCS60 |  | -15.2 | -13 | -11.8 | -10.7 | -9.8 | -8.5 | -8 | -7.5 | -6.6 | -5.9 | -5.3 | -4.8 | -4.3 |
| Power tolerance | | ± (9+TT)dB | | | | | | | | | | | | | |
| Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3G.1.5.  Note 2: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3G.4.1.5-3. | | | | | | | | | | | | | | | |

Table 6.3G.4.1.5-2: Absolute power tolerance: test point 2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | Channel bandwidth / expected output power (dBm) | | | | | | | | | | | | | |
| 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 45 MHz | 50 MHz | 60 MHz | 70 MHz | 80 MHz | 90 MHz | 100 MHz |
| Expected Measured power | SCS15 | -3.6 | 0.4 | 1.4 | 2.7 | 3.6 | 4.4 | 5.7 | 6.2 | 6.7 | N/A | N/A | N/A | N/A | N/A |
| SCS30 | -4.2 | -0.8 | 1.2 | 2.5 | 3.5 | 4.3 | 5.7 | 6.2 | 6.6 | 7.5 | 8.2 | 8.8 | 9.3 | 9.8 |
| SCS60 | N/A | -1.2 | 1 | 2.2 | 3.3 | 4.2 | 5.5 | 6 | 6.5 | 7.4 | 8.1 | 8.7 | 9.2 | 9.7 |
| Power tolerance | | ± (9+TT)dB | | | | | | | | | | | | | |
| Note 1: The higher power limit shall not exceed the maximum output power requirements defined in sub-clause 6.2G.1.5.  Note 2: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3G.4.1.5-3. | | | | | | | | | | | | | | | |

Table 6.3G.4.1.5-3: Test Tolerance

|  |  |  |  |
| --- | --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 4.2GHz | 4.2GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.0 dB | 1.4 dB | 1.4 dB |
| 40MHz < BW ≤ 100MHz | 1.4 dB | 1.4 dB | 1.4 dB |

#### 6.3G.4.2 Relative power tolerance for Tx Diversity

6.3G.4.2.1 Test purpose

Same test purpose as in 6.3.4.3.1.

6.3G.4.2.2 Test applicability

This test case applies to all types of NR Power Class 1.5 UE, Power Class 2 and Power Class 3 UE release 15 and forward that support Tx diversity.

6.3G.4.2.3 Minimum conformance requirement

For UE supporting Tx diversity, the relative power tolerance applies to the sum of output power at each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3G.4.

6.3G.4.2.4 Test description

Same test description as in clause 6.3.4.3.4 with the output power is measured as the sum of both antenna connectors.

6.3G.4.2.5 Test requirement

Each UE power step measured in the test procedure 6.3G.4.2.4 should satisfy the test requirements specified in Table 6.3G.4.2.5-1 through 6.3G.4.2.5-7.

To account for RF Power amplifier mode changes 2 exceptions are allowed for each of ramping up and ramping down test patterns. For these exceptions the power tolerance limit is a maximum of ± (6.0 + TT) dB. If there is an exception in the power step caused by the RB change for all test patterns (A, B, C) then fail the UE.

Table 6.3G.4.2.5-1: Test Requirements Relative Power Tolerance for Transmission, channel BW 5MHz, ramp up sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Up) | Power step size range (Up) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Sub-frames before RB change | Fixed = 1 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Sub-frames before RB change | Fixed = 1 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 1RB to 15 RBs | TPC=+1dB | 12.76 | 10dB ≤ ΔP < 15dB | 12.76 +/- (4 + TT) |
|  |  | Sub-frames after RB change | Fixed = 15 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Sub-frames before RB change | Fixed = 1 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 30 |  | Sub-frames before RB change | Fixed = 1 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 1RB to 10 RBs | TPC=+1dB | 11.00 | 10dB ≤ ΔP < 15dB | 11.00 +/- (4 + TT) |
|  |  | Sub-frames after RB change | Fixed = 10 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Sub-frames Pattern B the position of RB uplink allocation change is after 20 active uplink Sub-frames Pattern C the position of RB uplink allocation change is after 30 active uplink Sub-frames  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3G.1. | | | | | | | |

Table 6.3G.4.2.5-2: Test Requirements Relative Power Tolerance for Transmission, channel BW 5MHz, ramp down sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Down) | Power step size range (Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Sub-frames before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 |  | Sub-frames before RB change | Fixed = 15 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 15 RBs to 1 RB | TPC=-1dB | 12.76 | 10dB ≤ ΔP < 15dB | 12.76 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Sub-frames before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Sub-frames after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 30 |  | Sub-frames before RB change | Fixed = 10 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 10 RBs to 1 RB | TPC=-1dB | 11.00 | 10dB ≤ ΔP < 15dB | 11.00 +/- (4 + TT) |
|  |  | Sub-frames after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Sub-frames Pattern B the position of RB uplink allocation change is after 20 active uplink Sub-frames Pattern C the position of RB uplink allocation change is after 30 active uplink Sub-frames  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3G.1. | | | | | | | |

Table 6.3G.4.2.5-3: Test Requirements Relative Power Tolerance for Transmission, channel BW 10MHz, 15MHz, 20MHz, 25MHz, 30MHz, 40MHz, 50MHz ramp up sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Up) | Power step size range (Up) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 | 2 | RB change | 1RB to 20 RBs | TPC=+1dB | 14.01 | 10dB ≤ ΔP < 15dB | 14.01 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 20 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/-0.7 + TT |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 3 | RB change | 1RB to 50 RBs | TPC=+1dB | 17.99 | 15dB ≤ ΔP | 17.99 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 50 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 30 |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/-0.7 + TT |
|  | 2 | RB change | 1RB to 24 RBs | TPC=+1dB | 14.80 | 10dB ≤ ΔP < 15dB | 14.80+/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 24 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/-0.7 + TT |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 60 |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 1RB to 10 RBs | TPC=+1dB | 11.00 | 10dB ≤ ΔP < 15dB | 11.00 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 10 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3G.1. | | | | | | | |

Table 6.3G.4.2.5-4: Test Requirements Relative Power Tolerance for Transmission, channel BW 10MHz, 15MHz, 20MHz, 25MHz, 30MHz, 40MHz, 50MHz ramp down sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Down) | Power step size range (Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1RBs | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 20 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 15 | 2 | RB change | 20 RBs to 1 RB | TPC=-1dB | 14.01 | 10dB ≤ ΔP < 15dB | 14.01 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 50 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 3 | RB change | 50 RBs to 1 RB | TPC=-1dB | 17.99 | 15dB ≤ ΔP | 17.99 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/-0.7 + TT |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  |  |  |  |  |  |  |
| 30 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  | Subframes before RB change | Fixed = 24 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/-0.7 + TT |
|  | 2 | RB change | 24 RBs to 1 RB | TPC=-1dB | 14.80 | 10dB ≤ ΔP < 15dB | 14.80 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 60 |  | Subframes before RB change | Fixed = 10 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/-0.7 + TT |
|  | 2 | RB change | 10 RBs to 1 RB | TPC=-1dB | 11.00 | 10dB ≤ ΔP < 15dB | 11.00 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3G.1. | | | | | | | |

Table 6.3G.4.2.5-5: Test Requirements Relative Power Tolerance for Transmission, channel BW 60MHz, 70MHz, 80MHz, 90MHz, 100MHz ramp up sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Up) | Power step size range (Up) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 30 | 2 | RB change | 1RB to 24 RBs | TPC=+1dB | 14.80 | 10dB ≤ ΔP < 15dB | 14.80 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 24 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 3 | RB change | 1RB to 81 RBs | TPC=+1dB | 20.08 | 15dB < ΔP | 20.08 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 81 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 1RB to 5 RBs | TPC=+1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 5 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 60 |  | Subframes before RB change | 1RB | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 1RB to 75 RBs | TPC=+1dB | 19.75 | 15dB < ΔP | 19.75 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 75 | TPC=+1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3G.1. | | | | | | | |

Table 6.3G.4.2.5-6: Test Requirements Relative Power Tolerance for Transmission, channel BW 60MHz, 70MHz, 80MHz, 90MHz, 100MHz ramp down sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Test SCS [kHz] | Sub-test ID | Applicable sub-frames | Uplink RB allocation | TPC command | Expected power step size (Down) | Power step size range (Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | Subframes before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/-0.7 + TT |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 24 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 30 | 2 | RB change | 24 RBs to 1 RB | TPC=-1dB | 14.80 | 10dB ≤ ΔP < 15dB | 14.80 +/- (4 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 81 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 3 | RB change | 81 RBs to 1 RB | TPC=-1dB | 20.08 | 15dB < ΔP | 20.08 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  |  | Subframes before RB change | Fixed = 5 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 1 | RB change | 5 RBs to 1 RB | TPC=-1dB | 7.99 | 4dB ≤ ΔP < 10dB | 7.99 +/- (3.5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| 60 |  | Subframes before RB change | Fixed = 75 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
|  | 2 | RB change | 75 RBs to 1 RB | TPC=-1dB | 19.75 | 15dB < ΔP | 19.75 +/- (5 + TT) |
|  |  | Subframes after RB change | Fixed = 1 | TPC=-1dB | 1 | ΔP ≤ 1 dB | 1 +/- (0.7 + TT) |
| Note 1: Position of RB change: Pattern A the position of RB uplink allocation change is after 10 active uplink Subframes. Pattern B the position of RB uplink allocation change is after 20 active uplink Subframes Pattern C the position of RB uplink allocation change is after 30 active uplink Subframes.  Note 2: The starting resource block shall be RB# 0.  Note 3: TT=0.7dB  Note 4: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3G.1. | | | | | | | |

Table 6.3G.4.2.5-7: Test Requirements Relative Power Tolerance for Transmission, alternating sub-test

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| BW | Test SCS [kHz] | Sub-test ID | Uplink RB allocation | TPC command | Expected power step size (Up or Down) | Power step size range (Up or Down) | PUSCH |
|  |  |  |  |  | ΔP [dB] | ΔP [dB] | [dB] |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
|  | 15 | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
| 5 |  | 3 | Alternating 1 and 15 | TPC=0dB | 11.76 | 10dB ≤ ΔP < 15dB | 11.76 +/- (4 + TT) |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
|  | 30 | 2 | Alternating 1 and 10 | TPC=0dB | 10.00 | 10dB ≤ ΔP < 15dB | 10.00 +/- (4 + TT) |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
|  |  | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  | 15 | 3 | Alternating 1 and 20 | TPC=0dB | 13.01 | 10dB ≤ ΔP < 15dB | 13.01 +/- (4 + TT) |
|  |  | 4 | Alternating 1 and 50 | TPC=0dB | 16.99 | 15dB ≤ ΔP | 16.99 +/- (5 + TT) |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
| 10,15,20, 25,30,40,50 | 30 | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  |  | 3 | Alternating 1 and 24 | TPC=0dB | 13.80 | 10dB ≤ ΔP < 15dB | 13.80 +/- (4 + TT) |
|  |  | 1 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  | 60 | 2 | Alternating 1 and 10 | TPC=0dB | 10.00 | 10dB ≤ ΔP < 15dB | 10.00 +/- (4 + TT) |
|  |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
|  | 30 | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  |  | 3 | Alternating 1 and 81 | TPC=0dB | 19.08 | 15dB < ΔP | 19.08 +/- (5 + TT) |
| 60, 70,80,90,100 |  | 1 | Alternating 1 and 2 | TPC=0dB | 3.01 | 3dB ≤ ΔP < 4dB | 3.01 +/- (3 + TT) |
|  | 60 | 2 | Alternating 1 and 5 | TPC=0dB | 6.99 | 4dB ≤ ΔP < 10dB | 6.99 +/- (3.5 + TT) |
|  |  | 3 | Alternating 1 and 75 | TPC=0dB | 18.75 | 15dB < ΔP | 18.75 +/- (5 + TT) |
| Note 1: The starting resource block shall be RB# 0.  Note 2: TT=0.7dB  Note 3: Applicable if PUMAX ≥ P ≥ Pmin. Pmin as defined in sub-clause 6.3G.1. | | | | | | | |

#### 6.3G.4.3 Aggregate power tolerance for Tx Diversity

6.3G.4.3.1 Test purpose

Same test purpose as in 6.3.4.4.1.

6.3G.4.3.2 Test applicability

This test case applies to all types of NR Power Class 1.5 UE, Power Class 2 and Power Class 3 UE release 15 and forward that support Tx diversity.

6.3G.4.3.3 Minimum conformance requirements

For UE supporting Tx diversity, the absolute power tolerance applies to the sum of output power at each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3G.4.

6.3G.4.3.4 Test description

Same test description as in clause 6.3.4.4.4 with the output power is measured as the sum of both antenna connectors.

6.3G.4.3.5 Test requirement

The requirement for the power measurements made in step 1.3 and 2.3 of the test procedure shall not exceed the values specified in Table 6.3G.4.3.5-1. The power measurement period shall be 1 sub-frame(1ms).

Table 6.3G.4.3.5-1: Power control tolerance

|  |  |  |
| --- | --- | --- |
| TPC command | UL channel | Test requirement measured power |
| 0 dB | PUCCH | Given 5power measurements in the pattern, the 2nd, and later measurements shall be within ± (2.5 + TT) dB of the 1st measurement. |
| 0 dB | PUSCH | Given 5 power measurements in the pattern, the 2nd, and later measurements shall be within ± (3.5 + TT) dB of the 1st measurement. |
| Note 1: For SCS 30kHz 1 sub-frame corresponds to 2 slots and for SCS 60kHz 1 sub-frame corresponds to 4 slots, so 2 TPC commands will be sent for a single measurement period.  Note 2: TT=0.7dB. | | |

## 6.3H Output power dynamics for CA with UL MIMO

### 6.3H.1 Output power dynamics for intra-band UL contiguous CA with UL MIMO

#### 6.3H.1.1 Minimum output power for intra-band UL contiguous CA with UL MIMO

6.3H.1.1.1 Test purpose

To verify the UE's ability to transmit with a broadband output power for intra-band UL contiguous CA with UL MIMO below the value specified in the test requirement when the power is set to a minimum value.

6.3H.1.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support intra-band UL contiguous CA with UL MIMO.

6.3H.1.1.3 Minimum conformance requirements

For intra-band UL contiguous CA and UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the minimum output power is defined as the sum of the mean power from both transmit connector in one sub-frame (1 ms) on each CC. The minimum output power shall not exceed the values specified in clause 6.3A.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission with precoding matrix *W*=1 [6.3.1.5 TS 38.211], the requirements in clause 6.3A.1 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3H.1.1.

6.3H.1.1.4 Test description

6.3H.1.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configurations specified in 5.5A. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in Table 6.3H.1.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3H.1.1.4.1-1: Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range  High range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation (NOTE 1) | |
|  |  |  | PCC | SCC |
| 1 | N/A for this test | CP-OFDM QPSK | Outer Full | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in 6.1A-1a  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.3.1-1 and SCS is specified in Table 5.3.5-1 for each NR band.. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.6 for TE diagram and section A.3.2.3.11 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals for PCC are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3H.1.1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3H.1.1.4.3.

6.3H.1.1.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3H.1.1.4.3.

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[19], clause 9.3).

4. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3H.1.1.4.1-1 on both PCC and SCC as appropriate. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

5. Send continuously uplink power control "down" commands for both carriers in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step to ensure that the UE transmits at its minimum output power.

6. Measure the sum of mean transmitted power from antenna connectors for each component carrier in the associated measurement channel bandwidth specified in Table 6.3H.1.1.5-1 for the specific channel bandwidth under test. The period of measurement shall be at least the continuous duration of 1ms in all active uplink slots and in the uplink symbols. For TDD, only slots consisting of only UL symbols are under test.

6.3H.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 ensuring Table 4.6.3-182 with the condition 2TX\_UL\_MIMO.

6.3H.1.1.5 Test requirement

The maximum output power, derived in step 6 shall be within the range prescribed by the nominal maximum output power and tolerance in Table 6.3H.1.1.5-1.

Table 6.3H.1.1.5-1: Minimum output power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 10 | -40+TT | 9.375 |
| 15 | -40+TT | 14.235 |
| 20 | -40+TT | 19.095 |
| 25 | -39+TT | 23.955 |
| 30 | -38.2+TT | 28.815 |
| 40 | -37+TT | 38.895 |
| 50 | -36+TT | 48.615 |
| 60 | -35.2+TT | 58.35 |
| 70 | -34.6+TT | 68.07 |
| 80 | -34+TT | 78.15 |
| 90 | -33.5+TT | 88.23 |
| 100 | -33+TT | 98.31 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3H.1.1.5-2 | | |

Table 6.3H.1.1.5-2: Test Tolerance (Minimum output power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.0 | 1.3 |
| 40MHz < BW ≤ 100MHz | 1.3 | 1.3 |
| 100MHz < BW ≤ 200MHz | FFS | FFS |

#### 6.3H.1.2 Transmit OFF power for intra-band UL contiguous CA with UL MIMO

Editor’s Note:

- Test tolerance for BW>100M is FFS.

6.3H.1.2.1 Test purpose

To verify that the UE transmit OFF power for intra-band UL contiguous CA with UL MIMO is lower than the value specified in the test requirement.

6.3H.1.2.2 Test applicability

The requirements of 6.3H.1.2 apply in test case 6.3H.1.3 Transmit ON/OFF time mask for intra-band UL contiguous CA with UL MIMO to all types of NR UE release 15 and forward that support intra-band UL contiguous CA with UL MIMO. Therefore, no test case description and requirements are specified.

6.3H.1.2.3 Minimum conformance requirements

The transmit OFF power is defined as the mean power at each transmit antenna connector in a duration of at least one sub-frame (1 ms) excluding any transient periods.

The transmit OFF power at each transmit antenna connector on each CC shall not exceed the values specified in clause 6.3A.2.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3H.1.2.

6.3H.1.2.4 Test description

This test is covered by clause 6.3H.1.3 Transmit ON/OFF time mask for intra-band UL contiguous CA with UL MIMO.

6.3H.1.2.5 Test requirement

The requirement for the transmit OFF power of each component carrier shall not exceed the values specified in Table 6.3H.1.2.5-1.

Table 6.3H.1.2.5-1: Transmit OFF power

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -50+TT | 4.515 |
| 10 | -50+TT | 9.375 |
| 15 | -50+TT | 14.235 |
| 20 | -50+TT | 19.095 |
| 25 | -50+TT | 23.955 |
| 30 | -50+TT | 28.815 |
| 40 | -50+TT | 38.895 |
| 50 | -50+TT | 48.615 |
| 60 | -50+TT | 58.35 |
| 80 | -50+TT | 78.15 |
| 100 | -50+TT | 88.23 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3H.1.2.5-2 | | |

Table 6.3H.1.2.5-2: Test Tolerance (Transmit OFF power)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | 1.5 | 1.8 |
| 40MHz < BW ≤ 100MHz | 1.7 | 1.8 |
| 100MHz < BW ≤ 200MHz | FFS | FFS |

#### 6.3H.1.3 Transmit ON/OFF time mask for intra-band UL contiguous CA with UL MIMO

Editor’s Note:

- Test tolerance for BW>100M is FFS.

6.3H.1.3.1 Test purpose

To verify that the general ON/OFF time mask for intra-band UL contiguous CA with UL MIMO meets the requirements specified in the test requirement

The transmit power time mask for transmit ON/OFF defines the transient period(s) allowed between transmit OFF power and transmit ON power symbols for intra-band UL contiguous CA with UL MIMO.

Transmission of the wrong power increases interference to other channels, or increases transmission errors in the uplink channel.

6.3H.1.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support intra-band UL contiguous CA with UL MIMO.

6.3H.1.3.3 Minimum conformance requirements

For UE supporting intra-band UL contiguous CA and UL MIMO, the ON/OFF time mask requirements in clause 6.3A.3 apply at each transmit antenna connector on each CC. The requirements shall be met with the UL MIMO configurations described in clause 6.2H.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission with precoding matrix *W*=1 [6.3.1.5 TS 38.211], the requirements in clause 6.3A.3 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3H.1.3.

6.3H.1.3.4 Test description

6.3H.1.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configurations specified in 5.5A. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in Table 6.3H.1.3.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3H.1.3.4.1-1: Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1.1.4 for intra band contiguous CA in FR1 | | Low range  High range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest, Highest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration for PCC & SCC | Uplink Configuration | | |
|  |  | Modulation for all CCs | RB allocation (NOTE 1) | |
|  |  |  | PCC | SCC |
| 1 | N/A for this test | CP-OFDM QPSK | Inner Full | Inner Full |
| NOTE 1: The specific configuration of each RB allocation is defined in 6.1A-1a NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.3.1-1 and SCS is specified in Table 5.3.5-1 for each NR band. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.6 for TE diagram and section A.3.2.3.11 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals for PCC are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3H.1.3.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3H.1.3.4.3.

6.3H.1.3.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.3H.1.3.4.3.

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[19], clause 9.3).

4. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3H.1.3.4.1-1 on both PCC and SCC as appropriate. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The UL assignment is such that the UE transmits on slots 8 for 15kHz SCS, on slots 8 and 18 for 30kHz SCS and on slots 17 and 37 for 60kHz SCS. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

5. Send continuously uplink power control "up" commands for both carriers in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

6. On power sub test:

6.1. Measure the sum of mean output power over both antenna connectors and all component carriers in the CA configuration of the UE PUSCH transmission during one slot of the radio access mode.

7. OFF power sub test:

7.1. Measure the UE transmission OFF power for each component carrier at each antenna connector during the slot prior to the PUSCH transmission, excluding a transient period of 10 µs in the end of the slot.

7.2. Measure the UE transmission OFF power for each component carrier at each antenna connector during the slot following the PUSCH transmission, excluding a transient period of 10 µs at the beginning of the slot.

6.3H.1.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 ensuring Table 4.6.3-182 with the condition 2TX\_UL\_MIMO and following exceptions:

Table 6.3H.1.3.4.3-1: TDD-UL-DL-Config

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 |
|  | ms10 |  | FR1\_15kHz |
| nrofDownlinkSlots | 6 |  | FR1\_15kHz |
|  | 6 |  | FR1\_30kHz |
|  | 14 |  | FR1\_60kHz |
| nrofDownlinkSymbols | 10 |  | FR1\_15kHz |
|  | 6 |  | FR1\_30kHz |
|  | 12 |  | FR1\_60kHz |
| nrofUplinkSlots | 3 |  | FR1\_15kHz,FR1\_30kHz |
|  | 4 |  | FR1\_60kHz |
| nrofUplinkSymbols | 4 |  | FR1\_30kHz |
|  | 2 |  | FR1\_15kHz, |
|  | 8 |  | FR1\_60kHz |
| } |  |  |  |
| pattern2 | Not present |  |  |
| } |  |  |  |

Table 6.3H.1.3.4.3-2: PUSCH-TimeDomainResourceAllocationList

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-122 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF { | 2 entries |  |  |
| PUSCH-TimeDomainResourceAllocation[1] SEQUENCE { |  |  |  |
| k2 | 4 |  | FR1\_15kHz,FR1\_30kHz |
| 6 |  | FR1\_60kHz |
| mappingType | typeA |  |  |
| startSymbolAndLength | 27 | Start symbol(S)=0, Length(L)=14 |  |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation[2] SEQUENCE { |  | addressed by Msg3 PUSCH time resource allocation field of the Random Access Response acc. to TS 38.213 [22] Table 8.2-1. |  |
| k2 | 2 | K2+ Δ=4 acc. to TS 38.214 [21] Table 6.1.2.1.1-5  (NOTE 1) | FR1\_15kHz |
| 6 | K2+ Δ=9 acc. to TS 38.214 [21] Table 6.1.2.1.1-5  (NOTE 1) | FR1\_30kHz |
| mappingType | typeA |  |  |
| startSymbolAndLength | 27 | Start symbol(S)=0, Length(L)=14 |  |
| } |  |  |  |
| } |  |  |  |
| NOTE 1: Values are chosen so that first slot of a TDD-UL-DL slot configuration period can be used for the Random Access Response and the last slot (of the same or another period) for the corresponding Msg3. | | | |

|  |  |
| --- | --- |
| Condition | Explanation |
| FR1\_15kHz | FR1 is used under the test. SCS is set to 15kHz. |
| FR1\_30kHz | FR1 is used under the test. SCS is set to 30kHz. |
| FR1\_60kHz | FR1 is used under the test. SCS is set to 60kHz. |

Table 6.3H.1.3.4.3-4: FrequencyInfoUL-SIB for CA\_n41C (Power Class 3)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-62 FrequencyInfoUL-SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 16 |  | Test IDs 1, 3 |
|  | 14 |  | Test ID 5 |
|  | 11 |  | Test ID 7 |
|  | 10 |  | Test IDs 2, 4, 6, 8 |

Table 6.3H.1.3.4.3-5: FrequencyInfoUL-SIB for CA\_n41C (Power Class 2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-62 FrequencyInfoUL-SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 19 |  | Test IDs 1, 3 |
|  | 17 |  | Test ID 5 |
|  | 14 |  | Test ID 7 |
|  | 12 |  | Test IDs 2, 4, 6, 8 |

6.3H.1.3.5 Test requirement

The requirement for the transmit ON power and transmit OFF power for intra-band UL contiguous CA with UL MIMO measured in steps 5, 6 and 7 of the test procedure shall not exceed the values specified in Table 6.3H.1.3.5-1.

Table 6.3H.1.3.5-1: General ON/OFF time mask

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Channel bandwidth / minimum output power / measurement bandwidth | | | | | | | | | | | | |
|  | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 40  MHz | 50  MHz | 60  MHz | 70  MHz | 80  MHz | 90  MHz | 100  MHz |
| Transmit OFF power | ≤ -50+TT dBm | | | | | | | | | | | | |
| Transmission OFF Measurement bandwidth | 4.515 | 9.375 | 14.235 | 19.095 | 23.955 | 28.815 | 38.895 | 48.615 | 58.35 | 68.07 | 78.15 | 88.23 | 98.31 |
| Transmit ON power | Same as Test ID 1 of Table 6.2H.1.2.5-1 and Table 6.2H.1.2.5-2 as appropriate | | | | | | | | | | | | |
| NOTE 1: TT for each frequency and channel bandwidth of OFF power is specified in Table 6.3H.1.3.5-2. | | | | | | | | | | | | | |

Table 6.3H.1.3.5-2: Test Tolerance for OFF power

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 1.5 | 1.8 |
| 40MHz < BW ≤ 100MHz | 1.7 | 1.8 |
| 100MHz < BW ≤ 200MHz | FFS | FFS |

#### 6.3H.1.4 Power control for intra-band UL contiguous CA with UL MIMO

##### 6.3H.1.4.0 Minimum conformance requirements

For UE supporting intra-band UL contiguous CA and UL MIMO, the power control tolerance in clause 6.3A.4.1.0, 6.3A.4.2 and 6.3A.4.3.0 for intra-band UL contiguous CA applies to the sum of output powers from both transmit antenna connector on each CC. The requirements shall be met with UL MIMO configurations described in clause 6.2H.1.3.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission with precoding matrix W=1 [6.3.1.5 TS 38.211], the requirements in clause 6.3A.4.1.0, 6.3A.4.2 and 6.3A.4.3.0 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3H.1.4.

##### 6.3H.1.4.1 Absolute power tolerance for intra-band UL contiguous CA with UL MIMO

6.3H.1.4.1.1 Test purpose

To verify the ability of the UE transmitter for 2UL CA to set its initial output power to a specific value at the start of a contiguous transmission or non-contiguous transmission on each active component carrier with a long transmission gap, i.e. transmission gap is larger than 20ms.

6.3H.1.4.1.2 Test applicability

The requirements of this test apply in test cases 6.3D.4.1 Absolute power tolerance for UL MIMO.

6.3H.1.4.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3H.1.4.0.

6.3H.1.4.1.4 Test description

This test is covered by clause 6.3D.4.1 Absolute power tolerance for UL MIMO.

##### 6.3H.1.4.2 Relative power tolerance for intra-band UL contiguous CA with UL MIMO

6.3H.1.4.2.1 Test purpose

To verify the ability of the UE transmitter to set its output power of each component carrier in a target sub-frame(1ms) relatively to the power of the most recently transmitted reference sub-frame if the transmission gap between these sub-frames is less than or equal to 20ms.

6.3H.1.4.2.2 Test applicability

The requirements of this test apply in test cases 6.3D.4.2 Relative power tolerance for UL MIMO.

6.3H.1.4.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3H.1.4.0.

6.3H.1.4.2.4 Test description

This test is covered by clause 6.3D.4.2 Relative power tolerance for UL MIMO.

##### 6.3H.1.4.3 Aggregate power tolerance for intra-band UL contiguous CA with UL MIMO

6.3H.1.4.2.1 Test purpose

To verify the ability of the UE transmitter to maintain its power during non-contiguous transmissions within 21ms in response to 0 dB commands with respect to the first UE transmission and all other power control parameters as specified in 38.213 kept constant on all active component carriers.

6.3H.1.4.2.2 Test applicability

The requirements of this test apply in test cases 6.3D.4.3 Aggregate power tolerance for UL MIMO.

6.3H.1.4.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.3H.1.4.0.

6.3H.1.4.2.4 Test description

This test is covered by clause 6.3D.4.3 Aggregate power tolerance for UL MIMO.

## 6.3J Output power dynamics for ATG

### 6.3J.1 Minimum output power for ATG

Editor’s note: This clause is incomplete. The following aspects are either missing or not yet determined:

- MU and TT are FFS

- Message Contents are FFS pending on Rel-18 ASN.1 freeze

6.3J.1.1 Test purpose

To verify the UE's ability to transmit with a broadband output power below the value specified in the test requirement when the power is set to a minimum value.

6.3J.1.2 Test applicability

This test case applies to all types of NR UE release 18 and forward that support NR standalone ATG.

6.3J.1.3 Minimum conformance requirements

The minimum controlled output power of the UE is defined as the power in the channel bandwidth for all transmit bandwidth configurations (resource blocks) when the power is set to a minimum value.

The minimum output power is defined as the mean power in at least one sub-frame (1 ms). The minimum output power shall not exceed the values specified in Table 6.3J.1.3-1for ATG UE with omni-directional antenna and in Table 6.3J.1.3-2 for ATG UE with antenna array.

Table 6.3J.1.3-1: Minimum output power for ATG UE with omni-directional antenna

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth | (MHz) | 5,10,15,20 | 25,30,35,40,45,50 | 60,70,80,90,100 |
| REF\_SCS | (kHz) | 15 | | 30 |
| Minimum output power | (dBm) | -15 | -15+10log10 (BWChannel /20) | -15+10log10 (BWChannel /20) |
| Measurement bandwidth | (MHz) | MBW=REF\_SCS\*(12\*NRB+1)/1000 | | |
| NOTE: The minimum output power value is rounded to the nearest number down to one decimal point. | | | | |

Table 6.3J.1.3-2: Minimum output power for ATG UE with antenna array

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth | (MHz) | 5,10,15,20 | 25,30,35,40,45,50 | 60,70,80,90,100 |
| REF\_SCS | (kHz) | 15 | | 30 |
| Minimum output power | (dBm) | -19 | -19+10log10 (BWChannel /20) | -19+10log10 (BWChannel /20) |
| Measurement bandwidth | (MHz) | MBW=REF\_SCS\*(12\*NRB+1)/1000 | | |
| NOTE: The minimum output power value is rounded to the nearest number down to one decimal point. | | | | |

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3J.1.

6.3J.1.4 Test description

6.3J.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in Table 6.3J.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3J.1.4.1-1: Test Configuration Table

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Highest | |
| Test Parameters for Channel Bandwidths | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A for minimum output power | Modulation | RB allocation (NOTE 1) |
| 1 | test case | DFT-s-OFDM QPSK | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3J.1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in State RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.3J.1.4.3.

6.3J.1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.3J.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send continuously uplink power control "down" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step to ensure that the UE transmits at its minimum output power.

3. Measure the sum of power of all antenna connectors (for ATG UE with omni-directional antennas) or of all TAB connectors (for ATG UE with antenna array) in the associated measurement channel bandwidth specified in Table 6.3J.1.5-1 or Table 6.3J.1.5-2 for the specific channel bandwidth under test. The period of measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD symbols with transient periods are not under test.

6.3J.1.4.3 Message contents

FFS

6.3J.1.5 Test requirement

The minimum output power, derived in step 3 shall not exceed the values specified in Table 6.3J.1.5-1 or Table 6.3J.1.5-2.

Table 6.3J.1.5-1: Minimum output power for ATG UE with omni-directional antenna

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -15+TT | 4.515 |
| 10 | -15+TT | 9.375 |
| 15 | -15+TT | 14.235 |
| 20 | -15+TT | 19.095 |
| 25 | -14+TT | 23.955 |
| 30 | -13.2+TT | 28.815 |
| 35 | -12.6+TT | 33.855 |
| 40 | -12+TT | 38.895 |
| 45 | -11.5+TT | 43.575 |
| 50 | -11+TT | 48.615 |
| 60 | -10.2+TT | 58.35 |
| 70 | -9.6+TT | 68.07 |
| 80 | -9+TT | 78.15 |
| 90 | -8.5+TT | 88.23 |
| 100 | -8+TT | 98.31 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3J.1.5-3 | | |

Table 6.3.1.5-2: Minimum output power for ATG UE with antenna array

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Minimum output power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -19+TT | 4.515 |
| 10 | -19+TT | 9.375 |
| 15 | -19+TT | 14.235 |
| 20 | -19+TT | 19.095 |
| 25 | -18+TT | 23.955 |
| 30 | -17.2+TT | 28.815 |
| 35 | -16.6+TT | 33.855 |
| 40 | -16+TT | 38.895 |
| 45 | -15.5+TT | 43.575 |
| 50 | -15+TT | 48.615 |
| 60 | -14.2+TT | 58.35 |
| 70 | -13.6+TT | 68.07 |
| 80 | -13+TT | 78.15 |
| 90 | -12.5+TT | 88.23 |
| 100 | -12+TT | 98.31 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3.1.5-3 | | |

Table 6.3J.1.5-3: Test Tolerance (Minimum output power for ATG)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | FFS | FFS |
| 40MHz < BW ≤ 100MHz | FFS | FFS |

### 6.3J.2 Transmit OFF power for ATG

Editor’s note: This clause is incomplete. The following aspects are either missing or not yet determined:

- MU and TT are FFS

- The referenced clause 6.3J.3 is FFS

6.3J.2.1 Test purpose

To verify that the UE transmit OFF power is lower than the value specified in the test requirement.

An excess Transmit OFF power potentially increases the Rise Over Thermal (RoT) and therefore reduces the cell coverage area for other UEs.

6.3J.2.2 Test applicability

The requirements of this test apply in test case 6.3J.3 Transmit ON/OFF time mask for ATG to all types of NR UE release 18 and forward that support NR standalone ATG.

6.3J.2.3 Minimum conformance requirements

Transmit OFF power is defined as the mean power in the channel bandwidth when the transmitter is OFF. The transmitter is considered OFF when the UE is not allowed to transmit on any of its ports.

The Transmit OFF power is defined as the mean power in a duration of at least one sub-frame (1ms) excluding any transient periods. The Transmit OFF power shall not exceed the values specified in Table 6.3J.2.3-1.

Table 6.3J.2.3-1: Transmit OFF power for ATG

|  |  |  |  |
| --- | --- | --- | --- |
| **Channel bandwidth** | (MHz) | 3,5,10,15,20,25,30,35,40,45,50 | 60,70,80,90,100 |
| **REF\_SCS** | (kHz) | 15 | 30 |
| **Transmit OFF power** | (dBm) | -50 | |
| **Measurement bandwidth** | (MHz) | MBW=REF\_SCS\*(12\*NRB+1)/1000 | |
| NOTE: “NRB” in the formula is the maximum transmission bandwidth configuration as defined in Table 5.3.2-1. | | | |

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3J.2 and 6.3.2.

6.3J.2.4 Test description

This test is covered by clause 6.3J.3 Transmit ON/OFF time mask for ATG.

6.3J.2.5 Test requirement

The requirement for the Transmit OFF power for ATG is the sum of power of all antenna connectors (for ATG UE with omni-directional antennas) or of all TAB connectors (for ATG UE with antenna array) and shall not exceed the values specified in Table 6.3J.2.5-1.

Table 6.3J.2.5-1: Transmit OFF power for ATG

|  |  |  |
| --- | --- | --- |
| Channel bandwidth  (MHz) | Transmit OFF power  (dBm) | Measurement bandwidth  (MHz) |
| 5 | -50+TT | 4.515 |
| 10 | -50+TT | 9.375 |
| 15 | -50+TT | 14.235 |
| 20 | -50+TT | 19.095 |
| 25 | -50+TT | 23.955 |
| 30 | -50+TT | 28.815 |
| 35 | -50+TT | 33.855 |
| 40 | -50+TT | 38.895 |
| 45 | -50+TT | 43.575 |
| 50 | -50+TT | 48.615 |
| 60 | -50+TT | 58.35 |
| 70 | -50+TT | 68.07 |
| 80 | -50+TT | 78.15 |
| 90 | -50+TT | 88.23 |
| 100 | -50+TT | 98.31 |
| NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3J.2.5-2 | | |

Table 6.3J.2.5-2: Test Tolerance (Transmit OFF power for ATG)

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6.0GHz |
| BW ≤ 40MHz | FFS | FFS |
| 40MHz < BW ≤ 100MHz | FFS | FFS |

## 6.4 Transmit signal quality

In this clause a multitude of results are derived, all using one common algorithm returning these results: Global In-Channels TX-Test Annex E. Each sub clause of this clause contains a procedure and test requirements described for a specific measurement. If all relevant test parameters in different sub clauses are the same, then the results, returned by the Global In-Channel TX-Test, may be used across the applicable sub clauses.

### 6.4.1 Frequency error

6.4.1.1 Test purpose

This test verifies the ability of both, the receiver and the transmitter, to process frequency correctly.

Receiver: to extract the correct frequency from the stimulus signal, offered by the System simulator, under ideal propagation conditions and low level.

Transmitter: to derive the correct modulated carrier frequency from the results, gained by the receiver.

6.4.1.2 Test applicability

This test case applies to all types of NR Power Class 1 UE release 15 and forward.

This test case applies to all types of NR Power Class 2 and Power Class 3 UE release 15 and forward that don't support Tx diversity.

6.4.1.3 Minimum conformance requirements

The UE basic measurement interval of modulated carrier frequency is 1 UL slot. The mean value of basic measurements of UE modulated carrier frequency shall be accurate to within ±0.1 PPM observed over a period of 1 ms of cumulated measurement intervals compared to the carrier frequency received from the NR Node B.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4.1

6.4.1.4 Test description

6.4.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4.1.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.1.4.1-1: Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid range (NOTE 3) | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Highest | |
| Test SCS as specified in Table 5.3.5-1 | | | Lowest | |
| Test Parameters | | | | |
|  | Downlink Configuration | | Uplink Configuration | |
| Test ID | Modulation | RB allocation | Modulation | RB allocation |
| 1 | CP-OFDM QPSK | Full RB (NOTE 1) | DFT-s-OFDM QPSK | REFSENS (NOTE 2) |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2  NOTE 2: REFSENS refers to Table 7.3.2.4.1-3 which defines uplink RB configuration and start RB location for each SCS, channel BW and NR band.  NOTE 3: For NR band n28, 30MHz test channel bandwidth is tested with Low range test frequencies. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The DL and UL Reference Measurement channels are set according to Table 6.4.1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4.1.4.3

6.4.1.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1\_1 for C\_RNTI to transmit the DL RMC according to Table 6.4.1.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.

2. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

3. Set the Downlink signal level to the appropriate REFSENS value defined in Table 7.3.2.5-1. Send continuously uplink power control "up" commands to the UE in every uplink scheduling information to the UE so that the UE transmits at PUMAX level for the duration of the test. Allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

4. Measure the Frequency Error using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

5. For UEs supporting DSS, repeat steps 1~4 on the applicable bands as specified in Section 5.4.2.1 with message contents being according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-61 and Table 4.6.3-62 with condition DSS.

6.4.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6.

6.4.1.5 Test requirement

The 10 frequency error Δf results must fulfil the test requirement:

|Δf| ≤ (0.1 PPM + 15 Hz)

### 6.4.2 Transmit modulation quality

Transmit modulation quality defines the modulation quality for expected in-channel RF transmissions from the UE. The transmit modulation quality is specified in terms of:

- Error Vector Magnitude (EVM) for the allocated resource blocks (RBs),

- EVM equalizer spectrum flatness derived from the equalizer coefficients generated by the EVM measurement process

- Carrier leakage

- In-band emissions for the non-allocated RB

All the parameters defined in subclause 6.4.2 are defined using the measurement methodology specified in Annex E.

In case the parameter 3300 or 3301 is reported from UE via *txDirectCurrentLocation* IE (as defined in TS 38.331 [6]), carrier leakage measurement requirement in subclause 6.4.2.2 and 6.4.2.3 shall be waived, and the RF correction with regard to the carrier leakage and IQ image shall be omitted during the calculation of transmit modulation quality.

#### 6.4.2.1 Error Vector Magnitude

6.4.2.1.1 Test Purpose

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM.

The measured waveform is further equalised using the channel estimates subjected to the EVM equaliser spectrum flatness requirement specified in sub-clause 6.4.2.4.3. For DFT-s-OFDM waveforms, the EVM result is defined after the front-end FFT and IDFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %. For CP-OFDM waveforms, the EVM result is defined after the front-end FFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %.

The basic EVM measurement interval in the time domain is one preamble sequence for the PRACH and the duration of PUCCH/PUSCH channel, or one hop, if frequency hopping is enabled for PUCCH and PUSCH in the time domain. The EVM measurement interval is reduced by any symbols that contains an allowable power transient as defined in subclause 6.3.3.3.

6.4.2.1.2 Test applicability

This test case applies to all types of NR Power Class 1 UE release 15 and forward.

This test case applies to all types of NR Power Class 2 and Power Class 3 UE release 15 and forward that don't support Tx diversity.

6.4.2.1.3 Minimum conformance requirements

The RMS average of the basic EVM measurements for 10 sub-frames excluding any transient period for the average EVM case, and 60 sub-frames excluding any transient period for the reference signal EVM case, for the different modulation schemes shall not exceed the values specified in Table 6.4.2.1.3-1 for the parameters defined in Table 6.4.2.1.3-2. For EVM evaluation purposes, all PRACH preamble formats 0-4 and all 5 PUCCH formats are considered to have the same EVM requirement as QPSK modulated.

Table 6.4.2.1.3-1: Requirements for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| Pi/2-BPSK | % | 30 |
| QPSK | % | 17.5 |
| 16 QAM | % | 12.5 |
| 64 QAM | % | 8 |
| 256 QAM | % | 3.5 |

Table 6.4.2.1.3-2: Parameters for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Level |
| UE Output Power | dBm | ≥ Table 6.3.1.3-1 |
| UE Output Power for 256 QAM | dBm | ≥ Table 6.3.1-1 + 10 dB |
| Operating conditions |  | Normal conditions |

The normative reference for this requirement is TS 38.101 [2] clause 6.4.2.1.

6.4.2.1.4 Test description

6.4.2.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4.2.1.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.2.1.4.1-1: Test Configuration Table for PUSCH

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range (NOTE 4) | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | All | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation (NOTE 3) | RB allocation (NOTE 1) |
| 13 |  | DFT-s-OFDM PI/2 BPSK | Inner Full |
| 23 |  | DFT-s-OFDM PI/2 BPSK | Outer Full |
| 3 |  | DFT-s-OFDM QPSK | Inner Full |
| 4 |  | DFT-s-OFDM QPSK | Outer Full |
| 5 |  | DFT-s-OFDM 16 QAM | Inner Full |
| 6 |  | DFT-s-OFDM 16 QAM | Outer Full |
| 7 |  | DFT-s-OFDM 64 QAM | Outer Full |
| 8 |  | DFT-s-OFDM 256 QAM | Outer Full |
| 9 |  | CP-OFDM QPSK | Inner Full |
| 10 |  | CP-OFDM QPSK | Outer Full |
| 11 |  | CP-OFDM 16 QAM | Inner Full |
| 12 |  | CP-OFDM 16 QAM | Outer Full |
| 13 |  | CP-OFDM 64 QAM | Outer Full |
| 14 |  | CP-OFDM 256 QAM | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.  NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.  NOTE 4: For NR band n28, 30MHz test channel bandwidth is tested with Low range and High range test frequencies. | | | |

Table 6.4.2.1.4.1-2: Test Configuration Table for PUCCH

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | See Table 6.4.2.1.4.1-1 | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | See Table 6.4.2.1.4.1-1 | | |
| Test SCS as specified in Table 5.3.5-1 | | | See Table 6.4.2.1.4.1-1 | | |
| Test Parameters | | | | | |
| ID | Downlink Configuration | | Uplink Configuration | | |
|  | Modulation | RB allocation | Waveform | PUCCH format | RB index |
| 1 | CP-OFDM QPSK | Full RB (Note 1) | CP-OFDM | PUCCH format = Format 1 (Note 4)  Length in OFDM symbols = 14 | 0 |
| 2 | CP-OFDM QPSK | Full RB (Note 1) | CP-OFDM | PUCCH format = Format (Note 4)1  Length in OFDM symbols = 14 | NRB-1 |
| 3 | CP-OFDM QPSK | Full RB (Note 1) | DFT-s-OFDM | PUCCH format = Format 3 (Note 3)  Length in OFDM symbols = 14 | 0 |
| 4 | CP-OFDM QPSK | Full RB (Note 1) | DFT-s-OFDM | PUCCH format = Format 3 (Note 3)  Length in OFDM symbols = 14 | NRB-1 |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.  NOTE 3: For FDD, set K1 value (PDSCH-to-HARQ-timing-indicator) as follows: K1 = 2 if mod(i,5) = 0 K1 = 2 if mod(i,5) = 1 K1 = 4 if mod(i,5) = 2 K1 = 3 if mod(i,5) = 3 K1 = 2 if mod(i,5) = 4 where i is slot index per frame  NOTE 4: For PUCCH format = Format 1, TDD and SCS 30 kHz, schedule the DL RMC as follows: if mod(i,10) = 3: Scheduled Other slots: Not scheduled where i is slot index per frame | | | | | |

Table 6.4.2.1.4.1-3: Test Configuration for PRACH

|  |  |  |
| --- | --- | --- |
| Initial Conditions | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | See Table 6.4.2.1.4.1-1 | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | See Table 6.4.2.1.4.1-1 | |
| Test SCS as specified in Table 5.3.5-1 | SCS defined in TS 38.211 [8] subclause 6.3.3.2 determined by PRACH Configuration Index | |
| PRACH preamble format | | |
|  | FDD | TDD |
| PRACH Configuration Index | 17 | 7 |
| RS EPRE setting for test point 1 (dBm/15kHz) | -71 | |
| RS EPRE setting for test point 2 (dBm/15kHz) | -86 | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4.2.1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4.2.1.4.3

6.4.2.1.4.2 Test procedure

Test procedure for PUSCH:

1.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4.2.1.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

1.2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level, allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

1.3. Measure the EVM and  using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

1.4. For modulations except 256QAM, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where:

- Pmin is the minimum output power according to Table 6.3.1.3-1.

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

For 256 QAM, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin + 10 dB, where Pmin, MU and Uplink power control window size are defined above.

1.5. Measure the EVM and  using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4.2.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

Table 6.4.2.1.4.2-1: Void

Test procedure for PUCCH:

2.1. PUCCH is set according to Table 6.4.2.1.4.1-2.

2.2. SS transmits PDSCH via PDCCH DCI format 1\_1 for C\_RNTI to transmit the DL RMC according to Table 6.4.2.1.4.1-2. The SS sends downlink MAC padding bits on the DL RMC. The transmission of PDSCH will make the UE send uplink ACK/NACK using PUCCH. There is no PUSCH transmission.

2.3. SS send appropriate TPC commands for PUCCH to the UE until the UE transmit PUCCH at PUMAX level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

2.4. Measure PUCCH EVM using Global In-Channel Tx-Test (Annex E).

2.5. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE PUCCH output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where:

- Pmin is the minimum output power according to Table 6.3.1.3-1.

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 2.0dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 2.0dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

2.6. Measure PUCCH EVM using Global In-Channel Tx-Test (Annex E).

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4.2.1.4.1-2, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

Test procedure for PRACH:

3.1. The SS shall set RS EPRE according to Table 6.4.2.1.4.1-3.

3.2. PRACH is set according to Table 6.4.2.1.4.1-3.

3.3. The SS shall signal a Random Access Preamble ID via a PDCCH order to the UE and initiate a Non-contention based Random Access procedure.

3.4. The UE shall send the signalled preamble to the SS.

3.5. In response to the preamble, the SS shall transmit a random access response not corresponding to the transmitted random access preamble, or send no response.

3.6. The UE shall consider the random access response reception not successful then re-transmit the preamble with the calculated PRACH transmission power.

3.7. Repeat step 5 and 6 until the SS collect enough PRACH preambles. Measure the EVM in PRACH channel using Global In-Channel Tx-Test (Annex E).

6.4.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the following exceptions:

Table 6.4.2.1.4.3-1: *RACH-ConfigCommon:* PRACH measurement

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-128 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigCommon::= SEQUENCE { |  |  |  |
| rach-ConfigGeneric | RACH-ConfigGeneric |  |  |
| totalNumberOfRA-Preambles | Not present |  |  |
| ssb-perRACH-OccasionAndCB-PreamblesPerSSB CHOICE { |  |  |  |
| one | n8 |  | FR1 |
| } |  |  |  |
| groupBconfigured | Not present |  |  |
| ra-ContentionResolutionTimer | sf64 |  |  |
| rsrp-ThresholdSSB | RSRP-Range |  |  |
| rsrp-ThresholdSSB-SUL | Not present |  |  |
| RSRP-Range |  | SUL |
| prach-RootSequenceIndex CHOICE { |  |  |  |
| l139 | Set according to table 4.4.2-2 for the NR Cell. |  | PRACH Format A3 |
| l839 | 0 | NR Cell 1 | PRACH Format 0 |
|  | TBD | Other than NR Cell 1 | PRACH Format 0 |
| } |  |  |  |
| msg1-SubcarrierSpacing | SubcarrierSpacing |  |  |
| restrictedSetConfig | unrestrictedSet |  |  |
| msg3-transformPrecoder | Not present | transform precoding is disabled for Msg3 PUSCH transmission and any PUSCH transmission scheduled with DCI format 0\_0 |  |
| } |  |  |  |

Table 6.4.2.1.4.3-2: *RACH-ConfigGeneric:* PRACH measurement

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-130 | | | |
| Information Element | Value/remark | Comment | Condition |
| RACH-ConfigGeneric ::= SEQUENCE { |  |  |  |
| prach-ConfigurationIndex | 17 | Paired Spectrum | PRACH Format 0 |
|  | 7 | Unpaired Spectrum | PRACH Format 0 |
| msg1-FDM | four |  | FR1 |
| msg1-FrequencyStart | 0 |  |  |
| zeroCorrelationZoneConfig | 15 |  |  |
| preambleReceivedTargetPower | -92 |  | Test point 1 |
|  | -74 |  | Test point 2 |
| preambleTransMax | n7 |  |  |
| powerRampingStep | dB0 |  |  |
| ra-ResponseWindow | sl20 |  |  |
| } |  |  |  |

Table 6.4.2.1.4.3-3: PUSCH-TimeDomainResourceAllocationList: PRACH measurement

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-122 | | | |
| Information Element | Value/remark | Comment | Condition |
| PUSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF PUSCH-TimeDomainResourceAllocation { | 2 entries |  |  |
| PUSCH-TimeDomainResourceAllocation[2] SEQUENCE { |  | entry 2  addressed by Msg3 PUSCH time resource allocation field of the Random Access Response acc. to TS 38.213 [22] Table 8.2-1. |  |
| k2 | 6 | K2+ Δ=8 acc. to TS 38.214 [21] Table 6.1.2.1.1-5 | Unpaired Spectrum  for SCS15kHz and PRACH Format 0 |
| } |  |  |  |
| } |  |  |  |

Table 6.4.2.1.4.3-4: PDSCH-ServingCellConfig: PUCCH format3 measurement

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[15], Table 4.6.3-102 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-ServingCellConfig ::= SEQUENCE { |  |  |  |
| codeBlockGroupTransmission | Not present |  |  |
| xOverhead | Not present |  |  |
| nrofHARQ-ProcessesForPDSCH | n6 |  | FDD |
| pucch-Cell | Not present |  |  |
| maxMIMO-Layers | Not present |  |  |
| processingType2Enabled | Not present |  |  |
| pdsch-CodeBlockGroupTransmissionList-r16 | Not present |  |  |
| } |  |  |  |

6.4.2.1.5 Test requirement

The PUSCH EVM, derived in Annex E.4.2, shall not exceed the values in Table 6.4.2.1.5-1.

The PUSCH, derived in Annex E.4.6.2, shall not exceed the values in Table 6.4.2.1.5-1 when embedded with data symbols of the respective modulation scheme.

Table 6.4.2.1.5-1: Test requirements for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| Pi/2-BPSK | % | 30 + TT |
| QPSK | % | 17.5 + TT |
| 16 QAM | % | 12.5 + TT |
| 64 QAM | % | 8 + TT |
| 256 QAM | % | 3.5 + TT |
| Note 1: TT is defined in Table 6.4.2.1.5-2. | | |

Table 6.4.2.1.5-2: Test Tolerance

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| Pi/2-BPSK | % | 0 |
| QPSK | % | 0 |
| 16 QAM | % | 0 |
| 64 QAM | % | 0 |
| 256 QAM | % | 0.3 for 15 dBm < PUL  0.8 for -25 dBm < PUL≤ 15 dBm  1.1 for -40dBm ≤ PUL ≤ -25dBm |

The PUCCH EVM derived in Annex E.5.9.2 shall not exceed 17.5 %.

The PRACH EVM derived in Annex E.6.9.2 shall not exceed 17.5%.

#### 6.4.2.1a Error Vector Magnitude including symbols with transient period

Editor’s note: This clause is incomplete. The following aspects are either missing or not yet determined:

* RB allocation conditions and output power levels at initial conditions
* Figure of transient period at test procedure
* Test procedures to change RB allocation
* A way to calculate EVM whether to include only rising edge of transient or falling edge, or both
* UL-DL configurations at message contents

6.4.2.1a.1 Test Purpose

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM.

6.4.2.1a.2 Test applicability

This test case applies to all types of NR Power Class 1 UE release 16 and forward that support short transient period capability.

This test case applies to all types of NR Power Class 2 and Power Class 3 UE release 16 and forward that support short transient period capability and don’t support Tx diversity..

6.4.2.1a.3 Minimum conformance requirements

In 6.4.2.1, EVM has been defined by excluding the symbols which have a transient period. In this section, measurement interval is defined for the symbols with a transient period to include these symbols in the RMS average EVM computation when the UE reports a transient period capability other than the default. Before calculating the EVM, the measured waveform is corrected for sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM. The symbols with transient period should not be used for equalization. Only CP-OFDM waveform is used for conformance testing.

In the case of PUSCH or PUCCH transmissions when the mean power, modulation or RB allocation across slot or subslot boundaries is expected to change the EVM result over the symbols where the transient occurs is calculated according to Table 6.4.2.1a.3-1.

Table 6.4.2.1a.3-1: EVM definition for reported transient period

| Reported transient capability (us) | EVM definition | tpstart (µs) | SCS4 |
| --- | --- | --- | --- |
| 2 |  | -0.5 | 15kHz or 30kHz5 |
| 4 |  | -1 | 15kHz |
| 7 |  | -2.7 | 15kHz |
| NOTE 1: ,,and are defined in Annex E.4.7  NOTE 2: is the EVM for a symbol right after a transition; is the EVM for a symbol right before a transition  NOTE 3: *tpstart* denotes the start position of the EVM exclusion window as shown in Annex E.4.7  NOTE 4: SCS denotes the SCS that can be used in the conformance test  NOTE 5: 30kHz shall be used in the conformance test unless the UE signals in *supportedSubCarrierSpacingUL*in *FeatureSetPerCC* that it only supports 15kHz in the corresponding band | | | |

The RMS average of the basic EVM measurements over 108 subframes calculated only on the symbols where the transient occurs for the different modulation schemes shall not exceed the values specified in Table 6.4.2.1a.3-2 for the parameters defined in Table 6.4.2.1a.3-3. This requirement can be verified with 64 QAM and 256 QAM modulation.

Table 6.4.2.1a.3-2: Requirements for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| 64 QAM | % | 10 |
| 256 QAM | % | 8 |

Table 6.4.2.1a.3-3: Parameters for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Level |
| UE Output Power | dBm | ≥ Table 6.3.1-1 |
| UE Output Power for 256 QAM | dBm | ≥ Table 6.3.1-1 + 10 dB |
| Operating conditions |  | Normal conditions |

The normative reference for this requirement is TS 38.101 [2] clause 6.4.2.1a.

6.4.2.1a.4 Test description

6.4.2.1a.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4.2.1a.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.2.1a.4.1-1: Test Configuration Table for PUSCH

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range (NOTE 4) | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | 15 kHz (Note 3) | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation | RB allocation (NOTE 1) |
| 1 |  | CP-OFDM 64 QAM | Outer Full |
| 2 |  | CP-OFDM 256 QAM | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.  NOTE 3: For UE supporting 2 us transient period, 30kHz shall be used in the conformance test unless the UE signals in *supportedSubCarrierSpacingUL*in *FeatureSetPerCC* that it only supports 15kHz in the corresponding band.  NOTE 4: For NR band n28, 30MHz test channel bandwidth is tested with Low range and High range test frequencies. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4.2.1a.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4.2.1a.4.3

6.4.2.1a.4.2 Test procedure

Symbol after transient

Symbol before transient

Assigned UL slot

Transient period

Transient period

Figure 6.4.2.1a.4.2-1: Error Vector Magnitude including symbols with transient period

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4.2.1a.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC. The UL assignment is such that the UE transmits on slots 8 for 15 kHz SCS, on slots 8 and 18 for 30 kHz SCS and on slots 17 and 37 for 60 kHz SCS.

2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level, allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

3. Measure the EVM and  using Global In-Channel Tx-Test (Annex E) applying tpstart of Table 6.4.2.1a.3-1 according to the declared enhanced transient capability. For TDD, only slots consisting of only UL symbols are under test as indicated in Figure 6.4.2.1a.4.2-1.

4. For CP-OFDM 64 QAM modulations, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where:

- Pmin is the minimum output power according to Table 6.3.1.3-1.

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

For CP-OFDM 256 QAM modulations, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin + 10 dB, where Pmin, MU and Uplink power control window size are defined above.

5. Measure the EVM and  using Global In-Channel Tx-Test (Annex E) applying tpstart of Table 6.4.2.1a.3-1 according to the declared enhanced transient capability. For TDD, only slots consisting of only UL symbols are under test.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

6.4.2.1a.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the following exceptions:

Table 6.4.2.1a.4.3-1: TDD-UL-DL-Config

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[5], Table 4.6.3-192 | | | |
| Information Element | Value/remark | Comment | Condition |
| TDD-UL-DL-ConfigCommon ::= SEQUENCE { |  |  |  |
| referenceSubcarrierSpacing | SubcarrierSpacing |  |  |
| pattern1 SEQUENCE { |  |  |  |
| dl-UL-TransmissionPeriodicity | ms5 |  | FR1 |
|  | ms10 |  | FR1\_15kHz |
| nrofDownlinkSlots | 6 |  | FR1\_15kHz |
|  | 6 |  | FR1\_30kHz |
|  | 14 |  | FR1\_60kHz |
| nrofDownlinkSymbols | 10 |  | FR1\_15kHz |
|  | 6 |  | FR1\_30kHz |
|  | 12 |  | FR1\_60kHz |
| nrofUplinkSlots | 3 |  | FR1\_15kHz,FR1\_30kHz |
|  | 4 |  | FR1\_60kHz |
| nrofUplinkSymbols | 4 |  | FR1\_30kHz |
|  | 2 |  | FR1\_15kHz, |
|  | 8 |  | FR1\_60kHz |
|  |  |  |  |
| } |  |  |  |
| pattern2 | Not present |  |  |
| } |  |  |  |

6.4.2.1a.5 Test requirement

The PUSCH EVM, derived in Annex E.4.2, shall not exceed the values in Table 6.4.2.1a.5-1.

The PUSCH, derived in Annex E.4.6.2, shall not exceed the values in Table 6.4.2.1a.5-1 when embedded with data symbols of the respective modulation scheme.

Table 6.4.2.1a.5-1: Test requirements for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| 64 QAM | % | 10 + TT |
| 256 QAM | % | 8 + TT |
| Note 1: TT is defined in Table 6.4.2.1a.5-2. | | |

Table 6.4.2.1a.5-2: Test Tolerance

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| 64 QAM | % | 0 |
| 256 QAM | % | 0.3 for 15 dBm < PUL  0.8 for -25 dBm < PUL≤ 15 dBm  1.1 for -40dBm ≤ PUL ≤ -25dBm |

#### 6.4.2.2 Carrier leakage

6.4.2.2.1 Test purpose

Carrier leakage expresses itself as unmodulated sine wave with the carrier frequency or centre frequency of aggregated transmission bandwidth configuration. It is an interference of approximately constant amplitude and independent of the amplitude of the wanted signal.

The purpose of this test is to exercise the UE transmitter to verify its modulation quality in terms of carrier leakage.

6.4.2.2.2 Test applicability

This test case applies to all types of NR Power Class 1 UE release 15 and forward.

This test case applies to all types of NR Power Class 2 and Power Class 3 UE release 15 and forward that don't support Tx diversity..

6.4.2.2.3 Minimum conformance requirements

Carrier leakage is an additive sinusoid waveform whose frequency is the same as the modulated waveform carrier frequency. The measurement interval is one slot in the time domain.

In the case that uplink sharing, the carrier leakage may have 7.5 kHz shift with the carrier frequency.

The relative carrier leakage power is a power ratio of the additive sinusoid waveform and the modulated waveform. The relative carrier leakage power shall not exceed the values specified in Table 6.4.2.2.3-1.

Table 6.4.2.2.3-1: Requirements for Carrier Leakage

|  |  |
| --- | --- |
| Parameter | Relative Limit (dBc) |
| Output power > 10 dBm | -28 |
| 0 dBm ≤ Output power ≤ 10 dBm | -25 |
| -30 dBm ≤ Output power < 0 dBm | -20 |
| -40 dBm ≤ Output power < -30 dBm | -10 |

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4.2.2.

6.4.2.2.4 Test description

6.4.2.2.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4.2.2.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.2.2.4.1-1: Test Configuration

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Mid | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation | RB allocation (NOTE 1, 3) |
| 1 |  | DFT-s-OFDM QPSK | Inner\_1RB\_Left |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.  NOTE 3: When the reported DC carrier position is at Inner\_1RB\_Left, use Inner\_1RB\_Right for UL RB allocation. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to AnnexC.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4.2.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4.2.2.4.3.

7. In case the parameter 3300 or 3301 is reported from the UE via *txDirectCurrentLocation* IE, do not proceed to test procedure and mark the test not applicable with reasoning in the test report.

6.4.2.2.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4.2.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 10 dBm, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7 dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

3. Measure carrier leakage using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

4. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 0 dBm, where MU and Uplink power control window size are defined above.

5. Measure carrier leakage using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

6. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level -30 dBm, where MU and Uplink power control window size are defined above.

7. Measure carrier leakage using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

8. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where MU and Uplink power control window size are defined above, Pmin is the minimum output power according to Table 6.3.1.3-1.

9. Measure carrier leakage using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

Table 6.4.2.2.4.2-1: Void

Table 6.4.2.1.4.2-2: Void

6.4.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the following exception:

Table 6.4.2.2.4.3-1: *PUSCH-Config*

|  |
| --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-118 with condition TRANSFORM\_PRECODER\_ENABLED |

Table 6.4.2.2.4.3-2: *CellGroupConfig*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| reportUplinkTxDirectCurrent | true |  |  |
| } |  |  |  |

6.4.2.2.5 Test requirement

In case the parameter 3300 or 3301 is reported from UE via *txDirectCurrentLocation* IE, carrier leakage measurement requirement shall be waived. Otherwise, each of the *n* carrier leakage results, derived in Annex E.3.1, shall not exceed the values in table 6.4.2.2.5-1. Allocated RBs are not under test.

Table 6.4.2.2.5-1: Test requirements for Relative Carrier Leakage Power

|  |  |
| --- | --- |
| Parameters  UE output power | Relative limit (dBc) |
| 10 + MU to 10 + (MU + Uplink power control window size) dBm | -28 + TT |
| 0 + MU to 0 + (MU + Uplink power control window size) dBm | -25 + TT |
| -30 + MU to -30 + (MU + Uplink power control window size) dBm | -20 + TT |
| Pmin + MU to Pmin + (MU + Uplink power control window size) dBm | -10 + TT |
| NOTE 1: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 2: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE, and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.  NOTE 3:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 4: MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.  NOTE 5: Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.  NOTE 6: Test tolerance TT = 0.8 dB.  NOTE 7: Pmin is the minimum output power according to Table 6.3.1.3-1. | |

#### 6.4.2.3 In-band emissions

6.4.2.3.1 Test purpose

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks

The in-band emission is defined as the average emission across 12 sub-carriers and as a function of the RB offset from the edge of the allocated UL transmission bandwidth. The in-band emission is measured as the ratio of the UE output power in a non–allocated RB to the UE output power in an allocated RB.

The basic in-band emissions measurement interval is defined over one slot in the time domain, however, the minimum requirement applies when the in-band emission measurement is averaged over 10 sub-frames. When the PUSCH or PUCCH transmission slot is shortened due to multiplexing with SRS, the in-band emissions measurement interval is reduced by one or more symbols, accordingly.

The purpose of this test is to exercise the UE transmitter to verify its modulation quality in terms of in-band emissions.

6.4.2.3.2 Test applicability

This test case applies to all types of NR Power Class 1 UE release 15 and forward.

This test case applies to all types of NR Power Class 2 and Power Class 3 UE release 15 and forward that don't support Tx diversity..

6.4.2.3.3 Minimum conformance requirements

The average of the basic in-band emission measurement over 10 sub-frames shall not exceed the values specified in Table 6.4.2.3.3-1.

Table 6.4.2.3.3-1: Requirements for in-band emissions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter description | Unit | Limit (NOTE 1) | | Applicable Frequencies |
| General | dB |  | | Any non-allocated (NOTE 2) |
| IQ Image | dB | -28 | Image frequencies when output power > 10 dBm | Image frequencies (NOTES 2, 3) |
| -25 | Image frequencies when output power ≤ 10 dBm |
| Carrier leakage | dBc | -28 | Output power > 10 dBm | Carrier leakage frequency (NOTES 4, 5) |
| -25 | 0 dBm ≤ Output power ≤ 10 dBm |
| -20 | -30 dBm ≤ Output power < 0 dBm |
| -10 | -40 dBm ≤ Output power < -30 dBm |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of *PRB* - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* is defined in NOTE 10.  NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs.  NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.  NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 5: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE, and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.  NOTE 6:  is the Transmission Bandwidth (see Section 5.3).  NOTE 7:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 8:  is the limit specified in Table 6.4.2.1.3-1 for the modulation format used in the allocated RBs.  NOTE 9:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth.  NOTE 10:  is an average of the transmitted power over 10 sub-frames normalized by the number of allocated RBs, measured in dBm. | | | | |

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4.2.3.

6.4.2.3.4 Test description

6.4.2.3.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4.2.3.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.2.3.4.1-1: Test Configuration Table for PUSCH

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range (NOTE 3) | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation | RB allocation (NOTE 1) |
| 1 |  | DFT-s-OFDM QPSK | Inner\_1RB\_Left |
| 2 |  | DFT-s-OFDM QPSK | Inner\_1RB\_Right |
| 3 |  | CP-OFDM QPSK | Inner\_1RB\_Left |
| 4 |  | CP-OFDM QPSK | Inner\_1RB\_Right |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.  NOTE 3: For NR band n28, 30MHz test channel bandwidth is tested with Low range and High range test frequencies. | | | |

Table 6.4.2.3.4.1-2: Test Configuration Table for PUCCH

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | See Table 6.4.2.3.4.1-1 | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | See Table 6.4.2.3.4.1-1 | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | See Table 6.4.2.3.4.1-1 | | |
| Test SCS as specified in Table 5.3.5-1 | | | See Table 6.4.2.3.4.1-1 | | |
| Test Parameters | | | | | |
| ID | Downlink Configuration | | Uplink Configuration | | |
|  | Modulation | RB allocation | Waveform | PUCCH format | RB index |
| 1 | CP-OFDM QPSK | Full RB (Note 1) | DFT-s-OFDM | PUCCH format = Format 3 (Note 4)  Length in OFDM symbols = 14 | 0 |
| 2 | CP-OFDM QPSK | Full RB (Note 1) | DFT-s-OFDM | PUCCH format = Format 3 (Note 4)  Length in OFDM symbols = 14 | NRB-1 |
| 3 | CP-OFDM QPSK | Full RB (Note 1) | CP-OFDM | PUCCH format = Format 1 (Note 5)  Length in OFDM symbols = 14 | 0 |
| 4 | CP-OFDM QPSK | Full RB (Note 1) | CP-OFDM | PUCCH format = Format 1 (Note 5)  Length in OFDM symbols = 14 | NRB-1 |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.  NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.  NOTE 4: For FDD, set K1 value (PDSCH-to-HARQ-timing-indicator) as follows: K1 = 2 if mod(i,5) = 0 K1 = 2 if mod(i,5) = 1 K1 = 4 if mod(i,5) = 2 K1 = 3 if mod(i,5) = 3 K1 = 2 if mod(i,5) = 4 where i is slot index per frame  NOTE 5: For TDD and SCS 30 kHz, schedule the DL RMC as follows: if mod(i,10) = 3: Scheduled Other slots: Not scheduled where i is slot index per frame | | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4.2.3.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4.2.3.4.3

6.4.2.3.4.2 Test procedure

Test procedure for PUSCH:

1.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4.2.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

1.2. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 10 dBm, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

1.3. Measure In-band emission using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

1.4. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 0 dBm, where MU and Uplink power control window size are defined above.

1.5. Measure In-band emission using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

1.6. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level -30 dBm, where MU and Uplink power control window size are defined above.

1.7. Measure In-band emission using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

1.8. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where MU and Uplink power control window size are defined above and Pmin is the minimum output power according to Table 6.3.1.3-1.

1.9. Measure In-band emission using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4.2.3.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

Test procedure for PUCCH:

2.1. PUCCH is set according to Table 6.4.2.3.4.1-2. SS transmits PDSCH via PDCCH DCI format 1-1 for C\_RNTI to transmit the DL RMC according to Table 6.4.2.3.4.1-2. The SS sends downlink MAC padding bits on the DL RMC. The transmission of PDSCH will make the UE send uplink ACK/NACK using PUCCH.

2.2. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 10 dBm, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 2.0 dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

2.3. Measure In-band emission using Global In-Channel Tx-Test (Annex E)

2.4. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 0 dBm, where MU and Uplink power control window size are defined above.

2.5. Measure In-band emission using Global In-Channel Tx-Test (Annex E)

2.6. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level -30 dBm, where MU and Uplink power control window size are defined above.

2.7. Measure In-band emission using Global In-Channel Tx-Test (Annex E)

2.8. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where MU and Uplink power control window size are defined above and Pmin is the minimum output power according to Table 6.3.1.3-1.

2.9. Measure In-band emission using Global In-Channel Tx-Test (Annex E)

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4.2.3.4.1-2, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

Table 6.4.2.3.4.2-1: Void

Table 6.4.2.3.4.2-2: Void

6.4.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the following exceptions:

Table 6.4.2.3.4.3-1: PDSCH-ServingCellConfig: PUCCH format3 measurement

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[15], Table 4.6.3-102 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-ServingCellConfig ::= SEQUENCE { |  |  |  |
| codeBlockGroupTransmission | Not present |  |  |
| xOverhead | Not present |  |  |
| nrofHARQ-ProcessesForPDSCH | n6 |  | FDD |
| pucch-Cell | Not present |  |  |
| maxMIMO-Layers | Not present |  |  |
| processingType2Enabled | Not present |  |  |
| pdsch-CodeBlockGroupTransmissionList-r16 | Not present |  |  |
| } |  |  |  |

6.4.2.3.5 Test requirement

The averaged In-band emission result, derived in Annex E.4.3 shall not exceed the corresponding values in Tables 6.4.2.3.5-1.

Table 6.4.2.3.5-1: Test requirements for in-band emissions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter description | Unit | Limit (NOTE 1) | | Applicable Frequencies |
| General (NOTE 12) | dB | + TT | | Any non-allocated  (NOTE 2) |
| IQ Image (NOTE 12) | dB | -28 + TT | Image frequencies when output power > 10 dBm | Image frequencies (NOTES 2, 3) |
| -25 + TT | Image frequencies when output power ≤ 10 dBm |
| Carrier leakage (NOTE 12) | dBc | -28 + TT | Output power > 10 dBm | Carrier leakage frequency (NOTES 4, 5) |
| -25 + TT | 0 dBm ≤ Output power ≤ 10 dBm |
| -20 + TT | -30 dBm ≤ Output power < 0 dBm |
| -10 + TT | -40 dBm ≤ Output power < -30 dBm |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of *PRB* - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* is defined in NOTE 10.  NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs.  NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.  NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 5: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE, and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency, but excluding any allocated RB.  NOTE 6:  is the Transmission Bandwidth (see Section 5.3).  NOTE 7:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 8:  is the limit specified in Table 6.4.2.1.3-1 for the modulation format used in the allocated RBs.  NOTE 9:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth.  NOTE 10:  is an average of the transmitted power over 10 sub-frames normalized by the number of allocated RBs, measured in dBm.  NOTE 11: Test tolerance TT = 0.8 dB.  NOTE 12: In case the parameter 3300 or 3301 is reported from UE via *txDirectCurrentLocation* IE, IQ Image and Carrier leakage limit do not apply and General limit applies for all non-allocated frequencies. | | | | |

#### 6.4.2.4 EVM equalizer spectrum flatness

6.4.2.4.1 Test purpose

The zero-forcing equalizer correction applied in the EVM measurement process (as described in Annex E) must meet a spectral flatness requirement for the EVM measurement to be valid. The EVM equalizer spectrum flatness is defined in terms of the maximum peak-to-peak ripple of the equalizer coefficients (dB) across the allocated uplink block, at which the equalizer coefficients are generated by the EVM measurement process. The basic measurement interval is the same as for EVM.

The EVM equalizer spectrum flatness requirement does not limit the correction applied to the signal in the EVM measurement process but for the EVM result to be valid, the equalizer correction that was applied must meet the EVM equalizer spectrum flatness minimum requirements.

6.4.2.4.2 Test applicability

This test case applies to all types of NR Power Class 1 UE release 15 and forward.

This test case applies to all types of NR Power Class 2 and Power Class 3 UE release 15 and forward that don't support Tx diversity.

6.4.2.4.3 Minimum conformance requirements

The peak-to-peak variation of the EVM equalizer coefficients contained within the frequency range of the uplink allocation shall not exceed the maximum ripple specified in Table 6.4.2.4.3-1 for normal conditions. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 5 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 7 dB (see Figure 6.4.2.4.3-1).

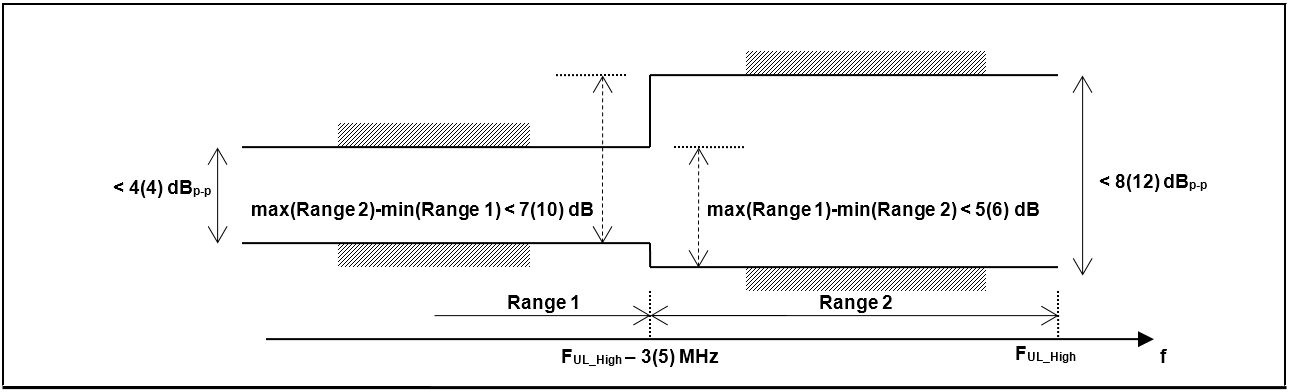
The EVM equalizer spectral flatness shall not exceed the values specified in Table 6.4.2.4.3-2 for extreme conditions. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 10 dB (see Figure 6.4.2.4.3-1).

Table 6.4.2.4.3-1: Requirements for EVM equalizer spectrum flatness (normal conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum ripple (dB) |
| FUL\_Meas – FUL\_Low ≥ 3 MHz and FUL\_High – FUL\_Meas ≥ 3 MHz  (Range 1) | 4 (p-p) |
| FUL\_Meas – FUL\_Low < 3 MHz or FUL\_High – FUL\_Meas < 3 MHz  (Range 2) | 8 (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each E-UTRA frequency band specified in Table 5.5-1 | |

Table 6.4.2.4.3-2: Minimum requirements for EVM equalizer spectrum flatness (extreme conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum Ripple (dB) |
| FUL\_Meas – FUL\_Low ≥ 5 MHz and FUL\_High – FUL\_Meas ≥ 5 MHz  (Range 1) | 4 (p-p) |
| FUL\_Meas – FUL\_Low < 5 MHz or FUL\_High – FUL\_Meas < 5 MHz  (Range 2) | 12 (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each E-UTRA frequency band specified in Table 5.5-1 | |

Figure 6.4.2.4.3-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated (the ETC minimum requirement are within brackets)

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4.2.4.

6.4.2.4.4 Test description

6.4.2.4.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4.2.4.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.2.4.4.1-1: Test Configuration

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range (NOTE 3) | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation | RB allocation (NOTE 1) |
| 1 |  | DFT-s-OFDM QPSK | Outer Full |
| 2 |  | CP-OFDM QPSK | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.  NOTE 3: For NR band n28, 30MHz test channel bandwidth is tested with Low range and High range test frequencies. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4.2.4.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4.2.4.4.3.

6.4.2.4.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4.2.4.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

3. Measure spectrum flatness using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4.2.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

6.4.2.4.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6.

6.4.2.4.5 Test requirement

Each of the *n* spectrum flatness functions, shall derive four ripple results in Annex E.4.4.1. The derived results shall not exceed the values in Figure 6.4.2.4.5-1:

For normal conditions, the maximum ripple in Range 1 and Range 2 shall not exceed the values specified in Table 6.4.2.4.5-1 and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 8.4 dB (see Figure 6.4.2.4.5-1).

For normal conditions, the peak-to-peak variation of the EVM equalizer coefficients contained within the frequency range of the uplink allocation shall not exceed the maximum ripple specified in Table 6.4.2.4.5-1. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 8.4 dB (see Figure 6.4.2.4.5-1).

For extreme conditions, the EVM equalizer spectral flatness shall not exceed the values specified in Table 6.4.2.4.5-2. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 7.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 11.4 dB (see Figure 6.4.2.4.5-1).

Table 6.4.2.4.5-1: Requirements for EVM equalizer spectrum flatness (normal conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum ripple [dB] |
| FUL\_Meas – FUL\_Low ≥ 3 MHz and FUL\_High – FUL\_Meas ≥ 3 MHz  (Range 1) | 4 + TT (p-p) |
| FUL\_Meas – FUL\_Low < 3 MHz or FUL\_High – FUL\_Meas < 3 MHz  (Range 2) | 8 + TT (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each E-UTRA frequency band specified in Table 5.5-1  NOTE 3: Test tolerance TT = 1.4 dB. | |

Table 6.4.2.4.5-2: Minimum requirements for EVM equalizer spectrum flatness (extreme conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum Ripple [dB] |
| FUL\_Meas – FUL\_Low ≥ 5 MHz and FUL\_High – FUL\_Meas ≥ 5 MHz  (Range 1) | 4 + TT (p-p) |
| FUL\_Meas – FUL\_Low < 5 MHz or FUL\_High – FUL\_Meas < 5 MHz  (Range 2) | 12 + TT (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each E-UTRA frequency band specified in Table 5.5-1  NOTE 3: Test tolerance TT = 1.4 dB. | |



Figure 6.4.2.4.5-1: The test requirements for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated for unshaped modulations (the ETC test requirements are within brackets)

#### 6.4.2.5 EVM equalizer spectrum flatness for Pi/2 BPSK

Editor’s Note: The following aspects are either missing or not yet determined:

6.4.2.5.1 Test purpose

The zero-forcing equalizer correction applied in the EVM measurement process (as described in Annex E) must meet a spectral flatness requirement for the EVM measurement to be valid. The EVM equalizer spectrum flatness is defined in terms of the maximum peak-to-peak ripple of the equalizer coefficients (dB) across the allocated uplink block, at which the equalizer coefficients are generated by the EVM measurement process. The basic measurement interval is the same as for EVM.

6.4.2.5.2 Test applicability

This test case applies to all types of power class 3 capable NR UE release 15 and forward that support UE capability *powerBoosting-pi2BPSK* and operating in TDD bands n40, n41, n77, n78 and n79, and don’t support Tx diversity.

This test case applies to all types of NR UE release 16 and forward that support UE capability *lowPAPR-DMRS-PUSCHwithPrecoding-r16*, and don’t support Tx diversity.

6.4.2.5.3 Minimum conformance requirements

These requirements apply if the IE *powerBoostPi2BPSK* is set to 1 for power class 3 capable UE operating in TDD bands n40, n41, n77, n78 and n79 with pi/2 BPSK modulation and UE indicates support for UE capability *powerBoosting-pi2BPSK* and 40 % or less slots in radio frame are used for UL transmission. These requirements also apply if the IE *dmrs-UplinkTransformPrecoding-r16* is configured and UE indicates support for UE capability *lowPAPR-DMRS-PUSCHwithPrecoding-r16*. Otherwise the requirements for EVM equalizer spectrum flatness defined in clause 6.4.2.4.3 apply.

The EVM equalizer coefficients across the allocated uplink block shall be modified to fit inside the mask specified in Table 6.4.2.5.3-1 for normal conditions, prior to the calculation of EVM. The limiting mask shall be placed to minimize the change in equalizer coefficients in a sum of squares sense.

Table 6.4.2.5.3-1: Mask for EVM equalizer coefficients for Pi/2 BPSK, normal conditions

|  |  |  |
| --- | --- | --- |
| Frequency range | Parameter | Maximum ripple (dB) |
| |FUL\_Meas – F\_center| ≤ X MHz  (Range 1) | X1 | 6 (p-p) |
| |FUL\_Meas – F\_center| > X MHz  (Range 2) | X2 | 14 (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: F\_center refers to the center frequency of an allocated block of PRBs  NOTE 3: X, in MHz, is equal to 25% of the bandwidth of the PRB allocation  NOTE 4: See Figure 6.4.2.5.3-1 for description of X1, X2 | | |



Figure 6.4.2.5.3-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation. F\_center denotes the center frequency of the allocated block of PRBs. X, in MHz, is equal to 25 % of the bandwidth of the PRB allocation.

For pi/2 BPSK modulation the UE shall be allowed to employ spectral shaping and the shaping filter shall be restricted so that the impulse response of the shaping filter itself shall meet

│*ãt*(*t*,0)│ ≥ │*ãt*(*t*, *τ*)│ ∀*τ* ≠ 0

20*log*10│*ãt*(*t*,*τ*)│< -15 dB 1< *τ* < M - 1,

where,│*ãt*(*t*, *τ*)│=*IDFT*{│*ãt*(*t*,*f*)│*ejφ (t*,*f)*}, *f* is the frequency of the *M* allocated subcarriers, *ã*(*t*,*f*) and *φ*(*t*,*f*) are the amplitude and phase response.

0dB reference is defined as20*log*10│*ãt*(*t*,0)│.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4.2.4.1.

6.4.2.5.4 Test description

6.4.2.5.4.1 Initial condition

Same initial conditions as in clause 6.4.2.4.4.1 with following exceptions:

- Instead of Table 6.4.2.4.4.1-1 🡪 use Table 6.4.2.5.4.1-1

Table 6.4.2.5.4.1-1: Test Configuration

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range (NOTE 3) | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation | RB allocation (NOTE 1) |
| 14 |  | DFT-s-OFDM Pi/2 BPSK | Outer Full |
| 25 |  | DFT-s-OFDM Pi/2 BPSK w Pi/2 BPSK DMRS | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.  NOTE 3: For NR band n28, 30MHz test channel bandwidth is tested with Low range and High range test frequencies.  NOTE 4: UEs indicating support for UE capability *powerBoosting-pi2BPSK*.  NOTE 5: Applicable to UEs indicating support for UE capability *lowPAPR-DMRS-PUSCHwithPrecoding-r16*.. | | | |

6.4.2.5.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4.2.5.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

3. Measure spectrum flatness using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

6.4.2.5.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the following exception:

Table 6.4.2.5.4.3-1: ServingCellConfig (Test ID 1 in Table 6.4.2.5.4.1-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-167 | | | |
| Information Element | Value/remark | Comment | Condition |
| uplinkConfig SEQUENCE { |  |  |  |
| initialUplinkBWP | BWP-UplinkDedicated |  |  |
| uplinkBWP-ToReleaseList | Not present |  |  |
| uplinkBWP-ToAddModList | Not present |  |  |
| firstActiveUplinkBWP-Id | BWP-Id |  |  |
| pusch-ServingCellConfig CHOICE { |  |  |  |
| setup | PUSCH-ServingCellConfig |  |  |
| } |  |  |  |
| carrierSwitching | Not present |  |  |
| powerBoostPi2BPSK | enabled |  |  |
| } |  |  |  |

Table 6.4.2.5.4.3-2: DMRS-UplinkConfig (Test ID 2 in Table 6.4.2.5.4.1-1)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-51 | | | |
| Information Element | Value/remark | Comment | Condition |
| DMRS-UplinkConfig ::= SEQUENCE { |  |  |  |
| transformPrecodingEnabled SEQUENCE { |  |  |  |
| nPUSCH-Identity | Not present |  |  |
| sequenceGroupHopping | Not present |  |  |
| sequenceHopping | Not present |  |  |
| dmrs-UplinkTransformPrecoding-r16 SEQUENCE { |  |  |  |
| pi2BPSK-ScramblingID0 | Not present |  |  |
| pi2BPSK-ScramblingID1 | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

6.4.2.5.5 Test requirement

Each of the *n* spectrum flatness functions, shall derive four ripple results in Annex E.4.4.1 The derived results shall not exceed the values in Figure 6.4.2.5.5-1:

Table 6.4.2.5.5-1: Mask for EVM equalizer coefficients for Pi/2 BPSK, normal conditions

|  |  |  |
| --- | --- | --- |
| Frequency range | Parameter | Maximum ripple (dB) |
| |FUL\_Meas – F\_center| ≤ X MHz  (Range 1) | X1 | 6 + TT (p-p) |
| |FUL\_Meas – F\_center| > X MHz  (Range 2) | X2 | 14 + TT (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: F\_center refers to the center frequency of an allocated block of PRBs  NOTE 3: X, in MHz, is equal to 25% of the bandwidth of the PRB allocation  NOTE 4: See Figure 6.4.2.5.5-1 for description of X1, X2  NOTE 5: Test tolerance TT = 1.4 dB. | | |



Figure 6.4.2.5.5-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation. F\_center denotes the center frequency of the allocated block of PRBs. X, in MHz, is equal to 25 % of the bandwidth of the PRB allocation.

Each of the *n* spectrum flatness functions shall derive an impulse response of the spectral shaping filter in Annex E.4.4.2. The derived results shall fulfill:





where TT = 1.4 dB.

#### 6.4.2.6 Phase continuity requirements for DMRS bundling

Editor’s note: This clause is incomplete. The following aspects are either missing or not yet determined:

- MU/TT analysis is pending

6.4.2.6.1 Test purpose

The objective of this test is to verify the maximum allowable phase difference for FR1 UEs that support DMRS bundling.

6.4.2.6.2 Test applicability

This test case applies to all types of NR FR1 UEs release 17 and forward supporting *DMRS-BundlingPUSCH-Config-r17* and *DMRS-BundlingPUCCH-Config-r17*

6.4.2.6.3 Minimum conformance requirements

For bands that UE indicates the support of DMRS bundling, when the UE is configured with DMRS bundling, the maximum allowable difference between the measured phase value in any slot *p-1* and slot *p*, or slot 0 and any slot *p* for each antenna connector shall satisfy the requirements as listed in Table 6.4.2.6-1 for the measurement conditions defined in Table 6.4.2.6-2, within a measurement time window limited by the UE capability of maximum duration for DMRS bundling i.e. *maxDurationDMRS-Bundling-r17*, and defined for each frequency band separately. The phase value for each slot is measured as shown in Annex F.9. These requirements apply to PUCCH and PUSCH transmissions with DFT-s-OFDM and CP-OFDM waveforms.

Table 6.4.2.6.3-1: Maximum allowable phase difference for DMRS bundling

|  |  |  |  |
| --- | --- | --- | --- |
| UL channel | Modulation order | Phase difference between any slot *p-1* and slot *p*  (NOTE 2) | Phase difference between slot *0* and any slot *p*  (NOTE 3) |
| PUSCH | Pi/2 BPSK, QPSK | [25] degrees | [30] degrees |
| PUCCH | Pi/2 BPSK, BPSK, QPSK |  |  |
| NOTE 1: The UE capability of the length of maximum duration refers to the maximum time duration during which UE is able to meet the phase continuity requirements, assuming no phase consistency violating events defined in TS 38.214 in between.  NOTE 2: This requirement applies for FDD and TDD bands, for supported DMRS bundling configurations ≤ 8 slots.  NOTE 3: This requirement applies only for FDD bands, for supported DMRS bundling configurations of 16 slots. | | | |

The above requirements are applicable when all the following conditions are met within the measurement time window:

- RB allocation in terms of length and frequency position does not change, and intra-slot and inter-slot frequency hopping is not activated.

- Modulation order does not change.

- No network commanded TA takes effect.

- The TPMI precoder does not change.

- There is no change in UE transmission power level, and no change in the level of P-MPR applied by the UE.

- UE is not scheduled with uplink transmission of other physical channel/signal in-between the PUSCH or PUCCH transmissions.

- For TDD, no downlink slot(s) or downlink symbol(s) or flexible symbol(s) with/without DL monitoring occasion configured in-between the PUSCH or PUCCH transmissions.

Table 6.4.2.6.3-2: Measurement conditions for the maximum allowable phase difference

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Level |
| UE Output Power | dBm | PCMAX,f,c in clause 6.2.4, P-MPR = 0 |
| UE downlink received power |  | Not change |
| Operating conditions |  | Normal conditions |
| Transmission bandwidth |  | Confined within FUL\_low + [4] MHz and FUL\_high – [4] MHz |
| DL signal frequency |  | Not change before and during the measurement window |
| DL signal timing |  | Maintained constant before and during the measurement window |
| UL slots for testing |  | Tested on consecutive UL slots |
| PUSCH waveform for testing |  | DFT-s-OFDM |

6.4.2.6.4 Test description

6.4.2.6.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in Table 6.4.2.6.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.2.6.4.1-1: Test Configuration Table for PUSCH

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range (NOTE 4) | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation (NOTE 3) | RB allocation (NOTE 1) |
| 1 |  | DFT-s-OFDM QPSK | Inner Full |
| 2 |  | DFT-s-OFDM PI/2 BPSK | Inner Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.  NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.  NOTE 4: For NR band n28, 30MHz test channel bandwidth is tested with Low range and High range test frequencies. | | | |

Table 6.4.2.6.4.1-2: Test Configuration Table for PUCCH

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | See Table 6.4.2.6.4.1-1 | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | See Table 6.4.2.6.4.1-1 | | |
| Test SCS as specified in Table 5.3.5-1 | | | See Table 6.4.2.6.4.1-1 | | |
| Test Parameters | | | | | |
| ID | Downlink Configuration | | Uplink Configuration | | |
|  | Modulation | RB allocation | Waveform | PUCCH format | RB index |
| 1 | - | - | DFT-s-OFDM QPSK | PUCCH format = Format 3 (Note 3)  Length in OFDM symbols = 14 | 0 |
| 2 | - | - | DFT-s-OFDM QPSK | PUCCH format = Format 3 (Note 3)  Length in OFDM symbols = 14 | NRB-1 |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.  NOTE 3: For FDD, set K1 value (PDSCH-to-HARQ-timing-indicator) as follows: K1 = 2 if mod(i,5) = 0 K1 = 2 if mod(i,5) = 1 K1 = 4 if mod(i,5) = 2 K1 = 3 if mod(i,5) = 3 K1 = 2 if mod(i,5) = 4 where i is slot index per frame | | | | | |

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, in Figure A.3.3.1.1 for TE diagram and section A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C, and uplink signals according to Annex G.

4. The UL Reference Measurement channels are set according to Table [TBD].

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [10] clause 4.5. Message contents are defined in clause 6.4.2.1.4.3

6.4.2.6.4.2 Test procedure

Test procedure for PUSCH:

1.1 SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4.2.1.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

1.2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level. Allow at least 200 ms starting from the first TPC command in this step for the UE to reach PUMAX level.

Editor's note:

1.3 Measure the phase offset using the test measurement described in Annex [TBD]. For TDD, only slots consisting of only UL symbols are under test.

NOTE1: When switching to DFT-s-OFDM waveform, as specified in Table 6.4.2.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [10] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

Test procedure for PUCCH:

2.1 PUCCH is set according to Table Table 6.4.2.6.4.1-1.

2.2 SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4.2.1.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

2.3 Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level. Allow at least 200 ms starting from the first TPC command in this step for the UE to reach PUMAX level.

2.4 Measure the phase offset using the test measurement described in Annex [TBD]. For TDD, only slots consisting of only UL symbols are under test.

NOTE1: When switching to DFT-s-OFDM waveform, as specified in Table 6.4.2.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [10] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

6.4.2.6.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 with TRANSFORM\_PRECODER\_ENABLED condition in Table 4.6.3-118 PUSCH-Config. In addition, the following message contents shall be configured:

Table 6.4.2.6.4.3-1: *DMRS-BundlingPUCCH-Config*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [11], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| DMRS-BundlingPUCCH-Config-r17::= CHOICE { |  |  |  |
| Setup SEQUENCE { |  |  |  |
| pucch-DMRS-Bundling-r17 | ENABLED |  |  |
| pucch-TimeDomainWindowLength-r17 | [2] |  |  |
| pucch-WindowRestart-r17 | TBD |  |  |
| pucch-FrequencyHoppingInterval-r17 | [s2] |  |  |
| } |  |  |  |

Table 6.4.2.6.4.3-2: *DMRS-BundlingPUSCH-Config*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.331 [11], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| DMRS-BundlingPUSCH-Config-r17::= CHOICE { |  |  |  |
| Setup SEQUENCE { |  |  |  |
| pucch-DMRS-Bundling-r17 | ENABLED |  |  |
| pucch-TimeDomainWindowLength-r17 | [2] |  |  |
| pucch-WindowRestart-r17 | TBD |  |  |
| pucch-FrequencyHoppingInterval-r17 | [s2] |  |  |
| } |  |  |  |

6.4.2.6.5 Test requirement

The maximum allowable phase difference for UEs supporting DMRS dbundling and as measured in Step 1.3 for PUSCH and 2.4 for PUCCH of test procedure in sub-clause 6.4.2.6.4.2 should meet the following requirements.

Table 6.4.2.6.5-1: Test Requirements for Maximum allowable phase difference for DMRS bundling

|  |  |  |  |
| --- | --- | --- | --- |
| UL channel | Modulation order | Phase difference between any slot *p-1* and slot *p*  (NOTE 2) | Phase difference between slot *0* and any slot *p*  (NOTE 3) |
| PUSCH | Pi/2 BPSK, QPSK | [25+TT] degrees | [30+TT] degrees |
| PUCCH | Pi/2 BPSK, BPSK, QPSK |  |  |
| NOTE 1: The UE capability of the length of maximum duration refers to the maximum time duration during which UE is able to meet the phase continuity requirements, assuming no phase consistency violating events defined in TS 38.214 in between.  NOTE 2: This requirement applies for FDD and TDD bands, for supported DMRS bundling configurations ≤ 8 slots.  NOTE 3: This requirement applies only for FDD bands, for supported DMRS bundling configurations of 16 slots. | | | |

Table 6.4.2.6.5-2: Test Tolerance for Maximum allowable phase difference for DMRS bundling

|  |  |  |
| --- | --- | --- |
| UL channel | Modulation order | TT |
| PUSCH | Pi/2 BPSK, QPSK | FFS |
| PUCCH | Pi/2 BPSK, BPSK, QPSK | FFS |

## 6.4A Transmit signal quality for CA

### 6.4A.1 Frequency error for CA

#### 6.4A.1.0 Minimum conformance requirements

For intra-band contiguous carrier aggregation the UE modulated carrier frequencies per band shall be accurate to within ±0.1 PPM observed over a period of 1 ms of cumulated measurement intervals compared to the carrier frequency of primary component carrier received in the corresponding band.

For intra-band non-contiguous carrier aggregation the requirements in Section 6.4.1 applies per component carrier.

For inter-band carrier aggregation with uplink assigned to two NR bands, the minimum conformance requirements specified in subclause 6.4.1.3 shall apply on each component carrier with all component carriers active.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4A.1.

#### 6.4A.1.1 Frequency error for CA (2UL CA)

6.4A.1.1.1 Test purpose

This test verifies the ability of both, the receiver and the transmitter, to process frequency for 2UL CA correctly.

Receiver: to extract the correct frequency from the stimulus signal, offered by the System simulator, under ideal propagation conditions and low level.

Transmitter: to derive the correct modulated carrier frequency from the results, gained by the receiver.

6.4A.1.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports 2UL CA.

6.4A.1.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.4A.1.0.

6.4A.1.1.4 Test description

6.4A.1.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state. The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configuration specified in clause 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in Table 6.4A.1.1.4.1-1 to table 6.4A.1.1.4.1-3. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4A.1.1.4.1-1: Inter band CA Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1 | | | Mid range for PCC and SCC (NOTE 3) | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Highest NRB\_agg for both PCC and SCC | |
| Test SCS as specified in Table 5.3.5-1 | | | Lowest | |
| Test Parameters | | | | |
|  | Downlink Configuration | | Uplink Configuration | |
| Test ID | Modulation | RB allocation | Modulation | RB allocation |
| 1 | CP-OFDM QPSK | Full RB (NOTE 1) | DFT-s-OFDM QPSK | REFSENS (NOTE 2) |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2.  NOTE 2: REFSENS refers to Table 7.3.2.4.1-3 which defines uplink RB configuration and start RB location for each SCS, channel BW and NR band belongs to inter-band CA combination.  NOTE 3: For NR band n28, 30MHz test channel bandwidth is tested with Low range test frequencies. | | | | |

Table 6.4A.1.1.4.1-2: Intra band contiguous CA Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1 | | | Mid range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | | Lowest | | |
| Test Parameters | | | | | |
|  | Downlink Configuration | | Uplink Configuration | | |
| Test ID | Modulation | RB allocation | Modulation | RB allocation | |
| PCC | SCC |
| 1 | CP-OFDM QPSK | Full RB (NOTE 1) | DFT-s-OFDM QPSK | REFSENS (NOTE 2) | |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2.  NOTE 2: REFSENS refers to Table 7.3.2.4.1-3 for each carrier which defines uplink RB configuration and start RB location for each SCS, channel BW and NR band belongs to intra-band CA combination. | | | | | |

Table 6.4A.1.1.4.1-3: Intra band non-contiguous CA Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1 | | | One frequency chosen from Low range or High range test frequencies as specified in tables for non-contiguous CA configuration with UL CA | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | | Lowest | | |
| Test Parameters | | | | | |
|  | Downlink Configuration | | Uplink Configuration | | |
| Test ID | Modulation | RB allocation | Modulation | RB allocation | |
| PCC | SCC |
| 1 | CP-OFDM QPSK | Full RB (NOTE 1) | DFT-s-OFDM QPSK | REFSENS (NOTE 2) | |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2.  NOTE 2: REFSENS refers to Table 7.3.2.4.1-3 for each carrier which defines uplink RB configuration and start RB location for each SCS, channel BW and NR band belongs to intra-band CA combination. | | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure 3.1.1.3 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause4.4.3.

3. Downlink signals for PCC are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The DL and UL Reference Measurement channels are set according to Tables 6.4A.1.1.4.1-1 to 6.4A.1.1.4.1-3 as appropriate.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4A.1.1.4.3

6.4A.1.1.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.4A.1.1.4.3

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[19], clause 9.3).

4. SS transmits PDSCH via PDCCH DCI format 1\_1 for C\_RNTI to transmit the DL RMC according to Tables 6.4A.1.1.4.1-1 to 6.4A.1.1.4.1-3 as appropriate on both PCC and SCC. The SS sends downlink MAC padding bits on the DL RMC.

5. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Tables 6.4A.1.1.4.1-1 to 6.4A.1.1.4.1-3 as appropriate on both PCC and SCC. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

6. Set the Downlink signal level to the appropriate REFSENS value defined in subclauses 7.3A.1.5. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE so that the UE transmits at PUMAX level for the duration of the test. Allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

7. Measure the Frequency Error on PCC and SCC using Global In-Channel Tx-Test (Annex E) respectively. For TDD slots with transient periods are not under test.

8. For UEs supporting DSS, repeat steps 1~7 on the applicable bands as specified in Section 5.4.2.1 with message contents being according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-61 and Table 4.6.3-62 with condition DSS.

NOTE 1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.5.2.2.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

6.4A.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with following exception.

Table 6.4A.1.1.4.3-1 FrequencyInfoUL-SIB for inter-band CA

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-62 FrequencyInfoUL-SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 20 |  |  |

6.4A.1.1.5 Test requirement

The 10 frequency error Δf results must fulfil the test requirement:

|Δf| ≤ (0.1 PPM + TT) for each test point

For inter-band CA, PPM refers to each CC UL frequency.

For intra-band contiguous CA, PPM refers to PCC UL frequency.

For intra-band non-contiguous CA, PPM refers to each CC UL frequency.

Table 6.4A.1.1.5-1: Test Tolerance for frequency error

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 15Hz | 15Hz |
| 40MHz < BW ≤ 100MHz | 15Hz | 15Hz |

### 6.4A.2 Transmit modulation quality for CA

#### 6.4A.2.0 General

The requirements in this clause apply with PCC and SCC in the UL configured and activated: PCC with PRB allocation and SCC without PRB allocation and without CSI reporting and SRS configured.

##### 6.4A.2.0.1 Transmit modulation quality for intra-band contiguous CA

The Carrier leakage frequency is optionally indicated by the UE via IE *UplinkTxDirectCurrentList ,* IE *UplinkTxDirectCurrentTwoCarrierList-r16* for CA with two component carriers configured for uplink *or* IE *UplinkTxDirectCurrentMoreCarrierList-r17* for CA of any configuration*.*

If the UE does not indicate DC location parameters, the carrier leakage measurement requirement in clauses 6.4A.2.2 and 6.4A.2.3 shall be waived and the UE’s UL signal left uncorrected for carrier leakage. Any requirement relaxation to accommodate the IQ image shall be omitted.

If the UE indicates carrier leakage frequency as 3300 or 3301 with IE *UplinkTxDirectCurrentList or UplinkTxDirectCurrentTwoCarrierList-r16*, or if the carrier leakage frequency is outside the activated UL component carriers, the carrier leakage measurement requirement in clauses 6.4A.2.2 and 6.4A.2.3 shall be waived and the UE’s UL signal left uncorrected for carrier leakage. Any requirement relaxation to accommodate the IQ image shall be omitted.

##### 6.4A.2.0.2 Transmit modulation quality for intra-band contiguous CA

For intra-band non-contiguous carrier aggregation, the requirements in subclauses 6.4A.2.1, 6.4A.2.2 applies.

The requirements in this clause apply with PCC and SCC in the UL configured and activated: PCC with PRB allocation and SCC without PRB allocation and without CSI reporting and SRS configured.

Carrier leakage frequency is indicated by the UE with IE UplinkTxDirectCurrentMoreCarrierList-r17 or UplinkTxDirectCurrentTwoCarrierList-r16 or UplinkTxDirectCurrentList.

The carrier leakage measurement requirement in clause 6.4A.2.2.2 shall be waived and the UE’s UL signal left uncorrected for carrier leakage when one of the following qualifying conditions apply:

1. UE reports the parameter 3300 or 3301

2. UE doesn’t indicate the DC location parameters

Any requirement relaxation to accommodate the IQ image shall be omitted if the qualifying conditions above are present or if the IQ image frequency is outside the activated UL component carriers.

#### 6.4A.2.1 Error Vector Magnitude for CA

##### 6.4A.2.1.0 Minimum conformance requirements

For Inter-band carrier aggregation, EVM measurements are evaluated for each component carrier, and for the different modulations schemes, the EVM requirements shall not exceed the values specified in Table 6.4.2.1.3-1 for the parameters defined in Table 6.4.2.1.3-2, if CA is configured in uplink.

For the intra-band non-contiguous carrier aggregation, EVM measurements are evaluated for each component carrier,

and for the different modulation schemes, the EVM requirements shall not exceed the values specified in Table

6.4A.2.1.0-1, if CA is configured in uplink.

For the intra-band contiguous carrier aggregation, EVM measurements are evaluated for each component carrier, and for the different modulation schemes, the EVM requirements shall not exceed the values specified in Table 6.4A.2.1.0-1, if CA is configured in uplink.

When a single component carrier is configured Table 6.4.2.1.3-1 apply.

The EVM requirements are according to Table 6.4A.2.1.0-1 if CA is configured in uplink with the parameters defined in Table 6.4.2.1.3-2.

Table 6.4A.2.1.0-1: Minimum requirements for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level per CC |
| Pi/2-BPSK | % | 30 |
| QPSK | % | 17.5 |
| 16 QAM | % | 12.5 |
| 64 QAM | % | 8 |
| 256 QAM | % | 3.5 |

The normative reference for this requirement is TS 38.101 [2] clause 6.4A.2.1

##### 6.4A.2.1.1 Error Vector Magnitude for CA (2UL CA)

6.4A.2.1.1.1 Test Purpose

For 2UL carrier aggregation, the Error Vector Magnitude requirement should be defined for each component carrier. Requirement applies for the allocated component carrier, when all other component carriers are activated, but not allocated.

Similar transmitter impairment removal procedures are applied for CA waveform before EVM calculation as is specified for non-CA waveform in clause 6.4.2.1.

6.4A.2.1.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports 2UL CA.

6.4A.2.1.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.4A.2.1.0.

6.4A.2.1.1.4 Test description

6.4A.2.1.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configuration specified in clause 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in Table 6.4A.2.1.1.4.1-1 and 6.4A.2.1.1.4.1-2. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4A.2.1.1.4.1-1: Inter band CA Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1 | | Low range for PCC and SCC  High range for PCC and SCC | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg for both PCC and SCC  Highest NRB\_agg for both PCC and SCC | | |
| Test SCS as specified in Table 5.3.5-1 | | Smallest and biggest supported SCS per Channel Bandwidth | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | |
| Modulation (NOTE 3) | RB allocation (NOTE 1) | |
| PCC | SCC |
| 13 | N/A | DFT-s-OFDM PI/2 BPSK | Inner Full | 0 |
| 23 | DFT-s-OFDM PI/2 BPSK | Outer Full | 0 |
| 3 | DFT-s-OFDM QPSK | Inner Full | 0 |
| 4 | DFT-s-OFDM QPSK | Outer Full | 0 |
| 5 | DFT-s-OFDM 16 QAM | Inner Full | 0 |
| 6 | DFT-s-OFDM 16 QAM | Outer Full | 0 |
| 7 | DFT-s-OFDM 64 QAM | Outer Full | 0 |
| 8 | DFT-s-OFDM 256 QAM | Outer Full | 0 |
| 9 | CP-OFDM QPSK | Inner Full | 0 |
| 10 | CP-OFDM QPSK | Outer Full | 0 |
| 11 | CP-OFDM 16 QAM | Inner Full | 0 |
| 12 | CP-OFDM 16 QAM | Outer Full | 0 |
| 13 | CP-OFDM 64 QAM | Outer Full | 0 |
| 14 | CP-OFDM 256 QAM | Outer Full | 0 |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.3.1-1 and SCS is specified in Table 5.3.5-1 for each NR band.  NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.  NOTE 4: The frequencies of PCC and SCC shall be switched and tested in each configuration. | | | | |

Table 6.4A.2.1.1.4.1-2: Intra band contiguous CA and non-contiguous CA Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Contiguous CA: Low range, High range  Non-contiguous CA: Low range and High range test frequencies as specified in tables for non-contiguous CA configuration with UL CA | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg,Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | lowest and highest supported SCS | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | |
| Modulation (NOTE 3) | RB allocation (NOTE 1) | |
| PCC | SCC |
| 13 | N/A | DFT-s-OFDM PI/2 BPSK | Inner Full | 0 |
| 23 | DFT-s-OFDM PI/2 BPSK | Outer Full | 0 |
| 3 | DFT-s-OFDM QPSK | Inner Full | 0 |
| 4 | DFT-s-OFDM QPSK | Outer Full | 0 |
| 5 | DFT-s-OFDM 16 QAM | Inner Full | 0 |
| 6 | DFT-s-OFDM 16 QAM | Outer Full | 0 |
| 7 | DFT-s-OFDM 64 QAM | Inner Full | 0 |
| 8 | DFT-s-OFDM 64 QAM | Outer Full | 0 |
| 9 | DFT-s-OFDM 256 QAM | Inner Full | 0 |
| 10 | DFT-s-OFDM 256 QAM | Outer Full | 0 |
| 11 | CP-OFDM QPSK | Inner Full | 0 |
| 12 | CP-OFDM QPSK | Outer Full | 0 |
| 13 | CP-OFDM 16 QAM | Inner Full | 0 |
| 14 | CP-OFDM 16 QAM | Outer Full | 0 |
| 15 | CP-OFDM 64 QAM | Inner Full | 0 |
| 16 | CP-OFDM 64 QAM | Outer Full | 0 |
| 17 | CP-OFDM 256 QAM | Inner Full | 0 |
| 18 |  | CP-OFDM 256 QAM | Outer Full | 0 |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.1-1 and SCS is specified in Table 5.3.5-1 for each NR band.  NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.  NOTE 4: If the UE supports multiple CC Combinations in the CA Configuration with the same NRB\_agg, only the combination with the highest NRB\_PCC is tested. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.3 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause4.4.3.

3. Downlink signals for PCC are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4A.2.1.1.4.1-1 and 6.4A.2.1.1.4.1-2.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4A.2.1.1.4.3

6.4A.2.1.1.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.4A.2.1.1.4.3.

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[19], clause9.3).

4. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4A.2.1.1.4.1-1 and 6.4A.2.1.1.4.1-2. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

5. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level, allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

6. Measure the EVM and on PCC using Global In-Channel Tx-Test (Annex E).

7. For modulations except 256QAM, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where:

- Pmin is the minimum output power according to Table 6.3.1.3-1.

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

For 256 QAM, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin + 10 dB, where Pmin, MU and Uplink power control window size are defined above.

8. Measure the EVM and on PCC using Global In-Channel Tx-Test (Annex E).

NOTE 1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.5.2.2.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

6.4A.2.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6.

6.4A.2.1.1.5 Test requirement

The PUSCH EVM, derived in Annex E.4.2, shall not exceed the values in Table 6.4A.2.1.1.5-1.

The PUSCH,derived in Annex E.4.6.2, shall not exceed the values in Table 6.4A.2.1.1.5-1 when embedded with data symbols of the respective modulation scheme.

Table 6.4A.2.1.1.5-1: Test requirements for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| Pi/2-BPSK | % | 30+TT |
| QPSK | % | 17.5+TT |
| 16QAM | % | 12.5+TT |
| 64QAM | % | 8+TT |
| 256 QAM | % | 3.5+TT |

Table 6.4A.2.1.1.5-2: Test Tolerance for Error Vector Magnitude

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | f ≤ 6.0GHz, BW ≤ 100MHz | | |
| 15dBm < PUL | -25dBm < PUL ≤ 15dBm | -40dBm ≤ PUL ≤ -25dBm |
| Pi/2-BPSK | 0% | 0% | 0% |
| QPSK | 0% | 0% | 0% |
| 16QAM | 0% | 0% | 0% |
| 64QAM | 0% | 0% | 0% |
| 256 QAM | 0.3% | 0.8% | 1.1% |

#### 6.4A.2.2 Carrier leakage for CA

##### 6.4A.2.2.0 Minimum conformance requirements

6.4A.2.2.0.1 Minimum conformance requirements for intra-band contiguous CA

6.4A.2.2.0.1 Minimum conformance requirements for intra-band contiguous CA

The relative carrier leakage power is a power ratio of the additive sinusoid waveform and the modulated waveform. For intra-band contiguous CA, the relative carrier leakage power shall not exceed the values specified in Table 6.4A.2.1.3-1. The requirement does not apply if the indicated location of carrier leakage is outside the activated UL carriers.

Table 6.4A.2.2.0.1-1: Minimum requirements for Relative Carrier Leakage Power

|  |  |
| --- | --- |
| Parameters | Relative Limit (dBc) |
| Output power > 10 dBm | -28 |
| 0 dBm ≤ Output power ≤ 10 dBm | -25 |
| -30 dBm ≤ Output power < 0 dBm | -20 |
| -40 dBm ≤ Output power < -30 dBm | -10 |

6.4A.2.2.0.2 Minimum conformance requirements for intra-band non-contiguous CA

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6.4A.2.2.0.3 Minimum conformance requirements for inter-band CA

For inter-band carrier aggregation, the carrier leakage shall not exceed the values specified in Table 6.4A.2.2.0.3-1.

In the case that uplink sharing, the carrier leakage may have 7.5 kHz shift with the carrier frequency.

Table 6.4A.2.2.0.3-1: Requirements for carrier leakage

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter description | Unit | Limit | | Applicable Frequencies |
| Carrier leakage | dBc | -28 | Output power > 10 dBm | Carrier leakage frequency (NOTES 1, 2) |
| -25 | 0 dBm ≤ Output power ≤10 dBm |
| -20 | -30 dBm ≤ Output power ≤ 0 dBm |
| -10 | -40 dBm ≤ Output power < -30 dBm |
| NOTE 1: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 2: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE, and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB. | | | | |

The normative reference for this requirement is TS 38.101-1 [2] clauses 6.4A.2.3.

##### 6.4A.2.2.1 Carrier leakage for CA (2UL CA)

Editor’s note: The following aspects are either missing or not yet determined:

* The minimum requirements for intra-band non-contiguous CA have not been defined.

6.4A.2.2.1.1 Test purpose

Carrier leakage is an additive sinusoid waveform that is confined within the aggregated transmission bandwidth configuration. The carrier leakage requirement for 2UL CA is defined for each component carrier and is measured on the component carrier with PRBs allocated.

6.4A.2.2.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports 2UL CA.

6.4A.2.2.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.4A.2.2.0.

6.4A.2.2.1.4 Test description

6.4A.2.2.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configuration specified in clause 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in Table 6.4A.2.2.1.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4A.2.2.1.4.1-1: Inter band CA Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1 | | Low range for PCC and SCC  High range for PCC and SCC | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Mid channel bandwidth for both PCC and SCC | | |
| Test SCS as specified in Table 5.3.5-1 | | Smallest supported SCS per Channel Bandwidth | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | |
| Modulation | RB allocation (NOTE 1, 3) | |
| PCC | SCC |
| 1 | N/A | DFT-s-OFDM QPSK | Inner\_1RB\_Left | 0 |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.3.1-1 and SCS is specified in Table 5.3.5-1 for each NR band.  NOTE 3: When the signalled DC carrier position is at Inner\_1RB\_Left, use Inner\_1RB\_Right for UL RB allocation.  NOTE 4: The frequencies of PCC and SCC shall be switched and tested in each configuration. | | | | |

Table 6.4A.2.2.1.4.1-2: Intra band contiguous CA Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1 | | Low range, High range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | |
| Modulation | RB allocation (NOTE 1, 3) | |
| PCC | SCC |
| 1 | N/A | DFT-s-OFDM QPSK | Inner\_1RB\_Left | 0 |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.1-1 and SCS is specified in Table 5.3.5-1 for each NR band.  NOTE 3: When the signalled DC carrier position is at Inner\_1RB\_Left, use Inner\_1RB\_Right for UL RB allocation.  NOTE 4: The frequencies of PCC and SCC shall be switched and tested in each configuration. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure 3.1.1.3 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause4.4.3.

3. Downlink signals for PCC are initially set up according to AnnexC.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4A.2.2.1.4.1-1 and 6.4A.2.2.1.4.1-2.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4A.2.2.1.4.3.

6.4A.2.2.1.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.4A.2.2.1.4.3.

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[19], clause9.3).

4. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4A.2.2.1.4.1-1 for inter-band CA and table 6.4A.2.2.1.4.1-2 for intra-band contiguous CA. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

5. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 10 dBm, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

6. Measure carrier leakage using Global In-Channel Tx-Test (Annex E). For TDD slots with transient periods are not under test.

7. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 0 dBm, where MU and Uplink power control window size are defined above.

8. Measure carrier leakage on PCC using Global In-Channel Tx-Test (Annex E). For TDD slots with transient periods are not under test.

9. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level -30 dBm, where MU and Uplink power control window size are defined above.

10. Measure carrier leakage on PCC using Global In-Channel Tx-Test (Annex E). For TDD slots with transient periods are not under test.

11. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where MU and Uplink power control window size are defined above, and Pmin is the minimum output power according to Table 6.3.1.3-1.

12. Measure carrier leakage on PCC using Global In-Channel Tx-Test (Annex E). For TDD slots with transient periods are not under test.

NOTE 1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.5.2.2.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

Table 6.4A.2.2.1.4.2-1: Void

Table 6.4A.2.2.1.4.2-2: Void

6.4A.2.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6.

6.4A.2.2.1.5 Test requirement

Each of the [20] carrier leakage results, derived in Annex E.3.1, shall not exceed the values in table 6.4A.2.2.1.5-1. Allocated RBs are not under test.

Table 6.4A.2.2.1.5-1: Test requirements for Carrier Leakage

|  |  |  |
| --- | --- | --- |
| LO Leakage | Parameters  UE output power | Relative limit (dBc) |
| 10 + MU to 10 + (MU + Uplink power control window size) dBm | -28+TT |
| 0 + MU to 0 + (MU + Uplink power control window size) dBm | -25+TT |
| -30 + MU to -30 + (MU + Uplink power control window size) dBm | -20+TT |
| Pmin + MU to Pmin + (MU + Uplink power control window size) dBm | -10+TT |
| NOTE 1: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 2: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE, and are those that are enclosed in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.  NOTE 3:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 4: Void  NOTE 5: MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.  NOTE 6: Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.  NOTE 7: Pmin is the minimum output power according to Table 6.3.1.3-1. | | |

Table 6.4A.2.2.1.5-2: Test Tolerance for Carrier Leakage

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 0.8dB | 0.8dB |
| 40MHz < BW ≤ 100MHz | 0.8dB | 0.8dB |

#### 6.4A.2.3 In-band emissions for CA

##### 6.4A.2.3.0 Minimum conformance requirements

For inter-band carrier aggregation with uplink assigned to two NR bands, the requirements shall apply on each component carrier as defined in clause 6.4.2 with all component carriers active.

The requirements in Table 6.4A.2.3.0-1 apply with PCC and SCC in the UL configured and activated: PCC with PRB allocation and SCC without PRB allocation and without CSI reporting and SRS configured.

Table 6.4A.2.3.0-1: Inter band CA Requirements for in-band emissions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter description | Unit | Limit (NOTE 1) | | Applicable Frequencies |
| General | dB |  | | Any non-allocated (NOTE 2) |
| IQ Image | dB | -28 | Image frequencies when output power > 10 dBm | Image frequencies (NOTES 2, 3) |
| -25 | Image frequencies when output power ≤ 10 dBm |
| Carrier leakage | dBc | -28 | Output power > 10 dBm | Carrier leakage frequency (NOTES 4, 5) |
| -25 | 0 dBm ≤ Output power ≤10 dBm |
| -20 | -30 dBm ≤ Output power ≤ 0 dBm |
| -10 | -40 dBm≤ Output power < -30 dBm |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of *PRB* - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* is defined in NOTE 10.  NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs.  NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.  NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 5: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE, and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.  NOTE 6:  is the Transmission Bandwidth (see Section 5.3).  NOTE 7:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 8:  is the limit specified in Table 6.4A.2.3.1.3-1 for the modulation format used in the allocated RBs.  NOTE 9:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth.  NOTE 10:  is the transmitted power normalized by the number of allocated RBs, measured in dBm. | | | | |

For intra-band contiguous carrier aggregation, the requirements in Table 6.4A.2.3.0-2 and 6.4A.2.3.0-3 apply within the aggregated transmission bandwidth configuration with both component carrier (s) active and one single contiguous PRB allocation of bandwidth  at the edge of the aggregated transmission bandwidth configuration.

The in band emission is defined as the interference falling into the non-allocated resource blocks for all component carriers. The measurement method for the inland emissions in the component carrier with PRB allocation is specified in annex E.4.3. For a non-allocated component carrier a spectral measurement is specified.

Table 6.4A.2.3.0-2: Minimum requirements for in-band emissions (allocated component carrier)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Unit | Limit | | Applicable Frequencies |
| General | dB |  | | Any non-allocated (NOTE 2) |
| IQ Image | dB | -28 | Output power > 10 dBm | Image frequencies  (NOTE 3) |
|  |  | -25 | 0≤ Output power ≤ 10 dBm |  |
| Carrier leakage | dBc | -28 | Output power > 10 dBm | Carrier leakage frequency (NOTE 4,5) |
|  |  | -25 | 0 dBm ≤ Output power ≤ 10 dBm |  |
|  |  | -20 | -30 dBm ≤ Output power ≤ 0 dBm |  |
|  |  | -10 | -40 dBm ≤ Output power < -30 dBm |  |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. is defined in NOTE 10. The limit is evaluated in each non-allocated RB.  NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs  NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.  NOTE 4: Exceptions to the general limit are allowed for up to two contiguous non-allocated RBs. The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in the non-allocated RB to the measured total power in all allocated RBs.  NOTE 5: The applicable frequencies for this limit are those that are enclosed either in the RB containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB. Carrier leakage frequency is indicated by the UE as described in clause 6.4A.2.1.0. When only one uplink carrier is activated, the applicable LO leakage frequency follow definition in clause 6.4.2.  NOTE 6:  is the Transmission Bandwidth (see clause 5.3) not exceeding  .  NOTE 7:  is the Transmission Bandwidth Configuration (see clause 5.3) of the component carrier with RBs allocated.  NOTE 8:  is the limit specified in Table 6.4.2.1-1 for the modulation format used in the allocated RBs.  NOTE 9:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth).  NOTE 10:  is an average of the transmitted power over 10 sub-frames normalized by the number of allocated RBs, measured in dBm. | | | | |

Table 6.4A.2.3.0-3: Minimum requirements for in-band emissions (not allocated component carrier)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Para-meter | Unit | Meas BW  NOTE 1 | Limit | | | remark | Applicable Frequencies |
| General | dB | BW of 1 RB |  | | | The reference value is the average power per allocated RB in the allocated component carrier | Any RB in the non-allocated component carrier.  The frequency raster of the RBs is derived when this component carrier is allocated with RBs |
| IQ Image | dB | BW of 1 RB | NOTE 2 | | | The reference value is the average power per allocated RB in the allocated component carrier | Image frequencies (NOTES 6,7) If UE does not indicate exact frequency for carrier leakage, this requirement does not apply. |
|  |  |  | -28 | Output power > 10 dBm | |  |  |
|  |  |  | -25 | 0≤ Output power ≤ 10 dBm | |  |  |
| Carrier leakage | dBc | BW of 1 RB | NOTE 3 | | | The reference value is the total power of the allocated RBs in the allocated component carrier | The frequencies of the up to 2 non-allocated RBs are indicated with IE *UplinkTxDirectCurrentMoreCarrierList-r17*. If UE does not indicate exact frequency for carrier leakage, this requirement does not apply. |
|  |  |  | -28 | | Output power > 10 dBm |  |  |
|  |  |  | -25 | | 0 dBm ≤ Output power ≤ 10 dBm |  |  |
|  |  |  | -20 | | -30 dBm ≤ Output power ≤ 0 dBm |  |  |
|  |  |  | -10 | | -40 dBm ≤ Output power < -30 dBm |  |  |
| NOTE1: Resolution BWs smaller than the measurement BW may be integrated to achieve the measurement bandwidth.  NOTE 2: Exceptions to the general limit are allowed for up to +1 RBs within a contiguous width of +1 non-allocated RBs.  NOTE 3: Two Exceptions to the general limit are allowed for up to two contiguous non-allocated RBs  NOTE 4: NOTES 1, 5, 6, 7, 8, 9 from Table 6.4A.2.1.1-1 apply for Table 6.4A.2.1.2-2 as well.  NOTE 5:  for measured non-allocated RB in the non-allocated component carrier may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.  NOTE 6: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs  NOTE 7: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. | | | | | | | |

For intra-band non-contiguous carrier aggregation the requirements for in-band emissions are defined for each component carrier. Requirements defined in clause 6.4.2.3 only apply with PRB allocation in one of the component carriers.

When signalling for dualPA-Architecture IE is absent, carrier leakage or I/Q image may land inside the gap spectrum between 2 UL CCs.

For intra-band non-contiguous CA, the IQ image requirement is defined with the applicable frequencies based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4A.2.

##### 6.4A.2.3.1 In-band emissions for CA (2UL CA)

6.4A.2.3.1.1 Test purpose

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks.

For an allocated component carrier, the in-band emission is defined as the average across 12 sub-carrier and as a function of the RB offset from the edge of the allocated UL transmission bandwidth. The in-band emission is measured as the ratio of the UE output power in a non–allocated RB to the UE output power in an allocated RB. The basic in-band emissions measurement interval is defined over one slot in the time domain; however, the minimum requirement applies when the in-band emission measurement is averaged over 10 sub-frames. When the PUSCH or PUCCH transmission slot is shortened due to multiplexing with SRS, the in-band emissions measurement interval is reduced by one or more symbols, accordingly.

For a non-allocated component carrier a spectral measurement is specified.

6.4A.2.3.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports 2UL CA.

6.4A.2.3.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.4A.2.3.0.

6.4A.2.3.1.4 Test description

6.4A.2.3.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configuration specified in clause 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in Table 6.4A.2.3.1.4.1-1 to Table 6.4A.2.3.1.4.1-3 as appropriate. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4A.2.3.1.4.1-1: Test Configuration Table for inter-band UL CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1 | | Low range for PCC and SCC  High range for PCC and SCC | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg for both PCC and SCC  Highest NRB\_agg for both PCC and SCC | | |
| Test SCS as specified in Table 5.3.5-1 | | Smallest supported SCS per Channel Bandwidth | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | |
| Modulation | RB allocation (NOTE 1) | |
| PCC | SCC |
| 1 | N/A | DFT-s-OFDM QPSK | Inner\_1RB\_Left | 0 |
| 2 | DFT-s-OFDM QPSK | Inner\_1RB\_Right | 0 |
| 3 | CP-OFDM QPSK | Inner\_1RB\_Left | 0 |
| 4 | CP-OFDM QPSK | Inner\_1RB\_Right | 0 |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.5A.3.1-1.  NOTE 3: The frequencies of PCC and SCC shall be switched and tested in each configuration. | | | | |

Table 6.4A.2.3.1.4.1-2: Test Configuration Table for intra-band contiguous UL CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1 | | Low range, High range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | |
| Modulation | RB allocation (NOTE 1) | |
| PCC | SCC |
| 13 | N/A | DFT-s-OFDM QPSK | Edge\_Full\_Left | 0 |
| 24 | DFT-s-OFDM QPSK | Edge\_Full\_Right | 0 |
| 33 | CP-OFDM QPSK | Edge\_Full\_Left | 0 |
| 44 | CP-OFDM QPSK | Edge\_Full\_Right | 0 |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.5A.1-1.  NOTE 3: The component carrier with lower centre frequency is PCC.  NOTE 4: The component carrier with higher centre frequency is PCC. | | | | |

Table 6.4A.2.3.1.4.1-3: Test Configuration Table for intra-band non-contiguous UL CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1 | | Low range and High range test frequencies as specified in tables for non-contiguous CA configuration with UL CA | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | |
| Modulation | RB allocation (NOTE 1) | |
| PCC | SCC |
| 1 | N/A | DFT-s-OFDM QPSK | Inner\_1RB\_Left | 0 |
| 2 | DFT-s-OFDM QPSK | Inner\_1RB\_Right | 0 |
| 3 | CP-OFDM QPSK | Inner\_1RB\_Left | 0 |
| 4 | CP-OFDM QPSK | Inner\_1RB\_Right | 0 |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.5A.1-1. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.3 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause4.4.3.

3. Downlink signals for PCC are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Tables 6.4A.2.3.1.4.1-1 to 6.4A.2.3.1.4.1-3 as appropriate.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4A.2.3.1.4.3.

6.4A.2.3.1.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.4A.2.3.1.4.3.

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[19], clause9.3).

4. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4A.2.3.1.4.1-1 to 6.4A.2.3.1.4.1-3 as appropriate. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

5. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 10 dBm, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

6. Measure In-band emission on PCC using Global In-Channel Tx-Test (Annex E). Measure power spectral density on the SCC. For TDD slots with transient periods are not under test.

7. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 0 dBm, where MU and Uplink power control window size are defined above.

8. Measure In-band emission on PCC using Global In-Channel Tx-Test (Annex E). Measure power spectral density on the SCC. For TDD slots with transient periods are not under test.

9. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU +Uplink power control window size) dB of the target power level -30 dBm, where MU and Uplink power control window size are defined above.

10. Measure In-band emission on PCC using Global In-Channel Tx-Test (Annex E). Measure power spectral density on the SCC. For TDD slots with transient periods are not under test.

11. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where MU and Uplink power control window size are defined above, and Pmin is the minimum output power according to Table 6.3.1.3-1.

12. Measure In-band emission on PCC using Global In-Channel Tx-Test (Annex E). Measure power spectral density on the SCC. For TDD slots with transient periods are not under test.

NOTE 1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.5.2.2.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

Table 6.4A.2.3.1.4.2-1: Void

Table 6.4A.2.3.1.4.2-2: Void

6.4A.2.3.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6.

6.4A.2.3.1.5 Test requirement

The averaged In-band emission result, derived in Annex E.4.3, shall not exceed the corresponding values in Table 6.4A.2.3.1.5-1 and 6.4A.2.3.1.5-1a. n is 10 for 15kHz SCS, 20 for 30kHz SCS and 40 for 60kHz SCS..

Table 6.4A.2.3.1.5-1: Test requirements for in-band emissions for Inter-band CA and Intra-band non-contiguous CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter description | Unit | Limit (NOTE 1) | | Applicable Frequencies |
| General | dB | + TT | | Any non-allocated (NOTE 2) |
| IQ Image | dB | -28+TT | Image frequencies when output power > 10 dBm | Image frequencies (NOTES 2, 3) |
| -25+TT | Image frequencies when output power ≤ 10 dBm |
| Carrier leakage | dBc | -28+TT | Output power > 10 dBm | Carrier leakage frequency (NOTES 4, 5) |
| -25+TT | 0 dBm ≤ Output power ≤10 dBm |
| -20+TT | -30 dBm ≤ Output power ≤ 0 dBm |
| -10+TT | -40 dBm≤ Output power < -30 dBm |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of *PRB* - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB*is defined in NOTE 10.  NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs.  NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.  NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 5: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE, and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.  NOTE 6:  is the Transmission Bandwidth (see Section 5.3).  NOTE 7:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 8:  is the limit specified in Table 6.4.2.1.3-1 for the modulation format used in the allocated RBs.  NOTE 9:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth.  NOTE 10:  is the transmitted power normalized by the number of allocated RBs, measured in dBm. | | | | |

Table 6.4A.2.3.1.5-1a: Test requirements for in-band emissions for intra-band contiguous CA (allocated component carrier)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Unit | Limit | | Applicable Frequencies |
| General | dB | +TT | | Any non-allocated (NOTE 2) |
| IQ Image | dB | -28+TT | Output power > 10 dBm | Image frequencies  (NOTE 3) |
|  |  | -25+TT | 0≤ Output power ≤ 10 dBm |  |
| Carrier leakage | dBc | -28+TT | Output power > 10 dBm | Carrier leakage frequency (NOTE 4,5) |
|  |  | -25+TT | 0 dBm ≤ Output power ≤ 10 dBm |  |
|  |  | -20+TT | -30 dBm ≤ Output power ≤ 0 dBm |  |
|  |  | -10+TT | -40 dBm ≤ Output power < -30 dBm |  |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. is defined in NOTE 10. The limit is evaluated in each non-allocated RB.  NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs  NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.  NOTE 4: Exceptions to the general limit are allowed for up to two contiguous non-allocated RBs. The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in the non-allocated RB to the measured total power in all allocated RBs.  NOTE 5: The applicable frequencies for this limit are those that are enclosed either in the RB containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB. Carrier leakage frequency is indicated by the UE as described in clause 6.4A.2.1.0. When only one uplink carrier is activated, the applicable LO leakage frequency follow definition in clause 6.4.2.  NOTE 6:  is the Transmission Bandwidth (see clause 5.3) not exceeding  .  NOTE 7:  is the Transmission Bandwidth Configuration (see clause 5.3) of the component carrier with RBs allocated.  NOTE 8:  is the limit specified in Table 6.4.2.1-1 for the modulation format used in the allocated RBs.  NOTE 9:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth).  NOTE 10:  is an average of the transmitted power over 10 sub-frames normalized by the number of allocated RBs, measured in dBm. | | | | |

Table 6.4A.2.3.1.5-1b: Test requirements for in-band emissions for intra-band contiguous CA (not allocated component carrier)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Para-meter | Unit | Meas BW  NOTE 1 | Limit | | | remark | Applicable Frequencies |
| General | dB | BW of 1 RB |  | | | The reference value is the average power per allocated RB in the allocated component carrier | Any RB in the non-allocated component carrier.  The frequency raster of the RBs is derived when this component carrier is allocated with RBs |
| IQ Image | dB | BW of 1 RB | NOTE 2 | | | The reference value is the average power per allocated RB in the allocated component carrier | Image frequencies (NOTES 6,7) If UE does not indicate exact frequency for carrier leakage, this requirement does not apply. |
|  |  |  | -28+TT | Output power > 10 dBm | |  |  |
|  |  |  | -25+TT | 0≤ Output power ≤ 10 dBm | |  |  |
| Carrier leakage | dBc | BW of 1 RB | NOTE 3 | | | The reference value is the total power of the allocated RBs in the allocated component carrier | The frequencies of the up to 2 non-allocated RBs are indicated with IE *UplinkTxDirectCurrentMoreCarrierList-r17*. If UE does not indicate exact frequency for carrier leakage, this requirement does not apply. |
|  |  |  | -28+TT | | Output power > 10 dBm |  |  |
|  |  |  | -25+TT | | 0 dBm ≤ Output power ≤ 10 dBm |  |  |
|  |  |  | -20+TT | | -30 dBm ≤ Output power ≤ 0 dBm |  |  |
|  |  |  | -10+TT | | -40 dBm ≤ Output power < -30 dBm |  |  |
| NOTE1: Resolution BWs smaller than the measurement BW may be integrated to achieve the measurement bandwidth.  NOTE 2: Exceptions to the general limit are allowed for up to +1 RBs within a contiguous width of +1 non-allocated RBs.  NOTE 3: Two Exceptions to the general limit are allowed for up to two contiguous non-allocated RBs  NOTE 4: NOTES 1, 5, 6, 7, 8, 9 from Table 6.4A.2.1.1-1 apply for Table 6.4A.2.1.2-2 as well.  NOTE 5:  for measured non-allocated RB in the non-allocated component carrier may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.  NOTE 6: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs  NOTE 7: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. | | | | | | | |

Table 6.4A.2.3.1.5-2: Test Tolerance for In-band emission

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 0.8dB | 0.8dB |
| 40MHz < BW ≤ 100MHz | 0.8dB | 0.8dB |
| 100MHz < BW ≤ 200MHz | TBD | TBD |

## 6.4B Transmit signal quality for NR-DC

For inter-band NR-DC with one uplink carrier assigned per NR band, the transmit signal quality for the corresponding inter-band CA configuration as specified in clause 6.4A applies.

Note: For NR-DC testing, replace CA by NR-DC, PCC by PCell, and SCC by PSCell in clause 6.4A.

### 6.4B.1 Frequency error for NR-DC

For inter-band dual connectivity, the frequency error for the corresponding inter-band CA configuration as specified in clause 6.4A.1 applies.

Note: For NR-DC testing, replace CA by NR-DC, PCC by PCell, and SCC by PSCell in clause 6.4A.1.

### 6.4B.2 Transmit modulation quality for NR-DC

For inter-band dual connectivity, the transmit modulation quality for the corresponding inter-band CA configuration as specified in clause 6.4A.2 applies.

Note: For NR-DC testing, replace CA by NR-DC, PCC by PCell, and SCC by PSCell in clause 6.4A.2.

#### 6.4B.2.1 Error Vector Magnitude for NR-DC

For inter-band dual connectivity, the Error Vector Magnitude for the corresponding inter-band CA configuration as specified in clause 6.4A.2.1 applies.

Note: For NR-DC testing, replace CA by NR-DC, PCC by PCell, and SCC by PSCell in clause 6.4A.2.1.

#### 6.4B.2.2 Carrier leakage for NR-DC

For inter-band dual connectivity, the carrier leakage for the corresponding inter-band CA configuration as specified in clause 6.4A.2.2 applies.

Note: For NR-DC testing, replace CA by NR-DC, PCC by PCell, and SCC by PSCell in clause 6.4A.2.2.

#### 6.4B.2.3 In-band emissions for NR-DC

For inter-band dual connectivity, the in-band emissions for the corresponding inter-band CA configuration as specified in clause 6.4A.2.3 applies.

Note: For NR-DC testing, replace CA by NR-DC, PCC by PCell, and SCC by PSCell in clause 6.4A.2.3.

## 6.4C Transmit signal quality for SUL

### 6.4C.1 Frequency error for SUL

6.4C.1.1 Test purpose

Same test purpose as in clause 6.4.1.1

6.4C.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward that support SUL operating on the SUL bands.

6.4C.1.3 Minimum conformance requirements

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3and 6.4.1.

6.4C.1.4 Test description

Same test description as specified in clause 6.4.1.4 with following exceptions:

Instead of table 5.3.5-1 🡪 use Table 5.5C-1.

Instead of table 6.4.1.4.1-1 🡪 use Table 6.4C.1.4-1

Table 6.4C.1.4-1: Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid range for both SUL carrier and Non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Highest for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | | UL Configuration | SUL Configuration | |
|  | Modulation | RB allocation | N/A | Modulation | RB allocation |
| 1 | CP-OFDM QPSK | Full RB (NOTE 1) |  | DFT-s-OFDM QPSK | SUL REFSENS (NOTE 2) |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2  NOTE 2: SUL REFSENS refers to Table 7.3C.2.4.1-1a which defines SUL RB configuration and start RB location for each SCS, channel BW and NR band.  NOTE 3: For NR band n83, 30MHz test channel bandwidth is tested with Low range test frequency. | | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.4 for TE diagram and section A.3.2 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL.

Table 6.4C.1.4-1: Void

6.4C.1.5 Test requirement

The 10 frequency error Δf results measured on the SUL carrier must fulfil the test requirement:

|Δf| ≤ (0.1 PPM + 15 Hz)

### 6.4C.2 Transmit modulation quality for SUL

#### 6.4C.2.1 Error Vector Magnitude for SUL

6.4C.2.1.1 Test purpose

Same test purpose as in clause 6.4.2.1

6.4C.2.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward that support SUL operating on the SUL bands.

6.4C.2.1.3 Minimum conformance requirements

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3and 6.4.2.1.

6.4C.2.1.4 Test description

Same test description as specified in clause 6.4.2.1.4 with following exceptions:

Instead of table 5.3.5-1 🡪 use Table 5.5C-1.

Instead of table 6.4.2.1.4.1-1, table 6.4.2.1.4.1-2, table 6.4.2.1.4.1-3 🡪 use Table 6.4C.2.1.4-1, table 6.4C.2.1.4-2, table 6.4C.2.1.4-3

Table 6.4C.2.1.4-1: Test Configuration Table for PUSCH

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low, Mid, High range for SUL carrier  Mid range for Non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Highest for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | UL Configuration | | SUL Configuration | |
|  | N/A | N/A | | Modulation | RB allocation (NOTE 2) |
| 13 |  |  | | DFT-s-OFDM PI/2 BPSK | Inner Full |
| 23 |  |  | | DFT-s-OFDM PI/2 BPSK | Outer Full |
| 3 |  |  | | DFT-s-OFDM QPSK | Inner Full |
| 4 |  |  | | DFT-s-OFDM QPSK | Outer Full |
| 5 |  |  | | DFT-s-OFDM 16 QAM | Inner Full |
| 6 |  |  | | DFT-s-OFDM 16 QAM | Outer Full |
| 7 |  |  | | DFT-s-OFDM 64 QAM | Outer Full |
| 8 |  |  | | DFT-s-OFDM 256 QAM | Outer Full |
| 9 |  |  | | CP-OFDM QPSK | Inner Full |
| 10 |  |  | | CP-OFDM QPSK | Outer Full |
| 11 |  |  | | CP-OFDM 16 QAM | Inner Full |
| 12 |  |  | | CP-OFDM 16 QAM | Outer Full |
| 13 |  |  | | CP-OFDM 64 QAM | Outer Full |
| 14 |  |  | | CP-OFDM 256 QAM | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.  NOTE 4: For NR band n83, 30MHz test channel bandwidth is tested with Low range and High range test frequencies. | | | | | |

Table 6.4C.2.1.4-2: Test Configuration Table for PUCCH

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | | See Table 6.4C.2.1.4.1-1 | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | See Table 6.4C.2.1.4.1-1 | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | See Table 6.4C.2.1.4.1-1 | | |
| Test SCS as specified in Table 5.3.5-1 | | | | See Table 6.4C.2.1.4.1-1 | | |
| Test Parameters | | | | | | |
| ID | Downlink Configuration | | Uplink Configuration | SUL Configuration | | |
|  | Modulation | RB allocation | N/A | Waveform | PUCCH format | RB index |
| 1 | CP-OFDM QPSK | Full RB (Note 1) |  | CP-OFDM | PUCCH format = Format 1  Length in OFDM symbols = 14 | 0 |
| 2 | CP-OFDM QPSK | Full RB (Note 1) |  | CP-OFDM | PUCCH format = Format 1  Length in OFDM symbols = 14 | NRB-1 |
| 3 | CP-OFDM QPSK | Full RB (Note 1) |  | DFT-s-OFDM | PUCCH format = Format 3  Length in OFDM symbols = 14 | 0 |
| 4 | CP-OFDM QPSK | Full RB (Note 1) |  | DFT-s-OFDM | PUCCH format = Format 3  Length in OFDM symbols = 14 | NRB-1 |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1. | | | | | | |

Table 6.4C.2.1.4-3: Test Configuration Table for PRACH

|  |  |
| --- | --- |
| Initial Conditions | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | Normal |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | See Table 6.4C.2.1.4.1-1 |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | See Table 6.4C.2.1.4.1-1 |
| Test SCS as specified in Table 5.3.5-1 | See Table 6.4C.2.1.4.1-1 |
| PRACH preamble format | |
|  | SUL |
| PRACH Configuration Index | 17 |
| RS EPRE setting for test point 1 (dBm/15kHz) | -71 |
| RS EPRE setting for test point 2 (dBm/15kHz) | -86 |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.4 for TE diagram and section A.3.2 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL. Additionally the following exceptions shown in Table 6.4C.2.1.4-2 is considered.

Table 6.4C.2.1.4-1: Void

Table 6.4C.2.1.4-2: *BWP-UplinkCommon:* PRACH measurement

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-14 | | | |
| Information Element | Value/remark | Comment | Condition |
| BWP-UplinkCommon ::= SEQUENCE { |  |  |  |
| rach-ConfigCommon CHOICE { |  |  | SUL\_SUL AND RF |
| setup | RACH-ConfigCommon |  |  |
| } |  |  |  |
| } |  |  |  |

6.4C.2.1.5 Test requirement

Same test requirement for EVM measured on the SUL carrier as specified in 6.4.2.1.5.

#### 6.4C.2.2 Carrier leakage for SUL

6.4C.2.2.1 Test purpose

Same test purpose as in clause 6.4.2.2.1.

6.4C.2.2.2 Test applicability

This test applies to all types of NR UE release 15 and forward that support SUL operating on the SUL bands.

6.4C.2.2.3 Minimum conformance requirements

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3and 6.4.2.2.

6.4C.2.2.4 Test description

Same test description as specified in clause 6.4.2.2.4 with following exceptions:

Instead of table 5.3.5-1 🡪 use Table 5.5C-1.

Instead of table 6.4.2.2.4.1-1 🡪 use Table 6.4C.2.2.4-1

Table 6.4C.2.2.4-1: Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low, Mid, High range for SUL carrier  Mid range for Non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | UL Configuration | | SUL Configuration | |
|  | N/A | N/A | | Modulation | RB allocation (NOTE 1) |
| 1 |  |  | | DFT-s-OFDM QPSK | Inner\_1RB\_Left |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 3: When the signalled DC carrier position is at Inner\_1RB\_Left, use Inner\_1RB\_Right for UL RB allocation.  NOTE 4: For NR band n83, 30MHz test channel bandwidth is tested with Low range and High range test frequencies. | | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.4 for TE diagram and section A.3.2 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Table 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_ON\_SUL.

Table 6.4C.2.2.4-1: Void

6.4C.2.2.5 Test requirement

Same test requirement for carrier leakage measured on the SUL carrier as specified in 6.4.2.2.5.

#### 6.4C.2.3 In-band emissions for SUL

6.4C.2.3.1 Test purpose

Same test purpose as in clause 6.4.2.3.1.

6.4C.2.3.2 Test applicability

This test applies to all types of NR UE release 15 and forward that support SUL operating on the SUL bands.

6.4C.2.3.3 Minimum conformance requirements

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3and 6.4.2.3.

6.4C.2.3.4 Test description

Same test description as specified in clause 6.4.2.3.4 with following exceptions:

Instead of table 5.3.5-1 🡪 use Table 5.5C-1.

Instead of table 6.4.2.3.4.1-1 🡪 use Table 6.4C.2.3.4-1

Instead of table 6.4.2.3.4.1-2 🡪 use Table 6.4C.2.3.4-2

Table 6.4C.2.3.4-1: Test Configuration Table for PUSCH

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low range, Mid range, High range for SUL carrier  Mid range for Non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | UL Configuration | | SUL Configuration | |
|  | N/A | N/A | | Modulation | RB allocation (NOTE 1) |
| 1 |  |  | | DFT-s-OFDM QPSK | Inner\_1RB\_Left |
| 2 |  |  | | DFT-s-OFDM QPSK | Inner\_1RB\_Right |
| 3 |  |  | | CP-OFDM QPSK | Inner\_1RB\_Left |
| 4 |  |  | | CP-OFDM QPSK | Inner\_1RB\_Right |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 3: For NR band n83, 30MHz test channel bandwidth is tested with Low range and High range test frequencies. | | | | | |

Table 6.4C.2.3.4-2: Test Configuration Table for PUCCH

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | | See Table 6.4C.2.3.4.1-1 | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | See Table 6.4C.2.3.4.1-1 | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | | See Table 6.4C.2.3.4.1-1 | | |
| Test SCS as specified in Table 5.3.5-1 | | | | See Table 6.4C.2.3.4.1-1 | | |
| Test Parameters | | | | | | |
| ID | Downlink Configuration | | Uplink Configuration | SUL Configuration | | |
|  | Modulation | RB allocation | N/A | Waveform | PUCCH format | RB index |
| 1 | CP-OFDM QPSK | Full RB (Note 1) |  | DFT-s-OFDM | PUCCH format = Format 3  Length in OFDM symbols = 14 | 0 |
| 2 | CP-OFDM QPSK | Full RB (Note 1) |  | DFT-s-OFDM | PUCCH format = Format 3  Length in OFDM symbols = 14 | NRB-1 |
| 3 | CP-OFDM QPSK | Full RB (Note 1) |  | CP-OFDM | PUCCH format = Format 1  Length in OFDM symbols = 14 | 0 |
| 4 | CP-OFDM QPSK | Full RB (Note 1) |  | CP-OFDM | PUCCH format = Format 1  Length in OFDM symbols = 14 | NRB-1 |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1. | | | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.4 for TE diagram and section A.3.2 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL.

Table 6.4C.2.3.4-1: Void

6.4C.2.3.5 Test requirement

Same test requirement for In-band emissions measured on the SUL carrier as specified in 6.4.2.3.5.

#### 6.4C.2.4 EVM equalizer spectrum flatness for SUL

6.4C.2.4.1 Test purpose

Same test purpose as in clause 6.4.2.4.1.

6.4C.2.4.2 Test applicability

This test applies to all types of NR UE release 15 and forward that support SUL operating on the SUL bands.

6.4C.2.4.3 Minimum conformance requirements

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3 and 6.4.2.4.

6.4C.2.4.4 Test description

Same test description as specified in clause 6.4.2.4.4 with following exceptions:

Instead of table 5.3.5-1 🡪 use Table 5.5C-1.

Instead of table 6.4.2.4.4.1-1 🡪 use Table 6.4C.2.4.4-1

Table 6.4C.2.4.4-1: Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low range, Mid range, High range for SUL carrier  Mid range for Non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.5C-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | UL Configuration | | SUL Configuration | |
|  | N/A | N/A | | Modulation | RB allocation (NOTE 1) |
| 1 |  |  | | DFT-s-OFDM QPSK | Outer Full |
| 2 |  |  | | CP-OFDM QPSK | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 3: For NR band n83, 30MHz test channel bandwidth is tested with Low range and High range test frequencies. | | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.4 for TE diagram and section A.3.2 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Table 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL.

Table 6.4C.2.4.4-1: Void

6.4C.2.4.5 Test requirement

Same test requirement for EVM equalizer spectrum flatness measured on the SUL carrier as specified in 6.4.2.4.5.

#### 6.4C.2.5 EVM equalizer spectrum flatness for Pi/2 BPSK for SUL

6.4C.2.5.1 Test purpose

Same test purpose as in clause 6.4.2.5.1.

6.4C.2.5.2 Test applicability

This test applies to all types of NR UE release 16 and forward that support SUL operating on the SUL bands and indicate support for UE capability *lowPAPR-DMRS-PUSCHwithPrecoding-r16*.

6.4C.2.5.3 Minimum conformance requirements

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3 and 6.4.2.4.1.

6.4C.2.5.4 Test description

6.4C.2.5.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.5C-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4C.2.5.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4C.2.5.4.1-1: Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low range, Mid range, High range for SUL carrier  Mid range for Non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.5C-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | UL Configuration | | SUL Configuration | |
|  | N/A | N/A | | Modulation | RB allocation (NOTE 1) |
| 1 |  |  | | DFT-s-OFDM Pi/2 BPSK w Pi/2 BPSK DMRS | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 3: For NR band n83, 30MHz test channel bandwidth is tested with Low range and High range test frequencies. | | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.4 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4C.2.5.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4C.2.5.4.3.

6.4C.2.5.4.2 Test procedure

Same as in 6.4.2.5.4.2.

6.4C.2.5.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Tables 4.6.1-28 with condition SUL AND (RF OR RRM), Table 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL with the following exception:

Table 6.4C.2.5.4.3-1: DMRS-UplinkConfig

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-51 | | | |
| Information Element | Value/remark | Comment | Condition |
| DMRS-UplinkConfig ::= SEQUENCE { |  |  |  |
| transformPrecodingEnabled SEQUENCE { |  |  |  |
| dmrs-UplinkTransformPrecoding-r16 SEQUENCE { |  |  |  |
| pi2BPSK-ScramblingID0 | Not present |  |  |
| pi2BPSK-ScramblingID1 | Not present |  |  |
| } |  |  |  |
| } |  |  |  |
| } |  |  |  |

6.4C.2.5.5 Test requirement

Each of the *n* spectrum flatness functions, shall derive four ripple results in Annex E.4.4.1 The derived results shall not exceed the values in Figure 6.4C.2.5.5-1:

Table 6.4C.2.5.5-1: Mask for EVM equalizer coefficients for Pi/2 BPSK, normal conditions

|  |  |  |
| --- | --- | --- |
| Frequency range | Parameter | Maximum ripple (dB) |
| |FUL\_Meas – F\_center| ≤ X MHz  (Range 1) | X1 | 6 + TT (p-p) |
| |FUL\_Meas – F\_center| > X MHz  (Range 2) | X2 | 14 + TT (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: F\_center refers to the center frequency of an allocated block of PRBs  NOTE 3: X, in MHz, is equal to 25% of the bandwidth of the PRB allocation  NOTE 4: See Figure 6.4C.2.5.5-1 for description of X1, X2  NOTE 5: Test tolerance TT = 1.4 dB. | | |



Figure 6.4C.2.5.5-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation. F\_center denotes the center frequency of the allocated block of PRBs. X, in MHz, is equal to 25 % of the bandwidth of the PRB allocation.

Each of the *n* spectrum flatness functions shall derive an impulse response of the spectral shaping filter in Annex E.4.4.2. The derived results shall fulfill:





where TT = 1.4 dB.6.4D Transmit signal quality for UL MIMO.

## 6.4D Transmit signal quality for UL MIMO

### 6.4D.1 Frequency error for UL MIMO

Editor’note:

- For a transition period until RAN#104 (June 2024) previous test procedure in TS 38.521-1 V18.0.0 is allowed for TE implementation.

- Working assumption is that the same MU applies for the new UL MIMO test procedure as for the test procedure in TS 38.521-1 V18.0.0. This does not preclude to update the MU in future meetings.

6.4D.1.1 Test purpose

This test verifies the ability of both, the receiver and the transmitter for UL MIMO, to process frequency correctly.

Receiver: to extract the correct frequency from the stimulus signal, offered by the System simulator, under ideal propagation conditions and low level.

Transmitter: to derive the correct modulated carrier frequency for each antenna connector from the results, gained by the receiver.

6.4D.1.2 Test applicability

This test case applies to all types of NR Power Class 1.5, Power Class 2 and Power Class 3 UE release 15 and forward that support 2-layer codebook based UL MIMO.

6.4D.1.3 Minimum conformance requirements

For UE(s) supporting UL MIMO, the basic measurement interval of modulated carrier frequency is 1 UL slot. The mean value of basic measurements of UE modulated carrier frequency per layer shall be accurate to within ± 0.1 PPM observed over a period of 1 ms of cumulated measurement intervals compared to the carrier frequency received from the NR Node B.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4D.1.

6.4D.1.4 Test description

6.4D.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4D.1.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4D.1.4.1-1: Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Highest | |
| Test SCS as specified in Table 5.3.5-1 | | | Lowest | |
| Test Parameters | | | | |
|  | Downlink Configuration | | Uplink Configuration | |
| Test ID | Modulation | RB allocation | Modulation | RB allocation |
| 1 | CP-OFDM QPSK | Full RB (NOTE 1) | CP-OFDM QPSK | REFSENS (NOTE 2) |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2  NOTE 2: REFSENS refers to Table 7.3.2.4.1-3 which defines uplink RB configuration and start RB location for each SCS, channel BW and NR band. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.2.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.4D.1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4D.1.4.3.

6.4D.1.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1\_1 for C\_RNTI to transmit the DL RMC according to Table 6.4D.1.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.

2. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4D.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2

3. Set the Downlink signal level to the appropriate REFSENS value defined in 7.3D.2.5. Send continuously uplink power control "up" commands to the UE in every uplink scheduling information to the UE so that the UE transmits at PUMAX level for the duration of the test. Allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

4. Measure the Frequency Error using Global In-Channel Tx-Test for UL MIMO (Annex E with procedure in Annex E.8) for each layer using the two Tx antenna connectors of the UE. For TDD, only slots consisting of only UL symbols are under test.

5. For UEs supporting DSS, repeat steps 1~4 on the applicable bands as specified in Section 5.4.2.1 with message contents being according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-61 and Table 4.6.3-62 with condition DSS.

6.4D.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX\_UL\_MIMO.

6.4D.1.5 Test requirement

The requirements apply to each layer.

The 10 frequency error Δf results must fulfil the test requirement:

|Δf| ≤ (0.1PPM+15 Hz)

### 6.4D.1\_1 Frequency error for SUL with UL MIMO

Editor’note:

- For a transition period until RAN#104 (June 2024) previous test procedure in TS 38.521-1 V18.0.0 is allowed for TE implementation.

- Working assumption is that the same MU applies for the new UL MIMO test procedure as for the test procedure in TS 38.521-1 V18.0.0. This does not preclude to update the MU in future meetings.

6.4D.1\_1.1 Test purpose

Same as test purpose in clause 6.4D.1.1.

6.4D.1\_1.2 Test applicability

This test applies to all types of NR UE release 17 and forward that support SUL and UL MIMO operating on the SUL bands.

6.4D.1\_1.3 Minimum conformance requirements

For UE(s) supporting UL MIMO, the basic measurement interval of modulated carrier frequency is 1 UL slot. The mean value of basic measurements of UE modulated carrier frequency per layer shall be accurate to within ± 0.1 PPM observed over a period of 1 ms of cumulated measurement intervals compared to the carrier frequency received from the NR Node B.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4D.1.

6.4D.1\_1.4 Test description

6.4D.1\_1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing and are shown in table 6.4D.1\_1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4D.1\_1.4.1-1: Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid range for both SUL carrier and Non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Highest for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | | UL Configuration | SUL Configuration | |
|  | Modulation | RB allocation | N/A | Modulation | RB allocation |
| 1 | CP-OFDM QPSK | Full RB (NOTE 1) |  | CP-OFDM QPSK | SUL REFSENS (NOTE 2) |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2  NOTE 2: SUL REFSENS refers to Table 7.3C.2.4.1-1a which defines SUL RB configuration and start RB location for each SCS, channel BW and NR band. | | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.5 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.4D.1\_1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4D.1.4.3.

6.4D.1\_1.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1\_1 for C\_RNTI to transmit the DL RMC according to Table 6.4D.1\_1.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.

2. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4D.1\_1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2

3. Set the Downlink signal level to the appropriate REFSENS value defined in 7.3D.2\_1.5. Send continuously uplink power control "up" commands to the UE in every uplink scheduling information to the UE so that the UE transmits at PUMAX level for the duration of the test. Allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

4. Measure the Frequency Error using Global In-Channel Tx-Test for UL MIMO (Annex E with procedure in Annex E.8) for each layer using the two Tx antenna connectors of the UE. For TDD, only slots consisting of only UL symbols are under test.

5. For UEs supporting DSS, repeat steps 1~4 on the applicable bands as specified in Section 5.4.2.1 with message contents being according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-61 and Table 4.6.3-62 with condition DSS.

6.4D.1\_1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, and Table 4.6.3-182 with the condition 2TX\_UL\_MIMO.

6.4D.1\_1.5 Test requirement

The requirements apply to each layer.

The 10-frequency error Δf results must fulfil the test requirement:

|Δf| ≤ (0.1PPM+15 Hz)

### 6.4D.2 Transmit modulation quality for UL MIMO

For UE supporting UL-MIMO, the transmit modulation quality requirements are specified at each transmit antenna connector.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission with precoding matrix *W*=1 [6.3.1.5 TS 38.211], the requirements in clause 6.4.2 apply when *TxD* is not indicated, and the requirements in clause 6.4G.2 apply when *TxD* is indicated.

The transmit modulation quality is specified in terms of:

- Error Vector Magnitude (EVM) for the allocated resource blocks (RBs)

- EVM equalizer spectrum flatness derived from the equalizer coefficients generated by the EVM measurement process

- Carrier leakage (caused by IQ offset)

- In-band emissions for the non-allocated RB

In case the parameter 3300 or 3301 is reported from UE via the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrentList* IE (as defined in TS 38.331 [7]), carrier leakage measurement requirement in clause 6.4D.2.2 and 6.4D.2.3 shall be waived, and the RF correction with regard to the carrier leakage and IQ image shall be omitted during the calculation of transmit modulation quality.

#### 6.4D.2.1 Error Vector Magnitude for UL MIMO

Editor’note:

- For a transition period until RAN#104 (June 2024) previous test procedure in TS 38.521-1 V18.0.0 is allowed for TE implementation.

- Working assumption is that the same MU applies for the new UL MIMO test procedure as for the test procedure in TS 38.521-1 V18.0.0. This does not preclude to update the MU in future meetings.

6.4D.2.1.1 Test purpose

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM.

The measured waveform is further equalised using the channel estimates subjected to the EVM equaliser spectrum flatness requirement specified in sub-clause 6.4D.2.4.3. For DFT-s-OFDM waveforms, the EVM result is defined after the front-end FFT and IDFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %. For CP-OFDM waveforms, the EVM result is defined after the front-end FFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %.

The basic EVM measurement interval in the time domain is the duration of PUSCH channel, or one hop, if frequency hopping is enabled for PUSCH in the time domain. The EVM measurement interval is reduced by any symbols that contains an allowable power transient as defined in subclause 6.3D.3.3.

6.4D.2.1.2 Test applicability

This test case applies to all types of NR Power Class 1.5, Power Class 2 and Power Class 3 UE release 15 and forward that support 2-layer codebook based UL MIMO.

6.4D.2.1.3 Minimum conformance requirements

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the Error Vector Magnitude requirements specified in Table 6.4.2.1.3-1 apply per layer. The requirements shall be met with the UL MIMO configurations specified in Table 6.2D.1.3-2

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4D.2.1.

6.4D.2.1.4 Test description

6.4D.2.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4D.2.1.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4D.2.1.4.1-1: Test Configuration Table

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | All | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation | RB allocation (NOTE 1) |
| 1 |  | CP-OFDM QPSK | Inner Full |
| 2 |  | CP-OFDM QPSK | Outer Full |
| 3 |  | CP-OFDM 16 QAM | Inner Full |
| 4 |  | CP-OFDM 16 QAM | Outer Full |
| 5 |  | CP-OFDM 64 QAM | Outer Full |
| 6 |  | CP-OFDM 256 QAM | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.4D.2.1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4D.2.1.4.3.

6.4D.2.1.4.2 Test procedure

Test procedure for PUSCH:

1.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4D.2.1.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2

1.2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level, allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

1.3. Measure the EVM and  using Global In-Channel Tx-Test for UL MIMO (Annex E with procedure in Annex E.8) for each layer using the two Tx antenna connectors of the UE. For TDD, only slots consisting of only UL symbols are under test.

1.4. For modulations except 256QAM, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power at each antenna connector under measurement measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where:

- Pmin is the minimum output power according to Table 6.3.1.3-1.

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

For 256 QAM, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power at each antenna connector under measurement measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin + 10 dB, where MU and Uplink power control window size are defined above. Pmin is the minimum output power according to Table 6.3D.1.3-1.

1.5. Measure the EVM and  using Global In-Channel Tx-Test for UL MIMO (Annex E with procedure in Annex E.8) for each layer using the two Tx antenna connectors of the UE. For TDD, only slots consisting of only UL symbols are under test.

NOTE1: Void.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power at each antenna connector under measurement is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

NOTE3: Void.

Table 6.4D.2.1.4.2-1: Void

6.4D.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the condition 2TX\_UL\_MIMO.

6.4D.2.1.5 Test requirement

The requirements apply to each layer.

The PUSCH EVM, derived in Annex E.4.2 using Annex E.8, shall not exceed the values in Table 6.4D.2.1.5-1.

The PUSCH, derived in Annex E.4.6.2 using Annex E.8, shall not exceed the values in Table 6.4D.2.1.5-1 when embedded with data symbols of the respective modulation scheme.

Table 6.4D.2.1.5-1: Test requirements for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| Pi/2-BPSK | % | 30 + TT |
| QPSK | % | 17.5 + TT |
| 16 QAM | % | 12.5 + TT |
| 64 QAM | % | 8 + TT |
| 256 QAM | % | 3.5 + TT |
| Note 1: TT is defined in Table 6.4D.2.1.5-2. | | |

Table 6.4D.2.1.5-2: Test Tolerance

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| Pi/2-BPSK | % | 0 |
| QPSK | % | 0 |
| 16 QAM | % | 0 |
| 64 QAM | % | 0 |
| 256 QAM | % | 0.3 for 15 dBm < PUL  0.8 for -25 dBm < PUL≤ 15 dBm  1.1 for -40dBm ≤ PUL ≤ -25dBm |

#### 6.4D.2.1\_1 Error Vector Magnitude for SUL with UL MIMO

Editor’note:

- For a transition period until RAN#104 (June 2024) previous test procedure in TS 38.521-1 V18.0.0 is allowed for TE implementation.

- Working assumption is that the same MU applies for the new UL MIMO test procedure as for the test procedure in TS 38.521-1 V18.0.0. This does not preclude to update the MU in future meetings.

6.4D.2.1\_1.1 Test purpose

Same as test purpose in clause 6.4D.2.1.1.

6.4D.2.1\_1.2 Test applicability

This test applies to all types of NR UE release 17 and forward that support SUL and UL MIMO operating on the SUL bands.

6.4D.2.1\_1.3 Minimum conformance requirements

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the Error Vector Magnitude requirements specified in clause 6.4.2.1 apply per layer. The requirements shall be met with the UL MIMO configurations specified in Table 6.2D.1\_1.3-2.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4D.2.1.

6.4D.2.1\_1.4 Test description

6.4D.2.1\_1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4D.2.1\_1.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4D.2.1\_1.4.1-1: Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low, Mid, High range for SUL carrier  Mid-range for Non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Highest for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | UL Configuration | | SUL Configuration | |
|  | N/A | N/A | | Modulation | RB allocation (NOTE 2) |
| 1 |  |  | | CP-OFDM QPSK | Inner Full |
| 2 |  |  | | CP-OFDM QPSK | Outer Full |
| 3 |  |  | | CP-OFDM 16 QAM | Inner Full |
| 4 |  |  | | CP-OFDM 16 QAM | Outer Full |
| 5 |  |  | | CP-OFDM 64 QAM | Outer Full |
| 6 |  |  | | CP-OFDM 256 QAM | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1. | | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.5 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL and DL Reference Measurement channels are set according to Table 6.4D.2.1\_1.4.1-1

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4D.2.1\_1.4.3.

6.4D.2.1\_1.4.2 Test procedure

Test procedure for PUSCH:

1.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4D.2.1\_1.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2

1.2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level, allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

1.3. Measure the EVM and  using Global In-Channel Tx-Test for UL MIMO (Annex E with procedure in Annex E.8) for each layer using the two Tx antenna connectors of the UE. For TDD, only slots consisting of only UL symbols are under test.

1.4. For modulations except 256QAM, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power at each antenna connector under measurement measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where:

- Pmin is the minimum output power according to Table 6.3D.1.3-1.

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

For 256 QAM, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power at each antenna connector under measurement measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin + 10 dB, where MU and Uplink power control window size are defined above. Pmin is the minimum output power according to Table 6.3D.1.3-1.

1.5. Measure the EVM and  using Global In-Channel Tx-Test for UL MIMO (Annex E with procedure in Annex E.8) for each layer using the two Tx antenna connectors of the UE. For TDD, only slots consisting of only UL symbols are under test.

NOTE1: The purpose of the Uplink power control window is to ensure that the actual UE output power at each antenna connector under measurement is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

NOTE2: Void.

6.4D.2.1\_1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, and Table 4.6.3-182 with the condition 2TX\_UL\_MIMO.

6.4D.2.1\_1.5 Test requirement

The requirements apply to each layer.

The PUSCH EVM, derived in Annex E.4.2 using Annex E.8, shall not exceed the values in Table 6.4D.2.1\_1.5-1.

The PUSCH, derived in Annex E.4.6.2 using Annex E.8, shall not exceed the values in Table 6.4D.2.1\_1.5-1 when embedded with data symbols of the respective modulation scheme.

Table 6.4D.2.1\_1.5-1: Test requirements for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| Pi/2-BPSK | % | 30 + TT |
| QPSK | % | 17.5 + TT |
| 16 QAM | % | 12.5 + TT |
| 64 QAM | % | 8 + TT |
| 256 QAM | % | 3.5 + TT |
| Note 1: TT is defined in Table 6.4D.2.1.5-2. | | |

Table 6.4D.2.1\_1.5-2: Test Tolerance

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| QPSK | % | 0 |
| 16 QAM | % | 0 |
| 64 QAM | % | 0 |
| 256 QAM | % | 0.3 for 15 dBm < PUL  0.8 for -25 dBm < PUL≤ 15 dBm  1.1 for -40dBm ≤ PUL ≤ -25dBm |

#### 6.4D.2.2 Carrier leakage for UL MIMO

Editor’note:

- For a transition period until RAN#104 (June 2024) previous test procedure in TS 38.521-1 V18.0.0 is allowed for TE implementation.

- Working assumption is that the same MU applies for the new UL MIMO test procedure as for the test procedure in TS 38.521-1 V18.0.0. This does not preclude to update the MU in future meetings.

6.4D.2.2.1 Test purpose

The purpose of this test is to exercise the UE transmitter for UL MIMO to verify its modulation quality in terms of carrier leakage.

6.4D.2.2.2 Test applicability

This test case applies to all types of NR Power Class 1.5, Power Class 2 and Power Class 3 UE release 15 and forward that support 2-layer codebook based UL MIMO.

6.4D.2.2.3 Minimum conformance requirements

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the Relative Carrier Leakage Power requirements specified in Table 6.4.2.2.3-1 which is defined in subclause 6.4.2.2.3 per layer. The requirements shall be met with the UL MIMO configurations specified in Table 6.2D.1.3-2

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4D.2.2.

6.4D.2.2.4 Test description

6.4D.2.2.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4D.2.2.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4D.2.2.4.1-1: Test Configuration Table

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Mid | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation | RB allocation (NOTE 1, 3) |
| 1 |  | CP-OFDM QPSK | Inner\_1RB\_Left |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.  NOTE 3: When the signalled DC carrier position is at Inner\_1RB\_Left, use Inner\_1RB\_Right for UL RB allocation. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.4D.2.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4D.2.2.4.3.

6.4D.2.2.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4D.2.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power at each antenna connector under measurement measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 10 dBm, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

3. Measure carrier leakage using Global In-Channel Tx-Test for UL MIMO (Annex E with procedure in Annex E.8) for each layer using the two Tx antenna connectors of the UE. For TDD, only slots consisting of only UL symbols are under test.

4. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power at each antenna connector under measurement measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 0 dBm, where MU and Uplink power control window size are defined above.

5. Measure carrier leakage using Global In-Channel Tx-Test for UL MIMO (Annex E with procedure in Annex E.8) for each layer using the two Tx antenna connectors of the UE. For TDD, only slots consisting of only UL symbols are under test.

6. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power at each antenna connector under measurement measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level -30 dBm, where MU and Uplink power control window size are defined above.

7. Measure carrier leakage using Global In-Channel Tx-Test for UL MIMO (Annex E with procedure in Annex E.8) for each layer using the two Tx antenna connectors of the UE. For TDD, only slots consisting of only UL symbols are under test.

8. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power at each antenna connector under measurement measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where MU and Uplink power control window size are defined above. Pmin is the minimum output power according to Table 6.3D.1.3-1..

9. Measure carrier leakage using Global In-Channel Tx-Test for UL MIMO (Annex E with procedure in Annex E.8) for each layer using the two Tx antenna connectors of the UE. For TDD, only slots consisting of only UL symbols are under test.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power at each antenna connector under measurement is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

NOTE2: Void.

Table 6.4D.2.2.4.2-1: Void

Table 6.4D.2.1.4.2-2: Void

6.4D.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the condition 2TX\_UL\_MIMO.

6.4D.2.2.5 Test requirement

The requirements apply to each layer.

Each of the n carrier leakage results, derived in Annex E.3.1, shall not exceed the values in table 6.4D.2.2.5-1. Allocated RBs are not under test. n is 10 for 15kHz SCS, 20 for 30kHz SCS and 30 for 60kHz SCS.

Table 6.4D.2.2.5-1: Test requirements for Relative Carrier Leakage Power

|  |  |  |
| --- | --- | --- |
| LO Leakage | Parameters  UE output power | Relative limit (dBc) |
| 10 + MU to 10 + (MU + Uplink power control window size) dBm | -28 + TT |
| 0 + MU to 0 + (MU + Uplink power control window size) dBm | -25 + TT |
| -30 + MU to -30 + (MU + Uplink power control window size) dBm | -20 + TT |
| -40 + MU to -40 + (MU + Uplink power control window size) dBm | -10 + TT |
| NOTE 1: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 2: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE, and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.  NOTE 3:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 4: Void  NOTE 5: MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.  NOTE 6: Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.  NOTE 7: Test tolerance TT = 0.8 dB. | | |

Table 6.4D.2.2.5-2: Void

#### 6.4D.2.2\_1 Carrier leakage for SUL with UL MIMO

Editor’note:

- For a transition period until RAN#104 (June 2024) previous test procedure in TS 38.521-1 V18.0.0 is allowed for TE implementation.

- Working assumption is that the same MU applies for the new UL MIMO test procedure as for the test procedure in TS 38.521-1 V18.0.0. This does not preclude to update the MU in future meetings.

6.4D.2.2\_1.1 Test purpose

Same test purpose as in clause 6.4D.2.2.1.

6.4D.2.2\_1.2 Test applicability

This test case applies to all types of NR UE release 17 and forward that support SUL and UL MIMO operating on the SUL bands.

6.4D.2.2\_1.3 Minimum conformance requirements

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the Relative Carrier Leakage Power requirements specified in Table 6.4.2.2.3-1 which is defined in subclause 6.4.2.2.3 apply per layer. The requirements shall be met with the UL MIMO configurations specified in Table 6.2D.1\_1.3-2

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4D.2.2.

6.4D.2.2\_1.4 Test description

Same test description as specified in clause 6.4D.2.2.4 with following exceptions:

Instead of Table 5.3.5-1 🡪 use Table 5.5C-1.

Instead of Table 6.4D.2.2.4.1-1 🡪 use Table 6.4D.2.2\_1.4-1

Table 6.4D.2.2\_1.4-1: Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low, Mid, High range for SUL carrier  Mid range for Non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Mid for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | UL Configuration | | SUL Configuration | |
|  | N/A | N/A | | Modulation | RB allocation (NOTE 1) |
| 1 |  |  | | CP-OFDM QPSK | Inner\_1RB\_Left |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.  NOTE 3: When the signalled DC carrier position is at Inner\_1RB\_Left, use Inner\_1RB\_Right for UL RB allocation. | | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Table 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_ON\_SUL.

6.4D.2.2\_1.5 Test requirement

The requirements measured on the SUL carrier apply to each layer.

Each of the n carrier leakage results, derived in Annex E.3.1 using procedure in Annex Annex E.8, shall not exceed the values in table 6.4D.2.2\_1.5-1. Allocated RBs are not under test. n is 10 for 15kHz SCS, 20 for 30kHz SCS and 30 for 60kHz SCS.

Table 6.4D.2.2\_1.5-1: Test requirements for Relative Carrier Leakage Power

|  |  |  |
| --- | --- | --- |
| LO Leakage | Parameters  UE output power | Relative limit (dBc) |
| 10 + MU to 10 + (MU + Uplink power control window size) dBm | -28 + TT |
| 0 + MU to 0 + (MU + Uplink power control window size) dBm | -25 + TT |
| -30 + MU to -30 + (MU + Uplink power control window size) dBm | -20 + TT |
| -40 + MU to -40 + (MU + Uplink power control window size) dBm | -10 + TT |
| NOTE 1: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 2: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.  NOTE 3:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 4: Void  NOTE 5: MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.  NOTE 6: Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.  NOTE 7: Test tolerance TT = 0.8 dB. | | |

#### 6.4D.2.3 In-band emissions for UL MIMO

6.4D.2.3.1 Test purpose

The purpose of this test is to exercise the UE transmitter for UL MIMO to verify its modulation quality in terms of in-band emissions.

6.4D.2.3.2 Test applicability

This test case applies to all types of NR Power Class 1.5, Power Class 2 and Power Class 3 UE release 15 and forward that support 2-layer codebook based UL MIMO.

6.4D.2.3.3 Minimum conformance requirements

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the In-band Emission requirements specified in Table 6.4.2.3.3-1 which is defined in subclause 6.4.2.3.3 apply at each transmit antenna connector. The requirements shall be met with the uplink MIMO configurations specified in Table 6.2D.1.3-2.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4D.2.3.

6.4D.2.3.4 Test description

6.4D.2.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4D.2.3.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4D.2.3.4.1-1: Test Configuration Table

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation | RB allocation (NOTE 1) |
| 1 |  | CP-OFDM QPSK | Inner\_1RB\_Left |
| 2 |  | CP-OFDM QPSK | Inner\_1RB\_Right |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.4D.2.3.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4D.2.3.4.3.

6.4D.2.3.4.2 Test procedure

Test procedure for PUSCH:

1.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4D.2.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

1.2. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power at each antenna connector under measurement measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 10 dBm, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

1.3. Measure In-band emission using Global In-Channel Tx-Test (Annex E) for each of transmit antennas of the UE. For TDD, only slots consisting of only UL symbols are under test.

1.4. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power at each antenna connector under measurement measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 0 dBm, where MU and Uplink power control window size are defined above.

1.5. Measure In-band emission using Global In-Channel Tx-Test (Annex E) for each of transmit antennas of the UE. For TDD, only slots consisting of only UL symbols are under test.

1.6. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power at each antenna connector under measurement measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level -30 dBm, where MU and Uplink power control window size are defined above.

1.7. Measure In-band emission using Global In-Channel Tx-Test (Annex E) for each of transmit antennas of the UE. For TDD, only slots consisting of only UL symbols are under test.

1.8. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power at each antenna connector under measurement measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where MU and Uplink power control window size are defined above. Pmin is the minimum output power according to Table 6.3D.1.3-1.

1.9. Measure In-band emission using Global In-Channel Tx-Test (Annex E) for each of transmit antennas of the UE. For TDD, only slots consisting of only UL symbols are under test.

NOTE1: Void.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power at each antenna connector under measurement is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

NOTE3: For the UE which the output power at each antenna connector can reach the Uplink power control window at the same time, execute measurement for each of antenna connectors. For the UE which the output power at each antenna connector cannot reach the Uplink power control window at the same time, execute measurement for the one antenna connector which the output power is within Uplink power control window. And then ensure output power of the other antenna connector is within Uplink power control window and execute measurement for this antenna connector.

Table 6.4D.2.3.4.2-1: Void

Table 6.4D.2.3.4.2-2: Void

6.4D.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the condition 2TX\_UL\_MIMO.

6.4D.2.3.5 Test requirement

The requirements apply to each transmit antenna connector.

The averaged In-band emissions result, derived in Annex E.4.3, shall not exceed the corresponding values in Tables 6.4D.2.3.5-1. n is 10 for 15kHz SCS, 20 for 30kHz SCS and 40 for 60kHz SCS.

Table 6.4D.2.3.5-1: Test requirements for in-band emissions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter description | Unit | Limit (NOTE 1) | | Applicable Frequencies |
| General | dB | + TT | | Any non-allocated (NOTE 2) |
| IQ Image | dB | -28 + TT | Image frequencies when output power > 10 dBm | Image frequencies (NOTES 2, 3) |
| -25 + TT | Image frequencies when output power ≤ 10 dBm |
| Carrier leakage | dBc | -28 + TT | Output power > 10 dBm | Carrier leakage frequency (NOTES 4, 5) |
| -25 + TT | 0 dBm ≤ Output power ≤10 dBm |
| -20 + TT | -30 dBm ≤ Output power ≤ 0 dBm |
| -10 + TT | -40 dBm ≤ Output power < -30 dBm |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of *PRB* - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* is defined in NOTE 10.  NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs.  NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.  NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 5: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE and are those that are enclosed either in the RB containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.  NOTE 6:  is the Transmission Bandwidth (see Section 5.3).  NOTE 7:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 8:  is the limit specified in Table 6.4.2.1.3-1 for the modulation format used in the allocated RBs.  NOTE 9:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth.  NOTE 10:  is an average of the transmitted power over 10 sub-frames normalized by the number of allocated RBs, measured in dBm.  NOTE 11: Test tolerance TT = 0.8 dB. | | | | |

Table 6.4D.2.3.5-2: Void

#### 6.4D.2.3\_1 In-band emissions for SUL with UL MIMO

6.4D.2.3\_1.1 Test purpose

Same test purpose as in clause 6.4D.2.3.1.

6.4D.2.3\_1.2 Test applicability

This test case applies to all types of NR UE release 17 and forward that support SUL and UL MIMO operating on the SUL bands.

6.4D.2.3\_1.3 Minimum conformance requirements

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clauses 4.3 and 6.4D.2.3.

6.4D.2.3\_1.4 Test description

Same test description as specified in clause 6.4D.2.3.4 with following exceptions:

Instead of Table 5.3.5-1 🡪 use Table 5.5C-1.

Instead of Table 6.4D.2.3.4.1-1 🡪 use Table 6.4D.2.3\_1.4-1

Table 6.4D.2.3\_1.4-1: Test Configuration Table for PUSCH

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Low range, Mid range, High range for SUL carrier  Mid range for Non-SUL carrier | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Lowest, Mid, Highest for SUL carrier  Lowest for Non-SUL carrier | | |
| Test SCS as specified in Table 5.3.5-1 | | | 15kHz for SUL carrier and Lowest supported SCS for Non-SUL carrier | | |
| Test Parameters for Channel Bandwidths | | | | | |
| Test ID | Downlink Configuration | UL Configuration | | SUL Configuration | |
|  | N/A | N/A | | Modulation | RB allocation (NOTE 1) |
| 1 |  |  | | CP-OFDM QPSK | Inner\_1RB\_Left |
| 2 |  |  | | CP-OFDM QPSK | Inner\_1RB\_Right |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1. | | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

- The parameter setting for the cell are set up according to the TS 38.508-1 [5] subclause 4.4.3.

- Downlink signals are initially setup according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, and G.3.0 with consideration of supplementary uplink physical channels.

Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, and Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL.

6.4D.2.3\_1.5 Test requirement

The requirements measured on the SUL carrier apply to each transmit antenna connector.

The averaged In-band emissions result, derived in Annex E.4.3, shall not exceed the corresponding values in Table 6.4D.2.3\_1.5-1. n is 10 for 15kHz SCS, 20 for 30kHz SCS and 40 for 60kHz SCS.

Table 6.4D.2.3\_1.5-1: Test requirements for in-band emissions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter description | Unit | Limit (NOTE 1) | | Applicable Frequencies |
| General | dB | + TT | | Any non-allocated (NOTE 2) |
| IQ Image | dB | -28 + TT | Image frequencies when output power > 10 dBm | Image frequencies (NOTES 2, 3) |
| -25 + TT | Image frequencies when output power ≤ 10 dBm |
| Carrier leakage | dBc | -28 + TT | Output power > 10 dBm | Carrier leakage frequency (NOTES 4, 5) |
| -25 + TT | 0 dBm ≤ Output power ≤10 dBm |
| -20 + TT | -30 dBm ≤ Output power ≤ 0 dBm |
| -10 + TT | -40 dBm ≤ Output power < -30 dBm |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of *PRB* - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* is defined in NOTE 10.  NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs.  NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.  NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 5: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE and are those that are enclosed either in the RB containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.  NOTE 6:  is the Transmission Bandwidth (see Section 5.3).  NOTE 7:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 8:  is the limit specified in Table 6.4.2.1.3-1 for the modulation format used in the allocated RBs.  NOTE 9:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth.  NOTE 10:  is an average of the transmitted power over 10 sub-frames normalized by the number of allocated RBs, measured in dBm.  NOTE 11: Test tolerance TT = 0.8 dB. | | | | |

#### 6.4D.2.4 EVM equalizer spectrum flatness for UL MIMO

Editor’note:

- For a transition period until RAN#104 (June 2024) previous test procedure in TS 38.521-1 V18.0.0 is allowed for TE implementation.

- Working assumption is that the same MU applies for the new UL MIMO test procedure as for the test procedure in TS 38.521-1 V18.0.0. This does not preclude to update the MU in future meetings.

6.4D.2.4.1 Test purpose

The purpose of this test is to verify the zero-forcing equalizer correction applied in the EVM measurement process (as described in Annex E) meets a spectrum flatness requirement for the EVM measurement to be valid.

6.4D.2.4.2 Test applicability

This test case applies to all types of NR Power Class 1.5, Power Class 2 and Power Class 3 UE release 15 and forward that support 2-layer codebook based UL MIMO.

6.4D.2.4.3 Minimum conformance requirements

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the EVM Equalizer Spectrum Flatness requirements specified in Table 6.4.2.4.3-1 and Table 6.4.2.4.3-2 which are defined in subclause 6.4.2.4.3 apply at each layer. The requirements shall be met with the UL MIMO configurations specified in Table 6.2D.1.3-2

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4D.2.4.

6.4D.2.4.4 Test description

6.4D.2.4.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4D.2.4.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4D.2.4.4.1-1: Test Configuration Table

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation | RB allocation (NOTE 1) |
| 1 |  | CP-OFDM QPSK | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.2.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.4D.2.4.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4D.2.4.4.3.

6.4D.2.4.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4D.2.4.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

3. Measure spectrum flatness using Global In-Channel Tx-Test for UL MIMO (Annex E with procedure in Annex E.8) for each layer using the two Tx antenna connectors of the UE. For TDD, only slots consisting of only UL symbols are under test.

6.4D.2.4.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the condition 2TX\_UL\_MIMO.

6.4D.2.4.5 Test requirement

The requirements apply to each layer.

Each of the *n* spectrum flatness functions, shall derive four ripple results in Annex E.4.4.1 using Annex E.8. The derived results shall not exceed the values in Figure 6.4D.2.4.5-1:

For shaped Pi/2-BPSK modulated waveforms, the test requirements are TBD.

For normal conditions and unshaped modulated waveforms, the maximum ripple in Range 1 and Range 2 shall not exceed the values specified in Table 6.4D.2.4.5-1 and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 8.4 dB (see Figure 6.4D.2.4.5-1).

For normal conditions and for unshaped modulated waveforms, the peak-to-peak variation of the EVM equalizer coefficients contained within the frequency range of the uplink allocation shall not exceed the maximum ripple specified in Table 6.4D.2.4.5-1. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 8.4 dB (see Figure 6.4D.2.4.5-1).

For extreme conditions, the EVM equalizer spectral flatness shall not exceed the values specified in Table 6.4D.2.4.5-2. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 7.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 11.4 dB (see Figure 6.4D.2.4.5-1).

Table 6.4D.2.4.5-1: Requirements for EVM equalizer spectrum flatness for unshaped modulations (normal conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum ripple [dB] |
| FUL\_Meas – FUL\_Low ≥ 3 MHz and FUL\_High – FUL\_Meas ≥ 3 MHz  (Range 1) | 4 + TT (p-p) |
| FUL\_Meas – FUL\_Low < 3 MHz or FUL\_High – FUL\_Meas < 3 MHz  (Range 2) | 8 + TT (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each E-UTRA frequency band specified in Table 5.5-1  NOTE 3: Test tolerance TT = 1.4 dB. | |

Table 6.4D.2.4.5-2: Minimum requirements for EVM equalizer spectrum flatness for unshaped modulations (extreme conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum Ripple [dB] |
| FUL\_Meas – FUL\_Low ≥ 5 MHz and FUL\_High – FUL\_Meas ≥ 5 MHz  (Range 1) | 4 + TT (p-p) |
| FUL\_Meas – FUL\_Low < 5 MHz or FUL\_High – FUL\_Meas < 5 MHz  (Range 2) | 12 + TT (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each E-UTRA frequency band specified in Table 5.5-1  NOTE 3: Test tolerance TT = 1.4 dB. | |



Figure 6.4D.2.4.5-1: The test requirements for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated for unshaped modulations (the ETC test requirements are within brackets)

#### 6.4D.2.4\_1 EVM equalizer spectrum flatness for SUL with UL MIMO

Editor’note:

- For a transition period until RAN#104 (June 2024) previous test procedure in TS 38.521-1 V18.0.0 is allowed for TE implementation.

- Working assumption is that the same MU applies for the new UL MIMO test procedure as for the test procedure in TS 38.521-1 V18.0.0. This does not preclude to update the MU in future meetings.

6.4D.2.4\_1.1 Test purpose

The purpose of this test is to verify the zero-forcing equalizer correction applied in the EVM measurement process (as described in Annex E) meets a spectrum flatness requirement for the EVM measurement to be valid.

6.4D.2.4\_1.2 Test applicability

This test applies to all types of NR UE release 17 and forward that support SUL and UL MIMO operating on the SUL bands.

6.4D.2.4\_1.3 Minimum conformance requirements

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the EVM Equalizer Spectrum Flatness requirements specified in Table 6.4.2.4.3-1 and Table 6.4.2.4.3-2 which are defined in subclause 6.4.2.4.3 apply at layer. The requirements shall be met with the UL MIMO configurations specified in Table 6.2D.1\_1.3.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4D.2.4.

6.4D.2.4\_1.4 Test description

6.4D.2.4\_1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4D.2.4\_1.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4D.2.4\_1.4.1-1: Test Configuration Table

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation | RB allocation (NOTE 1) |
| 1 |  | CP-OFDM QPSK | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.5 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.4D.2.4\_1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4D.2.4\_1.4.3.

6.4D.2.4\_1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4D.2.4.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

3. Measure spectrum flatness using Global In-Channel Tx-Test for UL MIMO (Annex E with procedure in Annex E.8) for each layer using the two Tx antenna connectors of the UE. For TDD, only slots consisting of only UL symbols are under test.

6.4D.2.4\_1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, and Table 4.6.3-182 with the condition 2TX\_UL\_MIMO.

6.4D.2.4\_1.5 Test requirement

The requirements apply to each layer.

Each of the *n* spectrum flatness functions, shall derive four ripple results in Annex E.4.4.1 using Annex E.8. The derived results shall not exceed the values in Figure 6.4D.2.4\_1.5-1:

For shaped Pi/2-BPSK modulated waveforms, the test requirements are TBD.

For normal conditions and unshaped modulated waveforms, the maximum ripple in Range 1 and Range 2 shall not exceed the values specified in Table 6.4D.2.4\_1.5-1 and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 8.4 dB (see Figure 6.4D.2.4\_1.5-1).

For normal conditions and for unshaped modulated waveforms, the peak-to-peak variation of the EVM equalizer coefficients contained within the frequency range of the uplink allocation shall not exceed the maximum ripple specified in Table 6.4D.2.4\_1.5-1. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 8.4 dB (see Figure 6.4D.2.4\_1.5-1).

For extreme conditions, the EVM equalizer spectral flatness shall not exceed the values specified in Table 6.4D.2.4\_1.5-2. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 7.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 11.4 dB (see Figure 6.4D.2.4\_1.5-1).

Table 6.4D.2.4\_1.5-1: Requirements for EVM equalizer spectrum flatness for unshaped modulations (normal conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum ripple [dB] |
| FUL\_Meas – FUL\_Low ≥ 3 MHz and FUL\_High – FUL\_Meas ≥ 3 MHz  (Range 1) | 4 + TT (p-p) |
| FUL\_Meas – FUL\_Low < 3 MHz or FUL\_High – FUL\_Meas < 3 MHz  (Range 2) | 8 + TT (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each E-UTRA frequency band specified in Table 5.5-1  NOTE 3: Test tolerance TT = 1.4 dB. | |

Table 6.4D.2.4\_1.5-2: Minimum requirements for EVM equalizer spectrum flatness for unshaped modulations (extreme conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum Ripple [dB] |
| FUL\_Meas – FUL\_Low ≥ 5 MHz and FUL\_High – FUL\_Meas ≥ 5 MHz  (Range 1) | 4 + TT (p-p) |
| FUL\_Meas – FUL\_Low < 5 MHz or FUL\_High – FUL\_Meas < 5 MHz  (Range 2) | 12 + TT (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each E-UTRA frequency band specified in Table 5.5-1  NOTE 3: Test tolerance TT = 1.4 dB. | |



Figure 6.4D.2.4\_1.5-1: The test requirements for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated for unshaped modulations (the ETC test requirements are within brackets)

### 6.4D.3 Time alignment error for UL MIMO

6.4D.3.1 Test purpose

To verify that the error of time alignment in UL MIMO does not exceed the range prescribed by the specified UL MIMO Time Alignment Error (TAE) and tolerance.

An excess time alignment error has the possibility to interfere to other channels or other systems and decrease UL MIMO performance because of the timing unsynchronization.

6.4D.3.2 Test applicability

This test case applies to all types of NR Power Class 1.5, Power Class 2 and Power Class 3 UE release 15 and forward that support 2-layer codebook based UL MIMO.

6.4D.3.3 Minimum conformance requirements

For UE(s) with multiple transmit antenna connectors supporting UL MIMO, this requirement applies to frame timing differences between transmissions on multiple transmit antenna connectors in the closed-loop spatial multiplexing scheme.

The time alignment error (TAE) is defined as the average frame timing difference between any two transmissions on different transmit antenna connectors.

For UE(s) with multiple transmit antenna connectors, the Time Alignment Error (TAE) shall not exceed 130 ns.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4D.3.

6.4D.3.4 Test description

6.4D.3.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4D.3.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4D.3.4.1-1: Test Configuration Table

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Mid range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest, Highest | |
| Test Parameters for Channel Bandwidths | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A for Time alignment error for UL MIMO | Modulation | RB allocation (NOTE 1) |
| 1 | test case | CP-OFDM QPSK | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4D.3.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4D.3.4.3.

6.4D.3.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4D.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms from the first TPC command in this step for the UE to reach PUMAX level.

3. Measure the timing of one sub-frame at each antenna connector.

6.4D.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX\_UL\_MIMO.

6.4D.3.5 Test requirement

For UE(s) with multiple transmit antenna connectors, the Time Alignment Error (TAE) shall not exceed 130 + TT ns.

Table 6.4D.3.5-1: Test Tolerance (Time alignment error for UL MIMO)

|  |
| --- |
| Test Tolerance |
| 25ns |

### 6.4D.3\_1 Time alignment error for SUL with UL MIMO

6.4D.3\_1.1 Test purpose

To verify that the error of time alignment in UL MIMO does not exceed the range prescribed by the specified UL MIMO Time Alignment Error (TAE) and tolerance.

An excess time alignment error has the possibility to interfere to other channels or other systems and decrease UL MIMO performance because of the timing unsynchronization.

6.4D.3\_1.2 Test applicability

This test applies to all types of NR UE release 17 and forward that support SUL and UL MIMO operating on the SUL bands.

6.4D.3\_1.3 Minimum conformance requirements

For UE(s) with multiple transmit antenna connectors supporting UL MIMO, this requirement applies to frame timing differences between transmissions on multiple transmit antenna connectors in the closed-loop spatial multiplexing scheme.

The time alignment error (TAE) is defined as the average frame timing difference between any two transmissions on different transmit antenna connectors.

For UE(s) with multiple transmit antenna connectors, the Time Alignment Error (TAE) shall not exceed 130 ns.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4D.3.

6.4D.3\_1.4 Test description

6.4D.3\_1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4D.3\_1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4D.3\_1.4.1-1: Test Configuration Table

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Mid range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest, Highest | |
| Test Parameters for Channel Bandwidths | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A for Time alignment error for UL MIMO | Modulation | RB allocation (NOTE 1) |
| 1 | test case | CP-OFDM QPSK | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.5 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4D.3\_1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4D.3\_1.4.3.

6.4D.3\_1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4D.3\_1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms from the first TPC command in this step for the UE to reach PUMAX level.

3. Measure the timing of one sub-frame at each antenna connector.

6.4D.3\_1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.3.6.1.1.2 ensuring UL/SUL indicator in Table 4.3.6.1.1.2-1 with condition SUL, subclause 4.6 ensuring Table 4.6.1-28 with condition SUL AND (RF OR RRM), Tables 4.6.3-14 with condition SUL\_SUL for SUL carrier, Table 4.6.3-167 with condition PUSCH\_PUCCH\_ON\_SUL, and Table 4.6.3-182 with the condition 2TX\_UL\_MIMO.

6.4D.3\_1.5 Test requirement

For UE(s) with multiple transmit antenna connectors, the Time Alignment Error (TAE) shall not exceed 130 + TT ns.

Table 6.4D.3\_1.5-1: Test Tolerance (Time alignment error for UL MIMO)

|  |
| --- |
| Test Tolerance |
| 25ns |

### 6.4D.4 Requirements for coherent UL MIMO

Editor’s note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Test config table is still FFS.

- Scheduling pattern within 20ms measurement window is FFS

- The test procedure is FFS.

- MU and TT value are still FFS

6.4D.4.1 Test purpose

To verify that the difference of relative phase error and the difference of relative power error between antenna ports in coherent UL MIMO do not exceed the range prescribed by the specified requirements for coherent UL MIMO and tolerance.

An excess relative phase error or excess relative power error has the possibility to interfere to other channels and decrease UL MIMO performance because of the timing unsynchronization.

6.4D.4.2 Test applicability

This test case applies to all types of NR Power Class 1.5, Power Class 2 and Power Class 3 UE release 15 and forward that support coherent 2-layer codebook based UL MIMO.

6.4D.4.3 Minimum conformance requirements

For coherent UL MIMO, Table 6.4D.4.3-1 lists the maximum allowable difference between the measured relative power and phase errors between different antenna ports in any slot within the specified time window from the last transmitted SRS on the same antenna ports, for the purpose of uplink transmission (codebook or non-codebook usage) and those measured at that last SRS. The requirements in Table 6.4D.4.3-1 apply when the UL transmission power at each antenna port is larger than 0 dBm for SRS transmission and for the duration of time window.

Table 6.4D.4.3-1: Maximum allowable difference of relative phase and power errors in a given slot compared to those measured at last SRS transmitted

|  |  |  |
| --- | --- | --- |
| Difference of relative phase error | Difference of relative power error | Time window |
| 40 degrees | 4 dB | 20 msec |

The above requirements when all the following conditions are met within the specified time window:

- UE is not signalled with a change in number of SRS ports in SRS-config, or a change in PUSCH-config

- UE remains in DRX active time (UE does not enter DRX OFF time)

- No measurement gap occurs

- No instance of SRS transmission with the usage antenna switching occurs

- Active BWP remains the same

- EN-DC and CA configuration is not changed for the UE (UE is not configured or de-configured with PScell or SCell(s))

- When UE is not configured with uplink switching; or when UE is configured with uplink switching, and ‘fullCoherent’ codebook subset is supported in the corresponding carrier according to the capability *uplinkTxSwitching*-*PUSCH-TransCoherence* and/or *uplinkTxSwitching2T2T-PUSCH-TransCoherence*; or when UE is configured with uplink switching, ‘nonCoherent’ codebook subset is supported in the corresponding carrier according to the capability *uplinkTxSwitching*-*PUSCH-TransCoherence* and/or *uplinkTxSwitching2T2T-PUSCH-TransCoherence*,and uplink switching is not triggered by the switching mechanisms specified in sub-clause 6.1.6 of TS 38.214 [10] between last transmitted SRS and scheduled transmission.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4D.4

6.4D.4.4 Test description

6.4D.4.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4D.4.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4D.4.4.1-1: Test Configuration Table

FFS

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.2 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4D.4.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR,* Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4D.4.4.3

6.4D.4.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4D.4.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms starting from the first TPC command in this step to ensure that the UE reaches the Pumax level of the test point.

3. Measure the mean power of the UE on each antenna port on SRS symbol in the SRS channel bandwidth according to the test configuration from table 6.4D.4.4.1-1. Calculate the power difference between antenna ports and save this value as ‘Power\_ref’.

4. On the slots within 20ms following the SRS symbol, measure the mean power of the UE on each antenna port in the channel bandwidth according to the test configuration from table 6.2.4.4.1-1. The period of measurement shall be at least the continuous duration of one active slot and in the uplink symbols. For TDD slots with transient periods are not under test. Calculate the power difference between antenna ports and save this value as ‘Power\_meas’.

6.4D.4.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 ensuring Table 4.6.3-182 with the condition 2TX\_UL\_MIMO.

6.4D.4.5 Test requirement

Maximum allowable difference of ‘power\_ref’ measured in step 3 and ‘power\_meas’ measured in step 4 shall not exceed the described relative power error in Table 6.4D.4.5-1.

Table 6.4D.4.5-1: Maximum allowable difference of relative phase and power errors in a given slot compared to those measured at last SRS transmitted

|  |  |  |
| --- | --- | --- |
| Difference of relative phase error | Difference of relative power error | Time window |
| 40+TT degrees | 4+TT1 dB | 20 msec |
| NOTE 1: TT for relative power for each frequency and channel bandwidth is specified in Table 6.4D.4.5-2. | | |

Table 6.4D.4.5-2: Test Tolerance

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | FFS | FFS |
| 40MHz < BW ≤ 100MHz | FFS | FFS |

## 6.4E Transmit signal quality for V2X

### 6.4E.1 Frequency error for V2X

### 6.4E.2 Transmit modulation quality for V2X

#### 6.4E.2.1 General

The transmit modulation quality requirements in this clause apply to V2X sidelink transmissions.

For NR V2X UE supporting SL MIMO, the transmit modulation quality requirements for single carrier shall apply to each transmit antenna connector.

If V2X UE transmits on one-antenna connector at a time, the requirements specified for single carrier apply to the active antenna connector.

#### 6.4E.2.2 Error Vector Magnitude for V2X

##### 6.4E.2.2.1 Error Vector Magnitude for V2X / non-concurrent operation

Editor’s Note:

- The test case is not completed due to the following aspects are not yet determined:

- Test configuration is TBD

- Target power level is TBD

6.4E.2.2.1.1 Test purpose

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM.

The measured waveform is further equalised using the channel estimates subjected to the EVM equaliser spectrum flatness requirement specified in sub-clause 6.4E.2.5.1.3. For CP-OFDM waveforms, the EVM result is defined after the front-end FFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %.

6.4E.2.2.1.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR V2X sidelink communication.

6.4E.2.2.1.3 Minimum conformance requirements

For V2X sidelink physical channels PSCCH and PSSCH, the Error Vector Magnitude requirements shall be as specified for PUSCH in Table 6.4.2.1-1 except pi/2-BPSK for NR V2X operating bands in Table 5.2E.1-1. When sidelink transmissions are shortened due to transmission gap of 1 symbol at the end of the slot, the EVM measurement interval is reduced by one symbol, accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4E.2.2.

6.4E.2.2.1.4 Test description

6.4E.2.2.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2E.1-1 and Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4E.2.2.1.4.1-1. The details of the V2X reference measurement channels (RMCs) are specified in Annex A.7.5 and the GNSS configuration in TS 38.508-1 [5] subclause 4.11.

Table 6.4E.2.2.1.4.1-1: Test Configuration Table for PSSCH and PSCCH

FFS

1. Connect the SS and GNSS simulator to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.9.1 for TE diagram and section A.3.2.7 for UE diagram.

2. The parameter settings for the V2X sidelink transmission over PC5 are pre-configured according to TS 38.508-1 [5] subclause 4.10. Message content exceptions are defined in clause 6.4E.2.2.1.4.3.

3. The V2X Reference Measurement Channel is set according to Table 6.4E.2.2.1.4.1-1.

4. The GNSS simulator is configured for Scenario #1: static in Geographical area #1, as defined in TS38.508-1 [5] Table 4.11.2-2. Geographical area #1 is also pre-configured in the UE.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state Out\_of\_Coverage with generic procedure parameters Sidelink *On*, Test Loop Function *On* with UE test loop mode E closed for *Transmit Mode* according to TS 38.508-1 [5] clause 4.5.

6.4E.2.2.1.4.2 Test procedure

1. The UE starts to perform the V2X sidelink communication according to [SL-V2X-Preconfiguration]. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the V2X RMC.

2. Configure the UE to transmit at PUMAX level.

3. Measure the EVM and  using Global In-Channel Tx-Test (Annex E). The measurement period is [15] subframes. When V2X transmissions are shortened due to transmission gap of 1 symbol at the end of the subframe, the EVM measurement interval is reduced by one symbol, accordingly.

4. Modify SL-V2X-Preconfiguration to ensure the UE to transmit at a relative low power, according to Table [TBD].

5. Ensure the UE is in State [TBD] in Transmit Mode according to TS 38.508-1 [5] clause [TBD] using the new UL power control setting.

6. The UE starts to perform the V2X sidelink communication according to [SL-V2X-Preconfiguration]. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the V2X RMC.

7. Measure EVM and  using Global In-Channel Tx-Test (Annex E). The measurement period is [15] subframes. When V2X transmissions are shortened due to transmission gap of 1 symbol at the end of the subframe, the EVM measurement interval is reduced by one symbol, accordingly.

6.4E.2.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 with the following exceptions:

FFS

6.4E.2.2.1.5 Test requirement

FFS

##### 6.4E.2.2.1D Error Vector Magnitude for V2X / non-concurrent operation / SL-MIMO

Editor’s Note:

- No test points are defined since there is no configuration satisfying MPR=0dB requirements in TS 38.101-1.

- The test case is not completed due to the following aspects are not yet determined:

- Uplink RMC is TBD in TS 38.101-1

- Connection diagram is TBD

- Preconfiguration is TBD in 38.508-1

- Test state and generic procedure are TBD in 38.508-1

6.4E.2.2.1D.1 Test purpose

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM.

The measured waveform is further equalised using the channel estimates subjected to the EVM equaliser spectrum flatness requirement specified in sub-clause 6.4E.2.5.1D.3. For CP-OFDM waveforms, the EVM result is defined after the front-end FFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %.

6.4E.2.2.1D.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR V2X sidelink MIMO communication with non-concurrent operation.

NOTE: This test case can’t be performed due to lack of appropriate test points.

6.4E.2.2.1D.3 Minimum conformance requirements

For NR V2X UE with two transmit antenna connectors, the requirements specified for single carrier described in clause 6.4E.2.2.1.3 shall apply to each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4E.2.2.

6.4E.2.2.1D.4 Test description

6.4E.2.2.1D.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4E.2.2.1D.4.1-1. The details of the V2X reference measurement channels (RMCs) are specified in Annexes TBD.

Table 6.4E.2.2.1D.4.1-1: Test Configuration Table for PSSCH and PSCCH

FFS

NOTE: No test points are defined since there is no configuration satisfying MPR=0dB requirements in RAN4.

1. Connect the SS and GNSS simulator to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure [TBD] for TE diagram and section [TBD] for UE diagram.

2. The parameter settings for the V2X sidelink transmission over PC5 are pre-configured according to TS 38.508-1 [5] subclause [TBD]. Message content exceptions are defined in clause 6.4E.2.2.1D.4.3.

3. The V2X Reference Measurement Channel is set according to Table 6.4E.2.2.1D.4.1-1.

4. The GNSS simulator is configured for Scenario #1: static in Geographical area #1, as defined in TS38.508-1 [5] Table [TBD]. Geographical area #1 is also pre-configured in the UE.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state [TBD].

6.4E.2.2.1D.4.2 Test procedure

1. The UE starts to perform the V2X sidelink communication according to [SL-V2X-Preconfiguration]. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the V2X RMC.

2. Configure the UE to transmit at PUMAX level.

3. Measure the EVM and  using Global In-Channel Tx-Test (Annex E) for each of transmit antenna. The measurement period is [15] subframes. When V2X transmissions are shortened due to transmission gap of 1 symbol at the end of the subframe, the EVM measurement interval is reduced by one symbol, accordingly.

4. Modify SL-V2X-Preconfiguration to ensure the UE to transmit at a relative low power, according to Table [TBD].

5. Ensure the UE is in State [TBD] in Transmit Mode according to TS 38.508-1 [5] clause [TBD] using the new UL power control setting.

6. The UE starts to perform the V2X sidelink communication according to [SL-V2X-Preconfiguration]. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the V2X RMC.

7. Measure EVM and  using Global In-Channel Tx-Test (Annex E) for each of transmit antenna. The measurement period is [15] subframes. When V2X transmissions are shortened due to transmission gap of 1 symbol at the end of the subframe, the EVM measurement interval is reduced by one symbol, accordingly.

6.4E.2.2.1D.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 with the following exceptions:

FFS

6.4E.2.2.1D.5 Test requirement

FFS

#### 6.4E.2.4 In-band emissions for V2X

##### 6.4E.2.4.1 In-band emissions for V2X / non-concurrent operation

Editor’s Note:

- The test case is not completed due to the following aspects are not yet determined:

- Test configuration is TBD

- Target power level is TBD

6.4E.2.4.1.1 Test purpose

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks, this is to verify that the in-band emissions of V2X sidelink non-concurrent operation satisfy the minimum requirements.

6.4E.2.4.1.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR V2X sidelink communication with non-concurrent operation.

6.4E.2.4.1.3 Minimum conformance requirements

For V2X sidelink physical channels PSCCH, PSSCH and PSBCH, the In-band emissions requirements shall be as specified for PUSCH in subclause 6.4.2.3 for the corresponding modulation and transmission bandwidth. When V2X transmissions are shortened due to transmission gap of one symbol at the end of the subframe, the In-band emissions measurement interval is reduced by one symbol, accordingly.

Consequently, the relative in-band emission of each sidelink physical channel shall not exceed the values specified in Table 6.4E.2.4.1.3-1.

Table 6.4E.2.4.1.3-1: Minimum requirements for in-band emissions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter description | Unit | Limit (NOTE 1) | | Applicable Frequencies |
| General | dB |  | | Any non-allocated (NOTE 2) |
| IQ Image | dB | -28 | Image frequencies when output power > 10 dBm | Image frequencies (NOTES 2, 3) |
|  |  | -25 | Image frequencies when output power ≤ 10 dBm |  |
| Carrier leakage | dBc | -28 | Output power > 10 dBm | Carrier leakage frequency (NOTES 4, 5) |
|  |  | -25 | 0 dBm ≤ Output power ≤ 10 dBm |  |
|  |  | -20 | -30 dBm ≤ Output power < 0 dBm |  |
|  |  | -10 | -40 dBm ≤ Output power < -30 dBm |  |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. is defined in NOTE 10.  NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. For pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.  NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.  NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 5: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE, and are those that are enclosed either in the RB containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.  NOTE 6: *LCRB* is the Transmission Bandwidth (see clause 5.3).  NOTE 7: *NRB* is the Transmission Bandwidth Configuration (see clause 5.3).  NOTE 8: *EVM* is the limit specified in Table 6.4.2.1-1 for the modulation format used in the allocated RBs.  NOTE 9:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. *∆RB*= 1 or *∆RB*= -1 for the first adjacent RB outside of the allocated bandwidth.  NOTE 10:  is an average of the transmitted power over 10 sub-frames normalized by the number of allocated RBs, measured in dBm.  NOTE 11: For almost contiguous allocations defined in clause 6.2.2, *LCRB* = NRB\_alloc + NRB\_gap with no in-gap emission requirement. | | | | |

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4E.2.4.

6.4E.2.4.1.4 Test description

6.4E.2.4.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2E.1-1 and Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4E.2.4.1.4.1-1 and 6.4E.2.4.1.4.1-2. The details of the V2X reference measurement channels (RMCs) are specified in Annex A.7.5 and the GNSS configuration in TS 38.508-1 [5] subclause 4.11.

Table 6.4E.2.4.1.4.1-1: Test Configuration Table for PSSCH and PSCCH

FFS

Table 6.4E.2.4.1.4.1-2: Test Configuration Table for PSBCH

FFS

1. Connect the SS and GNSS simulator to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.9.1 for TE diagram and section A.3.2.7 for UE diagram.

2. The parameter settings for the V2X sidelink transmission over PC5 are pre-configured according to TS 38.508-1 [5] subclause 4.10. Message content exceptions are defined in clause 6.4E.2.4.1.4.3.

3. The V2X Reference Measurement Channel is set according to Table 6.4E.2.4.1.4.1-1.

4. The GNSS simulator is configured for Scenario #1: static in Geographical area #1, as defined in TS 38.508-1 [5] Table 4.11.2-2. Geographical area #1 is also pre-configured in the UE.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state Out\_of\_Coverage with generic procedure parameters Sidelink *On*, Test Loop Function *On* with UE test loop mode E closed for *Transmit Mode* according to TS 38.508-1 [5] clause 4.5.

6.4E.2.4.1.4.2 Test procedure

Test procedure for PSCCH+PSSCH:

1. Set the V2X sidelink communication parameters forboth the V2X sidelink capable UE (hereinafter referred to as V2X UE) and SS according to *SL-PreconfigurationNR* in [TBD].

2. V2X UE schedules the V2X RMC according to *SL-PreconfigurationNR* which is in line with the test configuration in Table 6.4E.2.4.1.4.1-1.

3. Measure the V2X UE output power to make sure V2X UE transmission power to be [TBD]

4. Measure In-band emission using Global In-Channel Tx-Test (Annex E)

[TP2: V2X UE output power within (0 -30) dBm]

Repeat the above steps 1~4 with the exception that making sure V2X UE transmission power to be -25.5dBm+/-4.5dB for carrier frequency f > 5GHz in step3.

Test procedure for PSBCH:

1. Set the V2X sidelink communication parameters forboth the V2X sidelink capable UE (hereinafter referred to as V2X UE) and SS according to *SL-PreconfigurationNR* in [TBD].

2. V2X UE schedules the V2X RMC according to *SL-PreconfigurationNR* which is in line with the test configuration in Table 6.4E.2.4.1.4.1-2.

3. Measure the V2X UE output power to make sure V2X UE transmission power to be [TBD]

4. Measure In-band emission using Global In-Channel Tx-Test (Annex E)

[TP2: V2X UE output power within (0 -30) dBm]

Repeat the above steps 1~4 with the exception that making sure V2X UE transmission power to be -25.5dBm+/-4.5 dB for carrier frequency f > 5GHz in step3.

6.4E.2.4.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 with the following exceptions:

FFS

6.4E.2.4.1.5 Test requirement

FFS

##### 6.4E.2.4.1D In-band emissions for V2X / non-concurrent operation / SL-MIMO

Editor’s Note:

- The test case is not completed due to the following aspects are not yet determined:

- Test configuration is TBD

- Target power level is TBD

6.4E.2.4.1D.1 Test purpose

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks, this is to verify that the in-band emissions of V2X sidelink non-concurrent operation satisfy the minimum requirements.

6.4E.2.4.1D.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR V2X sidelink MIMO communication with non-concurrent operation.

NOTE: This test case can’t be performed due to lack of appropriate test points.

6.4E.2.4.1D.3 Minimum conformance requirements

For NR V2X UE with two transmit antenna connectors, the requirements specified for single carrier described in clause 6.4E.2.4.1.3 shall apply to each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4E.2.4.

6.4E.2.4.1D.4 Test description

6.4E.2.4.1D.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2E.1-1 and Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4E.2.4.1D.4.1-1 and 6.4E.2.4.1D.4.1-2. The details of the V2X reference measurement channels (RMCs) are specified in Annexes A.7.5 and the GNSS configuration in TS 38.508-1 [5] subclause 4.11.

Table 6.4E.2.4.1D.4.1-1: Test Configuration Table for PSSCH and PSCCH

FFS

Table 6.4E.2.4.1D.4.1-2: Test Configuration Table for PSBCH

FFS

1. Connect the SS and GNSS simulator to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.9.1 for TE diagram and section A.3.2.7 for UE diagram.

2. The parameter settings for the V2X sidelink transmission over PC5 are pre-configured according to TS 38.508-1 [5] subclause 4.10. Message content exceptions are defined in clause 6.4E.2.4.1D.4.3.

3. The V2X Reference Measurement Channel is set according to Table 6.4E.2.4.1D.4.1-1.

4. The GNSS simulator is configured for Scenario #1: static in Geographical area #1, as defined in TS38.508-1 [5] Table 4.11.2-2. Geographical area #1 is also pre-configured in the UE.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state Out\_of\_Coverage with generic procedure parameters Sidelink *On*, Test Loop Function *On* with UE test loop mode E closed for *Transmit Mode* according to TS 38.508-1 [5] clause 4.5.

6.4E.2.4.1D.4.2 Test procedure

Test procedure for PSCCH+PSSCH:

1. Set the V2X sidelink communication parameters forboth the V2X sidelink capable UE (hereinafter referred to as V2X UE) and SS according to *SL-PreconfigurationNR* in [TBD].

2. V2X UE schedules the V2X RMC according to *SL-PreconfigurationNR* which is in line with the test configuration in Table 6.4E.2.4.1D.4.1-1.

3. Measure the V2X UE output power to make sure V2X UE transmission power to be [TBD].

4. Measure In-band emission using Global In-Channel Tx-Test (Annex E) for each of transmit antenna.

Test procedure for PSBCH:

1. Set the V2X sidelink communication parameters forboth the V2X sidelink capable UE (hereinafter referred to as V2X UE) and SS according to *SL-PreconfigurationNR* in [TBD].

2. V2X UE schedules the V2X RMC according to *SL-PreconfigurationNR* which is in line with the test configuration in Table 6.4E.2.4.1D.4.1-2.

3. Measure the V2X UE output power to make sure V2X UE transmission power to be [TBD].

4. Measure In-band emission using Global In-Channel Tx-Test (Annex E) for each of transmit antenna.

6.4E.2.4.1D.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 with the following exceptions:

FFS

6.4E.2.4.1D.5 Test requirement

FFS

##### 6.4E.2.4.2 In-band emissions for V2X / con-current operation

Editor’s Note:

- The test case is not completed due to the following aspects are not yet determined:

- Test configuration is TBD

- Target power level is TBD

6.4E.2.4.2.1 Test purpose

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks, this is to verify that the in-band emissions of V2X sidelink con-current operation satisfy the minimum requirements.

6.4E.2.4.2.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR V2X sidelink communication with con-current operation.

NOTE: This test case can’t be performed due to lack of appropriate test points.

6.4E.2.4.2.3 Minimum conformance requirements

For V2X sidelink physical channels PSCCH, PSSCH and PSBCH, the In-band emissions requirements shall be as specified for PUSCH in subclause 6.4.2.3 for the corresponding modulation and transmission bandwidth. When V2X transmissions are shortened due to transmission gap of one symbol at the end of the subframe, the In-band emissions measurement interval is reduced by one symbol, accordingly.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4E.2.4.

6.4E.2.4.2.4 Test description

6.4E.2.4.2.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2E.1-1 and Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4E.2.4.2.4.1-1 and 6.4E.2.4.2.4.1-2. The details of the V2X reference measurement channels (RMCs) are specified in Annexes A.7.5 and the GNSS configuration in TS 38.508-1 [5] subclause 4.11.

Table 6.4E.2.4.2.4.1-1: Test Configuration Table for PSSCH and PSCCH

FFS

Table 6.4E.2.4.2.4.1-2: Test Configuration Table for PSBCH

FFS

1. Connect the SS and GNSS simulator to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.9.1 for TE diagram and section A.3.2.7 for UE diagram.

2. The parameter settings for the V2X sidelink transmission over PC5 are pre-configured according to TS 38.508-1 [5] subclause 4.10. Message content exceptions are defined in clause 6.4E.2.4.2.4.3.

3. The V2X Reference Measurement Channel is set according to Table 6.4E.2.4.2.4.1-1.

4. The GNSS simulator is configured for Scenario #1: static in Geographical area #1, as defined in TS38.508-1 [5] Table 4.11.2-2. Geographical area #1 is also pre-configured in the UE.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state Out\_of\_Coverage with generic procedure parameters Sidelink *On*, Test Loop Function *On* with UE test loop mode E closed for *Transmit Mode* according to TS 38.508-1 [5] clause 4.5.

6.4E.2.4.2.4.2 Test procedure

Test procedure for PSCCH+PSSCH:

1. Set the V2X sidelink communication parameters forboth the V2X sidelink capable UE (hereinafter referred to as V2X UE) and SS according to *SL-PreconfigurationNR* in [TBD].

2. V2X UE schedules the V2X RMC according to *SL-PreconfigurationNR* which is in line with the test configuration in Table 6.4E.2.4.2.4.1-1.

3. Measure the V2X UE output power to make sure V2X UE transmission power to be [TBD].

4. Measure In-band emission using Global In-Channel Tx-Test (Annex E) for each of transmit antenna.

Test procedure for PSBCH:

1. Set the V2X sidelink communication parameters forboth the V2X sidelink capable UE (hereinafter referred to as V2X UE) and SS according to *SL-PreconfigurationNR* in [TBD].

2. V2X UE schedules the V2X RMC according to *SL-PreconfigurationNR* which is in line with the test configuration in Table 6.4E.2.4.2.4.1-2.

3. Measure the V2X UE output power to make sure V2X UE transmission power to be [TBD].

4. Measure In-band emission using Global In-Channel Tx-Test (Annex E) for each of transmit antenna.

6.4E.2.4.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 with the following exceptions:

FFS

6.4E.2.4.2.5 Test requirement

FFS

#### 6.4E.2.5 EVM equalizer spectrum flatness for V2X

##### 6.4E.2.5.1 EVM equalizer spectrum flatness for V2X / non-concurrent operation

Editor’s Note:

- The test case is not completed due to the following aspects are not yet determined:

- Test configuration is TBD

- Target power level is TBD

6.4E.2.5.1.1 Test purpose

The zero-forcing equalizer correction applied in the EVM measurement process (as described in Annex E) must meet a spectrum flatness requirement for the EVM measurement to be valid. The EVM equalizer spectrum flatness is defined in terms of the maximum peak-to-peak ripple of the equalizer coefficients (dB) across the V2X sidelink allocated block variation in dB of the equalizer coefficients generated by the EVM measurement process. The EVM equalizer spectrum flatness requirement does not limit the correction applied to the signal in the EVM measurement process but for the EVM result to be valid, the equalizer correction that was applied must meet the EVM equalizer spectrum flatness minimum requirements. The basic measurement interval is the same as for EVM.

6.4E.2.5.1.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR V2X sidelink communication.

NOTE: This test case can’t be performed due to lack of appropriate test points.

6.4E.2.5.1.3 Minimum conformance requirements

The peak-to-peak variation of the EVM equalizer coefficients contained within the frequency range of the V2X sidelink allocation shall not exceed the maximum ripple. The EVM equalizer spectrum flatness shall not exceed the values specified in Table 6.4E.2.5.1.3-1 for normal conditions. For V2X sidelink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 5 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 7 dB (see Figure 6.4E.2.5.1.3-1).

The EVM equalizer spectrum flatness shall not exceed the values specified in Table 6.4E.2.5.1.3-2 for extreme conditions. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 10 dB (see Figure 6.4E.2.5.1.3-1).

For V2X sidelink physical channels PSCCH, PSSCH and PSBCH, the EVM equalizer spectrum flatness requirements shall be as specified for PUSCH in clause 6.4.2.4 for the corresponding modulation and transmission bandwidth.

Table 6.4E.2.5.1.3-1: Minimum requirements for EVM equalizer spectrum flatness (normal conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum ripple (dB) |
| FUL\_Meas – FUL\_Low ≥ 3 MHz and FUL\_High – FUL\_Meas ≥ 3 MHz  (Range 1) | 4 (p-p) |
| FUL\_Meas – FUL\_Low < 3 MHz or FUL\_High – FUL\_Meas < 3 MHz  (Range 2) | 8 (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each NR frequency band specified in Table 5.2-1 | |

Table 6.4E.2.5.1.3-2: Minimum requirements for EVM equalizer spectrum flatness (extreme conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum Ripple (dB) |
| FUL\_Meas – FUL\_Low ≥ 5 MHz and FUL\_High – FUL\_Meas ≥ 5 MHz  (Range 1) | 4 (p-p) |
| FUL\_Meas – FUL\_Low < 5 MHz or FUL\_High – FUL\_Meas < 5 MHz  (Range 2) | 12 (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each NR frequency band specified in Table 5.2-1 | |

f

FUL\_High

FUL\_High – 3(5) MHz

< 4(4) dBp-p

Range 1

Range 2

max(Range 1)-min(Range 2) < 5(6) dB

max(Range 2)-min(Range 1) < 7(10) dB

< 8(12) dBp-p

Figure 6.4E.2.5.1.3-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated (the ETC minimum requirement are within brackets).

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4E.2.5.

6.4E.2.5.1.4 Test description

6.4E.2.5.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.2E.1-1 and Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4E.2.5.1.4.1-1. The details of the V2X reference measurement channels (RMCs) are specified in Annex A.7.5 and the GNSS configuration in TS 38.508-1 [5] subclause 4.11.

Table 6.4E.2.5.1.4.1-1: Test Configuration Table for PSSCH and PSCCH

FFS

1. Connect the SS and GNSS simulator to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.9.1 for TE diagram and section A.3.2.7 for UE diagram.

2. The parameter settings for the V2X sidelink transmission over PC5 are pre-configured according to TS 38.508-1 [5] subclause 4.10. Message content exceptions are defined in clause 6.4E.2.5.1.4.3.

3. The V2X Reference Measurement Channel is set according to Table 6.4E.2.5.1.4.1-1.

4. The GNSS simulator is configured for Scenario #1: static in Geographical area #1, as defined in TS38.508-1 [5] Table 4.11.2-2. Geographical area #1 is also pre-configured in the UE.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state Out\_of\_Coverage with generic procedure parameters Sidelink *On*, Test Loop Function *On* with UE test loop mode E closed for *Transmit Mode* according to TS 38.508-1 [5] clause 4.5.

6.4E.2.5.1.4.2 Test procedure

1. The V2X UE schedules the V2X RMC with transmission power at PUMAX level according to *SL-PreconfigurationNR* which is in line with the test configuration in Table 6.4E.2.5.1.4.1-1;

2. Measure spectrum flatness using Global In-Channel Tx-Test (Annex E). For TDD slots with transient periods are not under test.

6.4E.2.5.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 with the following exceptions:

FFS

6.4E.2.5.1.5 Test requirement

FFS

##### 6.4E.2.5.1D EVM equalizer spectrum flatness for V2X / non-concurrent operation / SL-MIMO

Editor’s Note:

- The test case is not completed due to the following aspects are not yet determined:

- Uplink RMC is TBD in RAN4

- Connection diagram is TBD

- Preconfiguration is TBD in 38.508-1

- Test state and generic procedure are TBD in 38.508-1

6.4E.2.5.1D.1 Test purpose

The zero-forcing equalizer correction applied in the EVM measurement process (as described in Annex E) must meet a spectrum flatness requirement for the EVM measurement to be valid. The EVM equalizer spectrum flatness is defined in terms of the maximum peak-to-peak ripple of the equalizer coefficients (dB) across the V2X sidelink allocated block variation in dB of the equalizer coefficients generated by the EVM measurement process. The EVM equalizer spectrum flatness requirement does not limit the correction applied to the signal in the EVM measurement process but for the EVM result to be valid, the equalizer correction that was applied must meet the EVM equalizer spectrum flatness minimum requirements. The basic measurement interval is the same as for EVM.

6.4E.2.5.1D.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR V2X sidelink MIMO communication with non-concurrent operation.

NOTE: This test case can’t be performed due to lack of appropriate test points.

6.4E.2.5.1D.3 Minimum conformance requirements

For NR V2X UE with two transmit antenna connectors, the requirements specified for single carrier described in clause 6.4E.2.5.1.3 shall apply to each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4E.2.5.

6.4E.2.5.1D.4 Test description

6.4E.2.5.1D.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4E.2.5.1.4.1-1. The details of the V2X reference measurement channels (RMCs) are specified in Annexes TBD.

Table 6.4E.2.5.1D.4.1-1: Test Configuration Table for PSSCH and PSCCH

FFS

1. Connect the SS and GNSS simulator to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure [TBD] for TE diagram and section [TBD] for UE diagram.

2. The parameter settings for the V2X sidelink transmission over PC5 are pre-configured according to TS 38.508-1 [5] subclause [TBD]. Message content exceptions are defined in clause 6.4E.2.5.1.4.3.

3. The V2X Reference Measurement Channel is set according to Table 6.4E.2.5.1.4.1-1.

4. The GNSS simulator is configured for Scenario #1: static in Geographical area #1, as defined in TS38.508-1 [5] Table [TBD]. Geographical area #1 is also pre-configured in the UE.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state [TBD].

6.4E.2.5.1D.4.2 Test procedure

1. The V2X UE schedules the V2X RMC with transmission power at PUMAX level according to *SL-PreconfigurationNR* which is in line with the test configuration in Table 6.4E.2.5.1D.4.1-1;

2. Measure spectrum flatness using Global In-Channel Tx-Test (Annex E). For TDD slots with transient periods are not under test.

6.4E.2.5.1D.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 with the following exceptions:

FFS

6.4E.2.5.1D.5 Test requirement

FFS

##### 6.4E.2.5.2 EVM equalizer spectrum flatness for V2X / con-current operation

Editor’s Note:

- The test case is not completed due to the following aspects are not yet determined:

- Uplink RMC is TBD in TS 38.101-1

- Connection diagram is TBD

- Preconfiguration is TBD in 38.508-1

- Test state and generic procedure are TBD in 38.508-1

6.4E.2.5.2.1 Test purpose

The zero-forcing equalizer correction applied in the EVM measurement process (as described in Annex E) must meet a spectrum flatness requirement for the EVM measurement to be valid. The EVM equalizer spectrum flatness is defined in terms of the maximum peak-to-peak ripple of the equalizer coefficients (dB) across the V2X sidelink allocated block variation in dB of the equalizer coefficients generated by the EVM measurement process. The EVM equalizer spectrum flatness requirement does not limit the correction applied to the signal in the EVM measurement process but for the EVM result to be valid, the equalizer correction that was applied must meet the EVM equalizer spectrum flatness minimum requirements. The basic measurement interval is the same as for EVM.

6.4E.2.5.2.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR V2X sidelink communication with con-current operation.

NOTE: This test case can’t be performed due to lack of appropriate test points.

6.4E.2.5.2.3 Minimum conformance requirements

For V2X sidelink physical channels PSCCH, PSSCH and PSBCH, the EVM equalizer spectrum flatness requirements shall be as specified for PUSCH in clause 6.4.2.4 for the corresponding modulation and transmission bandwidth.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4E.2.5.

6.4E.2.5.2.4 Test description

6.4E.2.5.2.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.4E.2.5.1.4.1-1. The details of the V2X reference measurement channels (RMCs) are specified in Annexes TBD.

Table 6.4E.2.5.2.4.1-1: Test Configuration Table for PSSCH and PSCCH

FFS

1. Connect the SS and GNSS simulator to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure [TBD] for TE diagram and section [TBD] for UE diagram.

2. The parameter settings for the V2X sidelink transmission over PC5 are pre-configured according to TS 38.508-1 [5] subclause [TBD]. Message content exceptions are defined in clause 6.4E.2.5.2.4.3.

3. The V2X Reference Measurement Channel is set according to Table 6.4E.2.5.2.4.1-1.

4. The GNSS simulator is configured for Scenario #1: static in Geographical area #1, as defined in TS38.508-1 [5] Table [TBD]. Geographical area #1 is also pre-configured in the UE.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state [TBD].

6.4E.2.5.2.4.2 Test procedure

1. The V2X UE schedules the V2X RMC with transmission power at PUMAX level according to *SL-PreconfigurationNR* which is in line with the test configuration in Table 6.4E.2.5.2.4.1-1;

2. Measure spectrum flatness using Global In-Channel Tx-Test (Annex E). For TDD slots with transient periods are not under test.

6.4E.2.5.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 with the following exceptions:

FFS

6.4E.2.5.2.5 Test requirement

FFS

## 6.4F Transmit signal quality for shared spectrum channel access

### 6.4F.1 Frequency error

Editor’s Note: This test is incomplete. The following aspects are not yet determined:

- Test configuration table is FFS

- Test state and generic procedure are TBD in 38.508-1

6.4F.1.1 Test purpose

This test verifies the ability of both, the receiver and the transmitter, to process frequency correctly.

Receiver: to extract the correct frequency from the stimulus signal, offered by the System simulator, under ideal propagation conditions and low level.

Transmitter: to derive the correct modulated carrier frequency from the results, gained by the receiver.

6.4F.1.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR standalone shared spectrum channel access.

6.4F.1.3 Minimum conformance requirements

The requirements for frequency error requirements in clause 6.4.1 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4F.1

6.4F.1.4 Test description

6.4F.1.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4F.1.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4F.1.4.1-1: Test Configuration Table

FFS

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The DL and UL Reference Measurement channels are set according to Table 6.4F.1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4F.1.4.3

6.4F.1.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1\_1 for C\_RNTI to transmit the DL RMC according to Table 6.4F.1.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.

2. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4F.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

3. Set the Downlink signal level to the appropriate REFSENS value defined in Table 7.3.2.5-1. Send continuously uplink power control "up" commands to the UE in every uplink scheduling information to the UE so that the UE transmits at PUMAX level for the duration of the test. Allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

4. Measure the Frequency Error using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

5. For UEs supporting DSS, repeat steps 1~4 on the applicable bands as specified in Section 5.4.2.1 with message contents being according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-61 and Table 4.6.3-62 with condition DSS.

6.4F.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6.

6.4F.1.5 Test requirement

The 10 frequency error Δf results must fulfil the test requirement:

|Δf| ≤ (0.1 PPM + 15 Hz)

### 6.4F.2 Transmit modulation quality

#### 6.4F.2.0 General

Transmit modulation quality defines the modulation quality for expected in-channel RF transmissions from the UE. The transmit modulation quality is specified in terms of:

- Error Vector Magnitude (EVM) for the allocated resource blocks (RBs),

- EVM equalizer spectrum flatness derived from the equalizer coefficients generated by the EVM measurement process

- Carrier leakage

- In-band emissions for the non-allocated RB

All the parameters defined in subclause 6.4F.2 are defined using the measurement methodology specified in Annex E.

In case the parameter 3300 or 3301 is reported from UE via *txDirectCurrentLocation* IE (as defined in TS 38.331 [6]), carrier leakage measurement requirement in subclause 6.4F.2.2 and 6.4F.2.3 shall be waived, and the RF correction with regard to the carrier leakage and IQ image shall be omitted during the calculation of transmit modulation quality.

#### 6.4F.2.1 Error Vector Magnitude

Editor’s Note: This test is incomplete. The following aspects are not yet determined:

- Test configuration table is FFS

- Test state and generic procedure are TBD in 38.508-1

- MU and TT for > 6GHz (band n96)

- Message exception for NR-U

6.4F.2.1.1 Test Purpose

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM.

The measured waveform is further equalised using the channel estimates subjected to the EVM equaliser spectrum flatness requirement specified in sub-clause 6.4F.2.4.3. For DFT-s-OFDM waveforms, the EVM result is defined after the front-end FFT and IDFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %. For CP-OFDM waveforms, the EVM result is defined after the front-end FFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %.

6.4F.2.1.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR standalone shared spectrum channel access.

6.4F.2.1.3 Minimum conformance requirements

The requirements for EVM requirements in clause 6.4.2.1 apply.

The normative reference for this requirement is TS 38.101 [2] clause 6.4F.2.1.

6.4F.2.1.4 Test description

6.4F.2.1.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4F.2.1.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4F.2.1.4.1-1: Test Configuration

FFS

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4F.2.1.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4F.2.1.4.3

6.4F.2.1.4.2 Test procedure

Test procedure for PUSCH:

1.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4F.2.1.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

1.2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level, allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

1.3. Measure the EVM and  using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

1.4. For modulations except 256QAM, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where:

- Pmin is the minimum output power according to Table 6.3.1.3-1.

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

For 256 QAM, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin + 10 dB, where Pmin, MU and Uplink power control window size are defined above.

1.5. Measure the EVM and  using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4F.2.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

6.4F.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6.

6.4F.2.1.5 Test requirement

The PUSCH EVM, derived in Annex E.4.2, shall not exceed the values in Table 6.4F.2.1.5-1.

The PUSCH, derived in Annex E.4.6.2, shall not exceed the values in Table 6.4F.2.1.5-1 when embedded with data symbols of the respective modulation scheme.

Table 6.4F.2.1.5-1: Test requirements for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| Pi/2-BPSK | % | 30 + TT |
| QPSK | % | 17.5 + TT |
| 16 QAM | % | 12.5 + TT |
| 64 QAM | % | 8 + TT |
| 256 QAM | % | 3.5 + TT |
| Note 1: TT is defined in Table 6.4.2.1.5-2. | | |

Table 6.4F.2.1.5-2: Test Tolerance

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| Pi/2-BPSK | % | 0 |
| QPSK | % | 0 |
| 16 QAM | % | 0 |
| 64 QAM | % | 0 |
| 256 QAM | % | 0.3 for 15 dBm < PUL  0.8 for -25 dBm < PUL≤ 15 dBm  1.1 for -40dBm ≤ PUL ≤ -25dBm |

#### 6.4F.2.2 Carrier leakage

Editor’s Note: This test is incomplete. The following aspects are not yet determined:

- Test configuration table is FFS

- Test state and generic procedure are TBD in 38.508-1

- MU and TT for frequency > 5.925 GHz is TBD.

6.4F.2.2.1 Test purpose

Carrier leakage expresses itself as unmodulated sine wave with the carrier frequency or centre frequency of aggregated transmission bandwidth configuration. It is an interference of approximately constant amplitude and independent of the amplitude of the wanted signal.

The purpose of this test is to exercise the UE transmitter to verify its modulation quality in terms of carrier leakage for shared spectrum channel access.

6.4F.2.2.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR standalone shared spectrum channel access.

6.4F.2.2.3 Minimum conformance requirements

The requirements for carrier leakage in clause 6.4.2.2 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4F.2.2.

6.4F.2.2.4 Test description

6.4F.2.2.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4F.2.2.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4F.2.2.4.1-1: Test Configuration

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Mid | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation | RB allocation (NOTE 1, 3) |
| 1 |  | DFT-s-OFDM QPSK | Inner\_1RB\_Left |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.  NOTE 3: When the reported DC carrier position is at Inner\_1RB\_Left, use Inner\_1RB\_Right for UL RB allocation. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to AnnexC.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4F.2.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4F.2.2.4.3.

7. In case the parameter 3300 or 3301 is reported from the UE via *txDirectCurrentLocation* IE, do not proceed to test procedure and mark the test not applicable with reasoning in the test report.

6.4F.2.2.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4F.2.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 10 dBm, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7 dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

3. Measure carrier leakage using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

4. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 0 dBm, where MU and Uplink power control window size are defined above.

5. Measure carrier leakage using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

6. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level -30 dBm, where MU and Uplink power control window size are defined above.

7. Measure carrier leakage using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

8. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where MU and Uplink power control window size are defined above, Pmin is the minimum output power according to Table 6.3.1.3-1.

9. Measure carrier leakage using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

6.4F.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the following exception:

Table 6.4F.2.2.4.3-1: *PUSCH-Config*

|  |
| --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-118 with condition TRANSFORM\_PRECODER\_ENABLED |

Table 6.4F.2.2.4.3-2: *CellGroupConfig*

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5], Table 4.6.3-19 | | | |
| Information Element | Value/remark | Comment | Condition |
| CellGroupConfig ::= SEQUENCE { |  |  |  |
| reportUplinkTxDirectCurrent | true |  |  |
| } |  |  |  |

6.4F.2.2.5 Test requirement

In case the parameter 3300 or 3301 is reported from UE via *txDirectCurrentLocation* IE, carrier leakage measurement requirement shall be waived. Otherwise, each of the *n* carrier leakage results, derived in Annex E.3.1, shall not exceed the values in table 6.4F.2.2.5-1. Allocated RBs are not under test.

Table 6.4F.2.2.5-1: Test requirements for Relative Carrier Leakage Power

|  |  |
| --- | --- |
| Parameters  UE output power | Relative limit (dBc) |
| 10 + MU to 10 + (MU + Uplink power control window size) dBm | -28 + TT |
| 0 + MU to 0 + (MU + Uplink power control window size) dBm | -25 + TT |
| -30 + MU to -30 + (MU + Uplink power control window size) dBm | -20 + TT |
| Pmin + MU to Pmin + (MU + Uplink power control window size) dBm | -10 + TT |
| NOTE 1: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 2: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.  NOTE 3:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 4: MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.  NOTE 5: Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.  NOTE 6: Test tolerance TT = 0.8 dB.  NOTE 7: Pmin is the minimum output power according to Table 6.3F.1.3-1. | |

#### 6.4F.2.3 In-band emissions

Editor’s Note: This test is incomplete. The following aspects are not yet determined:

- Test configuration table is FFS

- Test state and generic procedure are TBD in 38.508-1

- MU and TT for frequency > 5.925 GHz is TBD

6.4F.2.3.1 Test purpose

The purpose of this test is to exercise the UE transmitter to verify its modulation quality in terms of in-band emissions.

6.4F.2.3.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR standalone shared spectrum channel access.

6.4F.2.3.3 Minimum conformance requirements

The in-band emission is defined as the average emission across 12 sub-carriers and as a function of the RB offset from the edge of the allocated UL transmission bandwidth. The in-band emission is measured as the ratio of the UE output power in a non–allocated RB to the UE output power in an allocated RB.

The basic in-band emissions measurement interval is defined over one slot in the time domain; however, the minimum requirement applies when the in-band emission measurement is averaged over 10 sub-frames. When the PUSCH or PUCCH transmission slot is shortened, the in-band emissions measurement interval is reduced by one or more symbols, accordingly. The requirement applies for power class 5 UE for 20 MHz channel bandwidth and 15 kHz SCS,

Instead of the general requirement in clause 6.4.2.3, the average of the basic in-band emission measurement over 10 sub-frames shall not exceed the values specified in Table 6.4F.2.3.3-1.

Table 6.4F.2.3.3-1: Minimum requirements for in-band emissions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter description | Unit | Limit (NOTE 1) | | Applicable Frequencies |
| General | dB |  | | Any non-allocated (NOTE 2) |
| IQ Image | dB | -28 | Image frequencies when output power > 10 dBm | Image frequencies (NOTES 2, 3) |
|  |  | -25 | Image frequencies when output power ≤ 10 dBm |  |
| Carrier leakage | dBc | -28 | Output power > 10 dBm | Carrier frequency (NOTES 4, 5) |
|  |  | -25 | 0 dBm ≤ Output power ≤10 dBm |  |
|  |  | -20 | -30 dBm ≤ Output power ≤ 0 dBm |  |
|  |  | -10 | -40 dBm ≤ Output power < -30 dBm |  |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of *PRB* - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* is defined in NOTE 10.  NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. The requirement applies with  for any non-allocated RB with *RIV*=1 and *RIV*=5 in the uplink scheduling grant where *RIV* is specified in [10].  NOTE 3: [The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated RBs, based on symmetry with respect to the reported carrier frequency location in *txDirectCurrentLocation* field of the *UplinkTxDirectCurrentBWP*, but excluding any allocated RBs. If *txDirectCurrentLocation* is not available or is reported with value 3300 or 3301, applicable frequencies shall be calculated with an assumed carrier frequency location at the centre of the channel.]  NOTE 4: [The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs with *RIV*=1 and *RIV*=5 in the uplink scheduling grant.]  NOTE 5: [The applicable frequencies for this limit are those that are enclosed in the RBs containing the DC frequency if  is odd, or in the two RBs immediately adjacent to the DC frequency if  is even, but excluding any allocated RB. The location of the DC frequency is given by *txDirectCurrentLocation* field of the *UplinkTxDirectCurrentBWP*. If *txDirectCurrentLocation* is not available or is reported with value 3300 or 3301, applicable frequencies shall be those that are enclosed in the RB(s) in the center of the channel.]  NOTE 6:  is the Transmission Bandwidth Configuration (see Figure 5.6-1 in TS 38.101-1 [2]).  NOTE 7:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth.  NOTE 10:  is the transmitted power per 180\*2m kHz in allocated RBs, measured in dBm. | | | | |

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4F.2.3.

6.4F.2.3.4 Test description

6.4F.2.3.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4F.2.3.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4F.2.3.4.1-1: Test Configuration Table for PUSCH

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation | RB allocation (NOTE 1) |
| 1 |  | DFT-s-OFDM QPSK | Inner\_1RB\_Left |
| 2 |  | DFT-s-OFDM QPSK | Inner\_1RB\_Right |
| 3 |  | CP-OFDM QPSK | Inner\_1RB\_Left |
| 4 |  | CP-OFDM QPSK | Inner\_1RB\_Right |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1. | | | |

Table 6.4F.2.3.4.1-2: Test Configuration Table for PUCCH

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | See Table 6.4F.2.3.4.1-1 | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | | See Table 6.4F.2.3.4.1-1 | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | See Table 6.4F.2.3.4.1-1 | | |
| Test SCS as specified in Table 5.3.5-1 | | | See Table 6.4F.2.3.4.1-1 | | |
| Test Parameters | | | | | |
| ID | Downlink Configuration | | Uplink Configuration | | |
|  | Modulation | RB allocation | Waveform | PUCCH format | RB index |
| 1 | CP-OFDM QPSK | Full RB (Note 1) | DFT-s-OFDM | PUCCH format = Format 3 (Note 4)  Length in OFDM symbols = 14 | 0 |
| 2 | CP-OFDM QPSK | Full RB (Note 1) | DFT-s-OFDM | PUCCH format = Format 3 (Note 4)  Length in OFDM symbols = 14 | NRB-1 |
| 3 | CP-OFDM QPSK | Full RB (Note 1) | CP-OFDM | PUCCH format = Format 1 (Note 5)  Length in OFDM symbols = 14 | 0 |
| 4 | CP-OFDM QPSK | Full RB (Note 1) | CP-OFDM | PUCCH format = Format 1 (Note 5)  Length in OFDM symbols = 14 | NRB-1 |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3F.2.4.1-2.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.  NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.  NOTE 4: Void  NOTE 5: For TDD and SCS 30 kHz, schedule the DL RMC as follows: if mod(i,10) = 3: Scheduled Other slots: Not scheduled where i is slot index per frame | | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4F.2.3.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4F.2.3.4.3

6.4F.2.3.4.2 Test procedure

Test procedure for PUSCH:

1.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4F.2.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

1.2. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 10 dBm, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

1.3. Measure In-band emission using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

1.4. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 0 dBm, where MU and Uplink power control window size are defined above.

1.5. Measure In-band emission using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

1.6. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level -30 dBm, where MU and Uplink power control window size are defined above.

1.7. Measure In-band emission using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

1.8. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where MU and Uplink power control window size are defined above and Pmin is the minimum output power according to Table 6.3.1.3-1.

1.9. Measure In-band emission using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4F.2.3.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

Test procedure for PUCCH:

2.1. PUCCH is set according to Table 6.4F.2.3.4.1-2. SS transmits PDSCH via PDCCH DCI format 1-1 for C\_RNTI to transmit the DL RMC according to Table 6.4F.2.3.4.1-2. The SS sends downlink MAC padding bits on the DL RMC. The transmission of PDSCH will make the UE send uplink ACK/NACK using PUCCH.

2.2. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 10 dBm, where:

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 2.0 dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

2.3. Measure In-band emission using Global In-Channel Tx-Test (Annex E)

2.4. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 0 dBm, where MU and Uplink power control window size are defined above.

2.5. Measure In-band emission using Global In-Channel Tx-Test (Annex E)

2.6. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level -30 dBm, where MU and Uplink power control window size are defined above.

2.7. Measure In-band emission using Global In-Channel Tx-Test (Annex E)

2.8. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where MU and Uplink power control window size are defined above and Pmin is the minimum output power according to Table 6.3.1.3-1.

2.9. Measure In-band emission using Global In-Channel Tx-Test (Annex E)

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4F.2.3.4.1-2, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

6.4F.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the following exceptions:

Table 6.4F.2.3.4.3-1: PDSCH-ServingCellConfig: PUCCH format3 measurement

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1[15], Table 4.6.3-102 | | | |
| Information Element | Value/remark | Comment | Condition |
| PDSCH-ServingCellConfig ::= SEQUENCE { |  |  |  |
| codeBlockGroupTransmission | Not present |  |  |
| xOverhead | Not present |  |  |
| nrofHARQ-ProcessesForPDSCH | n6 |  | FDD |
| pucch-Cell | Not present |  |  |
| maxMIMO-Layers | Not present |  |  |
| processingType2Enabled | Not present |  |  |
| pdsch-CodeBlockGroupTransmissionList-r16 | Not present |  |  |
| } |  |  |  |

6.4F.2.3.5 Test requirement

The averaged In-band emission result, derived in Annex E.4.3 shall not exceed the corresponding values in Tables 6.4F.2.3.5-1.

Table 6.4F.2.3.5-1: Test requirements for in-band emissions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter description | Unit | Limit (NOTE 1) | | Applicable Frequencies |
| General | dB |  | | Any non-allocated (NOTE 2) |
| IQ Image | dB | -28 | Image frequencies when output power > 10 dBm | Image frequencies (NOTES 2, 3) |
|  |  | -25 | Image frequencies when output power ≤ 10 dBm |  |
| Carrier leakage | dBc | -28 | Output power > 10 dBm | Carrier frequency (NOTES 4, 5) |
|  |  | -25 | 0 dBm ≤ Output power ≤10 dBm |  |
|  |  | -20 | -30 dBm ≤ Output power ≤ 0 dBm |  |
|  |  | -10 | -40 dBm ≤ Output power < -30 dBm |  |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of *PRB* - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* is defined in NOTE 10.  NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. The requirement applies with  for any non-allocated RB with *RIV*=1 and *RIV*=5 in the uplink scheduling grant where *RIV* is specified in [10].  NOTE 3: [The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated RBs, based on symmetry with respect to the reported carrier frequency location in *txDirectCurrentLocation* field of the *UplinkTxDirectCurrentBWP*, but excluding any allocated RBs. If *txDirectCurrentLocation* is not available or is reported with value 3300 or 3301, applicable frequencies shall be calculated with an assumed carrier frequency location at the centre of the channel.]  NOTE 4: [The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs with *RIV*=1 and *RIV*=5 in the uplink scheduling grant.]  NOTE 5: [The applicable frequencies for this limit are those that are enclosed in the RBs containing the DC frequency if  is odd, or in the two RBs immediately adjacent to the DC frequency if  is even, but excluding any allocated RB. The location of the DC frequency is given by *txDirectCurrentLocation* field of the *UplinkTxDirectCurrentBWP*. If *txDirectCurrentLocation* is not available or is reported with value 3300 or 3301, applicable frequencies shall be those that are enclosed in the RB(s) in the centre of the channel.]  NOTE 6:  is the Transmission Bandwidth Configuration (see Figure 5.6-1 in TS 38.101-1 [2]).  NOTE 7:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth.  NOTE 10:  is the transmitted power per 180\*2m kHz in allocated RBs, measured in dBm.  NOTE 11: Test tolerance TT = 0.8 dB.  NOTE 12: In case the parameter 3300 or 3301 is reported from UE via *txDirectCurrentLocation* IE, IQ Image and Carrier leakage limit do not apply and General limit applies for all non-allocated frequencies | | | | |

#### 6.4F.2.4 EVM equalizer spectrum flatness

Editor’s Note: This test is incomplete. The following aspects are not yet determined:

- Test configuration table is FFS

- Test state and generic procedure are TBD in 38.508-1.

- MU and TT for frequency > 5.925 GHz is TBD

6.4F.2.4.1 Test purpose

The zero-forcing equalizer correction applied in the EVM measurement process (as described in Annex E) must meet a spectral flatness requirement for the EVM measurement to be valid. The EVM equalizer spectrum flatness is defined in terms of the maximum peak-to-peak ripple of the equalizer coefficients (dB) across the allocated uplink block, at which the equalizer coefficients are generated by the EVM measurement process. The basic measurement interval is the same as for EVM.

The EVM equalizer spectrum flatness requirement does not limit the correction applied to the signal in the EVM measurement process but for the EVM result to be valid, the equalizer correction that was applied must meet the EVM equalizer spectrum flatness minimum requirements.

6.4F.2.4.2 Test applicability

This test case applies to all types of NR UE release 16 and forward that support NR standalone shared spectrum channel access.

6.4F.2.4.3 Minimum conformance requirements

The requirements for EVM equalizer spectrum flatness in clause 6.4.2.4 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4F.2.4.

6.4F.2.4.4 Test description

6.4F.2.4.4.1 Initial condition

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4F.2.4.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4F.2.4.4.1-1: Test Configuration

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Conditions | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, Mid range, High range | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest, Mid, Highest | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | |
| Test Parameters | | | |
| Test ID | Downlink Configuration | Uplink Configuration | |
|  | N/A | Modulation | RB allocation (NOTE 1) |
| 1 |  | DFT-s-OFDM QPSK | Outer Full |
| 2 |  | CP-OFDM QPSK | Outer Full |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4F.2.4.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4F.2.4.4.3.

6.4F.2.4.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4F.2.4.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

3. Measure spectrum flatness using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

6.4F.2.4.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6.

6.4F.2.4.5 Test requirement

Each of the *n* spectrum flatness functions, shall derive four ripple results in Annex E.4.4.1. The derived results shall not exceed the values in Figure 6.4F.2.4.5-1:

For normal conditions, the maximum ripple in Range 1 and Range 2 shall not exceed the values specified in Table 6.4F.2.4.5-1 and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 8.4 dB (see Figure 6.4F.2.4.5-1).

For normal conditions, the peak-to-peak variation of the EVM equalizer coefficients contained within the frequency range of the uplink allocation shall not exceed the maximum ripple specified in Table 6.4F.2.4.5-1. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 8.4 dB (see Figure 6.4F.2.4.5-1).

For extreme conditions, the EVM equalizer spectral flatness shall not exceed the values specified in Table 6.4F.2.4.5-2. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 7.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 11.4 dB (see Figure 6.4F.2.4.5-1).

Table 6.4F.2.4.5-1: Requirements for EVM equalizer spectrum flatness (normal conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum ripple [dB] |
| FUL\_Meas – FUL\_Low ≥ 3 MHz and FUL\_High – FUL\_Meas ≥ 3 MHz  (Range 1) | 4 + TT (p-p) |
| FUL\_Meas – FUL\_Low < 3 MHz or FUL\_High – FUL\_Meas < 3 MHz  (Range 2) | 8 + TT (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each E-UTRA frequency band specified in Table 5.5-1  NOTE 3: Test tolerance TT = 1.4 dB. | |

Table 6.4F.2.4.5-2: Minimum requirements for EVM equalizer spectrum flatness (extreme conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum Ripple [dB] |
| FUL\_Meas – FUL\_Low ≥ 5 MHz and FUL\_High – FUL\_Meas ≥ 5 MHz (Range 1) | 4 + TT (p-p) |
| FUL\_Meas – FUL\_Low < 5 MHz or FUL\_High – FUL\_Meas < 5 MHz (Range 2) | 12 + TT (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each E-UTRA frequency band specified in Table 5.5-1  NOTE 3: Test tolerance TT = 1.4 dB. | |



Figure 6.4F.2.4.5-1: The test requirements for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated for unshaped modulations (the ETC test requirements are within brackets)

## 6.4G Transmit signal quality for Tx Diversity

In this clause a multitude of results are derived, all using one common algorithm returning these results: Global In-Channels TX-Test Annex E. Each sub clause of this clause contains a procedure and test requirements described for a specific measurement. If all relevant test parameters in different sub clauses are the same, then the results, returned by the Global In-Channel TX-Test, may be used across the applicable sub clauses.

### 6.4G.1 Frequency error for Tx Diversity

6.4G.1.1 Test purpose

Same test purpose as in 6.4.1.1.

6.4G.1.2 Test applicability

This test case applies to all types of NR Power Class 1.5 UE, Power Class 2 and Power Class 3 UE release 15 and forward that support Tx diversity.

6.4G.1.3 Minimum conformance requirements

For UE(s) supporting Tx diversity, the basic measurement interval of modulated carrier frequency is 1 UL slot. The mean value of basic measurements of UE modulated carrier frequency at each transmit antenna connector shall be accurate to within ± 0.1 PPM observed over a period of 1 ms of cumulated measurement intervals compared to the carrier frequency received from the NR Node B.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4G.1

6.4G.1.4 Test description

Same test description as in clause 6.4.1.4 with the measurement performed at each transmit antenna connector.

6.4G.1.5 Test requirement

For each transmit antenna connector, the 10 frequency error Δf results must fulfil the test requirement:

|Δf| ≤ (0.1 PPM + 15 Hz)

### 6.4G.2 Transmit modulation quality for Tx Diversity

For UE supporting Tx diversity, the transmit modulation quality requirements are specified at each transmit antenna connector. The transmit modulation quality is specified in terms of:

- Error Vector Magnitude (EVM) for the allocated resource blocks (RBs)

- EVM equalizer spectrum flatness derived from the equalizer coefficients generated by the EVM measurement process

- Carrier leakage (caused by IQ offset)

- In-band emissions for the non-allocated RB

In case the parameter 3300 or 3301 is reported from UE via *txDirectCurrentLocation* IE (as defined in TS 38.331 [6]), carrier leakage measurement requirement in clause 6.4G.2.2 and 6.4G.2.3 shall be waived, and the RF correction with regard to the carrier leakage and IQ image shall be omitted during the calculation of transmit modulation quality.

#### 6.4G.2.1 Error Vector Magnitude for Tx Diversity

6.4G.2.1.1 Test Purpose

Same test purpose as in 6.4.2.1.1.

6.4G.2.1.2 Test applicability

This test case applies to all types of NR Power Class 1.5 UE, Power Class 2 and Power Class 3 UE release 15 and forward that support Tx diversity.

6.4G.2.1.3 Minimum conformance requirements

For UE supporting Tx diversity, the Error Vector Magnitude requirements specified in clause 6.4.2.1.3. The total EVM requirement is derived based on the measurement at each antenna connector according to Annex E.4.8.

The normative reference for this requirement is TS 38.101 [2] clause 6.4G.2.1.

6.4G.2.1.4 Test description

6.4G.2.1.4.1 Initial conditions

Same initial conditions as in 6.4.2.1.4.1.

6.4G.2.1.4.2 Test procedure

Test procedure for PUSCH:

1.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4.2.1.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

1.2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level, allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

1.3. Measure the mean power at each antenna connector in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD symbols with transient periods are not under test.

1.4. Measure the EVM and  using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

- If the UE’s transmit power measured in step 1.3 is higher than the minimum output power requirement in 6.3G.1.5 at both antenna connectors, the composite EVM is measured according to E.4.8.

- If UE’s transmit power measured in step 1.3 is higher than the minimum output power requirement in 6.3G.1.5 at only one antenna connector, the EVM is measured only on this antenna connector according to E.4.2 and E.4.6.

1.5. For modulations except 256QAM, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where:

- Pmin is the minimum output power according to Table 6.3.1.3-1.

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

For 256 QAM, send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin + 10 dB, where Pmin, MU and Uplink power control window size are defined above.

1.6. Measure the mean power at each antenna connector in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD symbols with transient periods are not under test.

1.7. Measure the EVM and  using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

- If the UE’s transmit power measured in step 1.6 is higher than the minimum output power requirement in 6.3G.1.5 at both antenna connectors, the composite EVM is measured according to E.4.8.

- If UE’s transmit power measured in step 1.6 is higher than the minimum output power requirement in 6.3G.1.5 at only one antenna connector, the EVM is measured only on this antenna connector according to E.4.2 and E.4.6.

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4.2.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

Test procedure for PUCCH:

2.1. PUCCH is set according to Table 6.4.2.1.4.1-2.

2.2. SS transmits PDSCH via PDCCH DCI format 1\_1 for C\_RNTI to transmit the DL RMC according to Table 6.4.2.1.4.1-2. The SS sends downlink MAC padding bits on the DL RMC. The transmission of PDSCH will make the UE send uplink ACK/NACK using PUCCH. There is no PUSCH transmission.

2.3. SS send appropriate TPC commands for PUCCH to the UE until the UE transmit PUCCH at PUMAX level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

2.4. Measure the mean power at each antenna connector in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD symbols with transient periods are not under test.

2.5. Measure PUCCH EVM using Global In-Channel Tx-Test (Annex E).

- If the UE’s transmit power measured in step 2.4 is higher than the minimum output power requirement in 6.3G.1.5 at both antenna connectors, the composite EVM is measured according to E.5.9.4.

- If UE’s transmit power measured in step 2.4 is higher than the minimum output power requirement in 6.3G.1.5 at only one antenna connector, the EVM is measured only on this antenna connector according to E.5.9.2.

2.6. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE PUCCH output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level Pmin, where:

- Pmin is the minimum output power according to Table 6.3.1.3-1.

- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.

- Uplink power control window size = 1dB (UE power step size) + 2.0dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 2.0dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

2.7. Measure the mean power at each antenna connector in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD symbols with transient periods are not under test.

2.8. Measure PUCCH EVM using Global In-Channel Tx-Test (Annex E).

- If the UE’s transmit power measured in step 2.7 is higher than the minimum output power requirement in 6.3G.1.5 at both antenna connectors, the composite EVM is measured according to E.5.9.4.

- If UE’s transmit power measured in step 2.7 is higher than the minimum output power requirement in 6.3G.1.5 at only one antenna connector, the EVM is measured only on this antenna connector according to E.5.9.4.

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4.2.1.4.1-2, send an NR RRCReconfiguration message according to TS 38.508-1 [5] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM\_PRECODER\_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

Test procedure for PRACH:

3.1. The SS shall set RS EPRE according to Table 6.4.2.1.4.1-3.

3.2. PRACH is set according to Table 6.4.2.1.4.1-3.

3.3. The SS shall signal a Random Access Preamble ID via a PDCCH order to the UE and initiate a Non-contention based Random Access procedure.

3.4. The UE shall send the signalled preamble to the SS.

3.5. In response to the preamble, the SS shall transmit a random access response not corresponding to the transmitted random access preamble, or send no response.

3.6. The UE shall consider the random access response reception not successful then re-transmit the preamble with the calculated PRACH transmission power.

3.7. Measure the output power of the transmitted PRACH preamble at each antenna connector.

3.8. Repeat step 3.5 ~ 3.7 until the SS collect enough PRACH preambles. Measure the EVM in PRACH channel using Global In-Channel Tx-Test (Annex E).

- If the UE’s transmit power measured in step 3.7 is higher than the minimum output power requirement in 6.3G.1.5 at both antenna connectors, the composite EVM is measured according to E.6.9.3.

- If UE’s transmit power measured in step 3.7 is higher than the minimum output power requirement in 6.3G.1.5 at only one antenna connector, the EVM is measured only on this antenna connector according to E.6.9.2.

6.4G.2.1.4.3 Message contents

Same message contents as specified in 6.4.2.1.4.3.

6.4G.2.1.5 Test requirement

The PUSCH EVM, derived in steps 1.4 and 1.7, shall not exceed the values in Table 6.4G.2.1.5-1.

The PUSCH, derived in steps 1.4 and 1.7, shall not exceed the values in Table 6.4G.2.1.5-1 when embedded with data symbols of the respective modulation scheme.

Table 6.4G.2.1.5-1: Test requirements for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| Pi/2-BPSK | % | 30 + TT |
| QPSK | % | 17.5 + TT |
| 16 QAM | % | 12.5 + TT |
| 64 QAM | % | 8 + TT |
| 256 QAM | % | 3.5 + TT |
| Note 1: TT is defined in Table 6.4G.2.1.5-2. | | |

Table 6.4G.2.1.5-2: Test Tolerance

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| Pi/2-BPSK | % | 0 |
| QPSK | % | 0 |
| 16 QAM | % | 0 |
| 64 QAM | % | 0 |
| 256 QAM | % | 0.3 for 15 dBm < PUL  0.8 for -25 dBm < PUL≤ 15 dBm  1.1 for -40dBm ≤ PUL ≤ -25dBm |

The PUCCH EVM derived in steps 2.5 and 2.8 shall not exceed 17.5 %.

The PRACH EVM derived in step 3.8 shall not exceed 17.5%.

#### 6.4G.2.2 Carrier leakage for Tx Diversity

6.4G.2.2.1 Test purpose

Same test purpose as in 6.4.2.2.1.

6.4G.2.2.2 Test applicability

This test case applies to all types of NR Power Class 1.5 UE, Power Class 2 and Power Class 3 UE release 15 and forward that support Tx diversity.

6.4G.2.2.3 Minimum conformance requirements

For UE supporting Tx diversity, the Relative Carrier Leakage Power requirements specified in Table 6.4.2.2.3-1 which is defined in clause 6.4.2.2.3 apply at each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4G.2.2.

6.4G.2.2.4 Test description

Same test description as in clause 6.4.2.2.4 with the following exceptions:

- Adding the following test steps:

10. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level, allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

11. Measure carrier leakage using Global In-Channel Tx-Test (Annex E) with the measurement performed at each transmit antenna connector. For TDD, only slots consisting of only UL symbols are under test.

- If the UE’s transmit power at both antenna connectors are higher than the minimum output power requirement in 6.3G.1.5, the carrier leakage is measured on each transmit antenna. Pass the UE if the carrier leakage on each antenna connector meets the requirements in 6.4G.2.2.5.

- If UE’s transmit power is higher than the minimum output power requirement in 6.3G.1.5 at only one antenna connector, the carrier leakage is measured only on this antenna connector. Pass the UE if the carrier leakage on this antenna connector meets the requirements in 6.4G.2.2.5.

6.4G.2.2.5 Test requirement

In case the parameter 3300 or 3301 is reported from UE via *txDirectCurrentLocation* IE, carrier leakage measurement requirement shall be waived. Otherwise, for each transmit antenna connector, each of the *n* carrier leakage results, derived in Annex E.3.1, shall not exceed the values in Table 6.4G.2.2.5-1. Allocated RBs are not under test. n is 10 for 15kHz SCS, 20 for 30kHz SCS and 30 for 60kHz SCS.

Table 6.4G.2.2.5-1: Test requirements for Relative Carrier Leakage Power

|  |  |
| --- | --- |
| Parameters  UE output power | Relative limit (dBc) |
| 10 + MU to 10 + (MU + Uplink power control window size) dBm | -28 + TT |
| 0 + MU to 0 + (MU + Uplink power control window size) dBm | -25 + TT |
| -30 + MU to -30 + (MU + Uplink power control window size) dBm | -20 + TT |
| Pmin + MU to Pmin + (MU + Uplink power control window size) dBm | -10 + TT |
| NOTE 1: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 2: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE, and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.  NOTE 3:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 4: MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.  NOTE 5: Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.  NOTE 6: Test tolerance TT = 0.8 dB.  NOTE 7: Pmin is the minimum output power according to Table 6.3.1.3-1. | |

#### 6.4G.2.3 In-band emissions for Tx Diversity

6.4G.2.3.1 Test purpose

Same test purpose as in 6.4.2.3.1.

6.4G.2.3.2 Test applicability

This test case applies to all types of NR Power Class 1.5 UE, Power Class 2 and Power Class 3 UE release 15 and forward that support Tx diversity.

6.4G.2.3.3 Minimum conformance requirements

For UE supporting Tx diversity, the In-band Emission requirements specified in Table 6.4.2.3.3-1 which is defined in clause 6.4.2.3.3 apply at each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4G.2.3.

6.4G.2.3.4 Test description

Same test description as in clause 6.4.2.3.4 with the following exceptions:

- Adding the following test steps:

Test procedure for PUSCH:

1.10 Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level, allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

1.11 Measure In-band emission using Global In-Channel Tx-Test (Annex E) with the measurement performed at each transmit antenna connector. For TDD, only slots consisting of only UL symbols are under test.

Test procedure for PUCCH:

2.10 Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level, allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

2.11 Measure In-band emission using Global In-Channel Tx-Test (Annex E) with the measurement performed at each transmit antenna connector.

- If the UE’s transmit power at both antenna connectors are higher than the minimum output power requirement in 6.3G.1.5, the In-band emissions are measured on each transmit antenna. Pass the UE if the In-band emissions on each antenna connector meets the requirements in 6.4G.2.3.5.

- If UE’s transmit power is higher than the minimum output power requirement in 6.3G.1.5 at only one antenna connector, the In-band emissions are measured only on this antenna connector. Pass the UE if the carrier leakage on this antenna connector meets the requirements in 6.4G.2.3.5.

6.4G.2.3.5 Test requirement

For each transmit antenna connector, the averaged In-band emission result, derived in Annex E.4.3 shall not exceed the corresponding values in Table 6.4G.2.3.5-1.

Table 6.4G.2.3.5-1: Test requirements for in-band emissions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter description | Unit | Limit (NOTE 1) | | Applicable Frequencies |
| General (NOTE 12) | dB | + TT | | Any non-allocated  (NOTE 2) |
| IQ Image (NOTE 12) | dB | -28 + TT | Image frequencies when output power > 10 dBm | Image frequencies (NOTES 2, 3) |
| -25 + TT | Image frequencies when output power ≤ 10 dBm |
| Carrier leakage (NOTE 12) | dBc | -28 + TT | Output power > 10 dBm | Carrier leakage frequency (NOTES 4, 5) |
| -25 + TT | 0 dBm ≤ Output power ≤ 10 dBm |
| -20 + TT | -30 dBm ≤ Output power < 0 dBm |
| -10 + TT | -40 dBm ≤ Output power < -30 dBm |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of *PRB* - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. *PRB* is defined in NOTE 10.  NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs.  NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.  NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 5: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE, and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency, but excluding any allocated RB.  NOTE 6:  is the Transmission Bandwidth (see Section 5.3).  NOTE 7:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 8:  is the limit specified in Table 6.4G.2.1.3-1 for the modulation format used in the allocated RBs.  NOTE 9:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth.  NOTE 10:  is an average of the transmitted power over 10 sub-frames normalized by the number of allocated RBs, measured in dBm.  NOTE 11: Test tolerance TT = 0.8 dB.  NOTE 12: In case the parameter 3300 or 3301 is reported from UE via *txDirectCurrentLocation* IE, IQ Image and Carrier leakage limit do not apply and General limit applies for all non-allocated frequencies. | | | | |

#### 6.4G.2.4 EVM equalizer spectrum flatness for Tx Diversity

6.4G.2.4.1 Test purpose

Same test purpose as in 6.4.2.4.1.

6.4G.2.4.2 Test applicability

This test case applies to all types of NR Power Class 1.5 UE, Power Class 2 and Power Class 3 UE release 15 and forward that support Tx diversity.

6.4G.2.4.3 Minimum conformance requirements

For UE supporting Tx diversity, the EVM Equalizer Spectrum Flatness requirements specified in Table 6.4.2.4.3-1 and Table 6.4.2.4.3-2 which are defined in clause 6.4.2.4.3. The composite EVM equalizer *EC(f)* is defined as

where

*ECn(f)* represents equalizer coefficient for each antenna connector, ，f is the allocated subcarriers within the transmission bandwidth ((|*F*|=12\*);

*P1* and *P2* denote the linear power measured at each antenna connector respectively.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4G.2.4.

6.4G.2.4.4 Test description

Same test description as specified in clause 6.4.2.4.4 with following exceptions:

Step 3 of Test procedure as in 6.4.2.4.4.2 is replaced by:

3. Measure the mean power at each antenna connector in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD symbols with transient periods are not under test.

4. Measure spectrum flatness using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

- If the UE’s transmit power at both antenna connectors are higher than the minimum output power requirement in 6.3G.1.5, spectrum flatness is measured at both antenna connectors and the composite EVM equalizer EC(f) is determined by applying

where

*ECn(f)* represents equalizer coefficient for each antenna connector, ，f is the allocated subcarriers within the transmission bandwidth ((|*F*|=12\*);

*P1* and *P2* denote the linear power measured at each antenna connector respectively.

- If UE’s transmit power is higher than the minimum output power requirement in 6.3G.1.5 at only one antenna connector, the spectrum flatness is measured only on this antenna connector using Global In-Channel Tx-Test (Annex E).

6.4G.2.4.5 Test requirement

Each of the *n* spectrum flatness functions, shall derive four ripple results in Annex E.4.4.1. The derived results shall not exceed the values in Figure 6.4G.2.4.5-1:

For normal conditions, the peak-to-peak variation of the EVM equalizer coefficients contained within the frequency range of the uplink allocation shall not exceed the maximum ripple specified in Table 6.4G.2.4.5-1. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 8.4 dB (see Figure 6.4G.2.4.5-1).

For extreme conditions, the EVM equalizer spectral flatness shall not exceed the values specified in Table 6.4G.2.4.5-2. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 7.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 11.4 dB (see Figure 6.4G.2.4.5-1).

Table 6.4G.2.4.5-1: Requirements for EVM equalizer spectrum flatness (normal conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum ripple [dB] |
| FUL\_Meas – FUL\_Low ≥ 3 MHz and FUL\_High – FUL\_Meas ≥ 3 MHz  (Range 1) | 4 + TT (p-p) |
| FUL\_Meas – FUL\_Low < 3 MHz or FUL\_High – FUL\_Meas < 3 MHz  (Range 2) | 8 + TT (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each E-UTRA frequency band specified in Table 5.5-1  NOTE 3: Test tolerance TT = 1.4 dB. | |

Table 6.4G.2.4.5-2: Minimum requirements for EVM equalizer spectrum flatness (extreme conditions)

|  |  |
| --- | --- |
| Frequency range | Maximum Ripple [dB] |
| FUL\_Meas – FUL\_Low ≥ 5 MHz and FUL\_High – FUL\_Meas ≥ 5 MHz  (Range 1) | 4 + TT (p-p) |
| FUL\_Meas – FUL\_Low < 5 MHz or FUL\_High – FUL\_Meas < 5 MHz  (Range 2) | 12 + TT (p-p) |
| NOTE 1: FUL\_Meas refers to the sub-carrier frequency for which the equalizer coefficient is evaluated  NOTE 2: FUL\_Low and FUL\_High refer to each E-UTRA frequency band specified in Table 5.5-1  NOTE 3: Test tolerance TT = 1.4 dB | |



Figure 6.4G.2.4.5-1: The test requirements for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated for unshaped modulations (the ETC test requirements are within brackets)

## 6.4H Transmit signal quality for CA with UL MIMO

### 6.4H.1 Transmit signal quality for intra-band UL contiguous CA with UL MIMO

#### 6.4H.1.1 Frequency error for intra-band UL contiguous CA with UL MIMO

6.4H.1.1.1 Test purpose

This test verifies the ability of both, the receiver and the transmitter, to process frequency for 2UL CA correctly.

Receiver: to extract the correct frequency from the stimulus signal, offered by the System simulator, under ideal propagation conditions and low level.

Transmitter: to derive the correct modulated carrier frequency from the results, gained by the receiver.

6.4H.1.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support intra-band UL contiguous CA with UL MIMO.

6.4H.1.1.3 Minimum conformance requirements

For UE supporting intra-band UL contiguous CA and UL MIMO, the basic measurement interval of modulated carrier frequency is 1 UL slot. The mean value of basic measurements of UE modulated carrier frequency at each transmit antenna connector on each CC shall be accurate to within ± 0.1 PPM observed over a period of 1 ms of cumulated measurement intervals compared to the carrier frequency of primary component carrier received from the NR Node B.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4H.1.1.

6.4H.1.1.4 Test description

Same test description as specified in clause 6.4A.1.1.4 for intra-band contiguous CA with following exceptions:

For initial conditions:

- Table 6.4A.1.1.4.1-2 is replaced by Table 6.4H.1.1.4-1.

Table 6.4H.1.1.4-1: Intra band contiguous CA Test Configuration Table

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Initial Conditions | | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | | Normal, TL/VL, TL/VH, TH/VL, TH/VH | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1 | | | Mid range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | | Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | | Lowest | | |
| Test Parameters | | | | | |
|  | Downlink Configuration | | Uplink Configuration | | |
| Test ID | Modulation | RB allocation | Modulation | RB allocation | |
| PCC | SCC |
| 1 | CP-OFDM QPSK | Full RB (NOTE 1) | CP-OFDM QPSK | REFSENS (NOTE 2) | |
| NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2.  NOTE 2: REFSENS refers to Table 7.3.2.4.1-3 for each carrier which defines uplink RB configuration and start RB location for each SCS, channel BW and NR band belongs to intra-band CA combination. | | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.6 for TE diagram and section A.3.2.3.11 for UE diagram.

- The DL and UL Reference Measurement channels are set according to Table 6.4H.1.1.4-1 as appropriate.

For test procedures:

- Table 6.4A.1.1.4.1-2 is replaced by Table 6.4H.1.1.4-1.

- Step 7 in 6.4A.1.1.4.1 is replaced by:

7. Measure the Frequency Error on PCC and SCC at each transmit antenna connector using Global In-Channel Tx-Test (Annex E) respectively. For TDD slots with transient periods are not under test.

For message contents:

- Ensuring Table 4.6.3-182 configured with the condition 2TX\_UL\_MIMO

Table 6.4H.1.1.4-2: FrequencyInfoUL-SIB for intra-band CA

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.508-1 [5] Table 4.6.3-62 FrequencyInfoUL-SIB | | | |
| Information Element | Value/remark | Comment | Condition |
| p-Max | 10 |  | Power class 3 |
|  | 12 |  | Power class 2 |

6.4H.1.1.5 Test requirement

The 10 frequency error Δf results must fulfil the test requirement:

|Δf| ≤ (0.1 PPM + TT) for each test point

For intra-band contiguous CA, PPM refers to PCC UL frequency.

Table 6.4H.1.1.5-1: Test Tolerance for frequency error

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 100MHz | 15Hz | 15Hz |

#### 6.4H.1.2 Transmit modulation quality for intra-band UL contiguous CA with UL MIMO

##### 6.4H.1.2.0 General

For UE supporting intra-band UL contiguous CA and UL MIMO, the transmit modulation quality requirements are specified based on measurements made at each transmit antenna connector on each CC.

The requirements in this clause apply with PCC and SCC in the UL configured and activated: PCC with PRB allocation and SCC without PRB allocation and without CSI reporting and SRS configured.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission with precoding matrix *W*=1 [6.3.1.5 TS 38.211], the requirements in clause 6.4A.2 apply.

The transmit modulation quality requirements listed below shall be met with UL MIMO configurations specified in Table 6.2D.1-2.

For all Transmit modulation quality requirements the Carrier leakage frequency is indicted by the UE with IE *UplinkTxDirectCurrentTwoCarrierList-r16* *or* *UplinkTxDirectCurrentMoreCarrierList-r17 or UplinkTxDirectCurrentList*.

The carrier leakage measurement requirement in clauses 6.4H.1.2.2.3 and 6.4H.1.2.3.3 shall be waived and the UE’s UL signal left uncorrected for carrier leakage when one of the following qualifying conditions apply:

1. UE reports the parameter 3300 or 3301

2. UE doesn’t indicate the DC location parameters

Any requirement relaxation to accommodate the IQ image shall be omitted if the qualifying conditions above are present or if the IQ image frequency is outside the activated UL component carriers.

##### 6.4H.1.2.1 Error Vector Magnitude for intra-band UL contiguous CA with UL MIMO

6.4H.1.2.1.1 Test purpose

For intra-band UL contiguous CA with UL MIMO, the Error Vector Magnitude requirement should be defined for each transmit antenna connector on each component carrier. Requirement applies for the allocated component carrier, when all other component carriers are activated, but not allocated.

Similar transmitter impairment removal procedures are applied for CA waveform before EVM calculation as is specified for non-CA waveform in clause 6.4.2.1.

6.4H.1.2.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support intra-band UL contiguous CA with UL MIMO.

6.4H.1.2.1.3 Minimum conformance requirements

For intra-band UL contiguous CA and UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the Error Vector Magnitude requirements specified in clause 6.4A.2.1.0 apply per layer.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4H.1.2.1.

6.4H.1.2.1.4 Test description

Same test description as specified in clause 6.4A.2.1.1.4 for intra-band contiguous CA with following exceptions:

For initial contitions:

- Table 6.4A.2.1.1.4.1-2 is replaced by Table 6.4H.1.2.1.4-1.

Table 6.4H.1.2.1.4-1: Intra-band contiguous CA Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Low range, High range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg,Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | lowest and highest supported SCS | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | |
| Modulation | RB allocation (NOTE 1) | |
| PCC | SCC |
| 1 | CP-OFDM QPSK | Inner Full | 0 |
| 2 | CP-OFDM QPSK | Outer Full | 0 |
| 3 | CP-OFDM 16 QAM | Inner Full | 0 |
| 4 | CP-OFDM 16 QAM | Outer Full | 0 |
| 5 | CP-OFDM 64 QAM | Inner Full | 0 |
| 6 | CP-OFDM 64 QAM | Outer Full | 0 |
| 7 | CP-OFDM 256 QAM | Inner Full | 0 |
| 8 |  | CP-OFDM 256 QAM | Outer Full | 0 |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.1-1 and SCS is specified in Table 5.3.5-1 for each NR band.  NOTE 3: If the UE supports multiple CC Combinations in the CA Configuration with the same NRB\_agg, only the combination with the highest NRB\_PCC is tested. | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.6 for TE diagram and section A.3.2.3.11 for UE diagram.

- The DL and UL Reference Measurement channels are set according to Table 6.4H.1.2.1.4-1 as appropriate.

For test procedures:

- Step 4 in 6.4A.2.1.1.4.2 is replaced by:

4. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4H.1.2.1.4-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

- In step 7, the UE ouput power is measured at each antenna connector.

- In step 6 and step 8, the EVM and  are measured for each layer.

For message contents:

- Ensuring Table 4.6.3-182 configured with the condition 2TX\_UL\_MIMO

6.4H.1.2.1.5 Test requirement

The PUSCH EVM, derived in Annex E.4.2, shall not exceed the values in Table 6.4H.1.2.1.5-1.

The PUSCH,derived in Annex E.4.6.2, shall not exceed the values in Table 6.4H.1.2.1.5-1 when embedded with data symbols of the respective modulation scheme.

Table 6.4H.1.2.1.5-1: Test requirements for Error Vector Magnitude

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Average EVM Level |
| QPSK | % | 17.5+TT |
| 16QAM | % | 12.5+TT |
| 64QAM | % | 8+TT |
| 256 QAM | % | 3.5+TT |

Table 6.4H.1.2.1.5-2: Test Tolerance for Error Vector Magnitude

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | f ≤ 6.0GHz, BW ≤ 100MHz | | |
| 15dBm < PUL | -25dBm < PUL ≤ 15dBm | -40dBm ≤ PUL ≤ -25dBm |
| QPSK | 0% | 0% | 0% |
| 16QAM | 0% | 0% | 0% |
| 64QAM | 0% | 0% | 0% |
| 256 QAM | 0.3% | 0.8% | 1.1% |

##### 6.4H.1.2.2 Carrier leakage for intra-band UL contiguous CA with UL MIMO

6.4H.1.2.2.1 Test purpose

Carrier leakage is an additive sinusoid waveform that is confined within the aggregated transmission bandwidth configuration. The carrier leakage requirement for intra-band UL contiguous CA with UL MIMO is defined for each transmit antenna connector on each component carrier and is measured on the component carrier with PRBs allocated.

6.4H.1.2.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support intra-band UL contiguous CA with UL MIMO.

6.4H.1.2.2.3 Minimum conformance requirements

For UE supporting intra-band UL contiguous CA and UL MIMO, the relative carrier leakage power requirements specified in clause 6.4A.2.2.0 apply at each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4H.1.2.2.

6.4H.1.2.2.4 Test description

Same test description as specified in clause 6.4A.2.2.1.4 for intra-band contiguous CA with following exceptions:

For initial contitions:

- Table 6.4A.2.2.1.4.1-2 is replaced by Table 6.4H.1.2.2.4-1.

Table 6.4H.1.2.2.4-1: Intra-band contiguous CA Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1 | | Low range, High range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | |
| Modulation | RB allocation (NOTE 1, 3) | |
| PCC | SCC |
| 1 | N/A | CP-OFDM QPSK | Inner\_1RB\_Left | 0 |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.1-1 and SCS is specified in Table 5.3.5-1 for each NR band.  NOTE 3: When the signalled DC carrier position is at Inner\_1RB\_Left, use Inner\_1RB\_Right for UL RB allocation.  NOTE 4: The frequencies of PCC and SCC shall be switched and tested in each configuration. | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.6 for TE diagram and section A.3.2.3.11 for UE diagram.

- The DL and UL Reference Measurement channels are set according to Table 6.4H.1.2.2.4-1 as appropriate.

For test procedures:

- Step 4 in 6.4A.2.1.1.4.2 is replaced by:

4. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4H.1.2.2.4-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

- In steps 5, 7, 9 and 11, the UE ouput power is measured at each antenna connector.

- In steps 6, 8, 10 and 12, the carrier leakage is measured at each antenna connector.

For message contents:

- Ensuring Table 4.6.3-182 configured with the condition 2TX\_UL\_MIMO

6.4H.1.2.2.5 Test requirement

Each of the [20] carrier leakage results, derived in Annex E.3.1, shall not exceed the values in table 6.4H.1.2.2.5-1. Allocated RBs are not under test.

Table 6.4H.1.2.2.5-1: Test requirements for Carrier Leakage

|  |  |  |
| --- | --- | --- |
| LO Leakage | Parameters  UE output power | Relative limit (dBc) |
| 10 + MU to 10 + (MU + Uplink power control window size) dBm | -28+TT |
| 0 + MU to 0 + (MU + Uplink power control window size) dBm | -25+TT |
| -30 + MU to -30 + (MU + Uplink power control window size) dBm | -20+TT |
| Pmin + MU to Pmin + (MU + Uplink power control window size) dBm | -10+TT |
| NOTE 1: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.  NOTE 2: The applicable frequencies for this limit depend on the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrent* IE, and are those that are enclosed in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.  NOTE 3:  is the Transmission Bandwidth Configuration (see Section 5.3).  NOTE 4: Void  NOTE 5: MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.  NOTE 6: Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.  NOTE 7: Pmin is the minimum output power according to Table 6.3.1.3-1. | | |

Table 6.4H.1.2.2.5-2: Test Tolerance for Carrier Leakage

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 0.8dB | 0.8dB |
| 40MHz < BW ≤ 100MHz | 0.8dB | 0.8dB |

##### 6.4H.1.2.3 In-band emissions for intra-band UL contiguous CA with UL MIMO

6.4H.1.2.3.1 Test purpose

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks. The in-band emission requirement for intra-band UL contiguous CA with UL MIMO is defined for each transmit antenna connector on each component carrier and is measured on the component carrier with PRBs allocated.

6.4H.1.2.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support intra-band UL contiguous CA with UL MIMO.

6.4H.1.2.3.3 Minimum conformance requirements

For UE supporting intra-band UL contiguous CA and UL MIMO, the In-band emission requirements specified in clause 6.4A.2.3.0 apply at each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4H.1.2.3.

6.4H.1.2.3.4 Test description

Same test description as specified in clause 6.4A.2.3.1.4 for intra-band contiguous CA with following exceptions:

For initial contitions:

- Table 6.4A.2.3.1.4.1-2 is replaced by Table 6.4H.1.2.3.4-1.

Table 6.4H.1.2.3.4-1: Test Configuration Table for intra-band contiguous UL CA

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1 | | Low range, High range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg, Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | Lowest | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | |
| Modulation | RB allocation (NOTE 1) | |
| PCC | SCC |
| 13 | CP-OFDM QPSK | Edge\_Full\_Left | 0 |
| 24 | CP-OFDM QPSK | Edge\_Full\_Right | 0 |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.5A.1-1.  NOTE 3: The component carrier with lower centre frequency is PCC.  NOTE 4: The component carrier with higher centre frequency is PCC. | | | | |

- Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.6 for TE diagram and section A.3.2.3.11 for UE diagram.

- The DL and UL Reference Measurement channels are set according to Table 6.4H.1.2.3.4-1 as appropriate.

For test procedures:

- Step 4 in 6.4A.2.1.1.4.2 is replaced by:

4. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4H.1.2.3.4-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

- In steps 5, 7, 9 and 11, the UE output power is measured at each antenna connector.

- In steps 6, 8, 10 and 12, the in-band emission is measured at each antenna connector.

For message contents:

- Ensuring Table 4.6.3-182 configured with the condition 2TX\_UL\_MIMO

6.4H.1.2.3.5 Test requirement

The averaged In-band emission result, derived in Annex E.4.3, shall not exceed the corresponding values in Table 6.4H.1.2.3.5-1 and 6.4H.1.2.3.5-2. n is 10 for 15kHz SCS, 20 for 30kHz SCS and 40 for 60kHz SCS..

Table 6.4H.1.2.3.5-1: Test requirements for in-band emissions for intra-band contiguous CA (allocated component carrier)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Unit | Limit | | Applicable Frequencies |
| General | dB | +TT | | Any non-allocated (NOTE 2) |
| IQ Image | dB | -28+TT | Output power > 10 dBm | Image frequencies  (NOTE 3) |
|  |  | -25+TT | 0≤ Output power ≤ 10 dBm |  |
| Carrier leakage | dBc | -28+TT | Output power > 10 dBm | Carrier leakage frequency (NOTE 4,5) |
|  |  | -25+TT | 0 dBm ≤ Output power ≤ 10 dBm |  |
|  |  | -20+TT | -30 dBm ≤ Output power ≤ 0 dBm |  |
|  |  | -10+TT | -40 dBm ≤ Output power < -30 dBm |  |
| NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. is defined in NOTE 10. The limit is evaluated in each non-allocated RB.  NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs  NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.  NOTE 4: Exceptions to the general limit are allowed for up to two contiguous non-allocated RBs. The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in the non-allocated RB to the measured total power in all allocated RBs.  NOTE 5: The applicable frequencies for this limit are those that are enclosed either in the RB containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB. Carrier leakage frequency is indicated by the UE as described in clause 6.4A.2.1.0. When only one uplink carrier is activated, the applicable LO leakage frequency follow definition in clause 6.4.2.  NOTE 6:  is the Transmission Bandwidth (see clause 5.3) not exceeding  .  NOTE 7:  is the Transmission Bandwidth Configuration (see clause 5.3) of the component carrier with RBs allocated.  NOTE 8:  is the limit specified in Table 6.4.2.1-1 for the modulation format used in the allocated RBs.  NOTE 9:  is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g.  or  for the first adjacent RB outside of the allocated bandwidth).  NOTE 10:  is an average of the transmitted power over 10 sub-frames normalized by the number of allocated RBs, measured in dBm. | | | | |

Table 6.4H.1.2.3.5-2: Test requirements for in-band emissions for intra-band contiguous CA (not allocated component carrier)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Para-meter | Unit | Meas BW  NOTE 1 | Limit | | | remark | Applicable Frequencies |
| General | dB | BW of 1 RB |  | | | The reference value is the average power per allocated RB in the allocated component carrier | Any RB in the non-allocated component carrier.  The frequency raster of the RBs is derived when this component carrier is allocated with RBs |
| IQ Image | dB | BW of 1 RB | NOTE 2 | | | The reference value is the average power per allocated RB in the allocated component carrier | Image frequencies (NOTES 6,7) If UE does not indicate exact frequency for carrier leakage, this requirement does not apply. |
|  |  |  | -28+TT | Output power > 10 dBm | |  |  |
|  |  |  | -25+TT | 0≤ Output power ≤ 10 dBm | |  |  |
| Carrier leakage | dBc | BW of 1 RB | NOTE 3 | | | The reference value is the total power of the allocated RBs in the allocated component carrier | The frequencies of the up to 2 non-allocated RBs are indicated with IE *UplinkTxDirectCurrentMoreCarrierList-r17*. If UE does not indicate exact frequency for carrier leakage, this requirement does not apply. |
|  |  |  | -28+TT | | Output power > 10 dBm |  |  |
|  |  |  | -25+TT | | 0 dBm ≤ Output power ≤ 10 dBm |  |  |
|  |  |  | -20+TT | | -30 dBm ≤ Output power ≤ 0 dBm |  |  |
|  |  |  | -10+TT | | -40 dBm ≤ Output power < -30 dBm |  |  |
| NOTE1: Resolution BWs smaller than the measurement BW may be integrated to achieve the measurement bandwidth.  NOTE 2: Exceptions to the general limit are allowed for up to +1 RBs within a contiguous width of +1 non-allocated RBs.  NOTE 3: Two Exceptions to the general limit are allowed for up to two contiguous non-allocated RBs  NOTE 4: NOTES 1, 5, 6, 7, 8, 9 from Table 6.4A.2.1.1-1 apply for Table 6.4A.2.1.2-2 as well.  NOTE 5:  for measured non-allocated RB in the non-allocated component carrier may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.  NOTE 6: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs  NOTE 7: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. | | | | | | | |

Table 6.4H.1.2.3.5-3: Test Tolerance for In-band emission

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | 0.8dB | 0.8dB |
| 40MHz < BW ≤ 100MHz | 0.8dB | 0.8dB |
| 100MHz < BW ≤ 200MHz | TBD | TBD |

##### 6.4H.1.3 Time alignment error for intra-band UL contiguous CA with UL MIMO

6.4H.1.3.1 Test purpose

To verify that the error of time alignment in UL MIMO does not exceed the range prescribed by the specified UL MIMO Time Alignment Error (TAE) and tolerance.

An excess time alignment error has the possibility to interfere to other channels or other systems and decrease UL MIMO performance because of the timing unsynchronization.

6.4H.1.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support intra-band UL contiguous CA with UL MIMO.

6.4H.1.3.3 Minimum conformance requirements

For intra-band UL contiguous CA and UE(s) with multiple transmit antenna connectors supporting UL MIMO, this requirement applies as specified in 6.4D.3: The time alignment error (TAE) is defined as the average frame timing difference between any two transmissions on different transmit antenna connectors for each CC. For UE(s) with multiple transmit antenna connectors, the Time Alignment Error (TAE) shall not exceed 130 ns.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4H.1.3.

6.4H.1.3.4 Test description

6.4H.1.3.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configuration specified in clause 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in Table 6.4H.1.3.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4H.1.3.4.1-1: Intra band contiguous CA Test Configuration Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Conditions | | | | |
| Test Environment as specified in TS 38.508-1 [5] subclause 4.1 | | Normal | | |
| Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1 | | Mid range, High range | | |
| Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1 | | Lowest NRB\_agg,Highest NRB\_agg | | |
| Test SCS as specified in Table 5.3.5-1 | | lowest and highest supported SCS | | |
| Test Parameters | | | | |
| Test ID | Downlink Configuration | Uplink Configuration | | |
| Modulation | RB allocation (NOTE 1) | |
| PCC | SCC |
| 1 | N/A | CP-OFDM QPSK | Outer Full | 0 |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.  NOTE 2: Test Channel Bandwidths and Test SCS are checked separately for each NR CA band combination, which applicable channel bandwidths is specified in Table 5.5A.1-1 and SCS is specified in Table 5.3.5-1 for each NR band.  NOTE 3: If the UE supports multiple CC Combinations in the CA Configuration with the same NRB\_agg, only the combination with the highest NRB\_PCC is tested.  NOTE 4: The frequencies of PCC and SCC shall be switched and tested in each configuration. | | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.6 for TE diagram and section A.3.2.3.11 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause4.4.3.

3. Downlink signals for PCC are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4H.1.3.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4A.2.1.1.4.3

6.4H.1.3.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.4H.1.3.4.3.

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[19], clause9.3).

4. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4A.2.1.1.4.1-1 and 6.4A.2.1.1.4.1-2. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

5. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level, allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

6. Measure the timing of one sub-frame at each antenna connector on PCC.

6.4H.1.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX\_UL\_MIMO.

6.4H.1.3.5 Test requirement

For UE(s) with multiple transmit antenna connectors, the Time Alignment Error (TAE) shall not exceed 130 + TT ns.

Table 6.4H.1.3.5-1: Test Tolerance (Time alignment error for UL MIMO)

|  |
| --- |
| Test Tolerance |
| 25ns |

##### 6.4H.1.4 Coherent UL MIMO for intra-band UL contiguous CA with UL MIMO

Editor’s note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Test config table is still FFS.

- Scheduling pattern within 20ms measurement window is FFS

- The test procedure is FFS.

- MU and TT value are still FFS

6.4H.1.4.1 Test purpose

To verify that the difference of relative phase error and the difference of relative power error between antenna ports in coherent UL MIMO do not exceed the range prescribed by the specified requirements for coherent UL MIMO and tolerance.

6.4H.1.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support intra-band UL contiguous CA with UL MIMO.

6.4H.1.4.3 Minimum conformance requirements

For UE supporting intra-band UL contiguous CA and UL MIMO, the coherent UL MIMO requirement are specified on each CC as in 6.4D.4.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4H.1.4.

6.4H.1.4.4 Test description

6.4H.1.4.4.1 Initial conditions

Initial conditions are a set of test configurations the UE needs to be tested in and the steps for the SS to take with the UE to reach the correct measurement state.

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR CA configuration specified in clause 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, and are shown in Table 6.4H.1.4.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4H.1.4.4.1-1: Intra band contiguous CA Test Configuration Table

FFS

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.1.6 for TE diagram and section A.3.2.3.11 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [5] subclause4.4.3.

3. Downlink signals for PCC are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4H.1.4.4.1-1.

5. Propagation conditions are set according to Annex B.0.

6. Ensure the UE is in state RRC\_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 6.4A.2.1.1.4.3

6.4H.1.4.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.

2. The SS shall configure SCC as per TS 38.508-1 [5] clause 5.5.1. Message contents are defined in clause 6.4H.1.4.4.3.

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [18], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[19], clause9.3).

4. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0\_1 for C\_RNTI to schedule the UL RMC according to Table 6.4H.1.4.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0\_1 is specified with the condition 2TX\_UL\_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

5. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at PUMAX level, allow at least 200ms starting from the first TPC command in this step for the UE to reach PUMAX level.

6. Measure the mean power of the UE on each antenna port on SRS symbol in the SRS channel bandwidth according to the test configuration from table 6.4H.1.4.4.1-1. Calculate the power difference between antenna ports and save this value as ‘Power\_ref’.

7. On the slots within 20ms following the SRS symbol, measure the mean power of the UE on each antenna port in the channel bandwidth according to the test configuration from table 6.2.4.4.1-1. The period of measurement shall be at least the continuous duration of one active slot and in the uplink symbols. For TDD slots with transient periods are not under test. Calculate the power difference between antenna ports and save this value as ‘Power\_meas’.

6.4H.1.4.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX\_UL\_MIMO.

6.4H.1.4.5 Test requirement

Maximum allowable difference of ‘power\_ref’ measured in step 6 and ‘power\_meas’ measured in step 7 shall not exceed the described relative power error in Table 6.4H.1.4.5-1.

Table 6.4H.1.4.5-1: Maximum allowable difference of relative phase and power errors in a given slot compared to those measured at last SRS transmitted

|  |  |  |
| --- | --- | --- |
| Difference of relative phase error | Difference of relative power error | Time window |
| 40+TT degrees | 4+TT1 dB | 20 msec |
| NOTE 1: TT for relative power for each frequency and channel bandwidth is specified in Table 6.4H.1.4.5-2. | | |

Table 6.4H.1.4.5-2: Test Tolerance

|  |  |  |
| --- | --- | --- |
|  | f ≤ 3.0GHz | 3.0GHz < f ≤ 6GHz |
| BW ≤ 40MHz | FFS | FFS |
| 40MHz < BW ≤ 100MHz | FFS | FFS |