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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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The present document is one part of a multi-part Technical Specification (TS) covering the New Radio (NR) User Equipment (UE) conformance specification, which is divided in the following parts:

- 3GPP TS 38.521-1: " NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Range 1 Standalone" (the present document).
- 3GPP TS 38.521-2 [13]: " NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 2: Range 2 Standalone".
- 3GPP TS 38.521-3 [14]: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios"
- 3GPP TS 38.521-4 [15]: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 4: Performance".
- 3GPP TS 38.522 [16]: NR; User Equipment (UE) conformance specification; Applicability of RF and RRM test cases;
- 3GPP TS 38.533 [17]: NR; User Equipment (UE) conformance specification; Radio resource management;

1 Scope

The present document specifies the measurement procedures for the conformance test of the user equipment (UE) that contain RF characteristics for frequency Range 1 as part of the 5G-NR.

The requirements are listed in different clauses only if the corresponding parameters deviate. More generally, tests are only applicable to those mobiles that are intended to support the appropriate functionality. To indicate the circumstances in which tests apply, this is noted in the "*definition and applicability*" part of the test.

For example only Release 15 and later UE declared to support 5G-NR shall be tested for this functionality. In the event that for some tests different conditions apply for different releases, this is indicated within the text of the test itself.

2 Reference

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

For a specific reference, subsequent revisions do not apply.

For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

Editor's note: intended to capture more references

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[3] 3GPP TS 38.101-2: " NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[4] 3GPP TS 38.101-3: " NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

[5] 3GPP TS 38.508-1: "5GS; User Equipment (UE) conformance specification; Part 1: Common test environment ".

[6] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[7] Recommendation ITU-R M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".

[8] 3GPP TS 38.211: "NR; Physical channels and modulation".

[9] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[10] 3GPP TR 38.903: "NR; Derivation of test tolerances and measurement uncertainty for User Equipment (UE) conformance tests".

[11] 3GPP TR 38.905: "NR; Derivation of test points for radio transmission and reception conformance test cases".

[12] 3GPP TS 38.214: "NR; Physical layer procedures for data".

[13] 3GPP TS 38.521-2: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 2: Range 2 Standalone".

[14] 3GPP TS 38.521-3: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

[15] 3GPP TS 38.521-4: “NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 4: Performance”.

[16] 3GPP TS 38.522: "NR; User Equipment (UE) conformance specification; Applicability of RF and RRM test cases".

[17] 3GPP TS 38.533: "NR; User Equipment (UE) conformance specification; Applicability of RF and RRM test cases".

[18] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

[19] 3GPP TS 38.133: "NR; Requirements for support of radio resource management ".

[20] 3GPP TS 38.215: "NR; Physical layer measurements".

[21] 3GPP TS 36.521-1: “Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment UE) conformance specification; Radio transmission and reception; Part 1: Conformance Testing”.

[22] ITU-R Recommendation SM.329-10, "Unwanted emissions in the spurious domain".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

Aggregated Channel Bandwidth: The RF bandwidth in which a UE transmits and receives multiple contiguously aggregated carriers.

Carrier aggregation: Aggregation of two or more component carriers in order to support wider transmission bandwidths.

Carrier aggregation band: A set of one or more operating bands across which multiple carriers are aggregated with a specific set of technical requirements.

Carrier aggregation bandwidth class: A class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by a UE.

Carrier aggregation configuration: A combination of CA operating band(s) and CA bandwidth class(es) supported by a UE.

Contiguous carriers: A set of two or more carriers configured in a spectrum block where there are no RF requirements based on co-existence for un-coordinated operation within the spectrum block.

Contiguous resource allocation: A resource allocation of consecutive resource blocks within one carrier or across contiguously aggregated carriers. The gap between contiguously aggregated carriers due to the nominal channel spacing is allowed.

Contiguous spectrum: Spectrum consisting of a contiguous block of spectrum with no sub-block gaps.

Inter-band carrier aggregation: Carrier aggregation of component carriers in different operating bands.

NOTE: Carriers aggregated in each band can be contiguous or non-contiguous.

Intra-band contiguous carrier aggregation: Contiguous carriers aggregated in the same operating band.

Intra-band non-contiguous carrier aggregation: Non-contiguous carriers aggregated in the same operating band.

Sub-block: This is one contiguous allocated block of spectrum for transmission and reception by the same UE. There may be multiple instances of sub-blocks within an RF bandwidth.

Sub-block bandwidth: The bandwidth of one sub-block.

Sub-block gap: A frequency gap between two consecutive sub-blocks within an RF bandwidth, where the RF requirements in the gap are based on co-existence for un-coordinated operation.

UE transmission bandwidth configuration: Set of resource blocks located within the UE channel bandwidth which may be used for transmitting or receiving by the UE.

Vehicular UE: A UE embedded in a vehicle, permanently connected to an embedded antenna system that radiates externally for NR operating bands.

NOTE: Vehicular UE does not refer to other UE form factors placed inside the vehicle.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

ΔF_{Global}	Granularity of the global frequency raster
ΔF_{Raster}	Band dependent channel raster granularity
Δf_{OOB}	Δ Frequency of Out Of Band emission
$\Delta F_{TX\text{-}RX}$	Δ Frequency of default TX-RX separation of the FDD operating band
$\Delta P_{PowerClass}$	Adjustment to maximum output power for a given power class
Δ_{RB}	The starting frequency offset between the allocated RB and the measured non-allocated RB
$\Delta R_{IB,c}$	Allowed reference sensitivity relaxation due to support for inter-band CA operation, for serving cell *c*
$\Delta R_{IB,4R}$	Reference sensitivity adjustment due to support for 4 antenna ports
Δ_{Shift}	Channel raster offset
ΔT_C	Allowed operating band edge transmission power relaxation
$\Delta T_{C,c}$	Allowed operating band edge transmission power relaxation for serving cell *c*
$\Delta T_{IB,c}$	Allowed maximum configured output power relaxation due to support for inter-band CA operation and due to support for SUL operations, for serving cell *c*
$BW_{Channel}$	Channel bandwidth
$BW_{Channel,block}$	Sub-block bandwidth, expressed in MHz. $BW_{Channel,block}= F_{edge,block,high}- F_{edge,block,low}$
$BW_{Channel\_CA}$	Aggregated channel bandwidth, expressed in MHz
$BW_{Channel,max}$	Maximum channel bandwidth supported among all bands in a release
BW_{GB}	$\max(BW_{GB,Channel(k)})$
$BW_{GB,Channel(k)}$	Minimum guard band defined in sub-clause 5.3A.1 of carrier *k*
BW_{DL}	Channel bandwidth for DL
BW_{UL}	Channel bandwidth for UL
$BW_{interferer}$	Bandwidth of the interferer
Ceil(x)	Rounding upwards; ceil(x) is the smallest integer such that ceil(x) ≥ x
Floor(x)	Rounding downwards; floor(x) is the greatest integer such that floor(x) ≤ x
F_C	RF reference frequency on the channel raster, given in table 5.4.2.2-1
$F_{C,block, high}$	Fc of the highest transmitted/received carrier in a sub-block
$F_{C,block, low}$	Fc of the lowest transmitted/received carrier in a sub-block
$F_{C, low}$	The Fc of the lowest carrier, expressed in MHz
$F_{C, high}$	The Fc of the highest carrier, expressed in MHz
F_{DL_low}	The lowest frequency of the downlink operating band
F_{DL_high}	The highest frequency of the downlink operating band
F_{UL_low}	The lowest frequency of the uplink operating band
F_{UL_high}	The highest frequency of the uplink operating band
$F_{edge,block,low}$	The lower sub-block edge, where $F_{edge,block,low} = F_{C,block,low} - F_{offset., low}$
$F_{edge,block,high}$	The upper sub-block edge, where $F_{edge,block,high} = F_{C,block,high} + F_{offset., high}$
$F_{edge, low}$	The *lower edge* of aggregated channel bandwidth, expressed in MHz. $F_{edge,low} = F_{C,low} - F_{offset,low}$
$F_{edge, high}$	The *higher edge* of aggregated channel bandwidth, expressed in MHz. $F_{edge,high} = F_{C,high} + F_{offset,high}$
$F_{Interferer}$ (offset)	Frequency offset of the interferer (between the centre frequency of the interferer and the carrier frequency of the carrier measured)
$F_{Interferer}$	Frequency of the interferer
$F_{Ioffset}$	Frequency offset of the interferer (between the centre frequency of the interferer and the closest edge of the carrier measured)
F_{offset}	Frequency offset from $F_{C, high}$ to the *higher edge* or $F_{C, low}$ to the *lower edge*

$F_{offset,high}$	Frequency offset from $F_{C,high}$ to the upper *UE RF Bandwidth edge*, or from $F_{C,block, high}$ to the upper sub-block edge
$F_{offset,low}$	Frequency offset from $F_{C,low}$ to the lower *UE RF Bandwidth edge*, or from $F_{C,block, low}$ to the lower sub-block edge
F_{OOB}	The boundary between the NR out of band emission and spurious emission domains
F_{REF}	RF reference frequency
$F_{REF-Offs}$	Offset used for calculating F_{REF}
$F_{REF,Shift}$	RF reference frequency for Supplementary Uplink (SUL) bands and for the uplink for all FDD bands
F_{uw} (offset)	The frequency separation of the centre frequency of the carrier closest to the interferer and the centre frequency of the interferer
$GB_{Channel}$	Minimum guard band defined in sub-clause 5.3.3
L_{CRB}	Transmission bandwidth which represents the length of a contiguous resource block allocation expressed in units of resources blocks
Max()	The largest of given numbers
Min()	The smallest of given numbers
n_{PRB}	Physical resource block number
NR_{ACLR}	NR ACLR
N_{RB}	Transmission bandwidth configuration, expressed in units of resource blocks
N_{RB_alloc}	Total number of simultaneously transmitted resource blocks in Channel bandwidth or Aggregated Channel Bandwidth configuration
$N_{RB,low}$	The transmission bandwidth configurations according to Table 5.3.2-1 for the lowest assigned component carrier in section 5.3A.1
$N_{RB,high}$	The transmission bandwidth configurations according to Table 5.3.2-1 for the highest assigned component carrier in section 5.3A.1
N_{REF}	NR Absolute Radio Frequency Channel Number (NR-ARFCN)
$N_{REF-Offs}$	Offset used for calculating N_{REF}
P_{CMAX}	The configured maximum UE output power
$P_{CMAX,c}$	The configured maximum UE output power for serving cell *c*
$P_{CMAX,f,c}$	The configured maximum UE output power for carrier *f* of serving cell *c* in each slot
P_{EMAX}	Maximum allowed UE output power signalled by higher layers
$P_{EMAX,c}$	Maximum allowed UE output power signalled by higher layers for serving cell *c*
$P_{Interferer}$	Modulated mean power of the interferer
$P_{PowerClass}$	The nominal UE power (i.e., no tolerance)
$P\text{-}MPR_c$	Maximum allowed UE output power reduction for serving cell *c*
P_{RB}	The transmitted power per allocated RB, measured in dBm
P_{UMAX}	The measured configured maximum UE output power
Puw	Power of an unwanted DL signal
Pw	Power of a wanted DL signal
P_L_{CRB}	Number of transmitted resource blocks on the Primary Component Carrier
RB_{Start}	Indicates the lowest RB index of transmitted resource blocks
SCS_{low}	SCS for the lowest assigned component carrier in section 5.3A.1
SCS_{high}	SCS for the highest assigned component carrier in section 5.3A.1
S_L_{CRB}	Number of transmitted resource blocks on the Secondary Component Carrier
$T(P_{CMAX,f,c})$	Tolerance for applicable values of $P_{CMAX,f,c}$ for configured maximum UE output power for carrier *f* of serving cell *c*
$T_{L,c}$	Absolute value of the lower tolerance for the applicable *operating band* as specified in section 6.2.1
SS_{REF}	SS block reference frequency position
$UTRA_{ACLR}$	UTRA ACLR

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

ACLR	Adjacent Channel Leakage Ratio
ACS	Adjacent Channel Selectivity
A-MPR	Additional Maximum Power Reduction
BS	Base Station

BW	Bandwidth
BWP	Bandwidth Part
CA	Carrier Aggregation
CA_nX-nY	Inter-band CA of component carrier(s) in one sub-block within Band nX and component carrier(s) in one sub-block within Band nY where nX and nY are the applicable NR *operating bands*
CC	Component Carriers
CP-OFDM	Cyclic Prefix-OFDM
CW	Continuous Wave
DC	Dual Connectivity
DFT-s-OFDM	Discrete Fourier Transform-spread-OFDM
DM-RS	Demodulation Reference Signal
DTX	Discontinuous Transmission
E-UTRA	Evolved UTRA
EVM	Error Vector Magnitude
FR	Frequency Range
FRC	Fixed Reference Channel
GSCN	Global Synchronization Channel Number
IBB	In-band Blocking
IDFT	Inverse Discrete Fourier Transformation
ITU-R	Radio communication Sector of the International Telecommunication Union
MBW	Measurement bandwidth defined for the protected band
MOP	Maximum Output Power
MPR	Allowed maximum power reduction
MSD	Maximum Sensitivity Degradation
NR	New Radio
NR-ARFCN	NR Absolute Radio Frequency Channel Number
NS	Network Signalling
OCNG	OFDMA Channel Noise Generator
OOB	Out-of-band
P-MPR	Power Management Maximum Power Reduction
PRB	Physical Resource Block
QAM	Quadrature Amplitude Modulation
RE	Resource Element
REFSENS	Reference Sensitivity
RF	Radio Frequency
RMS	Root Mean Square (value)
RSRP	Reference Signal Receiving Power
Rx	Receiver
SC	Single Carrier
SCS	Subcarrier spacing
SDL	Supplementary Downlink
SEM	Spectrum Emission Mask
SNR	Signal-to-Noise Ratio
SRS	Sounding Reference Symbol
SUL	Supplementary uplink
SS	Synchronization Symbol
TAE	Time Alignment Error
Tx	Transmitter
UL-MIMO	Uplink Multiple Antenna transmission

4 General

4.1 Relationship between minimum requirements and test requirements

The TS 38.101-1 [2] is a Single-RAT specification for NR UE, covering RF characteristics and minimum performance requirements. Conformance to the TS 38.101-1 [2] is demonstrated by fulfilling the test requirements specified in the present document.

The Minimum Requirements given in TS 38.101-1 [2] make no allowance for measurement uncertainty (MU). The present document defines test tolerances (TT) and measurement uncertainty. These test tolerances are individually defined for each test. The test tolerances are used to relax the minimum requirements in TS 38.101-1 [2] to create test requirements. For some requirements, including regulatory requirements, the test tolerance is set to zero.

The measurement results returned by the test system are compared - without any modification - against the test requirements as defined by either the “Never fail a good DUT” principle for Test Tolerance equal measurement uncertainty (TT = MU) or “Shared Risk” principle for Test Tolerance equal to 0 (TT = 0). Test tolerances lower that measurement uncertainty and greater than 0 (0 < TT < MU) are also considered in this specification.

The “Never fail a good DUT” and the “Shared Risk” principles are defined in Recommendation ITU-R M.1545 [7].

4.2 Applicability of minimum requirements

a) In TS 38.101-1 [2] the Minimum Requirements are specified as general requirements and additional requirements. Where the Requirement is specified as a general requirement, the requirement is mandated to be met in all scenarios

b) For specific scenarios for which an additional requirement is specified, in addition to meeting the general requirement, the UE is mandated to meet the additional requirements.

c) The spurious emissions power requirements are for the long-term average of the power. For the purpose of reducing measurement uncertainty it is acceptable to average the measured power over a period of time sufficient to reduce the uncertainty due to the statistical nature of the signal.

d) All the requirements for intra-band contiguous and non-contiguous CA apply under the assumption of the same uplink-downlink and special subframe configurations in the PCell and SCells for SA.

4.3 Specification suffix information

Unless stated otherwise the following suffixes are used for indicating at 2nd level subclause, shown in Table 4.3-1.

Table 4.3-1: Definition of suffixes

Clause suffix	Variant
None	Single Carrier
A	Carrier Aggregation (CA)
B	Dual-Connectivity (DC)
C	Supplement Uplink (SUL)
D	UL MIMO

A terminal which supports the above features needs to meet both the general requirements and the additional requirement applicable to the additional subclause (suffix A, B, C and D) in clauses 5, 6 and 7. Where there is a difference in requirement between the general requirements and the additional subclause requirements (suffix A, B, C and D) in clauses 5, 6 and 7, the tighter requirements are applicable unless stated otherwise in the additional subclause.

A terminal which supports more than one feature in clauses 5, 6 and 7 shall meet all of the separate corresponding 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 a terminal that supports SUL, the current version of the specification assumes the terminal is not configured with UL MIMO on SUL carrier.

4.4 Test points analysis

The information on test point analysis and test point selection including number of test points for each test case is shown in TR 38.905 [11] clause 4.1.

5 Operating bands and Channel arrangement

5.1 General

The channel arrangements presented in this clause are based on the operating bands and channel bandwidths defined in the present release of specifications.

NOTE: Other operating bands and channel bandwidths may be considered in future releases.

Requirements throughout the RF specifications are in many cases defined separately for different frequency ranges (FR). The frequency ranges in which NR can operate according to this version of the specification are identified as described in Table 5.1-1.

Table 5.1-1: Definition of frequency ranges

Frequency range designation	Corresponding frequency range
FR1	410 MHz – 7125 MHz
FR2	24250 MHz – 52600 MHz

The present specification covers FR1 operating bands.

5.2 Operating bands

NR is designed to operate in the FR1 operating bands defined in Table 5.2-1.

Table 5.2-1: NR operating bands in FR1

NR operating band	Uplink (UL) *operating band* BS receive / UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) *operating band* BS transmit / UE receive F_{DL_low} – F_{DL_high}	Duplex Mode
n1	1920 MHz – 1980 MHz	2110 MHz – 2170 MHz	FDD
n2	1850 MHz – 1910 MHz	1930 MHz – 1990 MHz	FDD
n3	1710 MHz – 1785 MHz	1805 MHz – 1880 MHz	FDD
n5	824 MHz – 849 MHz	869 MHz – 894 MHz	FDD
n7	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	FDD
n8	880 MHz – 915 MHz	925 MHz – 960 MHz	FDD
n12	699 MHz – 716 MHz	729 MHz – 746 MHz	FDD
n20	832 MHz – 862 MHz	791 MHz – 821 MHz	FDD
n25	1850 MHz – 1915 MHz	1930 MHz – 1995 MHz	FDD
n28	703 MHz – 748 MHz	758 MHz – 803 MHz	FDD
n34	2010 MHz – 2025 MHz	2010 MHz – 2025 MHz	TDD
n38	2570 MHz – 2620 MHz	2570 MHz – 2620 MHz	TDD
n39	1880 MHz – 1920 MHz	1880 MHz – 1920 MHz	TDD
n40	2300 MHz – 2400 MHz	2300 MHz – 2400 MHz	TDD
n41	2496 MHz – 2690 MHz	2496 MHz – 2690 MHz	TDD
n50	1432 MHz – 1517 MHz	1432 MHz – 1517 MHz	TDD[1]
n51	1427 MHz – 1432 MHz	1427 MHz – 1432 MHz	TDD
n66	1710 MHz – 1780 MHz	2110 MHz – 2200 MHz	FDD
n70	1695 MHz – 1710 MHz	1995 MHz – 2020 MHz	FDD
n71	663 MHz – 698 MHz	617 MHz – 652 MHz	FDD
n74	1427 MHz – 1470 MHz	1475 MHz – 1518 MHz	FDD
n75	N/A	1432 MHz – 1517 MHz	SDL
n76	N/A	1427 MHz – 1432 MHz	SDL
n77	3300 MHz – 4200 MHz	3300 MHz – 4200 MHz	TDD
n78	3300 MHz – 3800 MHz	3300 MHz – 3800 MHz	TDD
n79	4400 MHz – 5000 MHz	4400 MHz – 5000 MHz	TDD
n80	1710 MHz – 1785 MHz	N/A	SUL
n81	880 MHz – 915 MHz	N/A	SUL
n82	832 MHz – 862 MHz	N/A	SUL
n83	703 MHz – 748 MHz	N/A	SUL
n84	1920 MHz – 1980 MHz	N/A	SUL
n86	1710 MHz – 1780MHz	N/A	SUL
NOTE 1: UE that complies with the NR Band n50 minimum requirements in this specification. Shall also comply with the NR Band n51 minimum requirements. NOTE 2: UE that complies with the NR Band n75 minimum requirements in this specification. Shall also comply with the NR Band n76 minimum requirements.			

5.2A Operating bands for CA

5.2A.1 Intra-band CA

NR intra-band contiguous carrier aggregation is designed to operate in the operating bands defined in Table 5.2A.1-1, where all operating bands are within FR1.

Table 5.2A.1-1: Intra-band contiguous CA operating bands in FR1

NR CA Band	NR Band (Table 5.2-1)
CA_n77	n77
CA_n78	n78
CA_n79	n79

5.2A.2 Inter-band CA

NR inter-band carrier aggregation is designed to operate in the operating bands defined in Table 5.2A.2-1, where all operating bands are within FR1.

Table 5.2A.2-1: Inter-band CA operating bands involving FR1 (two bands)

NR CA Band	NR Band (Table 5.2-1)
CA_n3-n77	n3, n77
CA_n3-n78	n3, n78
CA_n3-n79	n3, n79
CA_n8-n75	n8, n75
CA n8-n78	n8, n78
CA_n8-n79	n8, n79
CA_n28-n75[2]	n28, n75
CA_n28_n78	n28, n78
CA_n41-n78	n41, n78
CA_n75-n78[1]	n75, n78
CA_n76-n78	n76, n78
CA_n77-n79	n77, n79
CA_n78-n79	n78, n79
NOTE 1: Applicable for UE supporting inter-band carrier aggregation with mandatory simultaneous Rx/Tx capability. NOTE 2: The frequency range in band n28 is restricted for this band combination to 703-733 MHz for the UL and 758-788 MHz for the DL.	

5.2B Void

5.2B.1 Void

Table 5.2B.1-1:Void

5.2C Operating band combination for SUL

NR operation is designed to operate in the operating band combination defined in Table 5.2C-1, where all operating bands are within FR1.

Table 5.2C-1: Operating band combination for SUL in FR1

NR Band combination for SUL	NR Band (Table 5.2-1)
SUL_n78-n80[2]	n78, n80
SUL_n78-n81[2]	n78, n81
SUL_n78-n82[2]	n78, n82
SUL_n78-n83[2]	n78, n83
SUL_n78-n84[2]	n78, n84
SUL_n78-n86[2]	n78, n86
SUL_n79-n80[2]	n79, n80
SUL_n79-n81[2]	n79, n81
NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier is 0us. NOTE 2: For UE supporting SUL band combination simultaneous Rx/Tx capability is mandatory.	

5.3 UE channel bandwidth

5.3.1 General

The UE channel bandwidth supports a single NR RF carrier in the uplink or downlink at the UE. From a BS perspective, different UE channel bandwidths may be supported within the same spectrum for transmitting to and receiving from UEs connected to the BS. Transmission of multiple carriers to the same UE (CA) or multiple carriers to different UEs within the BS channel bandwidth can be supported.

From a UE perspective, the UE is configured with one or more BWP / carriers, each with its own UE channel bandwidth. The UE does not need to be aware of the BS channel bandwidth or how the BS allocates bandwidth to different UEs.

The placement of the UE channel bandwidth for each UE carrier is flexible but can only be completely within the BS channel bandwidth.

The relationship between the channel bandwidth, the guardband and the maximum transmission bandwidth configuration is shown in Figure 5.3.1-1.

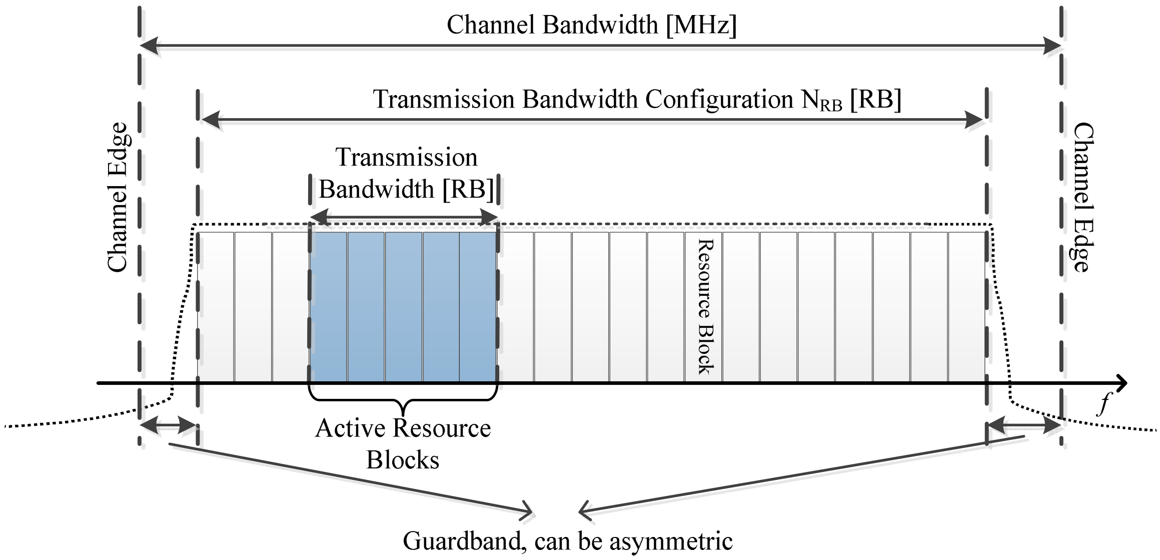

Figure 5.3.1-1: Definition of the channel bandwidth and the maximum transmission bandwidth configuration for one NR channel

5.3.2 Maximum transmission bandwidth configuration

The maximum transmission bandwidth configuration N_{RB} for each UE channel bandwidth and subcarrier spacing is specified in Table 5.3.2-1.

Table 5.3.2-1: Maximum transmission bandwidth configuration N_{RB}

SCS (kHz)	5MHz	10MHz	15MHz	20 MHz	25 MHz	30 MHz	40 MHz	50MHz	60 MHz	80 MHz	90 MHz	100 MHz
	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}	N_{RB}
15	25	52	79	106	133	160	216	270	N/A	N/A	N/A	N/A
30	11	24	38	51	65	78	106	133	162	217	245	273
60	N/A	11	18	24	31	38	51	65	79	107	121	135

5.3.3 Minimum guard band and transmission bandwidth configuration

The minimum guard band for each UE channel bandwidth and SCS is specified in Table 5.3.3-1.

Table 5.3.3-1: Minimum guard band for each UE channel bandwidth and SCS (kHz)

SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50MHz	60 MHz	80 MHz	90 MHz	100 MHz
15	242.5	312.5	382.5	452.5	522.5	592.5	552.5	692.5	N/A	N/A	N/A	N/A
30	505	665	645	805	785	945	905	1045	825	925	885	845
60	N/A	1010	990	1330	1310	1290	1610	1570	1530	1450	1410	1370

NOTE: The minimum guard bands have been calculated using the following equation: ($BW_{channel}$ x 1000 (kHz) - NRB x SCS x 12) / 2 - SCS/2, where N_{RB} are from Table 5.3.2-1.

Figure 5.3.3-1: Void

The number of RBs configured in any channel bandwidth shall ensure that the minimum guard band specified in this clause is met.

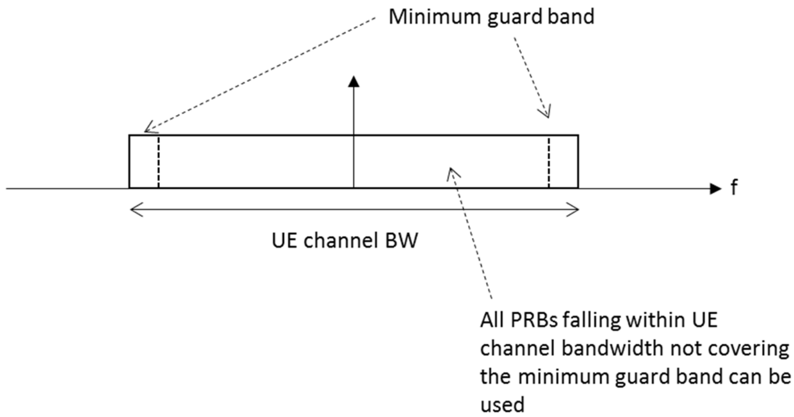

Figure 5.3.3-2: UE PRB utilization

In the case that multiple numerologies are multiplexed in the same symbol due to BS transmission of SSB, the minimum guard band on each side of the carrier is the guard band applied at the configured channel bandwidth for the numerology that is received immediately adjacent to the guard.

If multiple numerologies are multiplexed in the same symbol and the UE channel bandwidth is >50 MHz, the minimum guard band applied adjacent to 15 kHz SCS shall be the same as the minimum guard band defined for 30 kHz SCS for the same UE channel bandwidth.

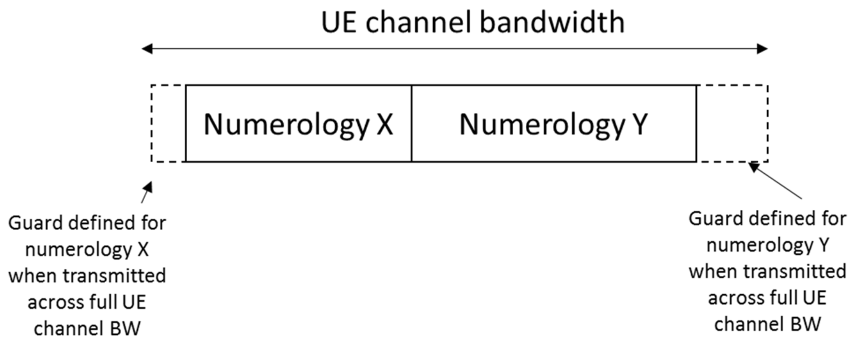

Figure 5.3.3-3: Guard band definition when transmitting multiple numerologies

NOTE: Figure 5.3.3-3 is not intended to imply the size of any guard between the two numerologies. Inter-numerology guard band within the carrier is implementation dependent.

5.3.4 RB alignment

For each numerology, its common resource blocks are specified in Section 4.4.4.3 in [8], and the starting point of its transmission bandwidth configuration on the common resource block grid for a given channel bandwidth is indicated by an offset to "Reference point A" in the unit of the numerology. The *UE transmission bandwidth configuration* is indicated by the higher layer parameter *carrierBandwidth* [6] and will fulfil the minimum UE guard band requirement specified in Section 5.3.3.

5.3.5 UE channel bandwidth per operating band

The requirements in this specification apply to the combination of channel bandwidths, SCS and operating bands shown in Table 5.3.5-1. The transmission bandwidth configuration in Table 5.3.2-1 shall be supported for each of the specified channel bandwidths. The channel bandwidths are specified for both the TX and RX path.

Table 5.3.5-1: Channel Bandwidths for Each NR band

NR band / SCS / UE Channel bandwidth													
NR Band	**SCS kHz**	**5 MHz**	**10[1,2] MHz**	**15[2] MHz**	**20[2] MHz**	**25[2] MHz**	**30 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**90 MHz**	**100 MHz**
n1	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60		Yes	Yes	Yes								
n2	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60		Yes	Yes	Yes								
n3	15	Yes	Yes	Yes	Yes	Yes	Yes						
	30		Yes	Yes	Yes	Yes	Yes						
	60		Yes	Yes	Yes	Yes	Yes						
n5	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60												
n7	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60		Yes	Yes	Yes								
n8	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60												
n12	15	Yes	Yes	Yes									
	30		Yes	Yes									
	60												
n20	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60												
n25	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60		Yes	Yes	Yes								
n28	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60												
n34	15	Yes	Yes	Yes									
	30		Yes	Yes									
	60		Yes	Yes									
n38	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60		Yes	Yes	Yes								
n39	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes					
	30		Yes	Yes	Yes	Yes	Yes	Yes					
	60		Yes	Yes	Yes	Yes	Yes	Yes					
n40	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
	30		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
	60		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
n41	15		Yes	Yes	Yes			Yes	Yes				
	30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes[6]	Yes
	60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes[6]	Yes
n50	15	Yes	Yes	Yes	Yes			Yes	Yes				
	30		Yes	Yes	Yes			Yes	Yes	Yes	Yes[3]		
	60		Yes	Yes	Yes			Yes	Yes	Yes	Yes[3]		
n51	15	Yes											
	30												
	60												
n66	15	Yes	Yes	Yes	Yes			Yes					
	30		Yes	Yes	Yes			Yes					
	60		Yes	Yes	Yes			Yes					
n70	15	Yes	Yes	Yes	Yes[3]	Yes[3]							
	30		Yes	Yes	Yes[3]	Yes[3]							
	60		Yes	Yes	Yes[3]	Yes[3]							

n71	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60												
n74	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60		Yes	Yes	Yes								
n75	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60		Yes	Yes	Yes								
n76	15	Yes											
	30												
	60												
n77	15		Yes	Yes	Yes			Yes	Yes				
	30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes[6]	Yes
	60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes[6]	Yes
n78	15		Yes	Yes	Yes			Yes	Yes				
	30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes[6]	Yes
	60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes[6]	Yes
n79	15							Yes	Yes				
	30							Yes	Yes	Yes	Yes		Yes
	60							Yes	Yes	Yes	Yes		Yes
n80	15	Yes	Yes	Yes	Yes	Yes	Yes						
	30		Yes	Yes	Yes	Yes	Yes						
	60		Yes	Yes	Yes	Yes	Yes						
n81	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60												
n82	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60												
n83	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60												
n84	15	Yes	Yes	Yes	Yes								
	30		Yes	Yes	Yes								
	60		Yes	Yes	Yes								
n86	15	Yes	Yes	Yes	Yes			Yes					
	30		Yes	Yes	Yes			Yes					
	60		Yes	Yes	Yes			Yes					

NOTE 1: 90% spectrum utilization may not be achieved for 30kHz SCS.
NOTE 2: 90% spectrum utilization may not be achieved for 60kHz SCS.
NOTE 3: This UE channel bandwidth is applicable only to downlink.
NOTE 4: For test configuration tables from the transmitter and receiver tests in Section 6 and 7 that refer to this table for test SCS, the Lowest SCS refers to lowest supported SCS per channel bandwidth, Highest SCS refers to highest supported SCS per channel bandwidth.
NOTE 5: For test configuration tables from the transmitter and receiver tests in Section 6 and 7 that refer to this table and list and list the test SCS as Mid or any other value; if that value is not supported by the UE in UL and/or DL, select the closest SCS supported by the UE in both UL and DL.
NOTE 6: This UE channel bandwidth is optional in R15.

5.3.6 Asymmetric channel bandwidths

The UE channel bandwidth can be asymmetric in downlink and uplink. In asymmetric channel bandwidth operation, the narrower carrier shall be confined within the frequency range of the wider channel bandwidth.

In FDD, the confinement is defined as a deviation to the default Tx-Rx carrier centre frequency separation (defined in Table 5.4.4-1) as following:

$$\Delta F_{TX\text{-}RX} = |\ (BW_{DL} - BW_{UL})/2\ |$$

The operating bands and supported asymmetric channel bandwidth combinations are defined in Table 5.3.6-1.

Table 5.3.6-1: FDD asymmetric UL and DL channel bandwidth combinations

NR Band	Channel bandwidths for UL (MHz)	Channel bandwidths for DL (MHz)
n66	5, 10	20, 40
	20	40
n70	5	10, 15
	5, 10, 15	20, 25
n71	5	10
	10	15
	15	20

In TDD, the operating bands and supported asymmetric channel bandwidth combinations are defined in Table 5.3.6-2.

Table 5.3.6-2: TDD asymmetric UL and DL channel bandwidth combinations

NR Band	Channel bandwidths for UL (MHz)	Channel bandwidths for DL (MHz)
n50	60	80

5.3A UE channel bandwidth for CA

5.3A.1 General

Figure 5.3A.1-1: Void

Figure 5.3A.1-2: Void

5.3A.2 Maximum transmission bandwidth configuration for CA

For carrier aggregation, the maximum transmission bandwidth configuration is defined per component carrier and the requirement is specified in subclause 5.3.2.

5.3A.3 Minimum guard band and transmission bandwidth configuration for CA

For intra-band contiguous carrier aggregation, *Aggregated Channel Bandwidth* and *Guard Bands* are defined as follows, see Figure 5.3A.3-1.

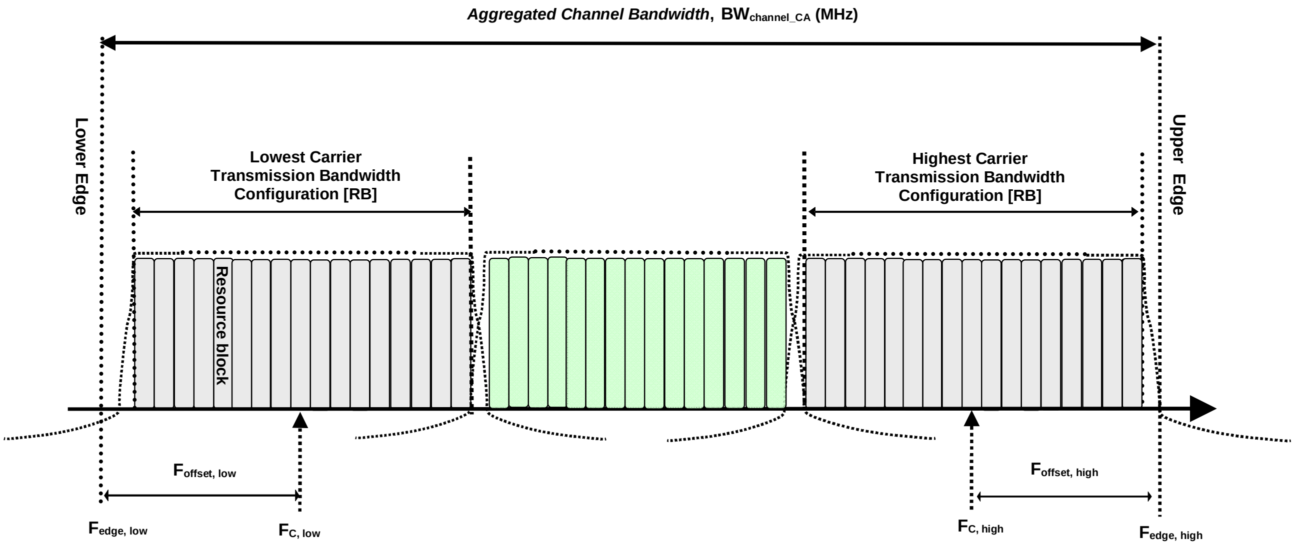

Figure 5.3A.3-1: Definition of *Aggregated Channel Bandwidth* for intra-band carrier aggregation

The *aggregated channel bandwidth,* $BW_{Channel\_CA}$, is defined as

$$BW_{Channel\_CA} = F_{edge,high} - F_{edge,low} \text{ (MHz)}.$$

The lower bandwidth edge $F_{edge,\ low}$ and the upper bandwidth edge $F_{edge,high}$ of the aggregated channel bandwidth are used as frequency reference points for transmitter and receiver requirements and are defined by

$$F_{edge,low} = F_{C,low} - F_{offset,low}$$

$$F_{edge,high} = F_{C,high} + F_{offset,high}$$

The lower and upper frequency offsets depend on the transmission bandwidth configurations of the lowest and highest assigned edge component carrier and are defined as

$$F_{offset,low} = (N_{RB,low}*12 + 1)*SCS_{low}/2 + BW_{GB} \text{ (MHz)}$$

$$F_{offset,high} = (N_{RB,high}*12 - 1)*SCS_{high}/2 + BW_{GB} \text{ (MHz)}$$

$$BW_{GB} = \max(BW_{GB,Channel(k)})$$

$BW_{GB,Channel(k)}$ is the minimum guard band defined in sub-clause 5.3.3 of carrier k, while $N_{RB,low}$ and $N_{RB,high}$ are the transmission bandwidth configurations according to Table 5.3.2-1 for the lowest and highest assigned component carrier, SCS_{low} and SCS_{high} are the sub-carrier spacing for the lowest and highest assigned component carrier respectively.

For intra-band non-contiguous carrier aggregation *Sub-block Bandwidth* and *Sub-block edges* are defined as follows, see Figure 5.3A.3-2.

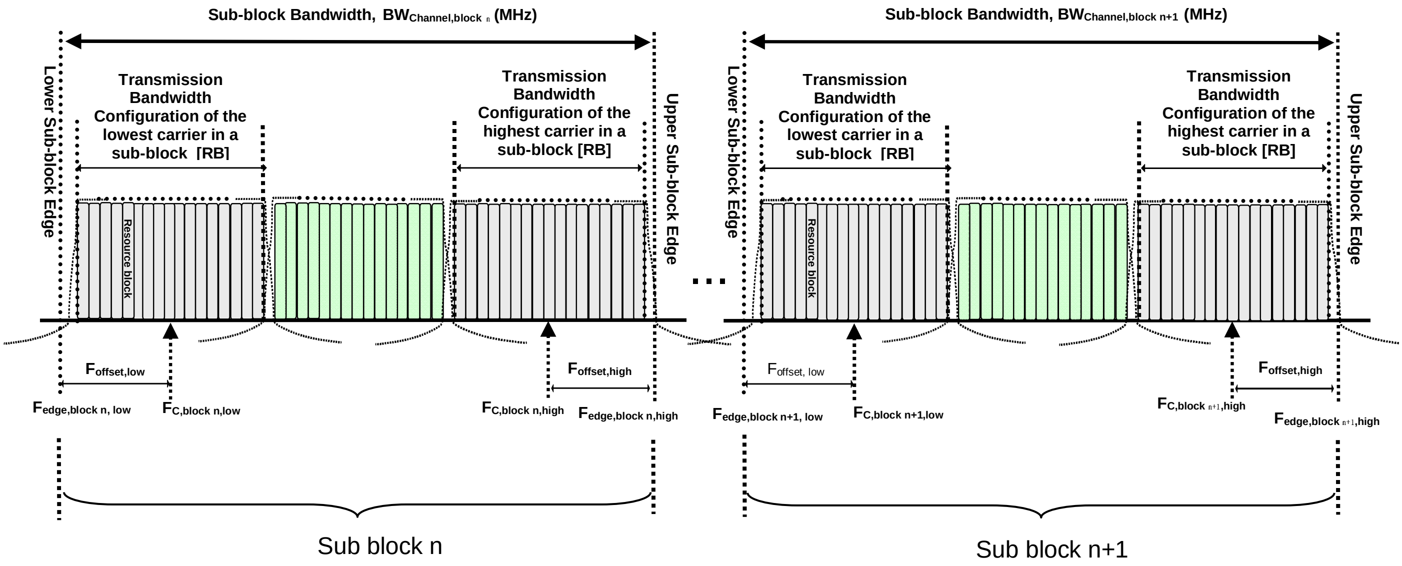

Figure 5.3A.3-2: Definition of sub-block bandwidth for intra-band non-contiguous spectrum

The lower sub-block edge of the Sub-block Bandwidth ($BW_{Channel,block}$) is defined as

$$F_{edge,block,\ low} = F_{C,block,low} - F_{offset,\ low}.$$

The upper sub-block edge of the Sub-block Bandwidth is defined as

$$F_{edge,block,high} = F_{C,block,high} + F_{offset,high}.$$

The Sub-block Bandwidth, $BW_{Channel,block}$, is defined as follows:

$$BW_{Channel,block} = F_{edge,block,high} - F_{edge,block,low} \text{ (MHz)}$$

The lower and upper frequency offsets $F_{offset,block,low}$ and $F_{offset,block,high}$ depend on the transmission bandwidth configurations of the lowest and highest assigned edge component carriers within a sub-block and are defined as

$$F_{offset,block,low} = (N_{RB,low}*12 + 1)*SCS_{low}/2 + BW_{GB} \text{ (MHz)}$$

$$F_{offset,block,high} = (N_{RB,high}*12 - 1)*SCS_{high}/2 + BW_{GB} \text{(MHz)}$$

$$BW_{GB} = \max(BW_{GB,Channel(k)})$$

where $N_{RB,low}$ and $N_{RB,high}$ are the transmission bandwidth configurations according to Table 5.3.2-1 for the lowest and highest assigned component carrier within a sub-block, respectively. SCS_{low} and SCS_{high} are the sub-carrier spacing for the lowest and highest assigned component carrier within a sub-block, respectively. $BW_{GB,Channel(k)}$ is the minimum guard band defined in sub-clause 5.3.3 of carrier k within a sub-block.

The sub-block gap size between two consecutive sub-blocks W_{gap} is defined as

$$W_{gap} = F_{edge,block\ n+1,low} - F_{edge,block\ n,high} \text{ (MHz)}$$

5.3A.4 RB alignment with different numerologies for CA

5.3A.5 UE channel bandwidth per operating band for CA

The requirements for carrier aggregation in this specification are defined for carrier aggregation configurations.

For intra-band contiguous carrier aggregation, a carrier aggregation configuration is a single operating band supporting a carrier aggregation bandwidth class with associated bandwidth combination sets specified in clause 5.5A.1. For each carrier aggregation configuration, requirements are specified for all aggregated channel bandwidths contained in a bandwidth combination set, a UE can indicate support of several bandwidth combination sets per carrier aggregation configuration. For intra-band non-contiguous carrier aggregation, a carrier aggregation configuration is a single operating band supporting two or more sub-blocks, each supporting a carrier aggregation bandwidth class.

For inter-band carrier aggregation, a carrier aggregation configuration is a combination of operating bands, each supporting a carrier aggregation bandwidth class.

Table 5.3A.4-1: CA bandwidth classes

NR CA bandwidth class	Aggregated channel bandwidth	Number of contiguous CC	Fallback group
A	$BW_{Channel\_CA} \leq BW_{Channel,max}$	1	0, 1, 2
B	20 MHz ≤ $BW_{Channel\_CA}$ ≤ 50 MHz	2	0
C	100 MHz < $BW_{Channel\_CA}$ ≤ 2 x $BW_{Channel,max}$	2	1
D	200 MHz < $BW_{Channel\_CA}$ ≤ 3 x $BW_{Channel,max}$	3	
E	300 MHz < $BW_{Channel\_CA}$ ≤ 4 x $BW_{Channel,max}$	4	
F	50 MHz < $BW_{Channel\_CA}$ ≤ 100 MHz	2	2
G	100 MHz < $BW_{Channel\_CA}$ ≤ 150 MHz	3	
H	150 MHz < $BW_{Channel\_CA}$ ≤ 200 MHz	4	
I	200 MHz < $BW_{Channel\_CA}$ ≤ 250 MHz	5	
J	250 MHz < $BW_{Channel\_CA}$ ≤ 300 MHz	6	
K	300 MHz < $BW_{Channel\_CA}$ ≤ 350 MHz	7	
L	350 MHz < $BW_{Channel\_CA}$ ≤ 400 MHz	8	
NOTE 1: $BW_{Channel,max}$ is maximum channel bandwidth supported among all bands in a release NOTE 2: It is mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration within a fallback group. It is not mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration that belong to a different fallback group			

5.4 Channel arrangement

5.4.1 Channel spacing

5.4.1.1 Channel spacing for adjacent NR carriers

The spacing between carriers will depend on the deployment scenario, the size of the frequency block available and the channel bandwidths. The nominal channel spacing between two adjacent NR carriers is defined as following:

- For NR operating bands with 100 kHz channel raster,

$$\text{Nominal Channel spacing} = (BW_{Channel(1)} + BW_{Channel(2)})/2$$

- For NR operating bands with 15 kHz channel raster,

$$\text{Nominal Channel spacing} = (BW_{Channel(1)} + BW_{Channel(2)})/2+\{-5\text{kHz}, 0\text{kHz}, 5\text{kHz}\}$$

- For NR operating bands with 30 kHz channel raster,

$$\text{Nominal Channel spacing} = (BW_{Channel(1)} + BW_{Channel(2)})/2+\{-10\text{ kHz}, 0\text{ kHz}, 10\text{ kHz}\}$$

where $BW_{Channel(1)}$ and $BW_{Channel(2)}$ are the channel bandwidths of the two respective NR carriers. The channel spacing can be adjusted depending on the channel raster to optimize performance in a particular deployment scenario.

5.4.2 Channel raster

5.4.2.1 NR-ARFCN and channel raster

The global frequency channel raster defines a set of RF reference frequencies $F_{REF.}$ The RF reference frequency is used in signalling to identify the position of RF channels, SS blocks and other elements.

The global frequency raster is defined for all frequencies from 0 to 100 GHz. The granularity of the global frequency raster is ΔF_{Global}.

RF reference frequencies are designated by an NR Absolute Radio Frequency Channel Number (NR-ARFCN) in the range (0.. 2016666] on the global frequency raster. The relation between the NR-ARFCN and the RF reference frequency F_{REF} in MHz is given by the following equation, where $F_{REF-Offs}$ and $N_{Ref-Offs}$ are given in Table 5.4.2.1-1 and N_{REF} is the NR-ARFCN.

$$F_{REF} = F_{REF-Offs} + \Delta F_{Global} (N_{REF} – N_{REF-Offs})$$

Table 5.4.2.1-1: NR-ARFCN parameters for the global frequency raster

Frequency range (MHz)	ΔF_{Global} (kHz)	$F_{REF-Offs}$ (MHz)	$N_{REF-Offs}$	Range of N_{REF}
0 – 3000	5	0	0	0 – 599999
3000 – 24250	15	3000	600000	600000 – 2016666

The channel raster defines a subset of RF reference frequencies that can be used to identify the RF channel position in the uplink and downlink. The RF reference frequency for an RF channel maps to a resource element on the carrier. For each operating band, a subset of frequencies from the global frequency raster are applicable for that band and forms a channel raster with a granularity ΔF_{Raster}, which may be equal to or larger than ΔF_{Global}.

For SUL bands and for the uplink of all FDD bands defined in Table 5.2-1.

$$F_{REF,\ shift} = F_{REF} + \Delta_{shift},\ \Delta_{shift}=0\text{kHz or } 7.5\text{ kHz.}$$

where Δ_{shift} is signalled by the network in higher layer parameter frequencyShift7p5khz [6].

The mapping between the channel raster and corresponding resource element is given in Section 5.4.2.2. The applicable entries for each operating band are defined in Section 5.4.2.3

5.4.2.2 Channel raster to resource element mapping

The mapping between the RF reference frequency on the channel raster and the corresponding resource element is given in Table 5.4.2.2-1 and can be used to identify the RF channel position. The mapping depends on the total number of RBs that are allocated in the channel and applies to both UL and DL. The mapping must apply to at least one numerology supported by the UE.

Table 5.4.2.2-1: Channel raster to resource element mapping

	$N_{\mathrm{RB}} \bmod 2 = 0$	$N_{\mathrm{RB}} \bmod 2 = 1$
Resource element index k	0	6
Physical resource block number n_{PRB}	$n_{\mathrm{PRB}} = \left\lfloor \frac{N_{\mathrm{RB}}}{2} \right\rfloor$	$n_{\mathrm{PRB}} = \left\lfloor \frac{N_{\mathrm{RB}}}{2} \right\rfloor$

k, n_{PRB}, N_{RB} are as defined in TS 38.211[8].

5.4.2.3 Channel raster entries for each operating band

The RF channel positions on the channel raster in each NR operating band are given through the applicable NR-ARFCN in Table 5.4.2.3-1, using the channel raster to resource element mapping in subclause 5.4.2.2.

For NR operating bands with 100 kHz channel raster, $\Delta F_{Raster} = 20 \times \Delta F_{Global}$. In this case every 20th NR-ARFCN within the operating band are applicable for the channel raster within the operating band and the step size for the channel raster in Table 5.4.2.3-1 is given as <20>.

For NR operating bands with 15 kHz channel raster below 3GHz, $\Delta F_{Raster} = I \times \Delta F_{Global}$, where $I \in \{3,6\}$. Every I^{th} NR-ARFCN within the operating band are applicable for the channel raster within the operating band and the step size for the channel raster in Table 5.4.2.3-1 is given as < *I* >.

For NR operating bands with 15 kHz channel raster above 3GHz, $\Delta F_{Raster} = I \times \Delta F_{Global}$, where $I \in \{1,2\}$. Every I^{th} NR-ARFCN within the operating band are applicable for the channel raster within the operating band and the step size for the channel raster in table 5.4.2.3-1 is given as <*I*>.

In frequency bands with two ΔF_{Raster}, the higher ΔF_{Raster} applies to channels using only the SCS that equals the higher ΔF_{Raster}.

Table 5.4.2.3-1: Applicable NR-ARFCN per operating band

NR Operating Band	ΔF_{Raster} (kHz)	Uplink Range of N_{REF} (First – <Step size> – Last)	Downlink Range of N_{REF} (First – <Step size> – Last)
n1	100	384000 – <20> – 396000	422000 – <20> – 434000
n2	100	370000 – <20> – 382000	386000 – <20> – 398000
n3	100	342000 – <20> – 357000	361000 – <20> – 376000
n5	100	164800 – <20> – 169800	173800 – <20> – 178800
n7	100	500000 – <20> – 514000	524000 – <20> – 538000
n8	100	176000 – <20> – 183000	185000 – <20> – 192000
n12	100	139800 – <20> – 143200	145800 – <20> – 149200
n20	100	166400 – <20> – 172400	158200 – <20> – 164200
n25	100	370000 – <20> – 383000	386000 – <20> – 399000
n28	100	140600 – <20> – 149600	151600 – <20> – 160600
n34	100	402000 – <20> – 405000	402000 – <20> – 405000
n38	100	514000 – <20> – 524000	514000 – <20> – 524000
n39	100	376000 – <20> – 384000	376000 – <20> – 384000
n40	100	460000 – <20> – 480000	460000 – <20> – 480000
n41	15	499200 – <3> – 537999	499200 – <3> – 537999
	30	499200 – <6> – 537996	499200 – <6> – 537996
n50	100	286400 – <20> – 303400	286400 – <20> – 303400
n51	100	285400 – <20> – 286400	285400 – <20> – 286400
n66	100	342000 – <20> – 356000	422000 – <20> – 440000
n70	100	339000 – <20> – 342000	399000 – <20> – 404000
n71	100	132600 – <20> – 139600	123400 – <20> – 130400
n75	100	N/A	286400 – <20> – 303400
n76	100	N/A	285400 – <20> – 286400
n77	15	620000 – <1> – 680000	620000 – <1> – 680000
	30	620000 – <2> – 680000	620000 – <2> – 680000
n78	15	620000 – <1> – 653333	620000 – <1> – 653333
	30	620000 – <2> – 653332	620000 – <2> – 653332
n79	15	693334 – <1> – 733333	693334 – <1> – 733333
	30	693334 – <2> – 733332	693334 – <2> – 733332
n80	100	342000 – <20> – 357000	N/A
n81	100	176000 – <20> – 183000	N/A
n82	100	166400 – <20> – 172400	N/A
n83	100	140600 – <20> –149600	N/A
n84	100	384000 – <20> – 396000	N/A
n86	100	342000 – <20> – 356000	N/A

5.4.3 Synchronization raster

5.4.3.1 Synchronization raster and numbering

The synchronization raster indicates the frequency positions of the synchronization block that can be used by the UE for system acquisition when explicit signalling of the synchronization block position is not present.

A global synchronization raster is defined for all frequencies. The frequency position of the SS block is defined as SS_{REF} with corresponding number GSCN. The parameters defining the SS_{REF} and GSCN for all the frequency ranges are in Table 5.4.3.1-1.

The resource element corresponding to the SS block reference frequency SS_{REF} is given in subclause 5.4.3.2. The synchronization raster and the subcarrier spacing of the synchronization block are defined separately for each band.

Table 5.4.3.1-1: GSCN parameters for the global frequency raster

Frequency range	SS Block frequency position SS_{REF}	GSCN	Range of GSCN
0 – 3000 MHz	N * 1200kHz + M * 50 kHz, N=1:2499, M ϵ {1,3,5} (Note 1)	3N + (M-3)/2	2 – 7498
3000-24250 MHz	3000 MHz + N * 1.44 MHz N = 0:14756	7499 + N	7499 – 22255
NOTE 1: The default value for operating bands with SCS spaced channel raster is M=3.			

5.4.3.2 Synchronization raster to synchronization block resource element mapping

The mapping between the synchronization raster and the corresponding resource element of the SS block is given in Table 5.4.3.2-1. The mapping depends on the total number of RBs that are allocated in the channel and applies to both UL and DL.

Table 5.4.3.2-1: Synchronization raster to SS block resource element mapping

Resource element index k	0
Physical resource block number n_{PRB} of the SS block	$n_{\text{PRB}} = 10$

k, n_{PRB} are as defined in TS 38.211[8].

5.4.3.3 Synchronization raster entries for each operating band

The synchronization raster for each band is given in Table 5.4.3.3-1. The distance between applicable GSCN entries is given by the <Step size> indicated in Table 5.4.3.3-1.

Table 5.4.3.3-1: Applicable SS raster entries per operating band

NR Operating Band	SS Block SCS	SS Block pattern[1]	Range of GSCN (First – <Step size> – Last)
n1	15kHz	Case A	5279 – <1> – 5419
n2	15kHz	Case A	4829 – <1> – 4969
n3	15kHz	Case A	4517 – <1> – 4693
n5	15kHz	Case A	2177 – <1> – 2230
	30kHz	Case B	2183 – <1> – 2224
n7	15kHz	Case A	6554 – <1> – 6718
n8	15kHz	Case A	2318 – <1> – 2395
n12	15kHz	Case A	1828 – <1> – 1858
n20	15kHz	Case A	1982 – <1> – 2047
n25	15 kHz	Case A	4829 – <1> – 4981
n28	15kHz	Case A	1901 – <1> – 2002
n34	15kHz	Case A	5030 – <1> – 5056
n38	15kHz	Case A	6431 – <1> – 6544
n39	15kHz	Case A	4706 – <1> – 4795
n40	15kHz	Case A	5756 – <1> – 5995
n41	15kHz	Case A	6246 – <3> – 6717
	30 kHz	Case C	6252 – <3> – 6714
n50	15kHz	Case A	3584 – <1> – 3787
n51	15kHz	Case A	3572 – <1> – 3574
n66	15kHz	Case A	5279 – <1> – 5494
	30kHz	Case B	5285 – <1> – 5488
n70	15kHz	Case A	4993 – <1> – 5044
n71	15kHz	Case A	1547 – <1> – 1624
n74	15kHz	Case A	3692 – <1> – 3790
n75	15kHz	Case A	3584 – <1> – 3787
n76	15kHz	Case A	3572 – <1> – 3574
n77	30kHz	Case C	7711 – <1> – 8329
n78	30kHz	Case C	7711 – <1> – 8051
n79	30kHz	Case C	8480 – <16> – 8880
NOTE 1: SS Block pattern is defined in section 4.1 in TS 38.213 [9]			

5.4.4 TX–RX frequency separation

The default TX channel (carrier centre frequency) to RX channel (carrier centre frequency) separation for operating bands is specified in Table 5.4.4-1.

Table 5.4.4-1: Default UE TX-RX frequency separation

NR Operating Band	TX – RX carrier centre frequency separation
n1	190 MHz
n2	80 MHz
n3	95 MHz
n5	45 MHz
n7	120 MHz
n8	45 MHz
n12	30 MHz
n20	-41 MHz
n25	80 MHz
n28	55 MHz
n66	400 MHz
n70	295,300[1] MHz
n71	-46 MHz
n74	48 MHz
NOTE 1: Default TX-RX carrier centre frequency separation.	

5.4A Channel arrangement for CA

5.4A.1 Channel spacing for CA

For intra-band contiguous carrier aggregation with two or more component carriers, the nominal channel spacing between two adjacent NR component carriers is defined as the following unless stated otherwise:

For NR operating bands with 100 kHz channel raster:

$$\text{Nominal channel spacing} = \left\lfloor \frac{BW_{Channel(1)} + BW_{Channel(2)} - 2\left|GB_{Channel(1)} - GB_{Channel(2)}\right|}{0.6} \right\rfloor 0.3\,[\text{MHz}]$$

For NR operating bands with 15 kHz channel raster:

$$\text{Nominal channel spacing} = \left\lfloor \frac{BW_{Channel(1)} + BW_{Channel(2)} - 2\left|GB_{Channel(1)} - GB_{Channel(2)}\right|}{0.015 * 2^{n+1}} \right\rfloor 0.015 * 2^{n}\ [\text{MHz}]$$

with

$$n = \max(\mu_1, \mu_2)$$

where $BW_{Channel(1)}$ and $BW_{Channel(2)}$ are the channel bandwidths of the two respective NR component carriers according to Table 5.3.2-1 with values in MHz. and the $GB_{Channel(i)}$ is the minimum guard band defined in sub-clause 5.3.3, while μ_1 and μ_2 are the subcarrier spacing configurations of the component carriers as defined in TS 38.211. The channel spacing for intra-band contiguous carrier aggregation can be adjusted to any multiple of least common multiple of channel raster and sub-carrier spacing less than the nominal channel spacing to optimize performance in a particular deployment scenario.

For intra-band non-contiguous carrier aggregation the channel spacing between two NR component carriers in different sub-blocks shall be larger than the nominal channel spacing defined in this subclause

5.4A.2 Channel raster for CA

For inter-band carrier aggregation, the channel raster requirements in subclause 5.4.2 apply for each operating band.

5.4A.3 Synchronization raster for CA

For inter-band carrier aggregation, the synchronization raster requirements in subclause 5.4.3 apply for each operating band.

5.4A.4 Tx-Rx frequency separation for CA

For inter-band carrier aggregation, the Tx-Rx frequency separation requirements in subclause 5.4.4 apply for each operating band.

5.5 Configurations

5.5A Configurations for CA

5.5A.1 Configurations for intra-band contiguous CA

Table 5.5A.1-1: NR CA configurations and bandwidth combination sets defined for intra-band contiguous CA for fallback group 1

NR CA configuration / Bandwidth combination set								
NR CA configuration	Uplink CA configurations	Component carriers in order of increasing carrier frequency					Aggregated bandwidth (MHz)	Bandwidth combination set
		Channel bandwidths for carrier (MHz)	Channel bandwidths for carrier (MHz)	Channel bandwidths for carrier (MHz)	Channel bandwidths for carrier (MHz)	Channel bandwidths for carrier (MHz)		
CA_n77C CA_n78C CA_n79C		50	60				110	0
		60	60				120	
		50	80				130	
		60	80				140	
		50	100				150	
		60	100				160	
		80	80					
		80	100				180	
		100	100				200	
CA_n77D, CA_n78D, CA_n79D		50	60	100			210	0
		60	60	100			220	
		50	80	100			230	
		60	80	100			240	
		50	100	100			250	
		80	80	100			260	
		80	90	100			270	
		80	100	100			280	
		90	100	100			290	
		100	100	100			300	
CA_n77E, CA_n78E, CA_n79E		50	60	100	100		310	0
		60	60	100	100		320	
		50	80	100	100		330	
		60	80	100	100		340	
		50	100	100	100		350	
		80	80	100	100		360	
		80	90	100	100		370	
		80	100	100	100		380	
		90	100	100	100		390	
		100	100	100	100		400	

Table 5.5A-2: Void

5.5A.2 Void

5.5A.3 Configurations for inter-band CA

Table 5.5A.3-1: NR CA configurations and bandwidth combinations sets defined for inter-band CA (two bands)

NR CA configuration	Uplink CA configuration	NR Band	SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz	Bandwidth combination set
CA_n3A-n77A	-	n3	15	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes							
		n77	15		Yes	Yes	Yes			Yes	Yes					
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
CA_n3A-n78A	CA_n3A-n78A	n3	15	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes							
		n78	15		Yes	Yes	Yes			Yes	Yes					
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
CA_n3A-n79A	-	n3	15	Yes	Yes	Yes	Yes	Yes	Yes							0
			30		Yes	Yes	Yes	Yes	Yes							
			60		Yes	Yes	Yes	Yes	Yes							
		n79	15		Yes	Yes	Yes			Yes	Yes					
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes		Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes		Yes	
CA_n8A-n75A	-	n8	15	Yes	Yes	Yes	Yes									0
			30		Yes	Yes	Yes									
			60													
		n75	15	Yes	Yes	Yes	Yes									
			30		Yes	Yes	Yes									
			60		Yes	Yes	Yes									
CA_n8A-n78A	CA_n8A-n78A	n8	15	Yes	Yes	Yes	Yes									0
			30		Yes	Yes	Yes									
			60													
		n78	15		Yes	Yes	Yes			Yes	Yes					
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
CA_n8A-n79A	-	n8	15	Yes	Yes	Yes	Yes									0
			30		Yes	Yes	Yes									
			60													
		n79	15		Yes	Yes	Yes			Yes	Yes					
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes		Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes		Yes	
CA_n28A-n75A	-	n28	15	Yes	Yes	Yes	Yes									0
			30		Yes	Yes	Yes									
			60													
		n75	15	Yes	Yes	Yes	Yes									

			30		Yes	Yes	Yes									
			60		Yes	Yes	Yes									
CA_n28A -n78A	-	n28	15	Yes	Yes	Yes	Yes									0
			30		Yes	Yes	Yes									
			60													
		n78	15		Yes	Yes	Yes			Yes	Yes					
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
CA_n41A -n78A	-	n41	15		Yes	Yes	Yes			Yes	Yes					0
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes		Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes		Yes	
		n78	15		Yes	Yes	Yes			Yes	Yes					
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
CA_n75A -n78A	-	n75	15	Yes	Yes	Yes	Yes									0
			30		Yes	Yes	Yes									
			60		Yes	Yes	Yes									
		n78	15		Yes	Yes	Yes			Yes	Yes					
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
CA_n76A -n78A	-	n76	15	Yes												0
			30													
			60													
		n78	15		Yes	Yes	Yes			Yes	Yes					
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
CA_n77A -n79A	-	n77	15		Yes	Yes	Yes			Yes	Yes					0
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
		n79	15							Yes	Yes					
			30							Yes	Yes	Yes	Yes		Yes	
			60							Yes	Yes	Yes	Yes		Yes	
CA_n78A -n79A	-	n78	15		Yes	Yes	Yes			Yes	Yes					0
			30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
			60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
		n79	15							Yes	Yes					
			30							Yes	Yes	Yes	Yes		Yes	
			60							Yes	Yes	Yes	Yes		Yes	

5.5B Void

5.5C Configurations for SUL

Table 5.5C-1: Supported channel bandwidths per SUL band combination

SUL configuration	NR Band	Subcarrier spacing (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz	Bandwidth combination set
SUL_n78A-n80A	n78	15		Yes	Yes	Yes			Yes	Yes					0
		30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
		60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
	n80	15	Yes	Yes	Yes	Yes	Yes	Yes							
SUL_n78A-n81A	n78	15		Yes	Yes	Yes			Yes	Yes					0
		30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
		60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
	n81	15	Yes	Yes	Yes	Yes									
SUL_n78A-n82A	n78	15		Yes	Yes	Yes			Yes	Yes					0
		30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
		60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
	n82	15	Yes	Yes	Yes	Yes									
SUL_n78A-n83A	n78	15		Yes	Yes	Yes			Yes	Yes					0
		30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
		60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
	n83	15	Yes	Yes	Yes	Yes									
SUL_n78A-n84A	n78	15		Yes	Yes	Yes			Yes	Yes					0
		30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
		60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
	n84	15	Yes	Yes	Yes	Yes									
SUL_n78A-n86A	n78	15		Yes	Yes	Yes			Yes	Yes					0
		30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
		60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes	
	n86	15	Yes	Yes	Yes	Yes									
SUL_n79A-n80A	n79	15							Yes	Yes					0
		30							Yes	Yes	Yes	Yes		Yes	
		60							Yes	Yes	Yes	Yes		Yes	
	n80	15	Yes	Yes	Yes	Yes	Yes	Yes							

SUL_n79A-n81A	n79	15							Yes	Yes					0
		30							Yes	Yes	Yes	Yes		Yes	
		60							Yes	Yes	Yes	Yes		Yes	
	n81	15	Yes	Yes	Yes	Yes									

6 Transmitter characteristics

6.1 General

Unless otherwise stated, the transmitter characteristics are specified at the antenna connector of the UE with a single or multiple transmit antenna(s). For UE with integral antenna only, a reference antenna with a gain of 0 dBi is assumed.

Unless otherwise stated, Channel Bandwidth shall be prioritized in the selecting of test points. Subcarrier spacing shall be selected after Test Channel Bandwidth is selected.

Uplink RB allocations given in Table 6.1-1 are used throughout this section, unless otherwise stated by the test case.

Table 6.1-1: Common uplink configuration

Channel Bandwidth	SCS(kHz)	OFDM	RB allocation							
			Edge_Full_Left	Edge_Full_Right	Edge_1RB_Left	Edge_1RB_Right	Outer_Full	Inner_Full	Inner_1RB_Left	Inner_1RB_Right
5MHz	15	DFT-s	2@0	2@23	1@0	1@24	25@0	12@6	1@1	1@23
		CP	2@0	2@23	1@0	1@24	25@0	13@6	1@1	1@23
	30	DFT-s	2@0	2@9	1@0	1@10	10@0	5@2[1]	1@1	1@9
		CP	2@0	2@9	1@0	1@10	11@0	5@2[1]	1@1	1@9
	60	DFT-s	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		CP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10MHz	15	DFT-s	2@0	2@50	1@0	1@51	50@0	25@12	1@1	1@50
		CP	2@0	2@50	1@0	1@51	52@0	26@13	1@1	1@50
	30	DFT-s	2@0	2@22	1@0	1@23	24@0	12@6	1@1	1@22
		CP	2@0	2@22	1@0	1@23	24@0	12@6	1@1	1@22
	60	DFT-s	2@0	2@9	1@0	1@10	10@0	5@2[1]	1@1	1@9
		CP	2@0	2@9	1@0	1@10	11@0	5@2[1]	1@1	1@9
15MHz	15	DFT-s	2@0	2@77	1@0	1@78	75@0	36@18	1@1	1@77
		CP	2@0	2@77	1@0	1@78	79@0	39@19[1]	1@1	1@77
	30	DFT-s	2@0	2@36	1@0	1@37	36@0	18@9	1@1	1@36
		CP	2@0	2@36	1@0	1@37	38@0	19@9	1@1	1@36
	60	DFT-s	2@0	2@16	1@0	1@17	18@0	9@4	1@1	1@16
		CP	2@0	2@16	1@0	1@17	18@0	9@4	1@1	1@16
20MHz	15	DFT-s	2@0	2@104	1@0	1@105	100@0	50@25	1@1	1@104
		CP	2@0	2@104	1@0	1@105	106@0	53@26	1@1	1@104
	30	DFT-s	2@0	2@49	1@0	1@50	50@0	25@12	1@1	1@49
		CP	2@0	2@49	1@0	1@50	51@0	25@12[1]	1@1	1@49
	60	DFT-s	2@0	2@22	1@0	1@23	24@0	12@6	1@1	1@22
		CP	2@0	2@22	1@0	1@23	24@0	12@6	1@1	1@22
25MHz	15	DFT-s	2@0	2@131	1@0	1@132	128@0	64@32	1@1	1@131
		CP	2@0	2@131	1@0	1@132	133@0	67@33	1@1	1@131
	30	DFT-s	2@0	2@63	1@0	1@64	64@0	32@16	1@1	1@63
		CP	2@0	2@63	1@0	1@64	65@0	33@16	1@1	1@63
	60	DFT-s	2@0	2@29	1@0	1@30	30@0	15@7[1]	1@1	1@29
		CP	2@0	2@29	1@0	1@30	31@0	15@7[1]	1@1	1@29
30MHz	15	DFT-s	2@0	2@158	1@0	1@159	160@0	80@40	1@1	1@158
		CP	2@0	2@158	1@0	1@159	160@0	80@40	1@1	1@158
	30	DFT-s	2@0	2@76	1@0	1@77	75@0	36@18	1@1	1@76
		CP	2@0	2@76	1@0	1@77	78@0	39@19	1@1	1@76
	60	DFT-s	2@0	2@36	1@0	1@37	36@0	18@9	1@1	1@36
		CP	2@0	2@36	1@0	1@37	38@0	19@9	1@1	1@36
40MHz	15	DFT-s	2@0	2@214	1@0	1@215	216@0	108@54	1@1	1@214
		CP	2@0	2@214	1@0	1@215	216@0	108@54	1@1	1@214
	30	DFT-s	2@0	2@104	1@0	1@105	100@0	50@25	1@1	1@104
		CP	2@0	2@104	1@0	1@105	106@0	53@26	1@1	1@104
	60	DFT-s	2@0	2@49	1@0	1@50	50@0	25@12	1@1	1@49
		CP	2@0	2@49	1@0	1@50	51@0	25@12[1]	1@1	1@49
50MHz	15	DFT-s	2@0	2@268	1@0	1@269	270@0	135@67	1@1	1@268
		CP	2@0	2@268	1@0	1@269	270@0	135@67	1@1	1@268
	30	DFT-s	2@0	2@131	1@0	1@132	128@0	64@32	1@1	1@131
		CP	2@0	2@131	1@0	1@132	133@0	67@33	1@1	1@131
	60	DFT-s	2@0	2@63	1@0	1@64	64@0	32@16	1@1	1@63
		CP	2@0	2@63	1@0	1@64	65@0	33@16	1@1	1@63
60MHz	15	DFT-s	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		CP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	30	DFT-s	2@0	2@160	1@0	1@161	162@0	81@40	1@1	1@160
		CP	2@0	2@160	1@0	1@161	162@0	81@40	1@1	1@160
	60	DFT-s	2@0	2@77	1@0	1@78	75@0	36@18	1@1	1@77
		CP	2@0	2@77	1@0	1@78	79@0	39@19[1]	1@1	1@77
80MHz	15	DFT-s	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		CP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	30	DFT-s	2@0	2@215	1@0	1@216	216@0	108@54	1@1	1@215
		CP	2@0	2@215	1@0	1@216	217@0	109@54	1@1	1@215
	60	DFT-s	2@0	2@105	1@0	1@106	100@0	50@25	1@1	1@105
		CP	2@0	2@105	1@0	1@106	107@0	53@26[1]	1@1	1@105
90MHz	15	DFT-s	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		CP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	30	DFT-s	2@0	2@243	1@0	1@244	240@0	120@60	1@1	1@243
		CP	2@0	2@243	1@0	1@244	245@0	123@61	1@1	1@243
	60	DFT-s	2@0	2@119	1@0	1@120	120@0	60@30	1@1	1@119
		CP	2@0	2@119	1@0	1@120	121@0	61@30	1@1	1@119
100MHz	15	DFT-s	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		CP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	30	DFT-s	2@0	2@271	1@0	1@272	270@0	135@67	1@1	1@271
		CP	2@0	2@271	1@0	1@272	273@0	137@68	1@1	1@271
	60	DFT-s	2@0	2@133	1@0	1@134	135@0	64@32	1@1	1@133
		CP	2@0	2@133	1@0	1@134	135@0	67@33[1]	1@1	1@133
Note 1: The allocated RB number L_{CRB} is ceil(N_{RB}/2) -1 in order to meet Inner RB allocation definition ($RB_{Start,Low} \leq RB_{Start} \leq RB_{Start,High}$) described in subclause 6.2.2 of TS 38.101-1 [2].										

6.2 Transmitter power

6.2.1 UE maximum output power

6.2.1.1 Test purpose

To verify that the error of the UE maximum output power does not exceed the range prescribed by the specified nominal maximum output power and tolerance.

An excess maximum output power has the possibility to interfere to other channels or other systems. A small maximum output power decreases the coverage area.

6.2.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.2.1.3 Minimum conformance requirements

The following UE Power Classes define the maximum output power for any transmission bandwidth within the channel bandwidth of NR carrier unless otherwise stated. The period of measurement shall be at least one sub frame (1ms).

Table 6.2.1.3-1: UE Power Class

NR band	Class 1 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
n1					23	± 2
n2					23	± 2[3]
n3					23	± 2[3]
n5					23	± 2
n7					23	± 2[3]
n8					23	± 2[3]
n12					23	± 2[3]
n20					23	± 2[3]
n25					23	± 2
n28					23	+2/-2.5
n34					23	± 2
n38					23	± 2
n39					23	± 2
n40					23	± 2
n41			26	+2/-3[3]	23	± 2[3]
n50					23	± 2
n51					23	± 2
n66					23	± 2
n70					23	± 2
n71					23	+2/-2.5
n74					23	± 2
n77			26	+2/-3	23	+2/-3
n78			26	+2/-3	23	+2/-3
n79			26	+2/-3	23	+2/-3
n80					23	± 2
n81					23	± 2
n82					23	± 2
n83					23	± 2/-2.5
n84					23	± 2
n86					23	± 2
NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance NOTE 2: Power class 3 is default power class unless otherwise stated NOTE 3: Refers to the transmission bandwidths (Figure 5.3.3-1) confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB						

If a UE supports a different power class than the default UE power class for the band and the supported power class enables the higher maximum output power than that of the default power class:

- if the field of UE capability *maxUplinkDutyCycle* is absent and the percentage of uplink symbols transmitted in a certain evaluation period is larger than 50% (The exact evaluation period is no less than one radio frame); or

- if the field of UE capability *maxUplinkDutyCycle* is not absent and the percentage of uplink symbols transmitted in a certain evaluation period is larger than *maxUplinkDutyCycle* as defined in TS 38.331 (The exact evaluation period is no less than one radio frame); or

- if the IE *P-Ma*x as defined in TS 38.331 [6] is provided and set to the maximum output power of the default power class or lower;

  - shall apply all requirements for the default power class to the supported power class and set the configured transmitted power as specified in sub-clause 6.2.4;

- else if (the IE *P-Max* as defined in TS 38.331 [6] is not provided or set to the higher value than the maximum output power of the default power class and the percentage of uplink symbols transmitted in a certain evaluation period is less than or equal to *maxUplinkDutyCycle* as defined in TS 38.331; or

  the IE *P-Max* as defined in TS 38.331 [6] is not provided or set to the higher value than the maximum output power of the default power class and the percentage of uplink symbols transmitted in a certain evaluation period is less than or equal to 50% when *maxUplinkDutyCycle* is absent. The exact evaluation period is no less than one radio frame):

- shall apply all requirements for the supported power class and set the configured transmitted power class as specified in sub-clause 6.2.4;

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.1.

6.2.1.4 Test description

6.2.1.4.1 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 6.2.1.4.1-1. 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 6.2.1.4.1-1: 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, Highest	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
	N/A for maximum output power test case	**Modulation (NOTE 2)**	**RB allocation (NOTE 1)**
1		DFT-s-OFDM PI/2 BPSK	Inner Full
2		DFT-s-OFDM PI/2 BPSK	Inner 1RB Left
3		DFT-s-OFDM PI/2 BPSK	Inner 1RB Right
4		DFT-s-OFDM QPSK	Inner Full
5		DFT-s-OFDM QPSK	Inner 1RB Left
6		DFT-s-OFDM QPSK	Inner 1RB Right
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.			

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 6.2.1.4.1-1.
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 6.2.1.4.3.

6.2.1.4.2 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 6.2.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

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 P_{UMAX} level corresponding to Power Class 3.

3. Measure the mean power of the UE 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. For UEs supporting Power Class 2, repeat steps 1~3 on the applicable bands except P_{UMAX} level in step 2 is corresponding to Power Class 2.

6.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 with the following exceptions.

Table 6.2.1.4.3-1: *PUSCH-Config*

Derivation Path: TS 38.508-1 [5], Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED

6.2.1.5 Test requirement

The maximum output power, derived in step 3 shall be within the range prescribed by the nominal maximum output power and tolerance in Table 6.2.1.5-1.

The maximum output power, derived in step 4 shall be within the range prescribed by the nominal maximum output power and tolerance in Table 6.2.1.5-2.

Table 6.2.1.5-1: Maximum Output Power test requirement for Power Class 3

NR band	Class 1 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
n1					23	±2±TT
n2					23	±2[3]±TT
n3					23	±2[3]±TT
n5					23	±2±TT
n7					23	±2[3]±TT
n8					23	±2[3]±TT
n12					23	±2[3]±TT
n20					23	±2[3]±TT
n25					23	±2±TT
n28					23	+2/-2.5
n34					23	±2±TT
n38					23	±2±TT
n39					23	±2±TT
n40					23	±2±TT
n41					23	± 2[3]±TT
n50					23	±2±TT
n51					23	±2±TT
n66					23	±2±TT
n70					23	±2±TT
n71					23	+2+TT/-2.5-TT
n74					23	±2±TT
n77					23	+2+TT/-3-TT
n78					23	+2+TT/-3-TT
n79					23	+2+TT/-3-TT
n80					23	±2±TT
n81					23	±2±TT
n82					23	±2±TT
n83					23	+2+TT/-2.5-TT
n84					23	±2±TT
n86					23	±2±TT
NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance NOTE 2: Power class 3 is default power class unless otherwise stated NOTE 3: Refers to the transmission bandwidths (Figure 5.3.3-1) confined within F_{UL_low} and FUL_low + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB NOTE 4: TT for each frequency and channel bandwidth is specified in Table 6.2.1.5-3						

Table 6.2.1.5-2: Maximum Output Power test requirement for Power Class 2

NR band	Class 1 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
n41			26	+2+TT/-3[3]-TT		
n77			26	+2+TT/-3-TT		
n78			26	+2+TT/-3-TT		
n79			26	+2+TT/-3-TT		
NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance NOTE 2: Power class 3 is default power class unless otherwise stated NOTE 3: Refers to the transmission bandwidths (Figure 5.3.3-1) confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB NOTE 4: TT for each frequency and channel bandwidth is specified in Table 6.2.1.5-3						

Table 6.2.1.5-3: Test Tolerance (UE maximum output power)

	f ≤ 3.0GHz	3.0GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6.0GHz
BW ≤ 40MHz	0.7 dB	1.0 dB	1.0 dB
40MHz < BW ≤ 100MHz	1.0 dB	1.0 dB	1.0 dB

6.2.2 Maximum Power Reduction (MPR)

Editor's Note: The following aspects are either missing or not yet determined:

- There is still TBD left for almost contiguous signals of PC 2 in the minimum requirement.

- Test points for the minimum requirement of almost contiguous signals are not included in the existing test case and will be added when the minimum requirement for almost contiguous signals of PC 2 is confirmed in RAN4.

- PC1 and PC4 requirements are not defined in RAN4 Rel-15 spec.

6.2.2.1 Test purpose

The number of RB identified in Table 6.2.2.3-1 is based on meeting the requirements for adjacent channel leakage ratio and the maximum power reduction (MPR) due to Cubic Metric (CM).

6.2.2.2 Test applicability

The requirements of this test apply to all types of NR Power Class 2 and 3 UE release 15 and forward.

NOTE: Test execution is not necessary if TS 38.521-1 6.5.2.4.1 is executed.

6.2.2.3 Minimum conformance requirements

UE is allowed to reduce the maximum output power due to higher order modulations and transmit bandwidth configurations. For UE Power Class 2 and 3, the allowed maximum power reduction (MPR) is defined in Table 6.2.2.3-2 and 6.2.2.3-1, respectively for channel bandwidths that meets both following criteria:

- Channel bandwidth ≤ 100 MHz.
- Relative channel bandwidth ≤ 4% for TDD bands and ≤ 3% for FDD bands.

Where relative channel bandwidth = $2*BW_{Channel} / (F_{UL\_low} + F_{UL\_high})$.

Table 6.2.2.3-1: Maximum Power Reduction (MPR) for Power 3

Modulation	MPR (dB)		
	Edge RB allocations	Outer RB allocations	Inner RB allocations
DFT-s-OFDM PI/2 BPSK	≤ 3.5[1]	≤ 1.2[1]	≤ 0.2[1]
	≤ 0.5[2]		0[2]
DFT-s-OFDM QPSK	≤ 1		0
DFT-s-OFDM 16 QAM	≤ 2		≤ 1
DFT-s-OFDM 64 QAM	≤ 2.5		
DFT-s-OFDM 256 QAM	≤ 4.5		
CP-OFDM QPSK	≤ 3		≤ 1.5
CP-OFDM 16 QAM	≤ 3		≤ 2
CP-OFDM 64 QAM	≤ 3.5		
CP-OFDM 256 QAM	≤ 6.5		

NOTE 1: Applicable for UE operating in TDD mode with PI/2 BPSK modulation and UE indicates support for UE capability *powerBoosting-pi2BPSK* and if the IE *powerBoostPi2BPSK* is set to 1 and 40 % or less slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79. The reference power of 0dB MPR is 26dBm.

NOTE 2: Applicable for UE operating in FDD mode, or in TDD mode in bands other than n40, n41, n77, n78 and n79 and if the IE *powerBoostPi2BPSK* is set to 0 and if more than 40% of slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79.

Table 6.2.2.3-2: Maximum Power Reduction (MPR) for Power Class 2

Modulation	MPR (dB)		
	Edge RB allocations	Outer RB allocations	Inner RB allocations
DFT-s-OFDM PI/2 BPSK	≤ 3.5	≤ 0.5	0
DFT-s-OFDM QPSK	≤ 3.5	≤ 1	0
DFT-s-OFDM 16 QAM	≤ 3.5	≤ 2	≤ 1
DFT-s-OFDM 64 QAM	≤ 3.5	≤ 2.5	
DFT-s-OFDM 256 QAM	≤ 4.5		
CP-OFDM QPSK	≤ 3.5	≤ 3	≤ 1.5
CP-OFDM 16 QAM	≤ 3.5	≤ 3	≤ 2
CP-OFDM 64 QAM	≤ 3.5		
CP-OFDM 256 QAM	≤ 6.5		

Where the following parameters are defined to specify valid RB allocation ranges for Outer and Inner RB allocations:

N_{RB} is the maximum number of RBs for a given Channel bandwidth and sub-carrier spacing defined in Table 5.3.2-1.

$$RB_{Start,Low} = \max(1, \mathrm{floor}(L_{CRB}/2))$$

where max() indicates the largest value of all arguments and floor(x) is the greatest integer less than or equal to x.

$$RB_{Start,High} = N_{RB} - RB_{Start,Low} - L_{CRB}$$

The RB allocation is an Inner RB allocation if the following conditions are met:

$$RB_{Start,Low} \leq RB_{Start} \leq RB_{Start,High}, \text{ and}$$

$$L_{CRB} \leq \mathrm{ceil}(N_{RB}/2)$$

where ceil(x) is the smallest integer greater than or equal to x.

An Edge RB allocation is one for which the RB's are allocated at the lowermost or uppermost edge of the channel with $L_{CRB} \leq 2$ RB's.

The RB allocation is an Outer RB allocation for all other allocations which are not an Inner RB allocation or Edge RB allocation.

If CP-OFDM allocation satisfies following conditions it is considered as almost contiguous allocation

$$N_{RB\_gap} / (N_{RB\_alloc} + N_{RB\_gap}) \leq 0.25$$

and N_{RB_alloc} + N_{RB_gap} is larger than 106, 51 or 24 RBs for 15 kHz, 30 kHz or 60 kHz respectively where N_{RB_gap} is the total number of unallocated RBs between allocated RBs and N_{RB_alloc} is the total number of allocated RBs. The size and location of allocated and unallocated RBs are restricted by RBG parameters specified in sub-clause 6.1.2.2 of TS 38.214. For these almost contiguous signals in power class 3, the allowed maximum power reduction defined in Table 6.2.2-1 is increased by

$$\text{CEIL}\{ 10 \log_{10}(1 + N_{RB\_gap} / N_{RB\_alloc}), 0.5 \} \text{ dB},$$

where CEIL{x,0.5} means x rounding upwards to closest 0.5dB.

For almost contiguous signals in power class 2, the allowed maximum power reduction is TBD.

For the UE maximum output power modified by MPR, the power limits specified in subclause 6.2.4 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.2.

6.2.2.4 Test description

6.2.2.4.1 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, 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 6.2.2.4.1-1. 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 6.2.2.4.1-1: Test Configuration Table for Power Class 3

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, Highest	
Test SCS as specified in Table 5.3.5-1			Lowest, Highest	
Test Parameters for Channel Bandwidths				
Test ID	**Freq**	**Downlink Configuration**	**Uplink Configuration**	
		N/A for Maximum Power Reduction (MPR) test case	**Modulation (NOTE 2)**	**RB allocation (NOTE 1)**
1[3]	Default		DFT-s-OFDM PI/2 BPSK	Inner Full
2[3]	Low		DFT-s-OFDM PI/2 BPSK	Edge_1RB_Left
3[3]	High		DFT-s-OFDM PI/2 BPSK	Edge_1RB_Right
4[3]	Default		DFT-s-OFDM PI/2 BPSK	Outer Full
5[4]	Default		DFT-s-OFDM PI/2 BPSK	Inner Full
6[4]	Low		DFT-s-OFDM PI/2 BPSK	Edge_1RB_Left
7[4]	High		DFT-s-OFDM PI/2 BPSK	Edge_1RB_Right
8[4]	Default		DFT-s-OFDM PI/2 BPSK	Outer Full
9	Default		DFT-s-OFDM QPSK	Inner Full
10	Low		DFT-s-OFDM QPSK	Edge_1RB_Left
11	High		DFT-s-OFDM QPSK	Edge_1RB_Right
12	Default		DFT-s-OFDM QPSK	Outer Full
13	Default		DFT-s-OFDM 16 QAM	Inner Full
14	Low		DFT-s-OFDM 16 QAM	Edge_1RB_Left
15	High		DFT-s-OFDM 16 QAM	Edge_1RB_Right
16	Default		DFT-s-OFDM 16 QAM	Outer Full
17	Low		DFT-s-OFDM 64 QAM	Edge_1RB_Left
18	High		DFT-s-OFDM 64 QAM	Edge_1RB_Right
19	Default		DFT-s-OFDM 64 QAM	Outer Full
20	Low		DFT-s-OFDM 256 QAM	Edge_1RB_Left
21	High		DFT-s-OFDM 256 QAM	Edge_1RB_Right
22	Default		DFT-s-OFDM 256 QAM	Outer Full
23	Default		CP-OFDM QPSK	Inner Full
24	Low		CP-OFDM QPSK	Edge_1RB_Left
25	High		CP-OFDM QPSK	Edge_1RB_Right
26	Default		CP-OFDM QPSK	Outer Full
27	Default		CP-OFDM 16 QAM	Inner Full
28	Low		CP-OFDM 16 QAM	Edge_1RB_Left
29	High		CP-OFDM 16 QAM	Edge_1RB_Right
30	Default		CP-OFDM 16 QAM	Outer Full
31	Low		DFT-s-OFDM 64 QAM	Edge_1RB_Left
32	High		DFT-s-OFDM 64 QAM	Edge_1RB_Right
33	Default		CP-OFDM 64 QAM	Outer Full
34	Low		DFT-s-OFDM 256 QAM	Edge_1RB_Left
35	High		DFT-s-OFDM 256 QAM	Edge_1RB_Right
36	Default		CP-OFDM 256 QAM	Outer Full

NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.
NOTE 2: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.
NOTE 3: UE operating in TDD mode with PI/2 BPSK modulation and UE indicates support for UE capability *powerBoosting-pi2BPSK* and the IE *powerBoostPi2BPSK* is set to 1 for bands n40, n41, n77, n78 and n79.
NOTE 4: UE operating in FDD mode, or in TDD mode in bands other than n40, n41, n77, n78 and n79, or in TDD mode the IE *powerBoostPi2BPSK* is set to 0 for bands n40, n77, n78 and n79.

Table 6.2.2.4.1-2: Test Configuration Table for Power Class 2

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, Highest	
Test SCS as specified in Table 5.3.5-1			Lowest, Highest	
Test Parameters for Channel Bandwidths				
Test ID	**Freq**	**Downlink Configuration**	**Uplink Configuration**	
		N/A for Maximum Power Reduction (MPR) test case	**Modulation (NOTE 2)**	**RB allocation (NOTE 1)**
1	Default		DFT-s-OFDM PI/2 BPSK	Inner Full
2	Low		DFT-s-OFDM PI/2 BPSK	Edge_1RB_Left
3	High		DFT-s-OFDM PI/2 BPSK	Edge_1RB_Right
4	Default		DFT-s-OFDM PI/2 BPSK	Outer Full
5	Default		DFT-s-OFDM QPSK	Inner Full
6	Low		DFT-s-OFDM QPSK	Edge_1RB_Left
7	High		DFT-s-OFDM QPSK	Edge_1RB_Right
8	Default		DFT-s-OFDM QPSK	Outer Full
9	Default		DFT-s-OFDM 16 QAM	Inner Full
10	Low		DFT-s-OFDM 16 QAM	Edge_1RB_Left
11	High		DFT-s-OFDM 16 QAM	Edge_1RB_Right
12	Default		DFT-s-OFDM 16 QAM	Outer Full
13	Low		DFT-s-OFDM 64 QAM	Edge_1RB_Left
14	High		DFT-s-OFDM 64 QAM	Edge_1RB_Right
15	Default		DFT-s-OFDM 64 QAM	Outer Full
16	Low		DFT-s-OFDM 256 QAM	Edge_1RB_Left
17	High		DFT-s-OFDM 256 QAM	Edge_1RB_Right
18	Default		DFT-s-OFDM 256 QAM	Outer Full
19	Default		CP-OFDM QPSK	Inner Full
20	Low		CP-OFDM QPSK	Edge_1RB_Left
21	High		CP-OFDM QPSK	Edge_1RB_Right
22	Default		CP-OFDM QPSK	Outer Full
23	Default		CP-OFDM 16 QAM	Inner Full
24	Low		CP-OFDM 16 QAM	Edge_1RB_Left
25	High		CP-OFDM 16 QAM	Edge_1RB_Right
26	Default		CP-OFDM 16 QAM	Outer Full
27	Low		CP-OFDM 64 QAM	Edge_1RB_Left
28	High		CP-OFDM 64 QAM	Edge_1RB_Right
29	Default		CP-OFDM 64 QAM	Outer Full
30	Low		CP-OFDM 256 QAM	Edge_1RB_Left
31	High		CP-OFDM 256 QAM	Edge_1RB_Right
32	Default		CP-OFDM 256 QAM	Outer Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.2.1 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 6.2.2.4.1-1.

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 6.2.2.4.3.

6.2.2.4.2 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 6.2.2.4.1-1. 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 continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200ms for the UE to reach P_{UMAX} level.

3. Measure the mean power of the UE in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration of 1ms over consecutive active uplink slots. For TDD, only slots consisting of only UL symbols are under test.

NOTE 1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.2.2.4.1-1, 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.

6.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4.

6.2.2.5 Test requirement

The maximum output power, derived in step 3 shall be within the range prescribed by the nominal maximum output power and tolerance in Table 6.2.2.5-1 and Table 6.2.2.5-4.

Table 6.2.2.5-1: UE Power Class test requirements(for Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n34, n38, n39, n40, n41, n50, n51, n66, n70, n74, n80, n81, n82, n84, n86) for Power Class 3

Test ID	$P_{PowerClass}$ (dBm)	$\Delta P_{PowerClass}$ (dB)	MPR (dB)	$\Delta T_{C,c}$ (dB)	$P_{CMAX\_L,f,c}$ (dBm)	$T(P_{CMAX\_L,f,c})$ (dB)	$T_{L,c}$ (dB)	Upper limit (dBm)	Lower limit (dBm)
1	23	-3	0.2	0 (1.5[2])	25.8 (24.3[2])	2.0	2 (3.5[2])	28.0 + TT	23.8 - TT (22.3 - TT[2])
2	23	-3	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	2 (3.5[2])	28.0 + TT	20.5 - TT (19.0 - TT[2])
3	23	-3	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	2 (3.5[2])	28.0 + TT	20.5 - TT (19.0 - TT[2])
4	23	-3	1.2	0 (1.5[2])	24.8 (23.3[2])	2.0	2 (3.5[2])	28.0 + TT	22.8 - TT (21.3 - TT[2])
5	23	0	0	0 (1.5[2])	23.0 (21.5[2])	2.0	2 (3.5[2])	25.0 + TT	21.0 - TT (19.5 - TT[2])
6	23	0	0.5	0 (1.5[2])	22.5 (21.0[2])	2.0	2 (3.5[2])	25.0 + TT	20.5 - TT (19.0 - TT[2])
7	23	0	0.5	0 (1.5[2])	22.5 (21.0[2])	2.0	2 (3.5[2])	25.0 + TT	20.5 - TT (19.0 - TT[2])
8	23	0	0.5	0 (1.5[2])	22.5 (21.0[2])	2.0	2 (3.5[2])	25.0 + TT	20.5 - TT (19.0 - TT[2])
9	23	0	0	0 (1.5[2])	23.0 (21.5[2])	2.0	2 (3.5[2])	25.0 + TT	21.0 - TT (19.5 - TT[2])
10	23	0	1	0 (1.5[2])	22.0 (20.5[2])	2.0 (2.5[2])	2 (3.5[2])	25.0 + TT	20.0 - TT (18.0 - TT[2])
11	23	0	1	0 (1.5[2])	22.0 (20.5[2])	2.0 (2.5[2])	2 (3.5[2])	25.0 + TT	20.0 - TT (18.0 - TT[2])
12	23	0	1	0 (1.5[2])	22.0 (20.5[2])	2.0 (2.5[2])	2 (3.5[2])	25.0 + TT	20.0 - TT (18.0 - TT[2])
13	23	0	1	0 (1.5[2])	22.0 (20.5[2])	2.0 (2.5[2])	2 (3.5[2])	25.0 + TT	20.0 - TT (18.0 - TT[2])
14	23	0	2	0 (1.5[2])	21.0 (19.5[2])	2.0 (3.5[2])	2 (3.5[2])	25.0 + TT	19.0 - TT (16.0 - TT[2])
15	23	0	2	0 (1.5[2])	21.0 (19.5[2])	2.0 (3.5[2])	2 (3.5[2])	25.0 + TT	19.0 - TT (16.0 - TT[2])
16	23	0	2	0 (1.5[2])	21.0 (19.5[2])	2.0 (3.5[2])	2 (3.5[2])	25.0 + TT	19.0 - TT (16.0 - TT[2])
17	23	0	2.5	0 (1.5[2])	20.5 (19.0[2])	2.5 (3.5[2])	2 (3.5[2])	25.0 + TT	18.0 - TT (15.5 - TT[2])
18	23	0	2.5	0 (1.5[2])	20.5 (19.0[2])	2.5 (3.5[2])	2 (3.5[2])	25.0 + TT	18.0 - TT (15.5 - TT[2])
19	23	0	2.5	0 (1.5[2])	20.5 (19.0[2])	2.5 (3.5[2])	2 (3.5[2])	25.0 + TT	18.0 - TT (15.5 - TT[2])
20	23	0	4.5	0 (1.5[2])	18.5 (17.0[2])	4.0 (5.0[2])	2 (3.5[2])	25.0 + TT	14.5 - TT (12.0 - TT[2])
21	23	0	4.5	0 (1.5[2])	18.5 (17.0[2])	4.0 (5.0[2])	2 (3.5[2])	25.0 + TT	14.5 - TT (12.0 - TT[2])

22	23	0	4.5	0 (1.5[2])	18.5 (17.0[2])	4.0 (5.0[2])	2 (3.5[2])	25.0 + TT	14.5 - TT (12.0 - TT[2])
23	23	0	1.5	0 (1.5[2])	21.5 (20.0[2])	2.0 (2.5[2])	2 (3.5[2])	25.0 + TT	19.5 - TT (17.5 - TT[2])
24	23	0	3	0 (1.5[2])	20.0 (18.5[2])	2.5 (4.0[2])	2 (3.5[2])	25.0 + TT	17.5 - TT (14.5 - TT[2])
25	23	0	3	0 (1.5[2])	20.0 (18.5[2])	2.5 (4.0[2])	2 (3.5[2])	25.0 + TT	17.5 - TT (14.5 - TT[2])
26	23	0	3	0 (1.5[2])	20.0 (18.5[2])	2.5 (4.0[2])	2 (3.5[2])	25.0 + TT	17.5 - TT (14.5 - TT[2])
27	23	0	2	0 (1.5[2])	21.0 (19.5[2])	2.0 (3.5[2])	2 (3.5[2])	25.0 + TT	19.0 - TT (16.0 - TT[2])
28	23	0	3	0 (1.5[2])	20.0 (18.5[2])	2.5 (4.0[2])	2 (3.5[2])	25.0 + TT	17.5 - TT (14.5 - TT[2])
29	23	0	3	0 (1.5[2])	20.0 (18.5[2])	2.5 (4.0[2])	2 (3.5[2])	25.0 + TT	17.5 - TT (14.5 - TT[2])
30	23	0	3	0 (1.5[2])	20.0 (18.5[2])	2.5 (4.0[2])	2 (3.5[2])	25.0 + TT	17.5 - TT (14.5 - TT[2])
31	23	0	3.5	0 (1.5[2])	19.5 (18.0[2])	3.5 (4.0[2])	2 (3.5[2])	25.0 + TT	16.0 - TT (14.0 - TT[2])
32	23	0	3.5	0 (1.5[2])	19.5 (18.0[2])	3.5 (4.0[2])	2 (3.5[2])	25.0 + TT	16.0 - TT (14.0 - TT[2])
33	23	0	3.5	0 (1.5[2])	19.5 (18.0[2])	3.5 (4.0[2])	2 (3.5[2])	25.0 + TT	16.0 - TT (14.0 - TT[2])
34	23	0	6.5	0 (1.5[2])	16.5 (15.0[2])	5.0	2 (3.5[2])	25.0 + TT	11.5 - TT (10.0 - TT[2])
35	23	0	6.5	0 (1.5[2])	16.5 (15.0[2])	5.0	2 (3.5[2])	25.0 + TT	11.5 - TT (10.0 - TT[2])
36	23	0	6.5	0 (1.5[2])	16.5 (15.0[2])	5.0	2 (3.5[2])	25.0 + TT	11.5 - TT (10.0 - TT[2])

NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance.
NOTE 2: For Band n2, n3, n7, n8, 12, 20, n41, transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}.
NOTE 3: TT for each frequency and channel bandwidth is specified in Table 6.2.2.5-5.

Table 6.2.2.5-2: UE Power Class test requirements(for Bands n28, n71, n83) for Power Class 3

Test ID	$P_{PowerClass}$ (dBm)	$\Delta P_{PowerClass}$ (dB)	MPR (dB)	$\Delta T_{C,c}$ (dB)	$P_{CMAX\_L,f,c}$ (dBm)	$T(P_{CMAX\_L,f,c})$ (dB)	$T_{L,c}$ (dB)	Upper limit (dBm)	Lower limit (dBm)
5	23	0	0	0	23.0	2.0	2.5	25.0 + TT	20.5 - TT
6	23	0	0.5	0	22.5	2.0	2.5	25.0 + TT	20.0 - TT
7	23	0	0.5	0	22.5	2.0	2.5	25.0 + TT	20.0 - TT
8	23	0	0.5	0	22.5	2.0	2.5	25.0 + TT	20.0 - TT
9	23	0	0	0	23.0	2.0	2.5	25.0 + TT	20.5 - TT
10	23	0	1	0	22.0	2.0	2.5	25.0 + TT	19.5 - TT
11	23	0	1	0	22.0	2.0	2.5	25.0 + TT	19.5 - TT
12	23	0	1	0	22.0	2.0	2.5	25.0 + TT	19.5 - TT
13	23	0	1	0	22.0	2.0	2.5	25.0 + TT	19.5 - TT
14	23	0	2	0	21.0	2.0	2.5	25.0 + TT	18.5 - TT
15	23	0	2	0	21.0	2.0	2.5	25.0 + TT	18.5 - TT
16	23	0	2	0	21.0	2.0	2.5	25.0 + TT	18.5 - TT
17	23	0	2.5	0	20.5	2.5	2.5	25.0 + TT	18.0 - TT
18	23	0	2.5	0	20.5	2.5	2.5	25.0 + TT	18.0 - TT
19	23	0	2.5	0	20.5	2.5	2.5	25.0 + TT	18.0 - TT
20	23	0	4.5	0	18.5	4.0	2.5	25.0 + TT	14.5 - TT
21	23	0	4.5	0	18.5	4.0	2.5	25.0 + TT	14.5 - TT
22	23	0	4.5	0	18.5	4.0	2.5	25.0 + TT	14.5 - TT
23	23	0	1.5	0	21.5	2.0	2.5	25.0 + TT	19.0 - TT
24	23	0	3	0	20.0	2.5	2.5	25.0 + TT	17.5 - TT
25	23	0	3	0	20.0	2.5	2.5	25.0 + TT	17.5 - TT
26	23	0	3	0	20.0	2.5	2.5	25.0 + TT	17.5 - TT
27	23	0	2	0	21.0	2.0	2.5	25.0 + TT	18.5 - TT
28	23	0	3	0	20.0	2.5	2.5	25.0 + TT	17.5 - TT
29	23	0	3	0	20.0	2.5	2.5	25.0 + TT	17.5 - TT
30	23	0	3	0	20.0	2.5	2.5	25.0 + TT	17.5 - TT
31	23	0	3.5	0	19.5	3.5	2.5	25.0 + TT	16.0 - TT
32	23	0	3.5	0	19.5	3.5	2.5	25.0 + TT	16.0 - TT
33	23	0	3.5	0	19.5	3.5	2.5	25.0 + TT	16.0 - TT
34	23	0	6.5	0	16.5	5.0	2.5	25.0 + TT	11.5 - TT
35	23	0	6.5	0	16.5	5.0	2.5	25.0 + TT	11.5 - TT
36	23	0	6.5	0	16.5	5.0	2.5	25.0 + TT	11.5 - TT
NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance. NOTE 2: TT for each frequency and channel bandwidth is specified in Table 6.2.2.5-5.									

Table 6.2.2.5-3: UE Power Class test requirements (for Bands n77, n78, n79) for Power Class 3

Test ID	$P_{PowerClass}$ (dBm)	$\Delta P_{PowerClass}$ (dB)	MPR (dB)	$\Delta T_{C,c}$ (dB)	$P_{CMAX\_L,f,c}$ (dBm)	$T(P_{CMAX\_L,f,c})$ (dB)	$T_{L,c}$ (dB)	Upper limit (dBm)	Lower limit (dBm)
1	23	-3	0.2	0	25.8	2.0	3	28.0 + TT	22.8 - TT
2	23	-3	3.5	0	22.5	2.0	3	28.0 + TT	19.5 - TT
3	23	-3	3.5	0	22.5	2.0	3	28.0 + TT	19.5 - TT
4	23	-3	1.2	0	24.8	2.0	3	28.0 + TT	21.8 - TT
5	23	0	0	0	23.0	2.0	3	25.0 + TT	20.0 - TT
6	23	0	0.5	0	22.5	2.0	3	25.0 + TT	19.5 - TT
7	23	0	0.5	0	22.5	2.0	3	25.0 + TT	19.5 - TT
8	23	0	0.5	0	22.5	2.0	3	25.0 + TT	19.5 - TT
9	23	0	0	0	23.0	2.0	3	25.0 + TT	20.0 - TT
10	23	0	1	0	22.0	2.0	3	25.0 + TT	19.0 - TT
11	23	0	1	0	22.0	2.0	3	25.0 + TT	19.0 - TT
12	23	0	1	0	22.0	2.0	3	25.0 + TT	19.0 - TT
13	23	0	1	0	22.0	2.0	3	25.0 + TT	19.0 - TT
14	23	0	2	0	21.0	2.0	3	25.0 + TT	18.0 - TT
15	23	0	2	0	21.0	2.0	3	25.0 + TT	18.0 - TT
16	23	0	2	0	21.0	2.0	3	25.0 + TT	18.0 - TT
17	23	0	2.5	0	20.5	2.5	3	25.0 + TT	17.5 - TT
18	23	0	2.5	0	20.5	2.5	3	25.0 + TT	17.5 - TT
19	23	0	2.5	0	20.5	2.5	3	25.0 + TT	17.5 - TT
20	23	0	4.5	0	18.5	4.0	3	25.0 + TT	14.5 - TT
21	23	0	4.5	0	18.5	4.0	3	25.0 + TT	14.5 - TT
22	23	0	4.5	0	18.5	4.0	3	25.0 + TT	14.5 - TT
23	23	0	1.5	0	21.5	2.0	3	25.0 + TT	18.5 - TT
24	23	0	3	0	20.0	2.5	3	25.0 + TT	17.0 - TT
25	23	0	3	0	20.0	2.5	3	25.0 + TT	17.0 - TT
26	23	0	3	0	20.0	2.5	3	25.0 + TT	17.0 - TT
27	23	0	2	0	21.0	2.0	3	25.0 + TT	18.0 - TT
28	23	0	3	0	20.0	2.5	3	25.0 + TT	17.0 - TT
29	23	0	3	0	20.0	2.5	3	25.0 + TT	17.0 - TT
30	23	0	3	0	20.0	2.5	3	25.0 + TT	17.0 - TT
31	23	0	3.5	0	19.5	3.5	3	25.0 + TT	16.0 - TT
32	23	0	3.5	0	19.5	3.5	3	25.0 + TT	16.0 - TT
33	23	0	3.5	0	19.5	3.5	3	25.0 + TT	16.0 - TT
34	23	0	6.5	0	16.5	5.0	3	25.0 + TT	11.5 - TT
35	23	0	6.5	0	16.5	5.0	3	25.0 + TT	11.5 - TT
36	23	0	6.5	0	16.5	5.0	3	25.0 + TT	11.5 - TT

NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance.
NOTE 2: TT for each frequency and channel bandwidth is specified in Table 6.2.2.5-5.

Table 6.2.2.5-4: UE Power Class test requirements (for Bands n41, n77, n78, n79) for Power Class 2

Test ID	$P_{PowerClass}$ (dBm)	$\Delta P_{PowerClass}$ (dB)	MPR (dB)	$\Delta T_{C,c}$ (dB)	$P_{CMAX\_L,f,c}$ (dBm)	$T(P_{CMAX\_L,f,c})$ (dB)	$T_{L,c}$ (dB)	Upper limit (dBm)	Lower limit (dBm)
1	26	0	0	0 (1.5[2])	26.0 (24.5[2])	2.0	3 (4.5[2])	28.0 + TT	23.0 - TT (21.5 - TT[2])
2	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0 - TT[2])
3	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0- TT[2])
4	26	0	0.5	0 (1.5[2])	25.5 (24.0[2])	2.0	3 (4.5[2])	28.0 + TT	22.5 - TT (21.0 - TT[2])
5	26	0	0	0 (1.5[2])	26.0 (24.5[2])	2.0	3 (4.5[2])	28.0 + TT	23.0 - TT (21.5 - TT[2])
6	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0 - TT[2])
7	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0 - TT[2])
8	26	0	1	0 (1.5[2])	25.0 (23.5[2])	2.0	3 (4.5[2])	28.0 + TT	22.0 - TT (20.5 - TT[2])
9	26	0	1	0 (1.5[2])	25.0 (23.5[2])	2.0	3 (4.5[2])	28.0 + TT	22.0 - TT (20.5 - TT[2])
10	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0 - TT[2])
11	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0 - TT[2])
12	26	0	2	0 (1.5[2])	24.0 (22.5[2])	2.0	3 (4.5[2])	28.0 + TT	21.0 - TT (19.5 - TT[2])
13	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0 - TT[2])
14	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0- TT[2])
15	26	0	2.5	0 (1.5[2])	23.5 (22.0[2])	2.0	3 (4.5[2])	28.0 + TT	20.5 - TT (19.0 - TT[2])
16	26	0	4.5	0 (1.5[2])	21.5 (20.0[2])	2.0 (2.5[2])	3 (4.5[2])	28.0 + TT	18.5 - TT (17.0 - TT[2])
17	26	0	4.5	0 (1.5[2])	21.5 (20.0[2])	2.0 (2.5[2])	3 (4.5[2])	28.0 + TT	18.5 - TT (17.0 - TT[2])
18	26	0	4.5	0 (1.5[2])	21.5 (20.0[2])	2.0 (2.5[2])	3 (4.5[2])	28.0 + TT	18.5 - TT (17.0 - TT[2])
19	26	0	1.5	0 (1.5[2])	24.5 (23.0[2])	2.0	3 (4.5[2])	28.0 + TT	21.5 - TT (20.0 - TT[2])
20	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0 - TT[2])
21	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0 - TT[2])
22	26	0	3	0 (1.5[2])	23.0 (21.5[2])	2.0	3 (4.5[2])	28.0 + TT	20.0 - TT (18.5 - TT[2])
23	26	0	2	0 (1.5[2])	24.0 (22.5[2])	2.0	3 (4.5[2])	28.0 + TT	21.0 - TT (19.5 - TT[2])
24	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0 - TT[2])
25	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0 - TT[2])
26	26	0	3	0 (1.5[2])	23.0 (21.5[2])	2.0	3 (4.5[2])	28.0 + TT	20.0 - TT (18.5 - TT[2])
27	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0 - TT[2])
28	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0 - TT[2])
29	26	0	3.5	0 (1.5[2])	22.5 (21.0[2])	2.0	3 (4.5[2])	28.0 + TT	19.5 - TT (18.0 - TT[2])
30	26	0	6.5	0 (1.5[2])	19.5 (18.0[2])	3.5 (4.0[2])	3 (4.5[2])	28.0 + TT	16.0 - TT (14.0 - TT[2])

31	26	0	6.5	0 (1.5^{2})	19.5 (18.0^{2})	3.5 (4.0^{2})	3 (4.5^{2})	28.0 + TT	16.0 - TT (14.0 - TT^{2})
32	26	0	6.5	0 (1.5^{2})	19.5 (18.0^{2})	3.5 (4.0^{2})	3 (4.5^{2})	28.0 + TT	16.0 - TT (14.0 - TT^{2})
NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance. NOTE 2: For Band n41, transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}. NOTE 3: TT for each frequency and channel bandwidth is specified in Table 6.2.2.5-5.									

Table 6.2.2.5-5: Test Tolerance (Maximum Power Reduction (MPR))

	f ≤ 3.0GHz	3.0GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6.0GHz
BW ≤ 40MHz	0.7 dB	1.0 dB	1.0 dB
40MHz < BW ≤ 100MHz	1.0 dB	1.0 dB	1.0 dB

6.2.3 UE additional maximum output power reduction

Editor's note: The following aspects are either missing or not yet determined:

- Tests for network signalling values NS_03, NS_10, NS_05, NS_08; NS_07, NS_40 and NS_09 not complete.

6.2.3.1 Test purpose

Additional emission requirements can be signalled by the network. Each additional emission requirement is associated with a unique network signalling (NS) value indicated in RRC signalling by an NR frequency band number of the applicable operating band and an associated value in the field *additionalSpectrumEmission.* Throughout this specification, the notion of indication or signalling of an NS value refers to the corresponding indication of an NR frequency band number of the applicable operating band, the IE *freqBandIndicatorNR* and an associated value of *additionalSpectrumEmission* in the relevant RRC information elements [6].

To meet the additional requirements, additional maximum power reduction (A-MPR) is allowed for the maximum output power as specified in Table 6.2.1.3-1. Unless stated otherwise, the total reduction to UE maximum output power is max(MPR, A-MPR) where MPR is defined in clause 6.2.2. Outer and inner allocation notation used in clause 6.2.3 is defined in clause 6.2.2. In absence of modulation and waveform types the A-MPR applies to all modulation and waveform types.

6.2.3.2 Test applicability

The requirements of this test apply in test case 6.5.2.3 Additional Spectrum Emission mask for network signalled values NS_03, NS_03U, NS_04, NS_06, NS_35, NS_40, NS_41, NS_42 and NS_100 to all types of NR UE release 15 and forward.

The requirements of this test apply in test case 6.5.3.3 Additional Spurious Emissions for network signalled values NS_04, NS_05, NS_05U, NS_43, NS_43U, NS_17, NS_18, NS_37, NS_38 and NS_39 to all types of NR UE release 15 and forward.

6.2.3.3 Minimum conformance requirements

6.2.3.3.1 General

Table 6.2.3.3.1-1 specifies the additional requirements with their associated network signalling values and the allowed A-MPR and applicable operating band(s) for each NS value. In case of a Power Class 3 UE, when IE *powerBoostPi2BPSK* is set to 1, PC2 A-MPR values apply. The mapping of NR frequency band numbers and values of the *additionalSpectrumEmission* to network signalling labels is specified in Table 6.2.3.3.1-1A.

For almost contiguous allocations in CP-OFDM waveforms, the allowed A-MPR is TBD.

Table 6.2.3.3.1-1: Additional maximum power reduction (A-MPR)

Network Signalling label	Requirements (subclause)	NR Band	Channel bandwidth (MHz)	Resources Blocks (N_{RB})	A-MPR (dB)
NS_01		Table 5.2-1	5, 10, 15, 20, 25, 30, 40, 50, 60, 80, 90, 100	Table 5.3.2-1	N/A
NS_03	6.5.2.3.3.3	n2, n25, n66,			Subclause 6.2.3.3.7
		n70, n86			
NS_03U	6.5.2.3.3.3, 6.5.2.4.2	n2, n25, n66, n86			Subclause 6.2.3.3.7
NS_04	6.5.2.3.3.2, 6.5.3.3.3.1	n41	10, 15, 20, 40, 50, 60, 80, 90, 100		Subclause 6.2.3.3.2
NS_05	6.5.3.3.3.3	n1, n84	5, 10, 15, 20 (NOTE 2)		Subclause 6.2.3.3.4
NS_05U	6.5.3.3.3.3, 6.5.2.4.2	n1, n84	5, 10, 15, 20		Subclause 6.2.3.3.4
NS_06	6.5.2.3.3.4	n12	5, 10, 15		N/A
NS_10		n20	15, 20	Table 6.2.3.3.3-1	Table 6.2.3.3.3-1
NS_17	6.5.3.3.3.2	n28, n83	5, 10	Table 5.3.2-1	N/A
NS_18	6.5.3.3.3.3	n28, n83	5		Table 6.2.3.3.13-1, A1
			10, 15, 20		Table 6.2.3.3.13-1, A2
NS_35	6.5.2.3.3.1	n71	5, 10, 15, 20	Table 5.3.2-1	N/A
NS_37	6.5.3.3.3.6	n74 (Note 3)	10, 15	Table 6.2.3.8-1	Table 6.2.3.3.8-1
NS_38	6.5.3.3.3.7	n74	5, 10, 15, 20	Table 6.2.3.9-1	Table 6.2.3.3.9-1
NS_39	6.5.3.3.3.8	n74	10, 15, 20	Table 6.2.3.10-1	Table 6.2.3.3.10-1
NS_40	6.5.2.3.3.5	n51	5		Table 6.2.3.3.5-1
NS_41	6.5.2.3.3.6	n50	5, 10, 15, 20, 40, 50, 60		Table 6.2.3.3.11-1
NS_42	6.5.2.3.3.7	n50	5, 10, 15, 20, 40, 50, 60		Table 6.2.3.3.12-1
NS_43	[TBD]	n8, n81	5, 10, 15		Subclause 6.2.3.3.6
NS_43U	[TBD]	n8, n81	5, 10, 15		Subclause 6.2.3.3.6
NS_100	6.5.2.4.2	n1, n2, n3, n5, n8, n25, n66, n80, n81, n84, n86 (Note 1)			Table 6.2.3.3.1-2
NOTE 1: This NS can be signalled for NR bands that have UTRA services deployed. NOTE 2: No A-MPR is applied for 5 MHz CBW where the lower channel edge is ≥1930 MHz,10 MHz CBW where the lower channel edge is ≥1950 MHz and 15 MHz CBW where the lower channel edge is ≥1955 MHz. NOTE 3: Applicable when the NR carrier is within 1447.9 – 1462.9 MHz.					

Table 6.2.3.3.1-1A: Mapping of Network Signalling label

NR band	Value of additionalSpectrumEmission							
	0	1	2	3	4	5	6	7
n1	NS_01	NS_100	NS_05	NS_05U				
n2	NS_01	NS_100	NS_03	NS_03U				
n3	NS_01	NS_100						
n5	NS_01	NS_100						
n7	NS_01							
n8	NS_01	NS_100	NS_43	NS_43U				
n12	NS_01	NS_06						
n20	NS_01	Void	NS_10					
n25	NS_01	NS_100	NS_03	NS_03U				
n28	NS_01	NS_17	NS_18					
n34	NS_01							
n38	NS_01							
n39	NS_01							
n40	NS_01							
n41	NS_01	NS_04						
n50	NS_01	NS_41	NS_42					
n51	NS_01							
n66	NS_01	NS_100	NS_03	NS_03U				
n70	NS_01	NS_03						
n71	NS_01	NS_35						
n74	NS_01	NS_37	NS_38	NS_39				
n77	NS_01							
n78	NS_01							
n79	NS_01							
n80	NS_01	NS_100						
n81	NS_01	NS_100	NS_43	NS_43U				
n82	NS_01	Void						
n83	NS_01	NS_17	NS_18					
n84	NS_01	NS_100	NS_05	NS_05U				
n86	NS_01	NS_100	NS_03	NS_03U				
NOTE: additionalSpectrumEmission corresponds to an information element of the same name defined in sub-clause 6.3.2 of TS 38.331 [6].								

Table 6.2.3.3.1-2: A-MPR for NS_100 (UTRA protection)

Modulation/Waveform		Outer (dB)
DFT-s-OFDM	Pi/2 BPSK	≤ 2
	QPSK	≤ 2
	16 QAM	≤ 2.5
	64 QAM	≤ 3
	256 QAM	≤ 4.5
CP-OFDM	QPSK	≤ 4
	16 QAM	≤ 4
	64 QAM	≤ 4
	256 QAM	≤ 6.5

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.3.1.

6.2.3.3.2 A-MPR for NS_04

For NS_04, A-MPR is not added to MPR. Also, when NS_04 is signalled, MPR shall be set to zero in the P_{CMAX} equations to avoid double-counting MPR.

Allowed maximum power reduction is defined as A-MPR=max(MPR, A-MPR'),

Note that A-MPR'=0 dB means only MPR is applied,

where A-MPR' is defined as

if $RB_{start} \leq f_{start,max,IMD3}$ / (12·SCS) and $L_{CRB} \leq AW_{max,IMD3}$ / (12·SCS) and F_C - $BW_{Channel}/2 < F_{UL\_low}$ + $offset_{IMD3}$, then

the A-MPR' is defined according to Table 6.2.3.3.2-2 PC3_A2 for Power Class 3 and PC2 A4 for Power Class 2,

else,

if $RB_{start} \leq L_{CRB}/2 + \Delta_{start}$ / (12·SCS) and $L_{CRB} \leq AW_{max,regrowth}$ / (12·SCS) and F_C - $BW_{Channel}/2 < F_{UL\_low}$ + $offset_{regrowth}$, then

the A-MPR' is defined according to Table 6.2.3.3.2-2 PC3_A1 for Power Class 3 and PC2 A3 for Power Class 2,

else

A-MPR' = 0 dB and apply MPR.

With the parameters defined in Table 6.2.3.3.2-1.

Table 6.2.3.3.2-1: Parameters for region edges and frequency offsets

Parameter	Symbol	Value		Related condition
		OFDM	DFT-S-OFDM	
Max allocation start in IMD3 region	$f_{start,max,IMD3}$	0.33 $BW_{Channel}$		$RB_{start} \leq f_{start,max,IMD3}$ / (12SCS)
Max allocation BW in IMD3 region	$AW_{max,IMD3}$	4 MHz		$L_{CRB} \leq AW_{max,IMD3}$ / (12SCS)
Max freq. offset for IMD3 region	$offset_{max,IMD3}$	$BW_{Channel}$ – 6 MHz		
Freq. offset required to avoid A-MPR in IMD3 region	$offset_{IMD3}$	$offset_{max,IMD3}$		F_C - $BW_{Channel}/2 \geq F_{UL\_low}$ + $offset_{IMD3}$
Right edge of regrowth region	Δ_{start}	0.08 $BW_{Channel}$		$RB_{start} \leq L_{CRB}/2 + \Delta_{start}$ / (12SCS)
Max allocation BW in regrowth region	$AW_{max,regrowth}$	100 MHz		$L_{CRB} \leq$ Min($L_{CRB,Max}$, $AW_{max,regrowth}$ / (12SCS))
Freq. offset required to avoid A-MPR in regrowth region	$offset_{regrowth}$	Max (10 MHz, 0.25* $BW_{Channel}$ MHz)	Max (10 MHz, 0.45* $BW_{Channel}$ MHz)	F_C - $BW_{Channel}/2 \geq F_{UL\_low}$ + $offset_{regrowth}$

Table 6.2.3.3.2-2: A-MPR' values Access

Access	Modulation	A-MPR' (dB)			
		PC3_A1	PC3_A2	PC2_A3	PC2_A4
DFT-S-OFDM	pi/2-BPSK	3.5	3.5	3.5	[5.5]
	QPSK	4	4	4.5	[6]
	16-QAM	4	4	5	[6]
	64-QAM	4	4.5	5	[6.5]
	256-QAM	4.5	6	6.5	[8]
CP-OFDM	QPSK	5.5	5.5	6.5	[7.5]
	16-QAM	5.5	5.5	6.5	[7.5]
	64-QAM	5.5	5.5	6.5	[7.5]
	256-QAM	6.5	8	7.5	[10]
NOTE: The A-MPR' values in this table apply for both A-MPR relative to 23 dBm for PC3 and A-MPR relative to 26 dBm for PC2					

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.3.2.

6.2.3.3.3 A-MPR for NS_10

Table 6.2.3.3.3-1: A-MPR for NS_10

Channel bandwidth [MHz]	Parameters	Region A
15	RB_{start}	[0 – 10]
	L_{CRB} (RBs)]]	[1 –20]
	A-MPR ([[dB)	≤ 3[6]
20	RB_{start}	[0 – 15]
	L_{CRB} (RBs)	[1 – 20]
	A-MPR (dB)	≤ 6[6]
NOTE 1: RB_{start} indicates the lowest RB index of transmitted resource blocks NOTE 2: L_{CRB} is the length of a contiguous resource block allocation NOTE 3: For intra-subframe frequency hopping which intersects Region A, notes 1 and 2 apply on a per slot basis. For intra-slot or intra-subslot frequency hopping which intersects Region A, notes 1 and 2 apply on a $T_{no\_hopping}$ basis. NOTE 4: For intra-subframe frequency hopping which intersect Region A, the larger A-MPR value may be applied for both slots in the subframe. For intra-slot frequency hopping which intersects Region A, the larger A-MPR value may be applied for the slot. For intra-subslot frequency hopping which intersects Region A, the larger A-MPR value may be applied for the subslot. NOTE 5: The total maximum output power reduction for NS_10 is obtained by taking the maximum value of MPR + A-MPR specified in Table 6.2.3.3.1-1and Table 6.2.4-1 in TS 36.101 and A-MPR specified in Table 6.2.3.3.3-1. NOTE 6: The A-MPR for CP-OFDM shall also add the corresponding MPR specified in Table 6.2.2.3-1.		

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.3.3.

6.2.3.3.4 A-MPR for NS_05 and NS_05U

Table 6.2.3.3.4-1: A-MPR for NS_05 and NS_05U

Channel Bandwidth, MHz	Carrier Centre Frequency, Fc, MHz	Region A			Region B			Region C		
		RB_{start}Rbstart	L_{CRB}LCRB	A-MPR	RB_{start}Rbstart	L_{CRB}LCRB	A-MPR	RB_{start}Rbstart	L_{CRB}LCRB	A-MPR

5 MHz	1922.5 ≤ F_C < 1927.5	<1.62MHz/12/SCS	>2.52MHz/12/SCS	A3						
10 MHz	1920 ≤ F_C < 1935	<1.62MHz/12/SCS	>0	A1	>1.62MHz/12/SCS ≤3.60MHz/12/SCS	>5.4MHz/12/SCS	A7	>7.74MHz/12/SCS	≤1.08 MHz/12/SCS	A2
10 MHz	1935 ≤ F_C < 1945		>4.5MHz/12/SCS	A4						
15 MHz	1927.5 ≤ F_C < 1932.5	<3.24MHz/12/SCS	>0	A1	>3.24MHz/12/SCS ≤5.40MHz/12/SCS	>8.1MHz/12/SCS	A7	>10.9MHz/12/SCS	≤1.08 MHz/12/SCS	A2
15 MHz	1932.5 ≤ F_C < 1942.5	<1.62MHz/12/SCS	>0	A1				>12.6 MHz/12/SCS	≤1.08 MHz/12/SCS	A2
15 MHz	1942.5 ≤ F_C < 1947.5		>7.2MHz/12/SCS	A5						
20 MHz	1930 ≤ F_C < 1950	<4.86MHz/12/SCS	>0	A1	>4.86MHz/12/SCS ≤7.20MHz/12/SCS	>9.0MHz/12/SCS	A7	>14.22MHz/12/SCS	≤1.08 MHz/12/SCS	A2
20 MHz	1950 ≤ F_C <1960		>9.0MHz/12/SCS	A6						
NOTE 1: The A-MPR values are listed in Table 6.2.3.3.4-2 and 6.2.3.3.4-3. NOTE 2: For any undefined region, MPR applies										

Table 6.2.3.3.4-2: A-MPR for modulation and waveform type for NS_05 and NS_05U

Modulation/Waveform	A1	A2	A3	
	Outer/Inner	Outer/Inner	Outer	Inner
DFT-s-OFDM PI/2 BPSK	≤ 10	≤ 5	≤ 4	N/A
DFT-s-OFDM QPSK	≤ 10	≤ 5	≤ 4.5	N/A
DFT-s-OFDM 16 QAM	≤ 10	≤ 5	≤ 6	N/A
DFT-s-OFDM 64 QAM	≤ 11	≤ 5	≤ 6	N/A
DFT-s-OFDM 256 QAM	≤ 13	≤ 5	≤ 7	N/A
CP-OFDM QPSK	≤ 10	≤ 5	≤ 7.5	≤ 2
CP-OFDM 16 QAM	≤ 10	≤ 5	≤ 7.5	N/A
CP-OFDM 64 QAM	≤ 11	≤ 5	≤ 8	N/A
CP-OFDM 256 QAM	≤ 13	N/A	≤ 10	N/A
NOTE 1: The backoff applied is max (MPR, A-MPR) where MPR is defined in Table 6.2.2.3-1 NOTE 2: Outer and inner allocations are defined in clause 6.2.2				

Table 6.2.3.3.4-3: A-MPR for modulation and waveform type for NS_05

Modulation/Waveform	A4		A5		A6		A7
	Outer	Inner	Outer	Inner	Outer	Inner	Outer/Inner

DFT-s-OFDM PI/2 BPSK	≤ 1		≤ 1	N/A	≤ 1		≤ 6
DFT-s-OFDM QPSK	N/A		≤ 1.5	N/A	≤ 1.5		≤ 6
DFT-s-OFDM 16 QAM	N/A		N/A	N/A	N/A		≤ 6
DFT-s-OFDM 64 QAM	N/A		N/A	N/A	N/A		≤ 6
DFT-s-OFDM 256 QAM	N/A	N/A	N/A	N/A	N/A	N/A	≤ 6
CP-OFDM QPSK	≤ 3.5		≤ 3.5	N/A	≤ 3.5		≤ 6
CP-OFDM 16 QAM	≤ 3.5		≤ 3.5	N/A	≤ 3.5		≤ 6
CP-OFDM 64 QAM	N/A		N/A	≤ 4	N/A		≤ 6
CP-OFDM 256 QAM	N/A		N/A	N/A	N/A		≤ 6
NOTE 1: The backoff applied is max (MPR, A-MPR) where MPR is defined in Table 6.2.2.3-1 NOTE 2: Outer and inner allocations are defined in clause 6.2.2							

Table 6.2.3.3.4-4: A-MPR for modulation and waveform type for NS_05U

Modulation/Waveform	A4		A5		A6		A7
	Outer	Inner	Outer	Inner	Outer	Inner	Outer/Inner
DFT-s-OFDM PI/2 BPSK	≤ 2		≤ 2	N/A	≤ 2		≤ 6
DFT-s-OFDM QPSK	≤ 2		≤ 2	N/A	≤ 2		≤ 6
DFT-s-OFDM 16 QAM	≤ 2.5		≤ 2.5	N/A	≤ 2.5		≤ 6
DFT-s-OFDM 64 QAM	≤ 3		≤ 3	N/A	≤ 3		≤ 6
DFT-s-OFDM 256 QAM	≤ 4.5	N/A	≤ 4.5	N/A	≤ 4.5	N/A	≤ 6
CP-OFDM QPSK	≤ 4		≤ 4	N/A	≤ 4		≤ 6
CP-OFDM 16 QAM	≤ 4		≤ 4	N/A	≤ 4		≤ 6
CP-OFDM 64 QAM	≤ 4		≤ 4	≤ 4	≤ 4		≤ 6
CP-OFDM 256 QAM	≤ 6.5		≤ 6.5	N/A	≤ 6.5		≤ 6.5
NOTE 1: The backoff applied is max (MPR, A-MPR) where MPR is defined in Table 6.2.2-1 NOTE 2: Outer and inner allocations are defined in clause 6.2.2							

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.3.4.

6.2.3.3.5 A-MPR for NS_40

Table 6.2.3.3.5-1: A-MPR for NS_40

Modulation	A-MPR	
	Channel bandwidth (MHz): 5 MHz	
	Outer RB allocations	Inner RB allocations
DFT-s-OFDM QPSK	15.5	12
DFT-s-OFDM 16 QAM	14.5	11
DFT-s-OFDM 64 QAM	14.5	10
DFT-s-OFDM 256 QAM	12.5	7.5
CP-OFDM QPSK	14.5	10
CP-OFDM 16 QAM	14.5	10
CP-OFDM 64 QAM	14	8
CP-OFDM 256 QAM	11	5.5
NOTE 1: The total maximum output power reduction for NS_40 is obtained by taking the maximum value of MPR + A-MPR specified in Table 6.2.3.3.1-1 and Table 6.2.4-30a in TS 36.101 and MPR+A-MPR specified in Table 6.2.2.3-1 and Table 6.2.3.3.5-1.		

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.3.5.

6.2.3.3.6 A-MPR for NS_43

Table 6.2.3.3.6-1: A-MPR for NS_43

Channel Bandwidth, MHz	Carrier Centre Frequency, Fc, MHz	Region A			Region B		
		RB_{start}	L_{CRB}	A-MPR	RB_{start}	L_{CRB}	A-MPR
5 MHz	F_C ≥ 902.5		> 15	A1			
10 MHz	F_C ≥ 910		> 40	A2		> 5.4 MHz/12/SCS	A4
			> 45	A3		> 7.2 MHz/12/SCS	A5
15 MHz	F_C = 907.5	< 1.8 MHz /12/SCS > 12.24 MHz/12/SCS	> 0	A6	> 1.8 MHz/12/SCS < 6.12 MHz/12/SCS	> 7.2 MHz/12/SCS	A6
NOTE 1: The A-MPR values are listed in Table 2. NOTE 2: 15 kHz SCS unless otherwise stated NOTE 3: For any undefined region, MPR applies							

Table 6.2.3.3.6-2: A-MPR for modulation and waveform type for NS_43

Modulation/Waveform	A1	A2	A3	A4	A5	A6
	Outer	Outer	Outer	Outer	Outer	Outer and Inner
DFT-s-OFDM PI/2 BPSK		≤ 1.5				≤ 9
DFT-s-OFDM QPSK	≤ 2			≤ 2.5		≤ 9
DFT-s-OFDM 16 QAM					≤ 2.5	≤ 9
DFT-s-OFDM 64 QAM			≤ 2.5			≤ 9
DFT-s-OFDM 256 QAM						≤ 9
CP-OFDM QPSK	≤ 3.5				≤ 4	≤ 9
CP-OFDM 16 QAM	≤ 3.5				≤ 4	≤ 9
CP-OFDM 64 QAM			≤ 4			≤ 9
CP-OFDM 256 QAM						≤ 9

Table 6.2.3.3.6-3: Void

Table 6.2.3.3.6-4: A-MPR for modulation and waveform type for NS_43U

Modulation/Waveform	A1	A2	A3	A4	A5	A6
	Outer	Outer	Outer	Outer	Outer	Outer and Inner
DFT-s-OFDM PI/2 BPSK	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 9
DFT-s-OFDM QPSK	≤ 2	≤ 2	≤ 2	≤ 2.5	≤ 2	≤ 9
DFT-s-OFDM 16 QAM	≤ 2.5	≤ 2.5	≤ 2.5	≤ 2.5	≤ 2.5	≤ 9
DFT-s-OFDM 64 QAM	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 9
DFT-s-OFDM 256 QAM	≤ 4.5	≤ 4.5	≤ 4.5	≤ 4.5	≤ 4.5	≤ 9
CP-OFDM QPSK	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 9
CP-OFDM 16 QAM	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 9
CP-OFDM 64 QAM	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 9
CP-OFDM 256 QAM	≤ 6.5	≤ 6.5	≤ 6.5	≤ 6.5	≤ 6.5	≤ 9

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.3.6.

6.2.3.3.7 A-MPR for NS_03 and NS_03U

Table 6.2.3.3.7-1: A-MPR for NS_03

Modulation		A-MPR outer
DFT-s-OFDM	PI/2 BPSK	≤ 1.5
	QPSK	≤ 2
	16 QAM	≤ 3
	64 QAM	≤ 3.5
	256 QAM	≤ 5.5
CP-OFDM	QPSK	≤ 4
	16 QAM	≤ 4
	64 QAM	≤ 4.5
	256 QAM	≤ 7.5
NOTE 1: The backoff applied is max (MPR, A-MPR) where MPR is defined in Table 6.2.2-1 NOTE 2: Outer allocations are defined in clause 6.2.2		

In case UE operates in a band where NS_03U applies and it receives *additionalSpectrumEmission* value of 3 then A-MPR values specified in Table 6.2.3.3.7-1 apply with an exception that DFT-s-OFDM PI/2 PBSK A-MPR is 2 dB.

6.2.3.3.8 A-MPR for NS_37

Table 6.2.3.3.8-1: A-MPR for B11/B21 protection (NS_37) for 10MHz, 15MHz (1447.9-1462.9MHz)

Channel Bandwidth, MHz	Carrier Centre Frequency, Fc, MHz	Region A (Outer/Inner)			Region B (Outer/Inner)			Region C (Outer/Inner)		
		RBstart,(MHz/12/ SCS)	LCRB (MHz/12/ SCS)	A-MPR	RBstart (MHz/12/ SCS)	LCRB (MHz/12/ SCS)	A-MPR	RBstart (MHz/12/ SCS)	LCRB (MHz/12/ SCS)	A-MPR
10 MHz	1452.9 < F_C ≤1457.9	≥0	>40	≤ A1	N/A	N/A	N/A	N/A	N/A	N/A
15 MHz	F_C =1455.4	≥0	>55	≤ A1	< [0.54]	< [1.08]	[≤ A2]	> [13.86]	< [1.08]	[≤ A2]
NOTE 1: A-MPR values in Table 6.2.3.3.8-2. NOTE 2: The backoff applied is max (MPR, A-MPR) where MPR is defined in Table 6.2.2.3-1 NOTE 3: For any undefined region, MPR applies NOTE 4: No A-MPR for SCS=60 kHz.										

Table 6.2.3.3.8-2: A-MPR for modulation and waveform type

Modulation/Waveform	A1		A2
	Outer	Inner	Outer/Inner
DFT-s-OFDM PI/2 BPSK	≤ 1	N/A	[≤ 3]
DFT-s-OFDM QPSK	≤ 1.5	N/A	[≤ 3]
DFT-s-OFDM 16 QAM	≤ 2.5	N/A	[≤ 3]
DFT-s-OFDM 64 QAM	≤ 3	N/A	[≤ 3]
DFT-s-OFDM 256 QAM	N/A	N/A	[N/A]
CP-OFDM QPSK	≤ 3.5	N/A	[≤ 3]
CP-OFDM 16 QAM	≤ 3.5	N/A	[≤ 3]
CP-OFDM 64 QAM	N/A	N/A	[N/A]
CP-OFDM 256 QAM	N/A	N/A	[N\A]
NOTE 1: The backoff applied is max(MPR, A-MPR) where MPR is defined in Table 6.2.2.3-1 NOTE 2: Outer and inner allocations are defined in clause 6.2.2			

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.3.8.

6.2.3.3.9 A-MPR for NS_38

Table 6.2.3.3.9-1: A-MPR for EESS (NS_38) Protection (1430-1470MHz)

Channel Bandwidth, MHz	Carrier Centre Frequency, Fc, MHz	Region A (Outer/Inner)			Region B (Outer/Inner)	
		RBstart,	LCRB	A-MPR	Rbstart+LCRB(MHz/12/SCS)	A-MPR
10 MHz	[1435 ≤ F_C < 1442]	[<= -1.8 MHz/12/SCS + LCRB/2]	[> 3.6]	[≤ 12]	[≤ 2.16]	[≤ 9]
15 MHz	[1437.5 ≤ F_C < 1447.5]	[<= -1.8 MHz/12/SCS + LCRB/2]	[> 3.6]	[≤ 13]	[≤ 3.6]	[≤ 10]
20 MHz	[1440 ≤ F_C < 1450]	[<= -1.8 MHz/12/SCS + LCRB/2]	[> 3.6]	[≤ 13]	[≤ 5.4]	[≤ 10]
NOTE 1: The backoff applied is max(MPR, A-MPR) where MPR is defined in Table 6.2.2.3-1. NOTE 2: Outer and inner allocations are defined in clause 6.2.2. NOTE 3: For any undefined region, MPR applies NOTE 4: A-MPR applies to all modulation and waveform types.						

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.3.9.

6.2.3.3.10 A-MPR for NS_39

Table 6.2.3.3.10-1: A-MPR for own RX (NS_39) Protection for 10MHz,15MHz, 20MHz (1440-1470MHz)

Channel Bandwidth, MHz	Carrier Centre Frequency, Fc, MHz	Region A (Outer/Inner)	
		Rbstart+LCRB(MHz/12/SCS)	A-MPR
10 MHz	[1462 < F_C ≤1465]	[> 7.9]	[≤ 6]
15 MHz	[1456.3 < F_C ≤ 1462.5]	[> 11.2]	[≤ 6]
20 MHz	[1450.8 < F_C ≤ 1460]	[> 14.4]	[≤ 6]
NOTE 1: The backoff applied is max(MPR, A-MPR) where MPR is defined in Table 6.2.2.3-1 NOTE 2: Outer and inner allocations are defined in clause 6.2.2. NOTE 3: For any undefined region, MPR applies NOTE 4: A-MPR applies to all modulation and waveform types.			

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.3.10.

6.2.3.3.11 A-MPR for NS_41

Table 6.2.3.3.11-1: A-MPR for NS_41

Channel Bandwidth, MHz	**Carrier Centre Frequency, Fc, MHz**	**Region A (Outer/Inner)**			**Region B (Outer/Inner)**	
		RB_{start}	**L_{CRB}**	**A-MPR (dB)**	**RB_{end}**	**A-MPR (dB)**
5 MHz	-	-	-	NA	-	NA
10 MHz	1437 ≤ F_C < 1442	<= -4.5MHz/12/SCS + L_{CRB}	> 4.5 MHz/12/SCS	≤ 9	L_{CRB} < 1.8MHz/12/SCS	≤ 9
15 MHz	1439.5 ≤ F_C < 1447.5	<= -5.4MHz/12/SCS + L_{CRB}	> 5.4 MHz/12/SCS	≤ 11	L_{CRB} < 3.42 MHz/12/SCS	≤ 9
20 MHz	1442 ≤ F_C < 1450	<= -5.4MHz/12/SCS + L_{CRB}	> 5.4 MHz/12/SCS	≤ 12	L_{CRB} < 5.04 MHz/12/SCS	≤ 9
40 MHz	1452 ≤ F_C < 1497	<= -7.2MHz/12/SCS + L_{CRB}	> 7.2 MHz/12/SCS	≤ 13.5	L_{CRB} < 11.7 MHz/12/SCS	≤ 13.5
50 MHz	1457 ≤ F_C < 1492	<= -7.2MHz/12/SCS + L_{CRB}	> 7.2 MHz/12/SCS	≤ 13.5	L_{CRB} < 15.12 MHz/12/SCS	≤ 13.5
60 MHz	1462 ≤ F_C < 1487	<= -7.2MHz/12/SCS + L_{CRB}	> 7.2 MHz/12/SCS	≤ 13.5	L_{CRB} < 18.72 MHz/12/SCS	≤ 13.5
NOTE 1: The backoff applied is max(MPR, A-MPR) where MPR is defined in Table 6.2.2-1 NOTE 2: Outer and inner allocations are defined in clause 6.2.2 NOTE 3: For any undefined region, MPR applies NOTE 4: A-MPR applies to all modulation and waveform types.						

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.3.11.

6.2.3.3.12 A-MPR for NS_42

Table 6.2.3.3.12-1: A-MPR for NS_42

Channel Bandwidth, MHz	Carrier Centre Frequency, Fc, MHz	Region A		Region B			
		RBend	A-MPR (Outer/Inner)	Rb_{start}	RB_{end} 5	A-MPR (Inner)	A-MPR (Outer)
5 MHz	1512 ≤ F_C ≤ 1514.5	>3.1MHz / 12 / SCS	≤ 7	<0.9 MHz / 12 / SCS	≤ 3.1 MHz / 12 / SCS	≤ 1.5	≤ 4
10 MHz	1497 ≤ F_C ≤ 1512	>6.2 MHz / 12 / SCS	≤ 8	<0.9 MHz / 12 / SCS	≤ 6.2 MHz / 12 / SCS	≤ 1.5	≤ 5
15 MHz	1502 F_C ≤ 1509.5	>9.3 MHz / 12 / SCS	≤ 8	<3.06 MHz / 12 / SCS	≤ 9.3 MHz / 12 / SCS	≤ 1.5	≤ 5
20 MHz	1497 ≤ F_C ≤ 1507	>12.4 MHz / 12 / SCS	≤ 8	<4.5 MHz / 12 / SCS	≤ 12.4 MHz / 12 / SCS	≤ 1.5	≤ 5
40 MHz	1477 ≤ F_C ≤ 1497	>24.8 MHz / 12 / SCS	≤ 8	<5.4 MHz / 12 / SCS	≤ 24.8 MHz / 12 / SCS	≤ 1.5	≤ 5
50 MHz	1467 ≤ F_C ≤ 1492	>31 MHz / 12 / SCS	≤ 8	<7.2 MHz / 12 / SCS	≤ 31 MHz / 12 / SCS	≤ 1.5	≤ 5
60 MHz	1462 ≤ F_C ≤ 1487	>37.2 MHz / 12 / SCS	≤ 8	<7.2 MHz / 12 / SCS	≤ 37.2 MHz / 12 / SCS	≤ 1.5	≤ 5

NOTE 1: The backoff applied is max(MPR, A-MPR) where MPR is defined in Table 6.2.2.3-1.
NOTE 2: Outer and inner allocations are defined in clause 6.2.2.
NOTE 3: For any undefined region, MPR applies
NOTE 4: A-MPR applies to all modulation and waveform types.
NOTE 5: In region B, RB_{end} > RB_{star}

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.3.12.

6.2.3.3.13 A-MPR for NS_18

Table 6.2.3.3.13-1: A-MPR for NS_18

Modulation/Waveform	A1	A2
	Outer	Inner/Outer
DFT-s-OFDM PI/2 BPSK	≤ 2	≤ 5
DFT-s-OFDM QPSK	≤ 2	≤ 5
DFT-s-OFDM 16 QAM	≤3	≤ 6
DFT-s-OFDM 64 QAM	≤ 4	≤ 7
DFT-s-OFDM 256 QAM	≤ 6	≤ 9
CP-OFDM QPSK	≤ 5	≤ 6.5
CP-OFDM 16 QAM	≤ 5	≤ 7
CP-OFDM 64 QAM	≤ 5.5	≤ 8.5
CP-OFDM 256 QAM	≤ 8.5	≤ 11.5

NOTE 1: The backoff applied is max(MPR, A-MPR) where MPR is defined in Table 6.2.2.3-1
NOTE 2: Outer and inner allocations are defined in clause 6.2.2

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.3.13.

6.2.3.4 Test description

6.2.3.4.1 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 6.2.3.4.1-2. 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 6.2.3.4.1-1: Test Configuration table for NS_35

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, Highest	
Test SCS as specified in Table 5.3.5-1					Lowest, Highest	
A-MPR test parameters for NS_35						
				Downlink Configuration	**Uplink Configuration**	
Test ID	**Freq**	**ChBw**	**SCS**	N/A for A-MPR testing.	**Modulation (NOTE 2)**	**RB allocation (NOTE 1)**
1	Low	Default	Default		DFT-s-OFDM PI/2 BPSK	Edge_1RB_Left
2	High				DFT-s-OFDM PI/2 BPSK	Edge_1RB_Right
3	Default				DFT-s-OFDM PI/2 BPSK	Outer Full
4	Low				DFT-s-OFDM QPSK	Edge_1RB_Left
5	High				DFT-s-OFDM QPSK	Edge_1RB_Right
6	Default				DFT-s-OFDM QPSK	Outer Full
7	Low				DFT-s-OFDM 16 QAM	Edge_1RB_Left
8	High				DFT-s-OFDM 16 QAM	Edge_1RB_Right
9	Default				DFT-s-OFDM 16 QAM	Outer Full
10	Low				DFT-s-OFDM 64 QAM	Edge_1RB_Left
11	High				DFT-s-OFDM 64 QAM	Edge_1RB_Right
12	Default				DFT-s-OFDM 64 QAM	Outer Full
13	Low				DFT-s-OFDM 256 QAM	Edge_1RB_Left
14	High				DFT-s-OFDM 256 QAM	Edge_1RB_Right
15	Default				DFT-s-OFDM 256 QAM	Outer Full
16	Low				CP-OFDM QPSK	Edge_1RB_Left
17	High				CP-OFDM QPSK	Edge_1RB_Right
18	Default				CP-OFDM QPSK	Outer Full
19	Low				CP-OFDM 16 QAM	Edge_1RB_Left
20	High				CP-OFDM 16 QAM	Edge_1RB_Right
21	Default				CP-OFDM 16 QAM	Outer Full
22	Low				CP-OFDM 64 QAM	Edge_1RB_Left
23	High				CP-OFDM 64 QAM	Edge_1RB_Right
24	Default				CP-OFDM 64 QAM	Outer Full
25	Low				CP-OFDM 256 QAM	Edge_1RB_Left
26	High				CP-OFDM 256 QAM	Edge_1RB_Right
27	Default				CP-OFDM 256 QAM	Outer Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.						

Table 6.2.3.4.1-2: Test Configuration table for NS_04

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 Freq column)	
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, Highest	
A-MPR test parameters for NS_04				
		Downlink Configuration	**Uplink Configuration**	
Test ID	**Freq**	N/A for A-MPR testing.	**Modulation (NOTE 2)**	**RB allocation (NOTE 1)**
1	Low		DFT-s-OFDM PI/2 BPSK	Edge_1RB_Left
2	$2496 + 3/2 \times BW_{Channel} - 6$ MHz		DFT-s-OFDM PI/2 BPSK	Edge_1RB_Left
3	$2496 + BW_{Channel}/2 + MAX(10\ MHz, 0.45 \times BW_{Channel})$		DFT-s-OFDM PI/2 BPSK	Inner Full
4			DFT-s-OFDM PI/2 BPSK	Outer Full
5	High		DFT-s-OFDM PI/2 BPSK	Edge_1RB_Right
6	High		DFT-s-OFDM PI/2 BPSK	Inner Full
7	High		DFT-s-OFDM PI/2 BPSK	Outer Full
8	Low		DFT-s-OFDM QPSK	Edge_1RB_Left
9	$2496 + 3/2 \times BW_{Channel} - 6$ MHz		DFT-s-OFDM QPSK	Edge_1RB_Left
10	$2496 + BW_{Channel}/2 + MAX(10\ MHz, 0.45 \times BW_{Channel})$		DFT-s-OFDM QPSK	Inner Full
11			DFT-s-OFDM QPSK	Outer Full
12	High		DFT-s-OFDM QPSK	Edge_1RB_Right
13	High		DFT-s-OFDM QPSK	Inner Full
14	High		DFT-s-OFDM QPSK	Outer Full
15	Low		DFT-s-OFDM 16 QAM	Edge_1RB_Left
16	$2496 + 3/2 \times BW_{Channel} - 6$ MHz		DFT-s-OFDM 16 QAM	Edge_1RB_Left
17	$2496 + BW_{Channel}/2 + MAX(10\ MHz, 0.45 \times BW_{Channel})$		DFT-s-OFDM 16 QAM	Inner Full
18			DFT-s-OFDM 16 QAM	Outer Full
19	High		DFT-s-OFDM 16 QAM	Edge_1RB_Right
20	High		DFT-s-OFDM 16 QAM	Inner Full
21	High		DFT-s-OFDM 16 QAM	Outer Full
22	Low		DFT-s-OFDM 64 QAM	Edge_1RB_Left
23	$2496 + 3/2 \times BW_{Channel} - 6$ MHz		DFT-s-OFDM 64 QAM	Edge_1RB_Left
24	$2496 + BW_{Channel}/2 + MAX(10\ MHz, 0.45 \times BW_{Channel})$		DFT-s-OFDM 64 QAM	Outer Full
25	High		DFT-s-OFDM 64 QAM	Edge_1RB_Right
26	High		DFT-s-OFDM 64 QAM	Outer Full
27	Low		DFT-s-OFDM 256 QAM	Edge_1RB_Left
28	$2496 + 3/2 \times BW_{Channel} - 6$ MHz		DFT-s-OFDM 256 QAM	Edge_1RB_Left
29	$2496 + BW_{Channel}/2 + MAX(10\ MHz, 0.45 \times BW_{Channel})$		DFT-s-OFDM 256 QAM	Outer Full
30	High		DFT-s-OFDM 256 QAM	Edge_1RB_Right
31	High		DFT-s-OFDM 256 QAM	Outer Full
32	Low		CP-OFDM QPSK	Edge_1RB_Left
33	$2496 + 3/2 \times BW_{Channel} - 6$ MHz		CP-OFDM QPSK	Edge_1RB_Left
34	$2496 + BW_{Channel}/2 + MAX(10\ MHz, 0.25 \times BW_{Channel})$		CP-OFDM QPSK	Inner Full
35			CP-OFDM QPSK	Outer Full
36	High		CP-OFDM QPSK	Edge_1RB_Right
37	High		CP-OFDM QPSK	Inner Full
38	High		CP-OFDM QPSK	Outer Full
39	Low		CP-OFDM 16 QAM	Edge_1RB_Left
40	$2496 + 3/2 \times BW_{Channel} - 6$ MHz		CP-OFDM 16 QAM	Edge_1RB_Left
41	$2496 + BW_{Channel}/2 + MAX(10\ MHz, 0.25 \times BW_{Channel})$		CP-OFDM 16 QAM	Inner Full
42			CP-OFDM 16 QAM	Outer Full
43	High		CP-OFDM 16 QAM	Edge_1RB_Right
44	High		CP-OFDM 16 QAM	Inner Full
45	High		CP-OFDM 16 QAM	Outer Full
46	Low		CP-OFDM 64 QAM	Edge_1RB_Left
47	$2496 + 3/2 \times BW_{Channel} - 6$ MHz		CP-OFDM 64 QAM	Edge_1RB_Left
48	$2496 + BW_{Channel}/2 + MAX(10\ MHz, 0.25 \times BW_{Channel})$		CP-OFDM 64 QAM	Outer Full
49	High		CP-OFDM 64 QAM	Edge_1RB_Right
50	High		CP-OFDM 64 QAM	Outer Full
51	Low		CP-OFDM 256 QAM	Edge_1RB_Left

52	2496 + 3/2 × $BW_{Channel}$ – 6 MHz		CP-OFDM 256 QAM	Edge_1RB_Left
53	2496 + $BW_{Channel}$ /2 + MAX(10 MHz, 0.25 × $BW_{Channel}$)		CP-OFDM 256 QAM	Outer Full
54	High		CP-OFDM 256 QAM	Edge_1RB_Right
55	High		CP-OFDM 256 QAM	Outer Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.				

Editor's note: The following lines belong at the end of subclause 6.2.3.4.1. As new tables are added to this section, these lines should always follow the tables

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 Annex G.0, G.1, G.2 and G.3.0.
4. The UL Reference Measurement channels are set according to the applicable table from Table 6.2.3.4.1-1 to Table 6.2.3.4.1-2.
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 6.2.3.4.3.

6.2.3.4.2 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 the applicable table from Table 6.2.4.3.1-1 to Table 6.2.4.3.1-2. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE Allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.
3. Measure the mean power of the UE in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration one sub-frame (1ms). [For TDD slots with transient periods are not under test.]

6.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6.1, with the following exceptions for each network signalled value.

6.2.3.4.3.1 Message contents exceptions for network signalled value "NS_03"

1. Information element additionalSpectrumEmission is set to NS_03. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.1-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_03" and NR band n2, n25 and n66

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_03)		

Table 6.2.3.4.3.1-2: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_03" and NR band n70

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_03)		

6.2.3.4.3.2 Message contents exceptions for network signalled value "NS_35"

1. Information element additionalSpectrumEmission is set to NS_35. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.2-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_35" and NR band n71

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_35)		

6.2.3.4.3.3 Message contents exceptions for network signalled value "NS_03U"

1. Information element additionalSpectrumEmission is set to NS_03U. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.3-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_03U"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	3 (NS_03U)		

6.2.3.4.3.4 Message contents exceptions for network signalled value "NS_04"

1. Information element additionalSpectrumEmission is set to NS_04. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.4-1: *AdditionalSpectrumEmission* Additional spurious emissions test requirement for "NS_04"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_04)		

6.2.3.4.3.5 Message contents exceptions for network signalled value "NS_05"

1. Information element additionalSpectrumEmission is set to NS_05. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.5-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_05"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_05)		

6.2.3.4.3.6 Message contents exceptions for network signalled value "NS_05U"

1. Information element additionalSpectrumEmission is set to NS_05U. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.6-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_05U"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	3 (NS_05U)		

6.2.3.4.3.7 Message contents exceptions for network signalled value "NS_06"

1. Information element additionalSpectrumEmission is set to NS_06. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.7-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_06"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_06)		

6.2.3.4.3.8 Message contents exceptions for network signalled value "NS_08"

1. Information element additionalSpectrumEmission is set to NS_08. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.8-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_08"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_08)		

6.2.3.4.3.9 Message contents exceptions for network signalled value "NS_08U"

1. Information element additionalSpectrumEmission is set to NS_08U. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.9-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_08U"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	3 (NS_08U)		

6.2.3.4.3.10 Message contents exceptions for network signalled value "NS_10"

1. Information element additionalSpectrumEmission is set to NS_10. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.10-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_10"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_10)		

6.2.3.4.3.11 Message contents exceptions for network signalled value "NS_17"

1. Information element additionalSpectrumEmission is set to NS_17. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.11-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_17"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_17)		

6.2.3.4.3.12 Message contents exceptions for network signalled value "NS_18"

1. Information element additionalSpectrumEmission is set to NS_18. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.12-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_18"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_18)		

6.2.3.4.3.13 Message contents exceptions for network signalled value "NS_37"

1. Information element additionalSpectrumEmission is set to NS_37. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.13-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_37"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_37)		

6.2.3.4.3.14 Message contents exceptions for network signalled value "NS_38"

1. Information element additionalSpectrumEmission is set to NS_38. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.14-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_38"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_38)		

6.2.3.4.3.15 Message contents exceptions for network signalled value "NS_39"

1. Information element additionalSpectrumEmission is set to NS_39. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.15-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_39"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	3 (NS_39)		

6.2.3.4.3.16 Message contents exceptions for network signalled value "NS_40"

1. Information element additionalSpectrumEmission is set to NS_40. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.16-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_40"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_40)		

6.2.3.4.3.17 Message contents exceptions for network signalled value "NS_41"

1. Information element additionalSpectrumEmission is set to NS_41. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.17-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_41"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_41)		

6.2.3.4.3.18 Message contents exceptions for network signalled value "NS_42"

1. Information element additionalSpectrumEmission is set to NS_42. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.18-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_42"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_42)		

6.2.3.4.3.19 Message contents exceptions for network signalled value "NS_100"

1. Information element additionalSpectrumEmission is set to NS_100. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.19-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_100"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_100)		

6.2.3.5 Test requirement

The maximum output power, derived in step 3 shall be within the range prescribed by the nominal maximum output power and tolerance in the applicable table from table 6.2.3.5-1. The allowed A-MPR values specified in table 6.2.3.3-1 are in addition to the allowed MPR requirements specified in clause 6.2.2. For the UE maximum output power modified by MPR and/or A-MPR, the power limits specified in table 6.2.1.3-1 apply.

Table 6.2.3.5-0: Test Tolerance (UE additional maximum output power reduction)

	f ≤ 3.0GHz	3.0GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6.0GHz
BW ≤ 40MHz	0.7 dB	1.0 dB	1.0 dB
40MHz < BW ≤ 100MHz	1.0 dB	1.0 dB	1.0 dB

Table 6.2.3.5-1: UE Power Class 3 test requirements (NS_35) for band n71

Test ID	$P_{PowerClass}$ (dBm)	MPR (dB)	A-MPR (dB)	$\Delta T_{C,c}$ (dB)	$P_{CMAX,c}$ (dBm)	$T(P_{CMAX\_L,c})$ (dB)	$T_{L,c}$ (dB)	Upper limit (dBm)	Lower limit (dBm)
1	23	0.5	0	0	22.5	2	2.5	25+TT	20-TT
2	23	0.5	0	0	22.5	2	2.5	25+TT	20-TT
3	23	0.5	0	0	22.5	2	2.5	25+TT	20-TT
4	23	1	0	0	22	2	2.5	25+TT	19.5-TT
5	23	1	0	0	22	2	2.5	25+TT	19.5-TT
6	23	1	0	0	22	2	2.5	25+TT	19.5-TT
7	23	2	0	0	21	2	2.5	25+TT	18.5-TT
8	23	2	0	0	21	2	2.5	25+TT	18.5-TT
9	23	2	0	0	21	2	2.5	25+TT	18.5-TT
10	23	2.5	0	0	20.5	2.5	2.5	25+TT	18-TT
11	23	2.5	0	0	20.5	2.5	2.5	25+TT	18-TT
12	23	2.5	0	0	20.5	2.5	2.5	25+TT	18-TT
13	23	4.5	0	0	18.5	4	2.5	25+TT	14.5-TT
14	23	4.5	0	0	18.5	4	2.5	25+TT	14.5-TT
15	23	4.5	0	0	18.5	4	2.5	25+TT	14.5-TT
16	23	3	0	0	20	2.5	2.5	25+TT	17.5-TT
17	23	3	0	0	20	2.5	2.5	25+TT	17.5-TT
18	23	3	0	0	20	2.5	2.5	25+TT	17.5-TT
19	23	3	0	0	20	2.5	2.5	25+TT	17.5-TT
20	23	3	0	0	20	2.5	2.5	25+TT	17.5-TT
21	23	3	0	0	20	2.5	2.5	25+TT	17.5-TT
22	23	3.5	0	0	19.5	3.5	2.5	25+TT	16-TT
23	23	3.5	0	0	19.5	3.5	2.5	25+TT	16-TT
24	23	3.5	0	0	19.5	3.5	2.5	25+TT	16-TT
25	23	6.5	0	0	16.5	5	2.5	25+TT	11.5-TT
26	23	6.5	0	0	16.5	5	2.5	25+TT	11.5-TT
27	23	6.5	0	0	16.5	5	2.5	25+TT	11.5-TT
NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance. NOTE 2: TT for each frequency and channel bandwidth is specified in Table 6.2.3.5-0.									

Table 6.2.3.5-2: UE Power Class 2 test requirements (NS_04) for band n41

Test ID	$P_{PowerClass}$ (dBm)	MPR (dB)	A-MPR (dB)	$\Delta T_{C,c}$ (dB)	$P_{CMAX,c}$ (dBm)	$T(P_{CMAX\_L,c})$ (dB)	$T_{L,c}$ (dB)	Upper limit (dBm)	Lower limit (Note 2) (dBm)
1	26	0	[5.5]	0	20.5	2.5	2	28+TT	[18.0-TT]
2	26	0	[5.5]	0	20.5	2.5	2	28+TT	[18.0-TT]
3	26	0	3.5	0	22.5	2	2	28+TT	20.5-TT
4	26	0	3.5	0	22.5	2	2	28+TT	20.5-TT
5	26	3.5	0	0	22.5	2	2	28+TT	20.5-TT
6	26	0	0	0	26	2	2	28+TT	24-TT
7	26	0.5	0	0	25.5	2	2	28+TT	23.5-TT
8	26	0	[6]	0	20	2.5	2	28+TT	[17.5-TT]
9	26	0	[6]	0	20	2.5	2	28+TT	[17.5-TT]
10	26	0	4.5	0	21.5	2	2	28+TT	19.5-TT
11	26	0	4.5	0	21.5	2	2	28+TT	19.5-TT
12	26	3.5	0	0	22.5	2	2	28+TT	20.5-TT
13	26	0	0	0	26	2	2	28+TT	24-TT
14	26	1	0	0	25	2	2	28+TT	23-TT
15	26	0	[6]	0	20	2.5	2	28+TT	[17.5-TT]
16	26	0	[6]	0	20	2.5	2	28+TT	[17.5-TT]
17	26	0	5	0	21	2	2	28+TT	19-TT
18	26	0	5	0	21	2	2	28+TT	19-TT
19	26	3.5	0	0	22.5	2	2	28+TT	20.5-TT
20	26	1	0	0	25	2	2	28+TT	23-TT
21	26	2	0	0	24	2	2	28+TT	22-TT
22	26	0	[6.5]	0	19.5	3.5	2	28+TT	[16-TT]
23	26	0	[6.5]	0	19.5	3.5	2	28+TT	[16-TT]
24	26	0	5	0	21	2	2	28+TT	19-TT
25	26	3.5	0	0	22.5	2	2	28+TT	20.5-TT
26	26	2.5	0	0	23.5	2	2	28+TT	21.5-TT
27	26	0	[8]	0	18	4	2	28+TT	[14-TT]
28	26	0	[8]	0	18	4	2	28+TT	[14-TT]
29	26	0	6.5	0	19.5	3.5	2	28+TT	16-TT
30	26	4.5	0	0	21.5	2	2	28+TT	19.5-TT
31	26	4.5	0	0	21.5	2	2	28+TT	19.5-TT
32	26	0	[7.5]	0	18.5	4	2	28+TT	[14.5-TT]
33	26	0	[7.5]	0	18.5	4	2	28+TT	[14.5-TT]
34	26	0	6.5	0	19.5	3.5	2	28+TT	16-TT
35	26	0	6.5	0	19.5	3.5	2	28+TT	16-TT
36	26	3.5	0	0	22.5	2	2	28+TT	20.5-TT
37	26	1.5	0	0	24.5	2	2	28+TT	22.5-TT
38	26	3	0	0	23	2	2	28+TT	21-TT
39	26	0	[7.5]	0	18.5	4	2	28+TT	[14.5-TT]
40	26	0	[7.5]	0	18.5	4	2	28+TT	[14.5-TT]
41	26	0	6.5	0	19.5	3.5	2	28+TT	16-TT
42	26	0	6.5	0	19.5	3.5	2	28+TT	16-TT
43	26	3.5	0	0	22.5	2	2	28+TT	20.5-TT
44	26	2.0	0	0	24	2	2	28+TT	22-TT
45	26	3.0	0	0	23	2	2	28+TT	21-TT
46	26	0	[7.5]	0	18.5	4	2	28+TT	[14.5-TT]
47	26	0	[7.5]	0	18.5	4	2	28+TT	[14.5-TT]
48	26	0	6.5	0	19.5	3.5	2	28+TT	16-TT

49	26	3.5	0	0	22.5	2	2	28+TT	20.5-TT
50	26	3.5	0	0	22.5	2	2	28+TT	20.5-TT
51	26	0	[10]	0	16	5	2	28+TT	[11-TT]
52	26	0	[10]	0	16	5	2	28+TT	[11-TT]
53	26	0	7.5	0	18.5	4	2	28+TT	14.5-TT
54	26	6.5	0	0	19.5	3.5	2	28+TT	16-TT
55	26	6.5	0	0	19.5	3.5	2	28+TT	26-TT

NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance.
NOTE 2: For Band n41, refers to the transmission bandwidths (Figure 5.3.3-1) confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the lower limit shall be decreased by 1.0 dB for CP-OFDM 256 QAM and decreased by 1.5 dB for other modulations.
NOTE 3: TT=0.7 dB for $BW_{channel}$ ≤ 40 MHz; TT=1.0 dB for 40 MHz < $BW_{channel}$ ≤ 100 MHz.

Table 6.2.3.5-3: UE Power Class 3 test requirements (NS_04) for band n41

Test ID	$P_{PowerClass}$ (dBm)	MPR (dB)	A-MPR (dB)	$\Delta T_{C,c}$ (dB)	$P_{CMAX,c}$ (dBm)	$T(P_{CMAX\_L,c})$ (dB)	$T_{L,c}$ (dB)	Upper limit (dBm)	Lower limit (Note 2) (dBm)
1	23	0	3.5	0	19.5	3.5	2	25+TT	16-TT
2	23	0	3.5	0	19.5	3.5	2	25+TT	16-TT
3	23	0	3.5	0	19.5	3.5	2	25+TT	16-TT
4	23	0	3.5	0	19.5	3.5	2	25+TT	16-TT
5	23	0.5	0	0	22.5	2	2	25+TT	20.5-TT
6	23	0	0	0	23	2	2	25+TT	21-TT
7	23	0.5	0	0	22.5	2	2	25+TT	20.5-TT
8	23	0	4	0	19	3.5	2	25+TT	15.5-TT
9	23	0	4	0	19	3.5	2	25+TT	15.5-TT
10	23	0	4	0	19	3.5	2	25+TT	15.5-TT
11	23	0	4	0	19	3.5	2	25+TT	15.5-TT
12	23	1	0	0	22	2	2	25+TT	20-TT
13	23	0	0	0	23	2	2	25+TT	21-TT
14	23	1	0	0	22	2	2	25+TT	10-TT
15	23	0	4	0	19	3.5	2	25+TT	15.5-TT
16	23	0	4	0	19	3.5	2	25+TT	15.5-TT
17	23	0	4	0	19	3.5	2	25+TT	15.5-TT
18	23	0	4	0	19	3.5	2	25+TT	15.5-TT
19	23	2	0	0	21	2	2	25+TT	19-TT
20	23	1	0	0	22	2	2	25+TT	20-TT
21	23	2	0	0	21	2	2	25+TT	19-TT
22	23	0	4.5	0	18.5	4	2	25+TT	14.5-TT
23	23	0	4.5	0	18.5	4	2	25+TT	14.5-TT
24	23	0	4	0	19	3.5	2	25+TT	15.5-TT
25	23	2.5	0	0	20.5	2.5	2	25+TT	18-TT
26	23	2.5	0	0	20.5	2.5	2	25+TT	18-TT
27	23	0	6.0	0	17	5	2	25+TT	12+TT
28	23	0	6.0	0	17	5	2	25+TT	12-TT
29	23	0	4.5	0	18.5	4	2	25+TT	14.4-TT
30	23	4.5	0	0	18.5	4	2	25+TT	14.5-TT
31	23	4.5	0	0	18.5	4	2	25+TT	14.5-TT
32	23	0	5.5	0	17.5	5	2	25+TT	12.5-TT
33	23	0	5.5	0	17.5	5	2	25+TT	12.5-TT
34	23	0	5.5	0	17.5	5	2	25+TT	12.5-TT
35	23	0	5.5	0	17.5	5	2	25+TT	12.5-TT
36	23	3	0	0	20	2.5	2	25+TT	17.5-TT
37	23	1.5	0	0	21.5	2	2	25+TT	19.5-TT
38	23	3	0	0	20	2.5	2	25+TT	17.5-TT
39	23	0	5.5	0	17.5	5	2	25+TT	12.5-TT
40	23	0	5.5	0	17.5	5	2	25+TT	12.5-TT
41	23	0	5.5	0	17.5	5	2	25+TT	12.5-TT
42	23	0	5.5	0	17.5	5	2	25+TT	12.5-TT
43	23	3	0	0	20	2.5	2	25+TT	17.5-TT
44	23	2	0	0	21	2	2	25+TT	19-TT
45	23	3	0	0	20	2.5	2	25+TT	17.5-TT
46	23	0	5.5	0	17.5	5	2	25+TT	12.5-TT
47	23	0	5.5	0	17.5	5	2	25+TT	12.5-TT
48	23	0	5.5	0	17.5	5	2	25+TT	12.5-TT

49	23	3.5	0	0	19.5	3.5	2	25+TT	16-TT
50	23	3.5	0	0	19.5	3.5	2	25+TT	16-TT
51	23	0	8	0	15	5	2	25+TT	10-TT
52	23	0	8	0	15	5	2	25+TT	10-TT
53	23	0	6.5	0	16.5	5	2	25+TT	11.5-TT
54	23	6.5	0	0	16.5	5	2	25+TT	11.5-TT
55	23	6.5	0	0	16.5	5	2	25+TT	11.5-TT
NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance. NOTE 2: For Band n41, refers to the transmission bandwidths (Figure 5.3.3-1) confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the lower limit shall be decreased by 1.0 dB for CP-OFDM 256 QAM and decreased by 1.5 dB for other modulations. NOTE 3: TT=0.7 dB for $BW_{channel}$ ≤ 40 MHz; TT=1.0 dB for 40 MHz < $BW_{channel}$ ≤ 100 MHz.									

6.2.4 Configured transmitted power

6.2.4.1 Test purpose

To verify the measured UE configured maximum output power $P_{UMAX,f,c}$ is within the specified bounds.

6.2.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.2.4.3 Minimum conformance requirements

The UE is allowed to set its configured maximum output power $P_{CMAX,f,c}$ for carrier f of serving cell c in each slot. The configured maximum output power $P_{CMAX,f,c}$ is set within the following bounds:

$$P_{CMAX\_L,f,c} \leq P_{CMAX,f,c} \leq P_{CMAX\_H,f,c} \text{ with}$$

$$P_{CMAX\_L,f,c} = \text{MIN}\{P_{EMAX,c} - \Delta T_{C,c},\ (P_{PowerClass} - \Delta P_{PowerClass}) - \text{MAX}(MPR_c + A\text{-}MPR_c + \Delta T_{IB,c} + \Delta T_{C,c} + \Delta T_{RxSRS},\ P\text{-}MPR_c)\}$$

$$P_{CMAX\_H,f,c} = \text{MIN}\{P_{EMAX,c},\ P_{PowerClass} - \Delta P_{PowerClass}\}$$

where

$P_{EMAX,c}$ is the value given by IE P-Max for serving cell c, defined in TS 38.331[6];

$P_{PowerClass}$ is the maximum UE power specified in Table 6.2.1.3-1 without taking into account the tolerance specified in the Table 6.2.1.3-1;

When the IE *powerBoostPi2BPSK* is set to 1, $P_{EMAX,c}$ is increased by +3 dB for a 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 when $P_{EMAX,c} \geq 20$ dBm.

When the IE *powerBoostPi2BPSK* is set to 1, $\Delta P_{PowerClass}$ = -3 dB for a power class 3 capable UE operating in TDD bands n40, n41, n77, n78, and n79 with PI/2 BPSK modulation and 40% or less slots in radio frame are used for UL transmission.

$\Delta P_{PowerClass}$ = 3 dB for a power class 2 capable UE, when P-max of 23 dBm or lower is indicated; or when the field of UE capability *maxUplinkDutyCycle* is absent and the percentage of uplink symbols transmitted in a certain evaluation period is larger than 50%; or when the field of UE capability *maxUplinkDutyCycle* is not absent and the percentage of uplink symbols transmitted in a certain evaluation period is larger than *maxUplinkDutyCycle* as defined in TS 38.331 (The exact evaluation period is no less than one radio frame); otherwise $\Delta P_{PowerClass}$ = 0 dB;

$\Delta T_{IB,c}$ is the additional tolerance for serving cell c as specified in TS 38.101-3 [4] subclause 6.2A.4.2 and 6.2B.4.2; $\Delta T_{IB,c}$ = 0 dB otherwise;

$\Delta T_{C,c}$= 1.5dB when NOTE 3 in Table 6.2.1-1 in 38.101-1 applies for a serving cell c, otherwise $\Delta T_{C,c}$ = 0dB ;

MPR_c and A-MPR_c for serving cell c are specified in subclause 6.2.2.3 and subclause 6.2.3.3, respectively;

ΔT_{RxSRS} is applied when UE transmits SRS to other than first SRS port when the *SRS-TxSwitch* capability is indicated as '1T2R', '1T4R' or, '1T4R/2T4R' with UE configured with 4 SRS resources in the SRS resource set, and when UE transmits SRS to other than first or second SRS port when the *SRS-TxSwitch* capability is indicated as '2T4R' or '1T4R/2T4R' with the UE configured with 2 SRS resources in the SRS resource set. The value of ΔT_{RxSRS} is 4.5dB for n79 and 3 dB for bands whose F_{UL_high} is lower than the F_{UL_low} of n79.

For other SRS transmissions ΔT_{RxSRS} is zero;

P-MPR_c is the allowed maximum output power reduction for

a) ensuring compliance with applicable electromagnetic energy absorption requirements and addressing unwanted emissions / self defence requirements in case of simultaneous transmissions on multiple RAT(s) for scenarios not in scope of 3GPP RAN specifications;

b) ensuring compliance with applicable electromagnetic energy absorption requirements in case of proximity detection is used to address such requirements that require a lower maximum output power.

The UE shall apply P-MPR_c for serving cell c only for the above cases. For UE conducted conformance testing P-MPR_c shall be 0 dB

NOTE 1: P-MPR_c was introduced in the $P_{CMAX,f,c}$ equation such that the UE can report to the eNB the available maximum output transmit power. This information can be used by the eNB for scheduling decisions.

NOTE 2: P-MPR_c may impact the maximum uplink performance for the selected UL transmission path.

T_{REF} and T_{eval} are specified in Table 6.2.4.3-1. For each T_{REF}, the $P_{CMAX,L,c}$ for serving cell c are evaluated per T_{eval} and given by the minimum value taken over the transmission(s) within the T_{eval}; the minimum $P_{CMAX\_L,f,c}$ over one or more T_{eval} is then applied for the entire T_{REF}

Table 6.2.4.3-1: Evaluation and reference periods for Pcmax

T_{REF}	T_{eval}	T_{eval} with frequency hopping
Physical channel length	Physical channel length	Min($T_{no\_hopping}$, Physical Channel Length)

The measured configured maximum output power $P_{UMAX,f,c}$ shall be within the following bounds:

$$P_{CMAX\_L,f,c} - MAX\{T_{L,c}, T(P_{CMAX\_L,f,c})\} \leq P_{UMAX,f,c} \leq P_{CMAX\_H,f,c} + T(P_{CMAX\_H,f,c}).$$

where the tolerance $T(P_{CMAX,f,c})$ for applicable values of $P_{CMAX,f,c}$ is specified in Table 6.2.4.3-2. The tolerance $T_{L,c}$ is the absolute value of the lower tolerance for the applicable operating band as specified in Table 6.2.1.3-1.

Table 6.2.4.3-2: P_{CMAX} tolerance

$P_{CMAX,f,c}$ (dBm)	Tolerance $T(P_{CMAX,f,c})$ (dB)
$23 < P_{CMAX,c} \leq 33$	2.0
$21 \leq P_{CMAX,c} \leq 23$	2.0
$20 \leq P_{CMAX,c} < 21$	2.5
$19 \leq P_{CMAX,c} < 20$	3.5
$18 \leq P_{CMAX,c} < 19$	4.0
$13 \leq P_{CMAX,c} < 18$	5.0
$8 \leq P_{CMAX,c} < 13$	6.0
$-40 \leq P_{CMAX,c} < 8$	7.0

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2.4.

6.2.4.4 Test description

6.2.4.4.1 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 test channel bandwidth and sub-carrier spacing, and are shown in table 6.2.4.4.1-1. 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 6.2.4.4.1-1: 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		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	
Test Parameters for Channel Bandwidths			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
	N/A for minimum output power test case	**Modulation (NOTE 2)**	**RB allocation (NOTE 1)**
1		DFT-s-OFDM Pi/2 BPSK	Inner Full
2		DFT-s-OFDM QPSK	Inner Full
3[3]		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: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1. NOTE 3: UE operating in TDD mode with PI/2 PBSK modulation and UE indicates support for UE capability [*powerBoosting-pi2BPSK*] and the IE *powerBoostPi2BPSK* is set to 1 for bands n40, n41, n77, n78 and n79.			

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 6.2.4.4.1-1.

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 6.2.4.4.3.

6.2.4.4.2 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 6.2.4.4.1-1. 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 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 in the channel bandwidth for each test point in table 6.2.4.5-1 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.

6.2.4.4.3 Message contents

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

Table 6.2.4.4.3-1: FrequencyInfoUL: Test point 1

Derivation Path: TS 38.508-1 [5] Table 4.6.3-61 FrequencyInfoUL			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	-10		

Table 6.2.4.4.3-2: FrequencyInfoUL: Test point 2

Derivation Path: TS 38.508-1 [5] Table 4.6.3-61 FrequencyInfoUL			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	10		

Table 6.2.4.4.3-3: FrequencyInfoUL: Test point 3

Derivation Path: TS 38.508-1 [5] Table 4.6.3-61 FrequencyInfoUL			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	15		

Table 6.2.4.4.3-4: FrequencyInfoUL: Test point 4

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

Table 6.2.4.4.3-5: ServingCellConfig

Derivation Path: TS 38.508-1 [5] Table 4.6.3-167			
Information Element	**Value/remark**	**Comment**	**Condition**
ServingCellConfig ::= SEQUENCE {			
uplinkConfig SEQUENCE {			
powerBoostPi2BPSK	0		Test ID 1, 2
	1		Test ID 3
}			
}			

6.2.4.5 Test requirement

The maximum output power measured shall not exceed the values specified in Table 6.2.4.5-1.

Table 6.2.4.5-1: P_{CMAX} configured UE output power

	Maximum output power	
	Test ID 1,2 Test ID 3 for Power Class 2	Test ID 3 for Power Class 3
Measured UE output power test point 1	-10 dBm ± (7+TT)	-10 dBm ± (7+TT)
Measured UE output power test point 2	10 dBm ± (6+TT)	10 dBm ± (6+TT)
Measured UE output power test point 3	15 dBm ± (5+TT)	15 dBm ± (5+TT)
Measured UE output power test point 4	20 dBm ± (2.5+TT)	23 dBm ± (2.0+TT)
Note 1: TT for each frequency and channel bandwidth is specified in Table 6.2.4.5-2. Note 2: In addition note 2 in Table 6.2.1.3-1 shall apply to the tolerances.		

Table 6.2.4.5-2: Test Tolerance (Configured transmitted power)

	f ≤ 3.0GHz	**3.0GHz < f ≤ 6.0GHz**
BW ≤ 40MHz	0.7 dB	1.0 dB
40MHz < BW ≤ 100MHz	1.0 dB	1.0 dB

For the UE which supports inter-band NR CA configurations or inter-band EN-DC configurations, the $\Delta T_{IB,c}$ in TS 38.101-3 [4] subclause 6.2A.4.2 and 6.2B.4.2 shall be applied for applicable bands.

6.2A Transmitter power for CA

6.2A.1 UE maximum output power for CA

6.2A.1.0 Minimum conformance requirements

6.2A.1.0.1 Void

6.2A.1.0.2 Void

6.2A.1.0.3 UE maximum output power for Inter-band CA

For inter-band carrier aggregation with one uplink carrier assigned to one NR band, the transmitter power requirements in subclause 6.2.1.3 apply.

For inter-band carrier aggregation with uplink assigned to two NR bands, UE maximum output power shall be measured over all component carriers from different bands. If each band has separate antenna connectors, maximum output power is measured as the sum of maximum output power at each UE antenna connector. The period of measurement shall be at least one sub frame (1 ms). The maximum output power is specified in Table 6.2A.1.0.3-1.

Table 6.2A.1.0.3-1 UE Power Class for uplink inter-band CA (two bands)

NR CA Configuration	Class 1 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)	Class 4 (dBm)	Tolerance (dB)
CA_n3A-n78A					23	+2/-3[2]		
CA_n8A-n78A					23	+2/-3[2]		
NOTE 1: Void NOTE 2: 2 refers to the transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB NOTE 3: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance NOTE 4: For inter-band carrier aggregation the maximum power requirement should apply to the total transmitted power over all component carriers (per UE). NOTE 5: Power class 3 is the default power class unless otherwise stated								

6.2A.1.1 UE maximum output power for CA (2UL CA)

Editor's Note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Connection diagram is FFS in TS 38.508-1 [5].

- Procedure to configure SCC in TS 38.508-1[5] clause [TBD] is FFS.

- MU/TT is FFS in Annex F

6.2A.1.1.1 Test purpose

To verify that the error of the UE maximum output power in two uplink carrier aggregation does not exceed the range prescribed by the specified nominal maximum output power and tolerance.

An excess maximum output power has the possibility to interfere to other channels or other systems. A small maximum output power decreases the coverage area.

6.2A.1.1.2 Test applicability

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

6.2A.1.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.2A.1.0.

6.2A.1.1.4 Test description

6.2A.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 6.2A.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 6.2A.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] 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 N_{RB_agg}, Highest N_{RB_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 (NOTE 2)	**RB allocation (NOTE 1)**	
			PCC	**SCC**
1	N/A for this test	DFT-s-OFDM PI/2 BPSK	Inner Full	Inner Full
2		DFT-s-OFDM PI/2 BPSK	Inner 1RB Left	Inner 1RB Left
3		DFT-s-OFDM PI/2 BPSK	Inner 1RB Right	Inner 1RB Right
4		DFT-s-OFDM QPSK	Inner Full	Inner Full
5		DFT-s-OFDM QPSK	Inner 1RB Left	Inner 1RB Left
6		DFT-s-OFDM QPSK	Inner 1RB Right	Inner 1RB Right
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.				

1. Connect the SS 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 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 6.2A.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 6.2A.1.1.4.3.

6.2A.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 [TBD]. Message contents are defined in clause 6.2A.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 6.2A.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. 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 P_{UMAX} level corresponding to Power Class 3.
6. Measure the sum of mean transmitted power over all component carriers in the CA configuration 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.

6.2A.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4 with the following exceptions.

Table 6.2A.1.1.4.3-1: *PUSCH-Config*

Derivation Path: TS 38.508-1 [5], Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED

6.2A.1.1.5 Test requirement

The maximum output power for CA, derived in step 6 shall be within the range prescribed by the nominal maximum output power and tolerance in Table 6.2A.1.1.5-1 for Inter-band 2 UL CA configuration.

Table 6.2A.1.1.5-1: Maximum Output Power test requirement for Power Class 3

NR CA Configuration	Class 1 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)	Class 4 (dBm)	Tolerance (dB)
CA_n3A-n78A					23	+2+TT/-3[2]-TT		
CA_n8A-n78A					23	+2+TT/-3[2]-TT		
NOTE 1: Void NOTE 2: 2 refers to the transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB NOTE 3: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance NOTE 4: For inter-band carrier aggregation the maximum power requirement should apply to the total transmitted power over all component carriers (per UE). NOTE 5: Power class 3 is the default power class unless otherwise stated NOTE 6: The TT for 2UL CA Maximum Output Power is in the maximum TT among all UL CCs. For TT of each UL CC refer to Table 6.2.1.5-3.								

For the UE which supports inter-band NR CA configuration, $\Delta T_{IB,c}$ in Table 6.2A.4.0.2.3-1 applies. Unless otherwise stated, $\Delta T_{IB,c}$ is set to zero.

6.2A.2 UE maximum output power reduction for CA

FFS

6.2A.3 UE additional maximum output power reduction for CA

FFS

6.2A.4 Configured output power for CA

6.2A.4.0 Minimum conformance requirements

6.2A.4.0.1 Configured transmitted power level

6.2A.4.0.1.1 Void

6.2A.4.0.1.2 Void

6.2A.4.0.1.3 Configured transmitted power for Inter-band CA

For uplink carrier aggregation the UE is allowed to set its configured maximum output power $P_{CMAX,c}$ for serving cell *c* and its total configured maximum output power P_{CMAX}.

The configured maximum output power $P_{CMAX,c}$ on serving cell *c* shall be set as specified in subclause 6.2.4.3.

For uplink inter-band carrier aggregation, MPR_c and $A\text{-}MPR_c$ apply per serving cell c and are specified in subclause 6.2.2.3 and subclause 6.2.3.3, respectively. $P\text{-}MPR_c$ accounts for power management for serving cell c. $P_{CMAX,c}$ is calculated under the assumption that the transmit power is increased independently on all component carriers.

The total configured maximum output power P_{CMAX} shall be set within the following bounds:

$$P_{CMAX\_L} \leq P_{CMAX} \leq P_{CMAX\_H}$$

For uplink inter-band carrier aggregation with one serving cell c per operating band when same slot symbol pattern is used in all aggregated serving cells,

$$P_{CMAX\_L} = \text{MIN}\{10\log_{10}\sum \text{MIN}[\ p_{EMAX,c}/(\Delta t_{C,c}),\ p_{PowerClass}/(mpr_c \cdot a\text{-}mpr_c \cdot \Delta t_{C,c} \cdot \Delta t_{IB,c} \cdot \Delta t_{RxSRS,c}),\ p_{PowerClass}/pmpr_c],\ P_{PowerClass}\}$$

$$P_{CMAX\_H} = \text{MIN}\{10 \log_{10} \sum p_{EMAX,c}\ ,\ P_{PowerClass}\}$$

where

- $p_{EMAX,c}$ is the linear value of $P_{EMAX,\,c}$ which is given by IE *P-Max* for serving cell c in [7];
- $P_{PowerClass}$ is the maximum UE power specified in Table 6.2A.1.0.3-1 without taking into account the tolerance specified in the Table 6.2A.1.0.3-1; $p_{PowerClass}$ is the linear value of $P_{PowerClass}$;
- mpr_c and $a\text{-}mpr_c$ are the linear values of MPR_c and $A\text{-}MPR_c$ as specified in subclause 6.2.2.3 and subclause 6.2.3.3, respectively;
- $pmpr_c$ is the linear value of $P\text{-}MPR_c$;
- $\Delta t_{RxSRS,c}$ is the linear value of $\Delta T_{RxSRS,c}$;
- $\Delta t_{C,c}$ is the linear value of $\Delta T_{C,c}$. $\Delta t_{C,c}$ = 1.41 when NOTE 2 in Table 6.2A.1.0.3-1 applies for a serving cell c, otherwise $\Delta t_{C,c}$ = 1;
- $\Delta t_{IB,c}$ is the linear value of the inter-band relaxation term $\Delta T_{IB,c}$ of the serving cell c as specified in Table 6.2A.4.0.2.3-1; otherwise $\Delta t_{IB,c}$ = 1;

For uplink inter-band carrier aggregation with one serving cell c per operating band when at least one different numerology/slot pattern is used in aggregated cells, the UE is allowed to set its configured maximum output power $P_{CMAX,c(i),i}$ for serving cell c(i) of slot numerology type i, and its total configured maximum output power P_{CMAX}.

The configured maximum output power $P_{CMAX,c(i),i}$ (p) in slot p of serving cell c(i) on slot numerology type i shall be set within the following bounds:

$$P_{CMAX\_L,f,c(i),i}\ (p) \leq\ P_{CMAX,f,c(i),\,i}\ (p) \leq\ P_{CMAX\_H,f,c(i),i}\ (p)$$

where $P_{CMAX\_L,f,c\ (i),i}$ (p) and $P_{CMAX\_H,f,c(i),i}$ (p) are the limits for a serving cell c(i) of slot numerology type i as specified in subclause 6.2.4.3.

The total UE configured maximum output power P_{CMAX} (p,q) in a slot p of slot numerology or symbol pattern i, and a slot q of slot numerology or symbol pattern j that overlap in time shall be set within the following bounds unless stated otherwise:

$$P_{CMAX\_L}(p,q) \leq\ P_{CMAX}\ (p,q)\ \leq\ P_{CMAX\_H}\ (p,q)$$

When slots p and q have different transmissions lengths and belong to different cells on different bands:

$$P_{CMAX\_L}\ (p,q) = \text{MIN}\ \{10 \log_{10} [p_{CMAX\_L,f,c(i),i}\ (p) + p_{CMAX\_L,f,c(i),j}\ (q)],\ P_{PowerClass}\}$$

$$P_{CMAX\_H}\ (p,q) = \text{MIN}\ \{10 \log_{10} [p_{CMAX\_H,f,c(i),i}\ (p) + p_{CMAX\_H,f,c(i),j}\ (q)],\ P_{PowerClass}\}$$

where $p_{CMAX\_L,f,c\ (i),i}$ and $p_{CMAX\_H,f,c(i),i}$ are the respective limits $P_{CMAX\_L,f,c\ (i),i}$ and $P_{CMAX\_H,f,c(i),i}$ expressed in linear scale.

T_{REF} and T_{eval} are specified in Table 6.2A.4.0.1.3-0 when same and different slot patterns are used in aggregated carriers. For each T_{REF}, the P_{CMAX_L} is evaluated per T_{eval} and given by the minimum value taken over the transmission(s) within the T_{eval}; the minimum P_{CMAX_L} over the one or more T_{eval} is then applied for the entire T_{REF}. $P_{PowerClass}$ shall not be exceeded by the UE during any period of time.

Table 6.2A.4.0.1.3-0: P_{CMAX} evaluation window for different slot and channel durations

T_{REF}	T_{eval}	T_{eval} with frequency hopping
T_{REF} of largest slot duration over both UL CCs	Physical channel length	Min($T_{no\_hopping}$, Physical Channel Length)

If the UE is configured with multiple TAGs and transmissions of the UE on slot *i* for any serving cell in one TAG overlap some portion of the first symbol of the transmission on slot *i* +1 for a different serving cell in another TAG, the UE minimum of P_{CMAX_L} for slots *i* and *i* + 1 applies for any overlapping portion of slots *i* and *i* + 1. $P_{PowerClass}$ shall not be exceeded by the UE during any period of time.

The measured maximum output power P_{UMAX} over all serving cells with same slot pattern shall be within the following range:

$$P_{CMAX\_L} – MAX\{T_L, T_{LOW}(P_{CMAX\_L})\} \leq P_{UMAX} \leq P_{CMAX\_H} + T_{HIGH}(P_{CMAX\_H})$$

$$P_{UMAX} = 10 \log_{10} \sum p_{UMAX,c}$$

where $p_{UMAX,c}$ denotes the measured maximum output power for serving cell *c* expressed in linear scale. The tolerances $T_{LOW}(P_{CMAX})$ and $T_{HIGH}(P_{CMAX})$ for applicable values of P_{CMAX} are specified in Table 6.2A.4.0.1.3-1. The tolerance T_L is the absolute value of the lower tolerance for applicable NR CA configuration as specified in Table 6.2A.1.0.3-1 for inter-band carrier aggregation.

The measured maximum output power P_{UMAX} over all serving cells, when at least one slot has a different transmission numerology or symbol pattern, shall be within the following range:

$$P'_{CMAX\_L} – MAX\{T_L, T_{LOW}(P'_{CMAX\_L})\} \leq P'_{UMAX} \leq P'_{CMAX\_H} + T_{HIGH}(P'_{CMAX\_H})$$

$$P'_{UMAX} = 10 \log_{10} \sum p'_{UMAX,c}$$

where $p'_{UMAX,c}$ denotes the average measured maximum output power for serving cell *c* expressed in linear scale over T_{REF}. The tolerances $T_{LOW}(P'_{CMAX})$ and $T_{HIGH}(P'_{CMAX})$ for applicable values of P'_{CMAX} are specified in Table 6.2A.4.0.1.3-1 for inter-band carrier aggregation. The tolerance T_L is the absolute value of the lower tolerance for applicable NR CA configuration as specified in Table 6.2A.1.0.3-1 for inter-band carrier aggregation.

where:

$$P'_{CMAX\_L} = MIN\{ MIN \{10\log_{10}\sum(p_{CMAX\_L,f,c(i),i}), P_{PowerClass}\} \text{ over all overlapping slots in } T_{REF}\}$$

$$P'_{CMAX\_H} = MAX\{ MIN\{10 \log_{10} \sum p_{EMAX,c} , P_{PowerClass}\} \text{ over all overlapping slots in } T_{REF}\}$$

Table 6.2A.4.0.1.3-1: P_{CMAX} tolerance for uplink inter-band CA (two bands)

P_{CMAX} (dBm)	Tolerance $T_{LOW}(P_{CMAX})$ (dB)	Tolerance $T_{HIGH}(P_{CMAX})$ (dB)
$P_{CMAX} = 23$	3.0	2.0
$22 \leq P_{CMAX} < 23$	5.0	2.0
$21 \leq P_{CMAX} < 22$	5.0	3.0
$20 \leq P_{CMAX} < 21$	6.0	4.0
$16 \leq P_{CMAX} < 20$	5.0	
$11 \leq P_{CMAX} < 16$	6.0	
$-40 \leq P_{CMAX} < 11$	7.0	

6.2A.4.0.2 $\Delta T_{IB,c}$ for CA

6.2A.4.0.2.1 Void

6.2A.4.0.2.2 Void

6.2A.4.0.2.3 $\Delta T_{IB,c}$ for Inter-band CA

For the UE which supports inter-band NR CA configuration, $\Delta T_{IB,c}$ in tables below applies. Unless otherwise stated, $\Delta T_{IB,c}$ is set to zero.

Table 6.2A.4.0.2.3-1: $\Delta T_{IB,c}$ due to NR CA (two bands)

Inter-band CA combination	NR Band	$\Delta T_{IB,c}$ (dB)
CA_n3-n77	n3	0.6
	n77	0.8
CA_n3-n78	n3	0.6
	n78	0.8
CA_n3-n79	n3	0.3
	n79	0.8
CA n8-n75	n8	0.3
CA n8-n78	n8	0.6
	n78	0.8
CA_n8-n79	n8	0.3
	n79	0.8
CA n28-n75	n28	0.3
CA_n28-n78	n28	0.5
	n78	0.8
CA_n41-n78[1]	n41	0.3
	n78	0.8
CA_n75-n78	n78	0.8
CA_n76-n78	n78	0.8
CA n77-n79	n77	0.5
	n79	0.5
CA_n78-n79	n78	0.5
	n79	0.5
NOTE: The requirements only apply when the sub-frame and Tx-Rx timings are synchronized between the component carriers. In the absence of synchronization, the requirements are not within scope of these specifications.		

6.2B Void

6.2C Transmitter power for SUL

6.2C.1 Configured transmitted power for SUL

Editor's notes:

- Connection diagram is TBD.

- Parameters setting for Cell setup in 38.508 subclause is FFS.

6.2C.1.1 Test purpose

Same test purpose as in clause 6.2.4.1

6.2C.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.

6.2C.1.3 Minimum conformance requirements

Refer to clause 6.2.4.3, and with the following supplementary specification for UE configured with SUL

For single carrier configured transmit power, as the UL carrier and SUL carrier is a same cell, the configured transmit power is specified for each UL carrier in a serving cell. The configured transmit power requirement for serving cell is applied for each UL carrier.

For the UE which supports SUL band combination, $\Delta T_{IB,c}$ in Table 6.2C.2-1 applies.

The normative reference for this requirement is TS 38.101-1 [2] clauses 6.2C.

6.2C.1.4 Test description

Same test description as specified in clause 6.2.4.4 with following exceptions:

Instead of table 5.3.5-1 → use Table 5.5C-1

Table 6.2C.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		Lowest, Mid, Highest for both SUL carrier and Non-SUL carrier		
Test SCS as specified in Table 5.3.5-1		15kHz for both SUL carrier and Non-SUL carrier		
Test Parameters for Channel Bandwidths				
	Downlink Configuration	**UL Configuration**	**SUL Configuration**	
Test ID	N/A for Configured UE transmitted Output Power test case		Modulation	RB allocation
1		NA	DFT-s-OFDM Pi/2 BPSK	Inner Full
2		NA	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: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.				

- 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 4.6 ensuring Tables 4.6.3-13, 4.6.3-97, and 4.6.3-129A with conditions SUL, and Table 4.6.3-167 with condition PUSCH_PUCCH_ON_SUL, additionally the following exceptions shown in Table 6.2C.1.4-2 ~ Table 6.2C.1.4-4 are considered.Table 6.2C.1.4-2: SIB1: Test point 1

Derivation Path: TS 38.508-1 [5] Table 4.6.1-28 SIB1			
Information Element	**Value/remark**	**Comment**	**Condition**
supplementaryUplink ::= SEQUENCE {			
frequencyInfoUL SEQUENCE {			
p-Max	-10		
}			
}			

Table 6.2C.1.4-3: SIB1: Test point 2

Derivation Path: TS 38.508-1 [5] Table 4.6.1-28 SIB1			
Information Element	**Value/remark**	**Comment**	**Condition**
supplementaryUplink ::= SEQUENCE {			
frequencyInfoUL SEQUENCE {			
p-Max	10		
}			
}			

Table 6.2C.1.4-4: SIB1: Test point 3

Derivation Path: TS 38.508-1 [5] Table 4.6.1-28 SIB1			
Information Element	**Value/remark**	**Comment**	**Condition**
supplementaryUplink ::= SEQUENCE {			
frequencyInfoUL SEQUENCE {			
p-Max	15		
}			
}			

6.2C.1.5 Test requirement

The maximum output power measured on SUL carrier shall not exceed the values specified in Table 6.2C.1.5-1.

Table 6.2C.1.5-1: P_{CMAX} configured UE output power

	Channel bandwidth / maximum output power					
	5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**	**30 MHz**
Measured UE output power test point 1	-10 dBm ± (7+TT)					
Measured UE output power test point 2	10 dBm ± (6+TT)					
Measured UE output power test point 3	15 dBm ± (5+TT)					
Note 1: TT for each frequency and channel bandwidth is specified in Table 6.2.4.5-2. Note 2: In addition note 3 in Table 6.2.1.3-1 shall apply to the tolerances.						

For the UE which supports_SUL configurations with uplink assigned to one E-UTRA band and one supplementary E-UTRA band the $\Delta T_{IB,c}$ in Tables 6.2C.2-1 shall be applied for applicable bands.

6.2C.2 $\Delta T_{IB,c}$

For the UE which supports SUL band combination, $\Delta T_{IB,c}$ in Tables below applies. Unless otherwise stated, $\Delta T_{IB,c}$ is set to zero.

Table 6.2C.2-1: $\Delta T_{IB,c}$ due to SUL

Band combination for SUL	NR Band	$\Delta T_{IB,c}$ (dB)
SUL_n78-n80	n78	0.8
	n80	0.6
SUL_n78-n81	n78	0.8
	n81	0.6
SUL_n78-n82	n78	0.8
	n82	0.6
SUL_n78-n83	n78	0.8
	n83	0.5
SUL_n78-n84	n78	0.8
	n84	0.3
SUL_n78-n86	n78	0.8

6.2D Transmitter power for UL-MIMO

6.2D.1 UE maximum output power for UL-MIMO

Editor's Note:

- Test point selection is FFS.

- MU/TT is FFS

- Test case is incomplete since there is no CP-OFDM configuration satisfying MPR=0dB requirements in RAN4

6.2D.1.1 Test purpose

To verify that the error of the UE maximum output power for UL-MIMO does not exceed the range prescribed by the specified nominal maximum output power and tolerance.

An excess maximum output power has the possibility to interfere to other channels or other systems. A small maximum output power decreases the coverage area.

6.2D.1.2 Test applicability

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

6.2D.1.3 Minimum conformance requirements

For PC2 UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the maximum output power for any transmission bandwidth within the channel bandwidth is specified in Table 6.2D.1.3-1. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2D.1.3-2. For UE supporting UL-MIMO, the maximum output power is measured as the sum of the maximum output power at each UE antenna connector. The period of measurement shall be at least one sub frame (1ms).

The requirements shall be met with the UL-MIMO configurations of using 2-layer UL-MIMO transmission with codebook of $\frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$. DCI Format for UE configured in PUSCH transmission mode for uplink single-user MIMO shall be used.

Table 6.2D.1.3-1: UE Power Class for UL-MIMO in closed loop spatial multiplexing scheme

NR band	Class 1 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)	Class 4 (dBm)	Tolerance (dB)
n41			26	+2/-3[1]	23	+2/-3[1]		
n77			26	+2/-3	23	+2/-3		
n78			26	+2/-3	23	+2/-3		
n79			26	+2/-3	23	+2/-3		
NOTE 1: [1] refers to the transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB								

Table 6.2D.1.3-2: 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

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.2.1 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2D.1.

6.2D.1.4 Test description

6.2D.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 6.2D.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 6.2D.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.3.1.1.2 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 6.2D.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 6.2D.1.4.3.

6.2D.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 6.2D.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 starting from the first TPC command in this step for the UE to reach P_{UMAX} level.

3. Measure the sum of the mean power of the UE at each transmit antenna connector in the channel bandwidth of the radio access mode. 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 slots only slots consisting of only UL symbols are under.

Editor's note: the end of the sentence of 3. is missing!

6.2D.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.

6.2D.1.5 Test requirement

The maximum output power, derived in step 3 shall be within the range prescribed by the nominal maximum output power and tolerance in Table 6.2D.1.5-1.

Table 6.2D.1.5-1: UE Power Class

NR band	Class 1 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)	Class 4 (dBm)	Tolerance (dB)
n41			26	+2+TT/-3[1]-TT	23	+2+TT/-3[1]-TT		
n77			26	+2+TT/-3-TT	23	+2+TT/-3-TT		
n78			26	+2+TT/-3-TT	23	+2+TT/-3-TT		
n79			26	+2+TT/-3-TT	23	+2+TT/-3-TT		
NOTE 1: [1] refers to the transmission bandwidths confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB NOTE 2: TT for each frequency and channel bandwidth is specified in Table 6.2D.1.5-2								

Table 6.2D.1.5-2: Test Tolerance (UE maximum output power)

	f ≤ 3.0GHz	3.0GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6.0GHz
BW ≤ 40MHz	FFS	FFS	FFS
40MHz < BW ≤ 100MHz	FFS	FFS	FFS

6.2D.2 UE maximum output power reduction for UL-MIMO

6.2D.2.1 Test purpose

To verify that the power reduction of UE due to higher order modulations and transmit bandwidth configuration does not exceed the specified maximum power reduction.

6.2D.2.2 Test applicability

The requirements of this test apply in test cases 6.5.2.4 Adjacent Channel Leakage power Ratio for UL-MIMO to all types of NR UE release 15 and forward that support UL-MIMO.

6.2D.2.3 Minimum conformance requirements

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2D.1.3-1 is specified in Table 6.2.2.3-1. The requirements shall be met with UL-MIMO configurations defined in Table 6.2D.1.3-2. For UE supporting UL-MIMO, the maximum output power is measured as the sum of the maximum output power at each UE antenna connector.

For the UE maximum output power modified by MPR, the power limits specified in subclause 6.2D.4.3 apply.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.2.2.3 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2D.2.

6.2D.2.4 Test description

6.2D.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 6.2D.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 6.2D.2.4.1-1: Test Configuration Table for Power Class 3

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, Highest	
Test SCS as specified in Table 5.3.5-1			Lowest and Highest	
Test Parameters for Channel Bandwidths				
Test ID	**Freq**	**Downlink Configuration**	**Uplink Configuration**	
		N/A	**Modulation**	**RB allocation (NOTE 1)**
1	Default		CP-OFDM QPSK	Inner Full
2	Low		CP-OFDM QPSK	Edge_1RB_Left
3	High		CP-OFDM QPSK	Edge_1RB_Right
4	Default		CP-OFDM QPSK	Outer Full
5	Default		CP-OFDM 16 QAM	Inner Full
6	Low		CP-OFDM 16 QAM	Edge_1RB_Left
7	High		CP-OFDM 16 QAM	Edge_1RB_Right
8	Default		CP-OFDM 16 QAM	Outer Full
9	Low		CP-OFDM 64 QAM	Edge_1RB_Left
10	High		CP-OFDM 64 QAM	Edge_1RB_Right
11	Default		CP-OFDM 64 QAM	Outer Full
12	Low		CP-OFDM 256 QAM	Edge_1RB_Left
13	High		CP-OFDM 256 QAM	Edge_1RB_Right
14	Default		CP-OFDM 256 QAM	Outer Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: CP-OFDM 256 QAM test applies only for UEs which supports 256QAM in FR1.				

Table 6.2D.2.4.1-2: Test Configuration Table for Power Class 2

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, Highest	
Test SCS as specified in Table 5.3.5-1			Lowest and Highest	
Test Parameters for Channel Bandwidths				
Test ID	**Freq**	**Downlink Configuration**	**Uplink Configuration**	
		N/A	**Modulation**	**RB allocation (NOTE 1)**
1	Default		CP-OFDM QPSK	Inner Full
2	Low		CP-OFDM QPSK	Edge_1RB_Left
3	High		CP-OFDM QPSK	Edge_1RB_Right
4	Default		CP-OFDM QPSK	Outer Full
5	Default		CP-OFDM 16 QAM	Inner Full
6	Low		CP-OFDM 16 QAM	Edge_1RB_Left
7	High		CP-OFDM 16 QAM	Edge_1RB_Right
8	Default		CP-OFDM 16 QAM	Outer Full
9	Low		CP-OFDM 64 QAM	Edge_1RB_Left
10	High		CP-OFDM 64 QAM	Edge_1RB_Right
11	Default		CP-OFDM 64 QAM	Outer Full
12	Low		CP-OFDM 256 QAM	Edge_1RB_Left
13	High		CP-OFDM 256 QAM	Edge_1RB_Right
14	Default		CP-OFDM 256 QAM	Outer Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: CP-OFDM 256 QAM test applies only for UEs which supports 256QAM in FR1.				

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 6.2D.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 6.2D.2.4.3.

6.2D.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 6.2D.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 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 P_{UMAX} level.

3. Measure the sum of the mean power of the UE at each transmit 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 symbol with transient periods are not under test.

6.2D.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 and 5.4.

6.2D.2.5 Test requirement

The maximum output power, derived in step 3 shall be within the range prescribed by the nominal maximum output power and tolerance in Table 6.2D.2.5-1 and Table 6.2D.2.5-2.

Table 6.2D.2.5-1: UE Power Class test requirements (for Band n41, n77, n78, n79) for Power Class 3

Test ID	$P_{PowerClass}$ (dBm)	$\Delta P_{PowerClass}$ (dB)	MPR (dB)	$\Delta T_{C,c}$ (dB)	$P_{CMAX\_L,f,c}$ (dBm)	$T(P_{CMAX\_L,f,c})$ (dB)	$T_{L,c}$	Upper limit (dBm)	Lower limit (dBm)
1	23	0	1.5	0 (1.5[2])	21.5 (20.0[2])	5.0 (6.0[2])	3	25.0 + TT	16.5 - TT (14.0 - TT[2])
2	23	0	3	0 (1.5[2])	20.0 (18.5[2])	6.0 (5.0[2])	3	25.0 + TT	14.0 - TT (13.5 - TT[2])
3	23	0	3	0 (1.5[2])	20.0 (18.5[2])	6.0 (5.0[2])	3	25.0 + TT	14.0 - TT (13.5 - TT[2])
4	23	0	3	0 (1.5[2])	20.0 (18.5[2])	6.0 (5.0[2])	3	25.0 + TT	14.0 - TT (13.5 - TT[2])
5	23	0	2	0 (1.5[2])	21.0 (19.5[2])	5.0 (5.0[2])	3	25.0 + TT	16.0 - TT (14.5 - TT[2])
6	23	0	3	0 (1.5[2])	20.0 (18.5[2])	6.0 (5.0[2])	3	25.0 + TT	14.0 - TT (13.5 - TT[2])
7	23	0	3	0 (1.5[2])	20.0 (18.5[2])	6.0 (5.0[2])	3	25.0 + TT	14.0 - TT (13.5 - TT[2])
8	23	0	3	0 (1.5[2])	20.0 (18.5[2])	6.0 (5.0[2])	3	25.0 + TT	14.0 - TT (13.5 - TT[2])
9	23	0	3.5	0 (1.5[2])	19.5 (18.0[2])	5.0 (5.0[2])	3	25.0 + TT	14.5 - TT (13.0 - TT[2])
10	23	0	3.5	0 (1.5[2])	19.5 (18.0[2])	5.0 (5.0[2])	3	25.0 + TT	14.5 - TT (13.0 - TT[2])
11	23	0	3.5	0 (1.5[2])	19.5 (18.0[2])	5.0 (5.0[2])	3	25.0 + TT	14.5 - TT (13.0 - TT[2])
12	23	0	6.5	0 (1.5[2])	16.5 (15.0[2])	5.0 (6.0[2])	3	25.0 + TT	11.5 - TT (9.0 - TT[2])
13	23	0	6.5	0 (1.5[2])	16.5 (15.0[2])	5.0 (6.0[2])	3	25.0 + TT	11.5 - TT (9.0 - TT[2])
14	23	0	6.5	0 (1.5[2])	16.5 (15.0[2])	5.0 (6.0[2])	3	25.0 + TT	11.5 - TT (9.0 - TT[2])

Table 6.2D.2.5-2: UE Power Class test requirements (for Bands n41, n77, n78, n79) for Power Class 2

Test ID	$P_{PowerClass}$ (dBm)	$\Delta P_{PowerClass}$ (dB)	MPR (dB)	$\Delta T_{C,c}$ (dB)		$P_{CMAX\_L,f,c}$ (dBm)		$T(P_{CMAX\_L,f,c})$ (dB)		$T_{L,c}$ (dB)	Upper limit (dBm)	Lower limit (dBm)	
1	26	0	1.5	0	(1.5[2])	24.5	(23.0[2])	2.0	(2.5[2])	3	28.0 + TT	21.5 - TT	(20.0 - TT[2])
2	26	0	3.5	0	(1.5[2])	22.5	(21.0[2])	5.0	(5.0[2])	3	28.0 + TT	17.5 - TT	(16.0 - TT[2])
3	26	0	3.5	0	(1.5[2])	22.5	(21.0[2])	5.0	(5.0[2])	3	28.0 + TT	17.5 - TT	(16.0 - TT[2])
4	26	0	3	0	(1.5[2])	23.0	(21.5[2])	3.0	(5.0[2])	3	28.0 + TT	20.0 - TT	(16.5 - TT[2])
5	26	0	2	0	(1.5[2])	24.0	(22.5[2])	3.0	(5.0[2])	3	28.0 + TT	21.0 - TT	(17.5 - TT[2])
6	26	0	3.5	0	(1.5[2])	22.5	(21.0[2])	5.0	(5.0[2])	3	28.0 + TT	17.5 - TT	(16.0 - TT[2])
7	26	0	3.5	0	(1.5[2])	22.5	(21.0[2])	5.0	(5.0[2])	3	28.0 + TT	17.5 - TT	(16.0 - TT[2])
8	26	0	3	0	(1.5[2])	23.0	(21.5[2])	3.0	(5.0[2])	3	28.0 + TT	20.0 - TT	(16.5 - TT[2])
9	26	0	3.5	0	(1.5[2])	22.5	(21.0[2])	5.0	(5.0[2])	3	28.0 + TT	17.5 - TT	(16.0 - TT[2])
10	26	0	3.5	0	(1.5[2])	22.5	(21.0[2])	5.0	(5.0[2])	3	28.0 + TT	17.5 - TT	(16.0 - TT[2])
11	26	0	3.5	0	(1.5[2])	22.5	(21.0[2])	5.0	(5.0[2])	3	28.0 + TT	17.5 - TT	(16.0 - TT[2])
12	26	0	6.5	0	(1.5[2])	19.5	(18.0[2])	5.0	(5.0[2])	3	28.0 + TT	14.5 - TT	(13.0 - TT[2])
13	26	0	6.5	0	(1.5[2])	19.5	(18.0[2])	5.0	(5.0[2])	3	28.0 + TT	14.5 - TT	(13.0 - TT[2])
14	26	0	6.5	0	(1.5[2])	19.5	(18.0[2])	5.0	(5.0[2])	3	28.0 + TT	14.5 - TT	(13.0 - TT[2])

Table 6.2D.2.5-3: Test Tolerance (Maximum Power Reduction (MPR))

	f ≤ 3.0GHz	**3.0GHz < f ≤ 6.0GHz**
BW ≤ 40MHz	0.7	1.0
40MHz < BW ≤ 100MHz	1.0	1.0

6.2D.3 UE additional maximum output power reduction for UL-MIMO

6.2D.3.1 Test purpose

Additional emission requirements can be signalled by the network. Each additional emission requirement is associated a unique with network signalling (NS) value indicated in RRC signalling by an NR frequency band number of the applicable operating band and an associated value in the field *additionalSpectrumEmission.* Throughout this specification, the notion of indication or signalling of an NS value refers to the corresponding indication of an NR frequency band number of the applicable operating band (the IE *freqBandIndicatorNR*) and an associated value of *additionalSpectrumEmission* in the relevant RRC information elements [6].

To meet the additional requirements, additional maximum power reduction (A-MPR) is allowed for the maximum output power as specified in Table 6.2D.1.3-1. Unless stated otherwise, an A-MPR of 0 dB shall be used.

6.2D.3.2 Test applicability

The requirements of this test apply in test case 6.5D.2.3 Additional Spectrum Emission mask for UL-MIMO for network signalled value NS_04 to all types of NR UE release 15 and forward that support UL-MIMO.

The requirements of this test apply in test case 6.5D.3.3 Additional Spurious Emissions for network signalled value NS_04 to all types of NR UE release 15 and forward that support UL-MIMO.

6.2D.3.3 Minimum conformance requirements

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the A-MPR values specified in subclause 6.2.3.3 shall apply to the maximum output power specified in Table 6.2D.1.3-1. The requirements shall be met with the UL-MIMO configurations specified in Table 6.2D.1.3-2. For UE supporting UL-MIMO, the maximum output power is measured as the sum of the maximum output power at each UE antenna connector. Unless stated otherwise, an A-MPR of 0 dB shall be used.

For the UE maximum output power modified by A-MPR, the power limits specified in subclause 6.2D.4.3 apply.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.2.3.3 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2D.3.

6.2D.3.4 Test description

6.2D.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 6.2D.3.4.1-1. 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 6.2D.3.4.1-1: Test Configuration table for NS_04

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 Freq column)	
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, Highest	
A-MPR test parameters for NS_04				
		Downlink Configuration	**Uplink Configuration**	
Test ID	**Freq**	N/A	**Modulation (NOTE 2)**	**RB allocation (NOTE 1)**
1	Low		CP-OFDM QPSK	Edge_1RB_Left
2	2496 + 3/2 × $BW_{Channel}$ – 6 MHz		CP-OFDM QPSK	Edge_1RB_Left
3	2496 + $BW_{Channel}$ /2 + MAX(10 MHz, 0.25 × $BW_{Channel}$)		CP-OFDM QPSK	Inner Full
4			CP-OFDM QPSK	Outer Full
5	High		CP-OFDM QPSK	Edge_1RB_Right
6	High		CP-OFDM QPSK	Inner Full
7	High		CP-OFDM QPSK	Outer Full
8	Low		CP-OFDM 16 QAM	Edge_1RB_Left
9	2496 + 3/2 × $BW_{Channel}$ – 6 MHz		CP-OFDM 16 QAM	Edge_1RB_Left
10	2496 + $BW_{Channel}$ /2 + MAX(10 MHz, 0.25 × $BW_{Channel}$)		CP-OFDM 16 QAM	Inner Full
11			CP-OFDM 16 QAM	Outer Full
12	High		CP-OFDM 16 QAM	Edge_1RB_Right
13	High		CP-OFDM 16 QAM	Inner Full
14	High		CP-OFDM 16 QAM	Outer Full
15	Low		CP-OFDM 64 QAM	Edge_1RB_Left
16	2496 + 3/2 × $BW_{Channel}$ – 6 MHz		CP-OFDM 64 QAM	Edge_1RB_Left
17	2496 + $BW_{Channel}$ /2 + MAX(10 MHz, 0.25 × $BW_{Channel}$)		CP-OFDM 64 QAM	Outer Full
18	High		CP-OFDM 64 QAM	Edge_1RB_Right
19	High		CP-OFDM 64 QAM	Outer Full
20	Low		CP-OFDM 256 QAM	Edge_1RB_Left
21	2496 + 3/2 × $BW_{Channel}$ – 6 MHz		CP-OFDM 256 QAM	Edge_1RB_Left
22	2496 + $BW_{Channel}$ /2 + MAX(10 MHz, 0.25 × $BW_{Channel}$)		CP-OFDM 256 QAM	Outer Full
23	High		CP-OFDM 256 QAM	Edge_1RB_Right
24	High		CP-OFDM 256 QAM	Outer Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.				

Editor's note: The following lines belong at the end of subclause 6.2D.3.4.1. As new tables are added to this section, these lines should always follow the tables

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 Annex G.0, G.1, G.2 and G.3.0.

4. The UL Reference Measurement channels are set according to the applicable table Table 6.2D.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 6.2D.3.4.3.

6.2D.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 6.2D.3.4.1-1. 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.

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 P_{UMAX} level.

3. Measure the sum of the mean power of the UE at each transmit antenna connector in the channel bandwidth of the radio access mode. 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 slots only slots consisting of only UL symbols are under.

6.2D.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6.1 ensuring Table 4.6.3-182 with the condition 2TX_UL_MIMO, with the following exceptions for each network signalled value.

6.2D.3.4.3.1 Message contents exceptions for network signalled value "NS_04"

1. Information element additionalSpectrumEmission is set to NS_04. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2D.3.4.3.1-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_04"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_04)		

6.2D.3.5 Test requirement

The maximum output power, derived in step 3 shall be within the range prescribed by the nominal maximum output power and tolerance in the applicable table from table 6.2D.3.5-1. The allowed A-MPR values specified in table 6.2.3.3.1-1 are in addition to the allowed MPR requirements specified in clause 6.2.2.3. For the UE maximum output power modified by MPR and/or A-MPR, the power limits specified in table 6.2D.1.3-1 apply.

Table 6.2D.3.5-0: Test Tolerance (UE additional maximum output power reduction)

	f ≤ 3.0GHz	**3.0GHz < f ≤ 6.0GHz**
BW ≤ 40MHz	0.7	1.0
40MHz < BW ≤ 100MHz	1.0	1.0

Table 6.2D.3.5-1: UE Power Class 2 test requirements (NS_04) for band n41

Test ID	$P_{PowerClass}$ (dBm)	MPR (dB)	A-MPR (dB)	$\Delta T_{C,c}$ (dB)	$P_{CMAX,c}$ (dBm)	$T(P_{CMAX\_L,c})$ (dB)	$T_{L,c}$ (dB)	Upper limit (dBm)	Lower limit (Note 2) (dBm)
1	26	0	[7.5]	0	18.5	5	3	28+TT	[13.5-TT]
2	26	0	[7.5]	0	18.5	5	3	28+TT	[13.5-TT]
3	26	0	6.5	0	19.5	5	3	28+TT	14.5-TT
4	26	0	6.5	0	19.5	5	3	28+TT	14.5-TT
5	26	3.5	0	0	22.5	5	3	28+TT	17.5-TT
6	26	1.5	0	0	24.5	3	3	28+TT	21.3-TT
7	26	3	0	0	23	3	3	28+TT	20.0-TT
8	26	0	[7.5]	0	18.5	5	3	28+TT	[13.5-TT]
9	26	0	[7.5]	0	18.5	5	3	28+TT	[13.5-TT]
10	26	0	6.5	0	19.5	5	3	28+TT	14.5-TT
11	26	0	6.5	0	19.5	5	3	28+TT	14.5-TT
12	26	3.5	0	0	22.5	5	3	28+TT	17.5-TT
13	26	2	0	0	24	3	3	28+TT	21.0-TT
14	26	3	0	0	23	3	3	28+TT	20.0-TT
15	26	0	[7.5]	0	18.5	5	3	28+TT	[13.5-TT]
16	26	0	[7.5]	0	18.5	5	3	28+TT	[13.5-TT]
17	26	0	6.5	0	19.5	5	3	28+TT	14.5-TT
18	26	3.5	0	0	22.5	5	3	28+TT	17.5-TT
19	26	3.5	0	0	22.5	5	3	28+TT	17.5-TT
20	26	0	[10]	0	16	5	3	28+TT	[11.0-TT]
21	26	0	[10]	0	16	5	3	28+TT	[11.0-TT]
22	26	0	7.5	0	18.5	5	3	28+TT	13.5-TT
23	26	6.5	0	0	19.5	5	3	28+TT	14.5-TT
24	26	6.5	0	0	19.5	5	3	28+TT	14.5-TT

NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance.
NOTE 2: For Band n41, refers to the transmission bandwidths (Figure 5.3.3-1) confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the lower limit shall be decreased by 1.0 dB for CP-OFDM 256 QAM and decreased by 1.5 dB for other modulations.
NOTE 3: TT=0.7 for $BW_{channel} \leq 40$ MHz; TT=1.0 for 40 MHz < $BW_{channel} \leq 100$ MHz.

Table 6.2D.3.5-2: UE Power Class 3 test requirements (NS_04) for band n41

Test ID	$P_{PowerClass}$ (dBm)	MPR (dB)	A-MPR (dB)	$\Delta T_{C,c}$ (dB)	$P_{CMAX,c}$ (dBm)	$T(P_{CMAX\_L,c})$ (dB)	$T_{L,c}$ (dB)	Upper limit (dBm)	Lower limit (Note 2) (dBm)
1	23	0	5.5	0	17.5	5	3	25+TT	12.5-TT
2	23	0	5.5	0	17.5	5	3	25+TT	12.5-TT
3	23	0	5.5	0	17.5	5	3	25+TT	12.5-TT
4	23	0	5.5	0	17.5	5	3	25+TT	12.5-TT
5	23	3.0	0	0	20.0	6	3	25+TT	14.0-TT
6	23	1.5	0	0	21.5	5	3	25+TT	16.5-TT
7	23	3.0	0	0	20.0	6	3	25+TT	14.0-TT
8	23	0	5.5	0	17.5	5	3	25+TT	12.5-TT
9	23	0	5.5	0	17.5	5	3	25+TT	12.5-TT
10	23	0	5.5	0	17.5	5	3	25+TT	12.5-TT
11	23	0	5.5	0	17.5	5	3	25+TT	12.5-TT
12	23	3.0	0	0	20.0	6	3	25+TT	14.0-TT
13	23	2.0	0	0	21.0	5	3	25+TT	16.0-TT
14	23	3.0	0	0	20.0	6	3	25+TT	14.0-TT
15	23	0	5.5	0	17.5	5	3	25+TT	12.5-TT
16	23	0	5.5	0	17.5	5	3	25+TT	12.5-TT
17	23	0	5.5	0	17.5	5	3	25+TT	12.5-TT
18	23	3.5	0	0	19.5	5	3	25+TT	14.5-TT
19	23	3.5	0	0	19.5	5	3	25+TT	14.5-TT
20	23	0	8	0	15.0	6	3	25+TT	9.0-TT
21	23	0	8	0	15.0	6	3	25+TT	9.0-TT
22	23	0	6.5	0	16.5	5	3	25+TT	11.5-TT
23	23	6.5	0	0	16.5	5	3	25+TT	11.5-TT
24	23	6.5	0	0	16.5	5	3	25+TT	11.5-TT

NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance.
NOTE 2: For Band n41, refers to the transmission bandwidths (Figure 5.3.3-1) confined within F_{UL_low} and F_{UL_low} + 4 MHz or F_{UL_high} – 4 MHz and F_{UL_high}, the lower limit shall be decreased by 1.0 dB for CP-OFDM 256 QAM and decreased by 1.5 dB for other modulations.
NOTE 3: TT=0.7 for $BW_{channel}$ ≤ 40 MHz; TT=1.0 for 40 MHz < $BW_{channel}$ ≤ 100 MHz.

6.2D.4 Configured transmitted power for UL-MIMO

6.2D.4.1 Test purpose

To verify the measured UE configured maximum output power $P_{UMAX,f,c}$ for UL-MIMO is within the specified bounds.

6.2D.4.2 Test applicability

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

6.2D.4.3 Minimum conformance requirements

For UE supporting UL-MIMO, the transmitted power is configured per each UE.

The definitions of configured maximum output power $P_{CMAX,c}$, the lower bound $P_{CMAX\_L,c}$, and the higher bound $P_{CMAX\_H,c}$ specified in subclause 6.2.4 shall apply to UE supporting UL-MIMO, where

$P_{PowerClass}$, $\Delta P_{PowerClass}$ and $\Delta T_{C,c}$ are specified in subclause 6.2D.1.3;

MPR_c is specified in subclause 6.2D.2.3;

A-MPR$_c$ is specified in subclause 6.2D.3.3.

The measured configured maximum output power $P_{UMAX,c}$ for serving cell c shall be within the following bounds:

$$P_{CMAX\_L,c} - MAX\{T_L, T_{LOW}(P_{CMAX\_L,c})\} \leq P_{UMAX,c} \leq P_{CMAX\_H,c} + T_{HIGH}(P_{CMAX\_H,c})$$

where $T_{LOW}(P_{CMAX\_L,c})$ and $T_{HIGH}(P_{CMAX\_H,c})$ are defined as the tolerance and applies to $P_{CMAX\_L,c}$ and $P_{CMAX\_H,c}$ separately, while T_L is the absolute value of the lower tolerance in Table 6.2D.1.3-1 for the applicable operating band.

For UE with two transmit antenna connectors in closed-loop spatial amultiplexing scheme, the tolerance is specified in Table 6.2D.4.3-1. The requirements shall be met with UL-MIMO configurations specified in Table 6.2D.1.3-2.

Table 6.2D.4.3-1: $P_{CMAX,c}$ tolerance in closed-loop spatial multiplexing scheme

$P_{CMAX,c}$ (dBm)	Tolerance $T_{LOW}(P_{CMAX\_L,c})$ (dB)	Tolerance $T_{HIGH}(P_{CMAX\_H,c})$ (dB)
$P_{CMAX,c}$ =26	3.0	2.0
23 ≤ $P_{CMAX,c}$ < 26	3.0	2.0
22 ≤ $P_{CMAX,c}$ < 23	5.0	2.0
21 ≤ $P_{CMAX,c}$ < 22	5.0	3.0
20 ≤ $P_{CMAX,c}$ < 21	6.0	4.0
16 ≤ $P_{CMAX,c}$ < 20	5.0	
11 ≤ $P_{CMAX,c}$ < 16	6.0	
-40 ≤ $P_{CMAX,c}$ < 11	7.0	

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.2.4.3 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.2D.4.

6.2D.4.4 Test description

6.2D.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 6.2D.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 6.2D.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 for Channel Bandwidths			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
	N/A	**Modulation**	**RB allocation (NOTE 1)**
1		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 6.2D.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 6.2D.4.4.3.

6.2D.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 6.2D.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 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 P_{UMAX} level of the test point.
3. Measure the sum of the mean power of the UE at each transmit antenna connector in the channel bandwidth of the radio access mode. 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 slots only slots consisting of only UL symbols are under test.

6.2D.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 the condition 2TX_UL_MIMO and following exception.

Table 6.2D.4.4.3-1: FrequencyInfoUL: Test point 1

Derivation Path: TS 38.508-1 [5] Table 4.6.3-61 FrequencyInfoUL			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	0		

Table 6.2D.4.4.3-2: FrequencyInfoUL: Test point 2

Derivation Path: TS 38.508-1 [5] Table 4.6.3-61 FrequencyInfoUL			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	14		

Table 6.2D.4.4.3-3: FrequencyInfoUL: Test point 3

Derivation Path: TS 38.508-1 [5] Table 4.6.3-61 FrequencyInfoUL			
Information Element	**Value/remark**	**Comment**	**Condition**
p-Max	18		

6.2D.4.5 Test requirement

The maximum output power measured shall not exceed the values specified in Table 6.2D.4.5-1.

Table 6.2D.4.5-1: P_{CMAX} configured UE output power

Configured transmitted power	
Measured UE output power test point 1	0 dBm ± (7+TT)
Measured UE output power test point 2	14 dBm ± (6+TT)
Measured UE output power test point 3	18 dBm ± (5+TT)
Note 1: TT for each frequency and channel bandwidth is specified in Table 6.2D.4.5-2. Note 2: In addition note 2 in Table 6.2D.1.3-1 shall apply to the tolerances.	

Table 6.2D.4.5-2: Test Tolerance (Configured transmitted power for UL-MIMO)

	f ≤ 3.0GHz	3.0GHz < f ≤ 6.0GHz
BW ≤ 40MHz	0.7	1.0
40MHz < BW ≤ 100MHz	1.0	1.0

6.3 Output power dynamics

6.3.1 Minimum output power

6.3.1.1 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.

6.3.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.3.1.3 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 one sub-frame TBD ms. The minimum output power shall not exceed the values specified in Table 6.3.1.3-1.

Table 6.3.1.3-1: 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
50	-36	48.615
60	-35.2	58.35
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 6.3.1.

6.3.1.4 Test description

6.3.1.4.1 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 test channel bandwidth and sub-carrier spacing, and are shown in table 6.3.1.4.1-1. 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 6.3.1.4.1-1: 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	
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 test case	**Modulation**	**RB allocation (NOTE 1)**
1		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 6.3.1.4.1-1.

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 6.3.1.4.3.

6.3.1.4.2 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 6.3.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

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 6.3.1.5-1 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.

6.3.1.4.3 Message contents

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

Table 6.3.1.4.3-1: *PUSCH-Config*

Derivation Path: TS 38.508-1 [5], Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED

6.3.1.5 Test requirement

The minimum output power, derived in step 3 shall not exceed the values specified in Table 6.3.1.5-1.

Table 6.3.1.5-1: 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
60	-35.2+TT	58.35
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 6.3.1.5-2		

Table 6.3.1.5-2: 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

6.3.2 Transmit OFF power

6.3.2.1 Test purpose

To verify that the UE transmit OFF power is lower than the value specified in the test requirement.

6.3.2.2 Test applicability

The requirements of this test apply in test cases 6.3.3 Transmit ON/OFF time mask to all types of NR UE release 15 and forward.

6.3.2.3 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 or during periods when the UE is not transmitting a sub-frame. During DTX and measurements gaps, the transmitter is not considered OFF.

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 6.3.2.3-1.

Table 6.3.2.3-1: 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
80	-50	78.15
100	-50	88.23

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

An excess transmit OFF power potentially increases the Rise Over Thermal (RoT) and therefore reduces the cell coverage area for other UEs.

6.3.2.4 Test description

This test is covered by clause 6.3.3 Transmit ON/OFF time mask.

6.3.2.5 Test requirement

The requirement for the transmit OFF power shall not exceed the values specified in Table 6.3.2.5-1.

Table 6.3.2.5-1: 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 6.3.2.5-2		

Table 6.3.2.5-2: 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

6.3.3 Transmit ON/OFF time mask

6.3.3.1 General

The transmit power time mask defines the transient period(s) allowed

- between transmit OFF power as defined in sub-clause 6.3.2 and transmit ON power symbols (transmit ON/OFF)
- between continuous ON-power transmissions with power change or RB hopping is applied .

In case of RB hopping, transition period is shared symmetrically.

Unless otherwise stated the minimum requirements in clause 6.5 apply also in transient periods.

In the following sub-clauses, following definitions apply:

- A slot transmission is a Type A transmission.
- A long subslot transmission is a Type B transmission with more than 2 symbols.
- A short subslot transmission is a Type B transmission with 1 or 2 symbols.

6.3.3.2 General ON/OFF time mask

6.3.3.2.1 Test purpose

To verify that the general ON/OFF time mask meets the requirements given in 6.3.3.2.5.

The transmit power time mask for transmit ON/OFF defines the transient period(s) allowed between transmit OFF power as defined in sub-clause 6.3.2 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.

6.3.3.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.3.3.2.3 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. ON/OFF scenarios include : the beginning or end of DTX, measurement gap, 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 one slot excluding any transient period.

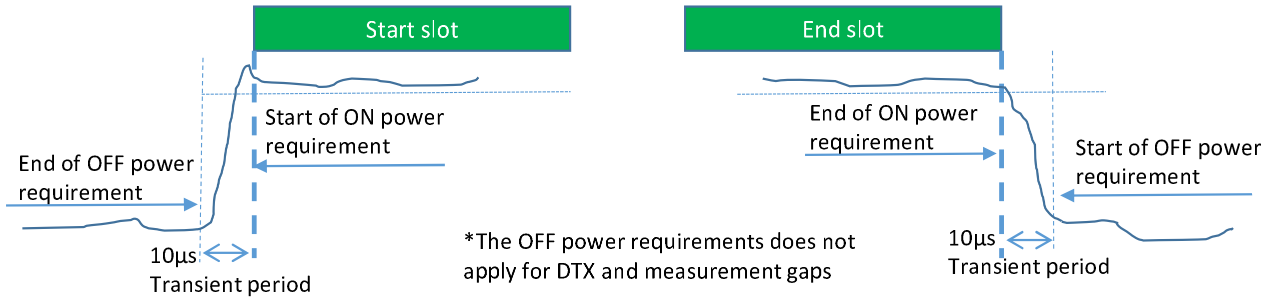

Figure 6.3.3.2.3-1: General ON/OFF time mask for NR UL transmission in FR1

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3.3.2.

6.3.3.2.4 Test description

6.3.3.2.4.1 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 6.3.3.2.4.1-1. 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 6.3.3.2.4.1-1: 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 test case	**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.			

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 6.3.3.2.4.1-1.
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 6.3.3.2.4.3.

6.3.3.2.4.2 Test procedure

1. SS sends uplink scheduling information via PDCCH DCI format 0_1 with TPC command 0dB for C_RNTI to schedule the UL RMC according to Table 6.3.3.2.4.1-1. 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 8 for15kHz SCS, on slots 8 and 18 for 30kHz SCS and on slots 17 and 37 for 60kHz SCS.
2. Measure the UE transmission OFF power during the slot prior to the PUSCH transmission, excluding a transient period of 10 µs in the end of the slot.
3. Measure the output power of the UE PUSCH transmission during one slot.
4. Measure the UE transmission OFF power during the slot following the PUSCH transmission, excluding a transient period of 10 µs at the beginning of the slot.

6.3.3.2.4.3 Message contents

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

Table 6.3.3.2.4.3-1: *PUSCH-ConfigCommon*

Derivation Path: TS 38.508-1[5], Table 4.6.3-119			
Information Element	**Value/remark**	**Comment**	**Condition**
PUSCH-ConfigCommon ::= SEQUENCE {			
p0-NominalWithGrant	-106		
}			

Table 6.3.3.2.4.3-2: *PUSCH-Config*

Derivation Path: TS 38.508-1 [5], Table 4.6.3-118 with condition CP-OFDM

Table 6.3.3.2.4.3-3: 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 6.3.3.2.4.3-4: 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	K_2+ Δ=4 acc. to TS 38.214 [21] Table 6.1.2.1.1-5 (NOTE 1)	FR1_15kHz
	6	K_2+ 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.

6.3.3.2.5 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 6.3.3.2.5-1.

Table 6.3.3.2.5-1: General ON/OFF time mask

	SCS [kHz]	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	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	78.15	88.23	98.31
Expected Transmission ON Measured power for CP-OFDM	15	-9.62±9.0 ±TT	-6.44±9.0 ±TT	-4.62±9.0 ±TT	-3.35±9.0 ±TT	-2.36±9.0 ±TT	-1.56±9.0 ±TT	-0.26±9.0 ±TT	0.71±9.0 ±TT	N/A	N/A	N/A	N/A
	30	-10.18±9.0 ±TT	-6.79±9.0 ±TT	-4.79±9.0 ±TT	-3.51±9.0 ±TT	-2.46±9.0 ±TT	-1.67±9.0 ±TT	-0.34±9.0 ±TT	0.65±9.0 ±TT	1.51±9.0 ±TT	2.77±9.0 ±TT	3.30±9.0 ±TT	3.77±9.0 ±TT
	60	N/A	-7.17±9.0 ±TT	-5.03±9.0 ±TT	-3.78±9.0 ±TT	-2.67±9.0 ±TT	-1.78±9.0 ±TT	-0.50±9.0 ±TT	0.55±9.0 ±TT	1.40±9.0 ±TT	2.71±9.0 ±TT	3.25±9.0 ±TT	3.72±9.0 ±TT
Expected Transmission ON Measured power for DFT-s-OFDM	15	-9.62±9.0 ±TT	-6.61±9.0 ±TT	-4.85±9.0 ±TT	-3.60±9.0 ±TT	-2.53±9.0 ±TT	-1.56±9.0 ±TT	-0.26±9.0 ±TT	0.71±9.0 ±TT	N/A	N/A	N/A	N/A
	30	-10.59±9.0 ±TT	-6.79±9.0 ±TT	-5.03±9.0 ±TT	-3.60±9.0 ±TT	-2.53±9.0 ±TT	-1.84±9.0 ±TT	-0.59±9.0 ±TT	0.48±9.0 ±TT	1.51±9.0 ±TT	2.75±9.0 ±TT	3.21±9.0 ±TT	3.72±9.0 ±TT
	60	N/A	-7.58±9.0 ±TT	-5.03±9.0 ±TT	-3.78±9.0 ±TT	-2.81±9.0 ±TT	-2.02±9.0 ±TT	-0.59±9.0 ±TT	0.48±9.0 ±TT	1.17±9.0 ±TT	2.42±9.0 ±TT	3.21±9.0 ±TT	3.72±9.0 ±TT
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3.3.2.5-2													

Table 6.3.3.2.5-2: 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 6.3.3.2.5-3: Test Tolerance for ON 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

6.3.3.3 Transmit power time mask for slot and short or subslot boundaries

No test case details are specified. Current test procedures for time masks are based on power measurement in relatively long period compared with transient period. For time masks between 2 active time slots with different power level, the test procedure can’t provide enough resolution to identify non-conformant UEs. Therefore the minimum requirement is not testable.

6.3.3.4 PRACH time mask

6.3.3.4.1 Test purpose

To verify that the PRACH time mask meets the requirements given in 6.3.3.4.5.

The time mask for PRACH time mask defines the transient period(s)allowed between transmit OFF power and transmit ON power when transmitting the PRACH.

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

6.3.3.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.3.3.4.3 Minimum conformance requirements

The PRACH ON power is specified as the mean power over the PRACH measurement period excluding any transient periods as shown in Figure 6.3.3.4.3-1. The measurement period for different PRACH preamble format is specified in Table 6.3.3.4.3-1.

Table 6.3.3.4.3-1: PRACH ON power measurement period

PRACH preamble format	SCS (kHz)	Measurement period (ms)
0	1.25	0.903125
1	1.25	2.284375
2	1.25	3.352604
3	5	0.903125
A1	15	0.142708
	30	0.071354
A2	15	0.285417
	30	0.142708
A3	15	0.428125
	30	0.2140625
B1	15	0.140365
	30	0.070182
B4	15	0.83046875
	30	0.415234375
A1/B1	15	0.142708 ms for first six occasion 0.140365 ms for the last occasion
	30	0.071354 ms for first six occasion 0.070182 ms for the last occasion
A2/B2	15	0.285417 ms for first two occasion 0.278385 ms for the third occasion
	30	0.142708 ms for first two occasion 0.1391925 ms for the third occasion
A3/B3	15	0.428125 ms for the first occasion 0.41640625 ms for the second occasion
	30	0.2140625 ms for the first occasion 0.208203125 ms for the second occasion
C0	15	0.10703125
	30	0.053515625
C2	15	0.333333
	30	0.166667
NOTE: For PRACH on PRACH occasion start from the beginning of 0.5ms or span the boundary of 0.5ms of the subframe, the measurement period will plus 0.032552µs		

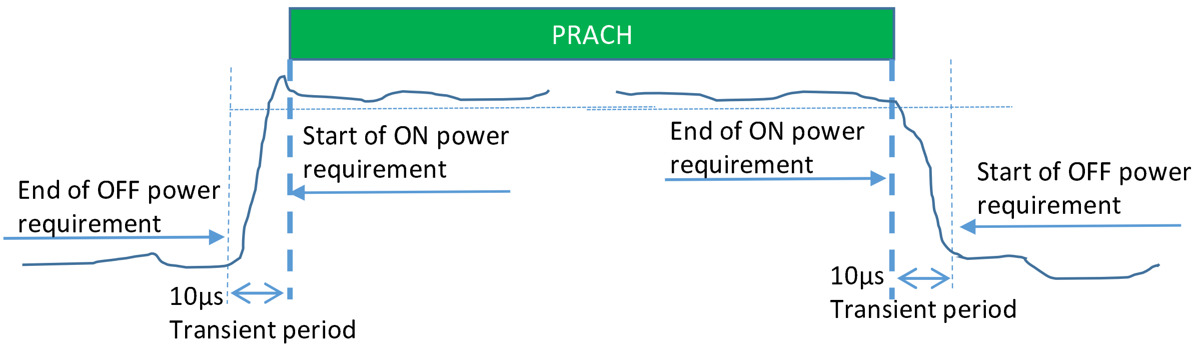

Figure 6.3.3.4.3-1: PRACH ON/OFF time mask

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3.3.4.

6.3.3.4.4 Test description

6.3.3.4.4.1 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 operating bands specified in table 5.2-1. 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 6.3.3.4.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes [TBD]. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3.3.4.4.1-1: 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	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	SCS defined in TS 38.211 [8] subclause 6.3.3.2 determined by PRACH Configuration Index for long sequence Lowest , Highest for short sequence	
PRACH preamble format		
	Paired Spectrum	Unpaired Spectrum
PRACH Configuration Index for test point 1	4 (long sequence)	12 (long sequence)
PRACH Configuration Index for test point 2	160 (short sequence)	123 (short sequence)

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

5. 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 6.3.3.4.4.3.

6.3.3.4.4.2 Test procedure

1. 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.

2. The UE shall send the signalled preamble to the SS.

3. The SS measure the UE transmission OFF power during the slot preceding the PRACH preamble excluding a transient period of 10 µs according to Figure 6.3.3.4.3-1.

4. Measure the output power of the transmitted PRACH preamble according to Figure 6.3.3.4.3-1.

5. Measure the UE transmission OFF power, starting 10 µs after the PRACH preamble ends for a measurement period.

6.3.3.4.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6.3 with the following exceptions:

Table 6.3.3.4.4.3-1: *RACH-ConfigGeneric:* PRACH measurement

Derivation Path: TS 38.331 [6], clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
RACH-ConfigGeneric ::= SEQUENCE {			
prach-ConfigurationIndex	4	Paired Spectrum	PRACH Format 0
	160	Paired Spectrum	PRACH Format A3
	12	Unpaired Spectrum	PRACH Format 0
	123	Unpaired Spectrum	PRACH Format A3
powerRampingStep	dB0		
}			

Table 6.3.3.4.4.3-2: *ServingCellConfigCommonSIB: PRACH measurement*

Derivation Path: TS 38.331 [6], clause 6.3.2			
Information Element	**Value/remark**	**Comment**	**Condition**
ServingCellConfigCommonSIB ::= SEQUENCE {			
ss-PBCH-BlockPower	32		
}			

6.3.3.4.5 Test requirement

The requirement for the power measured in steps (3), (4) and (5) of the test procedure shall not exceed the values specified in Table 6.3.3.4.5-1.

Table 6.3.3.4.5-1: PRACH time mask

	Channel bandwidth / minimum output power / measurement ba								
	5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**	**30 MHz**	**40 MHz**	**50 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	
Expected PRACH Transmission ON Measured Power	-1 dBm	-1 dBm	-1 dBm	-1 dBm	-1 dBm	-1 dBm	-1 dBm	-1 dBm	-
ON Power Tolerance	± (9+TT)dB								
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3.3.4.5-2									

Table 6.3.3.4.5-2: 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

6.3.3.5 Void

6.3.3.6 SRS time mask

6.3.3.6.1 Test purpose

To verify that the SRS time mask meets the requirements given in 6.3.3.6.5.

The time mask for SRS time mask defines the transient period(s) allowed between transmit OFF power and transmit ON power when transmitting the SRS.

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

6.3.3.6.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.3.3.6.3 Minimum conformance requirements

For SRS transmission mapped to one OFDM symbol, the ON power is defined as the mean power over the symbol duration excluding any transient period; Figure 6.3.3.6.3-1

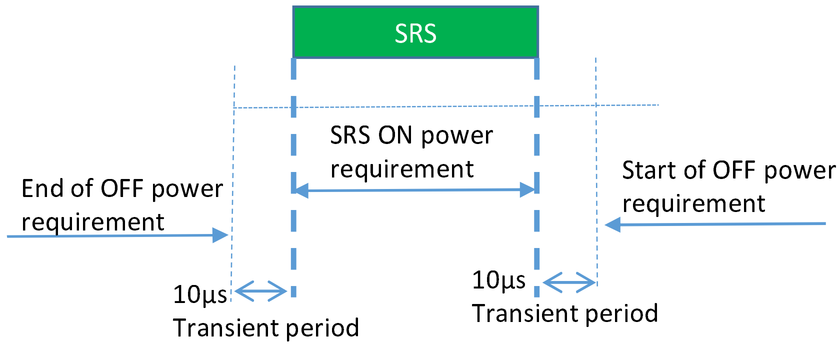

Figure 6.3.3.6.3-1: Single SRS time mask for NR UL transmission

For SRS transmission mapped to two OFDM symbols the ON power is defined as the mean power for each symbol duration excluding any transient period. See Figure 6.3.3.6.3-2

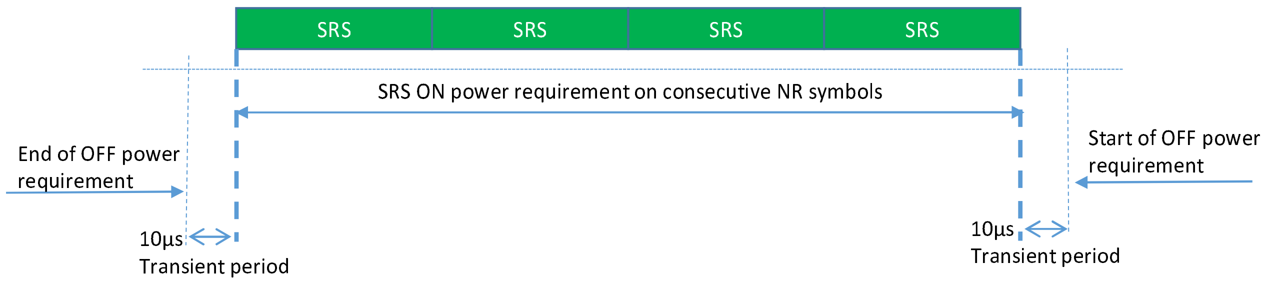

Figure 6.3.3.6.3-2: Consecutive SRS time mask for the case when no power change is required

When power change between consecutive SRS transmissions is required, then Figure 6.3.3.6.3-3 and Figure 6.3.3.6.3-4 apply.

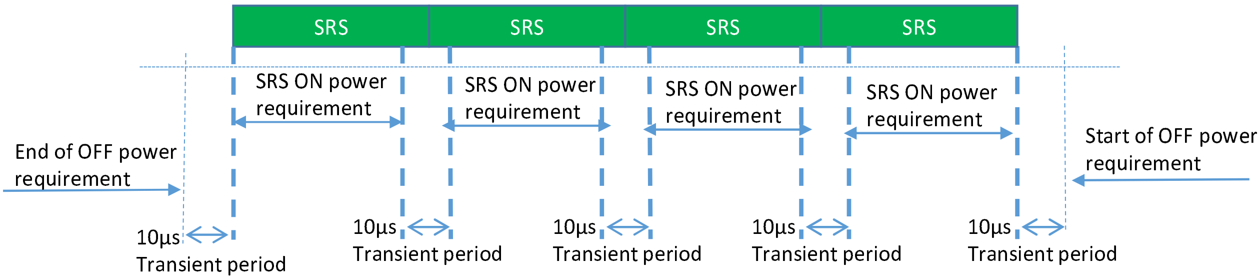

Figure 6.3.3.6.3-3: Consecutive SRS time mask for the case when power change is required and when 15kHz and 30kHz SCS is used in FR1

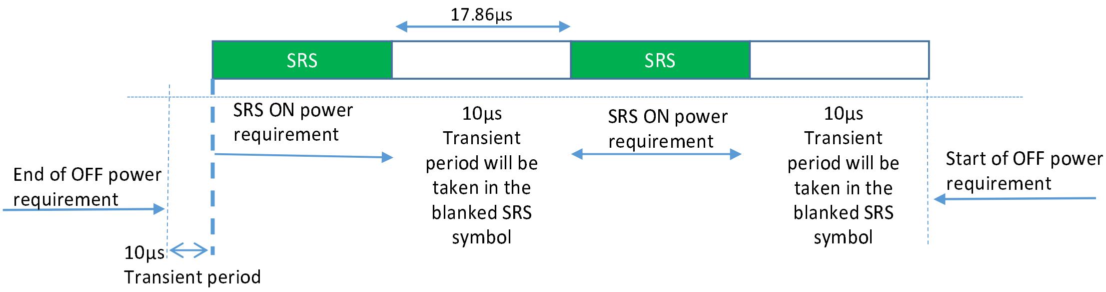

Figure 6.3.3.6.3-4: Consecutive SRS time mask for the case when power change is required and when 60kHz SCS is used in FR1

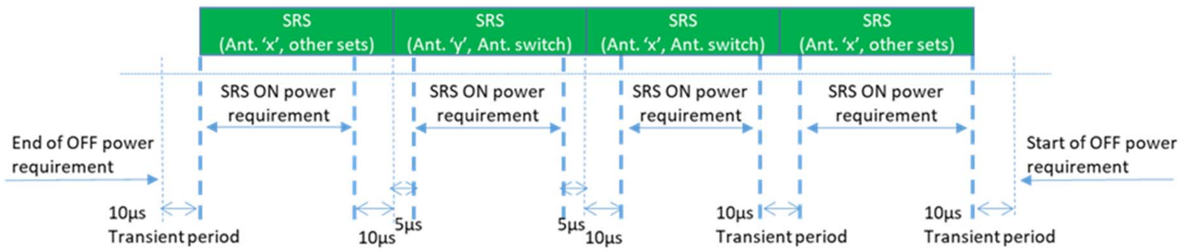

Figure 6.3.3.6-5: FR1 Time mask for 15 kHz and 30 kHz SCS for the case when consecutive SRS switching usage is between antenna switching & other sets

where "other sets" belongs to a "usage set" other than the set for antenna switching. The usage sets for SRS switching are defined in section 6.2 of TS 38.214 [12].

The above transient period applies to all the transmit CCs in CA with the CC sounding SRS. UE RF requirements do not apply during this transient period.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3.3.6.

6.3.3.6.4 Test description

6.3.3.6.4.1 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 6.3.3.6.4.1-1. 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 6.3.3.6.4.1-1: 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	Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1	Lowest , Highest	
SRS configuration	Paired Spectrum	Unpaired Spectrum
c-SRS (SRS bandwidth configuration)	61	7 (for BW 5 MHz) 13 (for BW 10 MHz) 19 (for BW 15 MHz) 25 (for BW 20 MHz) 30 (for BW 25 MHz) 40 (for BW 30 MHz) 51 (for BW 40MHz) 60 (for BW 50MHz) for SCS 15 KHz
		1 (for BW 5 MHz) 6 (for BW 10 MHz) 10 (for BW 15 MHz) 12 (for BW 20 MHz) 17 (for BW 25 MHz) 20 (for BW 30 MHz) 25 (for BW 40MHz) 30 (for BW 50MHz) 40 (for BW 60MHz) 51 (for BW 80MHz) 53 (for BW 90MHz) 61 (for BW 100MHz) for SCS 30 KHz
		1 (for BW 10 MHz) 4 (for BW 15 MHz) 7 (for BW 20, 25 MHz) 9 (for BW 30 MHz) 13 (for BW 40MHz) 17 (for BW 50MHz) 19 (for BW 60MHz) 25 (for BW 80MHz) 27 (for BW 90MHz) 30 (for BW 100MHz) for SCS 60 KHz
b-SRS	0	0
b-hop	3	0
freqDomainPosition	0	0
SRS-PeriodicityAndOffset	sl5 for SCS 15 KHz	sl5 for SCS 15 KHz
	sl10 for SCS 30 KHz	sl10 for SCS 30 KHz
	sl20 for SCS 60 KHz	sl20 for SCS 60 KHz
transmissionComb	0	0
cyclicShift	0	0
startPosition	0 for SCS 15 KHz	0 for SCS 15 KHz
	1 for SCS 30 KHz	1 for SCS 30 KHz
	2 for SCS 60 KHz	2 for SCS 60 KHz
nrofSymbols	n1 for SCS 15 KHz	n1 for SCS 15 KHz
	n2 for SCS 30 KHz	n2 for SCS 30 KHz
	n4 for SCS 60 KHz	n4 for SCS 60 KHz

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

5. 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 6.3.3.6.4.3.

6.3.3.6.4.2 Test procedure

1. The SS measure the UE transmission OFF power during the 13 OFDM symbols for 15kHz SCS, 12 OFDM symbols for 30kHz SCS and 10 OFDM symbols for 60kHz SCS, preceding the SRS symbol excluding a transient period of 10 μs.

2. Measure the output power of the transmitted SRS transmission during 1 OFDM symbols for 15kHz SCS, 2 OFDM symbols for 30kHz SCS and 4 OFDM symbols for 60kHz SCS.

3. Measure the UE transmission OFF power during the slot following the SRS under test, excluding a transient period of 10 μs

6.3.3.6.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6. 3 with the following exceptions:

Table 6.3.3.6.4.3-1: SRS-Config: SRS time mask measurement

Derivation Path: TS 38.508-1[5], Table 4.6.3-182			
Information Element	**Value/remark**	**Comment**	**Condition**
SRS-Config ::= SEQUENCE {			
srs-ResourceSetToReleaseList	Not present		
srs-ResourceSetToAddModList SEQUENCE (SIZE(0..maxNrofSRS-ResourceSets)) OF SEQUENCE {	[1 entry]		
srs-ResourceSetId	0		
srs-ResourceIdList SEQUENCE (SIZE(1..maxNrofSRS-ResourcesPerSet)) OF {	1 entry		
SRS-ResourceId[1]	0		
}			
resourceType CHOICE {			
aperiodic SEQUENCE {			
aperiodicSRS-ResourceTrigger	1		
csi-RS	Not present		
slotOffset	7		FR1
}			
}			
usage	codebook		
alpha	Alpha		
p0	0		
pathlossReferenceRS CHOICE {			
ssb-Index	SSB-Index		
}			
srs-PowerControlAdjustmentStates	Not present		
}			
srs-ResourceToReleaseList	Not present		
srs-ResourceToAddModList SEQUENCE (SIZE(1..maxNrofSRS-Resources)) OF SEQUENCE {	1 entry		
srs-ResourceId	0		
nrofSRS-Ports	ports2		2TX_UL_MIMO
	port1		
ptrs-PortIndex	Not present		
transmissionComb CHOICE {			
n4 SEQUENCE {			
combOffset-n4	0		
cyclicShift-n4	0		
}			
}			
resourceMapping SEQUENCE {			
startPosition	0		SCS 15k
	1		SCS 30k
	3		SCS 60k
nrofSymbols	n1		SCS 15k
	n2		SCS 30k
	n4		SCS 60k
repetitionFactor	n1		
}			
freqDomainPosition	0		
freqDomainShift	0		
freqHopping SEQUENCE {			
c-SRS	61		Paired Spectrum
	7 (for BW 5 MHz) 13 (for BW 10 MHz) 19 (for BW 15 MHz) 25 (for BW 20 MHz) 30 (for BW 25 MHz) 40 (for BW 30 MHz) 51 (for BW 40MHz) 60 (for BW 50MHz)		Unpaired Spectrum for SCS 15 KHz

	1 (for BW 5 MHz) 6 (for BW 10 MHz) 10 (for BW 15 MHz) 12 (for BW 20 MHz) 17 (for BW 25 MHz) 20 (for BW 30 MHz) 25 (for BW 40MHz) 30 (for BW 50MHz) 40 (for BW 60MHz) 51 (for BW 80MHz) 53 (for BW 90MHz) 61 (for BW 100MHz)		Unpaired Spectrum for SCS 30 KHz
	1 (for BW 10 MHz) 4 (for BW 15 MHz) 7 (for BW 20, 25 MHz) 9 (for BW 30 MHz) 13 (for BW 40MHz) 17 (for BW 50MHz) 19 (for BW 60MHz) 25 (for BW 80MHz) 27 (for BW 90MHz) 30 (for BW 100MHz)		Unpaired Spectrum for SCS 60 KHz
b-SRS	0		
b-hop	3		Paired Spectrum
	0		Unpaired Spectrum
}			
groupOrSequenceHopping	groupHopping		
resourceType CHOICE {			
periodic SEQUENCE {			
periodicityAndOffset-p CHOICE{			
sl5	4		SCS 15 KHz
sl10	8		SCS 30KHz
sl20	16		SCS 60 KHz
}			
}			
}			
sequenceId	0		
spatialRelationInfo SEQUENCE {	SRS-SpatialRelationInfo		
servingCellId	Not present		
referenceSignal CHOICE {			
ssb-Index	SSB-Index		
}			
}			
}			
tpc-Accumulation	Not present		
}			

6.3.3.6.5 Test requirement

The requirement for the power measured in steps (1), (2) and (3) of the test procedure shall not exceed the values specified in Table 6.3.3.6.5-1.

Table 6.3.3.6.5-1: SRS time mask

	SCS [kHz]	Channel bandwidth / minimum output power / measurement bandw								
		5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 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
Expected SRS Transmission ON Measured power	15	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	N/A
	30	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1
	60	N/A	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5
ON Power Tolerance		± (9+TT)dB								
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3.3.6.5-2										

Table 6.3.3.6.5-2: 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

6.3.3.7 PUSCH-PUCCH and PUSCH-SRS time masks

No test case details are specified. Current test procedures for time masks are based on power measurement in relatively long period compared with transient period. For time masks between 2 active time slots with different power level, the test procedure can’t provide enough resolution to identify non-conformant UEs. Therefore the minimum requirement is not testable.

6.3.3.8 Transmit power time mask for consecutive slot or long subslot transmission and short subslot transmission boundaries

No test case details are specified. Current test procedures for time masks are based on power measurement in relatively long period compared with transient period. For time masks between 2 active time slots with different power level, the test procedure can’t provide enough resolution to identify non-conformant UEs. Therefore the minimum requirement is not testable.

6.3.3.9 Transmit power time mask for consecutive short subslot transmissions boundaries

No test case details are specified. Current test procedures for time masks are based on power measurement in relatively long period compared with transient period. For time masks between 2 active time slots with different power level, the test procedure can’t provide enough resolution to identify non-conformant UEs. Therefore the minimum requirement is not testable.

6.3.4 Power control

6.3.4.1 General

The requirements on power control accuracy apply under normal conditions.

6.3.4.2 Absolute power tolerance

Editor’s Note:

- SA Generic procedures with condition NR in TS 38.508-1 [5] is FFS.

- SA message contents in TS 38.508-1 [5] subclause 4.6 is FFS

- Message Contents are tentative pending review of values for p0-NominalWithGrant
- Test requirement is TBD
- Test Tolerance is TBD for SCS60, needs to be higher due to shorter measurement period forced by UL-DL Config.

6.3.4.2.1 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 .

6.3.4.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.3.4.2.3 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(1ms) at the start of a contiguous transmission or non-contiguous transmission with a transmission gap larger than 20ms. The tolerance includes the channel estimation error.

The minimum requirement specified in Table 6.3.4.2.3-1 apply in the power range bounded by the minimum output power as specified in sub-clause 6.3.1 and the maximum output power as specified in sub-clause 6.2.1.

Table 6.3.4.2.3-1: Absolute power tolerance

Conditions	Tolerance
Normal	± 9.0 dB

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3.4.2

6.3.4.2.4 Test description

6.3.4.2.4.1 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 6.3.4.2.4.1-1. 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 6.3.4.2.4.1-1: 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 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.3.1.1.1 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 6.3.4.2.4.1-1 and Table 6.3.4.2.4.1-2

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 6.3.4.2.4.3. Note that PDCCH DCI format 0_1 sent after resetting uplink power with RRC Connection Reconfiguration, should have TPC command 0dB.

6.3.4.2.4.2 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 6.3.4.2.4.1-1 and Table 6.3.4.2.4.1-2. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. 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 6.3.4.2.4.3. The timing of the execution between the two test points shall be larger than 20ms.

6.3.4.2.4.3 Message contents

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

Table 6.3.4.2.4.3-1: 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	[-105]	Test point 1 to verify a UE relative low initial power transmission	
}			

Table 6.3.4.2.4.3-2: 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	[-93]	Test point 2 to verify a UE relative high initial power transmission	
}			

Table 6.3.4.2.4.3-3: *PUSCH-Config*

Derivation Path: TS 38.508-1 [5], Table 4.6.3-118 with condition CP-OFDM

6.3.4.2.5 Test requirement

The requirement for the power measured in step (2) of the test procedure is not to exceed the values specified in Table 6.3.4.2.5-1 and 6.3.4.2.5-2.

Table 6.3.4.2.5-1: 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	80 MHz	90 MHz	100 MHz
Expected Measured power	SCS15	-6	-2.8	-1.0	0.3	1.2	2.0	3.3	4.3				
	SCS30	-6.6	-3.2	-1.2	0.1	1.1	1.9	3.3	4.2	5.1	6.4	6.9	7.4
	SCS60		-3.6	-1.4	-0.2	0.9	1.8	3.1	4.1	5.0	6.3	6.8	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 6.3.4.2.5-3.													

Table 6.3.4.2.5-2: 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	80 MHz	90 MHz	100 MHz
Expected Measured power	SCS15	6	9.2	11.0	12.3	13.2	14.0	15.3	16.3				
	SCS30	5.4	8.8	10.8	12.1	13.1	13.9	15.3	16.2	17.1	18.4	18.9	19.4
	SCS60		8.4	10.6	11.8	12.9	13.8	15.1	16.1	17.0	18.3	18.8	19.3
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 6.3.4.2.5-3: Test Tolerance

		f ≤ 3.0GHz	3.0GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6.0GHz
FDD, TDD SCS 15kHz & TDD SCS 30khz	BW ≤ 40MHz	1.0 dB	1.4 dB	1.4 dB
	40MHz < BW ≤ 100MHz	1.4 dB	1.4 dB	1.4 dB
TDD SCS 60kHz		[TBD]	[TBD]	[TBD]

6.3.4.3 Power Control Relative power tolerance

6.3.4.3.1 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 larger than 20ms.

6.3.4.3.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

6.3.4.3.3 Minimum conformance requirement

The UE shall meet the requirements specified in Table 6.3.4.3.3-1.

The minimum requirements specified in Table 6.3.4.3.3-1 apply when the power of the target and reference sub-frames are within the power range bounded by the minimum output power as defined in sub-clause 6.3.1 and the measured PUMAXas defined in sub-clause 6.2.4.

Table 6.3.4.3.3-1: Relative Power Tolerance

Power step ΔP (Up or down) (dB)	All combinations of PUSCH and PUCCH transitions (dB)	All combinations of PUSCH/PUCCH and SRS transitions between sub-frames (dB)	PRACH (dB)
ΔP < 2	± 2.0 (NOTE)	± 2.5	± 2.0
2 ≤ ΔP < 3	± 2.5	± 3.5	± 2.5
3 ≤ ΔP < 4	± 3.0	± 4.5	± 3.0
4 ≤ ΔP ≤ 10	± 3.5	± 5.5	± 3.5
10 ≤ ΔP < 15	± 4.0	± 7.0	± 4.0
15 ≤ ΔP	± 5.0	± 8.0	± 5.0
NOTE: For PUSCH to PUSCH transitions with the allocated resource blocks fixed in frequency and no transmission gaps other than those generated by downlink subframes, DwPTS fields or Guard Periods: for a power step ΔP ≤ 1 dB, the relative power tolerance for transmission is ± 0.7 dB.			

The normative reference for this requirement is TS 38.101-1 [2] clause 6.3.4.3.

6.3.4.3.4 Test description

6.3.4.3.4.1 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 6.3.4.3.4.1-1 and table 6.3.4.3.4.1-2. 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 6.3.4.3.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 38.508-1 [5] subclause 4.3.1			Normal, TL/VL, TL/VH, TH/VL, TH/VH	
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		DFT-s-OFDM QPSK	See Table 6.3.4.3.5-1 See Table 6.3.4.3.5-2 See Table 6.3.4.3.5-7
10MHz			DFT-s-OFDM QPSK	See Table 6.3.4.3.5-3 See Table 6.3.4.3.5-4 See Table 6.3.4.3.5-7
15MHz			DFT-s-OFDM QPSK	See Table 6.3.4.3.5-3 See Table 6.3.4.3.5-4 See Table 6.3.4.3.5-7
20MHz			DFT-s-OFDM QPSK	See Table 6.3.4.3.5-3 See Table 6.3.4.3.5-4 See Table 6.3.4.3.5-7
25MHz			DFT-s-OFDM QPSK	See Table 6.3.4.3.5-3 See Table 6.3.4.3.5-4 See Table 6.3.4.3.5-7
30MHz			DFT-s-OFDM QPSK	See Table 6.3.4.3.5-3 See Table 6.3.4.3.5-4 See Table 6.3.4.3.5-7
40MHz			DFT-s-OFDM QPSK	See Table 6.3.4.3.5-3 See Table 6.3.4.3.5-4 See Table 6.3.4.3.5-7
50MHz			DFT-s-OFDM QPSK	See Table 6.3.4.3.5-3 See Table 6.3.4.3.5-4 See Table 6.3.4.3.5-7
60MHz			DFT-s-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			DFT-s-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
90MHz			DFT-s-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
100MHz			DFT-s-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
Note 1: The starting resource block shall be RB# 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 6.3.4.3.4.1-1 and Table 6.3.4.3.4.1-2.

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 6.3.4.3.4.3.

6.3.4.3.4.2 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 6.3.4.3.4.2-1 thru figure 6.3.4.3.4.2-5.

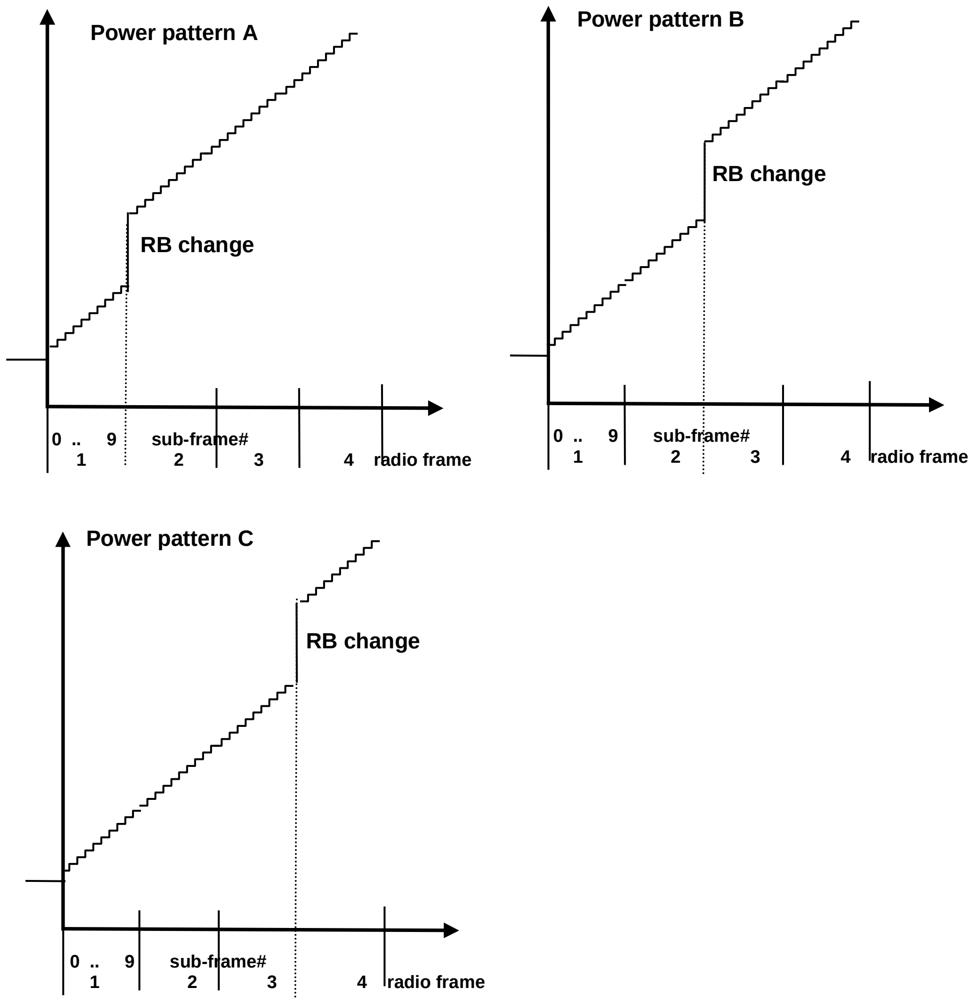

Figure 6.3.4.3.4.2-1: FDD ramping up test power patterns

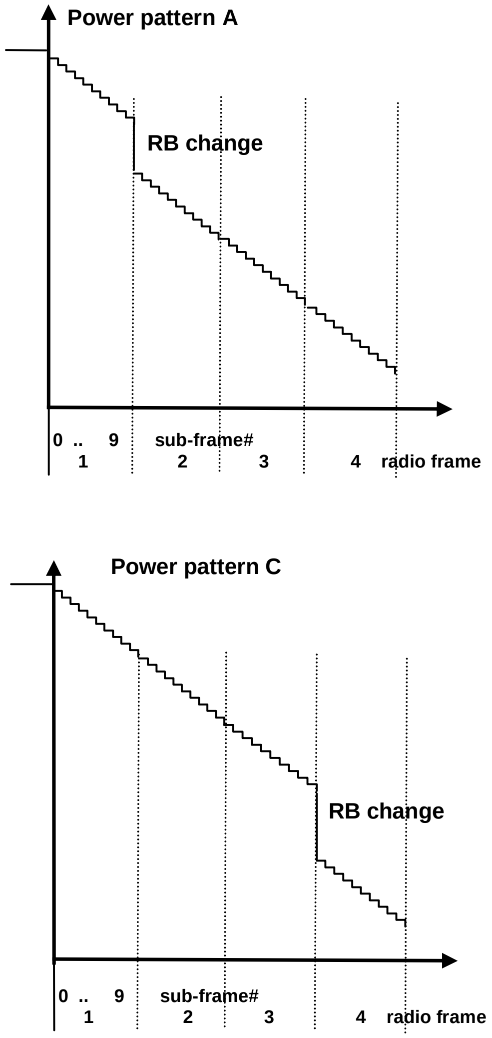

Figure 6.3.4.3.4.2-2: FDD ramping down test power patterns

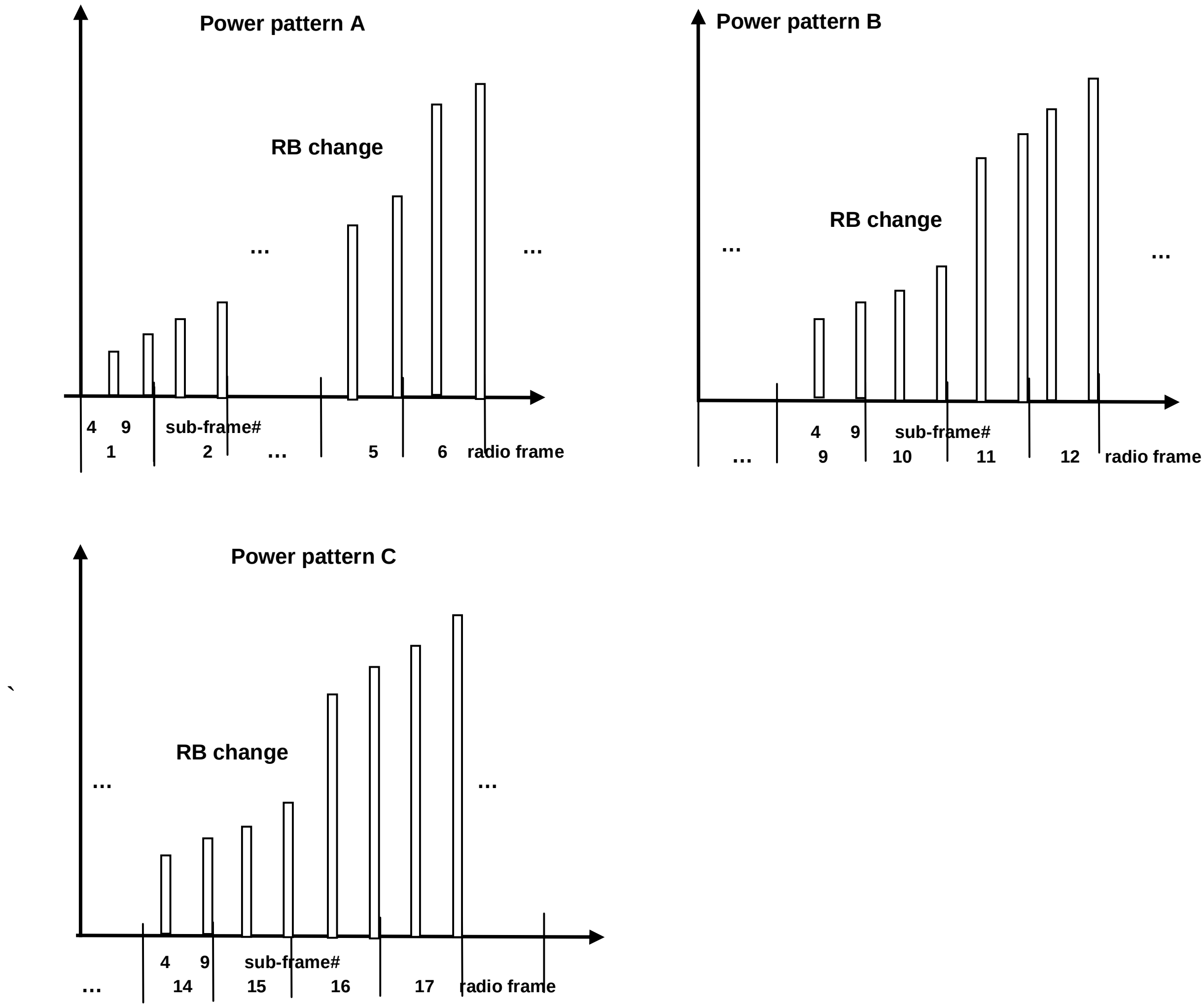

Figure 6.3.4.3.4.2-3: TDD ramping up test power patterns

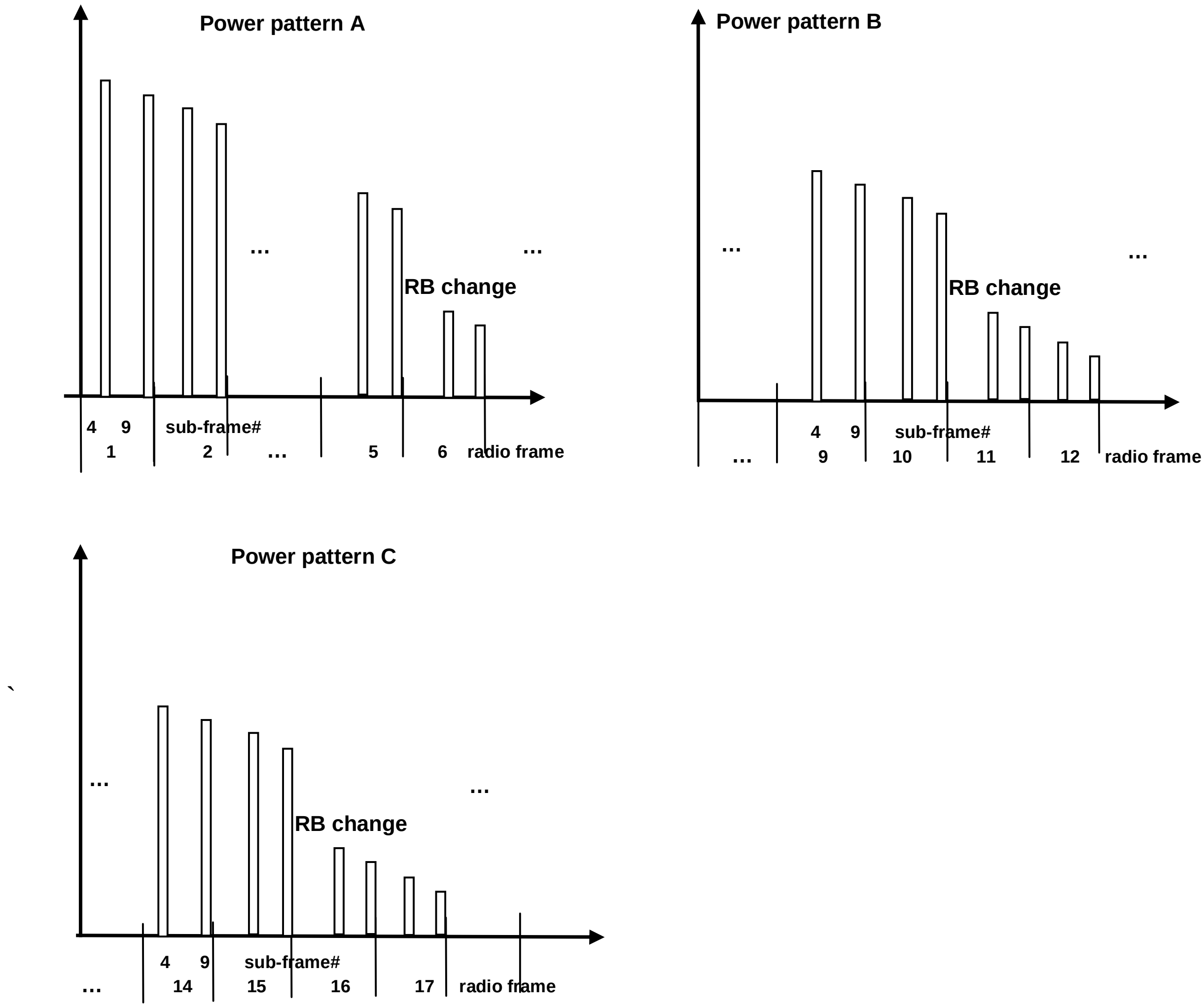

Figure 6.3.4.3.4.2-4: TDD ramping down test power patterns

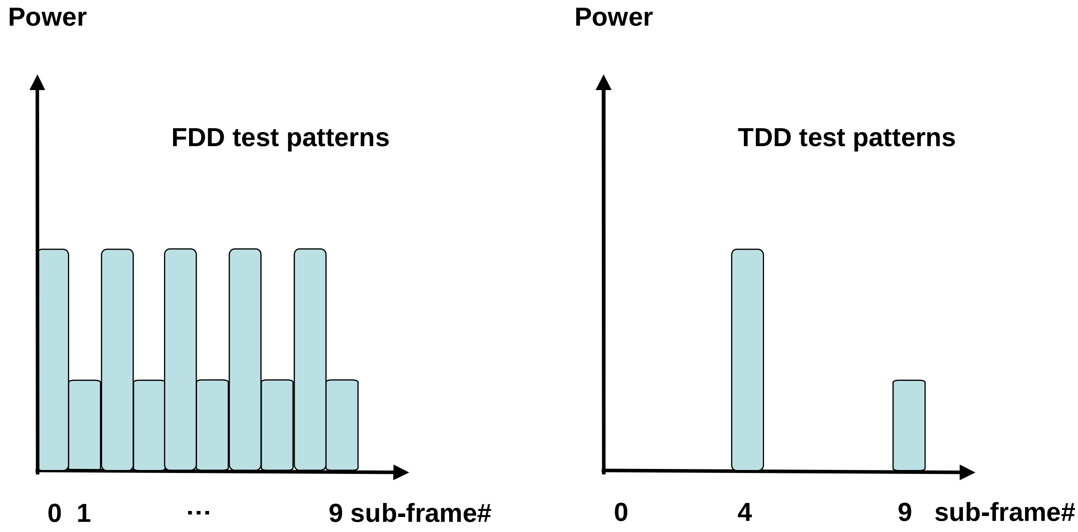

Figure 6.3.4.3.4.2-5: Alternating Test Power patterns

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 6.3.4.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send the appropriate TPC commands for PUSCH to the UE to ensure that the UE transmits PUSCH at -30.3 dBm +/- 2.7 dB

   1.2 Schedule the UE's PUSCH data transmission as described in Figure 6.3.4.3.4.2-1 (FDD pattern A: sub-test is divided in 4 arbitrary radio frames with 10 active uplink sub-frames per radio frame) and Figure 6.3.4.3.4.2-3 (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 6.3.4.3.5-1/6.3.4.3.5-3/ 6.3.4.3.5-5 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 6.3.4.3.5. 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 6.3.4.3.5-1/6.3.4.3.5-3/ 6.3.4.3.5-5 to force bigger UE power steps at various points in the power range.

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 6.3.4.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send the appropriate TPC commands for PUSCH to the UE to ensure that the UE transmits PUSCH at 18 dBm +/- 2.7 dB.

   2.2. Schedule the UE's PUSCH data transmission as described in Figure 6.3.4.3.4.2-2 (FDD pattern A: sub-test is divided in 4 arbitrary radio frames with 10 active uplink slots per radio frame) and Figure 6.3.4.3.4.2-4

(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 6.3.4.3.5-2/6.3.4.3.5-4/ 6.3.4.3.5-6 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 6.3.4.3.5-2/6.3.4.3.5-4/ 6.3.4.3.5-6 to force bigger UE power steps at various points in the power range.

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 6.3.4.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send the appropriate TPC commands for PUSCH to the UE to ensure that the UE transmits PUSCH at -10 dBm +/- 2.7 dB. The initial uplink RB allocation is defined as the smaller uplink RB allocation value specified in table 6.3.4.3.4.1-1. The power level and RB allocation are reset for each sub-test.

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 6.3.4.3.5-7 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 6.3.4.3.5. For power transients between sub-frames, transient periods of 20us between sub-frames are excluded.

6.3.4.3.4.3 Message contents

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

6.3.4.3.5 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 6.3.4.3.5-1 thru 6.3.4.3.5-7.

Table 6.3.4.3.5-1: 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) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
15	1	Sub-frames before RB change	Fixed = 1	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 5 RBs	TPC=+1dB	7.99	4dB ≤ ΔP < 10dB	7.99 +/- 3.5 + TT
		Sub-framesafter RB change	Fixed = 5	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Sub-framesbefore RB change	Fixed = 1	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 15 RBs	TPC=+1dB	12.76	10dB ≤ ΔP < 15dB	12.76 +/- 4 + TT
		Sub-framesafter RB change	Fixed = 15	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
30	1	Sub-framesbefore RB change	Fixed = 1	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 2 RBs	TPC=+1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- 3.5 + TT
		Sub-framesafter RB change	Fixed = 2	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Sub-framesbefore RB change	Fixed = 1	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 7 RBs	TPC=+1dB	12.46	10dB ≤ ΔP < 15dB	12.46 +/- 4 + TT
		Sub-framesafter RB change	Fixed = 7	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# 1. Note 3: TT=0.7dB					

Table 6.3.4.3.5-2: 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 (Up) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
15	1	Sub-framesbefore RB change	Fixed = 5	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	5 RBs to 1 RB	TPC=-1dB	7.99	4dB ≤ ΔP < 10dB	7.99 +/- 3.5 + TT
		Sub-framesafter RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Sub-framesbefore RB change	Fixed = 15	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	15 RBs to 1 RB	TPC=-1dB	12.76	10dB ≤ ΔP < 15dB	12.76 +/- 3.5 + TT
		Sub-framesafter RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
30	1	Sub-framesbefore RB change	Fixed = 2	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	2 RBs to 1 RB	TPC=-1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- 3.5 + TT
		Sub-framesafter RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Sub-framesbefore RB change	Fixed = 7	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	7 RBs to 1 RB	TPC=-1dB	12.46	10dB ≤ ΔP < 15dB	12.46 +/- 4 + 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# 1.
Note 3: TT=0.7dB

Table 6.3.4.3.5-3: 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) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
15	1	Subframes before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		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
	2	Subframes before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		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
	3	Subframes before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		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
30	1	Subframes before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 2 RBs	TPC=+1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- 3.5 + TT
		Subframes after RB change	Fixed = 2	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Subframes before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 10 RBs	TPC=+1dB	14.01	10dB ≤ ΔP < 15dB	14.01 +/- 4 + TT
		Subframes after RB change	Fixed = 10	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	3	Subframes before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 22 RBs	TPC=+1dB	17.43	15dB < ΔP	17.43 +/- 5 + TT
		Subframes after RB change	Fixed = 22	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
60	1	Subframes before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 5 RBs	TPC=+1dB	14.01	10dB ≤ ΔP < 15dB	14.01 +/- 4 + TT
		Subframes after RB change	Fixed = 5	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Subframes before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 9 RBs	TPC=+1dB	16.56	15dB < ΔP	16.56 +/- 5 + TT
		Subframes after RB change	Fixed = 9	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# 1.
Note 3:	TT=0.7dB

Table 6.3.4.3.5-4: 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 (Up) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
15	1	Subframes before RB change	Fixed = 5	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		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
	2	Subframes before RB change	Fixed = 20	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		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
	3	Subframes before RB change	Fixed = 50	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		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	1	Subframes before RB change	Fixed = 2	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	2 RBs to 1 RB	TPC=-1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- 3.5 + TT
		Subframes after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Subframes before RB change	Fixed = 10	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	10 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
	3	Subframes before RB change	Fixed = 22	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	22 RBs to 1 RB	TPC=-1dB	17.43	15dB < ΔP	17.43 +/- 5 + TT
		Subframes after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
60	1	Subframes before RB change	Fixed = 5	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	5 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
	2	Subframes before RB change	Fixed = 9	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	9 RBs to 1 RB	TPC=-1dB	16.56	15dB < ΔP	16.56 +/- 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# 1.
Note 3:	TT=0.7dB

Table 6.3.4.3.5-5: Test Requirements Relative Power Tolerance for Transmission, channel BW 60MHz, 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) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
30	1	Subframes before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 2 RBs	TPC=+1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- 3.5 + TT
		Subframes after RB change	Fixed = 2	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Subframes before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 6 RBs	TPC=+1dB	11.79	10dB ≤ ΔP < 15dB	11.79 +/- 4 + TT
		Subframes after RB change	Fixed = 6	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	3	Subframes before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 81 RBs	TPC=+1dB	23.10	15dB < ΔP	23.10 +/- 5 + TT
		Subframes after RB change	Fixed = 81	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
60	1	Subframes before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 5 RBs	TPC=+1dB	14.01	10dB ≤ ΔP < 15dB	14.01 +/- 4 + TT
		Subframes after RB change	Fixed = 5	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Subframes before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 75 RBs	TPC=+1dB	25.77	15dB < ΔP	25.77 +/- 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# 1. Note 3: TT=0.7dB							

Table 6.3.4.3.5-6: Test Requirements Relative Power Tolerance for Transmission, channel BW 60MHz, 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 (Up) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
30	1	Subframes before RB change	Fixed = 2	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	2 RBs to 1 RB	TPC=-1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- 3.5 + TT
		Subframes after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Subframes before RB change	Fixed = 6	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	6 RBs to 1 RB	TPC=-1dB	11.79	10dB ≤ ΔP < 15dB	11.79 +/- 4 + TT
		Subframes after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	3	Subframes before RB change	Fixed = 81	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	81 RBs to 1 RB	TPC=-1dB	23.10	15dB < ΔP	23.10 +/- 5 + TT
		Subframes after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
60	1	Subframes before RB change	Fixed = 5	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	5 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
	2	Subframes before RB change	Fixed = 75	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	75 RBs to 1 RB	TPC=-1dB	25.77	15dB < ΔP	25.77 +/- 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# 1.
Note 3: TT=0.7dB

Table 6.3.4.3.5-7: 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) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
5	15	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
		3	Alternating 1 and 15	TPC=0dB	11.76	10dB ≤ ΔP < 15dB	11.76 +/- 4 + TT
	30	1	Alternatting 1 and 2	TPC=0dB	6.02	4dB ≤ ΔP < 10dB	6.02 +/- 3.5 + TT
		2	Alternating 1 and 7	TPC=0dB	11.46	10dB ≤ ΔP < 15dB	11.46 +/- 4 + TT
10,15,20, 25,30,40,50	15	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
		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
	30	1	Alternating 1 and 2	TPC=0dB	6.02	4dB ≤ ΔP < 10dB	6.02 +/- 3.5 + TT
		2	Alternating 1 and 10	TPC=0dB	13.01	10dB ≤ ΔP < 15dB	13.01 +/- 4 + TT
		3	Alternating 1 and 22	TPC=0dB	16.43	15dB < ΔP	16.43 +/- 5 + TT
	60	1	Alternating 1 and 5	TPC=0dB	13.01	10dB ≤ ΔP < 15dB	13.01 +/- 4 + TT
		2	Alternating 1 and 9	TPC=0dB	15.56	15dB < ΔP	15.56 +/- 5 + TT
60,80,90,100	30	1	Alternating 1 and 2	TPC=0dB	6.02	4dB ≤ ΔP < 10dB	6.02 +/- 3.5 + TT
		2	Alternating 1 and 6	TPC=0dB	10.79	10dB ≤ ΔP < 15dB	10.79 +/- 4 + TT
		3	Alternating 1 and 81	TPC=0dB	22.10	15dB < ΔP	22.10 +/- 5 + TT
	60	1	Alternating 1 and 2	TPC=0dB	9.03	4dB ≤ ΔP < 10dB	9.03 +/- 3.5 + TT
		2	Alternating 1 and 5	TPC=0dB	13.01	10dB ≤ ΔP < 15dB	13.01 +/- 4 + TT
		3	Alternating 1 and 75	TPC=0dB	24.77	15dB < ΔP	24.77 +/- 5 + TT
Note 1: The starting resource block shall be RB# 1. Note 2: TT=0.7dB							

6.3.4.4 Aggregate power tolerance

Editor's Note:

- SA Generic procedures with condition NR in TS 38.508-1 [5] is FFS.

- SA message contents in TS 38.508-1 [5] subclause 4.6 is FFS

- Test Tolerance is TBD

6.3.4.4.1 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.

6.3.4.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.3.4.4.3 Minimum conformance requirements

The aggregate power control tolerance is the ability of the UE transmitter to maintain its power in a sub-frame(1ms) 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.

The minimum requirement specified in Table 6.3.4.4.3-1 apply in the power range bounded by the minimum output power as specified in sub-clause 6.3.1 and the maximum output power as specified in sub-clause 6.2.2.

Table 6.3.4.4.3-1: Aggregate power tolerance

TPC command	UL channel	Aggregate power tolerance within 21ms
0 dB	PUCCH	± 2.5 dB
0 dB	PUSCH	± 3.5 dB

The normative reference for this requirement is TS 38.01-1 [2] clause 6.3.4.4

6.3.4.4.4 Test description

6.3.4.4.4.1 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 6.3.4.4.4.1-1 and table 6.3.4.4.4.1-2. 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 6.3.4.4.4.1-1: Test Configuration Table: PUCCH sub-test

<table>
<tr><th colspan="3">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 38.508-1 [5] subclause 4.1</td><td>Normal</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1</td><td>Mid range</td></tr>
<tr><td colspan="2">Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1</td><td>Lowest, Mid, Highest</td></tr>
<tr><td colspan="2">Test SCS as specified in Table 5.3.5-1</td><td>Lowest, Highest</td></tr>
<tr><th colspan="3">Test Parameters for Channel Bandwidths</th></tr>
<tr><th>Test ID</th><th>Downlink Configuration</th><th>Uplink Configuration</th></tr>
<tr><td></td><td rowspan="2">N/A for aggregate power tolerance testcase</td><td rowspan="2">PUCCH format = Format 1
Length in OFDM symbols = 14</td></tr>
<tr><td>1</td></tr>
</table>

Table 6.3.4.4.4.1-2: 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.3.1.1.1 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 G.0, G.1, G.2, G.3.0.
4. The UL and DL Reference Measurement channels are set according to Table 6.3.4.4.4.1-1 (PUCCH sub-test) and Table 6.3.4.4.4.1-2 (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 6.3.4.4.4.3.

6.3.4.4.4.2 Test procedure

The procedure is separated in two subtests to verify PUCCH and PUSCH aggregate power control tolerance respectively. The uplink transmission patterns are described in figure 6.3.4.4.4.2-1.

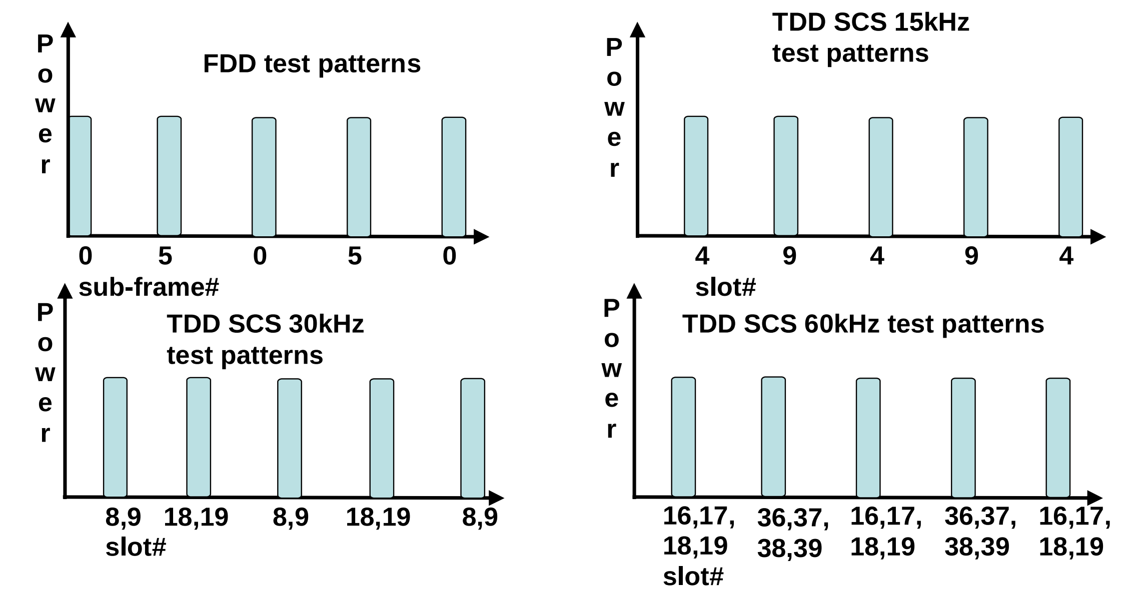

Figure 6.3.4.4.4.2-1 Test uplink transmission

1. PUCCH sub test:

1.1 The SS transmits PDSCH via PDCCH DCI format 0_1 for C_RNTI to transmit the DL RMC according to Table 6.3.4.4.4.1-1. 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. Send the appropriate TPC commands for PUCCH to the UE to ensure that the UE transmits PUCCH at 0dBm +/- 3.5 dB+TT for carrier frequency f ≤ 3.0GHz or at 0dBm +/- 3.5 dB+TT for carrier frequency 3.0GHz < f.

1.2. Every 5 sub-frames (5ms) transmit to the UE downlink PDSCH MAC padding bits as well as 0 dB TPC command for PUCCH via the PDCCH to make the UE transmit ACK/NACK on the PUCCH for 1 sub-frame(1ms). The downlink transmission is scheduled in the appropriate slots to make the UE transmit PUCCH as described in figure 6.3.4.4.4.2-1

1.3. Measure the power of 5 consecutive PUCCH transmissions to verify the UE transmitted PUCCH power is maintained within 21ms.

2. PUSCH sub test:

2.1. The SS sends uplink scheduling information via PDCCH DCI format 0_1 for C_RNTI to schedule the PUSCH. 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 0dBm +/- 2.5 dB+TT for carrier frequency f ≤ 3.0GHz or at 0dBm +/- 2.5 dB+TT for carrier frequency 3.0GHz < f.

2.2. 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 6.3.4.4.4.2-1,

2.3. Measure the power of 5 consecutive PUSCH transmissions to verify the UE transmitted PUSCH power is maintained within 21ms transmissions.

6.3.4.4.4.3 Message contents

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

6.3.4.4.5 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 6.3.4.4.5-1. The power measurement period shall be 1 sub-frame(1ms).

Table 6.3.4.4.5-1: 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 ± 2.5dB of the 1st measurement.
0 dB	PUSCH	Given TBD power measurements in the pattern, the 2nd, and later measurements shall be within ± 3.5dB 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 for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3.4.4.5-2.		

Table 6.3.4.4.5-2: Test Tolerance

[TBD]

6.3A Output power dynamics for CA

6.3A.1 Minimum output power for CA

6.3A.1.0 Minimum conformance requirements

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 subclause 6.3.1.

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)

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Connection diagram is FFS in TS 38.508-1.

- Procedure to configure SCC in TS 38.508-1[5] clause [TBD] is FFS.

- MU and TT is FFS in Annex F.

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. 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 N_{RB_agg}, Highest N_{RB_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 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 [FFS] for TE diagram and section A.3.2.1 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.

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] clause [TBD]. 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 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
40	-37+TT	38.895
50	-36+TT	48.615
60	-35.2+TT	58.35
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	FFS	FFS
40MHz < BW ≤ 100MHz	FFS	FFS

6.3A.2 Transmit OFF power for CA

6.3A.2.0 Minimum conformance requirements

For inter-band carrier aggregation with uplink assigned to two NR bands, the transmit OFF power specified in subclause 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.

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.3 Transmit ON/OFF time mask for CA

6.3A.3.0 Minimum conformance requirements

For inter-band carrier aggregation with uplink assigned to two NR bands, the general output power ON/OFF time mask specified in subclause 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 subclause 6.3.3.2 shall only be applicable for each component carrier when all the component carriers are OFF.

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)

Editor's Note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Connection diagram is FFS in TS 38.508-1.

- Procedure to configure SCC in TS 38.508-1[5] clause [TBD] is FFS.

- MU/TT is FFS in Annex F

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. 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

<table>
<tr><th colspan="5">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 38.508-1 [5] subclause 4.1</td><td colspan="3">Normal, TL/VL, TL/VH, TH/VL, TH/VH</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1</td><td colspan="3">Low range for PCC and SCC
High range for PCC and SCC</td></tr>
<tr><td colspan="2">Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="3">Lowest N_{RB_agg}, Highest N_{RB_agg}</td></tr>
<tr><td colspan="2">Test SCS as specified in Table 5.5A.3-1</td><td colspan="3">Lowest, Highest</td></tr>
<tr><th colspan="5">Test Parameters</th></tr>
<tr><th rowspan="3">Test ID</th><th rowspan="3">Downlink Configuration for PCC & SCC</th><th colspan="3">Uplink Configuration</th></tr>
<tr><th rowspan="2">Modulation for all CCs</th><th colspan="2">RB allocation (NOTE 1)</th></tr>
<tr><th>PCC</th><th>SCC</th></tr>
<tr><td>1</td><td>N/A for this test</td><td>CP-OFDM QPSK</td><td>Outer Full</td><td>Outer Full</td></tr>
<tr><td colspan="5">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 and SCS are specified in Table 5.5A.3-1.</td></tr>
</table>

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure [FFS] for TE diagram and section A.3.2.1 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.
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 [TBD]. 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 with TPC command 0dB for C_RNTI to schedule the UL RMC according to Table 6.3A.3.1.4.1-1 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. The UL assignment for each component carrier is such that the UE transmits on slots 4 and 9 for 15kHz SCS, on slots 9 and 19 for 30kHz SCS and on slots 4, 9, 14, 19, 24, 29, 34 and 39 for 60kHz SCS.
5. 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.
6. Measure the output power of the UE PUSCH transmission for each component carrier during one slot.
7. 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.3.3.4.3-1: 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	-106		
}			

6.3A.3.1.5 Test requirement

The requirement for the power of each component carrier 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

	SCS [kHz]	Channel bandwidth / minimum output power / measurement bandwidtl									
		5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 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	
Expected Transmission ON Measured power for CP-OFDM	15	-9.62±9.0 ±TT	-6.44±9.0 ±TT	-4.62±9.0 ±TT	-3.35±9.0 ±TT	-2.36±9.0 ±TT	-1.56±9.0 ±TT	-0.26±9.0 ±TT	0.71±9.0 ±TT	N/A	
	30	-10.18±9.0 ±TT	-6.79±9.0 ±TT	-4.79±9.0 ±TT	-3.51±9.0 ±TT	-2.46±9.0 ±TT	-1.67±9.0 ±TT	-0.34±9.0 ±TT	0.65±9.0 ±TT	1.51±9.0 ±TT	2
	60	N/A	-7.17±9.0 ±TT	-5.03±9.0 ±TT	-3.78±9.0 ±TT	-2.67±9.0 ±TT	-1.78±9.0 ±TT	-0.50±9.0 ±TT	0.55±9.0 ±TT	1.40±9.0 ±TT	2
Expected Transmission ON Measured power for DFT-s-OFDM	15	-9.62±9.0 ±TT	-6.61±9.0 ±TT	-4.85±9.0 ±TT	-3.60±9.0 ±TT	-2.53±9.0 ±TT	-1.56±9.0 ±TT	-0.26±9.0 ±TT	0.71±9.0 ±TT	N/A	
	30	-10.59±9.0 ±TT	-6.79±9.0 ±TT	-5.03±9.0 ±TT	-3.60±9.0 ±TT	-2.53±9.0 ±TT	-1.84±9.0 ±TT	-0.59±9.0 ±TT	0.48±9.0 ±TT	1.51±9.0 ±TT	2
	60	N/A	-7.58±9.0 ±TT	-5.03±9.0 ±TT	-3.78±9.0 ±TT	-2.81±9.0 ±TT	-2.02±9.0 ±TT	-0.59±9.0 ±TT	0.48±9.0 ±TT	1.17±9.0 ±TT	2
NOTE 1: TT of each transmit antenna for each frequency and channel bandwidth is specified in Table 6.3A.3.1.5-2 and Table 6.3.											

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

	f ≤ 3.0GHz	3.0GHz < f ≤ 6GHz
BW ≤ 40MHz	FFS	FFS
40MHz < BW ≤ 100MHz	FFS	FFS

Table 6.3A.3.1.5-3: Test Tolerance for ON power

	f ≤ 3.0GHz	3.0GHz < f ≤ 6GHz
BW ≤ 40MHz	FFS	FFS
40MHz < BW ≤ 100MHz	FFS	FFS

6.3D Output power dynamics for UL-MIMO

6.3D.1 Minimum output power for UL-MIMO

Editor's Note:

- MU/TT is still FFS

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 UE release 15 and forward that support 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
40	-37	38.895
50	-36	48.615
60	-35.2	58.35
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		Lowest, Highest	
Test Parameters for Channel Bandwidths			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
	N/A for minimum output power test case	**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.			

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
40	-37+TT	38.895
50	-36+TT	48.615
60	-35.2+TT	58.35
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	FFS	FFS
40MHz < BW ≤ 100MHz	FFS	FFS

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.

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 UE release 15 and forward that support 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)	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
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 6.3D.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
40	-50+TT	38.895
50	-50+TT	48.615
60	-50+TT	58.35
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.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 UE release 15 and forward that support 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 test case	**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.			

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 with TPC command 0dB 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 4 and 9 for15kHz SCS, on slots 9 and 19 for 30kHz SCS and on slots 4, 9, 14, 19, 24, 29, 34 and 39 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. Measure the UE transmission OFF power during the slot prior to the PUSCH transmission, excluding a transient period of 10 µs in the end of the slot.

3. Measure the output power of the UE PUSCH transmission during one slot.

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

5. Repeat step 2) until 4) for each of transmit antenna of the UE

6.3D.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-135 with condition 2TX_UL_MIMO and following exceptions.

Table 6.3D.3.4.3-1: PUSCH-ConfigCommon

Derivation Path: TS 38.508-1[5], Table 4.6.3-119			
Information Element	**Value/remark**	**Comment**	**Condition**
PUSCH-ConfigCommon ::= SEQUENCE {			
p0-NominalWithGrant	-106		
}			

6.3D.3.5 Test requirement

The requirement for the power of each transmit antenna 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

	SCS [kHz]	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	
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	
Expected Transmission ON Measured power for CP-OFDM	15	-9.62±9.0 ±TT	- 6.44±9.0 ±TT	- 4.62±9.0 ±TT	- 3.35±9.0 ±TT	- 2.36±9.0 ±TT	- 1.56±9.0 ±TT	- 0.26±9.0 ±TT	0.71±9.0 ±TT	N/A	
	30	- 10.18±9.0 ±TT	- 6.79±9.0 ±TT	- 4.79±9.0 ±TT	- 3.51±9.0 ±TT	- 2.46±9.0 ±TT	- 1.67±9.0 ±TT	- 0.34±9.0 ±TT	0.65±9.0 ±TT	1.51±9.0 ±TT	2
	60	N/A	- 7.17±9.0 ±TT	- 5.03±9.0 ±TT	- 3.78±9.0 ±TT	- 2.67±9.0 ±TT	- 1.78±9.0 ±TT	- 0.50±9.0 ±TT	0.55±9.0 ±TT	1.40±9.0 ±TT	2
Expected Transmission ON Measured power for DFT-s-OFDM	15	-9.62±9.0 ±TT	- 6.61±9.0 ±TT	- 4.85±9.0 ±TT	- 3.60±9.0 ±TT	- 2.53±9.0 ±TT	- 1.56±9.0 ±TT	- 0.26±9.0 ±TT	0.71±9.0 ±TT	N/A	
	30	- 10.59±9.0 ±TT	- 6.79±9.0 ±TT	- 5.03±9.0 ±TT	- 3.60±9.0 ±TT	- 2.53±9.0 ±TT	- 1.84±9.0 ±TT	- 0.59±9.0 ±TT	0.48±9.0 ±TT	1.51±9.0 ±TT	2
	60	N/A	- 7.58±9.0 ±TT	- 5.03±9.0 ±TT	- 3.78±9.0 ±TT	- 2.81±9.0 ±TT	- 2.02±9.0 ±TT	- 0.59±9.0 ±TT	0.48±9.0 ±TT	1.17±9.0 ±TT	2
NOTE 1: TT of each transmit antenna for each frequency and channel bandwidth is specified in Table 6.3D.3.5-2 and Table 6.3D.											

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: Test Tolerance for ON 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

Editor's Note:

- Test Tolerance is TBD for SCS60

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 UE release 15 and forward that support 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 fiest 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 Table 4.6.3-118 with condition CP-OFDM.

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	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
Expected Measured power	SCS15	-6	-2.8	-1.0	0.3	1.2	2.0	3.3	4.3				
	SCS30	-6.6	-3.2	-1.2	0.1	1.1	1.9	3.3	4.2	5.1	6.4	6.9	7.4
	SCS60		-3.6	-1.4	-0.2	0.9	1.8	3.1	4.1	5.0	6.3	6.8	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.4.1.5-3.													

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	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
Expected Measured power	SCS15	6	9.2	11.0	12.3	13.2	14.0	15.3	16.3				
	SCS30	5.4	8.8	10.8	12.1	13.1	13.9	15.3	16.2	17.1	18.4	18.9	19.4
	SCS60		8.4	10.6	11.8	12.9	13.8	15.1	16.1	17.0	18.3	18.8	19.3
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.4.1.5-3.													

Table 6.3D.4.1.5-3: Test Tolerance

		f ≤ 3.0GHz	3.0GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6.0GHz
FDD, TDD SCS 15kHz & TDD SCS 30khz	BW ≤ 40MHz	1.0 dB	1.4 dB	1.4 dB
	40MHz < BW ≤ 100MHz	1.4 dB	1.4 dB	1.4 dB
TDD SCS 60kHz		FFS	FFS	FFS

6.3D.4.2 Relative power tolerance for UL-MIMO

Editor's Note:

- MU/TT is still FFS

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 UE release 15 and forward that support 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 Table 6.3D.4.2.3-1

Table 6.3D.4.2.3-1: 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.4.2.4 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
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
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
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# 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.4.2.4.1-1.

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.

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 6.3.4.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Send 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 and Table 4.6.3-118 with condition CP-OFDM.

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.

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 slots	Uplink RB allocation	TPC command	Expected power step size (Up) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
15	1	Slots before RB change	Fixed = 1	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 5 RBs	TPC=+1dB	7.99	4dB ≤ ΔP < 10dB	7.99 +/- 3.5 + TT
		Slots after RB change	Fixed = 5	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	Fixed = 1	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 15 RBs	TPC=+1dB	12.76	10dB ≤ ΔP < 15dB	12.76 +/- 4 + TT
		Slots after RB change	Fixed = 15	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
30	1	Slots before RB change	Fixed = 1	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 2 RBs	TPC=+1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- 3.5 + TT
		Slots after RB change	Fixed = 2	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	Fixed = 1	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 7 RBs	TPC=+1dB	12.46	10dB ≤ ΔP < 15dB	12.46 +/- 4 + TT
		Slots after RB change	Fixed = 7	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 slots Pattern B the position of RB uplink allocation change is after 20 active uplink slots Pattern C the position of RB uplink allocation change is after 30 active uplink slots Note 2: The starting resource block shall be RB# 1. Note 3: TT=[TBD]dB					

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 (Up) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
15	1	Slots before RB change	Fixed = 5	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	5 RBs to 1 RB	TPC=-1dB	7.99	4dB ≤ ΔP < 10dB	7.99 +/- 3.5 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	Fixed = 15	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	15 RBs to 1 RB	TPC=-1dB	12.76	10dB ≤ ΔP < 15dB	12.76 +/- 3.5 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
30	1	Slots before RB change	Fixed = 2	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	2 RBs to 1 RB	TPC=-1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- 3.5 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	Fixed = 7	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	7 RBs to 1 RB	TPC=-1dB	12.46	10dB ≤ ΔP < 15dB	12.46 +/- 4 + TT

Note 1: Position of RB change:
Pattern A the position of RB uplink allocation change is after 10 active uplink slots
Pattern B the position of RB uplink allocation change is after 20 active uplink slots
Pattern C the position of RB uplink allocation change is after 30 active uplink slots
Note 2: The starting resource block shall be RB# 1.
Note 3: TT=[TBD]dB

Table 6.3D.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) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
15	1	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 5 RBs	TPC=+1dB	7.99	4dB ≤ ΔP < 10dB	7.99 +/- 3.5 + TT
		Slots after RB change	Fixed = 5	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 20 RBs	TPC=+1dB	14.01	10dB ≤ ΔP < 15dB	14.01 +/- 4 + TT
		Slots after RB change	Fixed = 20	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	3	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 50 RBs	TPC=+1dB	17.99	15dB ≤ ΔP	17.99 +/- 5 + TT
		Slots after RB change	Fixed = 50	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
30	1	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 2 RBs	TPC=+1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- 3.5 + TT
		Slots after RB change	Fixed = 2	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 10 RBs	TPC=+1dB	14.01	10dB ≤ ΔP < 15dB	14.01 +/- 4 + TT
		Slots after RB change	Fixed = 10	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	3	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 22 RBs	TPC=+1dB	17.43	15dB < ΔP	17.43 +/- 5 + TT
		Slots after RB change	Fixed = 22	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
60	1	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 5 RBs	TPC=+1dB	14.01	10dB ≤ ΔP < 15dB	14.01 +/- 4 + TT
		Slots after RB change	Fixed = 5	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 9 RBs	TPC=+1dB	16.56	15dB < ΔP	16.56 +/- 5 + TT
		Slots after RB change	Fixed = 9	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 slots, except for TDD SCS 60 kHz which is after 8 active uplink slots. Pattern B the position of RB uplink allocation change is after 20 active uplink slots Pattern C the position of RB uplink allocation change is after 30 active uplink slots, except for TDD SCS 60 kHz which is after 28 active uplink slots. Note 2: The starting resource block shall be RB# 1. Note 3: TT=[TBD]dB							

Table 6.3D.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 (Up) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
15	1	Slots before RB change	Fixed = 5	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	5 RBs to 1RBs	TPC=-1dB	7.99	4dB ≤ ΔP < 10dB	7.99 +/- 3.5 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	Fixed = 20	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	20 RBs to 1 RB	TPC=-1dB	14.01	10dB ≤ ΔP < 15dB	14.01 +/- 4 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	3	Slots before RB change	Fixed = 50	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	50 RBs to 1 RB	TPC=-1dB	17.99	15dB ≤ ΔP	17.99 +/- 5 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
30	1	Slots before RB change	Fixed = 2	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	2 RBs to 1 RB	TPC=-1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- 3.5 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	Fixed = 10	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	10 RBs to 1 RB	TPC=-1dB	14.01	10dB ≤ ΔP < 15dB	14.01 +/- 4 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	3	Slots before RB change	Fixed = 22	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	22 RBs to 1 RB	TPC=-1dB	17.43	15dB < ΔP	17.43 +/- 5 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
60	1	Slots before RB change	Fixed = 5	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	5 RBs to 1 RB	TPC=-1dB	14.01	10dB ≤ ΔP < 15dB	14.01 +/- 4 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	Fixed = 9	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	9 RBs to 1 RB	TPC=-1dB	16.56	15dB < ΔP	16.56 +/- 5 + TT
		Slots 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 slots, except for TDD SCS 60 kHz which is after 8 active uplink slots.
Pattern B the position of RB uplink allocation change is after 20 active uplink slots
Pattern C the position of RB uplink allocation change is after 30 active uplink slots, except for TDD SCS 60 kHz which is after 28 active uplink slots.
Note 2: The starting resource block shall be RB# 1.
Note 3: TT=[TBD]dB

Table 6.3D.4.2.5-5: Test Requirements Relative Power Tolerance for Transmission, channel BW 60MHz, 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) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
30	1	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 2 RBs	TPC=+1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- 3.5 + TT
		Slots after RB change	Fixed = 2	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 6 RBs	TPC=+1dB	11.79	10dB ≤ ΔP < 15dB	11.79 +/- 4 + TT
		Slots after RB change	Fixed = 6	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	3	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 81 RBs	TPC=+1dB	23.10	15dB < ΔP	23.10 +/- 5 + TT
		Slots after RB change	Fixed = 81	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
60	1	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 5 RBs	TPC=+1dB	14.01	10dB ≤ ΔP < 15dB	14.01 +/- 4 + TT
		Slots after RB change	Fixed = 5	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	1RB to 75 RBs	TPC=+1dB	25.77	15dB < ΔP	25.77 +/- 5 + TT
		Slots 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 slots, except for TDD SCS 60 kHz which is after 8 active uplink slots. Pattern B the position of RB uplink allocation change is after 20 active uplink slots Pattern C the position of RB uplink allocation change is after 30 active uplink slots, except for TDD SCS 60 kHz which is after 28 active uplink slots. Note 2: The starting resource block shall be RB# 1. Note 3: TT=[TBD]dB							

Table 6.3D.4.2.5-6: Test Requirements Relative Power Tolerance for Transmission, channel BW 60MHz, 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 (Up) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
30	1	Slots before RB change	Fixed = 2	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	2 RBs to 1 RB	TPC=-1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- 3.5 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	Fixed = 6	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	6 RBs to 1 RB	TPC=-1dB	11.79	10dB ≤ ΔP < 15dB	11.79 +/- 4 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	3	Slots before RB change	Fixed = 81	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	81 RBs to 1 RB	TPC=-1dB	23.10	15dB < ΔP	23.10 +/- 5 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
60	1	Slots before RB change	Fixed = 5	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	5 RBs to 1 RB	TPC=-1dB	14.01	10dB ≤ ΔP < 15dB	14.01 +/- 4 + TT
		Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
	2	Slots before RB change	Fixed = 75	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/-0.7 + TT
		RB change	75 RBs to 1 RB	TPC=-1dB	25.77	15dB < ΔP	25.77 +/- 5 + TT
		Slots 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 slots, except for TDD SCS 60 kHz which is after 8 active uplink slots. Pattern B the position of RB uplink allocation change is after 20 active uplink slots Pattern C the position of RB uplink allocation change is after 30 active uplink slots, except for TDD SCS 60 kHz which is after 28 active uplink slots. Note 2: The starting resource block shall be RB# 1. Note 3: TT=[TBD]dB							

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) ΔP [dB]	Power step size range (Up) ΔP [dB]	PUSCH [dB]
5	15	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
		3	Alternating 1 and 15	TPC=0dB	11.76	10dB ≤ ΔP < 15dB	11.76 +/- 4 + TT
	30	1	Alternatting 1 and 2	TPC=0dB	6.02	4dB ≤ ΔP < 10dB	6.02 +/- 3.5 + TT
		2	Alternating 1 and 7	TPC=0dB	11.46	10dB ≤ ΔP < 15dB	11.46 +/- 4 + TT
10,15,20, 25,30,40,50	15	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
		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
	30	1	Alternating 1 and 2	TPC=0dB	6.02	4dB ≤ ΔP < 10dB	6.02 +/- 3.5 + TT
		2	Alternating 1 and 10	TPC=0dB	13.01	10dB ≤ ΔP < 15dB	13.01 +/- 4 + TT
		3	Alternating 1 and 22 RBs	TPC=0dB	16.43	15dB < ΔP	16.43 +/- 5 + TT
	60	1	Alternating 1 and 5	TPC=0dB	13.01	10dB ≤ ΔP < 15dB	13.01 +/- 4 + TT
		2	Alternating 1 and 9	TPC=0dB	15.56	15dB < ΔP	15.56 +/- 5 + TT
60,80,90,100	30	1	Alternating 1 and 2	TPC=0dB	6.02	4dB ≤ ΔP < 10dB	6.02 +/- 3.5 + TT
		2	Alternating 1 and 6	TPC=0dB	10.79	10dB ≤ ΔP < 15dB	10.79 +/- 4 + TT
		3	Alternating 1 and 81	TPC=0dB	22.10	15dB < ΔP	22.10 +/- 5 + TT
	60	1	Alternating 1 and 2	TPC=0dB	9.03	4dB ≤ ΔP < 10dB	9.03 +/- 3.5 + TT
		2	Alternating 1 and 5	TPC=0dB	13.01	10dB ≤ ΔP < 15dB	13.01 +/- 4 + TT
		3	Alternating 1 and 75	TPC=0dB	24.77	15dB < ΔP	24.77 +/- 5 + TT
Note 1: The starting resource block shall be RB# 1. Note 2: TT=[TBD]dB							

6.3D.4.3 Aggregate power tolerance for UL-MIMO

Editor's Note:

- MU/TT is FFS

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 UE release 15 and forward that support 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**
	N/A for aggregate power tolerance testcase	PUCCH format = Format 1 Length in OFDM symbols = 14
1		

Table 6.3D.4.3.4.1-2: Test Configuration Table: PUSCH sub-test

<table>
<tr><th colspan="4">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 38.508-1 [5] subclause 4.1</td><td colspan="2">Normal</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="2">Mid range</td></tr>
<tr><td colspan="2">Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="2">Lowest, Mid, Highest</td></tr>
<tr><td colspan="2">Test SCS as specified in Table 5.3.5-1</td><td colspan="2">Lowest, Highest</td></tr>
<tr><th colspan="4">Test Parameters for Channel Bandwidths</th></tr>
<tr><th>Test ID</th><th>Downlink Configuration</th><th colspan="2">Uplink Configuration</th></tr>
<tr><td></td><th rowspan="2">N/A for aggregate power tolerance testcase</th><th>Modulation</th><th>RB allocation (NOTE 1)</th></tr>
<tr><td>1</td><td>CP-OFDM QPSK</td><td>Outer_Full</td></tr>
<tr><td colspan="4">NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.</td></tr>
</table>

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 PDCCH /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 and Table 4.6.3-118 with condition CP-OFDM.

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. Note 2: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3D.4.3.5-2.		

Table 6.3D.4.3.5-2: Test Tolerance

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 UE release 15 and forward.

6.4.1.3 Minimum conformance requirements

The UE modulated carrier frequency shall be accurate to within ±0.1 PPM observed over a period of 1 ms 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		
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.				

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_0 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 P_{UMAX} 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 P_{UMAX} 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.

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 20 frequency error Δf results must fulfil the test requirement:

$$|\Delta f| \le (0.1 \text{ PPM} + 15 \text{ Hz})$$

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.

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 UE release 15 and forward.

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	
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)**
1[3]		DFT-s-OFDM PI/2 BPSK	Inner Full
2[3]		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.			

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 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	N_{RB}-1
3	CP-OFDM QPSK	Full RB (Note 1)	DFT-s-OFDM	PUCCH format = Format 1 Length in OFDM symbols = 14	0
4	CP-OFDM QPSK	Full RB (Note 1)	DFT-s-OFDM	PUCCH format = Format 1 Length in OFDM symbols = 14	N_{RB}-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.					

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	12
RS EPRE setting for test point 1 (dBm/15kHz)	-71	-65
RS EPRE setting for test point 2 (dBm/15kHz)	-86	-80

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 $P_{UMAX\ level,}$ allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.

1.3 Measure the EVM and $\overline{EVM}_{DMRS}$ 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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is in the range $P_{min} + P_W \pm P_W$, where P_{min} is the minimum output power according to Table 6.3.1.3-1 and P_W is the power window according to Table 6.4.2.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.
For 256 QAM, send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is in the range P_{min} + 10 dB + $P_W \pm P_W$, where P_{min} is the minimum output power according to Table 6.3.1.3-1 and P_W is the power window according to Table 6.4.2.1.4.2-1 for the carrier frequency f and the channel bandwidth BW

1.5 Measure the EVM and $\overline{EVM}_{DMRS}$ 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 without CP-OFDM condition. When switching to CP-OFDM waveform, send an NR RRCReconfiguration message with CP-OFDM condition..

Table 6.4.2.1.4.2-1: Power Window (dB) for EVM PUSCH and PUCCH

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 40MHz	1.7	2.0	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.5

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_0 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 P_{UMAX} level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.

2.4 Measure PUCCH EVM using Global In-Channel Tx-Test (Annex E).

2.5 Send the appropriate TPC commands for PUCCH to the UE until the UE transmits PUCCH at $P_{min} + P_W \pm P_W$, where P_{min} is the minimum output power according to Table 6.3.1.3-1 and P_W is the power window according to Table 6.4.2.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.

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 without CP-OFDM condition. When switching to CP-OFDM waveform, send an NR RRCReconfiguration message with CP-OFDM condition.

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 ([2] preambles for format 0 and [10] preambles for format 4). 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.

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 $\overline{EVM}_{DMRS}$, 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 < P_{UL} 0.8 for -25 dBm < P_{UL}≤ 15 dBm 1.1 for -40dBm ≤ P_{UL} ≤ -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%.

6.4.2.2 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 UE release 15 and forward.

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 6.4.2.2-1.

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 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, 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

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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 10 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4.2.2.4.2-1 for the carrier frequency f and the channel bandwidth BW.

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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 0 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4.2.2.4.2-1 for the carrier frequency f and the channel bandwidth BW.

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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -30 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4.2.2.4.2-2 for the carrier frequency f and the channel bandwidth BW.

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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -40 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4.2.2.4.2-2 for the carrier frequency f and the channel bandwidth BW.

9. Measure carrier leakage using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

Table 6.4.2.2.4.2-1: Power Window (dB) for carrier leakage (step 2 and step 4)

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	1.4	1.7	2
20MHz < BW ≤ 40MHz	1.4	1.7	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.3

Table 6.4.2.1.4.2-2: Power Window (dB) for carrier leakage (step 6 and step 8)

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 40MHz	1.7	2.0	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.5

6.4.2.2.4.3 Message contents

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

6.4.2.2.5 Test requirement

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 + P_W dBm ± P_W dB[4]	-28 + TT
0 + P_W dBm ± P_W dB[4]	-25 + TT
-30 + P_W dBm ± P_W dB[5]	-20 + TT
-40 + P_W dBm ± P_W dB[5]	-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: N_{RB} is the Transmission Bandwidth Configuration (see Section 5.3). NOTE 4: P_W is the power window according to Table 6.4.2.2.4.2-1 for the carrier frequency f and the channel bandwidth BW. NOTE 5: P_W is the power window according to Table 6.4.2.2.4.2-2 for the carrier frequency f and the channel bandwidth BW. NOTE 6: Test tolerance TT = 0.8 dB.	

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 UE release 15 and forward.

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	$\max\{-25-10\cdot\log_{10}(N_{RB}/L_{CRB}),$ $20\cdot\log_{10}EVM-3-5\cdot(\lvert\Delta_{RB}\rvert-1)/L_{CRB},$ $-57\,dBm+10\log_{10}(SCS/15\,kHz)-\overline{P_{RB}}\}$		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 P_{RB} - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} 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: L_{CRB} is the Transmission Bandwidth (see Section 5.3).

NOTE 7: N_{RB} is the Transmission Bandwidth Configuration (see Section 5.3).

NOTE 8: EVM is the limit specified in Table 6.4.2.1.3-1 for the modulation format used in the allocated RBs.

NOTE 9: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB}=1$ or $\Delta_{RB}=-1$ for the first adjacent RB outside of the allocated bandwidth.

NOTE 10: $\overline{P_{RB}}$ 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	
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 6.4.2.3.4.1-2: 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 1 Length in OFDM symbols = 14	0
2	CP-OFDM QPSK	Full RB (Note 1)	DFT-s-OFDM	PUCCH format = Format 1 Length in OFDM symbols = 14	N_{RB}-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	N_{RB}-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.					

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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 10 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4.2.3.4.2-1 for the carrier frequency f and the channel bandwidth BW.

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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 0 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4.2.3.4.2-1 for the carrier frequency f and the channel bandwidth BW.

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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -30 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4.2.3.4.2-2 for the carrier frequency f and the channel bandwidth BW.

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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -40 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4.2.3.4.2-2 for the carrier frequency f and the channel bandwidth BW.

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 without CP-OFDM condition. When switching to CP-OFDM waveform, send an NR RRCReconfiguration message with CP-OFDM condition

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 [1A] 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 the appropriate TPC commands in the uplink scheduling information for PUCCH to the UE until UE output power is 10 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4.2.3.4.2-1 for the carrier frequency f and the channel bandwidth BW.

2.3 Measure In-band emission using Global In-Channel Tx-Test (Annex E)

2.4 Send the appropriate TPC commands in the uplink scheduling information for PUCCH to the UE until UE output power is 0 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4.2.3.4.2-1 for the carrier frequency f and the channel bandwidth BW.

2.5 Measure In-band emission using Global In-Channel Tx-Test (Annex E)

2.6 Send the appropriate TPC commands for PUCCH in the uplink scheduling information to the UE until UE output power is -30 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4.2.3.4.2-2 for the carrier frequency f and the channel bandwidth BW.

2.7 Measure In-band emission using Global In-Channel Tx-Test (Annex E)

2.8 Send the appropriate TPC commands for PUCCH in the uplink scheduling information to the UE until UE output power is -40 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4.2.3.4.2-2 for the carrier frequency f and the channel bandwidth BW.

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 without CP-OFDM condition. When switching to CP-OFDM waveform, send an NR RRCReconfiguration message with CP-OFDM condition

Table 6.4.2.3.4.2-1: Power Window (dB) for carrier leakage (steps 1.2, 1.4, 2.2, and 2.4)

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	1.4	1.7	2
20MHz < BW ≤ 40MHz	1.4	1.7	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.3

Table 6.4.2.3.4.2-2: Power Window (dB) for carrier leakage (steps 1.6, 1.8, 2.6, and 2.8)

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 40MHz	1.7	2.0	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.5

6.4.2.3.4.3 Message contents

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

6.4.2.3.5 Test requirement

The averaged In-band emissions results, 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	dB	$\max\left\{ -25-10\cdot\log_{10}(N_{RB}/L_{CRB}),\ 20\cdot\log_{10}EVM-3-5\cdot(\lvert\Delta_{RB}\rvert-1)/L_{CRB},\ -57\,dBm+10\log_{10}(SCS/15\,kHz)-\overline{P_{RB}} \right\}$ + 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 P_{RB} - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} 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: L_{CRB} is the Transmission Bandwidth (see Section 5.3).
NOTE 7: N_{RB} is the Transmission Bandwidth Configuration (see Section 5.3).
NOTE 8: EVM is the limit specified in Table 6.4.2.1.3-1 for the modulation format used in the allocated RBs.
NOTE 9: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB} = 1$ or $\Delta_{RB} = -1$ for the first adjacent RB outside of the allocated bandwidth.
NOTE 10: $\overline{P_{RB}}$ 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.

6.4.2.4 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 UE release 15 and forward.

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)
$F_{UL\_Meas} – F_{UL\_Low} ≥ 3$ MHz and $F_{UL\_High} – F_{UL\_Meas} ≥ 3$ MHz (Range 1)	4 (p-p)
$F_{UL\_Meas} – F_{UL\_Low} < 3$ MHz or $F_{UL\_High} – F_{UL\_Meas} < 3$ MHz (Range 2)	8 (p-p)
NOTE 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated NOTE 2: F_{UL_Low} and F_{UL_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)
$F_{UL\_Meas} – F_{UL\_Low} ≥ 5$ MHz and $F_{UL\_High} – F_{UL\_Meas} ≥ 5$ MHz (Range 1)	4 (p-p)
$F_{UL\_Meas} – F_{UL\_Low} < 5$ MHz or $F_{UL\_High} – F_{UL\_Meas} < 5$ MHz (Range 2)	12 (p-p)
NOTE 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated NOTE 2: F_{UL_Low} and F_{UL_High} refer to each E-UTRA frequency band specified in Table 5.5-1	

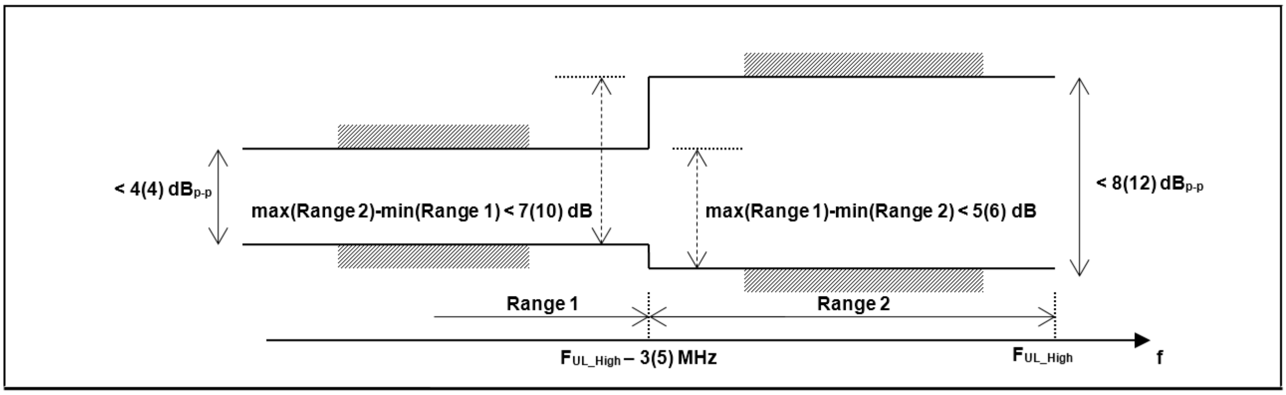

Figure 6.4.2.4.3-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated (the ETC minimum requirement are within brackets)

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	
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 6.4.2.4.4.1-1.

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 P_{UMAX} level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} 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 without CP-OFDM condition. When switching to CP-OFDM waveform, send an NR RRCReconfiguration message with CP-OFDM 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]
$F_{UL\_Meas} – F_{UL\_Low} \geq 3$ MHz and $F_{UL\_High} – F_{UL\_Meas} \geq 3$ MHz (Range 1)	4 + TT (p-p)
$F_{UL\_Meas} – F_{UL\_Low} < 3$ MHz or $F_{UL\_High} – F_{UL\_Meas} < 3$ MHz (Range 2)	8 + TT (p-p)
NOTE 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated NOTE 2: F_{UL_Low} and F_{UL_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]
$F_{UL\_Meas} – F_{UL\_Low} \geq 5$ MHz and $F_{UL\_High} – F_{UL\_Meas} \geq 5$ MHz (Range 1)	4 + TT (p-p)
$F_{UL\_Meas} – F_{UL\_Low} < 5$ MHz or $F_{UL\_High} – F_{UL\_Meas} < 5$ MHz (Range 2)	12 + TT (p-p)
NOTE 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated NOTE 2: F_{UL_Low} and F_{UL_High} refer to each E-UTRA frequency band specified in Table 5.5-1 NOTE 3: Test tolerance TT = 1.4 dB.	

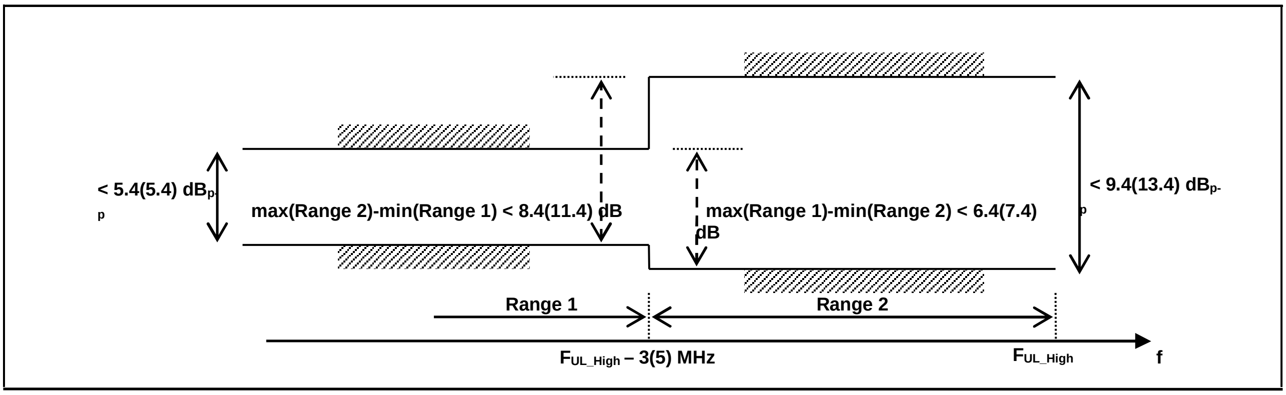

Figure 6.4.2.4.5-1: The test requirements for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated for unshaped modulations (the ETC test requirements are within brackets)

6.4.2.5 EVM equalizer spectrum flatness for Pi/2 BPSK

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 NR UE release 15 and forward indicating support for UE capability *powerBoosting-pi2BPSK*.

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. 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)
$\lvert F_{UL\_Meas} – F\_center \rvert \leq X$ MHz (Range 1)	X1	6 (p-p)
$\lvert F_{UL\_Meas} – F\_center \rvert > X$ MHz (Range 2)	X2	14 (p-p)
NOTE 1: F_{UL_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		

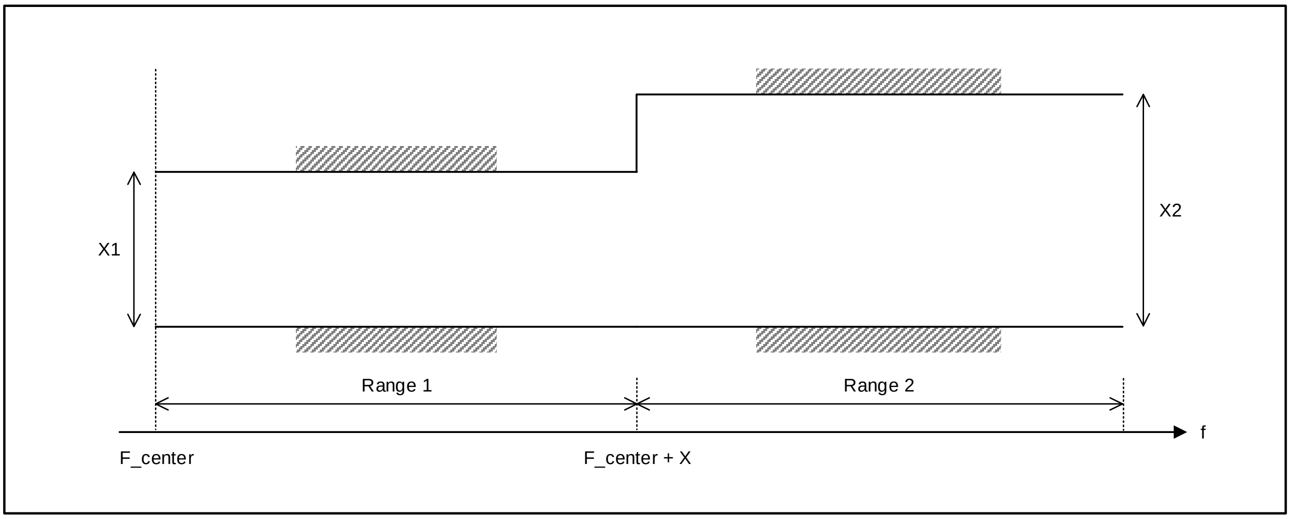

Figure 6.4.2.5.3-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation. F_center denotes the center frequency of the allocated block of PRBs. X, in MHz, is equal to 25 % of the bandwidth of the PRB allocation.

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

$$|\tilde{a}_t(t,0)| \geq |\tilde{a}_t(t,\tau)| \quad \forall\tau \neq 0$$

$$20log_{10}|\tilde{a}_t(t,\tau)| < -15 \text{ dB} \quad 1 < \tau < \text{M} - 1,$$

where, $|\tilde{a}_t(t,\tau)| = IDFT\{|\tilde{a}_t(t,f)|e^{j\varphi(t,f)}\}$, f is the frequency of the M allocated subcarriers , $\tilde{a}(t,f)$ and $\varphi(t,f)$ are the amplitude and phase response.

0dB reference is defined as $20log_{10}|\tilde{a}_t(t,0)|$.

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, 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 Pi/2 BPSK	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.			

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 6.4.2.4.4.1-1. 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 P_{UMAX} level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} 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

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		
}			

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)
$\|F_{UL\_Meas} – F\_center\| \leq X$ MHz (Range 1)	X1	6 + TT (p-p)
$\|F_{UL\_Meas} – F\_center\| > X$ MHz (Range 2)	X2	14 + TT (p-p)
NOTE 1: F_{UL_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.		

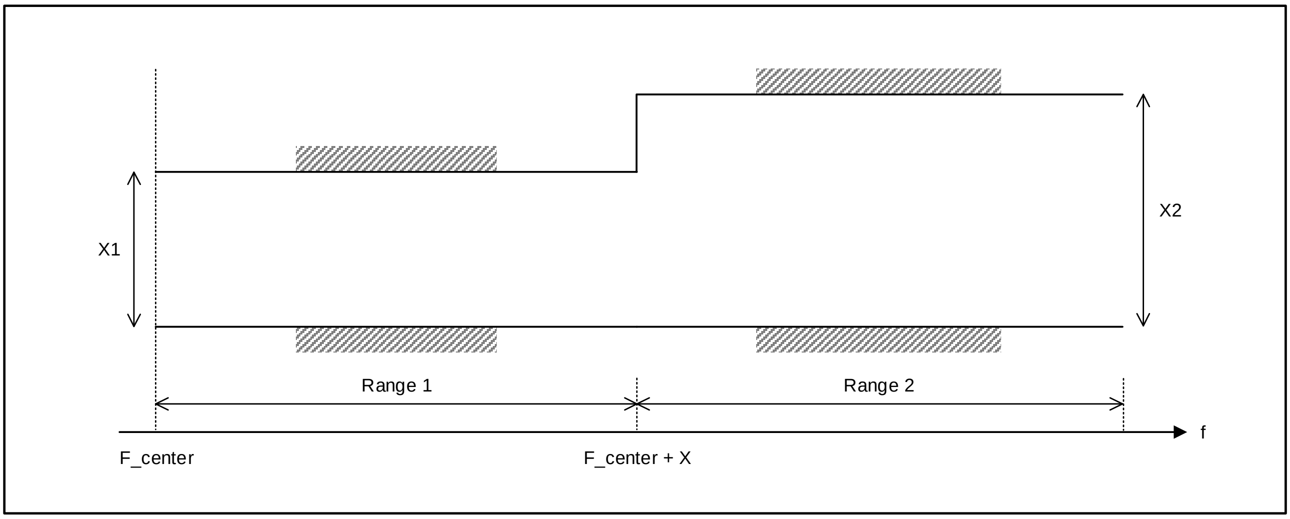

Figure 6.4.2.5.5-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation. F_center denotes the center frequency of the allocated block of PRBs. X, in MHz, is equal to 25 % of the bandwidth of the PRB allocation.

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:

$$|\tilde{a}(0)| \geq |\tilde{a}(\tau)| \quad \forall \tau \neq 0$$

$$20\log_{10}|\tilde{a}(\tau)| < -15\text{dB} + \text{TT} \quad 1 < \tau < M - 1,$$

where TT = 1.4 dB.

6.4A Transmit signal quality for CA

6.4A.1 Frequency error for CA

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- The connection diagram for inter-band CA in TS 38.508-1[5] Annex A is FFS.
- Procedure to configure SCC in TS 38.508-1[5] clause [TBD] is FFS.
- Extending the coverage of the TCs with intra-band CA scenarios is FFS
- The subclauses 7.3A.2.3.4 in reference to REFSENS value for inter-band CA is FFS
- TTs and MUs for CA are FFS in Annex F.

6.4A.1.0 Minimum conformance requirements

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.

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. 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		
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1		Highest for both PCC and SCC		
Test SCS as specified in Table 5.5A.3-1		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.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure [TBD] 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 Table 6.4A.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 6.4A.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 [TBD]. 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_0 for C_RNTI to transmit the DL RMC according to Table6.4A.1.3.4.1-1 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 Table 6.4A.1.1.4.1-1 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.2.3.4 and 7.3A.4. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE so that the UE transmits at P_{UMAX} 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 P_{UMAX} 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.

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.

6.4A.1.1.5 Test requirement

The 20 frequency error Δf results must fulfil the test requirement:

$$|\Delta f| \le (0.1 \text{ PPM} + \text{TT}) \text{ for each test point}$$

where 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	FFS	FFS
40MHz < BW ≤ 100MHz	FFS	FFS

6.4A.2 Transmit modulation quality for CA

Editor’s note: This clause is incomplete. The following aspects are either missing or not yet determined:

- The connection diagram for inter-band CA in TS 38.508-1[5] Annex A is FFS.
- Procedure to configure SCC in TS 38.508-1[5] clause [TBD] is FFS
- Extending the coverage of the TCs with intra-band CA scenarios is FFS
- MUs and TTs for CA is FFS in Annex F.

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.2.1 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 6.4A.2.1.0-1 for the parameters defined in Table 6.4A.2.1. 0-2, if CA is configured in uplink.

Table 6.4A.2.1.0-1: Requirements for Error Vector Magnitude

Parameter	Unit	Average EVM Level
Pi/2-BPSK	%	30
QPSK	%	17.5
16QAM	%	12.5
64QAM	%	8
256 QAM	%	3.5

Table 6.4A.2.1.0-2: 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 6.3.1.3-1 + 10 dB
Operating conditions		Normal conditions

The normative reference for this requirement is TS 38.101 [2] clause 6.4A.2.3.1

6.4A.2.1.1 Error Vector Magnitude for CA (2UL CA)

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Table 6.4A.2.1.1.4.1-1: Inter band CA Test Configuration Table is FFS.
- The minimum requirements for intra-band contiguous CA and intra-band non-contiguous CA have not been defined.
- TTs and MUs for Error Vector Magnitude for CA are FFS in Annex F.

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 sub-section 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 2DL and 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. 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 for both PCC and SCC Highest for both PCC and SCC		
Test SCS as specified in Table 5.5A.3-1		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**
1[3]	N/A	DFT-s-OFDM PI/2 BPSK	Inner Full	0
2[3]		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 and SCS are specified in Table 5.5A3-1. 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.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure [TBD] 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.

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 [TBD]. 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. 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 $P_{UMAX\ level,}$ allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.

6. Measure the EVM and $\overline{EVM}_{DMRS}$ on PCC using Global In-Channel Tx-Test (Annex E).

7. For modulations except 256QAM, send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is in the range P_{min} + P_W± P_W, where P_{min} is the minimum output power according to Table 6.3.1.3-1 and P_W is the power window according to Table 6.4.2.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.
   For 256 QAM, send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is in the range P_{min} + 10 dB + P_W ± P_W, where P_{min} is the minimum output power according to Table 6.3.1.3-1 and P_W is the power window according to Table 6.4.2.1.4.2-1 for the carrier frequency f and the channel bandwidth BW..

8. Measure the EVM and $\overline{EVM}_{DMRS}$ 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.

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 $\overline{EVM}_{DMRS}$,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	%	3.8+TT for 15 dBm< P_{UL} 4.3+TT for -25 dBm< P_{UL}≤ 15 dBm 4.6+TT for -40dBm ≤ P_{UL}≤ -25dBm

Table 6.4A.2.1.1.5-2: Test Tolerance for Error Vector Magnitude

	f ≤ 3.0GHz	3.0GHz < f ≤ 6GHz
BW ≤ 40MHz	FFS	FFS
40MHz < BW ≤ 100MHz	FFS	FFS

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

FFS

6.4A.2.2.0.2 Minimum conformance requirements for intra-band non-contiguous CA

FFS

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: This clause is incomplete. The following aspects are either missing or not yet determined:

- Table 6.4A.2.2.1.4.1-1: Inter band CA Test Configuration Table is FFS.
- The minimum requirements for intra-band contiguous CA and intra-band non-contiguous CA have not been defined.
- TTs and MUs for Error Vector Magnitude for CA are FFS in Annex F.

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 2DL and 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 for both PCC and SCC		
Test SCS as specified in Table 5.5A.3-1		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 and SCS are specified in Table 5.5A3-1. 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 [TBD] 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.

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 [TBD]. 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. 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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 10 + P_WdBm±P_W dB where P_W is the power window according to Table 6.4A.2.2.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.
6. Measure carrier leakage using Global In-Channel Tx-Test (Annex E). For TDD slots with transient periods are not under test.
7. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 0 + P_WdBm±P_W dB where P_W is the power window according to Table 6.4A.2.2.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.
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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -30 + P_WdBm±P_W dB where P_W is the power window according to Table 6.4A.2.2.1.4.2-2 for the carrier frequency f and the channel bandwidth BW.
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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -40 + P_WdBm±P_W dB where P_W is the power window according to Table 6.4A.2.2.1.4.2-2 for the carrier frequency f and the channel bandwidth BW.
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

Table 6.4A.2.2.1.4.2-1: Power Window (dB) for carrier leakage (step 5 and step 7)

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	[1.4]	[1.7]	[2]
20MHz < BW ≤ 40MHz	[1.4]	[1.7]	[2.2]
40MHz < BW ≤ 100MHz	[2.1]	[2.3]	[2.3]

Table 6.4A.2.2.1.4.2-2: Power Window (dB) for carrier leakage (step 9 and step 11)

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 40MHz	[1.7]	[2.0]	[2.2]
40MHz < BW ≤ 100MHz	[2.1]	[2.3]	[2.5]

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 + P_WdBm±P_W dB[5]	-27.2+TT
	0 + P_WdBm±P_W dB[5]	-24.2+TT
	-30 + P_WdBm±P_W dB[6]	-19.2+TT
	-40 + P_WdBm±P_W dB[6]	-9.2+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: N_{RB} is the Transmission Bandwidth Configuration (see Section 5.3). NOTE 4: Void NOTE 5: P_W is the power window according to Table 6.4A.2.3.2.4.2-1 for the carrier frequency f and the channel bandwidth BW. NOTE 6: P_W is the power window according to Table 6.4A.2.3.2.4.2-2 for the carrier frequency f and the channel bandwidth BW.		

Table 6.4A.2.2.1.5-2: Test Tolerance for Carrier Leakage

	f ≤ 3.0GHz	3.0GHz < f ≤ 6GHz
BW ≤ 40MHz	FFS	FFS
40MHz < BW ≤ 100MHz	FFS	FFS

6.4A.2.3 In-band emission 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	$\max\{-25-10\cdot\log_{10}(N_{RB}/L_{CRB}),\ 20\cdot\log_{10}EVM-3-5\cdot(\lvert\Delta_{RB}\rvert-1)/L_{CRB},\ -57\,dBm+10\log_{10}(SCS/15kHz)-P_{RB}\}$		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 P_{RB} - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} 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:	L_{CRB} is the Transmission Bandwidth (see Section 5.3).
NOTE 7:	N_{RB} is the Transmission Bandwidth Configuration (see Section 5.3).
NOTE 8:	EVM is the limit specified in Table 6.4A.2.3.1.3-1 for the modulation format used in the allocated RBs.
NOTE 9:	Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB} = 1$ or $\Delta_{RB} = -1$ for the first adjacent RB outside of the allocated bandwidth.
NOTE 10:	P_{RB} is the transmitted power normalized by the number of allocated RBs, measured in dBm.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.4A.2.3.

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 2DL and 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. 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

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 for both PCC and SCC Highest for both PCC and SCC		
Test SCS as specified in Table 5.5A.3-1		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 5.5A3-1. NOTE 3: 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 [TBD] 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.2.3.1.4.1-1.
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 6.4A.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 [TBD]. 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 1_0 for C_RNTI to schedule the UL RMC according to Table 6.4A.2.3.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
5. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 10 + P_WdBm±P_W dB where P_W is the power window according to Table 6.4A.2.3.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.
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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 0 + P_WdBm±P_W dB where P_W is the power window according to Table 6.4A.2.3.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.

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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -30 + P_WdBm±P_W dB where P_W is the power window according to Table 6.4A.2.3.1.4.2-2 for the carrier frequency f and the channel bandwidth BW.

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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -40 + P_WdBm±P_W dB where P_W is the power window according to Table 6.4A.2.3.1.4.2-2 for the carrier frequency f and the channel bandwidth BW.

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.Table 6.4A.2.3.1.4.2-1: Power Window (dB) for carrier leakage (steps 5, 7)

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	[1.4]	[1.7]	[2]
20MHz < BW ≤ 40MHz	[1.4]	[1.7]	[2.2]
40MHz < BW ≤ 100MHz	[2.1]	[2.3]	[2.3]

Table 6.4A.2.3.1.4.2-2: Power Window (dB) for carrier leakage (steps 9, 11)

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 40MHz	[1.7]	[2.0]	[2.2]
40MHz < BW ≤ 100MHz	[2.1]	[2.3]	[2.5]

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

Each of the [20] In-band emissions results, derived in Annex E.4.3 shall not exceed the corresponding values in Table 6.4A.2.1.3.5-1.

Table 6.4A.2.3.1.5-1: Test requirements for in-band emissions

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$\max\{ -25 - 10\cdot\log_{10}(N_{RB}/L_{CRB}),\ 20\cdot\log_{10} EVM - 3 - 5\cdot(\lvert\Delta_{RB}\rvert - 1)/L_{CRB},\ -57\ dBm + 10\log_{10}(SCS/15\,kHz) - P_{RB} \}$ + 0.8		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 P_{RB} - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} 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: L_{CRB} is the Transmission Bandwidth (see Section 5.3).
NOTE 7: N_{RB} is the Transmission Bandwidth Configuration (see Section 5.3).
NOTE 8: EVM is the limit specified in Table 6.4.2.1.3-1 for the modulation format used in the allocated RBs.
NOTE 9: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB} = 1$ or $\Delta_{RB} = -1$ for the first adjacent RB outside of the allocated bandwidth.
NOTE 10: P_{RB} is the transmitted power normalized by the number of allocated RBs, measured in dBm.

Table 6.4A.2.3.1.5-2: Test Tolerance for In-band emission

	f ≤ 3.0GHz	3.0GHz < f ≤ 6GHz
BW ≤ 40MHz	FFS	FFS
40MHz < BW ≤ 100MHz	FFS	FFS

6.4D Transmit signal quality for UL-MIMO

6.4D.1 Frequency error for UL-MIMO

Editor's Note:

- SA Generic procedures with condition NR in TS 38.508-1 is FFS.

- SA message contents in TS 38.508-1[5] subclause 4.6 is FFS

- Test point selection is FFS.

- Connection diagram is FFS.

- MU and TT need further study on whether any deviation from basic test case is needed.

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 UE release 15 and forward that support UL-MIMO.

6.4D.1.3 Minimum conformance requirements

For UE(s) supporting UL-MIMO, the UE modulated carrier frequency at each transmit antenna connector shall be accurate to within ± 0.1 PPM observed over a period of one sub-frame (1 ms) 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

FFS

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_0] 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 [Table 7.3D.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 P_{UMAX} 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 P_{UMAX} level.
4. Measure the Frequency Error using Global In-Channel Tx-Test (Annex E) at each transmit antenna connector of the UE. For TDD slots with transient periods are not under test.

6.4D.1.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with the exceptions in [clause 7.3D.4.3].

6.4D.1.5 Test requirement

The requirements apply to each transmit antenna connector.

The n frequency error Δf results must fulfil the test requirement:

$$|\Delta f| \leq (0.1\text{PPM}+15\text{ Hz})$$

n is 10 for 15kHz SCS, 20 for 30kHz SCS and 30 for 60kHz SCS.

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 configured for transmission on single-antenna port, the requirements specified for single carrier apply.

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

6.4D.2.1 Error Vector Magnitude for UL-MIMO

Editor's Note:

- SA Generic procedures with condition NR in TS 38.508-1 is FFS.

- SA message contents in TS 38.508-1[5] subclause 4.6 is FFS

- Test point selection is FFS.

- Connection diagram is FFS.

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 UE release 15 and forward that support 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 which is defined in subclause 6.4.2.1.3 apply at each transmit antenna connector. 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

FFS

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.2.1.4.1-1.
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 $P_{UMAX\ level,}$ allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.

1.3 Measure the EVM and $\overline{EVM}_{DMRS}$ using Global In-Channel Tx-Test (Annex E) for each of transmit antenna of the UE.

1.4 For modulations except 256QAM, send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is in the range $P_{min} + P_W \pm P_W$, where P_{min} is the minimum output power according to Table 6.3.1.3-1 and P_W is the power window according to Table 6.4D.2.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.
For 256 QAM, send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is in the range TBD ± TBD.

1.5 Measure the EVM and $\overline{EVM}_{DMRS}$ using Global In-Channel Tx-Test (Annex E).

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4D.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 without CP-OFDM condition. When switching to CP-OFDM waveform, send an NR RRCReconfiguration message with CP-OFDM condition.

Table 6.4D.2.1.4.2-1: Power Window (dB) for EVM PUSCH and PUCCH except 256QAM

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 40MHz	[1.7]	[2.0]	[2.2]
40MHz < BW ≤ 100MHz	[2.1]	[2.3]	[2.5]

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 transmit antenna connector.

The PUSCH EVM, derived in Annex E.4.2, shall not exceed the values in Table 6.4D.2.1.5-1.

The PUSCH $\overline{EVM}_{DMRS}$, derived in Annex E.4.6.2, shall not exceed the values in Table 6.4D.2.1.5-1 when embedded with data symbols of the respective modulation scheme.

Table 6.4.2.1.5-1: Test 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	%	3.8 for 15 dBm < P_{UL} 4.3 for -25 dBm < P_{UL}≤ 15 dBm 4.6 for -40dBm ≤ P_{UL} ≤ -25dBm

6.4D.2.2 Carrier leakage for UL-MIMO

Editor's Note:

- SA Generic procedures with condition NR in TS 38.508-1 is FFS.

- SA message contents in TS 38.508-1[5] subclause 4.6 is FFS

- Test point selection is FFS.

- Connection diagram is FFS.

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 UE release 15 and forward that support 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 apply at each transmit antenna connector. 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

FFS

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.2.2.4.1-1.
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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 10 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4D.2.2.4.2-1 for the carrier frequency f and the channel bandwidth BW.
3. Measure carrier leakage using Global In-Channel Tx-Test (Annex E) for each of transmit antenna of the UE. For TDD slots with transient periods are not under test.
4. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 0 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4D.2.2.4.2-1 for the carrier frequency f and the channel bandwidth BW.
5. Measure carrier leakage using Global In-Channel Tx-Test (Annex E) for each of transmit antenna of the UE. For TDD slots with transient periods are not under test.

6. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -30 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4D.2.2.4.2-2 for the carrier frequency f and the channel bandwidth BW.

7. Measure carrier leakage using Global In-Channel Tx-Test (Annex E) for each of transmit antenna of the UE. For TDD slots with transient periods are not under test

8. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -40 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4D.2.2.4.2-2 for the carrier frequency f and the channel bandwidth BW.

9. Measure carrier leakage using Global In-Channel Tx-Test (Annex E) for each of transmit antenna of the UE. For TDD slots with transient periods are not under test

Table 6.4D.2.2.4.2-1: Power Window (dB) for carrier leakage (step 2 and step 4)

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	[1.4]	[1.7]	[2]
20MHz < BW ≤ 40MHz	[1.4]	[1.7]	[2.2]
40MHz < BW ≤ 100MHz	[2.1]	[2.3]	[2.3]

Table 6.4D.2.1.4.2-2: Power Window (dB) for carrier leakage (step 6 and step 8)

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 40MHz	[1.7]	[2.0]	[2.2]
40MHz < BW ≤ 100MHz	[2.1]	[2.3]	[2.5]

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 transmit antenna connector.

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 + P_W dBm ± P_W dB[5]	-28 + TT
	0 + P_W dBm ± P_W dB[5]	-25 + TT
	-30 + P_W dBm ± P_W dB[6]	-20 + TT
	-40 + P_W dBm ± P_W dB[6]	-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: N_{RB} is the Transmission Bandwidth Configuration (see Section 5.3). NOTE 4: Void NOTE 5: P_W is the power window according to Table 6.4.2.2.4.2-1 for the carrier frequency f and the channel bandwidth BW. NOTE 6: P_W is the power window according to Table 6.4.2.2.4.2-2 for the carrier frequency f and the channel bandwidth BW. NOTE 7: TT for each frequency and channel bandwidth is specified in Table 6.4D.2.2.5-2		

Table 6.4D.2.2.5-2: Test Tolerance (Carrier leakage)

	f ≤ 3.0GHz	3.0GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 40MHz	0.8	0.8	1.0
40MHz < BW ≤ 100MHz	1.5	1.6	1.6

6.4D.2.3 In-band emissions for UL-MIMO

Editor's Note:

- SA Generic procedures with condition NR in TS 38.508-1 is FFS.

- SA message contents in TS 38.508-1[5] subclause 4.6 is FFS

- Test point selection is FFS.

- Connection diagram is FFS.

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 UE release 15 and forward that support 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

FFS

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.2.3.4.1-1.
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 [1_0] 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 the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 10 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4D.2.3.4.2-1 for the carrier frequency f and the channel bandwidth BW.

1.3 Measure In-band emission using Global In-Channel Tx-Test (Annex E) for each of transmit antennas of the UE. For TDD slots with transient periods are not under test.

1.4 Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is 0 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4D.2.3.4.2-1 for the carrier frequency f and the channel bandwidth BW.

1.5 Measure In-band emission using Global In-Channel Tx-Test (Annex E) for each of transmit antennas of the UE. For TDD slots with transient periods are not under test.

1.6 Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -30 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4D.2.3.4.2-2 for the carrier frequency f and the channel bandwidth BW.

1.7 Measure In-band emission using Global In-Channel Tx-Test (Annex E) for each of transmit antennas of the UE. For TDD slots with transient periods are not under test.

1.8 Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is -40 + P_W dBm ± P_W dB where P_W is the power window according to Table 6.4D.2.3.4.2-2 for the carrier frequency f and the channel bandwidth BW.

1.9 Measure In-band emission using Global In-Channel Tx-Test (Annex E) for each of transmit antennas of the UE. For TDD slots with transient periods are not under test.

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4D.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 without CP-OFDM condition. When switching to CP-OFDM waveform, send an NR RRCReconfiguration message with CP-OFDM condition

Table 6.4D.2.3.4.2-1: Power Window (dB) for carrier leakage (steps 1.2, 1.4)

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	[1.4]	[1.7]	[2]
20MHz < BW ≤ 40MHz	[1.4]	[1.7]	[2.2]
40MHz < BW ≤ 100MHz	[2.1]	[2.3]	[2.3]

Table 6.4D.2.3.4.2-2: Power Window (dB) for carrier leakage (steps 1.6, 1.8)

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 40MHz	[1.7]	[2.0]	[2.2]
40MHz < BW ≤ 100MHz	[2.1]	[2.3]	[2.5]

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.

Each of the n In-band emissions results, 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 30 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	$\max\{-25-10\cdot\log_{10}(N_{RB}/L_{CRB}),\ 20\cdot\log_{10}EVM-3-5\cdot(\lvert\Delta_{RB}\rvert-1)/L_{CRB},\ -57\,dBm+10\log_{10}(SCS/15kHz)-P_{RB}\}$ + 0.8		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 P_{RB} - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} 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: L_{CRB} is the Transmission Bandwidth (see Section 5.3).
NOTE 7: N_{RB} is the Transmission Bandwidth Configuration (see Section 5.3).
NOTE 8: EVM is the limit specified in Table 6.4.2.1.3-1 for the modulation format used in the allocated RBs.
NOTE 9: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB} = 1$ or $\Delta_{RB} = -1$ for the first adjacent RB outside of the allocated bandwidth.
NOTE 10: P_{RB} is the transmitted power normalized by the number of allocated RBs, measured in dBm.
NOTE 11: TT for each frequency and channel bandwidth is specified in Table 6.4D.2.3.5-2

Table 6.4D.2.3.5-2: Test Tolerance (In-band emissions)

	f ≤ 3.0GHz	3.0GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 40MHz	0.8	0.8	1.0
40MHz < BW ≤ 100MHz	1.5	1.6	1.6

6.4D.2.4 EVM equalizer spectrum flatness for UL-MIMO

Editor's Note:

- SA Generic procedures with condition NR in TS 38.508-1 is FFS.

- SA message contents in TS 38.508-1[5] subclause 4.6 is FFS

- Test point selection is FFS.

- Connection diagram is FFS.

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 UE release 15 and forward that support 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 transmit antenna connector. 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

FFS

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 P_{UMAX} level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.
3. Measure spectrum flatness using Global In-Channel Tx-Test (Annex E) for each of transmit antennas of the UE. For TDD slots with transient periods are not 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 transmit antenna connector.

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 6.4D.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]
$F_{UL\_Meas} – F_{UL\_Low} \geq 3$ MHz and $F_{UL\_High} – F_{UL\_Meas} \geq 3$ MHz (Range 1)	5.4 (p-p)
$F_{UL\_Meas} – F_{UL\_Low} < 3$ MHz or $F_{UL\_High} – F_{UL\_Meas} < 3$ MHz (Range 2)	9.4 (p-p)
NOTE 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated NOTE 2: F_{UL_Low} and F_{UL_High} refer to each E-UTRA frequency band specified in Table 5.5-1	

Table 6.4D.2.4.5-2: Minimum requirements for EVM equalizer spectrum flatness for unshaped modulations (extreme conditions)

Frequency range	Maximum Ripple [dB]
$F_{UL\_Meas} – F_{UL\_Low} \geq 5$ MHz and $F_{UL\_High} – F_{UL\_Meas} \geq 5$ MHz (Range 1)	5.4 (p-p)
$F_{UL\_Meas} – F_{UL\_Low} < 5$ MHz or $F_{UL\_High} – F_{UL\_Meas} < 5$ MHz (Range 2)	13.4 (p-p)
NOTE 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated NOTE 2: F_{UL_Low} and F_{UL_High} refer to each E-UTRA frequency band specified in Table 5.5-1	

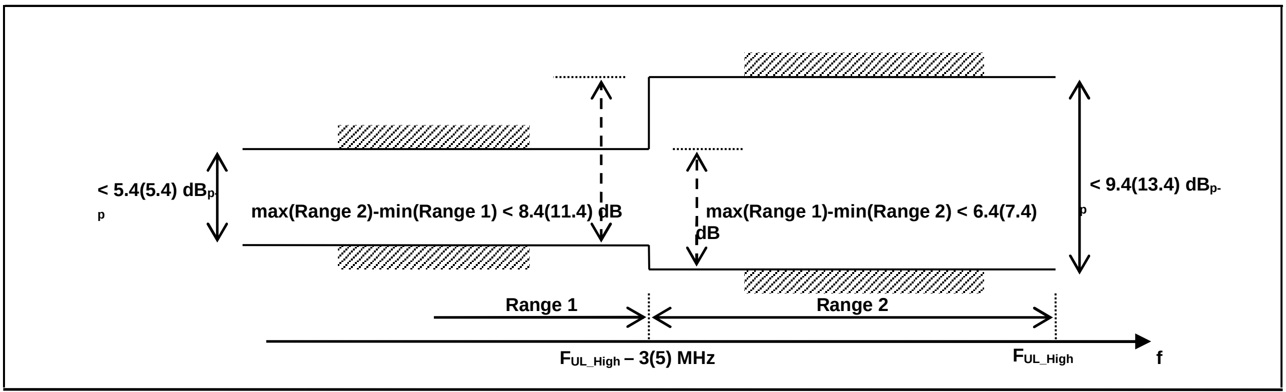

Figure 6.4D.2.4.5-1: The test requirements for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated for unshaped modulations (the ETC test requirements are within brackets)

6.4D.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 UE release 15 and forward that support 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 test case	**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.			

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 P_{UMAX} 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.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.

- SA Generic procedures with condition NR in TS 38.508-1 is FFS.

- SA message contents in TS 38.508-1[5] subclause 4.6 is FFS

- The test procedure is FFS.

- TT value is 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 UE release 15 and forward that support coherent 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 signaled 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))

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

FFS

6.4D.4.4.3 Message contents

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

6.4D.4.5 Test requirement

Maximum allowable difference of relative phase and power errors in a given slot within the Time window compared to those measured at last SRS transmitted shall not exceed the described value 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+TT dB	20 msec

6.5 Output RF spectrum emissions

Unwanted emissions are divided into "Out-of-band emission" and "Spurious emissions" in 3GPP RF specifications. This notation is in line with ITU-R recommendations such as SM.329 [TBD] and the Radio Regulations [TBD].

ITU defines:

Out-of-band emission = Emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions.

Spurious emission = Emission on a frequency, or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out-of-band emissions.

Unwanted emissions = Consist of spurious emissions and out-of-band emissions.

The UE transmitter spectrum emission consists of the three components; the occupied bandwidth (channel bandwidth), the Out Of Band (OOB) emissions and the far out spurious emission domain.

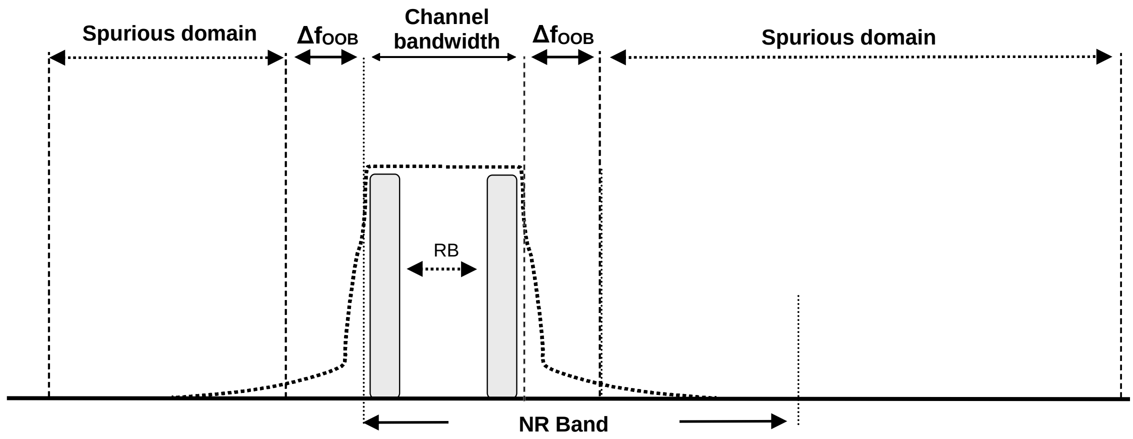

Figure 6.5-1: Transmitter RF spectrum

6.5.1 Occupied bandwidth

6.5.1.1 Test purpose

To verify that the UE occupied bandwidth for all transmission bandwidth configurations supported by the UE are less than their specific limits

6.5.1.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

6.5.1.3 Minimum conformance requirements

Occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel. The occupied bandwidth for all transmission bandwidth configurations (Resources Blocks) shall be less than the channel bandwidth specified in Table 6.5.1.3-1

Table 6.5.1.3-1: Occupied channel bandwidth

	Occupied channel bandwidth / NR Channel bandwidth											
	5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**	**30 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**90 MHz**	**100 MHz**
Channel bandwidth (MHz)	5	10	15	20	25	30	40	50	60	80	90	100

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5.1.

6.5.1.4 Test description

6.5.1.4.1 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 6.5.1.4.1-1. 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 6.5.1.4.1-1: 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 by default, exceptions listed in Table 6.5.1.4.1-2	
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1		All	
Test SCS as specified in Table 5.3.5-1		Lowest	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
	N/A for occupied bandwidth test case	**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.			

Table 6.5.1.4.1-2: Test frequency exceptions for Occupied Bandwidth

5G NR Band	Test Frequency
n77	Low Range, Mid Range, High Range
n78	Low Range, Mid Range, High Range
n79	Low Range, Mid Range, High Range

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 channels are set according to Table 6.5.1.4.1-1.
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 6.5.1.4.3

6.5.1.4.2 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 6.5.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send continuously power control “up” commands to the UE until the UE transmits at PUMAX level. Allow at least 200ms for the UE to reach PUMAX level.
3. Measure the power spectrum distribution within two times or more range over the requirement for Occupied Bandwidth specification centring on the current carrier frequency. The characteristics of the filter shall be approximately Gaussian (typical spectrum analyser filter). Other methods to measure the power spectrum distribution are allowed. The measuring duration is at least 1ms over consecutive active uplink slots.
4. Calculate the total power within the range of all frequencies measured in step 3 and save this value as “Total power”.
5. Identify the measurement window whose center is aligned on the center of the channel for which the sum of the power measured is 99% of the “Total power”.
6. The “Occupied Bandwidth” is the width of the measurement window obtained in step 5.

6.5.1.4.3 Message contents

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

6.5.1.5 Test requirement

The measured Occupied Bandwidth shall not exceed values in Table 6.5.1.5-1.

Table 6.5.1.5-1: Occupied channel bandwidth

	Occupied channel bandwidth / NR Channel bandwidth											
	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
Channel bandwidth (MHz)	5	10	15	20	25	30	40	50	60	80	90	100

6.5.2 Out of band emission

6.5.2.1 General

The Out of band emissions are unwanted emissions immediately outside the assigned channel bandwidth resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. This out of band emission limit is specified in terms of a spectrum emission mask and an adjacent channel leakage power ratio.

To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

6.5.2.2 Spectrum Emission Mask

The spectrum emission mask of the UE applies to frequencies (Δf_{OOB}) starting from the ± edge of the assigned NR channel bandwidth. For frequencies offset greater than Δf_{OOB}, the spurious requirements in subclause 6.5.3 are applicable.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

6.5.2.2.1 Test purpose

To verify that the power of any UE emission shall not exceed specified level for the specified channel bandwidth.

6.5.2.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.5.2.2.3 Minimum conformance requirements

The power of any UE emission shall not exceed the levels specified in Table 6.5.2.2.3-1 for the specified channel bandwidth.

Table 6.5.2.2.3-1: General NR spectrum emission mask

<table>
<tr><th></th><th colspan="13">Spectrum emission limit (dBm) / Channel bandwidth</th></tr>
<tr><th>Δf_{OOB} (MHz)</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th><th>25 MHz</th><th>30 MHz</th><th>40 MHz</th><th>50 MHz</th><th>60 MHz</th><th>80 MHz</th><th>90 MHz</th><th>100 MHz</th><th>Measurement bandwidth</th></tr>
<tr><td>± 0-1</td><td>-13</td><td>-13</td><td>-13</td><td>-13</td><td>-13</td><td>-13</td><td>-13</td><td></td><td></td><td></td><td></td><td></td><td>1 % channel bandwidth</td></tr>
<tr><td>± 0-1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-24</td><td>-24</td><td>-24</td><td>-24</td><td>-24</td><td>30 kHz</td></tr>
<tr><td>± 1-5</td><td>-10</td><td>-10</td><td>-10</td><td>-10</td><td>-10</td><td>-10</td><td>-10</td><td>-10</td><td>-10</td><td>-10</td><td>-10</td><td>-10</td><td rowspan="20">1 MHz</td></tr>
<tr><td>± 5-6</td><td>-13</td><td rowspan="2">-13</td><td rowspan="3">-13</td><td rowspan="4">-13</td><td rowspan="5">-13</td><td rowspan="6">-13</td><td rowspan="8">-13</td><td rowspan="10">-13</td><td rowspan="12">-13</td><td rowspan="14">-13</td><td rowspan="16">-13</td><td rowspan="18">-13</td></tr>
<tr><td>± 6-10</td><td>-25</td></tr>
<tr><td>± 10-15</td><td></td><td>-25</td></tr>
<tr><td>± 15-20</td><td></td><td></td><td>-25</td></tr>
<tr><td>± 20-25</td><td></td><td></td><td></td><td>-25</td></tr>
<tr><td>± 25-30</td><td></td><td></td><td></td><td></td><td>-25</td></tr>
<tr><td>± 30-35</td><td></td><td></td><td></td><td></td><td></td><td>-25</td></tr>
<tr><td>± 35-40</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 40-45</td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25</td></tr>
<tr><td>± 45-50</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 50-55</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25</td></tr>
<tr><td>± 55-60</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 60-65</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25</td></tr>
<tr><td>± 65-80</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 80-85</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25</td></tr>
<tr><td>± 85-90</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 90-95</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25</td></tr>
<tr><td>± 95-100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 100-105</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25</td></tr>
</table>

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5.2.2

6.5.2.2.4 Test description

6.5.2.2.4.1 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 channel bandwidth and sub-carrier spacing, are shown in table 6.5.2.2.4.1-1. 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 6.5.2.2.4.1-1: Test Configuration Table

Default 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, Highest		
Test SCS as specified in Table 5.3.5-1				Lowest, Highest		
Test Parameters for Channel Bandwidths						
Test ID	**Freq**	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
		Default	Default	N/A for Spectrum Emission Mask test case	**Modulation (NOTE 2)**	**RB allocation (NOTE 1)**
1[3]	Low				DFT-s-OFDM PI/2 BPSK	Edge_1RB_Left
2[3]	High				DFT-s-OFDM PI/2 BPSK	Edge_1RB_Right
3[3]	Default				DFT-s-OFDM PI/2 BPSK	Outer_Full
4	Low				DFT-s-OFDM QPSK	Edger_1RB_Left
5	High				DFT-s-OFDM QPSK	Edge_1RB_Right
6	Default				DFT-s-OFDM QPSK	Outer_Full
7	Low				DFT-s-OFDM 16 QAM	Edge_1RB_Left
8	High				DFT-s-OFDM 16 QAM	Edge_1RB_Right
9	Default				DFT-s-OFDM 16 QAM	Outer_Full
10	Low				DFT-s-OFDM 64 QAM	Edge_1RB_Left
11	High				DFT-s-OFDM 64 QAM	Edge_1RB_Right
12	Default				DFT-s-OFDM 64 QAM	Outer_Full
13	Low				DFT-s-OFDM 256 QAM	Edge_1RB_Left
14	High				DFT-s-OFDM 256 QAM	Edge_1RB_Right
15	Default				DFT-s-OFDM 256 QAM	Outer_Full
16	Low				CP-OFDM QPSK	Edge_1RB_Left
17	High				CP-OFDM QPSK	Edge_1RB_Right
18	Default				CP-OFDM QPSK	Outer_Full
19	Low				CP-OFDM 16 QAM	Edge_1RB_Left
20	High				CP-OFDM 16 QAM	Edge_1RB_Right
21	Default				CP-OFDM 16 QAM	Outer_Full
22	Low				CP-OFDM 64 QAM	Edge_1RB_Left
23	High				CP-OFDM 64 QAM	Edge_1RB_Right
24	Default				CP-OFDM 64 QAM	Outer_Full
25	Low				CP-OFDM 256 QAM	Edge_1RB_Left
26	High				CP-OFDM 256 QAM	Edge_1RB_Right
27	Default				CP-OFDM 256 QAM	Outer_Full

NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.
NOTE 2: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.
NOTE 3: For Power Class 3 testing, include two steps for UE operating in bands n40, n41, n77, n78 and n79, with IE *powerBoostPi2BPSK* set to 1 and 0 separately.

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 channels are set according to Table 6.5.2.2.4.1-1.

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 6.5.2.2.4.3

6.5.2.2.4.2 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 6.5.2.2.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send continuously power control “up” commands to the UE until the UE transmits at PUMAX level. Allow at least 200ms for the UE to reach PUMAX level.

3. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.2.1.5-1 for 6.2.2.5-1. The period of the measurement shall be at least the continuous duration of 1ms over consecutive active uplink slots. For TDD, only slots consisting of only UL symbols are under test.

4. Measure the power of the transmitted signal with a measurement filter of bandwidths according to table 6.5.2.2.5-1. The centre frequency of the filter shall be stepped in continuous steps according to the same table. The measured power shall be recorded for each step. The measurement period shall capture the active TSs.

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.

6.5.2.2.4.3 Message contents

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

6.5.2.2.5 Test requirement

The measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in Tables 6.2.1.5-1 or 6.2.2.5-1 as appropriate, and the power of any UE emission shall fulfil requirements in Table 6.5.2.2.5-1.

Table 6.5.2.2.5-1: General NR spectrum emission mask

<table>
<tr><th></th><th colspan="13">Spectrum emission limit (dBm) / Channel bandwidth</th></tr>
<tr><th>ΔfOOB (MHz)</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th><th>25 MHz</th><th>30 MHz</th><th>40 MHz</th><th>50 MHz</th><th>60 MHz</th><th>80 MHz</th><th>90 MHz</th><th>100 MHz</th><th>Measurement bandwidth</th></tr>
<tr><td>± 0-1</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td></td><td></td><td></td><td></td><td></td><td>1 % channel bandwidth</td></tr>
<tr><td>± 0-1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>30 kHz</td></tr>
<tr><td>± 1-5</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td rowspan="20">1 MHz</td></tr>
<tr><td>± 5-6</td><td>-13 + TT</td><td rowspan="2">-13 + TT</td><td rowspan="3">-13 + TT</td><td rowspan="4">-13 + TT</td><td rowspan="5">-13 + TT</td><td rowspan="6">-13 + TT</td><td rowspan="8">-13 + TT</td><td rowspan="10">-13 + TT</td><td rowspan="12">-13 + TT</td><td rowspan="14">-13 + TT</td><td rowspan="16">-13 + TT</td><td rowspan="18">-13 + TT</td></tr>
<tr><td>± 6-10</td><td>-25 + TT</td></tr>
<tr><td>± 10-15</td><td></td><td>-25 + TT</td></tr>
<tr><td>± 15-20</td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 20-25</td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 25-30</td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 30-35</td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 35-40</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 40-45</td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 45-50</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 50-55</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 55-60</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 60-65</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 65-80</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 80-85</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 85-90</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 90-95</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 95-100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 100-105</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td colspan="14">Note 1: The first and last measurement position with a 30 kHz filter is at ΔfOOB equals to 0.015 MHz and 0.985 MHz.
Note 2: At the boundary of spectrum emission limit, the first and last measurement position with a 1 MHz filter is the inside of +0.5MHz and -0.5MHz, respectively.
Note 3: The measurements are to be performed above the upper edge of the channel and below the lower edge of the channel.
Note 4: TT for each frequency and channel bandwidth is specified in Table 6.5.2.2.5-2.</td></tr>
</table>

Table 6.5.2.2.5-2: Test Tolerance (Spectrum Emission Mask)

	f ≤ 3.0GHz	3.0GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6.0GHz
BW ≤ 100MHz	1.5 dB	1.8 dB	1.8 dB

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

6.5.2.3 Additional spectrum emission mask

Editor's note: The following aspects are either missing or not yet determined:

- Initial condition is not complete.

6.5.2.3.1 Test purpose

To verify that the power of any UE emission shall not exceed specified level for the specified channel bandwidth under the deployment scenarios where additional requirements are specified.

6.5.2.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.5.2.3.3 Minimum conformance requirements

6.5.2.3.3.1 Minimum requirement for "NS_35"

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When " NS_35" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.2.2.3.3.1-1.

Table 6.5.2.2.3.3.1-1: Additional requirements for "NS_35"

Spectrum emission limit (dBm) / Channel bandwidth					
Δf_{OOB} (MHz)	5 MHz	10 MHz	15 MHz	20 MHz	Measurement bandwidth (unless otherwise stated)
± 0-0.1	-15	-18	-20	-21	30 kHz
± 0.1-6	-13	-13	-13	-13	100 kHz
± 6-10	-25[1]	-13	-13	-13	100 kHz
± 10-15		-25[1]	-13	-13	100 kHz
± 15-20			-25[1]	-13	100 kHz
± 20-25				-25	1 MHz
NOTE 1: The measurement bandwidth shall be 1 MHz					

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

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5.2.3.1.

6.5.2.3.3.2 Requirements for network signalled value "NS_04"

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

The n41 SEM transition point from -13 dBm/MHz to -25 dBm/MHz is based on the emission bandwidth. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier c frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. Since the 26-dB emission bandwidth is implementation dependent, the maximum transmission bandwidths in MHz (N_{RB} * SCS * 12 / 1,000,000) is used for the SEM.

Table 6.5.2.3.3.2-1: n41 maximum transmission bandwidths (MHz) for CP-OFDM

SCS (kHz)	Channel bandwidths (MHz)								
	10	**15**	**20**	**40**	**50**	**60**	**80**	**90**	**100**
15	9.36	14.22	19.08	38.88	48.6	N.A	N.A	N.A	N.A
30	8.64	13.68	18.36	38.16	47.88	58.32	78.12	88.02	98.28
60	7.92	12.96	17.28	36.72	46.8	56.88	77.04	87.12	97.20

Table 6.5.2.3.3.2-2: n41 maximum transmission bandwidths (MHz) for DFT-S-OFDM

SCS (kHz)	Channel bandwidths (MHz)								
	10	**15**	**20**	**40**	**50**	**60**	**80**	**90**	**100**
15	9.00	13.50	18.00	38.88	48.60	N/A	N/A	N/A	N/A
30	8.64	12.96	18.00	36.00	46.08	58.32	77.76	87.48	97.20
60	7.20	12.96	17.28	36.00	46.08	54.00	72.00	86.40	97.20

When "NS_04" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.2.3.2-3.

Table 6.5.2.3.3.2-3: n41 SEM with "NS_04"

	Spectrum emission limit (dBm) / measurement bandwidth for each channel bandwidth									
Δf_{OOB} MHz	**10 MHz**	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**90 MHz**	**100 MHz**	**Measurement bandwidth**
± 0 - 1	-10	-10	-10	-10						2 % channel bandwidth
					-10					1 MHz
± 1 - 5	-10									1 MHz
± 5 - X	-13									
± X - ($BW_{Channel}$ + 5 MHz)	-25									
NOTE: X is defined in Table 6.5.2.3.2-1 for CP-OFDM and 6.5.2.3.2-2 for DFT-S-OFDM										

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5.2.3.2.

6.5.2.3.3.3 Requirements for network signalled value "NS_03"

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS_03", is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.2.3.3-1.

Table 6.5.2.3.3.3-1: Additional requirements for "NS_03"

Spectrum emission limit (dBm)/ Channel bandwidth						
Δf_{OOB} (MHz)	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**40 MHz**	**Measurement bandwidth**
± 0-1	-13	-13	-13	-13	-13	1 % of channel BW
± 1-6	-13	-13	-13	-13	-13	1 MHz
± 6-10	-25	-13	-13	-13	-13	1 MHz
± 10-15		-25	-13	-13	-13	1 MHz
± 15-20			-25	-13	-13	1 MHz
± 20-25				-25	-13	1 MHz
± 25-40					-13	1 MHz
± 40-45					-25	1 MHz

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

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5.2.3.3.

6.5.2.3.3.4 Requirements for network signalled value "NS_06"

Additional spectrum emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

When "NS_06" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.2.3.4-1.

Table 6.5.2.3.3.4-1: Additional requirements for “NS_06”

<table>
<tr><th colspan="5">Spectrum emission limit (dBm) / Channel bandwidth</th></tr>
<tr><th>Δf_{OOB} (MHz)</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>Measurement bandwidth</th></tr>
<tr><td>± 0 – 0.1</td><td>-15</td><td>-18</td><td>-20</td><td>30 kHz</td></tr>
<tr><td>± 0.1 – 1</td><td>-13</td><td>-13</td><td>-13</td><td>100 kHz</td></tr>
<tr><td>± 1 – 6</td><td>-13</td><td rowspan="2">-13</td><td rowspan="3">-13</td><td rowspan="4">1 MHz</td></tr>
<tr><td>± 6 – 10</td><td>-25</td></tr>
<tr><td>± 10 – 15</td><td></td><td>-25</td></tr>
<tr><td>± 15 – 20</td><td></td><td></td><td>-25</td></tr>
</table>

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5.2.3.4.

6.5.2.3.3.5 Void

6.5.2.3.3.6 Void

6.5.2.3.3.7 Void

6.5.2.3.4 Test description

6.5.2.3.4.1 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 6.2.3.4.1-1 through 6.2.3.4.1-2”. 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.

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 Annex G.0, G.1, G.2, G.3.0..

4. The UL Reference Measurement channels are set according to the applicable table from Table 6.2.3.4.1-1 to Table 6.2.3.4.1-2.

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 6.2.3.4.3.

6.5.2.3.4.2 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 the applicable table from table 6.2.4.3.1-1 to table 6.2.4.3.1-2.1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE. Allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.

3. Measure the mean power of the UE in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration one sub-frame (1ms). For TDD slots with transient periods are not under test.

6.5.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6, with the following exceptions for each network signalled value.

6.5.2.3.4.3.1 Message contents exceptions (network signalled value "NS_35")

For " NS_35" see A-MPR test case in table 6.2.3.4.3.2-1.

6.5.2.3.4.3.2 Message contents exceptions (network signalled value "NS_04")

For "NS_04" see A-MPR test case in table 6.2.3.4.3.4-1.

6.5.2.3.5 Test requirement

Table 6.5.2.3.5-1: Test Tolerance (Additional spectrum emission mask)

	f ≤ 3.0GHz	3.0GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6.0GHz
BW ≤ 100MHz	1.5 dB	1.8 dB	1.8 dB

6.5.2.3.5.1 Test requirements (network signalled value "NS_35")

When "NS_35" is indicated in the cell:

- the measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in table 6.2.3.5-1 as appropriate for a NR UE.

and

- the power of any UE emission shall fulfil requirements in table 6.5.2.3.5.1-1, as applicable.

Table 6.5.2.3.5.1-1: Additional test requirements "NS_35"

Spectrum emission limit (dBm) / Channel bandwidth					
Δf_{OOB} (MHz)	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Measurement bandwidth (unless otherwise stated)**
± 0-0.1	13.5	16.5	18.5	19.5	30 kHz
± 0.1-6	11.5	11.5	11.5	11.5	100 kHz
± 6-10	23.5 [1]	11.5	11.5	11.5	100 kHz
± 10-15		23.5[1]	11.5	11.5	100 kHz
± 15-20			23.5 [1]	11.5	100 kHz
± 20-25				23.5	1 MHz
NOTE 1: The measurement bandwidth shall be 1 MHz					

6.5.2.3.5.2 Test requirements (network signalled value "NS_04")

When "NS_04" is indicated in the cell:

- the measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in Table 6.2.3.5-2 for UE power class 2 or Table 6.2.3.5-3 UE power class 3.

and

- the power of any UE emission shall fulfil requirements in table 6.5.2.3.5.2-1.

Table 6.5.2.3.5.2-1: Additional test requirements for "NS_04"

	Spectrum emission limit (dBm) / measurement bandwidth for each channel bandwidth									
Δf_{OOB} MHz	**10 MHz**	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**90 MHz**	**100 MHz**	**Measurement bandwidth**
± 0 - 1	-10 + TT	-10 + TT	-10 + TT	-10 + TT						2 % channel bandwidth
					-10 + TT					1 MHz
± 1 - 5	-10 + TT									1 MHz
± 5 - X	-13 + TT									
± X - ($BW_{Channel}$ + 5 MHz)	-25 + TT									
NOTE1: X is defined in Table 6.5.2.3.2-1 for CP-OFDM and 6.5.2.3.2-2 for DFT-S-OFDM NOTE2: TT for each frequency and channel bandwidth is specified in Table 6.5.2.3.5-1.										

6.5.2.4 Adjacent channel leakage ratio

Adjacent channel leakage power Ratio (ACLR) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency.

6.5.2.4.1 NR ACLR

6.5.2.4.1.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5.2.4.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.5.2.4.1.3 Minimum conformance requirements

NR adjacent channel leakage power ratio (NR_{ACLR}) is the ratio of the filtered mean power centred on the assigned NR channel frequency to the filtered mean power centred on an adjacent NR channel frequency at nominal channel spacing.

The assigned NR channel power and adjacent NR channel power are measured with rectangular filters with measurement bandwidths specified in Table 6.5.2.4.1.3-1.

If the measured adjacent channel power is greater than –50dBm then the NR_{ACLR} shall be higher than the value specified in Table 6.5.2.4.1.3-2.

Table 6.5.2.4.1.3-1: NR ACLR measurement bandwidth

NR channel bandwidth / NR ACLR measurement bandwidth												
	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
NR ACLR measurement bandwidth	4.515	9.375	14.235	19.095	23.955	28.815	38.895	48.615	58.35	78.15	88.23	98.31

Table 6.5.2.4.1.3-2: NR ACLR requirement

	Power class 1	Power class 2	Power class 3
NR ACLR		31 dB	30 dB

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5.2.4.1.

6.5.2.4.1.4 Test description

6.5.2.4.1.4.1 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 channel bandwidth and sub-carrier spacing, are shown in table 6.5.2.4.1.4.1-1. 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 6.5.2.4.1.4.1-1: Test Configuration Table

Default 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, Highest		
Test SCS as specified in Table 5.3.5-1				Lowest, Highest		
Test Parameters for Channel Bandwidths						
Test ID	**Freq**	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
		Default	Default	N/A for Adjacent Channel Leakage Ratio test case	**Modulation (NOTE 2)**	**RB allocation (NOTE 1)**
1[3]	Default				DFT-s-OFDM PI/2 BPSK	Inner_Full
2[3]	Low				DFT-s-OFDM PI/2 BPSK	Edge_1RB_Left
3[3]	High				DFT-s-OFDM PI/2 BPSK	Edge_1RB_Right
4[3]	Default				DFT-s-OFDM PI/2 BPSK	Outer_Full
5[4]	Default				DFT-s-OFDM PI/2 BPSK	Inner_Full
6[4]	Low				DFT-s-OFDM PI/2 BPSK	Edge_1RB_Left
7[4]	High				DFT-s-OFDM PI/2 BPSK	Edge_1RB_Right
8[4]	Default				DFT-s-OFDM PI/2 BPSK	Outer_Full
9	Default				DFT-s-OFDM QPSK	Inner_Full
10	Low				DFT-s-OFDM QPSK	Edge_1RB_Left
11	High				DFT-s-OFDM QPSK	Edge_1RB_Right
12	Default				DFT-s-OFDM QPSK	Outer_Full
13	Default				DFT-s-OFDM 16 QAM	Inner_Full
14	Low				DFT-s-OFDM 16 QAM	Edge_1RB_Left
15	High				DFT-s-OFDM 16 QAM	Edge_1RB_Right
16	Default				DFT-s-OFDM 16 QAM	Outer_Full
17	Low				DFT-s-OFDM 64 QAM	Edge_1RB_Left
18	High				DFT-s-OFDM 64 QAM	Edge_1RB_Right
18	Default				DFT-s-OFDM 64 QAM	Outer_Full
20	Low				DFT-s-OFDM 256 QAM	Edge_1RB_Left
21	High				DFT-s-OFDM 256 QAM	Edge_1RB_Right
22	Default				DFT-s-OFDM 256 QAM	Outer_Full
23	Default				CP-OFDM QPSK	Inner_Full
24	Low				CP-OFDM QPSK	Edge_1RB_Left
25	High				CP-OFDM QPSK	Edge_1RB_Right
26	Default				CP-OFDM QPSK	Outer_Full
27	Default				CP-OFDM 16 QAM	Inner_Full
28	Low				CP-OFDM 16 QAM	Edge_1RB_Left
29	High				CP-OFDM 16 QAM	Edge_1RB_Right

30	Default				CP-OFDM 16 QAM	Outer_Full
31	Low				CP-OFDM 64 QAM	Edge_1RB_Left
32	High				CP-OFDM 64 QAM	Edge_1RB_Right
33	Default				CP-OFDM 64 QAM	Outer_Full
34	Low				CP-OFDM 256 QAM	Edge_1RB_Left
35	High				CP-OFDM 256 QAM	Edge_1RB_Right
36	Default				CP-OFDM 256 QAM	Outer_Full
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1. NOTE 2: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1. NOTE 3: UE operating in TDD mode with PI/2 BPSK modulation and UE indicates support for UE capability *powerBoosting-pi2BPSK* and the IE *powerBoostPi2BPSK* is set to 1 for bands n40, n41, n77, n78 and n79. NOTE 4: UE operating in FDD mode, or in TDD mode in bands other than n40, n41, n77, n78 and n79, or in TDD mode the IE *powerBoostPi2BPSK* is set to 0 for bands n40, n77, n78 and n79.						

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 channels are set according to Table 6.5.2.4.1.4.1-1.

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 6.5.2.4.1.4.3

6.5.2.4.1.4.2 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 6.5.2.2.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Send continuously power control "up" commands to the UE until the UE transmits at P_{UMAX} level. Allow at least 200ms for the UE to reach P_{UMAX} level.

3. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Tables 6.2.2.5-1 and 6.2.2.5-5 as appropriate. The period of the measurement shall be at least the continuous duration of 1ms over consecutive active uplink slots. For TDD, only slots consisting of only UL symbols are under test.

4. Measure the rectangular filtered mean power for the assigned NR channel.

5. Measure the rectangular filtered mean power of the first NR adjacent channel on both lower and upper side of the assigned NR channel, respectively.

6. Calculate the ratios of the power between the values measured in step 4 over step 5 for lower and upper NR ACLR, respectively.

NOTE 1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.5.2.4.1.4.1-1, 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.

6.5.2.4.1.4.3 Message contents

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

6.5.2.4.1.5 Test requirement

The measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in Tables 6.2.2.5-1 and 6.2.2.5-5 as appropriate, and if the measured adjacent channel power is greater than –50 dBm then the measured NR ACLR, derived in step 6, shall be higher than the limits in Table 6.5.2.4.1.5-2.

Table 6.5.2.4.1.5-1: NR ACLR measurement bandwidth

NR channel bandwidth / NR ACLR measurement bandwidth												
	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
NR ACLR measurement bandwidth	4.515	9.375	14.235	19.095	23.955	28.815	38.895	48.615	58.35	78.15	88.23	98.31

Table 6.5.2.4.1.5-2: NR ACLR requirement

	Power class 1	Power class 2	Power class 3
NR ACLR		31 - TT dB	30 - TT dB
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5.2.4.1.5-3.			

Table 6.5.2.4.1.5-3: Test Tolerance (NR ACLR)

	f ≤ 3.0GHz	3.0GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6.0GHz
BW ≤ 100MHz	0.8 dB	0.8 dB	0.8 dB

6.5.2.4.2 UTRA ACLR

6.5.2.4.2.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5.2.4.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.5.2.4.2.3 Minimum conformance requirements

UTRA adjacent channel leakage power ratio ($UTRA_{ACLR}$) is the ratio of the filtered mean power centred on the assigned NR channel frequency to the filtered mean power centred on an adjacent(s) UTRA channel frequency.

$UTRA_{ACLR}$ is specified for the first adjacent UTRA channel ($UTRA_{ACLR1}$) which centre frequency is ± 2.5 MHz from NR channel edge and for the 2nd adjacent UTRA channel ($UTRA_{ACLR2}$) which centre frequency is ± 7.5 MHz from NR channel edge.

The UTRA channel power is measured with an RRC filter with roll-off factor α =0.22 and bandwidth of 3.84 MHz. The assigned NR channel power is measured with a rectangular filter with measurement bandwidth specified in Table 6.5.2.4.1.3-1.

If the measured adjacent channel power is greater than - 50dBm then the $UTRA_{ACLR1}$ and $UTRA_{ACLR2}$ shall be higher than the value specified in Table 6.5.2.4.2.3-1.

Table 6.5.2.4.2.3-1: UTRA ACLR requirement

	Power class 3
$UTRA_{ACLR1}$	33 dB
$UTRA_{ACLR2}$	36 dB

UTRA ACLR requirement is applicable when signalled by the network with network signalling value indicated by the field *additionalSpectrumEmission*.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5.2.4.2.

6.5.2.4.2.4 Test description

6.5.2.4.2.4.1 Initial conditions

Same as in subclause 6.5.2.4.1.4.1 with the following exepction;

- For band n8 and n81, use 15MHz test channel bandwidth instead of Highest if NS_08U is signaled.

6.5.2.4.2.4.2 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 6.5.2.2.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send continuously power control "up" commands to the UE until the UE transmits at P_{UMAX} level. Allow at least 200ms for the UE to reach P_{UMAX} level.
3. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Tables 6.2.2.5-1 and 6.2.2.5-5 as appropriate. The period of the measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD slots with transient periods are not under test.
4. Measure the rectangular filtered mean power for the assigned NR channel.
5. Measure the RRC filtered mean power of the first and the second UTRA adjacent channel on both lower and upper side of the NR channel, respectively.
6. Calculate the ratios of the power between the values measured in step 4 over step 5 for lower and upper UTRA ACLR, respectively.

NOTE 1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.5.2.4.2.4.1-1, 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.

6.5.2.4.2.4.3 Message contents

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

Table 6.5.2.4.2.4.3-1: AdditionalSpectrumEmission

Derivation Path: 38.508-1 [5] clause 4.6.3, Table 4.6.3-1 AdditionalSpectrumEmission			
Information Element	**Value/remark**	**Comment**	**Condition**
AdditionalSpectrumEmission	3 (NS_03U) 3 (NS_05U) 3 (NS_08U) 1 (NS_100)	for band n2, n25, n66 for band n1, n84 for band n8, n81 for band n1, n2, n3, n5, n8, n20, n25, n66, n80, n81, n82, n84 (NOTE1)	
NOTE 1: This NS can be signalled for NR bands that have UTRA services deployed			

6.5.2.4.2.5 Test requirement

The measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in Tables 6.2.2.5-1 and 6.2.2.5-5 as appropriate, and if the measured adjacent channel power is greater than –50 dBm then the measured UTRA ACLR, derived in step 6, shall be higher than the limits in table 6.5.2.2.1.5-2.

Table 6.5.2.4.2.5-1: Measurement bandwidth for NR carrier

NR channel bandwidth / NR ACLR measurement bandwidth												
	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
NR ACLR measurement bandwidth	4.515	9.375	14.235	19.095	23.955	28.815	38.895	48.615	58.35	78.15	88.23	98.31

Table 6.5.2.4.2.5-2: UTRA ACLR requirement

	Power class 3
$UTRA_{ACLR1}$	33 dB -TT
$UTRA_{ACLR2}$	36 dB - TT
NOTE 1: TT = 0.8 dB	

6.5.3 Spurious emissions

Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emissions, intermodulation products and frequency conversion products, but exclude out of band emissions unless otherwise stated. The spurious emission limits are specified in terms of general requirements in line with SM.329 [22] and NR operating band requirement to address UE co-existence.

To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

6.5.3.1 General spurious emissions

6.5.3.1.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions.

6.5.3.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.5.3.1.3 Minimum conformance requirements

This clause specifies the requirements for the specified NR band for Transmitter Spurious emissions requirement with frequency range as indicated in table 6.5.3.1.3-2.

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than Δf_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth. The spurious emission limits in Table 6.5.3.1.3-2 apply for all transmitter band configurations (N_{RB}) and channel bandwidths.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

Table 6.5.3.1.3-1: Boundary between NR out of band and general spurious emission domain

Channel bandwidth	OOB boundary Δf_{OOB} (MHz)
$BW_{Channel}$	$BW_{Channel}$ + 5

Table 6.5.3.1.3-2: Requirement for general spurious emissions limits

Frequency Range	Maximum Level	Measurement bandwidth	NOTE
9 kHz ≤ f < 150 kHz	-36 dBm	1 kHz	
150 kHz ≤ f < 30 MHz	-36 dBm	10 kHz	
30 MHz ≤ f < 1000 MHz	-36 dBm	100 kHz	
1 GHz ≤ f < 12.75 GHz	-30 dBm	1 MHz	
	-25 dBm	1 MHz	3
12.75 GHz ≤ f < 5th harmonic of the upper frequency edge of the UL operating band in GHz	-30 dBm	1 MHz	1
12.75 GHz < f < 26 GHz	-30 dBm	1 MHz	2
NOTE 1: Applies for Band that the upper frequency edge of the UL Band more than 2.69 GHz NOTE 2: Applies for Band that the upper frequency edge of the UL Band more than 5.2 GHz NOTE 3: Applies for Band n41, CA configurations including Band n41, and EN-DC configurations that include n41 specified in sub-clause 5.2B of [4] when NS_04 is signalled.			

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.1

6.5.3.1.4 Test description

6.5.3.1.4.1 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 channel bandwidth and sub-carrier spacing, are shown in table 6.5.3.1.4.1-1. 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 6.5.3.1.4.1-1: 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.		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**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for Spurious Emissions testing	CP-OFDM QPSK	OuterFull
2		CP-OFDM QPSK	Edge_1RB_Left
3		CP-OFDM QPSK	Edge_1RB_Right
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.1 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 and 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 6.5.3.1.4.1-1.

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 6.5.3.1.4.3.

6.5.3.1.4.2 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 6.5.3.1.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at P_{UMAX} level.

3. Measure the power of the transmitted signal with a measurement filter of bandwidths according to table 6.5.3.1.5-1. The centre frequency of the filter shall be stepped in contiguous steps according to table 6.5.3.1.5-1. The measured power shall be verified for each step. The measurement period shall capture the active time slots.

6.5.3.1.4.3 Message contents

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

6.5.3.1.5 Test requirement

This clause specifies the requirements for the specified NR band for Transmitter Spurious emissions requirement with frequency range as indicated in table 6.5.3.1.5-1.

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than Δf_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth. The spurious emission limits in Table 6.5.3.1.5-1 apply for all transmitter band configurations (NRB) and channel bandwidths.

The measured average power of spurious emission, derived in step 3, shall not exceed the described value in Table 6.5.3.1.5-1.

Table 6.5.3.1.5-1: General spurious emissions test requirements

Frequency Range	Maximum Level	Measurement bandwidth	NOTE
9 kHz ≤ f < 150 kHz	-36 dBm	1 kHz	
150 kHz ≤ f < 30 MHz	-36 dBm	10 kHz	
30 MHz ≤ f < 1000 MHz	-36 dBm	100 kHz	
1 GHz ≤ f < 12.75 GHz	-30 dBm	1 MHz	
	-25 dBm	1 MHz	3
12.75 GHz ≤ f < 5th harmonic of the upper frequency edge of the UL operating band in GHz	-30 dBm	1 MHz	1
12.75 GHz < f < 26 GHz	-30 dBm	1 MHz	2
NOTE 1: Applies for Band that the upper frequency edge of the UL Band more than 2.69 GHz NOTE 2: Applies for Band that the upper frequency edge of the UL Band more than 5.2 GHz NOTE 3: Applies for Band n41, CA configurations including Band n41, and EN-DC configurations that include n41 specified in sub-clause 5.2B of [4] when NS_04 is signalled.			

6.5.3.2 Spurious emission for UE co-existence

6.5.3.2.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to co-existing systems for the specified bands which has specific requirements in terms of transmitter spurious emissions.

6.5.3.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.5.3.2.3 Minimum conformance requirements

This clause specifies the requirements for the specified NR band for coexistence with protected bands as indicated in Table 6.5.3.2.3-1.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

Table 6.5.3.2.3-1: Requirements for spurious emissions for UE co-existence

NR Band	Spurious emission for UE co-existence						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
n1, n84	E-UTRA Band 1, 5, 7, 8, 11, 18, 19, 20, 21, 22, 26, 27, 28, 31, 32, 38, 40, 41, 42, 43, 44, 45, 50, 51, 65, 67, 68, 69, 72, 73, 74, 75, 76 NR Band n78, n79	F_{DL_low}	--	F_{DL_high}	-50	1	
	NR Band n77	F_{DL_low}	-	F_{DL_high}	-50	1	2
	E-UTRA Band 3, 34	F_{DL_low}	-	F_{DL_high}	-50	1	15
	Frequency range	1880	-	1895	-40	1	15, 27
	Frequency range	1895	-	1915	-15.5	5	15, 26, 27
	Frequency range	1915	-	1920	+1.6	5	15, 26, 27
n2	E-UTRA Band 4, 5, 10, 12, 13, 14, 17, 24, 26, 27, 28, 29, 30, 41, 42, 48, 50, 51, 66, 70, 71, 74	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 2, 25	F_{DL_low}	-	F_{DL_high}	-50	1	15
	E-UTRA Band 43	F_{DL_low}	-	F_{DL_high}	-50	1	2
n3, n80	E-UTRA Band 1, 5, 7, 8, 20, 26, 27, 28, 31, 32, 33, 34, 38, 39, 40, 41, 43, 44, 45, 50, 51, 65, 67, 68, 69, 72, 73,74, 75, 76 NR Band n79	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 3	F_{DL_low}	-	F_{DL_high}	-50	1	15
	E-UTRA Band 11, 18, 19, 21	F_{DL_low}	-	F_{DL_high}	-50	1	13
	E-UTRA Band 22, 42 NR Band n77, n78	F_{DL_low}	-	F_{DL_high}	-50	1	2
	Frequency range	1884.5	-	1915.7	-41	0.3	13
n5	E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 12, 13, 14, 17, 18, 19, 24, 25, 26, 28, 29, 30, 31, 34, 38, 40, 42, 43, 45, 48, 50, 51, 65, 66, 70, 71, 73, 74, 85	F_{DL_low}	-	F_{DL_high}	-50		
	E-UTRA Band 41, 52	F_{DL_low}	-	F_{DL_high}	-50	1	2
	E-UTRA Band 11, 21	F_{DL_low}	-	F_{DL_high}	-50	1	39
	Frequency range	1884.5	-	1915.7	-41	0.3	8,39
n7	E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 10, 12, 13, 14, 17, 20, 22, 26, 27, 28, 29, 30, 31, 32, 33, 34, 40, 42, 43, 50, 51, 65, 66, 67, 68, 72, 74, 75, 76 NR Band n77, n78	F_{DL_low}	-	F_{DL_high}	-50	1	
	Frequency range	2570	-	2575	+1.6	5	15, 21, 26
	Frequency range	2575	-	2595	-15.5	5	15, 21, 26
	Frequency range	2595	-	2620	-40	1	15, 21
n8, n81	E-UTRA Band 1, 20, 28, 31, 32, 33, 34, 38, 39, 40, 45, 50, 51, 65, 67, 68, 69, 72, 73, 74, 75, 76	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA band 3, 7, 22, 41, 42, 43 NR Band n77, n78, n79	F_{DL_low}	-	F_{DL_high}	-50	1	2
	E-UTRA 8	F_{DL_low}	-	F_{DL_high}	-50	1	15
	E-UTRA Band 11, 21	F_{DL_low}	-	F_{DL_high}	-50	1	23
	Frequency range	1884.5	-	1915.7	-41	0.3	8
n12	E-UTRA Band 2, 5, 13, 14, 17, 24, 25, 26, 27, 30, 41, 48, 50, 51, 71, 74	F_{DL_low}	-	F_{DL_high}	-50	1	

	E-UTRA Band 4, 10, 66, 70	F_{DL_low}	-	F_{DL_high}	-50	1	2
	E-UTRA Band 12, 85	F_{DL_low}	-	F_{DL_high}	-50	1	15
n20, n82	E-UTRA Band 1, 3, 7, 8, 22, 31, 32, 33, 34, 40, 43, 50, 51, 65, 67, 68, 72, 74, 75, 76	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 20	F_{DL_low}	-	F_{DL_high}	-50	1	15
	E-UTRA Band 38, 42, 69 NR Band n77, n78	F_{DL_low}	-	F_{DL_high}	-50	1	2
	Frequency range	758	-	788	-50	1	
n25	E-UTRA Band 4, 5, 10,12, 13, 14, 17, 24, 26, 27, 28, 29, 30, 41, 42, 48, 66, 70, 71, 85	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 2	F_{DL_low}	-	F_{DL_high}	-50	1	15
	E-UTRA Band 25	F_{DL_low}	-	F_{DL_high}	-50	1	15
	E-UTRA Band 43	F_{DL_low}	-	F_{DL_high}	-50	1	2
n28, n83	E-UTRA Band 1, 4, 10, 22, 42, 43, 50, 51, 65, 73, 74, 75, 76 NR Band n77, n78	F_{DL_low}	-	F_{DL_high}	-50	1	2
	E-UTRA Band 1	F_{DL_low}	-	F_{DL_high}	-50	1	19, 25
	E-UTRA Band 2, 3, 5, 7, 8, 18, 19, 20, 25, 26, 27, 31, 34, 38, 40, 41, 66, 72 NR Band n79	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 11, 21	F_{DL_low}	-	F_{DL_high}	-50	1	19, 24
	Frequency range	470	-	694	-42	8	15, 35
	Frequency range	470	-	710	-26.2	6	34
	Frequency range	662	-	694	-26.2	6	15
	Frequency range	758	-	773	-32	1	15
	Frequency range	773	-	803	-50	1	
	Frequency range	1884.5	-	1915.7	-41	0.3	8, 19
n34	E-UTRA Band 1, 3, 7, 8, 11, 18, 19, 20, 21, 22, 26, 28, 31, 32, 33, 38,39, 40, 41, 42, 43, 44, 45, 50, 51, 65, 67, 69, 72, 74, 75, 76 NR Band n78, n79	F_{DL_low}	-	F_{DL_high}	-50	1	5
	NR Band n77	F_{DL_low}	-	F_{DL_high}	-50	1	2
	Frequency range	1884.5	-	1915.7	-41	0.3	8
n38	E-UTRA Band 1, 2, 3, 4, 5, 8, 10, 12, 13, 14, 17, 20, 22, 27, 28, 29, 30, 31, 32, 33, 34, 40, 42, 43, 50, 51, 65, 66, 67, 68, 72, 74, 75, 76	F_{DL_low}	-	F_{DL_high}	-50	1	
	Frequency range	2620	-	2645	-15.5	5	15, 22, 26
	Frequency range	2645	-	2690	-40	1	15, 22
n39	E-UTRA Band 1, 8, 22, 26, 34, 40, 41, 42, 44, 45, 50, 51, 74 NR Band n79	F_{DL_low}	-	F_{DL_high}	-50		
	Frequency range	1805	-	1855	-40	1	33
	Frequency range	1855	-	1880	-15.5	5	15, 26, 33
n40	E-UTRA Band 1, 3, 5, 7, 8, 20, 22, 26, 27, 28, 31, 32, 33, 34, 38, 39, 41, 42, 43, 44, 45, 50, 51, 65, 67, 68, 69, 72, 74, 75, 76 NR Band n77, n78	F_{DL_low}	-	F_{DL_high}	-50	1	
	NR Band n79	F_{DL_low}	-	F_{DL_high}	-50	1	2
n41	E-UTRA Band 1, 2, 3, 4, 5, 8, 10, 12, 13, 14, 17, 24, 25, 26, 27, 28, 29, 30, 34, 39, 42, 44, 45, 48, 50, 51, 65, 66, 70, 71, 73, 74 NR Band n77, n78	F_{DL_low}	-	F_{DL_high}	-50	1	
	NR Band n79	F_{DL_low}	-	F_{DL_high}	-50	1	2

	E-UTRA Band 9, 11, 18, 19, 21	F_{DL_low}	-	F_{DL_high}	-50	1	30
	Frequency range	1884.5		1915.7	-41	0.3	8, 30
n50	E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 20, 26, 28, 29, 31, 34, 38, 39, 40, 41, 42, 43, 48, 65, 66, 67, 68	F_{DL_low}	-	F_{DL_high}	-50	1	
n51	E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 20, 26, 28, 29, 31, 34, 38, 39, 40, 41, 42, 43, 48, 65, 66, 67, 68	F_{DL_low}	-	F_{DL_high}	-50	1	
n66, n86	E-UTRA Band 2, 4, 5, 7, 12, 13, 17, 26, 28, 29, 38, 41, 43, 66, 70, 71	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 42, 48	F_{DL_low}	-	F_{DL_high}	-50	1	2
n70	E-UTRA Band 2, 4, 5, 10, 12, 13, 14, 17, 24, 25, 29, 30, 41, 48, 66, 70, 71	F_{DL_low}	-	F_{DL_high}	-50	1	2
n71	E-UTRA Band 4, 5, 12, 13, 14, 17, 24, 26, 30, 48, 66, 85	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 2, 25, 41, 70	F_{DL_low}	-	F_{DL_high}	-50	1	2
	E-UTRA Band 29	F_{DL_low}	-	F_{DL_high}	-38	1	15
	E-UTRA Band 71	F_{DL_low}	-	F_{DL_high}	-50	1	15
n74	E-UTRA Band 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 18, 19, 20, 26, 28, 29, 31, 34, 38, 39, 40, 41, 42, 43, 48, 65, 66, 67, 68	F_{DL_low}	-	F_{DL_high}	-50	1	
	Frequency range	1884.5	-	1915.7	-41	0.3	8
	Frequency range	1400	-	1427	-32	27	15, 41
	Frequency range	1475	-	1488	-50	1	42
	Frequency range	1488	-	1518	-50	1	15
n77, n78	E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 26, 28, 34, 39, 40, 41, 65	F_{DL_low}	-	F_{DL_high}	-50	1	
	Frequency range	1884.5	-	1915.7	-41	0.3	8
n79	E-UTRA Band 1, 3, 5, 8, 11, 18, 19, 21, 28, 34, 39, 40, 41, 42, 65	F_{DL_low}	-	F_{DL_high}	-50	1	
	Frequency range	1884.5	-	1915.7	-41	0.3	8
n80	See n3						
n81	See n8						
n82	See n20						
n83	See n28						
n84	See n1						
n86	See n66						

NOTE 1: F_{DL_low} and F_{DL_high} refer to each frequency band specified in Table 5.2-1 for NR band, Table 5.5-1 in TS 36.521-1 [21] for E-UTRA band.
NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1.3-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th [or 5th] harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x RBSizekHz), where N is 2, 3, 4, [5] for the 2nd, 3rd, 4th [or 5th] harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.
NOTE 3: 15 kHz SCS is assumed when RB is mentioned in the note when channel bandwidth is less than or equal to 50MHz, lowest SCS is assumed when channel bandwidth is larger than 50MHz.
NOTE 4: Void
NOTE 5: For non synchronised TDD operation to meet these requirements some restriction will be needed for either the operating band or protected band.
NOTE 6: N/A
NOTE 7: Void.
NOTE 8: Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz.
NOTE 9: Void
NOTE 10: Void
NOTE 11: Void
NOTE 12: Void
NOTE 13: This requirement applies for 5, 10, 15 and 20 MHz NR channel bandwidth allocated within 1744.9MHz and 1784.9MHz.
NOTE 14: Void
NOTE 15: These requirements also apply for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.6.3.1.3-1 and Table 6.6A.3.1.3-1 from the edge of the channel bandwidth.
NOTE 16: Void
NOTE 17: Void
NOTE 18: Void
NOTE 19: Applicable when the assigned NR carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.
NOTE 20: Void
NOTE 21: This requirement is applicable for any channel bandwidths within the range 2500 - 2570 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 - 2560 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.
NOTE 22: This requirement is applicable for power class 3 UE for any channel bandwidths within the range 2570 - 2615 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2605.5 - 2607.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2597 - 2605 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. For power class 2 UE for any channel bandwidths within the range 2570 - 2615 MHz, NS_44 shall apply. For power class 2 or 3 UE for carriers with channel bandwidth overlapping the frequency range 2615 - 2620 MHz the requirement applies with the maximum output power configured to +19 dBm in the IE P-Max.
NOTE 23: Void.
NOTE 24: As exceptions, measurements with a level up to the applicable requirement of -38 dBm/MHz is permitted for each assigned NR carrier used in the measurement due to 2nd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.3.3-1) for which the 2nd harmonic totally or partially overlaps the measurement bandwidth (MBW).
NOTE 25: As exceptions, measurements with a level up to the applicable requirement of -36 dBm/MHz is permitted for each assigned NR carrier used in the measurement due to 3rd harmonic spurious emissions. An exception is allowed if there is at least one individual RB within the transmission bandwidth (see Figure 5.3.3-1) for which the 3rd harmonic totally or partially overlaps the measurement bandwidth (MBW).
NOTE 26: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.
NOTE 27: This requirement is applicable for any channel bandwidths within the range 1920 - 1980 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1927.5 - 1929.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1930 - 1938 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB.
NOTE 28: Void
NOTE 29: Void
NOTE 30: This requirement applies when the NR carrier is confined within 2545-2575MHz or 2595-2645MHz and the channel bandwidth is 10 or 20 MHz

NOTE 31: Void NOTE 32: Void NOTE 33: This requirement is only applicable for carriers with bandwidth confined within 1885-1920 MHz (requirement for carriers with at least 1RB confined within 1880 - 1885 MHz is not specified). This requirement applies for an uplink transmission bandwidth less than or equal to 54 RB for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 1892.5 - 1894.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 1895 - 1903 MHz. NOTE 34: This requirement is applicable for 5 and 10 MHz NR channel bandwidth allocated within 718-728MHz. For carriers of 10 MHz bandwidth, this requirement applies for an uplink transmission bandwidth less than or equal to 30 RB with Restart > 1 and Restart<48. NOTE 35: This requirement is applicable in the case of a 10 MHz NR carrier confined within 703 MHz and 733 MHz, otherwise the requirement of -25 dBm with a measurement bandwidth of 8 MHz applies. NOTE 36: Void NOTE 37: VoidNOTE 38: Void NOTE 39: Void. NOTE 40: Void NOTE 41: Applicable for cases when the lower edge of the assigned NR UL channel bandwidth frequency is greater than or equal to 1427 MHz + the channel BW assigned for 5 and 10 MHz bandwidth, and when the lower edge of the assigned NR UL channel bandwidth frequency is greater than or equal to 1440 MHz for 15 and 20 MHz bandwidth. NOTE 42: Applicable for 5 MHz bandwidth, and when the upper edge of the assigned NR UL channel bandwidth frequency is less than or equal to 1467 MHz assigned for10 MHz bandwidth, and when the upper edge of the assigned NR UL channel bandwidth frequency is less than or equal to 1463.8 MHz for 15 MHz bandwidth, and when the upper edge of the assigned NR UL channel bandwidth frequency is less than or equal to 1460.8 MHz for 20 MHz bandwidth.

Note: To simplify Table 6.5.3.2.3-1, E-UTRA band numbers are listed for bands which are specified only for E-UTRA operation or both E-UTRA and NR operation. NR band numbers are listed for bands which are specified only for NR operation.

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.2.

6.5.3.2.4 Test description

6.5.3.2.4.1 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 channel bandwidth and sub-carrier spacing, are shown in table 6.5.3.2.4.1-1. 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 6.5.3.2.4.1-1: 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.		Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1		Lowest	
Test Parameters			
Ch BW	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
5 MHz	N/A for Spurious Emissions testing	CP-OFDM QPSK	Outer_Full
			Edge_1RB_Left
			Edge_1RB_Right
10 MHz		CP-OFDM QPSK	Outer_Full
			Edge_1RB_Left
			Edge_1RB_Right
15 MHz		CP-OFDM QPSK	Outer_Full
			Edge_1RB_Left
			Edge_1RB_Right
20 MHz		CP-OFDM QPSK	Outer_Full
			Edge_1RB_Left
			Edge_1RB_Right
25 MHz		CP-OFDM QPSK	Outer_Full
			Edge_1RB_Left
			Edge_1RB_Right
30 MHz		CP-OFDM QPSK	Outer_Full
			Edge_1RB_Left
			Edge_1RB_Right
40 MHz		CP-OFDM QPSK	Outer_Full
			Edge_1RB_Left
			Edge_1RB_Right
50 MHz		CP-OFDM QPSK	Outer_Full
			Edge_1RB_Left
			Edge_1RB_Right
60 MHz		CP-OFDM QPSK	Outer_Full
			Edge_1RB_Left
			Edge_1RB_Right
80 MHz		CP-OFDM QPSK	Outer_Full
			Edge_1RB_Left
			Edge_1RB_Right
90 MHz		CP-OFDM QPSK	Outer_Full
			Edge_1RB_Left
			Edge_1RB_Right
100 MHz		CP-OFDM QPSK	Outer_Full
			Edge_1RB_Left
			Edge_1RB_Right
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration.			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, Figure A.3.1.1.1 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 [6] 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 6.5.3.2.4.1-1.

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 6.5.3.2.4.3.

6.5.3.2.4.2 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 6.5.3.2.4.1-1. Since the UE has no payload data to send, the UE transmits 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 P_{UMAX} level.

3. Measure the power of the transmitted signal with a measurement filter of bandwidths according to table 6.5.3.2.3-1. The centre frequency of the filter shall be stepped in contiguous steps according to table 6.5.3.2.3-1. The measured power shall be verified for each step. The measurement period shall capture the active time slots.

6.5.3.2.4.3 Message contents

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

6.5.3.2.5 Test requirement

Test requirements for Spurious Emissions UE Co-existence are the same as the minimum requirements and are not repeated in this section.

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than Δf_{OOB} (MHz) in Table 6.5.3.2.3-1 from the edge of the channel bandwidth. The spurious emission limits in Table 6.5.3.2.3-1 apply for all transmitter band configurations (NRB) and channel bandwidths.

The measured average power of spurious emission, derived in step [3], shall not exceed the described value in Table 6.5.3.2.3-1.

NOTE 1: The frequency range applicable with network signalled values of NS_04, NS_17, NS_18, NS_05, NS_43, NS_37, NS_38, NS_39, NS_40, NS_41, and NS_42 are covered in subclause 6.6.3.3 Additional Spurious Emissions.

NOTE 2: The following is applied to Note 2 in Table 6.6.3.2.3-1. For frequency with 2nd, 3rd or 4th harmonic spurious emissions, the measurements are covered in subclause 6.5.3.1.

NOTE 3: The restriction on the maximum uplink transmission to 54 RB in Notes 21 and 22 of Table 6.5.3.2.3-1 is intended for conformance testing and may be applied to network operation to facilitate coexistence when the aggressor and victim bands are deployed in the same geographical area. The applicable spurious emission requirement of -15.5 dBm/5MHz is a least restrictive technical condition for FDD/TDD coexistence and may have to be revised in the future.

6.5.3.3 Additional spurious emissions

Editor’s note: Initial conditions for NS_17, NS_18, NS_05, NS_43, NS_37, NS_38, NS_39, NS_40, NS_41, and NS_42 are incomplete.

6.5.3.3.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions under the deployment scenarios where additional requirements are specified.

6.5.3.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.5.3.3.3 Minimum conformance requirements

These requirements are specified in terms of an additional spectrum emission requirement. Additional spurious emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

6.5.3.3.3.1 Minimum conformance requirements (network signalled value "NS_04")

When "NS 04" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.3.1-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.3.1-1: Additional requirements for “NS_04”

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth
	10, 15, 20, 40, 50, 60, 80, 90, 100 MHz	
2495 ≤ f < 2496	-13	1% of Channel BW
2490.5 ≤ f < 2495	-13	1 MHz
0.009 < f < 2490.5	-25	1 MHz

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.3.1.

6.5.3.3.3.2 Minimum conformance requirements (network signalled value "NS_17")

When “NS_17” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.3.2-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.3.2-1: Additional requirements for “NS_17”

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth	NOTE
	5, 10 MHz		
470 ≤ f ≤ 710	-26.2	6 MHz	1
NOTE 1: Applicable when the assigned E-UTRA carrier is confined within 718 MHz and 748 MHz and when the channel bandwidth used is 5 or 10 MHz.			

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.3.2.

6.5.3.3.3.3 Minimum conformance requirements (network signalled value "NS_18")

When “NS_18” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.3.3-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.3.3-1: Additional requirements for “NS_18”

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth	NOTE
	5, 10, 15, 20 MHz		
692-698	-26.2	6 MHz	

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.3.3.

6.5.3.3.3.4 Minimum conformance requirements (network signalled value "NS_05")

When “NS_05” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.3.4-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.3.4-1: Additional requirements for “NS_05”

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth	NOTE
	5, 10, 15, 20 MHz		
1884.5 ≤ f ≤1915.7	-41	300 KHz	

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.3.4.

6.5.3.3.3.5 Minimum conformance requirements (network signalled value "NS_43")

When “NS_43” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.3.5-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.3.5-1: Additional requirement for “NS_43”

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)			Measurement bandwidth
	5 MHz	10 MHz	15 MHz	
860 ≤ f ≤ 890	-40	-40	-40	1 MHz
NOTE 1: Applicable for channel BW confined between 900 MHz and 915 MHz				

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.3.5.

6.5.3.3.3.6 Minimum conformance requirements (network signalled value "NS_37")

When “NS 37” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.6-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.6-1: Additional requirement for “NS_37”

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth
	5, 10, 15, 20 MHz	
1475.9 ≤ f ≤ 1510.9	-35	1 MHz

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.3.6.

6.5.3.3.3.7 Minimum conformance requirements (network signalled value "NS_38")

When “NS 38” is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.7-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.7-1: Additional requirements for "NS_38"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth
	5, 10, 15, 20 MHz	
1400 ≤ f ≤ 1427	-32	27MHz
NOTE 1: This requirement shall be verified with UE transmission power of 15 dBm.		

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.3.7.

6.5.3.3.3.8 Minimum conformance requirements (network signalled value "NS_39")

When "NS 39" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.8-1. This requirement also applies for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.8-1: Additional requirements

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth
	5 MHz, 10 MHz, 15 MHz, 20 MHz	
1475 ≤ f ≤ 1488	-28	1MHz

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.3.8.

6.5.3.3.3.9 Requirement for network signalled value "NS_40"

When "NS_40" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.3.9-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.3.9-1: Additional requirements for NR channels assigned within 1427-1452MHz for "NS_40"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth
	27 MHz	
1400 ≤ f ≤ 1427	-32	27 MHz
NOTE 1: This requirement shall be verified with UE transmission power of 15 dBm.		

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.3.9.

6.5.3.3.3.10 Requirement for network signalled value "NS_41"

When "NS_41" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.3.10-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.3.10-1: Additional requirements for NR channels assigned within 1427-1452 MHz for "NS_41"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth
	27 MHz	
1400 ≤ f ≤ 1427	-32	27 MHz
NOTE 1: This requirement shall be verified with UE transmission power of 15 dBm.		

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.3.10..

6.5.3.3.3.11 Requirement for network signalled value "NS_42"

When "NS_42" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.3.11-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.3.11-1: Additional requirements for NR channels assigned within 1492-1517MHz for "NS_42"

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth
	1 MHz	
1518 ≤ f ≤ 1520	-0.8	1 MHz
1520 < f ≤ 1559	-30	1 MHz

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.3.11.

6.5.3.3.4 Test description

6.5.3.3.4.1 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 these configurations shall be tested with applicable test parameters for each channel bandwidth and sub-carrier spacing, are shown in Table 6.5.3.3.4.1-1 through Table 6.5.3.3.4.1-8 for different NS values. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.5.3.3.4.1-1: Test Configuration Table (network signalled value "NS_04")

Same test configuration as listed in Table 6.2.3.4.1-2 shall be used with the following exceptions:

Test Channel Bandwidths shall be: 10, 15, 20, 40, 50, 60, 80, 90, and 100 MHz.

Test SCS shall be: Lowest.

Table 6.5.3.3.4.1-2: Test Configuration Table (network signalled value "NS_17")

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		[TBD]	
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1		[TBD]	
Test SCS as specified in Table 5.3.5-1		[TBD]	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for Spurious Emissions testing	FFS	FFS
2		FFS	FFS
3		FFS	FFS
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration			

Table 6.5.3.3.4.1-3: Test Configuration Table (network signalled value "NS_18")

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		[TBD]	
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1		[TBD]	
Test SCS as specified in Table 5.3.5-1		[TBD]	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for Spurious Emissions testing	FFS	FFS
2		FFS	FFS
3		FFS	FFS
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration			

Table 6.5.3.3.4.1-4: Test Configuration Table (network signalled value "NS_05")

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		[TBD]	
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1		[TBD]	
Test SCS as specified in Table 5.3.5-1		[TBD]	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for Spurious Emissions testing	FFS	FFS
2		FFS	FFS
3		FFS	FFS
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration			

Table 6.5.3.3.4.1-5: Test Configuration Table (network signalled value "NS_43")

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		[TBD]	
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1		[TBD]	
Test SCS as specified in Table 5.3.5-1		[TBD]	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for Spurious Emissions testing	FFS	FFS
2		FFS	FFS
3		FFS	FFS
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration			

Table 6.5.3.3.4.1-6: Test Configuration Table (network signalled value "NS_37")

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		[TBD]	
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1		[TBD]	
Test SCS as specified in Table 5.3.5-1		[TBD]	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for Spurious Emissions testing	FFS	FFS
2		FFS	FFS
3		FFS	FFS
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration			

Table 6.5.3.3.4.1-7: Test Configuration Table (network signalled value "NS_38")

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		[TBD]	
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1		[TBD]	
Test SCS as specified in Table 5.3.5-1		[TBD]	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for Spurious Emissions testing	FFS	FFS
2		FFS	FFS
3		FFS	FFS
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration			

Table 6.5.3.3.4.1-8: Test Configuration Table (network signalled value "NS_39")

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		[TBD]	
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1		[TBD]	
Test SCS as specified in Table 5.3.5-1		[TBD]	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for Spurious Emissions testing	FFS	FFS
2		FFS	FFS
3		FFS	FFS
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration			

1. Connect the SS to the UE 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 channels are set according to Table 6.5.3.3.4.1-1 through Table 6.5.3.3.4.1-8.

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 6.5.3.3.4.3.

6.5.3.3.4.2 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 6.5.3.3.4.1-1 through Table [TBD]. Since the UE has no payload data to send, the UE transmits 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 P_{UMAX} level.

3. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements with allowed A-MPR values specified in table 6.2.3.5-2 per test condition specified in Table 6.2.3.4.1-2. For NS_04. The measured power shall be verified for each step. The measurement period shall capture the active time slots.

4. Measure the power of the transmitted signal with a measurement filter of bandwidths according to Tables 6.5.3.3.3.1-1 to Table 6.5.3.3.8-1 as appropriate. The centre frequency of the filter shall be stepped in contiguous steps according to the same table.

6.5.3.3.4.3 Message contents

6.6.3.3.4.3.1 Message contents exceptions (network signalled value "NS_04")

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

1. Information element additionalSpectrumEmission is set to NS_04. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.6.3.3.4.3.1-1: *AdditionalSpectrumEmission: A*dditional spurious emissions test requirement for "NS_04"

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_04)		

6.6.3.3.4.3.2 Message contents exceptions (network signalled value "NS_17")

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

1. Information element additionalSpectrumEmission is set to NS_17. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.6.3.3.4.3.2-1: *AdditionalSpectrumEmission: A*dditional spurious emissions test requirement for "NS_17"

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_17)		

6.6.3.3.4.3.3 Message contents exceptions (network signalled value "NS_18")

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

1. Information element additionalSpectrumEmission is set to NS_18. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.6.3.3.4.3.3-1: *AdditionalSpectrumEmission: A*dditional spurious emissions test requirement for "NS_18"

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_18)		

6.6.3.3.4.3.4 Message contents exceptions (network signalled value "NS_05")

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

1. Information element additionalSpectrumEmission is set to NS_05. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.6.3.3.4.3.4-1: *AdditionalSpectrumEmission: A*dditional spurious emissions test requirement for "NS_05"

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_05)		

6.6.3.3.4.3.5 Message contents exceptions (network signalled value "NS_08")

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

1. Information element additionalSpectrumEmission is set to NS_08. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.6.3.3.4.3.5-1: *AdditionalSpectrumEmission: A*dditional spurious emissions test requirement for "NS_43"

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_43)		

6.6.3.3.4.3.6 Message contents exceptions (network signalled value "NS_37")

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

1. Information element additionalSpectrumEmission is set to NS_37. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.6.3.3.4.3.6-1: *AdditionalSpectrumEmission: A*dditional spurious emissions test requirement for "NS_37"

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_37)		

6.6.3.3.4.3.7 Message contents exceptions (network signalled value "NS_38")

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

1. Information element additionalSpectrumEmission is set to NS_38. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.6.3.3.4.3.7-1: *AdditionalSpectrumEmission: A*dditional spurious emissions test requirement for "NS_38"

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_38)		

6.6.3.3.4.3.8 Message contents exceptions (network signalled value "NS_39")

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

1. Information element additionalSpectrumEmission is set to NS_39. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.6.3.3.4.3.8-1: *AdditionalSpectrumEmission: A*dditional spurious emissions test requirement for "NS_39"

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	3 (NS_39)		

6.6.3.3.4.3.9 Message contents exceptions (network signalled value "NS_40")

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

1. Information element additionalSpectrumEmission is set to NS_38. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.6.3.3.4.3.9-1: *AdditionalSpectrumEmission: A*dditional spurious emissions test requirement for "NS_40"

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_40)		

6.6.3.3.4.3.10 Message contents exceptions (network signalled value "NS_41")

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

1. Information element additionalSpectrumEmission is set to NS_38. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.6.3.3.4.3.10-1: *AdditionalSpectrumEmission: A*dditional spurious emissions test requirement for "NS_41"

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_41)		

6.6.3.3.4.3.11 Message contents exceptions (network signalled value "NS_42")

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

1. Information element additionalSpectrumEmission is set to NS_38. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.6.3.3.4.3.11-1: *AdditionalSpectrumEmission: A*dditional spurious emissions test requirement for "NS_42"

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_42)		

6.5.3.3.5 Test requirement

This clause specifies the requirements for the specified NR band for an additional spectrum emission requirement with protected bands as indicated from Table 6.5.3.3.5.1-1 to Table 6.5.3.3.5.8-1 for different NS_values.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

6.5.3.3.5.1 Test requirement (network signalled value “NS_04”)

When "NS 04" is indicated in the cell,

The measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in Table 6.2.3.5-2.

The power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.5.1-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3 from the edge of the channel bandwidth.

Table 6.5.3.3.5.1-1: Additional requirements

Frequency band (MHz)	Channel bandwidth / Spectrum emission limit (dBm)	Measurement bandwidth
	10, 15, 20, 40, 50, 60, 80, 90 100 MHz	
2495 ≤ f < 2496	-13	1% of Channel BW
2490.5 ≤ f < 2495	-13	1 MHz
0 < f < 2490.5	-25	1 MHz

6.5.3.3.5.2 Test requirement (network signalled value “NS_17”)

FFS

6.5.3.3.5.3 Test requirement (network signalled value “NS_18”)

FFS

6.5.3.3.5.4 Test requirement (network signalled value “NS_05”)

FFS

6.5.3.3.5.5 Test requirement (network signalled value "NS_43")

FFS

6.5.3.3.5.6 Test requirement (network signalled value "NS_37")

FFS

6.5.3.3.5.7 Test requirement (network signalled value "NS_38")

FFS

6.5.3.3.5.8 Test requirement (network signalled value "NS_39")

FFS

6.5.3.3.5.9 Test requirement (network signalled value "NS_40")

FFS

6.5.3.3.5.10 Test requirement (network signalled value "NS_41")

FFS

6.5.3.3.5.11 Test requirement (network signalled value "NS_42")

FFS

6.5.4 Transmit intermodulation

6.5.4.1 Test purpose

To verify that the UE transmit intermodulation does not exceed the described value in the test requirement.

The transmit intermodulation performance is a measure of the capability of the transmitter to inhibit the generation of signals in its non linear elements caused by presence of the wanted signal and an interfering signal reaching the transmitter via the antenna.

6.5.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward.

6.5.4.3 Minimum conformance requirements

UE transmit intermodulation is defined by the ratio of the mean power of the wanted signal to the mean power of the intermodulation product when an interfering CW signal is added at a level below the wanted signal at each transmitter antenna port with the other antenna port(s) if any terminated. Both the wanted signal power and the intermodulation product power are measured through NR rectangular filter with measurement bandwidth shown in Table 6.5.4.3-1.

The requirement of transmit intermodulation is specified in Table 6.5.4.3-1.

Table 6.5.4.3-1: Transmit Intermodulation

Wanted signal channel bandwidth	$BW_{Channel}$	
Interference signal frequency offset from channel centre	$BW_{Channel}$	$2*BW_{Channel}$
Interference CW signal level	-40dBc	
Intermodulation product	< -29dBc	< -35dBc
Measurement bandwidth	The maximum transmission bandwidth configuration among the different SCSs for the channel BW as defined in Table 6.5.2.2.3-1	
Measurement offset from channel centre	$BW_{Channel}$ and $2*BW_{Channel}$	$2*BW_{Channel}$ and $4*BW_{Channel}$

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5.4.

6.5.4.4 Test description

6.5.4.4.1 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 channel bandwidth and sub-carrier spacing, and are shown in table 6.5.4.4.1-1. 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 6.5.4.4.1-1: 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		Mid, Highest	
Test SCS as specified in Table 5.3.5-1		Lowest, Highest	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
	N/A for transmit intermodulation test case	**Modulation**	**RB allocation (NOTE 1)**
1		DFT-s-OFDM PI/2 BPSK	Inner Full
2		DFT-s-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, in Figure A.3.1.3.1 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 6.5.4.4.1-1.
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 6.5.4.4.3.

6.5.4.4.2 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 6.5.4.4.1-1. 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 to the UE until the UE transmits at its P_{UMAX} level.

3. Measure the rectangular filtered mean power of the UE. For TDD, only slots consisting of only UL symbols are under test for the wanted signal and for the intermodulation product.

4. Set the interference signal frequency below the UL carrier frequency using the first offset in table 6.5.4.5-1.

5. Set the interference CW signal level according to table 6.5.4.5-1.

6. Search the intermodulation product signals below and above the UL carrier frequency, then measure the rectangular filtered mean power of transmitting intermodulation for both signals, and calculate the ratios with the power measured in step 3.

7. Set the interference signal frequency above the UL carrier frequency using the first offset in table 6.5.4.5-1.

8. Search the intermodulation product signals below and above the UL carrier frequency, then measure the rectangular filtered mean power of transmitting intermodulation for both signals, and calculate the ratios with the power measured in step 3.

9. Repeat the measurement using the second offset in table 6.5.4.5-1.

6.5.4.4.3 Message contents

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

6.5.4.5 Test requirement

The ratio derived in step 6 and 8, shall not exceed the described value in table 6.5.4.5-1.

Table 6.5.4.5-1: Transmit Intermodulation

Wanted signal channel bandwidth	$BW_{Channel}$	
Interference signal frequency offset from channel centre	$BW_{Channel}$	$2*BW_{Channel}$
Interference CW signal level	-40dBc	
Intermodulation product	< -29dBc	< -35dBc
Measurement bandwidth	The maximum transmission bandwidth configuration among the different SCSs for the channel BW as defined in Table 6.5.2.2.3-1	
Measurement offset from channel centre	$BW_{Channel}$ and $2*BW_{Channel}$	$2*BW_{Channel}$ and $4*BW_{Channel}$

6.5A Output RF spectrum emissions for CA

6.5A.1 Occupied bandwidth for CA

6.5A.1.0 Minimum conformance requirements

For inter-band carrier aggregation with one uplink carrier assigned to one NR band, the output RF spectrum emissions requirements in subclause 6.5 apply.

6.5A.1.1 Occupied bandwidth for CA (2UL CA)

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

The connection diagram for inter-band CA in TS 38.508-1[5] Annex A is FFS

TP analysis is FFS

6.5A.1.1.1 Test purpose

To verify that the UE occupied bandwidth for all transmission bandwidth configurations supported by the UE are less than their specific limits for 2 UL CA

6.5A.1.1.2 Test applicability

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

6.5A.1.1.3 Minumum conformance requirements

The minimum conformance requirements are defined in subclause 6.5A.1.0.

6.5A.1.1.4 Test description

6.5A.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, are shown in Table 6.5A.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 6.5A.1.1.4.1-1: Inter band CA Test Configuration Table

<table>
<tr><th colspan="5">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 38.508-1 [5] subclause 4.1</td><td colspan="3">Normal</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="3">Mid range for both PCC and SCC</td></tr>
<tr><td colspan="2">Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="3">[Lowest for both PCC and SCC]
[Highest for both PCC and SCC]</td></tr>
<tr><td colspan="2">Test SCS as specified in Table 5.3.5-1</td><td colspan="3">Smallest supported SCS per Channel Bandwidth</td></tr>
<tr><th colspan="5">Test Parameters</th></tr>
<tr><th rowspan="3">Test ID</th><th rowspan="3">Downlink Configuration for PCC & SCC</th><th colspan="3">Uplink Configuration</th></tr>
<tr><th rowspan="2">Modulation for all CCs (NOTE 2)</th><th colspan="2">RB allocation (NOTE 1)</th></tr>
<tr><th>PCC</th><th>SCC</th></tr>
<tr><td>1</td><td>N/A for this test</td><td>CP-OFDM QPSK</td><td>Outer_Full</td><td>Outer_Full</td></tr>
<tr><td colspan="5">NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.
NOTE 2: CA Configuration Test CC Combination settings are checked separately for each CA Configuration, which applicable aggregated channel bandwidths are specified in Table 5.3A.4-1.
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 5.5A3-1.</td></tr>
</table>

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure [TBD] for TE diagram and section A.3.2.1 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 and 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 6.5A.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 6.5A.1.1.4.3.

6.5A.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 6.5A.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 6.5A.1.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
5. Send continuously power control "up" commands to the UE until the UE transmits at PUMAX level. Allow at least 200ms for the UE to reach PUMAX level.
6. Measure the power spectrum distribution of both PCC and SCC within two times or more range over the requirement for Occupied Bandwidth specification centring on the current carrier frequency. The characteristics of the filter shall be approximately Gaussian (typical spectrum analyser filter). Other methods to measure the power spectrum distribution are allowed. The measuring duration is at least 1ms over consecutive active uplink slots.
7. Calculate the total power within the range of all frequencies measured in step 6 and save this value as "Total power" for both PCC and SCC.
8. Identify the measurement window whose center is aligned on the center of the channel for which the sum of the power measured is 99% of the "Total power" for both PCC and SCC.
9. The "Occupied Bandwidth" is the width of the measurement window obtained in step 8.

6.5A.1.1.4.3 Message contents

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

6.5A.1.1.5 Test requirements

The measured Occupied Bandwidth for each component carrier shall not exceed values in Table 6.5A.1.1.5-1.

Table 6.5A.1.1.5-1: Occupied channel bandwidth

	NR Channel bandwidth											
	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
Occupied channel bandwidth (MHz)	5	10	15	20	25	30	40	50	60	80	90	100

6.5A.2 Out of band emission for CA

6.5A.2.2 Spectrum emission mask

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- The connection diagram for inter-band CA in TS 38.508-1[5] Annex A is FFS.
- Procedure to configure SCC in TS 38.508-1[5] clause [TBD] is FFS.
- The subclause 6.2A. 2 in reference to requirements for transmitter power for inter-band CA is FFS.
- Extending the coverage of the TCs with intra-band CA scenarios is FFS
- MU and TT for CA is FFS in Annex F.

6.5A.2.2.0 Minimum conformance requirements

For inter-band carrier aggregation with uplink assigned to two NR bands, the minimum conformance requirements specified in subclause 6.5.2.2 shall apply on each component carrier with all component carriers active. If for some frequency spectrum emission masks of component carriers overlap then spectrum emission mask allowing higher power spectral density applies for that frequency. If for some frequency a component carrier spectrum emission mask overlaps with the channel bandwidth of another component carrier, then the emission mask does not apply for that frequency.

6.5A.2.2.1 Spectrum emission mask for CA (2UL CA)

6.5A.2.2.1.1 Test purpose

To verify that the power of any UE emission shall not exceed specified level for the specified channel bandwidth for 2UL CA.

6.5A.2.2.1.2 Test applicability

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

6.5A.2.2.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in subclause6.5A.2.2.0.

6.5A.2.2.1.4 Test description

6.5A.2.2.1.4.1 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 CA configuration specified in clause 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, are shown in Table 6.5A.2.2.1.4.1-1. 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 6.5A.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			Lowest for both PCC and SCC Highest for both PCC and SCC			
Test SCS as specified in Table 5.5A.3-1			Smallest and biggest supported SCS per Channel Bandwidth			
Test Parameters						
Test ID	**Freq**	**Downlink Configuration**	**Uplink Configuration**			
			Modulation (NOTE 3)	**RB allocation (NOTE 1)**		
				PCC	**SCC**	
1[3]	Low	N/A	DFT-s-OFDM PI/2 BPSK	Edge_1RB_Left	Edge_1RB_Left	
2[3]	High		DFT-s-OFDM PI/2 BPSK	Edge_1RB_Right	Edge_1RB_Right	
3	Low		DFT-s-OFDM QPSK	Edge_1RB_Left	Edge_1RB_Left	
4	High		DFT-s-OFDM QPSK	Edge_1RB_Right	Edge_1RB_Right	
5	Low		DFT-s-OFDM 16 QAM	Edge_1RB_Left	Edge_1RB_Left	
6	High		DFT-s-OFDM 16 QAM	Edge_1RB_Right	Edge_1RB_Right	
7	Default		DFT-s-OFDM 64 QAM	Outer_Full	Outer_Full	
8	Default		DFT-s-OFDM 256 QAM	Outer_Full	Outer_Full	
9	Low		CP-OFDM QPSK	Edge_1RB_Left	Edge_1RB_Left	
10	High		CP-OFDM QPSK	Edge_1RB_Right	Edge_1RB_Right	
11	Low		CP-OFDM 16 QAM	Edge_1RB_Left	Edge_1RB_Left	
12	High		CP-OFDM 16 QAM	Edge_1RB_Right	Edge_1RB_Right	
13	Default		CP-OFDM 64 QAM	Outer_Full	Outer_Full	
14	Default		CP-OFDM 256 QAM	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 and SCS are specified in Table 5.5A3-1. NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.						

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure [TBD] 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 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 6.5A.2.2.1.4.1-1.

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 6.5A.2.2.1.4.3.

6.5A.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 [TBD]. Message contents are defined in clause 6.5A.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 6.5A.2.2.1.4.1-1 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.

5. Send continuously power control “up” commands in every uplink scheduling information to the UE until the UE transmits at PUMAX level. Allow at least 200ms for the UE to reach PUMAX level.

6. Measure the mean power of the UE in the channel bandwidth of the radio access mode for each CC according to the test configuration, which shall meet the requirements described in clause 6.2A.2. The period of the measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD slots with transient periods are not under test.

7. Measure the power of the transmitted signal with a measurement filter of bandwidths for each CC according to Table 6.5A.2.2.1.5-1. The centre frequency of the filter shall be stepped in continuous steps according to the same table. The measured power shall be recorded for each step. The measurement period shall capture the active TSs.

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.

6.5A.2.2.1.4.3 Message contents

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

6.5A.2.2.1.5 Test requirement

The measured UE mean power in the channel bandwidth for each CC, derived in step 6, shall fulfil requirements in clause 6.2A.2 as appropriate, and the power of any UE emission for each CC, derived in step 7, shall fulfil requirements in Table 6.5A.2.2.1.5-1.If for some frequency spectrum emission masks of component carriers overlap then spectrum emission mask allowing higher power spectral density applies for that frequency. If for some frequency a component carrier spectrum emission mask overlaps with the channel bandwidth of another component carrier, then the emission mask does not apply for that frequency.

Table 6.5A.2.2.1.5-1: NR General spectrum emission mask

<table>
<tr><th colspan="14">Spectrum emission limit (dBm) / Channel bandwidth</th></tr>
<tr><th>Δf_{OOB} (MHz)</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th><th>25 MHz</th><th>30 MHz</th><th>40 MHz</th><th>50 MHz</th><th>60 MHz</th><th>80 MHz</th><th>90 MHz</th><th>100 MHz</th><th>Measurement bandwidth</th></tr>
<tr><td>± 0-1</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td></td><td></td><td></td><td></td><td></td><td>1 % channel bandwidth</td></tr>
<tr><td>± 0-1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>30 kHz</td></tr>
<tr><td>± 1-5</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td rowspan="19">1 MHz</td></tr>
<tr><td>± 5-6</td><td>-13 + TT</td><td rowspan="2">-13 + TT</td><td rowspan="3">-13 + TT</td><td rowspan="4">-13 + TT</td><td rowspan="5">-13 + TT</td><td rowspan="6">-13 + TT</td><td rowspan="8">-13 + TT</td><td rowspan="10">-13 + TT</td><td rowspan="12">-13 + TT</td><td rowspan="14">-13 + TT</td><td rowspan="15">-13 + TT</td><td rowspan="17">-13 + TT</td></tr>
<tr><td>± 6-10</td><td>-25 + TT</td></tr>
<tr><td>± 10-15</td><td></td><td>-25 + TT</td></tr>
<tr><td>± 15-20</td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 20-25</td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 25-30</td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 30-35</td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 35-40</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 40-45</td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 45-50</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 50-55</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 55-60</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 60-65</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 65-80</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 80-90</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 90-95</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 95-100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 100-105</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td colspan="14">Note 1: The first and last measurement position with a 30 kHz filter is at ΔfOOB equals to 0.015 MHz and 0.985 MHz.
Note 2: At the boundary of spectrum emission limit, the first and last measurement position with a 1 MHz filter is the inside of +0.5MHz and -0.5MHz, respectively.
Note 3: The measurements are to be performed above the upper edge of the channel and below the lower edge of the channel.</td></tr>
</table>

Table 6.5A.2.2.1.5-2: Test Tolerance for Spectrum emission mask

	f ≤ 3.0GHz	3.0GHz < f ≤ 6GHz
BW ≤ 40MHz	FFS	FFS
40MHz < BW ≤ 100MHz	FFS	FFS

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

6.5A.2.4 Adjacent channel leakage ratio

6.5A.2.4.1 NR ACLR

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- PC1 and PC4 requirements are missing in TS 38.101-1 [2].
- The connection diagram for inter-band CA in TS 38.508-1[5] Annex A is FFS.
- Procedure to configure SCC in TS 38.508-1[5] clause [TBD] is FFS.
- The subclause 6.2A.2 in reference to requirements for transmitter power for inter-band CA is FFS.
- Extending the coverage of the TCs with intra-band CA scenarios is FFS
- MUs and TTs for CA is FFS in Annex F.

6.5A.2.4.1.0 Minimum conformance requirements

For inter-band carrier aggregation with uplink assigned to two NR bands, the minimum conformance requirements specified in subclause 6.5.2.4.1.3 shall apply on each component carrier with all component carriers active.

6.5A.2.4.1.1 NR ACLR for CA (2UL CA)

6.5A.2.4.1.1.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR) for 2UL CA.

6.5A.2.4.1.1.2 Test applicability

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

6.5A.2.4.1.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in subclause 6.5A.2.4.1.0.

6.5A.2.4.1.1.4 Test description

6.5A.2.4.1.1.4.1 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 CA configuration specified in clause 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, are shown in Table 6.5A.2.4.1.1.4.1-1. 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 6.5A.2.4.1.1.4.1-1: 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 for both PCC and SCC Highest for both PCC and SCC			
Test SCS as specified in Table 5.5A.3-1			Smallest and biggest supported SCS per Channel Bandwidth			
Test Parameters						
Test ID	**Freq**	**Downlink Configuration**	**Uplink Configuration**			
			Modulation (NOTE 3)	**RB allocation (NOTE 1)**		
				PCC	**SCC**	
1[3]	Low	N/A	DFT-s-OFDM PI/2 BPSK	Edge_1RB_Left	Edge_1RB_Left	
2[3]	High		DFT-s-OFDM PI/2 BPSK	Edge_1RB_Right	Edge_1RB_Right	
3[3]	Default		DFT-s-OFDM PI/2 BPSK	Outer_Full	Outer_Full	
4	Default		DFT-s-OFDM PI/2 BPSK	Inner_Full	Inner_Full	
5	Low		DFT-s-OFDM QPSK	Edge_1RB_Left	Edge_1RB_Left	
6	High		DFT-s-OFDM QPSK	Edge_1RB_Right	Edge_1RB_Right	
7	Default		DFT-s-OFDM QPSK	Outer_Full	Outer_Full	
8	Default		DFT-s-OFDM QPSK	Inner_Full	Inner_Full	
9	Default		DFT-s-OFDM 16 QAM	Inner_Full	Inner_Full	
10	Low		DFT-s-OFDM 16 QAM	Edge_1RB_Left	Edge_1RB_Left	
11	High		DFT-s-OFDM 16 QAM	Edge_1RB_Right	Edge_1RB_Right	
12	Default		DFT-s-OFDM 16 QAM	Outer_Full	Outer_Full	
13	Low		DFT-s-OFDM 64 QAM	Edge_1RB_Left	Edge_1RB_Left	
14	High		DFT-s-OFDM 64 QAM	Edge_1RB_Right	Edge_1RB_Right	
15	Default		DFT-s-OFDM 64 QAM	Outer_Full	Outer_Full	
16	Default		DFT-s-OFDM 256 QAM	Outer_Full	Outer_Full	
17	Default		CP-OFDM QPSK	Inner_Full	Inner_Full	
18	Low		CP-OFDM QPSK	Edge_1RB_Left	Edge_1RB_Left	
19	High		CP-OFDM QPSK	Edge_1RB_Right	Edge_1RB_Right	
20	Default		CP-OFDM QPSK	Outer_Full	Outer_Full	
21	Default		CP-OFDM 16 QAM	Inner_Full	Inner_Full	
22	Low		CP-OFDM 16 QAM	Edge_1RB_Left	Edge_1RB_Left	
23	High		CP-OFDM 16 QAM	Edge_1RB_Right	Edge_1RB_Right	
24	Default		CP-OFDM 16 QAM	Outer_Full	Outer_Full	
25	Low		CP-OFDM 64 QAM	Edge_1RB_Left	Edge_1RB_Left	
26	High		CP-OFDM 64 QAM	Edge_1RB_Right	Edge_1RB_Right	
27	Default		CP-OFDM 64 QAM	Outer_Full	Outer_Full	
28	Default		CP-OFDM 256 QAM	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 and SCS are specified in Table 5.5A3-1. NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.						

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure [TBD] 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 6.5A.2.4.1.1.4.1-1.

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 6.5A.2.4.1.1.4.3

6.5A.2.4.1.1.4.2 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] clause [TBD]. Message contents are defined in clause 6.5A.2.4.1.1.4.3.

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 6.5A.2.2.1.1.4.1-1 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.

5. Send continuously power control “up” commands in every uplink scheduling information to the UE until the UE transmits at P_{UMAX} level. Allow at least 200ms for the UE to reach P_{UMAX} level.

6. Measure the mean power of the UE in the channel bandwidth of the radio access mode on PCC according to the test configuration, which shall meet the requirements described in clause 6.2A.2 as appropriate. The period of the measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD slots with transient periods are not under test.

7. Measure the rectangular filtered mean power for the assigned NR channel on PCC.

8. Measure the rectangular filtered mean power of the first NR adjacent channel on both lower and upper side of the assigned NR channel on PCC, respectively.

9. Calculate the ratios of the power between the values measured in step 7 over step 8 for lower and upper NR ACLR, respectively.

10. Measure the mean power of the UE in the channel bandwidth of the radio access mode on PCC according to the test configuration, which shall meet the requirements described in clause 6.2A.2 as appropriate. The period of the measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD slots with transient periods are not under test.

11. Measure the rectangular filtered mean power for the assigned NR channel on PCC.

12. Measure the rectangular filtered mean power of the first NR adjacent channel on both lower and upper side of the assigned NR channel on PCC, respectively.

13. Calculate the ratios of the power between the values measured in step 11 over step 12 for lower and upper NR ACLR, respectively.

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.

6.5A.2.4.1.1.4.3 Message contents

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

6.5A.2.4.1.1.5 Test requirement

The measured UE mean power in the channel bandwidth, derived in step 6 and step 10, shall fulfil requirements in clause 6.2A.2 as appropriate, and if the measured adjacent channel power is greater than -50 dBm, then the measured NR ACLR for each CC, derived in step 9 and step 13, shall be higher than the limits in Table 6.5A.2.4.1.1.5-2.

Table 6.5A.2.4.1.1.5-1: NR ACLR measurement bandwidth

NR channel bandwidth / NR ACLR measurement bandwidth												
	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
NR ACLR measurement bandwidth	4.515	9.375	14.235	19.095	23.955	28.815	38.895	48.615	58.35	78.15	88.23	98.31

Table 6.5A.2.4.1.1.5-2: NR ACLR requirement

	Power class 1	Power class 2	Power class 3
NR ACLR		31 + TT dB	30 + TT dB

Table 6.5A.2.4.1.1.5-3: Test Tolerance for NR ACLR

	f ≤ 3.0GHz	3.0GHz < f ≤ 6GHz
BW ≤ 40MHz	FFS	FFS
40MHz < BW ≤ 100MHz	FFS	FFS

6.5A.2.4.2 UTRA ACLR

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- The connection diagram for inter-band CA in TS 38.508-1[5] Annex A is FFS.
- Procedure to configure SCC in TS 38.508-1[5] clause [TBD] is FFS.
- The subclause 6.2A.2 in reference to requirements for transmitter power for inter-band CA is FFS.
- Extending the coverage of the TCs with intra-band CA scenarios is FFS
- MUs and TTs for CA is FFS in Annex F.

6.5A.2.4.2.0 Minimum conformance requirements

For inter-band carrier aggregation with uplink assigned to two NR bands, the minimum conformance requirements specified in subclause 6.5.2.4.2.3 shall apply on each component carrier with all component carriers active.

6.5A.2.4.2.1 UTRA ACLR for CA (2UL CA)

6.5A.2.4.2.1.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent UTRA channels in terms of Adjacent Channel Leakage power Ratio (UTRA ACLR) for 2UL CA.

6.5A.2.4.2.1.2 Test applicability

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

6.5A.2.4.2.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in subclause 6.5A.2.4.2.0.

6.5A.2.4.2.1.4 Test description

6.5A.2.4.2.1.4.1 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 CA configuration specified in clause 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, are shown in Table 6.5A.2.4.1.1.4.1-1. 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 6.5A.2.4.2.1.4.1-1: Void

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure [TBD] 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 6.5A.2.4.2.1.4.1-1.
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 6.5A.2.4.2.1.4.3

6.5A.2.4.2.1.4.2 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] clause [TBD]. Message contents are defined in clause 6.5A.2.4.2.1.4.3.
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[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 6.5A.2.2.1.1.4.1-1 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.
5. Send continuously power control “up” commands in every uplink scheduling information to the UE until the UE transmits at P_{UMAX} level. Allow at least 200ms for the UE to reach P_{UMAX} level.
6. Measure the mean power of the UE in the channel bandwidth of the radio access mode on PCC according to the test configuration, which shall meet the requirements described in clause 6.2A.2 as appropriate. The period of the measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD slots with transient periods are not under test.
7. Measure the rectangular filtered mean power for the assigned NR channel on PCC.
8. Measure the RRC filtered mean power of the first and the second UTRA adjacent channel on both lower and upper side of the assigned NR channel on PCC, respectively.
9. Calculate the ratios of the power between the values measured in step 7 over step 8 for lower and upper UTRA ACLR, respectively.
10. Measure the mean power of the UE in the channel bandwidth of the radio access mode on SCC according to the test configuration, which shall meet the requirements described in clause [6.2A.3.3.5] as appropriate. The period of the measurement shall be at least the continuous duration of one active sub-frame (1ms) and in the uplink symbols. For TDD slots with transient periods are not under test.

11. Measure the rectangular filtered mean power for the assigned NR channel on SCC.
12. Measure the RRC filtered mean power of the first and the second UTRA adjacent channel on both lower and upper side of the assigned NR channel on SCC, respectively.
13. Calculate the ratios of the power between the values measured in step 11 over step 12 for lower and upper UTRA ACLR, respectively.

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.

6.5A.2.4.2.1.4.3 Message contents

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

Table 6.5A.2.4.2.3.4.3-1: AdditionalSpectrumEmission

Derivation Path: 38.508-1 [5] clause 4.6.3, Table 4.6.3-1 AdditionalSpectrumEmission			
Information Element	**Value/remark**	**Comment**	**Condition**
AdditionalSpectrumEmission	1	Only for NR band n1, n2, n3, n5, n8, n20, n25, and n66	
	3	For NR band n1, n2, n8, n25, n66	

6.5A.2.4.2.1.5 Test requirement

The measured UE mean power in the channel bandwidth, derived in step 6 and step 10, shall fulfil requirements in clause 6.2A.2 as appropriate, and if the measured adjacent channel power is greater than –50 dBm, then the measured UTRA ACLR for each CC, derived in step 9 and step 13, shall be higher than the limits in Table 6.5A.2.4.2.1.5-2.

Table 6.5A.2.4.2.1.5-1: Measurement bandwidth for NR carrier

	NR channel bandwidth / UTRA ACLR measurement bandwidth											
	5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**	**30 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**90 MHz**	**100 MHz**
NR channel measurement bandwidth (MHz)	4.515	9.375	14.235	19.095	23.955	28.815	38.895	48.615	58.35	78.15	88.23	98.31
UTRA channel Measurement bandwidth (MHz)	3.84											
1st Adjacent channel centre frequency offset	± 2.5 MHz from NR channel edge											
2nd Adjacent channel centre frequency offset	± 7.5 MHz from NR channel edge											

Table 6.5A.2.4.2.1.5-2: UTRA ACLR requirement

	Power class 3
$UTRA_{ACLR1}$	33 dB +TT
$UTRA_{ACLR2}$	36 dB + TT

Table 6.5A.2.4.2.1.5-3: Test Tolerance for UTRA ACLR

	f ≤ 3.0GHz
BW ≤ 40MHz	FFS
40MHz < BW ≤ 100MHz	FFS

6.5A.3 Spurious emission for CA

6.5A.3.1 General spurious emissions for CA

Editor's Note: This clause is incomplete. The following aspects are either missing or not yet determined:

- The connection diagram for inter-band CA in TS 38.508-1[5] Annex A is FFS.
- Extending the coverage of the TCs with intra-band CA scenarios is FFS
- Procedure to configure SCC in TS 38.508-1[5] clause [TBD] is FFS
- MUs for CA is FFS in Annex F

6.5A.3.1.0 Minimum conformance requirements

For inter-band carrier aggregation with uplink assigned to two NR bands, the spurious emission requirement Table 6.5.3.1.3-2 apply for the frequency ranges that are more than F_{OOB} as defined in Table 6.5.3.1.3-1 away from edges of the assigned channel bandwidth on a component carrier. If for some frequency a spurious emission requirement of individual component carrier overlaps with the spectrum emission mask or channel bandwidth of another component carrier then it does not apply.

NOTE 1: For inter-band carrier aggregation with uplink assigned to two NR bands the requirements in Table 6.5.3.1.3-2 could be verified by measuring spurious emissions at the specific frequencies where second and third order intermodulation products generated by the two transmitted carriers can occur; in that case, the requirements for remaining applicable frequencies in Table 6.5.3.1.3-2 would be considered to be verified by the measurements verifying the one uplink inter-band CA spurious emission requirement.

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5A.3.1

6.5A.3.1.1 General spurious emissions for CA (2UL CA)

6.5A.3.1.1.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions.

6.5A.3.1.1.2 Test applicability

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

6.5A.3.1.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in subclause 6.5A.3.1.0.

6.5A.3.1.1.4 Test description

6.5A.3.1.1.4.1 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, are shown in Table 6.5A.3.1.1.4.1-1. 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 6.5A.3.1.1.4.1-1: Inter band CA Test Configuration Table

<table>
<tr><th colspan="5">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 38.508-1 [5] subclause 4.1</td><td colspan="3">Normal</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1</td><td colspan="3">Low range for PCC and SCC
High range for PCC and SCC</td></tr>
<tr><td colspan="2">Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="3">Lowest for both PCC and SCC
Highest for both PCC and SCC</td></tr>
<tr><td colspan="2">Test SCS as specified in Table 5.5A.3-1</td><td colspan="3">Smallest and biggest supported SCS per Channel Bandwidth</td></tr>
<tr><th colspan="5">Test Parameters</th></tr>
<tr><th rowspan="3">Test ID</th><th rowspan="3">Downlink Configuration</th><th colspan="3">Uplink Configuration</th></tr>
<tr><th rowspan="2">Modulation</th><th colspan="2">RB allocation (NOTE 1)</th></tr>
<tr><th>PCC</th><th>SCC</th></tr>
<tr><td>1</td><td rowspan="3">N/A</td><td>CP-OFDM QPSK</td><td>Outer_Full</td><td>Outer_Full</td></tr>
<tr><td>2</td><td>CP-OFDM QPSK</td><td>Edge_1RB_Left</td><td>Edge_1RB_Left</td></tr>
<tr><td>3</td><td>CP-OFDM QPSK</td><td>Edge_1RB_Right</td><td>Edge_1RB_Right</td></tr>
<tr><td colspan="5">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 and SCS are specified in Table 5.5A3-1.</td></tr>
</table>

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure [TBD] 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 for PCC are initially set up according to Annex C.0, C.1 and 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 6.5A.3.1.1.4.1-1.

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 6.5A.3.1.1.4.3.

6.5A.3.1.1.4.2 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 [TBD]. Message contents are defined in clause 6.5A.3.1.1.4.3.

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 6.5A.3.1.1.4.1-1 on both PCC and SCC. 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 every uplink scheduling information to the UE until the UE transmits at P_{UMAX} level.

6. Measure the power of the transmitted signal with a measurement filter of bandwidths according to Table 6.5A.3.1.1.5-1. The centre frequency of the filter shall be stepped in contiguous steps according to Table 6.5A.3.1.1.5-1. The measured power shall be verified for each step. The measurement period shall capture the active time slots.

6.5A.3.1.1.4.3 Message contents

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

6.5A.3.1.1.5 Test requirement

This clause specifies the requirements for the specified NR band for Transmitter Spurious emissions requirement with frequency range as indicated in Table 6.5A.3.1.1.5-1.

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than Δf_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth. If for some frequency a spurious emission requirement of individual component carrier overlaps with the spectrum emission mask or channel bandwidth of another component carrier then it does not apply.

The measured average power of spurious emission, derived in step 6, shall not exceed the described value in Table 6.5A.3.1.1.5-1.

Table 6.5A.3.1.1.5-1: General spurious emissions test requirements

Frequency Range	Maximum Level	Measurement Bandwidth	Notes
Test requirements for CA_n3A-n78A Configuration			
270 MHz ≤ f ≤ 380 MHz	-36 dBm+TT	100 kHz	
1515MHz ≤ f ≤ 2090 MHz 3270 MHz ≤ f ≤ 3830 MHz 4815 MHz ≤ f ≤ 5890 MHz 6720 MHz ≤ f ≤ 7370 MHz 8310 MHz ≤ f ≤ 9385 MHz	-30 dBm+TT	1 MHz	
Test requirements for CA_n8A-n78A Configuration			
780 MHz ≤ f ≤1000 MHz	-36 dBm+TT	100 kHz	
1000MHz £ f £ 1015 MHz 1470 MHz £ f £ 2040MHz 2385 MHz ≤ f ≤ 2920 MHz 3290 MHz ≤ f ≤ 3810 MHz 4180 MHz ≤ f ≤4715 MHz 5060 MHz ≤ f ≤5630 MHz 5685 MHz ≤ f ≤6720 MHz 7480 MHz ≤ f ≤8515 MHz	-30 dBm+TT	1 MHz	

Table 6.5A.3.1.1.5-2: Test Tolerance for General spurious emissions

	f ≤ 3.0GHz	**3.0GHz < f ≤ 6GHz**
BW ≤ 40MHz	0	0
40MHz < BW ≤ 100MHz	0	0

6.5A.3.2 Spurious emission for UE co-existence

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Extending the coverage of the TCs with intra-band CA scenarios is FFS.
- The connection diagram for inter-band CA in TS 38.508-1[5] Annex A is FFS.
- Procedure to configure SCC in TS 38.508-1[5] clause [TBD] is FFS.
- MUs for CA is FFS in Annex F

6.5A.3.2.0 Minimum conformance requirements

This clause specifies the requirements for the specified NR carrier aggregation configurations for coexistence with protected bands.

NOTE 1: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

For inter-band carrier aggregation with the uplink assigned to two NR bands, the requirements in Table 6.5.3.2.3-1apply on each component carrier with both component carriers are active. The minimum conformance requirements are specified in Table 6.5A.3.2.0-1.

NOTE 2: For inter-band carrier aggregation with uplink assigned to two NR bands, the requirements in Table 6.5.3.2.3-1 could be verified by measuring spurious emissions at the specific frequencies where second and third order intermodulation products generated by the two transmitted carriers can occur; in that case, the requirements for remaining applicable frequencies in Table 6.5.3.2.3-1would be considered to be verified by the measurements verifying the one uplink inter-band CA UE to UE co-existence requirements.

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5A.3.2.

Table 6.5A.3.2.0-1: Requirements for uplink inter-band carrier aggregation (two bands)

NR CA Configuration	Spurious emission						
	Protected Band	Frequency range (Mhz)			Maximum Level (dBm)	MBW (MHz)	NOTE
CA_n3A-n78A	E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 26, 28, 34, 39, 40, 41, 65	F_{DL_low}	-	F_{DL_high}	-50	1	
	Frequency range	1884.5	-	1915.7	-41	0.3	3
	NR Band n257	26500	-	29500	-5	100	
CA_n8A-n78A	E-UTRA Band 1,8, 20, 28, 34, 39, 40,65	F_{DL_low}	-	F_{DL_high}	-50	1	
	E-UTRA Band 3, 7,41	F_{DL_low}	-	F_{DL_high}	-50	1	2
	E-UTRA Band 11, 21	F_{DL_low}	-	F_{DL_high}	-50	1	5
	Frequency range	860	-	890	-40	1	4,5
	Frequency range	1884.5	-	1915.7	-41	0.3	3
	NR Band n257	26500	-	29500	-5	100	
	NR Band n258	24250	-	27500	-5	100	

NOTE 1: FDL_low and FDL_high refer to each frequency band specified in Table 5.2-1 or Table 5.5-1 in TS 36.101
NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.
NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz
NOTE 4: These requirements also apply for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1-1 and Table 6.5A.3.1-1 from the edge of the channel bandwidth.
NOTE 5: This requirement is applicable only for the following cases: - for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 902.5 MHz ≤ Fc < 907.5 MHz with an uplink transmission bandwidth less than or equal to 20 RB - for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 907.5 MHz ≤ Fc ≤ 912.5 MHz without any restriction on uplink transmission bandwidth. - for carriers of 10 MHz channel bandwidth when carrier centre frequency (Fc) is Fc = 910 MHz with an uplink transmission bandwidth less than or equal to 32 RB with RBstart> 3.

6.5A.3.2.1 Spurious emissions for UE co-existence for CA (2UL CA)

6.5A.3.2.1.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to co-existing systems for the specified bands which has specific requirements in terms of transmitter spurious emissions for 2UL CA.

6.5A.3.2.1.2 Test applicability

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

6.5A.3.2.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in subclause 6.5A.3.2.0.

6.5A.3.2.1.4 Test description

6.5A.3.2.1.4.1 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 CA configuration specified in clause 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, are shown in Table 6.5A.3.2.1.4.1-1. 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 6.5A.3.2.1.4.1-1: Inter band CA Test Configuration Table

Initial Conditions	
Test Environment as specified in TS 38.508-1 [5] subclause 4.1	NC
Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1	For test frequencies refer to “Range” columns.
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1	Refer to “PCC N_{RB}@SCS”and “SCC N_{RB}@SCS” columns
Test SCS as specified in Table 5.5A.3-1	Refer to “PCC N_{RB}@SCS”and “SCC N_{RB}@SCS” columns

Test Parameters for CA Configurations											
ID	**CA Configuration / N_{RB_agg} (Note 4)**						**DL Allocation**			**UL Allocation (Note 2,3)**	
	CA Configuration				**PCC N_{RB} @SCS**	**SCC N_{RB}@SCS**	**CC MOD**	**PCC & SCC RB allocation**		**CC MOD**	**PCC & SCC RB allocations (L_{CRB} @ RB_{start})**
	PCC		**SCC**					**PCC**	**SCC**		
	Band	**Range**	**Band**	**Range**							
Default Test Settings for a CA_XA-YA Configuration											
1	X	Low	Y	Low	Highest N_{RB}**@SCS**	Highest N_{RB}**@SCS**	**CP-OFDM** QPSK	NA		**CP-OFDM** QPSK	1@0	1@0
2	X	High	Y	High	Highest N_{RB}**@SCS**	Highest N_{RB}**@SCS**	**CP-OFDM** QPSK	NA		**CP-OFDM** QPSK	1@RB_{max}	1@RB_{max}
Test Settings for CA_n3A-n78A Configuration											
1	n3	Mid	n78	Mid	160@15kHz	270@15kHz	CP-OFDM QPSK	NA		CP-OFDM QPSK	1@160	1@270
2	n3	Mid	n78	Mid	78@30KHz	273@30KHz	CP-OFDM QPSK	NA		CP-OFDM QPSK	1@78	1@273
3	n3	Mid	n78	Mid	38@60KHz	135@60KHz	CP-OFDM QPSK	NA		CP-OFDM QPSK	1@38	1@135
Test Settings for CA_n8A-n78A Configuration											
1	n8	Mid	n78	Mid	106@15kHz	270@15kHz	CP-OFDM QPSK	NA		CP-OFDM QPSK	1@0	1@0
2	n8	Mid	n78	Mid	106@15kHz	270@15kHz	CP-OFDM QPSK	NA		CP-OFDM QPSK	1@106	1@270
3	n8	Low	n78	Low	51@30KHz	273@30KHz	CP-OFDM QPSK	NA		CP-OFDM QPSK	1@51	1@273
4	n8	Mid	n78	Mid	51@30KHz	273@30KHz	CP-OFDM QPSK	NA		CP-OFDM QPSK	1@51	1@273

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure [TBD] 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 [6] 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 6.5A.3.2.1.4.1-1.
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 6.5A.3.2.1.4.3.

6.5A.3.2.1.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, and Annex C.2 for all downlink physical channels.
2. The SS shall configure SCC as per TS 38.508-1 [5] clause [TBD]. Message contents are defined in clause 6.5A.3.2.1.4.3.
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 6.5A.3.2.1.4.1-1 on both PCC and SCC. 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 every uplink scheduling information to the UE until the UE transmits at P_{UMAX} level.
6. Measure the power of the transmitted signal with a measurement filter of bandwidths according to Table 6.5.3.2.3-1. The centre frequency of the filter shall be stepped in contiguous steps according to Table 6.5.3.2.3-1. The measured power shall be verified for each step. The measurement period shall capture the active time slots.

6.5A.3.2.1.4.3 Message contents

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

6.5A.3.2.1.5 Test requirement

Test requirements for Spurious Emissions UE Co-existence are the same as the minimum requirements. The measured average power of spurious emission, derived in step 6, shall not exceed the described value in Table 6.5A.3.2.1.5-1.

Table 6.5A.3.2.1.5-1: Requirements for uplink inter-band carrier aggregation (two bands)

NR CA Configuration	Spurious emission						
	Protected Band	Frequency range (Mhz)			Maximum Level (dBm)	MBW (MHz)	NOTE
CA_n3A-n78A	E-UTRA Band 3, 34, 39	F_{DL_low}	-	F_{DL_high}	-50+TT	1	
	Frequency range	1884.5	-	1915.7	-41+TT	0.3	3
CA_n8A-n78A	E-UTRA Band 8, 20, 28, 34, 39, 40	F_{DL_low}	-	F_{DL_high}	-50+TT	1	
	E-UTRA Band 3, 7,41	F_{DL_low}	-	F_{DL_high}	-50+TT	1	2
	E-UTRA Band 11, 21	F_{DL_low}	-	F_{DL_high}	-50+TT	1	5
	Frequency range	860	-	890	-40+TT	1	4,5
	Frequency range	1884.5	-	1915.7	-41+TT	0.3	3

NOTE 1: FDL_low and FDL_high refer to each frequency band specified in Table 5.2-1 or Table 5.5-1 in TS 36.101

NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.

NOTE 3: Applicable when co-existence with PHS system operating in 1884.5 -1915.7MHz

NOTE 4: These requirements also apply for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1-1 and Table 6.5A.3.1-1 from the edge of the channel bandwidth.

NOTE 5: This requirement is applicable only for the following cases: - for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 902.5 MHz ≤ Fc < 907.5 MHz with an uplink transmission bandwidth less than or equal to 20 RB - for carriers of 5 MHz channel bandwidth when carrier centre frequency (Fc) is within the range 907.5 MHz ≤ Fc ≤ 912.5 MHz without any restriction on uplink transmission bandwidth. - for carriers of 10 MHz channel bandwidth when carrier centre frequency (Fc) is Fc = 910 MHz with an uplink transmission bandwidth less than or equal to 32 RB with RBstart> 3.

Table 6.5A.3.2.1.5-2: Test Tolerance for uplink inter-band carrier aggregation (two bands)

	f ≤ 3.0GHz	3.0GHz < f ≤ 6GHz
BW ≤ 40MHz	0	0
40MHz < BW ≤ 100MHz	0	0

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than Δf_{OOB} (MHz) in Table 6.5.3.2.3-1 from the edge of the channel bandwidth. The spurious emission limits in Table 6.5.3.2.3-1 apply for all transmitter band configurations (NRB) and channel bandwidths for all CC combinations.

6.5A.4 Transmit intermodulation for CA

Editor's Note: This clause is incomplete. The following aspects are either missing or not yet determined:

- The connection diagram for inter-band CA in TS 38.508-1 [5] Annex A is FFS.
- Procedure to configure SCC in TS 38.508-1 [5] clause [TBD] is FFS.
- Extending the coverage of the TCs with intra-band CA scenarios is FFS
- MUs and TTs for CA is FFS in Annex F.

6.5A.4.0 Minimum conformance requirements

For inter-band carrier aggregation with uplink assigned to two NR bands, the transmit intermodulation requirement is specified in Table 6.5.4-1 which shall apply on each component carrier with both component carriers active.

6.5A.4.1 Transmit intermodulation for CA (2UL CA)

6.5A.4.1.1 Test purpose

To verify that the UE transmit intermodulation does not exceed the described value in the test requirement.

The transmit intermodulation performance is a measure of the capability of the transmitter to inhibit the generation of signals in its non linear elements caused by presence of the wanted signal and an interfering signal reaching the transmitter via the antenna.

6.5A.4.1.2 Test applicability

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

6.5A.4.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in subclause 6.5A.4.0.

6.5A.4.1.4 Test description

6.5A.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 CA configuration specified in clause 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, are shown in Table 6.5A.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 6.5A.4.1.4.1-1: Inter-band CA Test Configuration Table

<table>
<tr><th colspan="5">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 38.508-1 [5] subclause 4.1</td><td colspan="3">Normal</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1.1.3 for inter band CA in FR1</td><td colspan="3">Mid range for PCC and SCC</td></tr>
<tr><td colspan="2">Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="3">Lowest for both PCC and SCC
Highest for both PCC and SCC</td></tr>
<tr><td colspan="2">Test SCS as specified in Table 5.5A.3-1</td><td colspan="3">Smallest and biggest supported SCS per Channel Bandwidth</td></tr>
<tr><th colspan="5">Test Parameters</th></tr>
<tr><th rowspan="3">Test ID</th><th rowspan="3">Downlink Configuration</th><th colspan="3">Uplink Configuration</th></tr>
<tr><th rowspan="2">Modulation(NOTE 3)</th><th colspan="2">RB allocation (NOTE 1)</th></tr>
<tr><th>PCC</th><th>SCC</th></tr>
<tr><td>1[3]</td><td rowspan="2">N/A</td><td>DFT-s-OFDM PI/2 BPSK</td><td>Inner Full</td><td>Inner Full</td></tr>
<tr><td>2</td><td>DFT-s-OFDM QPSK</td><td>Inner Full</td><td>Inner Full</td></tr>
<tr><td colspan="5">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 and SCS are specified in Table 5.5A3-1.
NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.</td></tr>
</table>

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure [TBD] 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 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 6.5A.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 6.5A.4.1.4.3.

6.5A.4.1.4.2 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 [TBD]. Message contents are defined in clause 6.5A.4.1.4.3.

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 6.5A.4.1.4.1-1 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. Send continuously uplink power control "up" commands on PCC and SCC to the UE until the UE transmits at its P_{UMAX} level; allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level

6. Measure the rectangular filtered mean power of the UE. For TDD slots with transient periods are not under test for the wanted signal and for the intermodulation product.

7. Set the interference signal frequency below the UL carrier frequency of the PCC using the first offset in Table 6.5A.4.1.5-1.

8. Set the interference CW signal level according to Table 6.5A.4.1.5-1.

9. Search the intermodulation product signals below and above the UL carrier frequency of the PCC, then measure the rectangular filtered mean power of transmitting intermodulation for both signals, and calculate the ratios with the power measured in step 6.

10. Set the interference signal frequency above the UL carrier frequency of the PCC using the first offset in Table 6.5A.4.1.5-1.

11. Search the intermodulation product signals below and above the UL carrier frequency of the PCC, then measure the rectangular filtered mean power of transmitting intermodulation for both signals, and calculate the ratios with the power measured in step 6.

12. Set the interference signal frequency below the UL carrier frequency of the SCC using the first offset in Table 6.5A.4.1.5-1.

13. Search the intermodulation product signals below and above the UL carrier frequency of the SCC, then measure the rectangular filtered mean power of transmitting intermodulation for both signals, and calculate the ratios with the power measured in step 6.

14. Set the interference signal frequency above the UL carrier frequency of the SCC using the first offset in Table 6.5A.4.1.5-1.

15. Search the intermodulation product signals below and above the UL carrier frequency of the SCC, then measure the rectangular filtered mean power of transmitting intermodulation for both signals, and calculate the ratios with the power measured in step 6.

16. Repeat the measurement using the second offset in Table 6.5A.4.1.5-1.

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.

6.5A.4.1.4.3 Message contents

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

6.5A.4.1.5 Test requirement

The ratio derived in steps9, 11, 13 and 15, shall not exceed the described value in Table 6.5A.4.1.5-1.

Table 6.5A.4.1.5-1: Transmit Intermodulation

Wanted signal channel bandwidth	$BW_{Channel}$	
Interference signal frequency offset from channel centre	$BW_{Channel}$	$2*BW_{Channel}$
Interference CW signal level	-40dBc	
Intermodulation product	<-29dBc+TT	< -35dBc+TT
Measurement bandwidth	The maximum transmission bandwidth configuration among the different SCSs for the channel BW as defined in Table 6.5.2.2.3-1	
Measurement offset from channel centre	$BW_{Channel}$ and $2*BW_{Channel}$	$2*BW_{Channel}$ and $4*BW_{Channel}$

Table6.5A.4.1.5-2: Test Tolerance for Transmit Intermodulation

	f ≤ 3.0GHz	**3.0GHz < f ≤ 6GHz**
BW ≤ 40MHz	FFS	FFS
40MHz < BW ≤ 100MHz	FFS	FFS

6.5C Output RF spectrum emissions 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

6.5C.1 Occupied bandwidth for SUL

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- SA message contents in TS 38.508-1 [5] subclause 4.6 is FFS

- Test Configuration Table is FFS

6.5C.1.1 Test purpose

To verify that the UE occupied bandwidth for all transmission bandwidth configurations supported by the UE supporting SUL are less than their specific limits when UE is configured using SUL transmission.

6.5C.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.

6.5C.1.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.5.1.3

6.5C.1.4 Test description

Same test description as specified in clause 6.5.1.4 with following exceptions:

- Instead of table 5.3.5-1 → use Table 5.5C-1
- Instead of table 6.5.1.4.1-1→ use Table 6.5C.1.4-1

Table 6.5C.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	FFS			
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1	FFS			
Test SCS as specified in Table 5.3.5-1	FFS			
Test Parameters for Channel Bandwidths				
	Downlink Configuration	**UL Configuration**	**SUL Configuration**	
Test ID	N/A for Configured UE transmitted Output Power test case		Modulation	RB allocation
1		NA	FFS	FFS
2		NA	FFS	FFS
Note 1: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.				

- 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 4.6 ensuring Tables 4.6.3-13, 4.6.3-97, and 4.6.3-129A with conditions SUL, and Table 4.6.3-167 with condition PUSCH_PUCCH_ON_SUL.

6.5C.1.5 Test requirement

The measured Occupied Bandwidth on SUL carrier shall not exceed values in Table 6.5C.1.5-1.

Table 6.5C.1.5-1: Occupied channel bandwidth

		Occupied channel bandwidth / NR Channel bandwidth										
	5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**	**30 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**90 MHz**	**100 MHz**
Channel bandwidth (MHz)	5	10	15	20	25	30	40	50	60	80	90	100

6.5C.2 Out of band emission for SUL

6.5C.2.1 General

Void

6.5C.2.2 Spectrum Emission Mask for SUL

The spectrum emission mask of the UE applies to frequencies (Δf_{OOB}) starting from the ± edge of the assigned NR channel bandwidth. For frequencies greater than (Δf_{OOB}) the spurious requirements in subclause 6.5.3 are applicable.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- SA message contents in TS 38.508-1[5] subclause 4.6 is FFS

- Configuration table is FFS

- The clause in reference to the total transmission power is TBD.

6.5C.2.2.1 Test purpose

To verify that the power of any UE emission shall not exceed specified level for the specified channel bandwidth.

6.5C.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.

6.5C.2.2.3 Minimum conformance requirements

Same minimum conformance requirements as in the clause 6.5.2.2.3.

6.5C.2.2.4 Test description

Same test description as specified in clause 6.5.2.2 with following exceptions:

- Instead of table 5.3.5-1 → use Table 5.5C-1
- Instead of table 6.5.2.2.4.1-1→ use Table 6.5C.2.2.4.1-1

Table 6.5C.2.2.4.1-1: Test Configuration Table(FFS)

<table>
<tr><th colspan="5">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 38.508-1 [5] subclause 4.1</td><td colspan="3">Normal, TL/VL, TL/VH, TH/VL, TH/VH</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="3">FFS</td></tr>
<tr><td colspan="2">Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="3">FFS</td></tr>
<tr><td colspan="2">Test SCS as specified in Table 5.3.5-1</td><td colspan="3">FFS</td></tr>
<tr><th colspan="5">Test Parameters for Channel Bandwidths</th></tr>
<tr><th></th><th>Downlink Configuration</th><th>UL Configuration</th><th colspan="2">SUL Configuration</th></tr>
<tr><td>Test ID</td><td rowspan="3">N/A for Configured UE transmitted Output Power test case</td><td></td><td>Modulation</td><td>RB allocation</td></tr>
<tr><td>1</td><td>NA</td><td>FFS</td><td>FFS</td></tr>
<tr><td>2</td><td>NA</td><td>FFS</td><td>FFS</td></tr>
<tr><td colspan="5">Note 1: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.</td></tr>
</table>

- 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 4.6 ensuring Tables 4.6.3-13, 4.6.3-97, and 4.6.3-129A with conditions SUL, and Table 4.6.3-167 with condition PUSCH_PUCCH_ON_SUL.

6.5C.2.2.5 Test requirement

The measured sum of the UE mean power in the channel bandwidth on the SUL carrier, derived in step 3, shall fulfil requirements in Tables [6.2C.1.5-1 or 6.2C.2.5-1] as appropriate, and the power of any UE emission shall fulfil requirements in Table 6.5C.2.2.5-1.

Table 6.5C.2.2.5-1: NR General spectrum emission mask

<table>
<tr><th></th><th colspan="13">Spectrum emission limit (dBm) / Channel bandwidth</th></tr>
<tr><th>ΔfOOB (MHz)</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th><th>25 MHz</th><th>30 MHz</th><th>40 MHz</th><th>50 MHz</th><th>60 MHz</th><th>80 MHz</th><th>90 MHz</th><th>100 MHz</th><th>Measurement bandwidth</th></tr>
<tr><td>± 0-1</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td></td><td></td><td></td><td></td><td></td><td>1 % channel bandwidth</td></tr>
<tr><td>± 0-1</td><td>-15 + TT</td><td>-18 + TT</td><td>-20 + TT</td><td>-21 + TT</td><td>-22 + TT</td><td>-23 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>30 kHz</td></tr>
<tr><td>± 1-5</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td rowspan="19">1 MHz</td></tr>
<tr><td>± 5-6</td><td>-13 + TT</td><td rowspan="2">-13 + TT</td><td rowspan="3">-13 + TT</td><td rowspan="4">-13 + TT</td><td rowspan="5">-13 + TT</td><td rowspan="6">-13 + TT</td><td rowspan="8">-13 + TT</td><td rowspan="10">-13 + TT</td><td rowspan="12">-13 + TT</td><td rowspan="14">-13 + TT</td><td rowspan="15">-13 + TT</td><td rowspan="17">-13 + TT</td></tr>
<tr><td>± 6-10</td><td>-25 + TT</td></tr>
<tr><td>± 10-15</td><td></td><td>-25 + TT</td></tr>
<tr><td>± 15-20</td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 20-25</td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 25-30</td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 30-35</td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 35-40</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 40-45</td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 45-50</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 50-55</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 55-60</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 60-65</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 65-80</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 80-90</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 90-95</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 95-100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 100-105</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td colspan="14">Note 1: The first and last measurement position with a 30 kHz filter is at ΔfOOB equals to 0.015 MHz and 0.985 MHz.
Note 2: At the boundary of spectrum emission limit, the first and last measurement position with a 1 MHz filter is the inside of +0.5MHz and -0.5MHz, respectively.
Note 3: The measurements are to be performed above the upper edge of the channel and below the lower edge of the channel.
Note 4: TT = 1.5 dB for f ≤ 3GHz, TT = 1.8 dB for 3GHz < f ≤ 4.2GHz, TT = 1.8 dB for 4.2GHz < f ≤ 6.0GHz.</td></tr>
</table>

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

6.5C.2.3 Additional spectrum emission mask for SUL

Editor's note: The following aspects are either missing or not yet determined:

- Configuration table is TBD and NS_XXS apply to SUL Bands is FFS.
- Parameters setting for Cell setup in 38.508 subclause is FFS
- SA Generic procedures with condition NR in TS 38.508-1 [5] is FFS.
- Message contents in reference to clause 6.2C.3.4.3 is TBD
- Test point analysis in reference to clause 6.2C.3 is TBD
- Test procedure is incomplete, the clause in reference to the total transmission power is TBD.
- Test requirements is incomplete.

6.5C.2.3.1 Test purpose

Same test purpose as in clause 6.5.2.3.1

6.5C.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.

6.5C.2.3.3 Minimum conformance requirements

Same minimum conformance requirements as in the clause 6.5.2.3.3 with consideration of the NS_XXs applicable to the SUL bands.

6.5C.2.3.4 Test description

Same test description as specified in clause 6.5.2.3.4 with following exceptions:

- Instead of table 5.3.5-1 → use Table 5.5C-1
- 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 4.6 ensuring Tables 4.6.3-13, 4.6.3-97, and 4.6.3-129A with conditions SUL, and Table 4.6.3-167 with condition PUSCH_PUCCH_ON_SUL, additionally the following exceptions shown in Table 6.2C.1.4-2 ~ Table 6.2C.1.4-4 are considered.

[FFS]

6.5C.2.3.4.3 Message contents

The same message contents as in Clause 6.2C.3.4.3

6.5C.2.3.5 Test requirement

[FFS for NS_XXs]

6.5C.2.4 Adjacent channel leakage ratio for SUL

Adjacent channel leakage power Ratio (ACLR) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency.

6.5C.2.4.1 NR ACLR for SUL

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- SA message contents in TS 38.508-1[5] subclause 4.6 is FFS
- PC1 and PC4 requirements are missing in TS 38.101-1 [2].
- Test point analysis is FFS
- The clause 6.2C.2.5 in reference to the total transmission power is TBD

6.5C.2.4.1.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5C.2.4.1.2 Test applicability

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

6.5C.2.4.1.3 Minimum conformance requirements

The minimum conformance requirements specified in Clause 6.5.2.4.1.3 applies to the UE that support SUL operating on the SUL bands.

The normative reference for this requirement is TS 38.101-] clauses 6.5.2.4.1.

6.5C.2.4.1.4 Test description

Same test description as specified in clause 6.5.2.4.1.4 with following exceptions:

- Instead of table 5.3.5-1 → use Table 5.5C-1
- Instead of table 6.5.2.4.1.4.1-1→ use Table 6.5C.2.4.1.4-1

Table 6.5C.2.4.1.4-1: 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	Lowest, Mid, Highest for both SUL carrier and Non-SUL carrier			
Test SCS as specified in Table 5.3.5-1	15kHz for both SUL carrier and Non-SUL carrier			
Test Parameters for Channel Bandwidths				
	Downlink Configuration	**UL Configuration**	**SUL Configuration**	
Test ID	N/A for Configured UE transmitted Output Power test case		Modulation	RB allocation
1		NA	FFS	FFS
2		NA	FFS	FFS
Note 1: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.				

- 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 4.6 ensuring Tables 4.6.3-13, 4.6.3-97, and 4.6.3-129A with conditions SUL, and Table 4.6.3-167 with condition PUSCH_PUCCH_ON_SUL.

6.5C.2.4.1.5 Test requirement

The measured UE mean power in the channel bandwidth on SUL carrier, derived in step 3, shall fulfil requirements in [Clause 6.2C.2.5] as appropriate, and if the measured adjacent channel power is greater than –50 dBm then the measured NR ACLR, derived in step 6, shall be higher than the limits in Table 6.5C.2.4.1.5-1.

Table 6.5C.2.4.1.5-1: NR ACLR measurement bandwidth

NR channel bandwidth / NR ACLR measurement bandwidth												
	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
NR ACLR measurement bandwidth	4.515	9.375	14.235	19.095	23.955	28.815	38.895	48.615	58.35	78.15	88.23	98.31

Table 6.5C.2.4.1.5-2: NR ACLR requirement

	Power class 1	Power class 2	Power class 3
NR ACLR		31 + TT dB	30 + TT dB
NOTE 1: TT = 0.8 dB for f ≤ 4.0GHz, TT = 1.0 dB for 4.0GHz < f ≤ 6.0GHz,			

6.5C.2.4.2 UTRA ACLR for SUL

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- SA message contents in TS 38.508-1[5] subclause 4.6 is FFS
- Test point analysis is FFS
- The requirement is incomplete: No specified requirements for the UEs of PC other than PC3, the additionalSpectrumEmission. is unspecified in the core requirement.
- The clause 6.2C.3.5 in reference to the total transmission power is TBD
- The clause 6.5.2.4.2.3 in reference to the minimum requirements is TBD.

6.5C.2.4.2.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5C.2.4.2.2 Test applicability

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

6.5C.2.4.2.3 Minimum conformance requirements

The minimum conformance requirements specified in Clause [6.5.2.4.2.3] the UE that support SUL operating on the SUL bands.

The normative reference for this requirement is TS 38.101-] clause 6.5.2.4.2.

6.5C.2.4.2.4 Test description

Same test description as specified in clause 6.5.2.4.2.4 with following exceptions:

- Instead of table 5.3.5-1 → use Table 5.5C-1
- Instead of table 6.5.2.4.2.4.1-1→ use Table 6.5C.2.4.2.4-1

Table 6.5C.2.4.2.4-1: Test Configuration Table(FFS)

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	FFS			
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1	FFS			
Test SCS as specified in Table 5.3.5-1	FFS			
Test Parameters for Channel Bandwidths				
	Downlink Configuration	**UL Configuration**	**SUL Configuration**	
Test ID	N/A for Configured UE transmitted Output Power test case		Modulation	RB allocation
1		NA	FFS	FFS
2		NA	FFS	FFS
Note 1: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.				

- 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 4.6 ensuring Tables 4.6.3-13, 4.6.3-97, and 4.6.3-129A with conditions SUL, and Table 4.6.3-167 with condition PUSCH_PUCCH_ON_SUL, together with the exceptions as specified in Table 6.5C.2.4.2.4-2

Table 6.5C.2.4.2.4-2: *SystemInformationBlockType2*: UTRA ACLR test requirement for "NS_XX"

Derivation Path: TS 38.508-1 [5] clause [TBD], Table [TBD]			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	XX (NS_XX)		

6.5C.2.4.2.5 Test requirement

UTRA ACLR requirement is applicable when signalled by the network with network signalling value indicated by the field *additionalSpectrumEmission*.

The measured UE mean total power in the channel bandwidth on SUL carrier, derived in step 3, shall fulfil requirements in [Clause 6.2C.3.5] as appropriate, and if the measured adjacent channel power is greater than –50 dBm then the measured UTRA ACLR, derived in step 6, shall be higher than the limits in Table 6.5C.2.4.2.5-1.

Table 6.5C.2.4.2.5-1: NR ACLR requirement

	Power class 3
$UTRA_{ACLR1}$	33 dB + TT
$UTRA_{ACLR2}$	36 dB + TT
NOTE 1: TT = 0.8 dB for f ≤ 4.0GHz, TT = 1.0 dB for 4.0GHz < f ≤ 6.0GHz,	

6.5C.3 Spurious emissions for SUL

6.5C.3.1 General spurious emissions for SUL

Editor's Note:

- SA message contents in TS 38.508-1[5] subclause 4.6 is FFS.

- The clause 6.2C.2.5 in reference to the total transmission power is TBD

- Parameters setting for Cell setup in 38.508 subclause is FFS.

- The configuration needs FFS to incorporate into the Edge allocation.

6.5C.3.1.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions.

6.5C.3.1.2 Test applicability

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

6.5C.3.1.3 Minimum conformance requirements

The general spurious emission requirement specified in clause 6.5.3.1.3 applies to the UE that support SUL operating on the SUL bands.

The normative reference for this requirement is TS 38.101-1 [2] subclauses 6.5.3.1

6.5C.3.1.4 Test description

Same test description as specified in clause 6.5.3.1.4 with following exceptions:

- Instead of table 5.3.5-1 → use Table 5.5C-1
- Instead of table 6.5.3.1.4.1-1→ use Table 6.5C.3.1.4-1

Table 6.5C.3.1.4-1: Test Configuration Table

<table>
<tr><th colspan="5">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 38.508-1 [5] subclause 4.1</td><td colspan="3">Normal, TL/VL, TL/VH, TH/VL, TH/VH</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="3">Low range, Mid range, High range</td></tr>
<tr><td colspan="2">Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="3">Lowest, Mid, Highest</td></tr>
<tr><td colspan="2">Test SCS as specified in Table 5.3.5-1</td><td colspan="3">Lowest, Highest</td></tr>
<tr><th colspan="5">Test Parameters for Channel Bandwidths</th></tr>
<tr><td></td><th>Downlink Configuration</th><th>UL Configuration</th><th colspan="2">SUL Configuration</th></tr>
<tr><td>Test ID</td><td rowspan="4">N/A for Configured UE transmitted Output Power test case</td><td></td><td>Modulation</td><td>RB allocation</td></tr>
<tr><td>1</td><td>CP-OFDM QPSK</td><td>Outer_Full</td><td>CP-OFDM QPSK</td></tr>
<tr><td>2</td><td>CP-OFDM QPSK</td><td>Edge_1RB_Left</td><td>CP-OFDM QPSK</td></tr>
<tr><td>3</td><td>CP-OFDM QPSK</td><td>Edge_1RB_Right</td><td>CP-OFDM QPSK</td></tr>
<tr><td colspan="5">Note 1: Test Channel Bandwidths are checked separately for each SUL band combination, the applicable channel bandwidths are specified in Table 5.5C-1.</td></tr>
</table>

- 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 4.6 ensuring Tables 4.6.3-13, 4.6.3-97, and 4.6.3-129A with conditions SUL, and Table 4.6.3-167 with condition PUSCH_PUCCH_ON_SUL.
- Instead of Table 6.5C.3.1.5-1 → use Table 6.5C.3.1.5-1

6.5C.3.1.5 Test requirement

The measured average power of spurious emission on the SUL carrier, derived in step 3, shall not exceed the described value in Table 6.5C.3.1.5-1.

The spurious emission limits apply for the frequency ranges that are more than ΔfOOB (MHz) in Table 6.5C.3.1.3-1from the edge of the channel bandwidth.

Table 6.5C.3.1.5-1: General spurious emissions test requirements

Frequency Range	Maximum Level	Measurement bandwidth	NOTE
9 kHz ≤ f < 150 kHz	-36 dBm	1 kHz	
150 kHz ≤ f < 30 MHz	-36 dBm	10 kHz	
30 MHz ≤ f < 1000 MHz	-36 dBm	100 kHz	
1 GHz ≤ f < 12.75 GHz	-30 dBm	1 MHz	
12.75 GHz ≤ f < 5th harmonic of the upper frequency edge of the UL operating band in GHz	-30 dBm	1 MHz	1
12.75 GHz < f < 26 GHz	-30 dBm	1 MHz	2
NOTE 1: Applies for Band that the upper frequency edge of the UL Band more than 2.69 GHz NOTE 2: Applies for Band that the upper frequency edge of the UL Band more than 5.2 GHz			

6.5C.3.2 Spurious emission for UE co-existence for SUL

Editor's note

- SA message contents in TS 38.508-1[5] subclause 4.6 is FFS.

- Initial conditions is incomplete.

- The configuration needs FFS to incorporate into the Edge allocation.

- Parameters setting for Cell setup in 38.508 subclause is FFS.

6.5C.3.2.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to co-existing systems for the specified bands which has specific requirements in terms of transmitter spurious emissions.

6.5C.3.2.2 Test applicability

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

6.5C.3.2.3 Minimum conformance requirements

The requirements for NR bands for coexistence with protected bands specified in subclause 6.5.3.2.3 apply to the UE that support SUL operating on the SUL bands

The normative reference for this requirement is TS 38.101-1 [2] subclause 6.5.3.2.

6.5C.3.2.4 Test description

Same test description as specified in clause 6.5.3.2.4 with following exceptions:

- Instead of table 5.3.5-1 → use Table 5.5C-1
- Instead of table 6.5.3.2.4.1-1→ use Table 6.5C.3.2.4-1

Table 6.5C.3.2.4-1: 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 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 supported SCS per test channel BW, Highest supported SCS per test channel BW		
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for Spurious Emissions testing	CP-OFDM QPSK	Outer_Full
2		CP-OFDM QPSK	Edge_1RB_Left
3		CP-OFDM QPSK	Edge_1RB_Right
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration.			

- 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 4.6 ensuring Tables 4.6.3-13, 4.6.3-97, and 4.6.3-129A with conditions SUL, and Table 4.6.3-167 with condition PUSCH_PUCCH_ON_SUL.

6.5C.3.2.5 Test requirement

Test requirements for Spurious Emissions UE Co-existence are the same as specified in clause 6.5.3.2.3-1.

The measured average power of spurious emission, derived in step 3, shall not exceed the described value in Table 6.5.3.2.3-1.

6.5C.3.3 Additional spurious emissions for SUL

- Initial condition for NS value is incomplete. TP analysis is pending.
- SA message contents in TS 38.508-1[5] subclause 4.6 is FFS.
- Initial conditions is incomplete: incomplete test configuration
- The test requirement is TBD
- The clause in reference to message contents is TBD.
- The configuration needs FFS to incorporate into the Edge allocation.
- Parameters setting for Cell setup in 38.508 subclause is FFS.

6.5C.3.3.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions under the deployment scenarios where additional requirements are specified.

6.5C.3.3.2 Test applicability

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

6.5C.3.3.3 Minimum conformance requirements

The additional spurious emission requirements specified in 6.5.3.3.3 apply to the UE operating on SUL bands.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5.3.3

6.5C.3.3.4 Test description

Same test description as specified in clause 6.5.3.2.4 with following exceptions:

- Instead of table 5.3.5-1 → use Table 5.5C-1
- Instead of table 6.5.3.3.4.1-1→ use Table 6.5C.3.3.4-1

Table 6.5C.3.3.4-1: 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		[TBD]	
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1		[TBD]	
Test SCS as specified in Table 5.3.5-1		[TBD]	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for Spurious Emissions testing	FFS	FFS
2		FFS	FFS
3		FFS	FFS
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration			

- 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.
- Instead of table 6.5.3.3.5.1-1→ use Table 6.5C.3.3.5-1
- Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.6 ensuring Tables 4.6.3-13, 4.6.3-97, and 4.6.3-129A with conditions SUL, and Table 4.6.3-167 with condition PUSCH_PUCCH_ON_SUL, together with the exceptions as specified in Clause [6.2C.3.4.3]

6.5C.3.3.5 Test requirement

The measured power on SUL carrier derived in step 4 shall meet the requirements for the specified NR band for an additional spectrum emission requirement with protected bands as indicated in Table 6.5C.3.3.5-1.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

Table 6.5C.3.3.5-1: Additional spurious emissions test requirements

[FFS]

6.5C.4 Transmit intermodulation for SUL

Editor's Note:

- SA message contents in TS 38.508-1 [5] subclause 4.6 is FFS

- How to deal with TDD slots with transient periods is FFS
- Initial conditions is incomplete: Test configuration table is incomplete
- Parameters setting for Cell setup in 38.508 subclause is FFS.

6.5C.4.1 Test purpose

To verify that the UE transmit intermodulation does not exceed the described value in the test requirement.

The transmit intermodulation performance is a measure of the capability of the transmitter to inhibit the generation of signals in its non linear elements caused by presence of the wanted signal and an interfering signal reaching the transmitter via the antenna.

6.5C.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.

6.5C.4.3 Minimum conformance requirements

The requirements in subclause 6.5.4 apply to the UE operating on SUL bands

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5.4.

6.5C.4.4 Test description

Same test description as specified in clause 6.2.4.4 with following exceptions:

- Instead of table 5.3.5-1 → use Table 5.5C-1
- Instead of table 6.5.4.4.1-1→ use Table 6.5C.4.4-1

Table 6.5C.4.4-1: 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		FFS	
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1		FFS	
Test SCS as specified in Table 5.3.5-1		Lowest, Highest	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
	N/A for transmit intermodulation test case	**Modulation**	**RB allocation (NOTE 1)**
1		FFS	FFS
2		FFS	FFS
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.			

- 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.
- Instead of table 6.5.4.5-1→ use Table 6.5C.4.5-1
- Message contents in initial conditions are according to TS 38.508-1 [5] subclause 4.6 ensuring Tables 4.6.3-13, 4.6.3-97, and 4.6.3-129A with conditions SUL, and Table 4.6.3-167 with condition PUSCH_PUCCH_ON_SUL.

6.5C.4.5 Test requirement

The ratio derived in step 6 and 8, shall not exceed the described value in table 6.5C.4.5-1.

Table 6.5C.4.5-1: Transmit Intermodulation

Wanted signal channel bandwidth	$BW_{Channel}$	
Interference signal frequency offset from channel centre	$BW_{Channel}$	$2*BW_{Channel}$
Interference CW signal level	-40dBc	
Intermodulation product	< -29dBc	< -35dBc
Measurement bandwidth	The maximum transmission bandwidth configuration among the different SCSs for the channel BW as defined in Table 6.5.2.2.3-1	
Measurement offset from channel centre	$BW_{Channel}$ and $2*BW_{Channel}$	$2*BW_{Channel}$ and $4*BW_{Channel}$

6.5D Output RF spectrum emissions for UL-MIMO

6.5D.1 Occupied bandwidth for UL-MIMO

6.5D.1.1 Test purpose

To verify that the UE occupied bandwidth for all transmission bandwidth configurations supported by the UE supporting UL-MIMO are less than their specific limits when UE is configured using UL-MIMO transmission.

6.5D.1.2 Test applicability

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

6.5D.1.3 Minimum conformance requirements

For UE supporting UL-MIMO, the requirements for occupied bandwidth is specified at each transmit antenna connector. The occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel at each transmit antenna connector.

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the occupied bandwidth at each transmitter antenna shall be less than the channel bandwidth specified in table 6.5.1.3-1. The requirements shall be met with UL-MIMO configurations described in sub-clause 6.2D.1.3.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.5.1.3 apply

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5D.1.

6.5D.1.4 Test description

6.5D.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 6.5D.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 6.5D.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 by default, exceptions listed in Table 6.5D.1.4.1-2	
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1		All	
Test SCS as specified in Table 5.3.5-1		Lowest SCS	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for occupied bandwidth test case	CP-OFDM QPSK	Outer_full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.			

Table 6.5D.1.4.1-2: Test frequency exceptions for Occupied Bandwidth

5G NR Band	Test Frequency
n77	Low Range, Mid Range, High Range
n78	Low Range, Mid Range, High Range
n79	Low Range, Mid Range, High Range

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 channels are set according to Table 6.5D.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 6.5D.1.4.3

6.5D.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 6.5D.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. The PDCCH DCI format 0_1 is specified with condition 2TX_UL_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2

2. Send continuously power control “up” commands to the UE until the UE transmits at P_{UMAX} level. Allow at least 200ms for the UE to reach P_{UMAX} level.

3. Measure the power spectrum distribution within two times or more range over the requirement for Occupied Bandwidth specification centring on the current carrier frequency. The characteristics of the filter shall be approximately Gaussian (typical spectrum analyser filter). Other methods to measure the power spectrum distribution are allowed. The measuring duration is 1ms over consecutive active uplink slots. For TDD, only slots consisting of only UL symbols are under test.

4. Calculate the total power within the range of all frequencies measured in step 3 and save this value as “Total power”.

5. Sum up the power upward from the lower boundary of the measured frequency range in step 3 and seek the limit frequency point by which this sum becomes 0.5% of “Total power” and save this point as “Lower Frequency”.

6. Sum up the power downward from the upper boundary of the measured frequency range in step 3 and seek the limit frequency point by which this sum becomes 0.5% of “Total power” and save this point as “Upper Frequency”.

7. Calculate the difference “Upper Frequency” – “Lower Frequency” = “Occupied Bandwidth” between the two limit frequencies obtained in step 5 and step 6.

8. Repeat step 3 until step 7 for each of transmit antenna of the UE.

6.5D.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

6.5D.1.5 Test requirement

The measured Occupied Bandwidth in step 6 for each antenna shall not exceed values in Table 6.5D.1.5-1.

Table 6.5D.1.5-1: Occupied channel bandwidth

		Occupied channel bandwidth / NR Channel bandwidth										
	5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**	**30 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**90 MHz**	**100 MHz**
Channel bandwidth (MHz)	5	10	15	20	25	30	40	50	60	80	90	100
Note 1: TT = 0.												

6.5D.2 Out of band emission for UL-MIMO

6.5D.2.1 General

For UE supporting UL-MIMO, the requirements for Out of band emissions resulting from the modulation process and non-linearity in the transmitters are specified at each transmit antenna connector.

For UEs with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements in subclause 6.5.2 apply to each transmit antenna connector. The requirements shall be met with UL-MIMO configurations described in sub-clause 6.2D.1.3

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.5.2 apply.

6.5D.2.2 Spectrum Emission Mask for UL-MIMO

The spectrum emission mask of the UE applies to frequencies (Δf_{OOB}) starting from the ± edge of the assigned NR channel bandwidth. For frequencies greater than (Δf_{OOB}) the spurious requirements in subclause 6.5D.3 are applicable.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

6.5D.2.2.1 Test purpose

To verify that the power of any UE emission shall not exceed specified level for the specified channel bandwidth.

6.5D.2.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports UL-MIMO.

6.5D.2.2.3 Minimum conformance requirements

The power of any UE emission shall not exceed the levels specified in Table 6.5.2.2.3-1 for the specified channel bandwidth at each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5D.2 and 6.5.2.2

6.5D.2.2.4 Test description

6.5D.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 channel bandwidth and sub-carrier spacing, and are shown in table 6.5D.2.2.4.1-1. 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 6.5D.2.2.4.1-1: Test Configuration Table

Default 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, Highest		
Test SCS as specified in Table 5.3.5-1				Lowest and Highest		
Test Parameters for Channel Bandwidths						
Test ID	**Freq**	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
		Default	Default	N/A for Spectrum Emission Mask test case	**Modulation**	**RB allocation (NOTE 1)**
1	Low				CP-OFDM QPSK	Edge_1RB_Left
2	High				CP-OFDM QPSK	Edge_1RB_Right
3	Default				CP-OFDM QPSK	Outer_Full
4	Low				CP-OFDM 16 QAM	Edge_1RB_Left
5	High				CP-OFDM 16 QAM	Edge_1RB_Right
6	Default				CP-OFDM 16 QAM	Outer_Full
7	Low				CP-OFDM 64 QAM	Edge_1RB_Left
8	High				CP-OFDM 64 QAM	Edge_1RB_Right
9	Default				CP-OFDM 64 QAM	Outer_Full
10	Low				CP-OFDM 256 QAM	Edge_1RB_Left
11	High				CP-OFDM 256 QAM	Edge_1RB_Right
12	Default				CP-OFDM 256 QAM	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 channels are set according to Table 6.5D.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 6.5D.2.2.4.3

6.5D.2.2.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format0_1 for C_RNTI to schedule the UL RMC according to Table 6.5D.2.2.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0_1 is specified with condition 2TX_UL_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2
2. Send continuously power control "up" commands to the UE until the UE transmits at P_{UMAX} level. Allow at least 200ms for the UE to reach P_{UMAX} level.
3. Measure the sum of the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Tables 6.2D.2.5-1 or 6.2D.2.5-2 as appropriate. The period of the measurement shall be at least the continuous duration of 1ms over consecutive active uplink slots and uplink symbols. For TDD, only slots consisting of only UL symbols are under test.
4. Measure the power of the transmitted signal at each antenna connector with a measurement filter of bandwidths according to table 6.5D.2.2.5-1. The centre frequency of the filter shall be stepped in continuous steps according to the same table. The measured power shall be recorded for each step. The measurement period shall capture the active TSs.

6.5D.2.2.4.3 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.

6.5D.2.2.5 Test requirement

The measured sum of the UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in Tables 6.2D.2.5-1 or 6.2D.2.5-2 as appropriate, and the power of any UE emission measured at each antenna in step 4 shall fulfil requirements in Table 6.5D.2.2.5-1.

Table 6.5D.2.2.5-1: NR General spectrum emission mask

<table>
<tr><th></th><th colspan="13">Spectrum emission limit (dBm) / Channel bandwidth</th></tr>
<tr><th>ΔfOOB (MHz)</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th><th>25 MHz</th><th>30 MHz</th><th>40 MHz</th><th>50 MHz</th><th>60 MHz</th><th>80 MHz</th><th>90 MHz</th><th>100 MHz</th><th>Measurement bandwidth</th></tr>
<tr><td>± 0-1</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td>-13 + TT</td><td></td><td></td><td></td><td></td><td></td><td>1 % channel bandwidth</td></tr>
<tr><td>± 0-1</td><td>-15 + TT</td><td>-18 + TT</td><td>-20 + TT</td><td>-21 + TT</td><td>-22 + TT</td><td>-23 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>-24 + TT</td><td>30 kHz</td></tr>
<tr><td>± 1-5</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td>-10 + TT</td><td rowspan="19">1 MHz</td></tr>
<tr><td>± 5-6</td><td>-13 + TT</td><td rowspan="2">-13 + TT</td><td rowspan="3">-13 + TT</td><td rowspan="4">-13 + TT</td><td rowspan="5">-13 + TT</td><td rowspan="6">-13 + TT</td><td rowspan="8">-13 + TT</td><td rowspan="10">-13 + TT</td><td rowspan="12">-13 + TT</td><td rowspan="14">-13 + TT</td><td rowspan="15">-13 + TT</td><td rowspan="17">-13 + TT</td></tr>
<tr><td>± 6-10</td><td>-25 + TT</td></tr>
<tr><td>± 10-15</td><td></td><td>-25 + TT</td></tr>
<tr><td>± 15-20</td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 20-25</td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 25-30</td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 30-35</td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 35-40</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 40-45</td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 45-50</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 50-55</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 55-60</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 60-65</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 65-80</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 80-90</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 90-95</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td>± 95-100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>± 100-105</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-25 + TT</td></tr>
<tr><td colspan="14">Note 1: The first and last measurement position with a 30 kHz filter is at ΔfOOB equals to 0.015 MHz and 0.985 MHz.
Note 2: At the boundary of spectrum emission limit, the first and last measurement position with a 1 MHz filter is the inside of +0.5MHz and -0.5MHz, respectively.
Note 3: The measurements are to be performed above the upper edge of the channel and below the lower edge of the channel.
Note 4: TT = 1.5 dB for f ≤ 3GHz, TT = 1.8 dB for 3GHz < f ≤ 4.2GHz, TT = 1.8 dB for 4.2GHz < f ≤ 6.0GHz.</td></tr>
</table>

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

6.5D.2.3 Additional spectrum emission mask for UL-MIMO

Editor's note:

-Test coverage for the NS_XXs other than NS_35 is FFS

6.5D.2.3.1 Test purpose

To verify that the power of any UE emission at each transmit antenna shall not exceed specified lever for the specified channel bandwidth under the deployment scenarios where additional requirements are specified.

6.5D.2.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports UL-MIMO.

6.5D.2.3.3 Minimum conformance requirements

The power of any UE emission shall not exceed the levels specified in Table 6.5.2.3.3-1 for the specified channel bandwidth at each transmit antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5D.2 and 6.5.2.3

6.5D.2.3.4 Test description

6.5D.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 channel bandwidth and sub-carrier spacing, and are shown in table 6.5D.2.3.4.1-1. 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 6.5D.2.3.4.1-1: Test Configuration Table for NS_35 for band n71

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 Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1					Lowest and Highest (NOTE 2)	
Test SCS as specified in Table 5.3.5-1					Lowest and Highest	
A-MPR test parameters for NS_35						
Downlink Configuration					**Uplink Configuration**	
Test ID	**Freq**	**ChBw**	**SCS**	**N/A for A-MPR testing.**	**Modulation**	**RB allocation (NOTE 1)**
1	Low				CP-OFDM QPSK	Edge_1RB_Left
2	High				CP-OFDM QPSK	Edge_1RB_Right
3	Default				CP-OFDM QPSK	Outer Full
4	Low				CP-OFDM 16 QAM	Edge_1RB_Left
5	High				CP-OFDM 16 QAM	Edge_1RB_Right
6	Default				CP-OFDM 16 QAM	Outer Full
7	Low				CP-OFDM 64 QAM	Edge_1RB_Left
8	High				CP-OFDM 64 QAM	Edge_1RB_Right
9	Default				CP-OFDM 64 QAM	Outer Full
10	Low				CP-OFDM 256 QAM	Edge_1RB_Left
11	High				CP-OFDM 256 QAM	Edge_1RB_Right
12	Default				CP-OFDM 256 QAM	Outer Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: Confining to channel bandwidths of 5MHz, 10MHz, 15MHz and 20MHz , which are applicable to NS_35 according to TS 38.101-1[2] Table 6.2.3.1-1.						

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 channels are set according to Tables 6.5D.2.3.4.1-1 as appropriate for NS_35.

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 6.5D.2.3.4.3

6.5D.2.3.4.2 Test procedure

Same test procedure as defined in clause 6.5D.2.2.4.2 with the following exceptions:

- Instead of Table 6.2D.2.5-1, Table 6.2D.3.5-1 as approriate for NS_35 is applied in step 3;

- Intead of Table 6.5D.2.2.5-1, 6.5D.2.3.5-1 as approriate for the corresponding NS_35 is applied in step 4;

6.5D.2.3.4.3 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 exceptions listed in clause 6.2D.3.4.3.

6.5D.2.3.5 Test requirement

The measured sum of the UE mean power in the channel bandwidth, derived in step 3 shall fulfil the requirements as specified in Table [6.2D.2.3.5-1] as approriate for the corresponding NS_35, and the power of any UE emission measured at each antenna in step 4 shall fulfil requirements in Table 6.5D.2.3.5-1.

Table 6.5D.2.3.5-1: Additional requirements for “NS_35”

Spectrum emission limit (dBm) / Channel bandwidth					
Δf_{OOB} (MHz)	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Measurement bandwidth (unless otherwise stated)**
± 0-0.1	-15 + TT	-18 + TT	-20 + TT	-21 + TT	30 kHz
± 0.1-6	-13 + TT	-13 + TT	-13 + TT	-13 + TT	100 kHz
± 6-10	-25[1] + TT	-13 + TT	-13 + TT	-13 + TT	100 kHz
± 10-15		-25[1] + TT	-13 + TT	-13 + TT	100 kHz
± 15-20			-25[1] + TT	-13 + TT	100 kHz
± 20-25				-25 + TT	1 MHz
NOTE 1: The measurement bandwidth shall be 1 MHz; NOTE 2: TT for each frequency and channel bandwidth is specified in Table 6.5D.2.3.5-2					

Table 6.5D.2.3.5-2: Test Tolerance (Spectrum Emission Mask)

	f ≤ 3.0GHz	**3.0GHz < f ≤ 4.2GHz**	**4.2GHz < f ≤ 6.0GHz**
BW ≤ 100MHz	1.5 dB	1.8 dB	1.8 dB

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

6.5D.2.4 Adjacent channel leakage ratio for UL-MIMO

Adjacent channel leakage power Ratio (ACLR) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency.

6.5D.2.4.1 NR ACLR for UL-MIMO

6.5D.2.4.1.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5D.2.4.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports UL-MIMO.

6.5D.2.4.1.3 Minimum conformance requirements

The minimum conformance requirements specified in Clause 6.5.2.4.1.3 applies to each antenna connector of the UE.

The normative reference for this requirement is TS 38.101-] clauses and 6.5D.2 and 6.5.2.4.1.

6.5D.2.4.1.4 Test description

6.5D.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 channel bandwidth and sub-carrier spacing, are shown in table 6.5D.2.4.1.4.1-1. 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 6.5D.2.4.1.4.1-1: Test Configuration Table

Default Conditions						
Test Environment as specified in TS 38.508-1 [5] subclause 4.1					NC, 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, Highest	
Test SCS as specified in Table 5.3.5-1					Lowest and Highest	
Test Parameters for Channel Bandwidths						
Test ID	**Freq**	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
		Default	Default	N/A for Adjacent Channel Leakage Ratio test case	**Modulation (NOTE 2)**	**RB allocation (NOTE 1)**
1	Default				CP-OFDM QPSK	Inner_Full
2	Low				CP-OFDM QPSK	Edge_1RB_Left
3	High				CP-OFDM QPSK	Edge_1RB_Right
4	Default				CP-OFDM QPSK	Outer_Full
5	Default				CP-OFDM 16 QAM	Inner_Full
6	Low				CP-OFDM 16 QAM	Edge_1RB_Left
7	High				CP-OFDM 16 QAM	Edge_1RB_Right
8	Default				CP-OFDM 16 QAM	Outer_Full
9	Low				CP-OFDM 64 QAM	Edge_1RB_Left
10	High				CP-OFDM 64 QAM	Edge_1RB_Right
11	Default				CP-OFDM 64 QAM	Outer_Full
12	Low				CP-OFDM 256 QAM	Edge_1RB_Left
13	High				CP-OFDM 256 QAM	Edge_1RB_Right
14	Default				CP-OFDM 256 QAM	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 channels are set according to Table 6.5D.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 6.5D.2.4.1.4.3

6.5.2.4.1.4.2 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 6.5D.2.4.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0_1 is specified with condition 2TX_UL_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2
2. Send continuously power control “up” commands to the UE until the UE transmits at P_{UMAX} level. Allow at least 200ms for the UE to reach P_{UMAX} level.
3. Measure the sum of the mean power of the UE at each antenna connector in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in clauses 6.2D.2.5 and [6.2D.3.5] as appropriate. The period of the measurement shall be at least the continuous duration of 1ms over consecutive active uplink slots and uplink symbols. For TDD, only slots consisting of only UL symbols are under test.
4. Measure the rectangular filtered mean power for the assigned NR channel at each antenna connector of UE.

5. Measure the rectangular filtered mean power of the first NR adjacent channel at each antenna connector of UE on both lower and upper side of the assigned NR channel, respectively.

6. Calculate the ratios of the power between the values measured in step 4 over step 5 for lower and upper NR ACLR at each antenna connector of UE, respectively.

6.5D.2.4.1.4.3 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.

6.5D.2.4.1.5 Test requirement

The measured UE mean total power in the channel bandwidth at all the antenna connectors, derived in step 3, shall fulfil requirements in Clause 6.2D.2.5 and [6.2D.3.5] as appropriate, and if the measured adjacent channel power is greater than –50 dBm then the measured NR ACLR, derived in step 6 for each antenna connector, shall be higher than the limits in Table 6.5D.2.4.1.5-2.

Table 6.5D.2.4.1.5-1: NR ACLR measurement bandwidth

NR channel bandwidth / NR ACLR measurement bandwidth												
	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
NR ACLR measurement bandwidth	4.515	9.375	14.235	19.095	23.955	28.815	38.895	48.615	58.35	78.15	88.23	98.31

Table 6.5D.2.4.1.5-2: NR ACLR requirement

	Power class 1	Power class 2	Power class 3
NR ACLR		31 + TT dB	30 + TT dB
NOTE 1: TT = 0.8 dB			

6.5D.2.4.2 UTRA ACLR for UL-MIMO

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Test point analysis for NS_05U, NS_43U and NS_100 is FFS

6.5D.2.4.2.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5D.2.4.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports UL-MIMO.

6.5D.2.4.2.3 Minimum conformance requirements

The minimum conformance requirements specified in Clause 6.5.2.4.2.3 applies to each antenna connector of the UE.

The normative reference for this requirement is TS 38.101-1 [2] clauses 6.5D.2 and 6.5.2.4.2.

6.5D.2.4.2.4 Test description

6.5D.2.4.2.4.1 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 channel bandwidth and sub-carrier spacing, are shown in table 6.5D.2.4.2.4.1-1. 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 6.5D.2.4.2.4.1-1: Test Configuration Table for NS_03U

Default 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, Highest	
Test SCS as specified in Table 5.3.5-1					Lowest, Highest	
Test Parameters for Channel Bandwidths						
Test ID	**Freq**	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
		Default	Default	N/A for Adjacent Channel Leakage Ratio test case	**Modulation**	**RB allocation (NOTE 1)**
1	Low				CP-OFDM QPSK	Edge_1RB_Left
2	High				CP-OFDM QPSK	Edge_1RB_Right
3	Default				CP-OFDM QPSK	Outer_Full
4	Low				CP-OFDM 16 QAM	Edge_1RB_Left
5	High				CP-OFDM 16 QAM	Edge_1RB_Right
6	Default				CP-OFDM 16 QAM	Outer_Full
7	Low				CP-OFDM 64 QAM	Edge_1RB_Left
8	High				CP-OFDM 64 QAM	Edge_1RB_Right
9	Default				CP-OFDM 64 QAM	Outer_Full
10	Low				CP-OFDM 256 QAM	Edge_1RB_Left
11	High				CP-OFDM 256 QAM	Edge_1RB_Right
12	Default				CP-OFDM 256 QAM	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 channels are set according to Table 6.5D.2.4.2.4.1-1.

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 6.5D.2.4.2.4.3

6.5D.2.4.2.4.2 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 6.5D.2.4.2.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0_1 is specified with condition 2TX_UL_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2

2. Send continuously power control "up" commands to the UE until the UE transmits at P_{UMAX} level. Allow at least 200ms for the UE to reach P_{UMAX} level.

3. Measure the sum of the mean power of the UE at each antenna connector in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in clause 6.2D.3.5 as appropriate. The period of the measurement shall be at least the continuous duration of 1ms over consecutive active uplink slots and uplink symbols. For TDD, only slots consisting of only UL symbols are under test.

4. Measure the rectangular filtered mean power for the assigned NR channel at each antenna connector of UE.

5. Measure the RRC filtered mean power of the first and the second UTRA adjacent channel at each antenna connector of UE on both lower and upper side of the assigned NR channel, respectively.

6. Calculate the ratio of the power between the values measured in step 4 over step 5 for $UTRA_{ACLR1}$, $UTRA_{ACLR2}$ for both lower an upper side of the assigned NR channel, respectively.

6.5D.2.4.2.4.3 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 and with the exception specified in Table 6.5D.2.4.2.4.3 - 1

Table 6.5D.2.4.2.4.3-1: *AdditionalSpectrumEmission*: UTRA ACLR test requirement for "NS_XX"

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1 AdditionalSpectrumEmission from SIB1			
Information Element	**Value/remark**	**Comment**	**Condition**
AdditionalSpectrumEmission	1(NS_100)	NS_100 for band n1, n2, n3, n5, n8, n20, n25, n66, n80, n81, n82, n84 NOTE1	
	3(NS_03U)	NS_03U for n2, n25, n66, n86 NS_05U for n1, n84 NS_43U for n8, n81	
NOTE 1: This NS can be signalled for NR bands that have UTRA services deployed			

6.5D.2.4.2.5 Test requirement

UTRA ACLR requirement is applicable when signalled by the network with network signalling value indicated by the field *additionalSpectrumEmission*.

The measured UE mean total power in the channel bandwidth at all the antenna connectors, derived in step 3, shall fulfil requirements in [Clause 6.2D.3.5] as appropriate, and if the measured adjacent channel power is greater than –50 dBm then the measured UTRA ACLR, derived in step 6 for each antenna connector, shall be higher than the limits in Table 6.5D.2.4.2.5-1.

Table 6.5D.2.4.2.5-1: UTRA ACLR requirement

	Power class 3
$UTRA_{ACLR1}$	33 dB + TT
$UTRA_{ACLR2}$	36 dB + TT
NOTE 1: TT = 0.8 dB	

6.5D.3 Spurious emissions for UL-MIMO

For UE supporting UL-MIMO, the requirements for Spurious emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emissions, intermodulation products and frequency conversion products are specified at each transmit antenna connector.

For UEs with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements specified in subclause 6.5.3 apply to each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations described in sub-clause 6.2D.1.3.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.5.3 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 6.5D.3

6.5D.3.1 General spurious emissions for UL-MIMO

6.5D.3.1.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions.

6.5D.3.1.2 Test applicability

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

6.5D.3.1.3 Minimum conformance requirements

The general spurious emission requirement specified in clause 6.5.3.1.3 applies to each antenna connector of the UE.

The normative reference for this requirement is TS 38.101-1 [2] subclauses 6.5D.3 and 6.5.3.1

6.5D.3.1.4 Test description

6.5D.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 channel bandwidth and sub-carrier spacing, are shown in table 6.5D.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 6.5D.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.		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			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for Spurious Emissions testing	CP-OFDM QPSK	OuterFull
2		CP-OFDM QPSK	Edge_1RB_Left
3		CP-OFDM QPSK	Edge_1RB_Right
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration			

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 and C.2, and uplink signals according to Annex G.0, G.1, G.2, and G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.5.3.1.4.1-1.

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 6.5D.3.1.4.3.

6.5D.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 6.5D.3.1.4.1-1. 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 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 P_{UMAX} level.

3. Measure the power of the transmitted signal at each antenna connector with a measurement filter of bandwidths according to table 6.5D.3.1.5-1. The centre frequency of the filter shall be stepped in contiguous steps according to table 6.5D.3.1.5-1. The measured power shall be verified for each step. The measurement period shall capture the active time slots.

6.5D.3.1.4.3 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

6.5D.3.1.5 Test requirement

The measured average power of spurious emission at each antenna connector, derived in step 3, shall not exceed the described value in Table 6.5D.3.1.5-1.

The spurious emission limits apply for the frequency ranges that are more than ΔfOOB (MHz) in Table 6.5.3.1.3-1from the edge of the channel bandwidth.

Table 6.5D.3.1.5-1: General spurious emissions test requirements

Frequency Range	Maximum Level	Measurement bandwidth	NOTE
9 kHz ≤ f < 150 kHz	-36 dBm	1 kHz	
150 kHz ≤ f < 30 MHz	-36 dBm	10 kHz	
30 MHz ≤ f < 1000 MHz	-36 dBm	100 kHz	
1 GHz ≤ f < 12.75 GHz	-30 dBm	1 MHz	
12.75 GHz ≤ f < 5th harmonic of the upper frequency edge of the UL operating band in GHz	-30 dBm	1 MHz	1
12.75 GHz < f < 26 GHz	-30 dBm	1 MHz	2
NOTE 1: Applies for Band that the upper frequency edge of the UL Band more than 2.69 GHz NOTE 2: Applies for Band that the upper frequency edge of the UL Band more than 5.2 GHz			

6.5D.3.2 Spurious emission for UE co-existence for UL-MIMO

6.5D.3.2.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to co-existing systems for the specified bands which has specific requirements in terms of transmitter spurious emissions.

6.5D.3.2.2 Test applicability

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

6.5D.3.2.3 Minimum conformance requirements

The requirements for NR bands for coexistence with protected bands specified in subclause 6.5.3.2.3 apply to each UE transmit antenna connector

The normative reference for this requirement is TS 38.101-1 [2] subclauses 6.5.3.2 and 6.5D.3.

6.5D.3.2.4 Test description

6.5D.3.2.4.1 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 channel bandwidth and sub-carrier spacing, are shown in table 6.5D.3.2.4.1-1. 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 6.5D.3.2.4.1-1: 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.		Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1		Lowest supported SCS per test channel BW, Highest supported SCS per test channel BW	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
	N/A for Spurious Emissions testing	**Modulation**	**RB allocation (NOTE 1)**
1		CP-OFDM QPSK	Outer_Full
2		CP-OFDM QPSK	Edge_1RB_Left
3		CP-OFDM QPSK	Edge_1RB_Right
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration.			

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 [6] 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 6.5D.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 6.5D.3.2.4.3.

6.5D.3.2.4.2 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 6.5D.3.2.4.1-1. 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 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 P_{UMAX} level.

3. Measure the power of the transmitted signal at each UE antenna connector with a measurement filter of bandwidths according to table 6.5.3.2.3-1. The centre frequency of the filter shall be stepped in contiguous steps according to table 6.5.3.2.3-1. The measured power shall be verified for each step. The measurement period shall capture the active time slots.

6.5D.3.2.4.3 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.

6.5D.3.2.5 Test requirement

The measured average power of spurious emission, derived in step 3 at each UE antenna connector, shall not exceed the described value in Table 6.5.3.2.3-1.

6.5D.3.3 Additional spurious emissions for UL-MIMO

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- There are NS-XXs other than NS_04 FFS:

6.5D.3.3.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions under the deployment scenarios where additional requirements are specified.

6.5D.3.3.2 Test applicability

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

6.5D.3.3.3 Minimum conformance requirements

The additional spurious emission requirements specified in 6.5.3.3.3 apply to each UE antenna connector.

The normative reference for this requirement is TS 38.101-1 [2] clauses 6.5D.3 and 6.5.3.3

6.5D.3.3.4 Test description

6.5D.3.3.4.1 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 these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, and are shown in Table

6.5D.3.3.4.1-1 through Table 6.5D.3.3.4.1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.5D.3.3.4.1-1: Test Configuration Table (network signalled value "NS_04")

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 Freq column)	
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, Highest	
A-MPR test parameters for NS_04				
		Downlink Configuration	**Uplink Configuration**	
Test ID	**Freq**	N/A for A-MPR testing.	**Modulation (NOTE 2)**	**RB allocation (NOTE 1)**
32	Low		CP-OFDM QPSK	Edge_1RB_Left
33	2496 + 3/2 × $BW_{Channel}$ – 6 MHz		CP-OFDM QPSK	Edge_1RB_Left
34	2496 + $BW_{Channel}$ /2 +		CP-OFDM QPSK	Inner Full
35	MAX(10 MHz, 0.25 × $BW_{Channel}$)		CP-OFDM QPSK	Outer Full
36	High		CP-OFDM QPSK	Edge_1RB_Right
37	High		CP-OFDM QPSK	Inner Full
38	High		CP-OFDM QPSK	Outer Full
39	Low		CP-OFDM 16 QAM	Edge_1RB_Left
40	2496 + 3/2 × $BW_{Channel}$ – 6 MHz		CP-OFDM 16 QAM	Edge_1RB_Left
41	2496 + $BW_{Channel}$ /2 +		CP-OFDM 16 QAM	Inner Full
42	MAX(10 MHz, 0.25 × $BW_{Channel}$)		CP-OFDM 16 QAM	Outer Full
43	High		CP-OFDM 16 QAM	Edge_1RB_Right
44	High		CP-OFDM 16 QAM	Inner Full
45	High		CP-OFDM 16 QAM	Outer Full
46	Low		CP-OFDM 64 QAM	Edge_1RB_Left
47	2496 + 3/2 × $BW_{Channel}$ – 6 MHz		CP-OFDM 64 QAM	Edge_1RB_Left
48	2496 + $BW_{Channel}$ /2 + MAX(10 MHz, 0.25 × $BW_{Channel}$)		CP-OFDM 64 QAM	Outer Full
49	High		CP-OFDM 64 QAM	Edge_1RB_Right
50	High		CP-OFDM 64 QAM	Outer Full
51	Low		CP-OFDM 256 QAM	Edge_1RB_Left
52	2496 + 3/2 × $BW_{Channel}$ – 6 MHz		CP-OFDM 256 QAM	Edge_1RB_Left
53	2496 + $BW_{Channel}$ /2 + MAX(10 MHz, 0.25 × $BW_{Channel}$)		CP-OFDM 256 QAM	Outer Full
54	High		CP-OFDM 256 QAM	Edge_1RB_Right
55	High		CP-OFDM 256 QAM	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 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 channels are set according to Table 6.5D.3.3.4.1-1 for NS_04. .

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 6.5D.3.3.4.3.

6.5D.3.3.4.2 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 6.5D.3.3.4.1-1 as appropriate for NS_04. 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 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 P_{UMAX} level.

3. Measure the sum of the mean power at each UE antenna connector in the channel bandwidth of the radio access mode, which shall meet the requirements described in Clauses from 6.2D.2.5, or 6.2D.3.5 as appropriate for NS_04. The period of measurement shall be at least the continuous duration of 1ms over consecutive active uplink slots and uplink symbols. For TDD, only slots consisting of only UL symbols are under test.

4. Measure the power of the transmitted signal at each UE antenna connector with a measurement filter of bandwidths according to Tables 6.5.3.3.5.1-1 as appropriate for NS_04. The centre frequency of the filter shall be stepped in contiguous steps according to the same table the measured power shall be verified for each step. The measurement period shall capture the active time slots.

6.5D.3.3.4.3 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 same exceptions listed in clause 6.5.3.3.4.3

6.5D.3.3.5 Test requirement

The measured power at each UE antenna connector derived in step 4 shall meet the requirements for the specified NR band for an additional spectrum emission requirement with protected bands as indicated in clause 6.5.3.3.5.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

6.5D.4 Transmit intermodulation for UL-MIMO

6.5D.4.1 Test purpose

To verify that the UE transmit intermodulation does not exceed the described value in the test requirement.

The transmit intermodulation performance is a measure of the capability of the transmitter to inhibit the generation of signals in its non linear elements caused by presence of the wanted signal and an interfering signal reaching the transmitter via the antenna.

6.5D.4.2 Test applicability

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

6.5D.4.3 Minimum conformance requirements

For UE supporting UL-MIMO, the transmit intermodulation requirements are specified at each transmit antenna connector and the wanted signal is defined as the sum of output power at each transmit antenna connector.

For UEs with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements specified in subclause 6.5.4 apply to each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations described in sub-clause 6.2D.1.

If UE is configured for transmission on single-antenna port, the requirements in subclause 6.5.4 apply.

The normative reference for this requirement is TS 38.101-1 [2] clauses 6.5D.4 and 6.5.4.

6.5D.4.4 Test description

6.5D.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 channel bandwidth and sub-carrier spacing, and are shown in table 6.5D.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 6.5D.4.4.1-1: Test Configuration Table

<table>
<tr><th colspan="4">Initial Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 38.508-1 [5] subclause 4.1</td><td colspan="2">Normal</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="2">Mid range</td></tr>
<tr><td colspan="2">Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="2">Mid, Highest</td></tr>
<tr><td colspan="2">Test SCS as specified in Table 5.3.5-1</td><td colspan="2">Lowest, Highest</td></tr>
<tr><th colspan="4">Test Parameters</th></tr>
<tr><th>Test ID</th><th>Downlink Configuration</th><th colspan="2">Uplink Configuration</th></tr>
<tr><td></td><td rowspan="2">N/A for transmit intermodulation test case</td><th>Modulation</th><th>RB allocation (NOTE 1)</th></tr>
<tr><td>1</td><td>CP-OFDM QPSK</td><td>Inner Full</td></tr>
<tr><td colspan="4">NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.</td></tr>
</table>

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.3.2 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 6.5D.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 6.5D.4.4.3.

6.5D.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 6.5D.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 condition 2TX_UL_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2

2. Send continuously uplink power control "up" commands to the UE until the UE transmits at its P_{UMAX} level.

3. Measure the rectangular filtered mean power at each antenna connector of the UE. For TDD, only slots consisting of only UL symbols are under test.

4. Set the interference signal frequency below the UL carrier frequency using the first offset in table 6.5D.4.5-1.

5. Set the interference CW signal level according to table 6.5D.4.5-1.

6. Search the intermodulation product signals below and above the UL carrier frequency at each UE antenna connector, then measure the rectangular filtered mean power of transmitting intermodulation for both signals, and calculate the ratios for each UE antenna connector with the power measured in step 3.

7. Set the interference signal frequency above the UL carrier frequency using the first offset in table 6.5D.4.5-1.

8. Search the intermodulation product signals below and above the UL carrier frequency at each UE antenna connector, then measure the rectangular filtered mean power of transmitting intermodulation for both signals, and calculate the ratios for each UE antenna with the power measured in step 3.

9. Repeat the measurement using the second offset in table 6.5D.4.5-1.

10. Repeat step 3) until 9) for each of transmit antenna of the UE.

6.5D.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.

6.5D.4.5 Test requirement

The ratio derived in step 6 and 8, shall not exceed the described value in table 6.5D.4.5-1.

Table 6.5D.4.5-1: Transmit Intermodulation

Wanted signal channel bandwidth	$BW_{Channel}$	
Interference signal frequency offset from channel centre	$BW_{Channel}$	$2*BW_{Channel}$
Interference CW signal level	-40dBc	
Intermodulation product	< -29dBc	< -35dBc
Measurement bandwidth	The maximum transmission bandwidth configuration among the different SCSs for the channel BW as defined in Table 5.3.5-1	
Measurement offset from channel centre	$BW_{Channel}$ and $2*BW_{Channel}$	$2*BW_{Channel}$ and $4*BW_{Channel}$

7 Receiver characteristics

TBD

7.1 General

Unless otherwise stated the receiver characteristics are specified at the antenna connector(s) of the UE. For UE(s) with an integral antenna only, a reference antenna(s) with a gain of 0 dBi is assumed for each antenna port(s). UE with an integral antenna(s) may be taken into account by converting these power levels into field strength requirements, assuming a 0 dBi gain antenna. For UEs with more than one receiver antenna connector, identical interfering signals shall be applied to each receiver antenna port if more than one of these is used (diversity).

The levels of the test signal applied to each of the antenna connectors shall be as defined in the respective sections below.

Unless otherwise stated, Channel Bandwidth shall be prioritized in the selecting of test points. Subcarrier spacing shall be selected after Test Channel Bandwidth is selected.

With the exception of subclause 7.3, the requirements shall be verified with the network signalling value NS_01 configured (Table 6.2.3.3-1).

All the parameters in clause 7 are defined using the UL reference measurement channels specified in Annexes A.2.2 and A.2.3, the DL reference measurement channels specified in Annex A.3.2 and using the set-up specified in Annex C.3.1.

7.2 Diversity characteristics

The UE is required to be equipped with a minimum of two Rx antenna ports in all operating bands except for the bands n7, n38, n41, n77, n78, n79 where the UE is required to be equipped with a minimum of four Rx antenna ports. This requirement applies when the band is used as a standalone band or as part of a band combination.

For the requirements in Section 7, the UE shall be verified with two Rx antenna ports in all supported frequency bands. Additional requirements for four Rx ports shall be verified in operating bands where the UE is equipped with four Rx antenna ports.

The above rules apply for all subclasses with the exception of subclause 7.9.

7.3 Reference sensitivity

7.3.1 General

The reference sensitivity power level REFSENS is the minimum mean power applied to each one of the UE antenna ports for all UE categories, at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

In later subclauses of Section 7 where the value of REFSENS is used as a reference to set the corresponding requirement.

For all bands, the UE shall be verified against those requirements by applying the REFSENS value in Table 7.3.2.3-1 with 2 Rx antenna ports tested.

For bands where the UE is required to be equipped with 4 Rx antenna ports, the UE shall additionally be verified against those requirements by applying the resulting REFSENS value derived from the requirement in Table 7.3.2_1.3-1with 4 Rx antenna ports tested.

7.3.2 Reference sensitivity power level

7.3.2.1 Test purpose

The test purpose is to verify the ability of the UE to receive data with a given average throughput for a specified reference measurement channel, under conditions of low signal level, ideal propagation and no added noise.

7.3.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward

7.3.2.3 Minimum conformance requirements

The reference sensitivity power level REFSENS is the minimum mean power applied to each one of the UE antenna ports for all UE categories, at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2.2, A.2.3.2, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.3.2.3-1 and Table 7.3.2.3-2.

Table 7.3.2.3-1: Two antenna port reference sensitivity QPSK $P_{REFSENS}$

Operating band / SCS / Channel bandwidth / Duplex-mode														
Operating Band	**SCS kHz**	**5 MHz (dBm)**	**10 MHz (dBm)**	**15 MHz (dBm)**	**20 MHz (dBm)**	**25 MHz (dBm)**	**30 MHz (dBm)**	**40 MHz (dBm)**	**50 MHz (dBm)**	**60 MHz (dBm)**	**80 MHz (dBm)**	**90 MHz (dBm)**	**100 MHz (dBm)**	**Duplex Mode**
n1	15	-100.0	-96.8	-95.0	-93.8									FDD
	30		-97.1	-95.1	-94.0									
	60		-97.5	-95.4	-94.2									
n2	15	-98.0	-94.8	-93.0	-91.8									FDD
	30		-95.1	-93.1	-92.0									
	60		-95.5	-93.4	-92.2									
n3	15	-97.0	-93.8	-92.0	-90.8	-89.7	-88.9							FDD
	30		-94.1	-92.1	-91.0	-89.8	-89.0							
	60		-94.5	-92.4	-91.2	-90.0	-89.1							
n5	15	-98.0	-94.8	-93.0	-90.8									FDD
	30		-95.1	-93.1	-91.0									
	60													
n7[1]	15	-98.0	-94.8	-93.0	-91.8									FDD
	30		-95.1	-93.1	-92.0									
	60		-95.5	-93.4	-92.2									
n8	15	-97.0	-93.8	-92.0	-90.0									FDD
	30		-94.1	-92.1	-90.2									
	60													
n12	15	-97.0	-93.8	-84.0										FDD
	30		-94.1	-84.1										
	60													
n20	15	-97.0	-93.8	-91.0	-89.8									FDD
	30		-94.1	-91.1	-90.0									
	60													
n25	15	-96.5	-93.3	-91.5	-90.3									FDD
	30		-93.6	-91.6	-90.5									
	60		-94.0	-91.9	-90.7									
n28	15	-98.5	-95.5	-93.5	-90.8									FDD
	30		-95.6	-93.6	-91.0									
	60													
n34	15	-100.0	-96.8	-95.0										TDD
	30		-97.1	-95.1										
	60		-97.5	-95.4										
n38[1]	15	-100.0	-96.8	-95.0	-93.8									TDD
	30		-97.1	-95.1	-94.0									
	60		-97.5	-95.4	-94.2									
n39	15	-100.0	-96.8	-95.0	-93.8	-92.7	-91.9	-90.6						TDD
	30		-97.1	-95.1	-94.0	-92.8	-92.0	-90.7						
	60		-97.5	-95.4	-94.2	-93.0	-92.1	-90.9						
n40	15	-100.0	-96.8	-95.0	-93.8	-92.7	-91.9	-90.6	-89.6					TDD
	30		-97.1	-95.1	-94.0	-92.8	-92.0	-90.7	-89.7	-88.9	-87.6			
	60		-97.5	-95.4	-94.2	-93.0	-92.1	-90.9	-89.8	-89.1	-87.6			
n41[1]	15		-94.8	-93.0	-91.8			-88.6	-87.6					TDD
	30		-95.1	-93.1	-92.0			-88.7	-87.7	-86.9	-85.6	-85.1	-84.7	
	60		-95.5	-93.4	-92.2			-88.9	-87.8	-87.1	-85.6	-85.1	-84.7	
n50	15	-100.0	-96.8	-95.0	-93.8			-90.6	-89.6					TDD
	30		-97.1	-95.1	-94.0			-90.7	-89.7	-88.9	-87.6			
	60		-97.5	-95.4	-94.2			-90.9	-89.8	-89.1	-87.6			
n51	15	-100.0												TDD
	30													

	60													
n66	15	-99.5	-96.3	-94.5	-93.3			-90.1						FDD
	30		-96.6	-94.6	-93.5			-90.2						
	60		-97.0	-94.9	-93.7			-90.4						
n70	15	-100.0	-96.8	-95.0	-93.8	-92.7								FDD
	30		-97.1	-95.1	-94.0	-92.8								
	60		-97.5	-95.4	-94.2	-93.0								
n71	15	-97.2	-94.0	-91.6	-86.0									FDD
	30		-94.3	-91.9	-87.4									
	60													
n74	15	-99.5[3]	-96.3[3]	-94.5[3]	-93.3[3]									FDD
	30		-96.6[3]	-94.6[3]	-93.5[3]									
	60		-97.0[3]	-94.9[3]	-93.7[3]									
n77(3.3 to 3.8 GHz) [1]	15		-95.8	-94.0	-92.7			-89.6	-88.6					TDD
	30		-96.1	-94.1	-92.9			-89.7	-88.7	-87.9	-86.6	-86.1	-85.6	
	60		-96.5	-94.4	-93.1			-89.9	-88.8	-88.0	-86.7	-86.2	-85.7	
n77[1]	15		-95.3	-93.5	-92.2			-89.1	-88.1					TDD
	30		-95.6	-93.6	-92.4			-89.2	-88.2	-87.4	-86.1	-85.6	-85.1	
	60		-96.0	-93.9	-92.6			-89.4	-88.3	-87.5	-86.2	-85.7	-85.2	
n78[1]	15		-95.8	-94.0	-92.7			-89.6	-88.6					TDD
	30		-96.1	-94.1	-92.9			-89.7	-88.7	-87.9	-86.6	-86.1	-85.6	
	60		-96.5	-94.4	-93.1			-89.9	-88.8	-88.0	-86.7	-86.2	-85.7	
n79[1]	15							-89.6	-88.6					TDD
	30							-89.7	-88.7	-87.9	-86.6		-85.6	
	60							-89.9	-88.8	-88.0	-86.7		-85.7	

NOTE 1: Four Rx antenna ports shall be the baseline for this operating band except for two Rx vehicular UE.
NOTE 2: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4.
NOTE 3: The requirement is modified by -0.5 dB when the assigned NR channel bandwidth is confined within 1475.9-1510.9 MHz

For UE(s) equipped with 4 Rx antenna ports, reference sensitivity for 2Rx antenna ports in Table 7.3.2.3-1 shall be modified by the amount given in $\Delta R_{IB,4R}$ in Table 7.3.2.3-2 for the applicable operating bands.

Table 7.3.2.3-2: Four antenna port reference sensitivity allowance $\Delta R_{IB,4R}$

Operating band	$\Delta R_{IB,4R}$ (dB)
n1, n2, n3, n40, n7, n34, n38, n39, n41, n66, n70	-2.7
n77, n78, n79	-2.2

The reference receive sensitivity (REFSENS) requirement specified in Table 7.3.2.3-1 and Table 7.3.2.3-2 shall be met with uplink transmission bandwidth less than or equal to that specified in Table 7.3.2.3-3.

Table 7.3.2.3-3: Uplink configuration for reference sensitivity

Operating Band	SCS kHz	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz	Duplex Mode
n1	15	25	50[1]	75[1]	100[1]									FDD
	30		24	36[1]	50[1]									
	60		10[1]	18	24									
n2	15	25	50[1]	50[1]	50[1]									FDD
	30	10[1]	24	24[1]	24[1]									
	60		10[1]	10[1]	10[1]									
n3	15	25	50[1]	50[1]	50[1]	50[1]	50[1]							FDD
	30		24	24[1]	24[1]	24[1]	24[1]							
	60		10[1]	10[1]	10[1]	10[1]	10[1]							
n5	15	25	25[1]	25[1]	25[1]									FDD
	30		10[1]	10[1]	10[1]									
	60													
n7	15	25	50[1]	75[1]	75[1]									FDD
	30		24	36[1]	36[1]									
	60		10[1]	18	18[1]									
n8	15	25	25[1]	25[1]	25[1]									FDD
	30		10[1]	10[1]	10[1]									
	60													
n12	15	20[1]	20[1]	20[1]										FDD
	30		10[1]	10[1]										
	60													
n20	15	25	20[1]	20[2]	20[2]									FDD
	30		10[1]	10[2]	10[2]									
	60													
n25	15	25	50	50[1]	50[1]									FDD
	30		24	24[1]	24[1]									
	60		10	10[1]	10[1]									
n28	15	25	25[1]	25[1]	25[1]									FDD
	30		10[1]	10[1]	10[1]									
	60													
n34	15	25	50	75										
	30		24	36										
	60		10	18										
n38	15	25	50	75	100									TDD
	30		24	36	50									
	60		10	18	24									
n39	15	25	50	75	100	128	160	216						TDD
	30		24	36	50	64	75	100						
	60		10	18	24	30	36	50						
n40	15	25	50	75	100	128	160	216	270					TDD
	30		24	36	50	64	75	100	128	162	216			
	60		10	18	24	30	36	50	64	75	100			
n41	15		50	75	100			216	270					TDD
	30		24	36	50			100	128	162	216	243	270	
	60		10	18	24			50	64	75	100	120	135	
n50	15	25	50	75	100			216	270					TDD
	30		24	36	50			100	128	162	NOTE 3			
	60		10	18	24			50	64	75	NOTE 3			
n51	15	25												TDD
	30													
	60													

n66	15	25	50[1]	75[1]	100[1]			216						FDD
	30		24	36[1]	50[1]			100[1]						
	60		10[1]	18	24									
n70	15	25	50[1]	75[1]	NOTE 3	NOTE 3								FDD
	30		24	36[1]	NOTE 3	NOTE 3								
	60		10[1]	18	NOTE 3	NOTE 3								
n71	15	25	25[1]	20[1]	20[1]									FDD
	30		12[1]	10[1]	10[1]									
	60													
n74	15	25	25[1]	25[1]	25[1]									FDD
	30		10[1]	10[1]	10[1]									
	60		5[1]	5[1]	5[1]									
n77	15		50	75	100			216	270					TDD
	30		24	36	50			100	128	162	216	243	270	
	60		10	18	24			50	64	75	100	120	135	
n77 (3.8 to 4.2 GHz)	15		50	75	100			216	270					TDD
	30		24	38	51			100	128	162	216	243	270	
	60		10	18	24			50	64	75	100	120	135	
n78	15		50	75	100			216	270					TDD
	30		24	36	50			100	128	162	216	243	270	
	60		10	18	24			50	64	75	100	120	135	
n79	15							216	270					TDD
	30							100	128	162	216		270	
	60							50	64	75	100		135	

NOTE 1: UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.3.2-1).

NOTE 2: For Band 20; for 15kHz SCS, in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 11 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 16; for 30kHz SCS, in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 6 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 8; for 60kHz SCS, in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 3 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 4.

NOTE 3: For DL channel bandwidths that do not have symmetric UL channel bandwidth, highest valid UL configuration with lowest duplex distance shall be used.

Unless given by Table 7.3.2.3-4, the minimum requirements specified in Tables 7.3.2.3-1 and 7.3.2.3-2 shall be verified with the network signalling value NS_01 (Table 6.2.3.3-1) configured.

Table 7.3.2.3-4: Network signalling value for reference sensitivity

Operating band	Network Signalling value
n2	NS_03
n12	NS_06
n25	NS_03
n66	NS_03
n70	NS_03
n71	NS_35

For the UE which supports inter-band carrier aggregation, the minimum requirement for reference sensitivity in Table 7.3.2.3-1 shall be increased by the amount given in $\Delta R_{IB,c}$ defined in subclause 7.3.3 for the applicable operating bands.

The normative reference for this requirement is TS 38.101-1 [2] clause 7.3.2.

7.3.2.4 Test description

7.3.2.4.1 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, and channel bandwidths 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 channel bandwidth, and are shown in Table 7.3.2.4.1-1, Table 7.3.2.4.1-2, and Table 7.3.2.4.1-3 The details of the uplink reference measurement channels (RMCs) are specified in Annexe A2.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.3.2.4.1-1: 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] subclause4.3.1			Low range, Mid range, High range (NOTE 4)	
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1			Lowest, Mid, Highest (NOTE 4) Lowest UL / Lowest DL, Lowest UL / Highest DL (NOTE 3)	
Test SCS as specified in Table 5.3.5-1			Lowest	
Test Parameters				
Test ID	**Downlink Configuration**		**Uplink Configuration**	
	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: According to asymmetric channel bandwidths specified in clause 5.3.6. NOTE 4: For n70, in addition to default test configurations, additional configurations shall be used to verify reference sensitivity requirements with the UE TX-RX frequency separation of 295MHz (table 5.4.4-1): 5 MHz CH BW with DL @ low range, UL @ mid range 5 MHz CH BW with DL @ mid range, UL @ high range 10 MHz CH BW with DL @ low range, UL @ high range				

Table 7.3.2.4.1-2: Downlink Configuration of each RB allocation

Channel Bandwidth	SCS(kHz)	LCRBmax	Outer RB allocation / Normal RB allocation
5MHz	15	25	25@0
	30	11	11@0
	60	N/A	N/A
10MHz	15	52	52@0
	30	24	24@0
	60	11	11@0
15MHz	15	79	79@0
	30	38	38@0
	60	18	18@0
20MHz	15	106	106@0
	30	51	51@0
	60	24	24@0
25MHz	15	133	133@0
	30	65	65@0
	60	31	31@0
30MHz	15	160	160@0
	30	78	78@0
	60	38	38@0
40MHz	15	216	216@0
	30	106	106@0
	60	51	51@0
50MHz	15	270	270@0
	30	133	133@0
	60	65	65@0
60MHz	15	N/A	N/A
	30	162	162@0
	60	79	79@0
80MHz	15	N/A	N/A
	30	217	217@0
	60	107	107@0
90MHz	15	N/A	N/A
	30	245	245@0
	60	121	121@0
100MHz	15	N/A	N/A
	30	273	273@0
	60	135	135@0
NOTE 1: Test Channel Bandwidths are checked separately for each NR band, the applicable channel bandwidths are specified in Table 5.3.5-1.			

Table 7.3.2.4.1-3: Uplink configuration for reference sensitivity, LCRB @ Restart format

Operating Band	SCS kHz	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz	Duplex Mode
n1	15	25@0	50@0[1]	75@0[1]	100@0[1]									FDD
	30		24@0	36@0[1]	50@0[1]									
	60		10@0[1]	18@0	24@0									
n2	15	25@0	50@0[1]	50@25[1]	50@50[1]									FDD
	30	10@0[1]	24@0	24@12[1]	24@26[1]									
	60		10@0[1]	10@8[1]	10@14[1]									
n3	15	25@0	50@0[1]	50@25[1]	50@50[1]	50@78[1]	50@110[1]							FDD
	30		24@0	24@12[1]	24@26[1]	24@40[1]	24@51[1]							
	60		10@0[1]	10@8[1]	10@14[1]	10@20[1]	10@26[1]							
n5	15	25@0	25@25[1]	25@50[1]	25@75[1]									FDD
	30		10@14[1]	10@26[1]	10@40[1]									
	60													
n7	15	25@0	50@0[1]	75@0[1]	75@25[1]									FDD
	30		24@0	36@0[1]	36@14[1]									
	60		10@0[1]	18@0	18@8[1]									
n8	15	25@0	25@25[1]	25@50[1]	25@75[1]									FDD
	30		10@14[1]	10@26[1]	10@40[1]									
	60													
n12	15	20@5[1]	20@30[1]	20@55[1]										
	30		10@14[1]	10@26[1]										
	60													
n20	15	25@0	20@0[1]	20@11[2]	20@16[2]									FDD
	30		10@0[1]	10@6[2]	10@8[2]									
	60													
n25	15	25@0	50@0	50@25[1]	50@50[1]									FDD
	30		24@0	24@12[1]	24@26[1]									
	60		10@0	10@8[1]	10@14[1]									
n28	15	25@0	25@25[1]	25@50[1]	25@75[1]									FDD
	30		10@14[1]	10@26[1]	10@40[1]									
	60													
n34	15	25@0	50@0	75@0										TDD
	30		24@0	36@0										
	60		10@0	18@0										

n38	15	25@0	50@0	75@0	100@0									TDD
	30		24@0	36@0	50@0									
	60		10@0	18@0	24@0									
n39	15	25@0	50@0	75@0	100@0	128@0	160@0	216@0						TDD
	30		24@0	36@0[1]	50@0	64@0	75@0	100@0						
	60		10@0	18@0	24@0	30@0	36@0	50@0						
n40	15	25@0	50@0	75@0	100@0	128@0	160@0	216@0	270@0					TDD
	30		24@0	36@0	50@0	64@0	75@0	100@0	128@0	162@0	216@0			
	60		10@0	18@0	24@0	30@0	36@0	50@0	64@0	75@0	100@0			
n41	15		50@0	75@0	100@0			216@0	270@0					TDD
	30		24@0	36@0	50@0			100@0	128@0	162@0	216@0	243@0	270@0	
	60		10@0	18@0	24@0			50@0	64@0	75@0	100@0	120@0	135@0	
n50	15	25@0	50@0	75@0	100@0[1]			216@0	270@0					TDD
	30		24@0	36@0	50@0			100@0	128@0	162@0	NOTE 3			
	60		10@0	18@0	24@0			50@0	64@0	75@0	NOTE 3			
n51	15	25@0												TDD
	30													
	60													
n66	15	25@0	50@0[1]	75@0[1]	100[1]			216@0						FDD
	30		24@0	36@0[1]	50@0[1]			100@0[1]						
	60		10@0[1]	18@0	24@0			50@0[1]						
n70	15	25@0	50@0[1]	75@0[1]	NOTE 3	NOTE 3								FDD
	30		24@0	36@0[1]	NOTE 3	NOTE 3								
	60		10@0[1]	18@0	NOTE 3	NOTE 3								
n71	15	25@0	25@0[1]	20@0[1]	20@0[1]									FDD
	30		12@0[1]	10@0[1]	10@0[1]									
	60													
n74	15	25@0	25@25[1]	25@50[1]	25@75[1]									FDD
	30		10@14[1]	10@26[1]	10@40[1]									
	60		5@5[1]	5@13[1]	5@19[1]									
n77	15		50@0	75@0	100@0			216@0	270@0					TDD
	30		24@0	36@0	50@0			100@0	128@0	162@0	216@0	243@0	270@0	
	60	-	10@0	18@0	24@0			50@0	64@0	75@0	100@0	120@0	135@0	

n77 (3.8 to 4.2 GHz)	15		50@0[1]	75@0[1]	100@0[1]			216@0	270@0					TDD
	30		24@0	36@0	50@0			100@0[1]	128@0[1]	162@0	216@0[1]	243@0[1]	270@0[1]	
	60		10@0[1]	18@0	24@0			50@0[1]	64@0[1]	75@0[1]	100@0[1]	120@0[1]	135@0	
n78	15		50@0	75@0	100@0[1]			216@0	270@0					TDD
	30		24@0	36@0	50@0			100@0	128@0	162@0	216@0	243@0	270@0	
	60		10@0	18@0	24@0			50@0	64@0	75@0	100@0	120@0	135@0	
n79	15							216@0	270@0					TDD
	30							100@0	128@0	162@0	216@0		270@0	
	60							50@0	64@0	75@0	100@0		135@0	

NOTE 1: UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.3.2-1).

NOTE 2: For Band 20; for 15kHz SCS, in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 11 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 16; for 30kHz SCS, in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 6 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 8; for 60kHz SCS, in the case of 15MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 3 and in the case of 20MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 4.

NOTE 3: For DL channel bandwidths that do not have symmetric UL channel bandwidth, highest valid UL configuration with lowest duplex distance shall be used.

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 diagramand 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 C.3.1, and uplink signals according to Annex G.0, G.1, G.2, and G.3.1.
4. The UL and Reference Measurement Channel is set according to Table 7.3.2.4.1-1, Table 7.3.2.4.1-2, and Table 7.3.2.4.1-3.
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 7.3.2.4.3.

7.3.2.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to Table 7.3.2.4.1-1. 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 Tables 7.3.2.4.1-1. Since the UE has no payload data to send, the UE transmits 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 in the uplink scheduling information to the UE to ensure the UE transmits PUMAX level for at least the duration of the Throughput measurement.
4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2

7.3.2.4.3 Message contents

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

7.3.2.4.3.1 Message contents exceptions (network signalled value "NS_01")

Message contents according to TS 38.508-1 [5] subclause 4.6 can be used without exceptions.

7.3.2.4.3.2 Message contents exceptions (network signalled value "NS_03")

1. Information element additionalSpectrumEmission is set to NS_03. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 7.3.2.4.3.2-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_03" and NR band n2, n25 and n66

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	2 (NS_03)		

Table 7.3.2.4.3.2-2: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_03" and NR band n70

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_03)		

7.3.2.4.3.3 Message contents exceptions (network signalled value "NS_06")

1. Information element additionalSpectrumEmission is set to NS_06. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 7.3.2.4.3.3-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_06" and NR band n12

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_06)		

7.3.2.4.3.4 Message contents exceptions (network signalled value "NS_35")

1. Information element additionalSpectrumEmission is set to NS_35. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 7.3.2.4.3.4-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_35" and NR band n71

Derivation Path: TS 38.508-1 [5] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
additionalSpectrumEmission	1 (NS_35)		

7.3.2.5 Test requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A3.2 with reference receive power level specified in Tables 7.3.2.5-1 for 2 Rx antenna port, Tables 7.3.2.5-2 for 4 Rx antenna port, and parameters specified Tables 7.3.2.4.1-1, Tables 7.3.2.4.1-2 and Tables 7.3.2.4.1-3.

Table 7.3.2.5-1: Reference sensitivity QPSK $P_{REFSENS}$

Operating band / SCS / Channel bandwidth / Duplex-mode														
Operating Band	**SCS kHz**	**5 MHz (dBm)**	**10 MHz (dBm)**	**15 MHz (dBm)**	**20 MHz (dBm)**	**25 MHz (dBm)**	**30 MHz (dBm)**	**40 MHz (dBm)**	**50 MHz (dBm)**	**60 MHz (dBm)**	**80 MHz (dBm)**	**90 MHz (dBm)**	**100 MHz (dBm)**	**Duplex Mode**
n1	15	-100.0 +TT	-96.8 +TT	-95.0 +TT	-93.8 +TT									FDD
	30		-97.1 +TT	-95.1 +TT	-94.0 +TT									
	60		-97.5 +TT	-95.4 +TT	-94.2 +TT									
n2	15	-98.0 +TT	-94.8 +TT	-93.0 +TT	-91.8 +TT									FDD
	30		-95.1 +TT	-93.1 +TT	-92.0 +TT									
	60		-95.5 +TT	-93.4 +TT	-92.2 +TT									
n3	15	-97.0 +TT	-93.8 +TT	-92.0 +TT	-90.8 +TT	-89.7 +TT	-88.9 +TT							FDD
	30		-94.1 +TT	-92.1 +TT	-91.0 +TT	-89.8 +TT	-89.0 +TT							
	60		-94.5 +TT	-92.4 +TT	-91.2 +TT	-90.0 +TT	-89.1 +TT							
n5	15	-98.0 +TT	-94.8 +TT	-93.0 +TT	-90.8 +TT									FDD
	30		-95.1 +TT	-93.1 +TT	-91.0 +TT									
	60													
n7[1]	15	-98.0 +TT	-94.8 +TT	-93.0 +TT	-91.8 +TT									FDD
	30		-95.1 +TT	-93.1 +TT	-92.0 +TT									
	60		-95.5 +TT	-93.4 +TT	-92.2 +TT									
n8	15	-97.0 +TT	-93.8 +TT	-92.0 +TT	-90.0 +TT									FDD
	30		-94.1 +TT	-92.1 +TT	-90.2 +TT									
	60													
n12	15	-97.0 +TT	-93.8 +TT	-84.0 +TT										FDD
	30		-94.1 +TT	-84.1 +TT										
	60													
n20	15	-97.0 +TT	-93.8 +TT	-91.0 +TT	-89.8 +TT									FDD

	30		-94.1 +TT	-91.1 +TT	-90.0 +TT									
	60													
n25	15	-96.5 +TT	-93.3 +TT	-91.5 +TT	-90.3 +TT									FDD
	30		-93.6 +TT	-91.6 +TT	-90.5 +TT									
	60		-94.0 +TT	-91.9 +TT	-90.7 +TT									
n28	15	-98.5 +TT	-95.5 +TT	-93.5 +TT	-90.8 +TT									FDD
	30		-95.6 +TT	-93.6 +TT	-91.0 +TT									
	60													
n34	15	-100.0 +TT	-96.8 +TT	-95.0 +TT										TDD
	30		-97.1 +TT	-95.1 +TT										
	60		-97.5 +TT	-95.4 +TT										
n38	15	-100.0 +TT	-96.8 +TT	-95.0 +TT	-93.8 +TT									TDD
	30		-97.1 +TT	-95.1 +TT	-94.0 +TT									
	60		-97.5 +TT	-95.4 +TT	-94.2 +TT									
n39	15	-100.0 +TT	-96.8 +TT	-95.0 +TT	-93.8 +TT	-92.7 +TT	-91.9 +TT	-90.6 +TT						TDD
	30		-97.1 +TT	-95.1 +TT	-94.0 +TT	-92.8 +TT	-92.0 +TT	-90.7 +TT						
	60		-97.5 +TT	-95.4 +TT	-94.2 +TT	-93.0 +TT	-92.1 +TT	-90.9 +TT						
n40	15	-100.0 +TT	-96.8 +TT	-95.0 +TT	-93.8 +TT	-92.7 +TT	-91.9 +TT	-90.6 +TT	-89.6 +TT					TDD
	30		-97.1 +TT	-95.1 +TT	-94.0 +TT	-92.8 +TT	-92.0 +TT	-90.7 +TT	-89.7 +TT	-88.9 +TT	-87.6 +TT			
	60		-97.5 +TT	-95.4 +TT	-94.2 +TT	-93.0 +TT	-92.1 +TT	-90.9 +TT	-89.8 +TT	-89.1 +TT	-87.6 +TT			
n41[1]	15		-94.8 +TT	-93.0 +TT	-91.8 +TT			-88.6 +TT	-87.6 +TT					TDD
	30		-95.1 +TT	-93.1 +TT	-92.0 +TT			-88.7 +TT	-87.7 +TT	-86.9 +TT	-85.6 +TT	-85.1 +TT	-84.7 +TT	
	60		-95.5 +TT	-93.4 +TT	-92.2 +TT			-88.9 +TT	-87.8 +TT	-87.1 +TT	-85.6 +TT	-85.1 +TT	-84.7 +TT	

n50	15	-100.0 +TT	-96.8 +TT	-95.0 +TT	-93.8 +TT			-90.6 +TT	-89.6 +TT					TDD
	30		-97.1 +TT	-95.1 +TT	-94.0 +TT			-90.7 +TT	-89.7 +TT	-88.9 +TT	-87.6 +TT			
	60		-97.5 +TT	-95.4 +TT	-94.2 +TT			-90.9 +TT	-89.8 +TT	-89.1 +TT	-87.6 +TT			
n51	15	-100.0 +TT												TDD
	30													
	60													
n66	15	-99.5 +TT	-96.3 +TT	-94.5 +TT	-93.3 +TT			-90.1 +TT						FDD
	30		-96.6 +TT	-94.6 +TT	-93.5 +TT			-90.2 +TT						
	60		-97.0 +TT	-94.9 +TT	-93.7 +TT			-90.4 +TT						
n70	15	-100.0 +TT	-96.8 +TT	-95.0 +TT	-93.8 +TT	-92.7 +TT								FDD
	30		-97.1 +TT	-95.1 +TT	-94.0 +TT	-92.8 +TT								
	60		-97.5 +TT	-95.4 +TT	-94.2 +TT	-93.0 +TT								
n71	15	-97.2 +TT	-94.0 +TT	-91.6 +TT	-86.0 +TT									FDD
	30		-94.3 +TT	-91.9 +TT	-87.4 +TT									
	60	-												
n74	15	-99.5[3] +TT	-96.3[3] +TT	-94.5[3] +TT	-93.3[3] +TT									FDD
	30		-96.6[3] +TT	-94.6[3] +TT	-93.5[3] +TT									
	60		-97.0[3] +TT	-94.9[3] +TT	-93.7[3] +TT									
n77(3.3 to 3.8 GHz)[1]	15		-95.8 +TT	-94.0 +TT	-92.7 +TT			-89.6 +TT	-88.6 +TT					TDD
	30		-96.1 +TT	-94.1 +TT	-92.9 +TT			-89.7 +TT	-88.7 +TT	-87.9 +TT	-86.6 +TT	-86.1 +TT	-85.6 +TT	
	60	-	-96.5 +TT	-94.4 +TT	-93.1 +TT			-89.9 +TT	-88.8 +TT	-88.0 +TT	-86.7 +TT	-86.2 +TT	-85.7 +TT	
n77[1]	15		-95.3 +TT	-93.5 +TT	-92.2 +TT			-89.1 +TT	-88.1 +TT					TDD
	30		-95.6 +TT	-93.6 +TT	-92.4 +TT			-89.2 +TT	-88.2 +TT	-87.4 +TT	-86.1 +TT	-85.6 +TT	-85.1 +TT	
	60	-	-96.0 +TT	-93.9 +TT	-92.6 +TT			-89.4 +TT	-88.3 +TT	-87.5 +TT	-86.2 +TT	-85.7 +TT	-85.2 +TT	

n78[1]	15		-95.8 +TT	-94.0 +TT	-92.7 +TT			-89.6 +TT	-88.6 +TT					TDD
	30		-96.1 +TT	-94.1 +TT	-92.9 +TT			-89.7 +TT	-88.7 +TT	-87.9 +TT	-86.6 +TT	-86.1 +TT	-85.6 +TT	
	60		-96.5 +TT	-94.4 +TT	-93.1 +TT			-89.9 +TT	-88.8 +TT	-88.0 +TT	-86.7 +TT	-86.2 +TT	-85.7 +TT	
n79[1]	15							-89.6 +TT	-88.6 +TT					TDD
	30							-89.7 +TT	-88.7 +TT	-87.9 +TT	-86.6 +TT		-85.6 +TT	
	60							-89.9 +TT	-88.8 +TT	-88.0 +TT	-86.7 +TT		-85.7 +TT	

NOTE 1: Four Rx antenna ports shall be the baseline for this operating band except for two Rx vehicular UE.
NOTE 2: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4
NOTE 3: [3] indicates that the requirement is modified by -0.5 dB when the assigned NR channel bandwidth is confined within 1475.9-1510.9 MHz.
NOTE 4: TT for each frequency and channel bandwidth is specified in Table 7.3.2.5-3.

Table 7.3.2.5-2: Reference sensitivity QPSK $P_{REFSENS}$ for Four Rx antenna ports

Operating band / SCS / Channel bandwidth / Duplex-mode														
Operating Band	**SCS kHz**	**5 MHz (dBm)**	**10 MHz (dBm)**	**15 MHz (dBm)**	**20 MHz (dBm)**	**25 MHz (dBm)**	**30 MHz (dBm)**	**40 MHz (dBm)**	**50 MHz (dBm)**	**60 MHz (dBm)**	**80 MHz (dBm)**	**90 MHz (dBm)**	**100 MHz (dBm)**	**Duplex Mode**
n1	15	-102.7 +TT	-99.5 +TT	-97.7 +TT	-96.5 +TT									FDD
	30		-99.8 +TT	-97.8 +TT	-96.7 +TT									
	60		-100.2 +TT	-98.1 +TT	-96.9 +TT									
n2	15	-100.7 +TT	-97.5 +TT	-95.7 +TT	-94.5 +TT									FDD
	30		-97.8 +TT	-95.8 +TT	-94.7 +TT									
	60		-98.2 +TT	-96.1 +TT	-94.9 +TT									
n3	15	-99.7 +TT	-96.5 +TT	-94.7 +TT	-93.5 +TT	-92.4 +TT	-91.6 +TT							FDD
	30		-96.8 +TT	-94.8 +TT	-93.7 +TT	-92.5 +TT	-91.7 +TT							
	60		-97.2 +TT	-95.1 +TT	-93.9 +TT	-92.7 +TT	-91.8 +TT							
n7	15	-100.7 +TT	-97.5 +TT	-95.7 +TT	-94.5 +TT									FDD
	30		-97.8 +TT	-95.8 +TT	-94.7 +TT									
	60		-98.2 +TT	-97.1 +TT	-94.9 +TT									
n34	15	-102.7 +TT	-99.5 +TT	-97.7 +TT										TDD
	30		-99.8 +TT	-97.8 +TT										
	60		-100.2 +TT	-98.1 +TT										
n38	15	-102.7 +TT	-99.5 +TT	-97.7 +TT	-96.5 +TT									TDD
	30		-99.8 +TT	-97.8 +TT	-96.7 +TT									
	60		-100.2 +TT	-98.1 +TT	-96.9 +TT									
n39	15	-102.7 +TT	-99.5 +TT	-97.7 +TT	-96.5 +TT	-95.4 +TT	-94.6 +TT	-93.3 +TT						TDD
	30		-99.8 +TT	-97.8 +TT	-96.7 +TT	-95.5 +TT	-94.7 +TT	-93.4 +TT						

	60		-100.2 +TT	-98.1 +TT	-96.9 +TT	-95.7 +TT	-94.8 +TT	-93.6 +TT						
n40	15	-102.7 +TT	-99.5 +TT	-97.7 +TT	-96.5 +TT	-95.4 +TT	-94.6 +TT	-93.3 +TT	-92.3 +TT					TDD
	30		-99.8 +TT	-97.8 +TT	-96.7 +TT	-95.5 +TT	-94.7 +TT	-93.4 +TT	-92.4 +TT	-91.6 +TT	-90.3 +TT			
	60		-100.2 +TT	-98.1 +TT	-96.9 +TT	-95.7 +TT	-94.8 +TT	-93.6 +TT	-92.5 +TT	-91.8 +TT	-90.3 +TT			
n41	15		-97.5 +TT	-95.7 +TT	-94.5 +TT			-91.3 +TT	-90.3 +TT					TDD
	30		-97.8 +TT	-95.8 +TT	-94.7 +TT			-91.4 +TT	-90.4 +TT	-89.6 +TT	-88.3 +TT	-87.8 +TT	-87.4 +TT	
	60		-98.2 +TT	-96.1 +TT	-94.9 +TT			-91.6 +TT	-90.5 +TT	-89.8 +TT	-88.3 +TT	-87.8 +TT	-87.4 +TT	
n66	15	-102.2 +TT	-99.0 +TT	-97.2 +TT	-96.0 +TT			-92.8 +TT						FDD
	30		-99.3 +TT	-97.3 +TT	-96.2 +TT			-92.9 +TT						
	60		-99.7 +TT	-97.6 +TT	-96.4 +TT			-93.1 +TT						
n70	15	-102.7 +TT	-99.5 +TT	-97.7 +TT	-96.5 +TT	-95.4 +TT								FDD
	30		-99.8 +TT	-97.8 +TT	-96.7 +TT	-95.5 +TT								
	60		-100.2 +TT	-98.1 +TT	-96.9 +TT	-95.7 +TT								
n77	15		-98.0 +TT	-96.2 +TT	-94.9 +TT			-91.8 +TT	-90.8 +TT					TDD
	30		-98.3 +TT	-96.3 +TT	-95.1 +TT			-91.9 +TT	-90.9 +TT	-90.1 +TT	-88.8 +TT	-88.3 +TT	-87.8 +TT	
	60	-	-98.7 +TT	-96.6 +TT	-95.3 +TT			-92.1 +TT	-91.0 +TT	-90.2 +TT	-88.9 +TT	-88.4 +TT	-87.9 +TT	
n78	15		-98.0 +TT	-96.2 +TT	-94.9 +TT			-91.8 +TT	-90.8 +TT					TDD
	30		-98.3 +TT	-96.3 +TT	-95.1 +TT			-91.9 +TT	-90.9 +TT	-90.1 +TT	-88.8 +TT	-88.3 +TT	-87.8 +TT	
	60		-98.7 +TT	-96.6 +TT	-95.3 +TT			-92.1 +TT	-91.0 +TT	-90.2 +TT	-88.9 +TT	-88.4 +TT	-87.9 +TT	
n79								-91.8 +TT	-90.8 +TT					TDD
								-91.9 +TT	-90.9 +TT	-90.1 +TT	-88.8 +TT		-87.8 +TT	
NOTE 1: Four Rx antenna ports shall be the baseline for above listed operating band except for two Rx vehicular UE NOTE 2: TT for each frequency and channel bandwidth is specified in Table 7.3.2.5-3														

Table 7.3.2.5-3: Test Tolerance (TT) for RX sensitivity level

f ≤ 3.0GHz	3.0GHz < f ≤ 6.0 GHz
0.7 dB	1.0 dB

For the UE which supports inter-band carrier aggregation, the minimum requirement for reference sensitivity in Table 7.3.2.5-1 shall be increased by the amount given in $\Delta R_{IB,c}$ defined in subclause 7.3.3 for the applicable operating bands

7.3.3 ΔRIB,c

Editor's note: ΔRIB,c is pending RAN4 update.

7.3A Reference sensitivity for CA

Editor's Note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Minimum requirement for Reference sensitivity power level for Intra-band non-contiguous CA is FFS (pending RAN4).
- Test procedure is not complete
- Message contents is not complete
- Test requirement table is incomplete.
- Reference sensitivity power level for 3DL CA is FFS.
- Tests for network signalling values NS_03, NS_04, NS_06, NS_40, NS_41 and NS_42 not complete.
- Test description for exceptional cases are incomplete.

7.3A.0 Minimum conformance requirements

7.3A.0.1 General

The reference sensitivity power level REFSENS is the minimum mean power applied to each one of the UE antenna ports for all UE categories, at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

7.3A.0.2 Reference sensitivity power level for CA

7.3A.0.2.1 Reference sensitivity power level for Intra-band contiguous CA

For intra-band contiguous carrier aggregation, the throughput of each component carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.2.2.2, A.2.3.2, A.3.2, and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.3.2.3-1, Table 7.3.2.3-2, and Table 7.3.2.3-3.

7.3A.0.2.2 Reference sensitivity power level for Intra-band non-contiguous CA

FFS

7.3A.0.2.3 Reference sensitivity power level for Inter-band CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink assigned to one NR band the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2.2, A.2.3.2, A.3.2, and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1 with parameters specified in Table 7.3.2-1, Table 7.3.2-2 and Table 7.3.2-3 modified in accordance with sub-clause 7.3A.3.2. The reference sensitivity is defined to be met with all downlink component carriers active and one of the uplink carriers active. Exceptions to reference sensitivity are allowed in accordance with sub-clause 7.3A.4.

7.3A.0.3 ΔRIB,c for CA

7.3A.0.3.1 General

For a UE supporting a CA configuration, the $\Delta R_{IB,c}$ applies for both SC and CA operation.

7.3A.0.3.2 ΔRIB,c for Inter-band CA

For the UE which supports inter-band carrier aggregation, the minimum requirement for reference sensitivity in subclause 7.3A.0 shall be increased by the amount given by $\Delta R_{IB,c}$ defined in subclause 7.3A.0.3.2 for the applicable operating bands. Unless otherwise stated, $\Delta R_{IB,c}$ is set to zero.

In case the UE supports more than one of band combinations for CA, SUL or DC, and an operating band belongs to more than one band combinations then

- When the operating band frequency range is ≤ 1 GHz, the applicable additional $\Delta R_{IB,c}$ shall be the average value for all band combinations defined in subclause 7.3A, 7.3B, 7.3C in this specification and 7.3A, 7.3B in TS 38.521-3 [14], truncated to one decimal place that apply for that operating band among the supported band combinations. In case there is a harmonic relation between low band UL and high band DL, then the maximum $\Delta R_{IB,c}$ among the different supported band combinations involving such band shall be applied

- When the operating band frequency range is > 1 GHz, the applicable additional $\Delta R_{IB,c}$ shall be the maximum value for all band combinations defined in subclause 7.3A, 7.3B, 7.3C in this specification and 7.3A, 7.3B in TS 38.521-3 [14] for the applicable operating bands.

7.3A.0.3.2.1 $\Delta R_{IB,c}$ for two bands

Table 7.3A.0.3.2.1-1: $\Delta R_{IB,c}$ due to CA (two bands)

Inter-band CA configuration	NR Band	$\Delta R_{IB,c}$ (dB)
CA_n3-n77	n3	0.2
	n77	0.5
CA_n3-n78	n3	0.2
	n78	0.5
CA_n3-n79	n79	0.5
CA_n8-n78	n8	0.2
	n78	0.5
CA_n8-n79	n79	0.5
CA n28-n75	n28	0.2
CA_n28-n78	n28	0.2
	n78	0.5
CA_n41-n78[1]	n78	0.5
CA_n75-n78	n78	0.5
CA_n76-n78	n78	0.5
NOTE 1: The requirements only apply when the sub-frame and Tx-Rx timings are synchronized between the component carriers. In the absence of synchronization, the requirements are not within scope of these specifications.		

7.3A.0.3.2.2 Void

Table 7.3A.0.3.2.2-1: $\Delta R_{IB,c}$ due to CA (three bands)

Inter-band CA configuration	NR Band	$\Delta R_{IB,c}$ (dB)
FFS	FFS	FFS

7.3A.0.4 Reference sensitivity exceptions due to UL harmonic interference for CA

Sensitivity degradation is allowed for a band in frequency range 1 if it is impacted by UL harmonic interference from another band in frequency range 1 of the same CA configuration. Reference sensitivity exceptions are specified in Table 7.3A.0.4-1 with uplink configuration specified in Table 7.3A.0.4-2.

Table 7.3A.0.4-1: Reference sensitivity exceptions due to UL harmonic for NR CA FR1

MSD due to harmonic exception for the DL band													
UL band	DL band	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
		dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB
n3	n77[1,2]		23.9	22.1	20.9			17.9	16.9	16.1	14.8	14.3	13.8
	n77[3]		1.1	0.8	0.3								
n3	n78[1,2]		23.9	22.1	20.9			17.9	16.9	16.1	14.8	14.3	13.8
	n78[3]		1.1	0.8	0.3								
n8	n78[4,5]		10.8	9.1	8.0			5.1	4.2	3.5	2.3	2.1	1.4
n8	n79[6,7]							[6.8]	6.2	[5.6]	4.9		4.4
n28	n75[1,2]	28.1	25.3	24.0	22.8								
	n78[6,7]		[10.4]	[8.9]	[7.8]			[4.7]	[3.7]	[3]	[1.7]	[1.2]	[0.7]

NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.

NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.2 \rfloor 0.1$ in MHz and $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ with f_{DL}^{HB} carrier frequency in the victim (higher) band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the lower band.

NOTE 3: The requirements are only applicable to channel bandwidths with a carrier frequency at $\pm\left(20 + BW_{Channel}^{HB} / 2\right)$ MHz offset from $2 f_{UL}^{LB}$ in the victim (higher band) with $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$, where $BW_{Channel}^{LB}$ and $BW_{Channel}^{HB}$ are the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.

NOTE 4: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 4th transmitter harmonic is within the downlink transmission bandwidth of a high band.

NOTE 5: The requirements should be verified for UL NR-ARFCN of a low band (superscript LB) such that $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.4 \rfloor 0.1$ in MHz and $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ with f_{DL}^{HB} the carrier frequency of a high band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the low band.

NOTE 6: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of a low band for which the 5th transmitter harmonic is within the downlink transmission bandwidth of a high band.

NOTE 7: The requirements should be verified for UL NR-ARFCN of a low band (superscript LB) such that $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.5 \rfloor 0.1$ in MHz and $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ with f_{DL}^{HB} the carrier frequency of a high band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the low band.

Table 7.3A.0.4-2: Uplink configuration for reference sensitivity exceptions due to UL harmonic interference for NR CA, FR1

NR Band / Channel bandwidth of the high band													
UL band	DL band	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
n3	n77		25	36	50			100	128	160	160	160	160
n3	n78		25	36	50			100	128	160	160	160	160
n8	n78		16	25	25			25	25	25	25	25	25
n8	n79							25	25	25	25		25
n28	n75	12	25	36	50								
n28	n78		10	15	20								
NOTE 1: 15kHz SCS is assumed for UL band. NOTE 2: The UL configuration applies regardless of the channel bandwidth of the low band unless the UL resource blocks exceed that specified in Table 7.3.2.3-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2.3-3 applies.													

Table 7.3A.0.4-3: Void

Table 7.3A.0.4-3a: Void

Sensitivity degradation is allowed for a band if it is impacted by receiver harmonic mixing due to another band part of the same CA configuration. Reference sensitivity exceptions are specified in Table 7.3A.0.4-4 with uplink configuration specified in Table 7.3A.0.4-4a.

Table 7.3A.0.4-4: Reference sensitivity exceptions due to harmonic mixing for CA in NR FR1

UL band	DL band	5 MHz (dB)	10 MHz (dB)	15 MHz (dB)	20 MHz (dB)	25 MHz (dB)	40 MHz (dB)	50 MHz (dB)	60 MHz (dB)	80 MHz (dB)	90 MHz (dB)	100 MHz (dB)
n41	n78[1]		8.3	8.0	6.9		3.9	3	2.3	1.2		0.4
n78	n41[2]		10.4	10.4	10.4		7.2	6.2	5.5	4.5		4.5
NOTE 1: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.15 \rfloor 0.1$ in MHz and $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ with f_{DL}^{HB} carrier frequency in the victim (higher) band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the lower band. NOTE 2: The requirements should be verified for UL EARFCN of the aggressor (high) band (superscript HB) such that $f_{UL}^{LB} = \lfloor 15 * f_{DL}^{HB} \rfloor 0.1$ in MHz and $F_{UL\_low}^{HB} + BW_{Channel}^{HB} / 2 \leq f_{UL}^{HB} \leq f_{UL\_high}^{HB} - BW_{Channel}^{HB} / 2$ with f_{DL}^{LB} carrier frequency in the victim (lower) band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the higher band.												

Table 7.3A.0.4-4a: Uplink configuration for reference sensitivity exceptions due to receiver harmonic mixing for CA in NR FR1

UL band	DL band	SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
n41	n78	30		24	24	24		24	24	24	24	24	24
n78	n41	30		50	50	50		50	50	50	50	50	50

7.3A.0.5 Reference sensitivity exceptions due to intermodulation interference due to 2UL CA

For inter-band carrier aggregation with uplink assigned to two NR bands given in Table 7.3A.0.5-1 the reference sensitivity is defined only for the specific uplink and downlink test points specified in Table 7.3A.0.5-1. For these test points the reference sensitivity requirement specified in Table 7.3.2.3-1 and Table 7.3.2.3-2 are relaxed by the amount of the corresponding parameter MSD given in Table 7.3A.0.5-1.

Table 7.3A.0.5-1: 2DL/2UL interband Reference sensitivity QPSK $P_{REFSENS}$ and uplink/downlink configurations

Band / Channel bandwidth / N_{RB} / Duplex mode								Source of IMD
NR CA Configuration	NR band	UL F_c (MHz)	UL/DL BW (MHz)	UL C_{LRB}	DL F_c (MHz)	MSD (dB)	Duplex mode	
CA_n3A-n78A	n3	1740	5	25	1835	[26] [28.7[5]]	FDD	IMD2[4]
	n78	3575	10	25	3575	N/A	TDD	N/A
CA_n3A-n78A	n3	1765	5	25	1860	[8.0] [10.7[5]]	FDD	IMD4[4]
	n78	3435	10	25	3435	N/A	TDD	N/A
CA_n8A-n78A	n8	897.5	5	25	942.5	8.3	FDD	IMD4
	n78	3635	10	50	3635	N/A	TDD	N/A
NOTE 1: Both of the transmitters shall be set min(+20 dBm, $P_{CMAX\_L,f,c}$) as defined in subclause 6.2A.4 NOTE 2: RB_{START} = 0, 15kHz SCS is assumed. NOTE 3: No requirements apply when there is at least one individual RE within the intermodulation generated by the dual uplink is within the downlink transmission bandwidth of the FDD band. The reference sensitivity should only be verified when this is not the case (the requirements specified in clause 7.3 apply). NOTE4: This band is subject to IMD5 also which MSD is not specified. NOTE 5: Applicable only if operation with 4 antenna ports is supported in the band with carrier aggregation configured.								

7.3A.0.6 Reference sensitivity exceptions due to cross band isolation for CA

For unsynchronized operation, Rx de-sensing in one band will be caused by another band due to lack of isolation in the band filters. Reference sensitivity exceptions for cross band are specified in Table 7.3A.0.6-1 with uplink configuration specified in Table 7.3A.0.6-2.

Table 7.3A.0.6-1: MSD for the CA configuration for asynchronous operation and cross band isolation for CA

NR Band / Channel bandwidth of the affected DL band														
NR CA Configuration	UL band	DL band	5 MHz (dB)	10 MHz (dB)	15 MHz (dB)	20 MHz (dB)	25 MHz (dB)	30 MHz (dB)	40 MHz (dB)	50 MHz (dB)	60 MHz (dB)	80 MHz (dB)	90 MHz (dB)	100 MHz (dB)
CA_n41A-n78A	n78	n41[1]		4.5	4.5	4.5			4.5	4.5				
NOTE 1: Applicable only when harmonic mixing MSD for this combination is not applied.														

Table 7.3A.0.6.2: Uplink configuration for reference sensitivity exceptions due to cross band isolation for CA

NR Band / SCS / Channel bandwidth of the affected DL band														
UL band	DL band	SCS of UL band (kHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
n78	n41	30		270	270	270			270	270				
NOTE 1: The UL configuration applies regardless of the channel bandwidth of the UL band unless the UL resource blocks exceed that specified in Table 7.3.2-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2-3 applies.														

The normative reference for this requirement is TS 38.101-1 [2] clause 7.3.A.

7.3A.1 Reference sensitivity power level for 2DL CA

7.3A.1.1 Test purpose

To verify the ability of UE that support CA to receive data with a given average throughput for a specified reference measurement channel, under conditions of low signal level, ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the effective coverage area.

7.3A.1.2 Test applicability

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

7.3A.1.3 Minimum requirements

The minimum conformance requirements are defined in clause 7.3A.0.

7.3A.1.4 Test description

7.3A.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, and channel bandwidths based on NR operating bands specified in Table 5.2-1. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in Table TBD. The details of the uplink reference measurement channels (RMCs) are specified in Annexe A2.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.3A.1.4.1-1: Test Configuration Table

FFS

7.3A.1.4.2 Test procedure

FFS

7.3A.1.4.3 Message contents

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

7.3A.1.5 Test requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.3A.1.5-1 and Table 7.3A.1.5-2.

Table 7.3A.1.5-1: Reference sensitivity for intra-band 2DL_CA

FFS

Table 7.3A.1.5-2: Intra-band 2DL_CA uplink configuration for reference sensitivity

FFS

7.3A.2 Reference sensitivity power level for 3DL CA

FFS

7.3A.3 Reference sensitivity power level for 4DL CA

FFS

7.3A.4 Reference sensitivity power level for 5DL CA

FFS

7.3B Void

7.3C Reference sensitivity for SUL

7.3C.0 Minimum conformance requirements

7.3C.0.1 General

7.3C.0.2 Minimum conformance requirements for Reference sensitivity power level

For SUL operation, the reference receive sensitivity (REFSENS) requirement for downlink bands specified in Table 7.3.2.3-1 and 7.3.2.3-2 shall be met for an uplink transmission bandwidth less than or equal to that specified in Table 7.3.2.3-1 or supplementary uplink transmission bandwidth less than or equal to that specified in Table 7.3C.0.2-1 with reference measurement channels as specified in Annexes A.2.2.2, A.2.3.2, A.3.2, and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1), unless sensitivity degradation is allowed in this section of this specification. These exceptions also apply to any higher order CA or DC combination containing one of the exception combinations in this section as subset.

Table 7.3C.0.2-1: Supplementary Uplink configuration for reference sensitivity

Downlink band/ Uplink band / Channel bandwidth / N_{RB}								
Downlink band	Uplink band	SCS kHz	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz
n78	n80	15	25	50	75	100	128	160
n78	n81	15	25	50	75	100		
n78	n82	15	25	50	75	100		
n78	n83	15	25	50	75	100		
n78	n84	15	25	50	75	100		
n78	n86	15	25	50	75	100		
n79	n80	15	25	50	75	100		
n79	n81	15	25	50	75	100		

For the UE that supports any of the SUL operation given in Table 7.3C.0.2-2, exceptions to the requirements specified in Table7.3.2.3-1 are allowed when the uplink is active in a lower frequency band and is within a specified frequency range such that transmitter harmonics fall within the downlink transmission bandwidth assigned in a higher band as noted in Table 7.3C.0.2-2. For these exceptions, the UE shall meet the requirements specified in Table 7.3C.0.2-2 and Supplementary Uplink configuration (exceptions due to harmonic issue given in Table 7.3C.0.2-3.

Table 7.3C.0.2-2: Reference sensitivity for SUL operation (exceptions due to harmonic issue)

NR Band / Channel bandwidth of the high band													
UL band	DL band	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
		dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB
n80	n78[1,2]		23.9	22.1	20.9			17.9	16.8	16.0	14.8	14.3	13.8
	n78[3]		1.1	0.8	0.3			0	0	0	0	0	0
n82	n78[4,5]		10.8	9.1	8			6	4.0	3.2	2.0	1.5	1.0
n81	n78[4,5]		10.8	9.1	8			5.1	4.2	3.5	2.3	1.5	1.4
n83	n78[6,7]		10.4	8.9	7.8			4.7	3.7	3	1.7	1.2	0.7
n86	n78[1,2]		23.9	22.1	20.9			17.9	16.8	16.0	14.8	14.3	13.8
	n78[3]		1.1	0.8	0.3				0	0	0	0	0
n81	n79[6,7]							[6.8]	6.2	[5.6]	4.9		4.4

NOTE 1: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 2nd transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.

NOTE 2: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.2 \rfloor 0.1$ in MHz and $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ with f_{DL}^{HB} carrier frequency in the victim (higher) band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the lower band.

NOTE 3: The requirements are only applicable to channel bandwidths with a carrier frequency at $\pm\left(20 + BW_{Channel}^{HB} / 2\right)$ MHz offset from $2 f_{UL}^{LB}$ in the victim (higher band) with $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$, where $BW_{Channel}^{LB}$ and $BW_{Channel}^{HB}$ are the channel bandwidths configured in the aggressor (lower) and victim (higher) bands in MHz, respectively.

NOTE 4: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 4th transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band.

NOTE 5: The requirements should be verified for UL EARFCN of the aggressor (lower) band (superscript LB) such that $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.4 \rfloor 0.1$ in MHz and $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ with f_{DL}^{HB} carrier frequency in the victim (higher) band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the lower band.

NOTE 6: These requirements apply when there is at least one individual RE within the uplink transmission bandwidth of the aggressor (lower) band for which the 5th transmitter harmonic is within the downlink transmission bandwidth of a victim (higher) band..

NOTE 7: The requirements should be verified for UL NR-ARFCN of the aggressor (lower) band (superscript LB) such that $f_{UL}^{LB} = \lfloor f_{DL}^{HB} / 0.5 \rfloor 0.1$ in MHz and $F_{UL\_low}^{LB} + BW_{Channel}^{LB} / 2 \leq f_{UL}^{LB} \leq F_{UL\_high}^{LB} - BW_{Channel}^{LB} / 2$ with f_{DL}^{HB} carrier frequency in the victim (higher) band in MHz and $BW_{Channel}^{LB}$ the channel bandwidth configured in the lower band.

Table 7.3C.0.2-3: Supplementary Uplink configuration (exceptions due to harmonic issue)

NR Band / Channel bandwidth of the high band													
UL band	DL band	5 MHz (N_{RB})	10 MHz (N_{RB})	15 MHz (N_{RB})	20 MHz (N_{RB})	25 MHz (N_{RB})	30 MHz (N_{RB})	40 MHz (N_{RB})	50 MHz (N_{RB})	60 MHz (N_{RB})	80 MHz (N_{RB})	90 MHz (N_{RB})	100 MHz (N_{RB})
n80	n78		25	36	50			50	50	50	50	50	50
n81	n78		16	25	25			25	25	25	25	25	25
n81	n79							25	25	25	25		25
n82	n78		16	20	20			20	20	20	20	20	20
n83	n78		10	15	20			25	25	25	25	25	25
n86	n78		25	36	50			100	100	100	100	100	100

NOTE 1: 15kHz SCS is assumed for UL band.

NOTE 2: The UL configuration applies regardless of the channel bandwidth of the low band unless the UL resource blocks exceed that specified in Table 7.3.2.3-3 for the uplink bandwidth in which case the allocation according to Table 7.3.2.3-3 applies.

7.3C.0.3 ΔRIB,c for SUL

7.3C.0.3.1 General

For a UE supporting a SUL configuration, the $\Delta R_{IB,c}$ applies for both SC and SUL operation.

7.3C.0.3.2 SUL band combination

For the UE which supports SUL band combination, the minimum requirement for reference sensitivity in subclause 7.3C.0 shall be increased by the amount given in $\Delta R_{IB,c}$ defined in subclause 7.3C.0.3 for the applicable operating bands. Unless otherwise stated, $\Delta R_{IB,c}$ is set to zero.

In case the UE supports more than one of band combinations for CA, SUL or DC, and an operating band belongs to more than one band combinations then

- When the operating band frequency range is ≤ 1 GHz, the applicable additional $\Delta R_{IB,c}$ shall be the average value for all band combinations defined in subclause 7.3A, 7.3B, 7.3C in this specification and 7.3A, 7.3B in TS 38.521-3 [14], truncated to one decimal place that apply for that operating band among the supported band combinations. In case there is a harmonic relation between low band UL and high band DL, then the maximum $\Delta R_{IB,c}$ among the different supported band combinations involving such band shall be applied

- When the operating band frequency range is > 1 GHz, the applicable additional $\Delta R_{IB,c}$ shall be the maximum value for all band combinations defined in subclause 7.3A, 7.3B, 7.3C in this specification and 7.3A, 7.3B in TS 38.521-3 [14] for the applicable operating bands.

7.3C.0.3.2.1 ΔRIB,c for two bands

Table 7.3C.0.3.2.1-1: $\Delta R_{IB,c}$ due to SUL (two bands)

Band combination for SUL	NR Band	$\Delta R_{IB,c}$ [dB]
SUL_n78-n80	n78	0.5
SUL_n78-n81	n78	0.2
SUL_n78-n82	n78	0.5
SUL_n78-n83	n78	0.5
SUL_n78-n84	n78	0.5
SUL_n78-n86	n78	0.5

The normative reference for this requirement is TS 38.101-1 [2] clause 7.3C.2.

7.3C.1 General

The reference sensitivity power level REFSENS is the minimum mean power applied to each one of the UE antenna ports for all UE categories, at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

7.3C.2 Reference sensitivity power level for SUL

Editor's Note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Test point analysis and selection are FFS.
- Initial condition is FFS
- Test configuration for exceptional test points is FFS

7.3C.2.1 Test purpose

The test purpose is to verify the ability of the UE to receive data with a given average throughput for a specified reference measurement channel, under SUL operation and conditions of low signal level, ideal propagation and no added noise.

7.3C.2.2 Test applicability

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

7.3C.2.3 Minimum conformance requirement

The minimum conformance requirements are defined in clause 7.3C.0.

7.3C.2.4 Test description

7.3C.2.4.1 Initial conditions

Same test description as specified in clause 7.3.2.4.1 with following exceptions:

- Instead of table 5.3.5-1 → use Table 5.5C-1
- Instead of table 7.3.2.4.1-1 → use Table 7.3C.2.4.1-1

Table 7.3C.2.4.1-1: Test Configuration Table

Initial Conditions						
Test Environment as specified in TS 38.508-1 [5] subclause 4.1		FFS				
Test Frequencies as specified in TS 38.508-1 [5] subclause4.3.1		FFS				
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1		FFS				
Test SCS as specified in Table 5.3.5-1		FFS				
Test Parameters						
Test ID	**Downlink Configuration**		**Uplink Configuration**		**SUL Configuration**	
	Modulation	**RB allocation**	**Modulation**	**RB allocation**	**Modulation**	**RB allocation**
1	FFS	FFS	FFS	FFS	FFS	FFS

Table 7.3C.2.4.1-2: Test configurations table for SUL operation exceptions due to UL harmonic issue for n78 with SUL 80

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 C0, C.1, C.2, C3.1, and uplink signals according to Annex G.0, G.1, G.2, G.3.0 with consideration of supplementary uplink physical channels.
4. The UL and DL Reference Measurement Channel shall be set according to Table 7.3.2.4.1-1, Table 7.3.2.4.1-2, Table 7.3.2.4.1-3 and Table 7.3C.2.4.1-1.
5. The UL Reference Measurement Channel shall be set according to Table 7.3C.2.3-2 and 7.3C.2.3-3 when testing is performed with UL/DL band combination listed in Table 7.3C.2.3-2 for exceptions due to harmonic issue.

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 7.3C.2.4.3

7.3C.2.4.2 Test procedure

1 SS transmits PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to Table 7.3.4.1-1. 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 Tables 7.3.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

3. Set the Downlink signal level to the appropriate REFSENS value defined in Table 7.3.3.1. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE to ensure the UE transmits P_{UMAX} level for at least the duration of the Throughput measurement.

4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2.

7.3C.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 ensuring Tables 4.6.3-13, 4.6.3-97, and 4.6.3-129A with conditions SUL, and Table 4.6.3-167 with condition PUSCH_PUCCH_ON_SUL.

7.3C.2.5 Test requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A3.2 with parameters specified in Tables 7.3.2.3-1 and Tables 7.3.2.3-2.

For SUL operation, the reference receive sensitivity (REFSENS) requirement for downlink bands specified in Table 7.3.2.5-1 shall be met for an uplink transmission bandwidth less than or equal to that specified in Table 7.3.2.4.1-3 with exceptions listed in clause 7.3C.2.5.1.

7.3C.2.5.1 Reference sensitivity exceptions due to harmonic issue

For SUL operation with DL band listed in Table 7.3C.2.3-2 with supplementary uplink transmission bandwidth less than or equal to that specified in Table 7.3C.2.3-1, the reference receive sensitivity (REFSENS) requirement for downlink bands specified in Table 7.3C.2.5.1-1 due to harmonic exceptions.

Table 7.3C.2.5.1-1: Reference sensitivity for SUL operation (exceptions due to harmonic issue)

SUL band	DL band	SCS	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
		kHz	dBm	dBm	dBm	dBm	dBm	dBm	dBm	dBm	dBm	dBm	dBm	dBm
n80	n78[1,2]	15		-70.9 +TT	-70.9 +TT	-70.8 +TT			-70.7 +TT					
		30		-71.2 +TT	-71.0 +TT	-70.9 +TT			-70.8 +TT					
		60		-71.6 +TT	-71.3 +TT	-71.2 +TT			-71.0 +TT					
n80	n78[3]	15		-93.7 +TT	-92.2 +TT	-91.4 +TT								
		30		-94.0 +TT	-92.3 +TT	-91.5 +TT								
		60		-94.4 +TT	-92.6 +TT	-91.8								

n82	n78[3]	15		-85.0 +TT	-84.9 +TT	-84.7 +TT			-83.6 +TT					
		30		-85.3 +TT	-85.0 +TT	-84.9 +TT			-83.7 +TT					
		60		-85.7 +TT	-85.3 +TT	-85.1 +TT			-83.9 +TT					
n81	n78[4]	15		-85.0 +TT	-84.9 +TT	-84.7 +TT			-84.5 +TT	-84.4 +TT				
		30		-85.3 +TT	-85.0 +TT	-84.9 +TT			-84.6 +TT	-84.5 +TT	-84.4 +TT	-84.3 +TT		-84.2 +TT
		60		-85.7 +TT	-85.3 +TT	-85.1 +TT			-84.8 +TT	-84.6 +TT	-84.5 +TT	-84.4 +TT		-84.3 +TT
n81	n78[5]	15		-85.4 +TT	-85.1 +TT	-84.9 +TT			-84.9 +TT	-84.9 +TT				
		30		-85.7 +TT	-85.2 +TT	-85.1 +TT			-85.0 +TT	-85.0 +TT	-84.9 +TT	-84.9 +TT	-84.9 +TT	-84.9 +TT
		60		-86.1 +TT	-85.5 +TT	-85.3 +TT			-85.2 +TT	-85.1 +TT	-85.0 +TT	-85.0 +TT	-85.0 +TT	-85.0 +TT
n86	n78[6]	15		-71.9 +TT	-71.9 +TT	-71.8 +TT			-71.7 +TT					
		30		-72.2 +TT	-72.0 +TT	-72.0 +TT			-71.8 +TT					
		60		-72.6 +TT	-72.3 +TT	-72.2 +TT			-72.0 +TT					
n86	n78[7]	15		-94.7 +TT	-93.2 +TT	-92.4 +TT								
		30		-95.0 +TT	-93.3 +TT	-92.6 +TT								
		60		-95.4 +TT	-93.6 +TT	-92.8 +TT								
n81	n79[8]	15							-82.8 +TT	-82.4 +TT				
		30							-85.0 +TT	-85.0 +TT	-84.9 +TT	-84.9 +TT		-84.9 +TT
		60							-85.2 +TT	-85.1 +TT	-85.0 +TT	-85.0 +TT		-85.0 +TT

NOTE 1: [1] indicates requirement for test configuration specified by Table [TBD]
NOTE 2: [2] indicates requirement for test configuration specified by Table [TBD]
NOTE 3: [3] indicates requirement for test configuration specified by Table [TBD]
NOTE 4: [4] indicates requirement for test configuration specified by Table [TBD]
NOTE 5: [5] indicates requirement for test configuration specified by Table [TBD]
NOTE 6: [6] indicates requirement for test configuration specified by Table [TBD]
NOTE 7: [7] indicates requirement for test configuration specified by Table [TBD]
NOTE 8: [8] indicates requirement for test configuration specified by Table [TBD]
NOTE 9: TT for each frequency and channel bandwidth is specified in Table 7.3C.2.5.1-2.

Table 7.3C.2.5.1-2: Test Tolerance (TT) for RX sensitivity level

f ≤ 3.0GHz	3.0GHz < f ≤ 6.0 GHz
0.7 dB	1.0 dB

For the UE which supports SUL band combination, the minimum requirement for reference sensitivity in Table 7.3C.2.3-1 shall be increased by the amount given in $\Delta R_{IB,c}$ defined in subclause 7.3C.0.3.

7.3D Reference sensitivity for UL-MIMO

7.3D.1 General

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements specified in subclause 7.3 shall be met with the UL-MIMO configurations described in sub-clause 6.2D.1. For UL-MIMO, the parameter P_{UMAX} is the total transmitter power over the two transmits power over the two transmit antenna connectors.

The normative reference for this requirement is TS 38.101-1 [2] clauses 7.3D

7.3D.2 Reference sensitivity power level for UL-MIMO

7.3D.2.1 Test purpose

The test purpose is to verify the ability of the UE to receive data with a given average throughput for a specified reference measurement channel, under conditions of low signal level, ideal propagation and no added noise.

7.3D.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support UL-MIMO

7.3D.2.3 Minimum conformance requirements

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements specified in subclause 7.3 shall be met with the UL-MIMO configurations described in sub-clause 6.2D.1. For UL-MIMO, the parameter P_{UMAX} is the total transmitter power over the two transmits power over the two transmit antenna connectors

The normative reference for this requirement is TS 38.101-1 [2] clauses 7.3D and 7.3.

7.3D.2.4 Test description

7.3D.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, and channel bandwidths based on NR operating bands specified in Table 5.2-1. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in Table 7.3D.2.4.1-1, Table 7.3D.2.4.1-2, and Table 7.3D.2.4.1-3. The details of the uplink and downlink 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 7.3D.2.4.1-1: 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] subclause4.3.1			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**	
	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.3.1.1.2 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 C.3.1, and uplink signals according to Annex G.0, G.1, G.2, and G.3.1.

4. The UL and DL Reference Measurement Channel is set according to Table 7.3D.2.4.1-1, Table 7.3.2.4.1-2, and Table 7.3.2.4.1-3.

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 7.3D.2.4.3.

7.3D.2.4.2 Test procedure

Same test procedure as specified in 7.3.2.4.2 with the following exception:

Step 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 7.3D.2.4.1-1. 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 condition 2TX_UL_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

7.3D.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 and exceptions listed in clause 7.3.2.4.3

7.3D.2.5 Test requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A3.2 with reference receive power level specified in Tables 7.3.2.5-1 and parameters specified Tables 7.3D.2.4.1-1, Tables 7.3.2.4.1-2 and Tables 7.3.2.4.1-3.

7.4 Maximum input level

7.4.1 Test purpose

Maximum input level tests the UE's ability to receive data with a given average throughput for a specified reference measurement channel, under conditions of high signal level, ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the coverage area near to a g-NodeB.

7.4.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

7.4.3 Minimum conformance requirements

Maximum input level is defined as the maximum mean power received at the UE antenna port, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel. The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.4.3-1.

Table 7.4.3-1: Maximum input level

Rx Parameter	Units	Channel bandwidth											
		5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
Power in Transmission Bandwidth Configuration	dBm	-25[2]				-24[2]	-23[2]	-22[2]	-21[2]	-20[2]			
		-27[3]				-26[3]	-25[3]	-24[3]	-23[3]	-22[3]			
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3.2.3-3 with P_{CMAX_L} as defined in subclause 6.2.4. NOTE 2: Reference measurement channel is Annex A.3.2.3/A.3.3.3 for 64-QAM. NOTE 3: Reference measurement channel is Annex A.3.2.4/A.3.3.4 for 256-QAM.													

The normative reference for this requirement is TS 38.101-1 [2] clause 7.4.

7.4.4 Test description

7.4.4.1 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 channel bandwidth and sub-carrier spacing, are shown in table 7.4.4.1-1. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.4.4.1-1: 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	
Test Parameters for Channel Bandwidths			
Downlink Configuration		**Uplink Configuration**	
Modulation	**RB allocation**	**Modulation**	**RB allocation**
CP-OFDM 64 QAM	NOTE 1	DFT-s-OFDM QPSK	NOTE 2
CP-OFDM 256 QAM	NOTE 1	DFT-s-OFDM QPSK	NOTE 2
NOTE 1: The specific configuration of downlink RB allocation is defined in Table 7.3.2.4.1-2. NOTE 2: The specific configuration of uplink RB allocation is defined in Table 7.3.2.4.1-3.			

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 C.3.1, and uplink signals according to Annex G.0, G.1, G.2, and G.3.1.
4. The DL and UL Reference Measurement Channels are set according to Table 7.4.4.1-1.
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 7.4.4.3.

7.4.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 7.4.4.1-1. 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 Tables 7.4.4.1-1. Since the UE has no payload data 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 value as defined in Table 7.4.5-1. Send uplink power control commands to the UE (less or equal to 1dB step size should be used), to ensure that the UE output power is within $-P_W \pm P_W$ dB of the target power level in Table 7.4.5-1 for at least the duration of the Throughput measurement. P_W is the power window according to Table 7.4.5-2 for the carrier frequency f and the channel bandwidth BW.
4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2

7.4.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED.

7.4.5 Test requirement

The throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3 with parameters specified in Tables 7.4.5-1.

Table 7.4.5-1: Maximum input level

Rx Parameter	Units	Channel bandwidth											
		5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
Power in Transmission Bandwidth Configuration	dBm	-25[2]-TT				-24[2]-TT	-23[2]-TT	-22[2]-TT	-21[2]-TT	-20[2]-TT			
		-27[3]-TT				-26[3]-TT	-25[3]-TT	-24[3]-TT	-23[3]-TT	-22[3]-TT			
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3.2.3-3 with P_{CMAX_L} as defined in subclause 6.2.4. NOTE 2: Reference measurement channel is Annex A.3.2.3/A.3.3.3 for 64-QAM. NOTE 3: Reference measurement channel is Annex A.3.2.4/A.3.3.4 for 256-QAM. NOTE 4: TT for each frequency is specified in Table 7.4.5-3.													

Table 7.4.5-2: Power Window (dB) for Maximum input level

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	1.4	1.7	2.0
20MHz < BW ≤ 40MHz	1.4	1.7	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.3
NOTE: Power Window comprises two parts, UE Power step tolerance and test system power measurement uncertainty.			

Table 7.4.5-3: Test Tolerance (Maximum input level)

f ≤ 3.0GHz	3.0GHz < f ≤6.0GHz
0.7 dB	1.0 dB

7.4A Maximum input level for CA

FFS

7.4D Maximum input level for UL-MIMO

7.4D.1 Test purpose

Maximum input level tests the ability of UE that supports UL- MIMO to receive data with a given average throughput for a specified reference measurement channel, under conditions of high signal level, ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the coverage area near to an e-NodeB.

7.4D.2 Test applicability

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

7.4D.3 Minimum conformance requirements

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing, the minimum requirements specified in sub-clause 7.4 shall be met with the UL-MIMO configurations described in sub-clause 6.2D.1. For UL-MIMO, the parameter P_{CMAX_L} is defined as the total transmitter power over the two transmit antenna connectors.

The normative reference for this requirement is TS 38.101-1 [2] clauses 7.4D and 7.4.

7.4D.4 Test description

7.4D.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, and channel bandwidths based on NR operating bands specified in Table 5.2-1. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in Table 7.4D.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annex A.2 and Annex A.3 respectively. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.4D.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**	
Test Parameters for Channel Bandwidths			
Downlink Configuration		**Uplink Configuration**	
Modulation	**RB allocation**	**Modulation**	**RB allocation**
CP-OFDM 64 QAM	NOTE 1	CP-OFDM QPSK	NOTE 2
CP-OFDM 256 QAM	NOTE 1	CP-OFDM QPSK	NOTE 2
NOTE 1: The specific configuration of downlink RB allocation is defined in Table 7.3.2.4.1-2. NOTE 2: The specific configuration of uplink RB allocation is defined in Table 7.3.2.4.1-3.			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A Figure A.3.1.1.2 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 C.3.1, and uplink signals according to Annex G.0, G.1, G.2, and G.3.1.

4. The UL and DL Reference Measurement Channel is set according to Table 7.4D.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 7.4D.4.3.

7.4D.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 7.4D.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 Tables 7.4D.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 condition 2TX_UL_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2

3. Set the Downlink signal level to the value defined in Table 7.4D.5-1. Send Uplink power control commands to the UE (less or equal to 1dB step size should be used), to ensure that the UE output power is within $-P_W \pm P_W$ of the target level in Table 7.4D.5-1, for at least the duration of the throughput measurement. P_W is the power window according to Table 7.4D.4.2-1 for the carrier frequency f and the channel bandwidth BW

4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2

Table 7.4D.4-2-1: Power Window (dB) for Maximum input level

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	1.4	1.7	2
20MHz < BW ≤ 40MHz	1.4	1.7	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.3

7.4D.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

7.4D.5 Test requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 and A3.3 with parameters specified in Table 7.4D.5-1.

Table 7.4D.5-1 Maximum input level

Rx Parameter	Units	Channel bandwidth											
		5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
Power in Transmission Bandwidth Configuration	dBm	-25[2]-TT + TT				-24[2] -TT + TT	-23[2] -TT + TT	-22[2] - TT + TT	-21[2] - TT + TT	-20-TT [2]+ TT			
		-27[3]-TT + TT				-26[3] - TT + TT	-25[3] - TT + TT	-24[3] - TT + TT	-23[3] - TT + TT	-22[3]-TT+ TT			
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified in Table 7.3-3 with P_{CMAX_L} as defined in subclause 6.2.4. NOTE 2: Reference measurement channel is A.3.2.3/A.3.3.3 for 64-QAM. NOTE 3: Reference measurement channel is A.3.2.4/A.3.3.4 for 256-QAM. NOTE 4: TT for each frequency is specified in Table 7.4D.5-2 Table 7.4.5-3.													

Table 7.4D.5-2: Test Tolerance (Maximum input level)

f ≤ 3.0GHz	3.0GHz < f ≤6.0GHz
0.7 dB	1.0 dB

7.5 Adjacent channel selectivity

7.5.1 Test purpose

Adjacent channel selectivity (ACS) is a measure of a receiver's ability to receive an NR signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel. ACS is the ratio of the receive filter attenuation on the assigned channel frequency to the receive filter attenuation on the adjacent channel(s).

7.5.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

7.5.3 Minimum conformance requirements

The UE shall fulfil the minimum requirements specified in Table 7.5.3-1 for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz and the minimum requirements specified in Table 7.5.3-2. for NR bands with $F_{DL\_low} \geq$ 3300 MHz and $F_{UL\_low} \geq$ 3300 MHz. These requirements apply for all values of an adjacent channel interferer up to -25 dBm and for any SCS specified for the channel bandwidth of the wanted signal. However, it is not possible to directly measure the ACS; instead the lower and upper range of test parameters are chosen as in Table 7.5.3-3 and Table 7.5.3-4 for verification of the requirements specified in Table 7.5.3-1 and as in Table 7.5.3-5, and Table 7.5.3-6 for verification of the requirements specified in Table 7.5.3-2. For these test parameters, the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3, A.3.2 and A.3.3(with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5). For operating bands with an unpaired DL part (as noted in Table 5.2-1), the requirements only apply for carriers assigned in the paired part.

Table 7.5.3-1: ACS for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz

RX parameter	Units	Channel bandwidth				
		5 MHz	10 MHz	15 MHz	20 MHz	25 MHz
ACS	dB	33	33	30	27	26
RX parameter	Units	Channel bandwidth				
		30 MHz	40 MHz	50 MHz	60 MHz	80 MHz
ACS	dB	25.5	24	23	22.5	21
RX parameter	Units	Channel bandwidth				
		90 MHz	100 MHz			
ACS	dB	20.5	20			

Table 7.5.3-2: ACS for NR bands with $F_{DL\_low} \geq$ 3300 MHz and $F_{UL\_low} \geq$ 3300 MHz

RX parameter	Units	Channel bandwidth				
		10 MHz	15 MHz	20 MHz	40 MHz	50 MHz
ACS	dB	33	33	33	33	33
RX parameter	Units	Channel bandwidth				
		60 MHz	80 MHz	90 MHz	100 MHz	
ACS	dB	33	33	33	33	

Table 7.5.3-3: Test parameters for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, case 1

RX parameter	Units	Channel bandwidth				
		5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS + 45.5 dB	REFSENS + 45.5 dB	REFSENS + 42.5 dB	REFSENS + 39.5 dB	REFSENS + 38.5 dB
$BW_{interferer}$	MHz	5	5	5	5	5
$F_{interferer}$ (offset)	MHz	5 / -5	7.5 / -7.5	10 / -10	12.5 / -12.5	15 / -15
RX parameter	**Units**	**Channel bandwidth**				
		30 MHz	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS + 38 dB	REFSENS + 36.5 dB	REFSENS + 35.5 dB	REFSENS + 35 dB	REFSENS + 33.5 dB
$BW_{interferer}$	MHz	5	5	5	5	5
$F_{interferer}$ (offset)	MHz	17.5 / -17.5	22.5 / -22.5	27.5 / -27.5	32.5 / -32.5	42.5 / -42.5
RX parameter	**Units**	**Channel bandwidth**				
		90 MHz	**100 MHz**			
Power in transmission bandwidth configuration	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS + 33 dB	REFSENS + 32.5 dB			
$BW_{interferer}$	MHz	5	5			
$F_{interferer}$ (offset)	MHz	47.5 / -47.5	52.5 / -52.5			

NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.

NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\left\lceil |F_{interferer}| / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS

NOTE 3: The interferer consists of the NR interferer RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

Table 7.5.3-4: Test parameters for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, case 2

RX parameter	Units	Channel bandwidth				
		5 MHz	10 MHz	15 MHz	20 MHz	25 MHz
Power in transmission bandwidth configuration	dBm	-56.5	-56.5	-53.5	-50.5	-49.5
$P_{interferer}$	dBm	-25				
$BW_{interferer}$	MHz	5	5	5	5	5
$F_{interferer}$ (offset)	MHz	5 / -5	7.5 / -7.5	10 / -10	12.5 / -12.5	15 / -15
RX parameter	**Units**	**Channel bandwidth**				
		30 MHz	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**
Power in transmission bandwidth configuration	dBm	-49	-47	-46.5	-46	-44.5
$P_{interferer}$	dBm	-25				
$BW_{interferer}$	MHz	5	5	5	5	5
$F_{interferer}$ (offset)	MHz	17.5 / -17.5	22.5 / -22.5	27.5 / -27.5	32.5 / -32.5	42.5 / -42.5
RX parameter	**Units**	**Channel bandwidth**				
		90 MHz	**100 MHz**			
Power in transmission bandwidth configuration	dBm	-44	-43.5			
$P_{interferer}$	dBm	-25				
$BW_{interferer}$	MHz	5	5			
$F_{interferer}$ (offset)	MHz	47.5 / -47.5	52.5 / -52.5			

NOTE 1: The transmitter shall be set to 24 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.

NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\left\lceil |F_{interferer}| / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS.

NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

Table 7.5.3-5: Test parameters for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz, case 1

RX parameter	Units	Channel bandwidth				
		10 MHz	15 MHz	20 MHz	40 MHz	50 MHz
Power in transmission bandwidth configuration	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS + 45.5 dB				
$BW_{interferer}$	MHz	10	15	20	40	50
$F_{interferer}$ (offset)	MHz	10 / -10	15 / -15	20 / -20	40 / -40	50 / -50
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
Power in transmission bandwidth configuration	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS + 45.5 dB	REFSENS + 45.5 dB	REFSENS + 45.5 dB	REFSENS + 45.5 dB	
$BW_{interferer}$	MHz	60	80	90	100	
$F_{interferer}$ (offset)	MHz	60 / -60	80 / -80	90 / -90	100 / -100	

NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.
NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\lceil |F_{interferer}| / SCS \rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.
NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

Table 7.5.3-6: Test parameters for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz, case 2

RX parameter	Units	Channel bandwidth				
		10 MHz	15 MHz	20 MHz	40 MHz	50 MHz
Power in transmission bandwidth configuration	dBm	-56.5				
$P_{interferer}$	dBm	-25				
$BW_{interferer}$	MHz	10	15	20	40	50
$F_{interferer}$ (offset)	MHz	10 / -10	15 / -15	20 / -20	40 / -40	50 / -50
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
Power in transmission bandwidth configuration	dBm	-56.5				
$P_{interferer}$	dBm	-25	-25	-25	-25	
$BW_{interferer}$	MHz	60	80	90	100	
$F_{interferer}$ (offset)	MHz	60 / -60	80 / -80	90 / -90	100 / -100	

NOTE 1: The transmitter shall be set to 24 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4 .
NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\lceil |F_{interferer}| / SCS \rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.
NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

The normative reference for this requirement is TS 38.101-1 [2] clause 7.5.

7.5.4 Test description

7.5.4.1 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 7.5.4.1-1. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. Configuration of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.5.4.1-1: Test Configuration Table

Default 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		
Test Parameters				
	Downlink Configuration		**Uplink Configuration**	
Test ID	**Mod'n**	**RB allocation**	**Mod'n**	**RB allocation**
1	CP-OFDM QPSK	NOTE 1	DFT-s-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3.2.4.1-1.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.4.1 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, C.3.1, and uplink signals according to Annex G.0, G.1, G.2, G.3.1.
4. The DL and UL Reference Measurement channels are set according to Table 7.5.4.1-1.
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 content are defined in clause 7.5.4.3.

7.5.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to Table 7.5.4.1-1. 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 7.5.4.1-1. 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 value as defined in Table 7.5.5-2 or Table 7.5.5-5 as appropriate (Case 1). Send Uplink power control commands to the UE (less or equal to 1 dB step size should be used), to ensure that the UE output power is within - $P_W \pm P_W$ dB of the target power level in Table 7.5.5-2 or Table 7.5.5-5 for at least the duration of the Throughput measurement. P_W is the power window according to Table 7.5.5-7 for the carrier frequency f and the channel bandwidth BW..

4. Set the Interferer signal level to the value as defined in Table 7.5.5-2 or Table 7.5.5-5 as appropriate (Case 1) and frequency below the wanted signal, using a modulated interferer bandwidth as defined in Annex D.

5. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.

6. Repeat steps from 3 to 5, using an interfering signal above the wanted signal in Case 1 at step 4.

7. Set the Downlink signal level to the value as defined in Table 7.5.5-3 or Table 7.5.5-6 as appropriate (Case 2). Send Uplink power control commands to the UE (less or equal to 1dB step size should be used), to ensure that the UE output power is within - $P_W \pm P_W$ dB of the target power level in Table 7.5.5-3 or Table 7.5.5-6 for at least the duration of the Throughput measurement. P_W is the power window according to Table 7.5.5-7 for the carrier frequency f and the channel bandwidth BW..

8. Set the Interferer signal level to the value as defined in Table 7.5.5-3 or Table 7.5.5-6 as appropriate (Case 2) and frequency below the wanted signal, using a modulated interferer bandwidth as defined in Annex D.

9. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.

10. Repeat steps from 7 to 9, using an interfering signal above the wanted signal in Case 2 at step 8.

11. Repeat for applicable channel bandwidths and operating band combinations in both Case 1 and Case 2.

7.5.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with TRANSFORM_PRECODER_ENABLED condition in Table 4.6.3-118 PUSCH-Config.

7.5.5 Test requirement

For NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, the throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.5.5-2 and 7.5.5-3.

Table 7.5.5-1: ACS for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz

RX parameter	Units	Channel bandwidth				
		5 MHz	10 MHz	15 MHz	20 MHz	25 MHz
ACS	dB	33	33	30	27	26
RX parameter	Units	Channel bandwidth				
		30 MHz	40 MHz	50 MHz	60 MHz	80 MHz
ACS	dB	25.5	24	23	22.5	21
RX parameter	Units	Channel bandwidth				
		90 MHz	100 MHz			
ACS	dB	20.5	20			

Table 7.5.5-2: Test parameters for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, case 1

RX parameter	Units	Channel bandwidth				
		5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS + 45.5 dB	REFSENS + 45.5 dB	REFSENS + 42.5 dB	REFSENS + 39.5 dB	REFSENS + 38.5 dB
$BW_{interferer}$	MHz	5	5	5	5	5
$F_{interferer}$ (offset)	MHz	5 / -5	7.5 / -7.5	10 / -10	12.5 / -12.5	15 / -15
RX parameter	**Units**	**Channel bandwidth**				
		30 MHz	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS + 38 dB	REFSENS + 36.5 dB	REFSENS + 35.5 dB	REFSENS + 35 dB	REFSENS + 33.5 dB
$BW_{interferer}$	MHz	5	5	5	5	5
$F_{interferer}$ (offset)	MHz	17.5 / -17.5	22.5 / -22.5	27.5 / -27.5	32.5 / -32.5	42.5 / -42.5
RX parameter	**Units**	**Channel bandwidth**				
		90 MHz	**100 MHz**			
Power in transmission bandwidth configuration	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS + 33 dB	REFSENS + 32.5 dB			
$BW_{interferer}$	MHz	5	5			
$F_{interferer}$ (offset)	MHz	47.5 / -47.5	52.5 / -52.5			

NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.

NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\left\lceil |F_{interferer}| / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS.

NOTE 3: The interferer consists of the NR interferer RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

Table 7.5.5-3: Test parameters for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, case 2

RX parameter	Units	Channel bandwidth				
		5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**
Power in transmission bandwidth configuration	dBm	-56.5	-56.5	-53.5	-50.5	-49.5
$P_{interferer}$	dBm	-25				
$BW_{interferer}$	MHz	5	5	5	5	5
$F_{interferer}$ (offset)	MHz	5 / -5	7.5 / -7.5	10 / -10	12.5 / -12.5	15 / -15
RX parameter	**Units**	**Channel bandwidth**				
		30 MHz	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**
Power in transmission bandwidth configuration	dBm	-49	-47	-46.5	-46	-44.5
$P_{interferer}$	dBm	-25				
$BW_{interferer}$	MHz	5	5	5	5	5
$F_{interferer}$ (offset)	MHz	17.5 / -17.5	22.5 / -22.5	27.5 / -27.5	32.5 / -32.5	42.5 / -42.5
RX parameter	**Units**	**Channel bandwidth**				
		90 MHz	**100 MHz**			
Power in transmission bandwidth configuration	dBm	-44	-43.5			
$P_{interferer}$	dBm	-25				
$BW_{interferer}$	MHz	5	5			
$F_{interferer}$ (offset)	MHz	47.5 / -47.5	52.5 / -52.5			
NOTE 1: The transmitter shall be set to 24 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4. NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\left\lceil \left\|F_{interferer}\right\| / SCS \right\rceil + 0.5\right)SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS equal to that of the wanted signal. NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1..						

For NR bands with F_{DL_high} < 3300 MHz and F_{UL_high} < 3300 MHz, the throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in [Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1)] with parameters specified in Tables 7.5.5-5 and 7.5.5-6.

Table 7.5.5-4: ACS for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

RX parameter	Units	Channel bandwidth				
		10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**
ACS	dB	33	33	33	33	33
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
ACS	dB	33	33	33	33	

Table 7.5.5-5: Test parameters for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz, case 1

RX parameter	Units	Channel bandwidth				
		10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS + 45.5 dB				
$BW_{interferer}$	MHz	10	15	20	40	50
$F_{interferer}$ (offset)	MHz	10 / -10	15 / -15	20 / -20	40 / -40	50 / -50
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
Power in transmission bandwidth configuration	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS + 45.5 dB	REFSENS + 45.5 dB	REFSENS + 45.5 dB	REFSENS + 45.5 dB	
$BW_{interferer}$	MHz	60	80	90	100	
$F_{interferer}$ (offset)	MHz	60 / -60	80 / -80	90 / -90	100 / -100	
NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4. NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\lceil \lvert F_{\text{interferer}} \rvert / SCS \rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal. NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1..						

Table 7.5.5-6: Test parameters for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz, case 2

RX parameter	Units	Channel bandwidth				
		10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**
Power in transmission bandwidth configuration	dBm	-56.5				
$P_{interferer}$	dBm	-25				
$BW_{interferer}$	MHz	10	15	20	40	50
$F_{interferer}$ (offset)	MHz	10 / -10	15 / -15	20 / -20	40 / -40	50 / -50
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
Power in transmission bandwidth configuration	dBm	-56.5				
$P_{interferer}$	dBm	-25	-25	-25	-25	
$BW_{interferer}$	MHz	60	80	90	100	
$F_{interferer}$ (offset)	MHz	60 / -60	80 / -80	90 / -90	100 / -100	
NOTE 1: The transmitter shall be set to 24 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4. NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\lceil \lvert F_{\text{interferer}} \rvert / SCS \rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal. NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.						

Table 7.5.5-7: Power Window (dB) for Adjacent channel selectivity

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	1.4	1.7	2
20MHz < BW ≤ 40MHz	1.4	1.7	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.3
Note: Power Window setting comprises two quantities, UE Power tolerance and test system power measurement			

7.5A Adjacent channel selectivity for CA

7.5A.0 Minimum conformance requirements

7.5A.0.1 Adjacent channel selectivity for Intra-band contiguous CA

For intra-band contiguous carrier aggregation with two component carriers and aggregated bandwidth BWChannel_CA shall be configured at nominal channel spacing to the PCC. The UE shall fulfil the minimum requirement specified in Table 7.5A.0.1-1 and 7.5A.0.1-1a for an adjacent channel interferer on either side of the aggregated downlink signal at a specified frequency offset and for an interferer power up to -25 dBm.

The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.5A.0.1-2, 7.5A.0.1-2a, 7.5A.0.1-3 and 7.5A.0.1-3a.

Table 7.5A.0.1-1: ACS for intra-band contiguous CA with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

		CA Bandwidth Class		
Rx Parameter	**Units**	**C**	**D**	**E**
ACS	dB	33.0	25.2	24.0

Table 7.5A.0.1-1a: ACS for intra-band contiguous CA with F_{DL_low} < 2700 MHz and F_{UL_low} < 2700 MHz

		CA Bandwidth Class
Rx Parameter	**Units**	**C**
ACS	dB	[17.0]

Table 7.5A.0.1-2: Test parameters for intra-band contiguous CA with $F_{DL\_low} \geq$ 3300 MHz and $F_{UL\_low} \geq$ 3300 MHz, case 1

Rx Parameter	Units	CA Bandwidth Class		
		C	D	E
Pw in Transmission Bandwidth Configuration, per CC	dBm	REFSENS + 14 dB	REFSENS + 14 dB	REFSENS + 14 dB
$P_{Interferer}$	dBm	Aggregated power + 31.5 dB	Aggregated power + 23.7 dB	Aggregated power + 22.5 dB
$BW_{Interferer}$	MHz	$BW_{channel\ CA}$	50	50
$F_{Interferer}$ (offset)	MHz	$BW_{channel\ CA}$ / $-BW_{channel\ CA}$	25 + F_{offset} / -25 -F_{offset}	25 + F_{offset} / -25 -F_{offset}

NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4 .
NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\left\lceil \left|F_{interferer}\right| / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.
NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

Table 7.5A.0.1-2a: Test parameters for intra-band contiguous CA with F_{DL_low}<2700 MHz and F_{UL_low}<2700 MHz, case 1

Rx Parameter	Units	CA Bandwidth Class
		C
Pw in Transmission Bandwidth Configuration, per CC	dBm	REFSENS + 14 dB
$P_{Interferer}$	dBm	Aggregated power + [15.5] dB
$BW_{Interferer}$	MHz	[5]
$F_{Interferer}$ (offset)	MHz	[2.5] + F_{offset} / -[2.5] - F_{offset}

NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4 .
NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\left\lceil \left|F_{interferer}\right| / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.
NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

Table 7.5A.0.1-3: Test parameters for intra-band contiguous CA with $F_{DL\_low} \geq$ 3300 MHz and $F_{UL\_low} \geq$ 3300 MHz, case 2

Rx Parameter	Units	CA Bandwidth Class		
		C	D	E
Pw in Transmission Bandwidth Configuration, per CC	dBm	-56.5	-48.7 + 10log(Nc/Nagg)	-47.5 + 10log(Nc/Nagg)
$P_{Interferer}$	dBm	-25	-25	-25
$BW_{Interferer}$	MHz	$BW_{channel\ CA}$	50	50
$F_{Interferer}$ (offset)	MHz	$BW_{channel\ CA}$ / $-BW_{channel\ CA}$	25 + F_{offset} / -25 -F_{offset}	25 + F_{offset} / -25 -F_{offset}

NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.
NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\left\lceil |F_{interferer}| / SCS \right\rceil + 0.5\right)SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.
NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

Table 7.5A.0.1-3a: Test parameters for intra-band contiguous CA with F_{DL_low} <2700 MHz and F_{UL_low}<2700 MHz, case 2

Rx Parameter	Units	CA Bandwidth Class
		C
Pw in Transmission Bandwidth Configuration, per CC	dBm	-[40.5]+ 10log(Nc/Nagg)
$P_{Interferer}$	dBm	-25
$BW_{Interferer}$	MHz	[5]
$F_{Interferer}$ (offset)	MHz	[2.5]+ F_{offset} / -[2.5]- F_{offset}

NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.
NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\left\lceil |F_{interferer}| / SCS \right\rceil + 0.5\right)SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.
NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

7.5A.0.2 Void

7.5A.0.3 Adjacent channel selectivity Inter-band CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink assigned to one NR band, the adjacent channel requirements are defined with the uplink active on the band(s) other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.5.3 for each component carrier while all downlink carriers are active.

The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1).

7.5A.1 Adjacent channel selectivity for 2DL CA

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Connection diagram is FFS
- Characteristics of the interfering signal is TBD.
- Statistical testing of receiver characteristics for CA is TBD
- MU/TT is still FFS
- ACS requirements in square brackets.

7.5A.1.1 Test Purpose

Adjacent channel selectivity for 2DL CA verifies the receiver's ability to receive a wanted 2DL carrier aggregated at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel.

7.5A.1.2 Test Applicability

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

7.5A.1.3 Minimum Conformance Requirements

The minimum conformance requirements are defined in clause 7.5A.0.

7.5A.1.4 Test Description

7.5A.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, are shown in table 7.5A.1.4.1-1 or table 7.5A.1.4.1-2. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. Configuration of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.5A.1.4.1-1: Test Configuration Table for intra-band contiguous 2CA

<table>
<tr><th colspan="6">Default Conditions</th></tr>
<tr><td colspan="2">Test Environment as specified in TS 38.508-1 [5] subclause 4.1</td><td colspan="4">Normal</td></tr>
<tr><td colspan="2">Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="4">Mid range</td></tr>
<tr><td colspan="2">Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1</td><td colspan="4">Lowest, Highest</td></tr>
<tr><td colspan="2">Test SCS as specified in Table 5.3.5-1</td><td colspan="4">Lowest</td></tr>
<tr><th colspan="6">Test Parameters</th></tr>
<tr><th></th><th colspan="3">Downlink Configuration</th><th colspan="2">Uplink Configuration</th></tr>
<tr><th>Test ID</th><th>CC Mod'n</th><th>PCC RB allocation</th><th>SCC RB allocation</th><th>CC Mod'n</th><th>PCC RB allocation</th></tr>
<tr><td>1</td><td>CP-OFDM QPSK</td><td>NOTE 1</td><td>NOTE 1</td><td>DFT-s-OFDM QPSK</td><td>NOTE 1</td></tr>
<tr><td colspan="6">NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3.2.4.1-1.</td></tr>
</table>

Table 7.5A.1.4.1-2: Test Configuration Table for inter-band 2CA

Default 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	Highest				
Test SCS as specified in Table 5.3.5-1	Lowest				
Test Parameters					
	Downlink Configuration			**Uplink Configuration**	
Test ID	**CC Mod'n**	**PCC RB allocation**	**SCC RB allocation**	**CC Mod'n**	**PCC RB allocation**
1	CP-OFDM QPSK	NOTE 1	NOTE 1	DFT-s-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3.2.4.1-1.					

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure [TBD] 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, C.3.1, and uplink signals according to Annex G.0, G.1, G.2, G.3.1.
4. The DL and UL Reference Measurement channels are set according to Table 7.5A.1.4.1-1 or Table 7.5A.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 according to TS 38.508-1 [5] clause 4.5. Message content are defined in clause 7.5A.1.4.3.

7.5A.1.4.2 Test Procedure

1. Intra-band contiguous CA test:

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 5.1.1. Message contents are defined in clause 7.5A.1.4.3.

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], clause9.3).

1.4 SS transmits PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to Table 7.5A.1.4.1-1 on both PCC and SCC. The SS sends downlink MAC padding bits on the DL RMC.

1.5 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 Table 7.5A.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.

1.6 Set the Downlink signal level for PCC and SCC to the value as defined in Table 7.5A.1.5-2 or 7.5A.1.5-2a as appropriate (Case 1). Send Uplink power control commands to the UE (less or equal to 1 dB step size should be used), to ensure that the UE output power is within - $P_W \pm P_W$ dB of the target power level in Table 7.5A.1.5-2 or 7.5A.1.5-2a at least the duration of the Throughput measurement. P_W is the power window according to Table 7.5A.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.

1.7 Set the Interferer signal level to the value as defined in Table 7.5A.1.5-2 or 7.5A.1.5-2a as appropriate (Case 1) and frequency below the wanted signal, using a modulated interferer bandwidth as defined in Annex [TBD].

1.8 Measure the average throughput for each component carrier for a duration sufficient to achieve statistical significance according to Annex [TBD].

1.9 Repeat steps from 1.6 to 1.8, using an interfering signal above the wanted signal in Case 1 at step 1.7.

1.10 Set the Downlink signal level for PCC and SCC to the value as defined in Table 7.5A.1.5-3 or 7.5A.1.5-3a as appropriate (Case 2). Send Uplink power control commands to the UE (less or equal to 1 dB step size should be used), to ensure that the UE output power is within - $P_W \pm P_W$ dB of the target power level in Table 7.5A.1.5-3 or 7.5A.1.5-3a for at least the duration of the Throughput measurement. P_W is the power window according to Table 7.5A.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.

1.11 Set the Interferer signal level to the value as defined in Table 7.5A.1.5-3 or 7.5A.1.5-3a as appropriate (Case 2) and frequency below the wanted signal, using a modulated interferer bandwidth as defined in Annex [TBD].

1.12 Measure the average throughput for each component carrier for a duration sufficient to achieve statistical significance according to Annex [TBD].

1.13 Repeat steps from 1.10 to 1.12, using an interfering signal above the wanted signal in Case 2 at step 1.11.

1.14 Repeat for applicable channel bandwidths and operating band combinations in both Case 1 and Case 2.

2. Inter-band CA test:

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 5.1.1. Message contents are defined in clause 7.5A.1.4.3.

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], clause9.3).

2.4 SS transmits PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to Table 7.5A.1.4.1-1 on both PCC and SCC. The SS sends downlink MAC padding bits on the DL RMC.

2.5 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 Table 7.5A.1.4.1-2. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2.6 Set the Downlink signal level for PCC and SCC to the value as defined in Table 7.5A.1.5-5 or 7.5A.1.5-8 as appropriate (Case 1). Send Uplink power control commands to the UE (less or equal to 1 dB step size should be used), to ensure that the UE output power is within - $P_W \pm P_W$ dB of the target power level in Table 7.5A.1.5-5 or 7.5A.1.5-8 at least the duration of the Throughput measurement. P_W is the power window according to Table 7.5A.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.

2.7 Set the Interferer signal level to the value as defined in Table 7.5A.1.5-5 or 7.5A.1.5-8 as appropriate (Case 1) and frequency below the wanted signal, using a modulated interferer bandwidth as defined in Annex [TBD].

2.8 Measure the average throughput of SCC for a duration sufficient to achieve statistical significance according to Annex H.

2.9 Repeat steps from 2.6 to 2.8, using an interfering signal above the wanted signal in Case 1 at step 2.7.

2.10 Set the Downlink signal level for PCC and SCC to the value as defined in Table 7.5A.1.5-6 or 7.5A.1.5-9 as appropriate (Case 2). Send Uplink power control commands to the UE (less or equal to 1 dB step size should be used), to ensure that the UE output power is within - $P_W \pm P_W$ dB of the target power level in Table 7.5A.1.5-6 or 7.5A.1.5-9 for at least the duration of the Throughput measurement. P_W is the power window according to Table 7.5A.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.

2.11 Set the Interferer signal level to the value as defined in Table 7.5A.1.5-6 or 7.5A.1.5-9 as appropriate (Case 2) and frequency below the wanted signal, using a modulated interferer bandwidth as defined in Annex [TBD].

2.12 Measure the average throughput of SCC for a duration sufficient to achieve statistical significance according to Annex H.

2.13 Repeat steps from 2.10 to 2.12, using an interfering signal above the wanted signal in Case 2 at step 2.11.

2.14 Repeat for applicable channel bandwidths and operating band combinations in both Case 1 and Case 2.

Table 7.5A.1.4.2-1: Power Window (dB) for Adjacent channel selectivity

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	1.4	1.7	2
20MHz < BW ≤ 40MHz	1.4	1.7	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.3
Note: Power Window setting comprises two quantities, UE Power tolerance and test system power measurement			

7.5A.1.4.3 Message Contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with DFT-s-OFDM condition in Table 4.6.3-118 PUSCH-Config.

7.5A.1.5 Test Requirement

The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.5A.1.5-2 and 7.5A.1.5-3.

Table 7.5A.1.5-1: ACS for intra-band contiguous 2CA with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

		CA Bandwidth Class		
Rx Parameter	Units	C	D	E
ACS	dB	33.0		

Table 7.5A.1.5-1a: ACS for intra-band contiguous CA with F_{DL_low} < 2700 MHz and F_{UL_low} < 2700 MHz

		CA Bandwidth Class
Rx Parameter	Units	C
ACS	dB	[17.0]

Table 7.5A.1.5-2: Test parameters for intra-band contiguous 2CA with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz, case 1

Rx Parameter	Units	CA Bandwidth Class		
		C	D	E
Pw in Transmission Bandwidth Configuration, per CC	dBm	REFSENS + 14 dB		
$P_{Interferer}$	dBm	Aggregated power + 31.5 dB		
$BW_{Interferer}$	MHz	$BW_{channel\ CA}$		
$F_{Interferer}$ (offset)	MHz	$BW_{channel\ CA}$ / $-BW_{channel\ CA}$		
NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.3 . NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\left\lceil \lvert F_{interferer} \rvert / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal. NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.				

Table 7.5A.1.5-2a: Test parameters for intra-band contiguous CA with F_{DL_low}<2700 MHz and F_{UL_low}<2700 MHz, case 1

Rx Parameter	Units	CA Bandwidth Class
		C
Pw in Transmission Bandwidth Configuration, per CC	dBm	REFSENS + 14 dB
$P_{Interferer}$	dBm	Aggregated power + [15.5] dB
$BW_{Interferer}$	MHz	[5]
$F_{Interferer}$ (offset)	MHz	[2.5] + F_{offset} / -[2.5] - F_{offset}

NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4 .
NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\lceil |F_{interferer}| / SCS \rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.
NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

Table 7.5A.1.5-3: Test parameters for intra-band contiguous 2CA with $F_{DL\_low} \geq$ 3300 MHz and $F_{UL\_low} \geq$ 3300 MHz, case 2

Rx Parameter	Units	CA Bandwidth Class		
		C	D	E
Pw in Transmission Bandwidth Configuration, per CC	dBm	-56.5		
$P_{Interferer}$	dBm	-25		
$BW_{Interferer}$	MHz	$BW_{channel\ CA}$		
$F_{Interferer}$ (offset)	MHz	$BW_{channel\ CA}$ / -$BW_{channel\ CA}$		

NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.3.
NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\lceil |F_{interferer}| / SCS \rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.
NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

Table 7.5A.1.5-3a: Test parameters for intra-band contiguous CA with F_{DL_low} <2700 MHz and F_{UL_low}<2700 MHz, case 2

Rx Parameter	Units	CA Bandwidth Class
		C

Pw in Transmission Bandwidth Configuration, per CC	dBm	-[40.5]+ 10log(Nc/Nagg)
$P_{Interferer}$	dBm	-25
$BW_{Interferer}$	MHz	[5]
$F_{Interferer}$ (offset)	MHz	[2.5]+ F_{offset} / -[2.5]- F_{offset}
NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4. NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\left\lceil \left\vert F_{interferer} \right\vert / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal. NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.		

For NR SCC of inter-band CA with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, the throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in [Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1)] with parameters specified in Tables 7.5A.1.5-5 and 7.5A.1.5-6.

Table 7.5A.1.5-4: ACS for NR band with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz

RX parameter	**Units**	**Channel bandwidth**				
		5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**
ACS	dB	[33]	[33]	[30]	[27]	[26]
RX parameter	**Units**	**Channel bandwidth**				
		30 MHz	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**
ACS	dB	[25.5]	[24]	[23]	[22.5]	[21]
RX parameter	**Units**	**Channel bandwidth**				
		90 MHz	**100 MHz**			
ACS	dB	[20.5]	[20]			

Table 7.5A.1.5-5: Test parameters for NR inter-band CA with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, case 1

RX parameter	Units	Channel bandwidth				
		5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**
Pw in Transmission Bandwidth Configuration, per CC	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS for SCC + [45.5] dB	REFSENS for SCC + [45.5] dB	REFSENS for SCC + [42.5] dB	REFSENS for SCC + [39.5] dB	REFSENS for SCC + [38.5] dB
$BW_{interferer}$	MHz	5	5	5	5	5
$F_{interferer}$ (offset from SCC)	MHz	5 / -5	7.5 / -7.5	10 / -10	12.5 / -12.5	15 / -15
RX parameter	**Units**	**Channel bandwidth**				
		30 MHz	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**
Pw in Transmission Bandwidth Configuration, per CC	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS for SCC + [38] dB	REFSENS for SCC + [36.5] dB	REFSENS for SCC + [35.5] dB	REFSENS for SCC + [35] dB	REFSENS for SCC + [33.5] dB
$BW_{interferer}$	MHz	5	5	5	5	5
$F_{interferer}$ (offset from SCC)	MHz	17.5 / -17.5	22.5 / -22.5	27.5 / -27.5	32.5 / -32.5	42.5 / -42.5
RX parameter	**Units**	**Channel bandwidth**				
		90 MHz	**100 MHz**			
Pw in Transmission Bandwidth Configuration, per CC	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS for SCC + [33] dB	REFSENS for SCC + [32.5] dB			
$BW_{interferer}$	MHz	5	5			
$F_{interferer}$ (offset from SCC)	MHz	47.5 / -47.5	52.5 / -52.5			

NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.

NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\left\lceil \left|F_{interferer}\right| / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.

NOTE 3: The interferer consists of the NR interferer RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

Table 7.5A.1.5-6: Test parameters for NR inter-band CA with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, case 2

RX parameter	Units	Channel bandwidth				
		5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**
Pw in Transmission Bandwidth Configuration, per CC	dBm	[-56.5]	[-56.5]	[-53.5]	[-50.5]	[-49.5]
$P_{interferer}$	dBm	-25				
$BW_{interferer}$	MHz	5	5	5	5	5
$F_{interferer}$ (offset from SCC)	MHz	5 / -5	7.5 / -7.5	10 / -10	12.5 / -12.5	15 / -15
RX parameter	**Units**	**Channel bandwidth**				
		30 MHz	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**
Pw in Transmission Bandwidth Configuration, per CC	dBm	[-49]	[-47]	[-46.5]	[-46]	[-44.5]
$P_{interferer}$	dBm	-25				
$BW_{interferer}$	MHz	5	5	5	5	5
$F_{interferer}$ (offset from SCC)	MHz	17.5 / -17.5	22.5 / -22.5	27.5 / -27.5	32.5 / -32.5	42.5 / -42.5
RX parameter	**Units**	**Channel bandwidth**				
		90 MHz	**100 MHz**			
Pw in Transmission Bandwidth Configuration, per CC	dBm	[-44]	[-43.5]			
$P_{interferer}$	dBm	-25				
$BW_{interferer}$	MHz	5	5			
$F_{interferer}$ (offset from SCC)	MHz	47.5 / -47.5	52.5 / -52.5			
NOTE 1: The transmitter shall be set to 24 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4. NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\lceil \lvert F_{interferer} \rvert / SCS \rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal. NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.						

For NR SCC of inter-band CA with F_{DL_high} < 3300 MHz and F_{UL_high} < 3300 MHz, the throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in [Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1)] with parameters specified in Tables 7.5A.1.5-8 and 7.5A.1.5-9.

Table 7.5A.1.5-7: ACS for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

RX parameter	Units	Channel bandwidth				
		10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**
ACS	dB	[33]	[33]	[33]	[33]	[33]
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
ACS	dB	[33]	[33]	[33]	[33]	

Table 7.5A.1.5-8: Test parameters for NR inter-band CA with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz, case 1

RX parameter	Units	Channel bandwidth				
		10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**
Pw in Transmission Bandwidth Configuration, per CC	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS for SCC + [45.5] dB				
$BW_{interferer}$	MHz	10	15	20	40	50
$F_{interferer}$ (offset from SCC)	MHz	10 / -10	15 / -15	20 / -20	40 / -40	50 / -50
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
Pw in Transmission Bandwidth Configuration, per CC	dBm	REFSENS + 14 dB				
$P_{interferer}$	dBm	REFSENS for SCC + [45.5] dB	REFSENS for SCC + [45.5] dB	REFSENS for SCC + [45.5] dB	REFSENS for SCC + [45.5] dB	
$BW_{interferer}$	MHz	60	80	90	100	
$F_{interferer}$ (offset from SCC)	MHz	60 / -60	80 / -80	90 / -90	100 / -100	

NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.

NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\left\lceil |F_{interferer}| / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.

NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

Table 7.5A.1.5-9: Test parameters for NR inter-band CA with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz, case 2

RX parameter	Units	Channel bandwidth				
		10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**
Pw in Transmission Bandwidth Configuration, per CC	dBm	[-56.5]				
$P_{interferer}$	dBm	-25				
$BW_{interferer}$	MHz	10	15	20	40	50
$F_{interferer}$ (offset from SCC)	MHz	10 / -10	15 / -15	20 / -20	40 / -40	50 / -50
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
Pw in Transmission Bandwidth Configuration, per CC	dBm	[-56.5]				
$P_{interferer}$	dBm	-25	-25	-25	-25	
$BW_{interferer}$	MHz	60	80	90	100	
$F_{interferer}$ (offset from SCC)	MHz	60 / -60	80 / -80	90 / -90	100 / -100	

NOTE 1: The transmitter shall be set to 24 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.

NOTE 2: The absolute value of the interferer offset $F_{interferer}$ (offset) shall be further adjusted to $\left(\lceil |F_{interferer}| / SCS \rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.

NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

7.5A.2 Adjacent channel selectivity for 3DL CA

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Test config table is FFS
- Connection diagram is FFS
- Characteristics of the interfering signal is TBD.
- Statistical testing of receiver characteristics for CA is TBD
- MU/TT is still FFS

7.5A.2.1 Test Purpose

Adjacent channel selectivity for 3DL CA verifies the receiver's ability to receive a wanted 3DL carrier aggregated at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel.

7.5A.2.2 Test Applicability

This test case applies to all types of NR UE release 15 and forward that support 3DL CA.

7.5A.2.3 Minimum Conformance Requirements

The minimum conformance requirements are defined in clause 7.5A.0.

7.5A.2.4 Test Description

7.5A.2.4.1 Initial Conditions

Same as in clause 7.5A.1.4.1 with following exceptions:

- Instead of Table 7.5A.1.4.1-1→ use Table 7.5A.2.4.1-1.
- Instead of Table 7.5A.1.4.1-2→ use Table 7.5A.2.4.1-2.

Table 7.5A.2.4.1-1: Test Configuration Table for intra-band contiguous 3CA

FFS

Table 7.5A.2.4.1-2: Test Configuration Table for inter-band 3CA

FFS

7.5A.2.4.2 Test Procedure

Same test procedure as clause 7.5A.1.4.2 with following exceptions:

- Instead of Table 7.5A.1.4.1-1→ use Table 7.5A.2.4.1-1.
- Instead of Table 7.5A.1.4.1-2→ use Table 7.5A.2.4.1-2.
- Instead of Table 7.5A.1.5-2→ use Table 7.5A.2.5-2.
- Instead of Table 7.5A.1.5-3→ use Table 7.5A.2.5-3.

7.5A.2.4.3 Message Contents

Same test procedure as clause 7.5A.1.4.3.

7.5A.2.5 Test Requirement

The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.5A.2.5-2 and 7.5A.2.5-3.

Table 7.5A.2.5-1: ACS for intra-band contiguous 3DL CA with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

		CA Bandwidth Class		
Rx Parameter	**Units**	**C**	**D**	**E**
ACS	dB		25.2	

Table 7.5A.2.5-2: Test parameters for intra-band contiguous 3DL CA with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz, case 1

Rx Parameter	Units	CA Bandwidth Class		
		C	D	E
Pw in Transmission Bandwidth Configuration, per CC	dBm		REFSENS + 14 dB	
$P_{Interferer}$	dBm		Aggregated power + 23.7 dB	
$BW_{Interferer}$	MHz		50	
$F_{Interferer}$ (offset)	MHz		25 + F_{offset} / -25 -F_{offset}	

NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.3 .
NOTE 2: The absolute value of the interferer offset $F_{Interferer}$ (offset) shall be further adjusted to $\left(\left\lceil |F_{interferer}| / SCS \right\rceil + 0.5\right)SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.
NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

Table 7.5A.2.5-3: Test parameters for intra-band contiguous 3DL CA with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz, case 2

Rx Parameter	Units	CA Bandwidth Class		
		C	D	E
Pw in Transmission Bandwidth Configuration, per CC	dBm		-48.7 + 10log(Nc/Nagg)	
$P_{Interferer}$	dBm		-25	
$BW_{Interferer}$	MHz		50	
$F_{Interferer}$ (offset)	MHz		25 + F_{offset} / -25 -F_{offset}	

NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.3.
NOTE 2: The absolute value of the interferer offset $F_{Interferer}$ (offset) shall be further adjusted to $\left(\left\lceil |F_{interferer}| / SCS \right\rceil + 0.5\right)SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.
NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.

7.5A.3 Adjacent channel selectivity for 4DL CA

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- Test config table is FFS
- Connection diagram is FFS
- Characteristics of the interfering signal is TBD.
- Statistical testing of receiver characteristics for CA is TBD
- MU/TT is still FFS

7.5A.3.1 Test Purpose

Adjacent channel selectivity for 4DL CA verifies the receiver's ability to receive a wanted 4DL carrier aggregated at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel.

7.5A.3.2 Test Applicability

This test case applies to all types of NR UE release 15 and forward that support 4DL CA.

7.5A.3.3 Minimum Conformance Requirements

The minimum conformance requirements are defined in clause 7.5A.0.

7.5A.3.4 Test Description

7.5A.3.4.1 Initial Conditions

Same as in clause 7.5A.1.4.1 with following exceptions:

- Instead of Table 7.5A.1.4.1-1→ use Table 7.5A.3.4.1-1.
- Instead of Table 7.5A.1.4.1-2→ use Table 7.5A.3.4.1-2.

Table 7.5A.3.4.1-1: Test Configuration Table for intra-band contiguous 4CA

FFS

Table 7.5A.3.4.1-2: Test Configuration Table for inter-band 4CA

FFS

7.5A.3.4.2 Test Procedure

Same test procedure as clause 7.5A.1.4.2 with following exceptions:

- Instead of Table 7.5A.1.4.1-1→ use Table 7.5A.3.4.1-1.
- Instead of Table 7.5A.1.4.1-2→ use Table 7.5A.3.4.1-2.
- Instead of Table 7.5A.1.5-2→ use Table 7.5A.3.5-2.
- Instead of Table 7.5A.1.5-3→ use Table 7.5A.3.5-3.

7.5A.3.4.3 Message Contents

Same test procedure as clause 7.5A.1.4.3.

7.5A.3.5 Test Requirement

The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.5A.3.5-2 and 7.5A.3.5-3.

Table 7.5A.3.5-1: ACS for intra-band contiguous 4DL CA with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

		CA Bandwidth Class		
Rx Parameter	Units	C	D	E
ACS	dB			24.0

Table 7.5A.3.5-2: Test parameters for intra-band contiguous 4DL CA with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz, case 1

Rx Parameter	Units	CA Bandwidth Class		
		C	D	E
Pw in Transmission Bandwidth Configuration, per CC	dBm			REFSENS + 14 dB
$P_{Interferer}$	dBm			Aggregated power + 22.5 dB
$BW_{Interferer}$	MHz			50
$F_{Interferer}$ (offset)	MHz			25 + F_{offset} / -25 -F_{offset}
NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.3 . NOTE 2: The absolute value of the interferer offset $F_{Interferer}$ (offset) shall be further adjusted to $\left(\left\lceil \lvert F_{interferer} \rvert / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal. NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.				

Table 7.5A.3.5-3: Test parameters for intra-band contiguous 4DL CA with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz, case 2

Rx Parameter	Units	CA Bandwidth Class		
		C	D	E
Pw in Transmission Bandwidth Configuration, per CC	dBm			-47.5 + 10log(Nc/Nagg)
$P_{Interferer}$	dBm			-25
$BW_{Interferer}$	MHz			50
$F_{Interferer}$ (offset)	MHz			25 + F_{offset} / -25 -F_{offset}
NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.3. NOTE 2: The absolute value of the interferer offset $F_{Interferer}$ (offset) shall be further adjusted to $\left(\left\lceil \lvert F_{interferer} \rvert / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal. NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.				

7.5D Adjacent channel selectivity for UL-MIMO

7.5D.1 Test purpose

Adjacent channel selectivity (ACS) is a measure of a receiver's ability to receive an NR signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel. ACS is the ratio of the receive filter attenuation on the assigned channel frequency to the receive filter attenuation on the adjacent channel(s).

7.5D.2 Test applicability

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

7.5D.3 Minimum conformance requirements

For UE(s) with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements specified in sub-clause 7.5 shall be met with the UL-MIMO configurations described in sub-clause 6.2D.1. For UL-MIMO, the parameter P_{CMAX_L} is defined as the total transmitter power over the two transmit antenna connectors.

The normative reference for this requirement is TS 38.101-1 [2] clauses 7.5D and 7.5.

7.5D.4 Test description

7.5D.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, and channel bandwidths based on NR operating bands specified in Table 5.2-1. All of these configurations shall be tested with applicable test parameters for each channel bandwidth, and are shown in Table 7.5D.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annex A.2 and Annex A.3 respectively. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.5D.4.1-1: Test Configuration Table

Default 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 and Highest		
Test SCS as specified in Table 5.3.5-1		Lowest		
Test Parameters				
	Downlink Configuration		**Uplink Configuration**	
Test ID	**Mod'n**	**RB allocation**	**Mod'n**	**RB allocation**
1	CP-OFDM QPSK	NOTE 1	CP-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3.2.4.1-2 and 7.3.2.4.1-3 for Downlinkd and Uplink respectively.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.4.4 for TE diagram and section A.3.2.3 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, C.3.1, and uplink signals according to Annex G.0, G.1, G.2, G.3.1.

4. The DL and UL Reference Measurement channels are set according to Table 7.5D.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* and Test Loop Function On according to TS 38.508-1 [5] clause 4.5. Message content are defined in clause 7.5D.4.3.

7.5D.4.2 Test procedure

Same test procedure as specified in 7.5.2.4.2 with the following exception:

- Instead of Table 7.5.4.1-1, use Table 7.5D.4.1-1 in step 1.
- Step 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 7.5D.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 condition 2TX_UL_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

7.5D.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

7.5D.5 Test requirement

Same test requirement as defined in Clause 7.5.5.

7.6 Blocking characteristics

The blocking characteristic is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response or the adjacent channels, without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit. The blocking performance shall apply at all frequencies except those at which a spurious response occurs.

7.6.1 General

FFS

7.6.2 Inband Blocking

7.6.2.1 Test purpose

Inband blocking is defined for an unwanted interfering signal falling into the range from 15 MHz below to 15 MHz above the UE receive band, with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, or into an immediately adjacent frequency range up 3CBW below or above the UE receive band, with F_{DL_high} < 3300 MHz and F_{UL_high} < 3300 MHz, at which the relative throughput shall meet or exceed the requirement for the specified measurement channel.

7.6.2.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

7.6.2.3 Minimum conformance requirements

For NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, in-band blocking (IBB) is defined for an unwanted interfering signal falling into the UE receive band or into the first 15 MHz below or above the UE receive band. The throughput of the wanted signal shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL signal as described in Annex A.5) with parameters specified in Table 7.6.2.3-1 and Table 7.6.2.3-2. The relative throughput shall be met for any SCS specified for the channel bandwidth of the wanted signal. For operating bands with an unpaired DL part (as noted in Table 5.2-1), the requirements only apply for carriers assigned in the paired part.

Table 7.6.2.3-1: In-band blocking parameters for NR bands with FDL_high < 2700 MHz and FUL_high < 2700 MHz

RX parameter	Units	Channel bandwidth				
		5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6	6	7	9	10
$BW_{interferer}$	MHz	5				
$F_{Ioffset, case 1}$	MHz	7.5				
$F_{Ioffset, case 2}$	MHz	12.5				
RX parameter	**Units**	**Channel bandwidth**				
		30 MHz	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	11	12	13	14	15
$BW_{interferer}$	MHz	5				
$F_{Ioffset, case 1}$	MHz	7.5				
$F_{Ioffset, case 2}$	MHz	12.5				
RX parameter	**Units**	**Channel bandwidth**				
		90 MHz	**100 MHz**			
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	15.5	16			
$BW_{interferer}$	MHz	5				
$F_{Ioffset, case 1}$	MHz	7.5				
$F_{Ioffset, case 2}$	MHz	12.5				
NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4. NOTE 2: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1 and 15 kHz SCS.						

Table 7.6.2.3-2: In-band blocking for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz

NR band	Parameter	Unit	Case 1	Case 2	Case 3
	$P_{interferer}$	dBm	-56	-44	-15
n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n34, n38, n39, n40, n41, n50, n51, n66, n70, n74, n75, n76	$F_{interferer}$ (offset)	MHz	-CBW/2 – $F_{Ioffset, case 1}$ and CBW/2 + $F_{Ioffset, case 1}$	≤ -CBW/2 – $F_{Ioffset, case 2}$ and ≥ CBW/2 + $F_{Ioffset, case 2}$	
	$F_{interferer}$	MHz	NOTE 2	F_{DL_low} – 15 to F_{DL_high} + 15	
n71	$F_{interferer}$	MHz	NOTE 2	F_{DL_low} – 12 to F_{DL_high} + 15	F_{DL_low} – 12
NOTE 1: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to $\left(\left\lceil \left|F_{interferer}\right| / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS. NOTE 2: For each carrier frequency, the requirement applies for two interferer carrier frequencies: a: -CBW/2 – $F_{Ioffset, case 1}$; b: CBW/2 + $F_{Ioffset, case 1}$					

For NR bands with $F_{DL\_low} \geq 3300$ MHz and $F_{UL\_low} \geq 3300$ MHz, in-band blocking (IBB) is defined for an unwanted interfering signal falling into the UE receive band or into an immediately adjacent frequency range up to 3CBW below or above the UE receive band where CBW is the bandwidth of the wanted signal. The throughput of the wanted signal shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in

Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.6.2.3-3 and Table 7.6.2.3-4. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

Table 7.6.2.3-3: In-band blocking parameters for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

RX parameter	Units	Channel bandwidth				
		10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6				
$BW_{interferer}$	MHz	10	15	20	40	50
$F_{Ioffset, case 1}$	MHz	15	22.5	30	60	75
$F_{Ioffset, case 2}$	MHz	25	37.5	50	100	125
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6				
$BW_{interferer}$	MHz	60	80	90	100	
$F_{Ioffset, case 1}$	MHz	90	120	135	150	
$F_{Ioffset, case 2}$	MHz	150	200	225	250	
NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4. NOTE 2: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.						

Table 7.6.2.3-4: In-band blocking for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

NR band	Parameter	Unit	Case 1	Case 2
	$P_{interferer}$	dBm	-56	-44
n77, n78, n79	$F_{interferer}$ (offset)	MHz	-CBW/2 – $F_{Ioffset, case 1}$ and BW/2 + $F_{Ioffset, case 1}$	≤ -CBW/2 – $F_{Ioffset, case 2}$ and ≥ CBW/2 + $F_{Ioffset, case 2}$
	$F_{interferer}$		NOTE 2	F_{DL_low} – 3CBW to F_{DL_high} + 3CBW
NOTE 1: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to $\left(\left\lceil \left|F_{\text{interferer}}\right| / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal. NOTE 2: For each carrier frequency, the requirement applies for two interferer carrier frequencies: a: -CBW/2 – $F_{Ioffset, case 1}$; b: CBW/2 + $F_{Ioffset, case 1}$ NOTE 3: CBW denotes the channel bandwidth of the wanted signal				

The normative reference for this requirement is TS 38.101-1 [2] clause 7.6.2.

7.6.2.4 Test description

7.6.2.4.1 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 channel bandwidth and sub-carrier spacing, are shown in table

7.6.2.4.1-1. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. Configuration of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.6.2.4.1-1: Test Configuration Table

Default 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		
Test Parameters				
	Downlink Configuration		**Uplink Configuration**	
Test ID	**Mod'n**	**RB allocation**	**Mod'n**	**RB allocation**
1	**CP-OFDM QPSK**	NOTE 1	DFT-s-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3.2.4.1-1.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.4.1 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, C.3.1, and uplink signals according to Annex G.0, G.1, G.2, G.3.1.
4. The DL and UL Reference Measurement channels are set according to Table 7.6.2.4.1-1.
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 content are defined in clause 7.6.2.4.3.

7.6.2.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to Table 7.6.2.4.1-1. 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 7.6.2.4.1-1. 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 parameters of the signal generator for an interfering signal below the wanted signal in Case 1 according to Tables 7.6.2.5-1 and 7.6.2.5-2 or Tables 7.6.2.5-3 and 7.6.2.5-4 as appropriate depending on NR band.
4. Set the downlink signal level according to the table 7.6.2.5-1 or 7.6.2.5-3 as appropriate. Send uplink power control commands to the UE (less or equal to 1 dB step size should be used), to ensure that the UE output power is within - P_W ± P_W dB of the target power level in Table 7.6.2.5-1 or Table 7.6.2.5-3 for at least the duration of the Throughput measurement. P_W is the power window according to Table 7.6.2.5-5 for the carrier frequency f and the channel bandwidth BW..
5. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.
6. Repeat steps from 3 to 5, using an interfering signal above the wanted signal in Case 1 at step 3.
7. Repeat steps from 3 to 6, using interfering signals in Case 2 at step 3and 6. The ranges of case 2 are covered in steps equal to the interferer bandwidth.

7.6.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with TRANSFORM_PRECODER_ENABLED condition in Table 4.6.3-118 PUSCH-Config.

7.6.1.5 Test requirement

For NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, the throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex in Annexes A.2.2, A.2.3 and A.3.2 with parameters specified in Tables 7.6.2.5-1 and 7.6.2.5-2.

Table 7.6.2.5-1: In-band blocking parameters for NR bands with FDL_high < 2700 MHz and FUL_high < 2700 MHz

RX parameter	Units	Channel bandwidth				
		5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6	6	7	9	10
$BW_{interferer}$	MHz	5				
$F_{Ioffset, case 1}$	MHz	7.5				
$F_{Ioffset, case 2}$	MHz	12.5				
RX parameter	**Units**	**Channel bandwidth**				
		30 MHz	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	11	12	13	14	15
$BW_{interferer}$	MHz	5				
$F_{Ioffset, case 1}$	MHz	7.5				
$F_{Ioffset, case 2}$	MHz	12.5				
RX parameter	**Units**	**Channel bandwidth**				
		90 MHz	**100 MHz**			
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	15.5	16			
$BW_{interferer}$	MHz	5				
$F_{Ioffset, case 1}$	MHz	7.5				
$F_{Ioffset, case 2}$	MHz	12.5				
NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4. NOTE 2: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1 and 15 kHz SCS..						

Table 7.6.2.5-2: In-band blocking for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz

NR band	Parameter	Unit	Case 1	Case 2	Case 3
	$P_{interferer}$	dBm	-56	-44	-15
n1, n2, n3, n5, n7, n8, n12, n20, n28, n38, n39, n40, n41, n50, n51, n66, n70, n74, n75, n76	$F_{interferer}$ (offset)	MHz	-CBW/2 – $F_{Ioffset, case 1}$ and CBW/2 + $F_{Ioffset, case 1}$	≤ -CBW/2 – $F_{Ioffset, case 2}$ and ≥ CBW/2 + $F_{Ioffset, case 2}$	
	$F_{interferer}$	MHz	NOTE 2	F_{DL_low} – 15 to F_{DL_high} + 15	
n71	$F_{interferer}$	MHz	NOTE 2	F_{DL_low} – 12 to F_{DL_high} + 15	F_{DL_low} – 12
NOTE 1: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to $\left(\left\lceil \lvert F_{\text{interferer}} \rvert / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS. NOTE 2: For each carrier frequency, the requirement applies for two interferer carrier frequencies: a: -CBW/2 – $F_{Ioffset, case 1}$; b: CBW/2 + $F_{Ioffset, case 1}$					

For NR bands with $F_{DL\_low} \geq$ 3300 MHz and $F_{UL\_low} \geq$ 3300 MHz, the throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.2 and A.3 with parameters specified in Tables 7.6.2.5-3 and 7.6.2.5-4.

Table 7.6.2.5-3: In-band blocking parameters for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

RX parameter	Units	Channel bandwidth				
		10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6				
$BW_{interferer}$	MHz	10	15	20	40	50
$F_{Ioffset, case 1}$	MHz	15	22.5	30	60	75
$F_{Ioffset, case 2}$	MHz	25	37.5	50	100	125
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6				
$BW_{interferer}$	MHz	60	80	90	100	
$F_{Ioffset, case 1}$	MHz	90	120	135	150	
$F_{Ioffset, case 2}$	MHz	150	200	225	250	
NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4. NOTE 2: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.						

Table 7.6.2.5-4: In-band blocking for NR bands with $F_{DL\_low} \geq$ 3300 MHz and $F_{UL\_low} \geq$ 3300 MHz

NR band	Parameter	Unit	Case 1	Case 2
	$P_{interferer}$	dBm	-56	-44
n77, n78, n79	$F_{interferer}$ (offset)	MHz	-CBW/2 – $F_{Ioffset, case 1}$ and BW/2 + $F_{Ioffset, case 1}$	≤ -CBW/2 – $F_{Ioffset, case 2}$ and ≥ CBW/2 + $F_{Ioffset, case 2}$
	$F_{interferer}$		NOTE 2	F_{DL_low} – 3CBW to F_{DL_high} + 3CBW
NOTE 1: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to $\left(\left\lceil \left\|F_{\text{interferer}}\right\| / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal. NOTE 2: For each carrier frequency, the requirement applies for two interferer carrier frequencies: a: -CBW/2 – $F_{Ioffset, case 1}$; b: CBW/2 + $F_{Ioffset, case 1}$ NOTE 3: CBW denotes the channel bandwidth of the wanted signal				

Table 7.6.2.5-5: Power Window (dB) for Inband Blocking

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	1.4	1.7	2
20MHz < BW ≤ 40MHz	1.4	1.7	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.3
Note: Power Window setting comprises two quantities, UE Power tolerance and test system power measurement			

7.6.3 Out-of-band blocking

7.6.3.1 Test Purpose

Out-of-band band blocking is defined for an unwanted CW interfering signal falling outside a frequency range 15 MHz below or above the UE receive band, with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, or falling outside a frequency range up to 3CBW below or from 3CBW above the UE receive band, with $F_{DL\_low} \geq$ 3300 MHz and $F_{UL\_low} \geq$ 3300 MHz, at which a given average throughput shall meet or exceed the requirement for the specified measurement channels.

7.6.3.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

7.6.3.3 Minimum Conformance Requirements

For NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz out-of-band band blocking is defined for an unwanted CW interfering signal falling outside a frequency range 15 MHz below or above the UE receive band. The throughput of the wanted signal shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.6.3-1 and Table 7.6.3-2. The said relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements only apply for carriers assigned in the paired part.

Table 7.6.3-1: Out-of-band blocking parameters for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz

RX parameter	Units	Channel bandwidth				
		5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6	6	7	9	10
RX parameter	**Units**	**Channel bandwidth**				
		30 MHz	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	11	12	13	14	15
RX parameter	**Units**	**Channel bandwidth**				
		90 MHz	**100 MHz**			
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	15.5	16			
NOTE: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.						

Table 7.6.3-2: Out of-band blocking for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz

NR band	Parameter	Unit	Range 1	Range 2	Range 3
n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n34, n38, n39, n40, n41, n51, n66, n70, n71, n75, n76	$P_{interferer}$	dBm	-44	-30	-15
	$F_{interferer}$ (CW)	MHz	-60 < f – F_{DL_low} < -15 or 15 < f – F_{DL_high} < 60	-85 < f – F_{DL_low} ≤ -60 or 60 ≤ f – F_{DL_high} < 85	1 ≤ f ≤ F_{DL_low} – 85 or F_{DL_high} + 85 ≤ f ≤ 12750
NOTE: The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm for $F_{Interferer}$ > 6000 MHz.					

For interferer frequencies across ranges 1, 2 and 3 in Table 7.6.3-2, a maximum of

$$\left\lfloor \max\{24, 6 \cdot \lceil n \cdot N_{RB} / 6 \rceil\} / \min\{\lfloor n \cdot N_{RB} / 10 \rfloor, 5\} \right\rfloor$$

exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a step size of $\min(\lfloor CBW/2 \rfloor, 5)$ MHz with N_{RB} the number of resource blocks in the downlink transmission bandwidth configuration, CBW the bandwidth of the frequency channel in MHz and n = 1,2,3 for SCS = 15,30,60 kHz, respectively. For these exceptions, the requirements in sub-clause 7.7 apply.

For NR bands with $F_{DL\_low} \geq$ 3300 MHz and $F_{UL\_low} \geq$ 3300 MHz out-of-band band blocking is defined for an unwanted CW interfering signal falling outside a frequency range up to 3CBW below or from 3CBW above the UE receive band, where CBW is the channel bandwidth. The throughput of the wanted signal shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.6.3-3 and Table 7.6.3-4. The said relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

Table 7.6.3-3: Out-of-band blocking parameters for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

RX parameter	Units	Channel bandwidth				
		10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6	7	9	9	9
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	9	9	9	9	
NOTE: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.						

Table 7.6.3-4: Out of-band blocking for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

NR band	Parameter	Unit	Range1	Range 2	Range 3
n77, n78 (NOTE 3)	$P_{interferer}$	dBm	-44	-30	-15
	$F_{interferer}$ (CW)	MHz	-60 < f – F_{DL_low} ≤ -3CBW or 3CBW ≤ f – F_{DL_high} < 60	-200 < f – F_{DL_low} ≤ -MAX(60,3CBW) or MAX(60,3CBW) ≤ f – F_{DL_high} < 200	1 ≤ f ≤ F_{DL_low} – MAX(200,3CBW) or F_{DL_high} + MAX(200,3CBW) ≤ f ≤ 12750
n79 (NOTE 4)	$F_{interferer}$ (CW)	MHz	N/A	-150 < f – F_{DL_low} ≤ -MAX(60,3CBW) or MAX(60,3CBW) ≤ f – F_{DL_high} < 150	1 ≤ f ≤ F_{DL_low} – MAX(150,3CBW) or F_{DL_high} + MAX(150,3CBW) ≤ f ≤ 12750
NOTE 1: The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm for $F_{Interferer}$ > 6000 MHz. NOTE 2: CBW denotes the channel bandwidth of the wanted signal NOTE 3: The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm, for $F_{Interferer}$ > 2700 MHz and $F_{Interferer}$ < 4800 MHz. For CBW > 15 MHz, the requirement for Range 1 is not applicable and Range 2 applies from the frequency offset of 3CBW from the band edge. For CBW larger than 60 MHz, the requirement for Range 2 is not applicable and Range 3 applies from the frequency offset of 3CBW from the band edge. NOTE 4: The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm, for $F_{Interferer}$ > 3650 MHz and $F_{Interferer}$ < 5750 MHz. For CBW ≥ 40 MHz, the requirement for Range 2 is not applicable and Range 3 applies from the frequency offset of 3CBW from the band edge.					

For interferer frequencies across ranges 1, 2 and 3 in Table 7.6.3-4, a maximum of

$$\left\lfloor \max\{24, 6 \cdot \lceil n \cdot N_{RB} / 6 \rceil\} / \min\{\lfloor n \cdot N_{RB} / 10 \rfloor, 5\} \right\rfloor$$

exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a step size of $\min(\lfloor CBW / 2 \rfloor, 5)$ MHz with N_{RB} the number of resource blocks in the downlink transmission bandwidth configuration, CBW the bandwidth of the frequency channel in MHz and n = 1,2,3 for SCS = 15, 30, 60 kHz, respectively. For these exceptions, the requirements in sub-clause 7.7 apply.

The normative reference for this requirement is TS 38.101-1 [2] clause 7.6.3.

7.6.3.4 Test Description

7.6.3.4.1 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, and channel bandwidths 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 7.6.3.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3 respectively. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.3.

Table 7.6.3.4.1-1: Test Configuration Table

Default 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	One frequency chosen arbitrarily from low or 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 TS 38.508-1 [5] subclause 4.3.1	Lowest			
Test Parameters				
	Downlink Configuration		**Uplink Configuration**	
Test ID	**Mod'n**	**RB allocation**	**Mod'n**	**RB allocation**
1	CP-OFDM QPSK	NOTE 1	DFT-s-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3.2.4.1-1.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508 [5] Annex A, in Figure A.3.1.4.1 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 [5] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, C.3.1, and uplink signals according to Annex G.0, G.1, G.2, and G.3.1.
4. The UL and DL Reference Measurement channels are set according to Table 7.6.3.4.1-1.
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 7.6.3.4.3.

7.6.3.4.2 Test Procedure

1. SS transmits PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to Table 7.6.3.4.1-1. 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 7.6.3.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
3. Set the parameters of the CW signal generator for an interfering signal below the wanted signal according to Table 7.6.3.5-2 or 7.6.3.5-4. The frequency step size is $\min(\lfloor CBW/2 \rfloor, 5)$ MHz.
4. Set the downlink signal level according to the table 7.6.3.5-1 or 7.6.3.5-3. Send uplink power control commands to the UE (less or equal to1 dB step size should be used), to ensure that the UE output power is within - PW ± PW dB of the target power level in table 7.6.3.5-1 for NR bands with FDL_high < 2700 MHz and FUL_high < 2700 MHz or - PW ± PW dB of the target power level in table 7.6.2.5-3 for NR bands with FDL_low ≥ 3300 MHz and FUL_low ≥ 3300 MHz, for at least the duration of the throughput measurement. PW is the power window according to Table 7.6.3.5-5 for the carrier frequency f and the channel bandwidth BW..
5. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.
6. Record the frequencies for which the throughput doesn't meet the requirements.

7. Repeat steps from 3 to 6, using an interfering signal above the wanted signal at step 3.

7.6.3.4.3 Message Contents

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

7.6.3.5 Test Requirement

For NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, the throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Tables 7.6.3.5-1 and 7.6.3.5-2.

For NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, the number of spurious response frequencies recorded in the final step of test procedure shall not exceed $\lfloor \max\{24, 6 \cdot \lceil n \cdot N_{RB}/6 \rceil\} / \min\{\lfloor n \cdot N_{RB}/10 \rfloor, 5\} \rfloor$ in each assigned frequency channel when measured using a $\min(\lfloor CBW/2 \rfloor, 5)$ MHz step size. For these exceptions the requirements of clause 7.7 Spurious Response are applicable.

Table 7.6.3.5-1: Out-of-band blocking parameters for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz

RX parameter	Units	Channel bandwidth				
		5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6	6	7	9	10
RX parameter	**Units**	**Channel bandwidth**				
		30 MHz	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	11	12	13	14	15
RX parameter	**Units**	**Channel bandwidth**				
		90 MHz	**100 MHz**			
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	15.5	16			
NOTE: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.						

Table 7.6.3.5-2: Out of-band blocking for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz

NR band	Parameter	Unit	Range 1	Range 2	Range 3
n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n34, n38, n39, n40, n41, n51, n66, n70, n71, n75, n76	$P_{interferer}$	dBm	-44	-30	-15
	$F_{interferer}$ (CW)	MHz	-60 < f – F_{DL_low} < -15 or 15 < f – F_{DL_high} < 60	-85 < f – F_{DL_low} ≤ -60 or 60 ≤ f – F_{DL_high} < 85	1 ≤ f ≤ F_{DL_low} – 85 or F_{DL_high} + 85 ≤ f ≤ 12750
NOTE: The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm for $F_{Interferer}$ > 6000 MHz.					

For NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz, the throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex 3.2 with parameters specified in Tables 7.6.3.5-3 and 7.6.3.5-4.

For NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz, the number of spurious response frequencies recorded in the final step of test procedure shall not exceed $\lfloor \max\{24, 6 \cdot \lceil n \cdot N_{RB}/6 \rceil\} / \min\{\lfloor n \cdot N_{RB}/10 \rfloor, 5\} \rfloor$ in each assigned frequency channel when measured using a $\min(\lfloor CBW/2 \rfloor, 5)$ MHz step size. For these exceptions the requirements of clause 7.7 Spurious Response are applicable.

Table 7.6.3.5-3: Out-of-band blocking parameters for NR bands with $F_{DL\_low} \geq$ 3300 MHz and $F_{UL\_low} \geq$ 3300 MHz

RX parameter	Units	Channel bandwidth				
		10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6	7	9	9	9
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	9	9	9	9	
NOTE: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.						

Table 7.6.3.5-4: Out of-band blocking for NR bands with $F_{DL\_low} \geq$ 3300 MHz and $F_{UL\_low} \geq$ 3300 MHz

NR band	Parameter	Unit	Range1	Range 2	Range 3
n77, n78 (NOTE 3)	$P_{interferer}$	dBm	-44	-30	-15
	$F_{interferer}$ (CW)	MHz	-60 < f – F_{DL_low} ≤ -3CBW or 3CBW ≤ f – F_{DL_high} < 60	-200 < f – F_{DL_low} ≤ -MAX(60,3CBW) or MAX(60,3CBW) ≤ f – F_{DL_high} < 200	1 ≤ f ≤ F_{DL_low} – MAX(200,3CBW) or F_{DL_high} + MAX(200,3CBW) ≤ f ≤ 12750
n79 (NOTE 4)	$F_{interferer}$ (CW)	MHz	N/A	-150 < f – F_{DL_low} ≤ -MAX(60,3CBW) or MAX(60,3CBW) ≤ f – F_{DL_high} < 150	1 ≤ f ≤ F_{DL_low} – MAX(150,3CBW) or F_{DL_high} + MAX(150,3CBW) ≤ f ≤ 12750
NOTE 1: The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm for $F_{Interferer}$ > 6000 MHz. NOTE 2: CBW denotes the channel bandwidth of the wanted signal NOTE 3: The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm, for $F_{Interferer}$ > 2700 MHz and $F_{Interferer}$ < 4800 MHz. For CBW > 15 MHz, the requirement for Range 1 is not applicable and Range 2 applies from the frequency offset of 3CBW from the band edge. For CBW larger than 60 MHz, the requirement for Range 2 is not applicable and Range 3 applies from the frequency offset of 3CBW from the band edge. NOTE 4: The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm, for $F_{Interferer}$ > 3650 MHz and $F_{Interferer}$ < 5750 MHz. For CBW ≥ 40 MHz, the requirement for Range 2 is not applicable and Range 3 applies from the frequency offset of 3CBW from the band edge.					

Table 7.6.3.5-5: Power Window (dB) for Out-of-band Blocking

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	1.4	1.7	2
20MHz < BW ≤ 40MHz	1.4	1.7	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.3
Note: Power Window setting comprises two quantities, UE Power tolerance and test system power measurement;			

7.6.4 Narrow band blocking

7.6.4.1 Test Purpose

Verifies a receiver's ability to receive a NR signal at its assigned channel frequency in the presence of an unwanted narrow band CW interferer at a frequency, which is less than the nominal channel spacing.

The lack of narrow-band blocking ability will decrease the coverage area when other NR Node B transmitters exist (except in the adjacent channels and spurious response).

7.6.4.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

7.6.4.3 Minimum Conformance Requirements

The relative throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.6.4.3-1. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements only apply for carriers assigned in the paired part.

Table 7.6.4.3-1: Narrow Band Blocking

NR band	Parameter	Unit	Channel Bandwidth										
			5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
n1,n2, n3, n5, n7, n8, n12, n20, n25 n28, n34, n38, n39, n40, n41, n50, n51, n66, n70, n71, n74, n75, n76	P_w	dBm		$P_{REFSENS}$ + channel-bandwidth specific value below									
			16	13	14	16	16	16	16	16	16	16	16
	P_{uw} (CW)	dBm	-55	-55	-55	-55	-55	-55	-55	-55	-55	-55	-55
	F_{uw} (offset SCS= 15 kHz)	MHz	2.7075	5.2125	7.7025	10.2075	13.0275	20.5575	NA	NA	NA	NA	NA
	F_{uw} (offset SCS= 30 kHz)	MHz	NA	NA	NA	NA			TBD	TBD			

NOTE 1: The transmitter shall be set a 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4

NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.

NOTE 3: The PREFSENS power level is specified in Table 7.3.1-1 and Table 7.3.1-1a for two and four antenna ports, respectively

The normative reference for this requirement is TS 38.101-1 [2] clause 7.6.4.

7.6.4.4 Test Description

7.6.4.4.1 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, and channel bandwidths 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 7.6.4.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3 respectively. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.6.4.4.1-1: Test Configuration Table

Default 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 and Highest			
Test SCS as specified in TS 38.508-1 [5] subclause 4.3.1	Lowest			
Test Parameters				
	Downlink Configuration		**Uplink Configuration**	
Test ID	**Mod'n**	**RB allocation**	**Mod'n**	**RB allocation**
1	CP-OFDM QPSK	NOTE 1	DFT-s-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3.2.4.1-1.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.4.2 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 C.3.1, and uplink signals according to Annex G.0, G.1, G.2, and G.3.1.

4. The UL and DL Reference Measurement channels are set according to Table 7.6.4.4.1-1.

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* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 7.6.4.4.3.

7.6.4.4.2 Test Procedure

1. SS transmits PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to Table 7.6.4.4.1-1. 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 7.6.4.4.1-1. Since the UE has no payload and no loopback data to send, the UE transmits uplink MAC padding bits on the UL RMC.

3. Set the parameters of the CW signal generator for an interfering signal below the wanted signal according to Table 7.6.4.5-1.

4. Set the downlink signal level according to the table 7.6.4.5-1. Send uplink power control commands to the UE (less or equal to 1 dB step size should be used), to ensure that the UE output power is within- $P_W \pm P_W$ dB of the target power level in table 7.6.4.5-1 for NR bands for at least the duration of the throughput measurement. P_W is the power window according to Table 7.6.4.5-2 for the carrier frequency f and the channel bandwidth BW.

5. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2.

6. Repeat steps from 3 to 5, using an interfering signal above the wanted signal at step 3.

7.6.4.4.3 Message Contents

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

7.6.4.5 Test Requirement

The throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Table 7.6.4.5-1.

Table 7.6.4.5-1: Narrow-band blocking

NR band	Parameter	Unit	Channel Bandwidth										
			5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
n1,n2, n3, n5, n7, n8, n12, n20, n25 n28, n34, n38, n39, n40, n41, n50, n51, n66, n70, n71, n74, n75, n76	P_w	dBm		$P_{REFSENS}$ + channel-bandwidth specific value below									
			16	13	14	16	16	16	16	16	16	16	16
	P_{uw} (CW)	dBm	-55	-55	-55	-55	-55	-55	-55	-55	-55	-55	-55
	F_{uw} (offset SCS= 15 kHz)	MHz	2.7075	5.2125	7.7025	10.2075	13.0275	20.5575	NA	NA	NA	NA	NA
	F_{uw} (offset SCS= 30 kHz)	MHz	NA	NA	NA	NA			TBD	TBD			
NOTE 1: The transmitter shall be set a 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4 NOTE 2: Reference measurement channel is specified in Annex A.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.													

Table 7.6.4.5-2 Power Window (dB) for Narrow Band Blocking

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	1.4	1.7	2
20MHz < BW ≤ 40MHz	1.4	1.7	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.3
Note: Power Window setting comprises two quantities, UE Power tolerance and test system power measurement;			

7.6A Blocking characteristics for CA

7.6A.1 General

7.6A.2 Inband blocking for CA

7.6A.2.1 Intra-band contiguous CA

FFS

7.6A.3 Out-of-band blocking for CA

7.6A.3.1 Intra-band contiguous CA

FFS

7.6A.4 Narrow band blocking for CA

7.6D Blocking characteristics for UL-MIMO

7.6D.1 General

The blocking characteristic for UL-MIMO is a measure of the receiver's ability of an UE that support UL-MIMO to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response or the adjacent channels, without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit. The blocking performance shall apply at all frequencies except those at which a spurious response occur.

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements specified in subclause 7.6 shall be met with the UL-MIMO configurations described in sub-clause 6.2D.1. For UL-MIMO, the parameter P_{CMAX_L} is defined as the total transmitter power over the two transmit antenna connectors.

7.6D.2 Inband blocking for UL-MIMO

7.6D.2.1 Test purpose

In-band blocking for UL- MIMO is defined for an unwanted interfering signal falling into the range from 15MHz below to 15MHz above the receive band of an UE that support UL-MIMO, with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, or into the range from 3CBW below to 3CBW above the receive band of an UE that support UL-MIMO, with F_{DL_high} < 3300 MHz and F_{UL_high} < 3300 MHz, at which the relative throughput shall meet or exceed the requirement for the specified measurement channels.

The lack of in-band blocking ability will decrease the coverage area when other g-NodeB transmitters exist (except in the adjacent channels and spurious response).

7.6D.2.2 Test applicability

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

7.6D.2.3 Minimum conformance requirements

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements specified in subclause 7.6 shall be met with the UL-MIMO configurations described in sub-clause 6.2D.1. For UL-MIMO, the parameter P_{CMAX_L} is defined as the total transmitter power over the two transmit antenna connectors.

The normative reference for this requirement is TS 38.101-1 [2] clause 7.6D.

7.6D.2.4 Test description

7.6D.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 channel bandwidth and sub-carrier spacing, are shown in table

7.6D.2.4.1-1. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.6D.2.4.1-1: Test Configuration Table

Default 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		
Test Parameters				
	Downlink Configuration		**Uplink Configuration**	
Test ID	**Mod'n**	**RB allocation**	**Mod'n**	**RB allocation**
1	CP-OFDM QPSK	NOTE 1	CP-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3D.2.4.1-1.				

1. Connect the SS and interfering source to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.4.4 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, C.3.1, and uplink signals according to Annex G.0, G.1, G.2, G.3.1.
4. The DL and UL Reference Measurement channels are set according to Table 7.6D.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 content are defined in clause 7.6D.2.4.3.

7.6D.2.4.2 Test procedure

Same test procedure as specified in 7.6.2.4.2 with the following exceptions:

P_W is the power window according to Table 7.6D.2.5-1 for the carrier frequency f and the channel bandwidth BW.

7.6D.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.

7.6D.2.5 Test requirement

Same test requirement as specified in 7.6.2.5 with the following exceptions:

The power window table is replaced by Table 7.6D.2.5-1.

Table 7.6D.2.5-1: Power Window (dB) for Inband blocking for UL-MIMO

	f ≤ 3GHz	**3GHz < f ≤ 4.2GHz**	**4.2GHz < f ≤ 6GHz**
BW ≤ 20MHz	1.7	2.1	2.5
20MHz < BW ≤ 40MHz	1.7	2.1	2.8
40MHz < BW ≤ 100MHz	2.7	3.0	3.0
NOTE: Power Window comprises two parts, UE Power step tolerance and test system power measurement uncertainty.			

7.6D.3 Out-of-band blocking for UL-MIMO

7.6D.3.1 Test purpose

Out-of-band blocking for UL-MIMO is defined for an unwanted CW interfering signal falling more than 15 MHz below or above the receive band of an UE that support UL- MIMO, with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz, or falling more than 3CBW below or above the receive band of an UE that support UL- MIMO, with $F_{DL\_low} \geq$ 3300 MHz and $F_{UL\_low} \geq$ 3300 MHz, at which a given average throughput shall meet or exceed the requirement for the specified measurement channels.

The lack of out-of-band blocking ability will decrease the coverage area when other g-NodeB transmitters exist (except in the adjacent channels and spurious response).

7.6D.3.2 Test applicability

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

7.6D.3.3 Minimum conformance requirements

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements specified in subclause 7.6 shall be met with the UL-MIMO configurations described in sub-clause 6.2D.1. For UL-MIMO, the parameter P_{CMAX_L} is defined as the total transmitter power over the two transmit antenna connectors.

The normative reference for this requirement is TS 38.101-1 [2] clause 7.6D.

7.6D.3.4 Test description

7.6D.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 channel bandwidth and sub-carrier spacing, are shown in table 7.6D.3.4.1-1. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.6D.3.4.1-1: Test Configuration Table

Default 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	One frequency chosen arbitrarily from low or 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				
	Downlink Configuration		**Uplink Configuration**	
Test ID	**Mod'n**	**RB allocation**	**Mod'n**	**RB allocation**
1	CP-OFDM QPSK	NOTE 1	CP-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3D.2.4.1-1.				

1. Connect the SS and interfering source to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.4.5 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, C.3.1, and uplink signals according to Annex G.0, G.1, G.2, G.3.1.

4. The DL and UL Reference Measurement channels are set according to Table 7.6D.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 content are defined in clause 7.6D.3.4.3.

7.6D.3.4.2 Test procedure

Same test procedure as specified in 7.6.3.4.2 with the following exceptions:

P_W is the power window according to Table 7.6D.3.5-1 for the carrier frequency f and the channel bandwidth BW.

7.6D.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.

7.6D.3.5 Test requirement

Same test requirement as specified in 7.6.3.5 with the following exceptions:

The power window table is replaced by Table 7.6D.3.5-1.

Table 7.6D.3.5-1: Power Window (dB) for Out-of-band blocking for UL-MIMO

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	1.7	2.1	2.5
20MHz < BW ≤ 40MHz	1.7	2.1	2.8
40MHz < BW ≤ 100MHz	2.7	3.0	3.0
NOTE: Power Window comprises two parts, UE Power step tolerance and test system power measurement uncertainty.			

7.6D.4 Narrow band blocking for UL-MIMO

7.6D.4.1 Test purpose

Narrow band blocking for UL-MIMO is defined for a receiver's ability of an UE that supports UL-MIMO to receive a NR signal at its assigned channel frequency in the presence of an unwanted narrow band CW interferer at a frequency, which is less than the nominal channel spacing, at which a given average throughput shall meet or exceed the requirement for the specified measurement channels.

The lack of narrow-band blocking ability will decrease the coverage area when other g-NodeB transmitters exist (except in the adjacent channels and spurious response).

7.6D.4.2 Test applicability

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

7.6D.4.3 Minimum conformance requirements

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements specified in subclause 7.6 shall be met with the UL-MIMO configurations described in sub-clause 6.2D.1. For UL-MIMO, the parameter P_{CMAX_L} is defined as the total transmitter power over the two transmit antenna connectors.

The normative reference for this requirement is TS 38.101-1 [2] clause 7.6D.

7.6D.4.4 Test description

7.6D.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 channel bandwidth and sub-carrier spacing, are shown in table 7.6D.4.4.1-1. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.6D.4.4.1-1: Test Configuration Table

Default 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			
Test Parameters				
	Downlink Configuration		**Uplink Configuration**	
Test ID	**Mod'n**	**RB allocation**	**Mod'n**	**RB allocation**
1	CP-OFDM QPSK	NOTE 1	CP-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3D.2.4.1-1.				

1. Connect the SS and interfering source to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.4.5 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, C.3.1, and uplink signals according to Annex G.0, G.1, G.2, G.3.1.
4. The DL and UL Reference Measurement channels are set according to Table 7.6D.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 content are defined in clause 7.6D.4.4.3.

7.6D.4.4.2 Test procedure

Same test procedure as specified in 7.6.4.4.2 with the following exceptions:

P_W is the power window according to Table 7.6D.4.5-1 for the carrier frequency f and the channel bandwidth BW.

7.6D.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.

7.6D.4.5 Test requirement

Same test requirement as specified in 7.6.4.5 with the following exceptions:

The power window table is replaced by Table 7.6D.4.5-1.

Table 7.6D.4.5-1: Power Window (dB) for Narrow band blocking for UL-MIMO

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	1.7	2.1	2.5
20MHz < BW ≤ 40MHz	1.7	2.1	2.8
40MHz < BW ≤ 100MHz	2.7	3.0	3.0
NOTE: Power Window comprises two parts, UE Power step tolerance and test system power measurement uncertainty.			

7.7 Spurious response

7.7A.0 Minimum conformance requirements

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- [Table 7.3A.2.xx] Intra-band xDL_CA uplink configuration for reference sensitivity are still missing in Clause 7.3A.2

7.7A.0.1 Minimum conformance requirements for intra-band contiguous CA

For intra-band contiguous carrier aggregation the downlink SCC(s) shall be configured at nominal channel spacing to the PCC. For FDD, the PCC shall configure closest to the uplink band. All downlink carriers shall be active throughout the test. The uplink output power shall be set as specified in Table 7.7A.0-1 with the uplink configuration set according to [Table 7.3A.2.xx] for the applicable carrier aggregation configuration. For UE(s) supporting one uplink carrier, the uplink configuration of the PCC shall be in accordance with Table 7.3.2.3-3. The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Tables 7.7A.0-1 and 7.7A.0-2. For operating bands of SDL (as noted in Table 5.2-1), the requirements also apply for an SCC assigned in the unpaired part with parameters specified in Tables 7.7A.0-1 and 7.7A.0-2.

The normative reference for this requirement is TS 38.101-1 [2] clause 7.7A.1.

Table 7.7A.0.1-1: Spurious response parameters for intra-band contiguous CA

RX parameter	Units	BW Class		
		C	D	E
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below		
	dB	9	9	9
NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.				

Table 7.7A.0.1-2: Spurious response for CA

Parameter	Unit	Level
$P_{Interferer}$ (CW)	dBm	-44
$F_{Interferer}$	MHz	Spurious response frequencies

7.7A.0.2 Void

7.7A.0.3 Minimum conformance requirements for inter-band CA

For inter-band carrier aggregation with one component carrier per operating band and the uplink assigned to one NR band, the spurious response are defined with the uplink active on the band(s) other than the band whose downlink is being tested. The UE shall meet the requirements specified in subclause 7.7 for each component carrier while all downlink carriers are active.

For the UE which supports inter-band CA configuration in Table 7.3A.0.3.2.1-1, $P_{interferer}$ power defined in Table 7.7.3-2 is increased by the amount given by $\Delta R_{IB,c}$ defined in Table 7.3A.0.3.2.1-1.

The throughput of each carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1).

The normative reference for this requirement is TS 38.101-1 [2] clause 7.7A.3.

7.7A.1 Spurious response for 2DL CA

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- The content of sub-clause 7.6A.3 is FFS.
- The content of clause "7.6A.3.1.4.1 Initial Conditions" for Out-of-band blocking for 2DL CA has not been defined yet.
- Annex [H.2A] Statistical testing of receiver characteristics for CA is FFS.
- The MU and TT for Spurious response CA is FFS in Annex F.

7.7A.1.1 Test Purpose

Spurious response for 2DL CA verifies the receiver's ability to receive a wanted 2DL carrier aggregated signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency at which a response is obtained i.e. for which the out of band blocking limit as specified in sub-clause 7.6A.3 is not met.

The lack of the spurious response ability decreases the coverage area when other unwanted interfering signal exists at any other frequency.

7.7A.1.2 Test Applicability

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

7.7A.1.3 Minimum Conformance Requirements

The minimum conformance requirements are defined in clause 7.7A.0.

7.7A.1.4 Test Description

7.7A.1.4.1 Initial Conditions

The initial conditions shall be the same as in clause [7.6A.3.1.4.1] in order to test spurious responses obtained in clause 7.6A.3.1 under the same conditions.

7.7A.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 Test Configuration Table [FFS] in Clause [7.6A.3] on both PCC and SCC. 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 Test Configuration Table [FFS] in Clause [7.6A.3] on both PCC and SCC. Since the UE has no payload data to send, the UE sends uplink MAC padding bits on the UL RMC.

3. Set the parameters of the CW signal generator for an interfering signal according to Table 7.7A.0.1-2. The spurious frequencies are taken from records in the final step of test procedures in clause 7.6A.3 Out-of-band blocking for CA.

4. Set the downlink signal level according to Table 7.7A.0.1-1 for both carriers. Send uplink power control commands to the UE (less or equal to 1dB step size should be used), to ensure that for at least the duration of the throughput measurement:
   The PCC output power is within $-P_W \pm P_W$ dB of (target level in Table 7.7A.0.1-1 + 10log(P_L_{CRB}/N_{RB_alloc})), for carrier frequency f ≤ 3.0GHz,
   or within $-P_W \pm P_W$ dB of (target level in Table 7.7A.0.1-1 + 10log(P_L_{CRB}/N_{RB_alloc})) for carrier frequency 3.0GHz < f ≤ 4.2GHz.
   The SCC output power is within $-P_W \pm P_W$ dB of (target level in Table 7.7A.0.1-1 + 10log(S_L_{CRB}/N_{RB_alloc})), for carrier frequency f ≤ 3.0GHz,
   or within $-P_W \pm P_W$ dB of (target level in Table 7.7A.0.1-1 + 10log(S_L_{CRB}/N_{RB_alloc})) for carrier frequency 3.0GHz < f ≤ 4.2GHz.

   P_W is the power window according to Table 7.7A.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.

5. For each spurious frequency, measure the average throughput for each component carrier for duration sufficient to achieve statistical significance according to Annex [H.2A].

Table 7.7A.1.4.2-1: Power Window (dB) for Spurious response CA

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	[1.4]	[1.7]	[2]
20MHz < BW ≤ 40MHz	[1.4]	[1.7]	[2.2]
40MHz < BW ≤ 100MHz	[2.1]	[2.3]	[2.3]

7.7A.1.4.3 Message Contents

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

7.7A.1.5 Test Requirement

The throughput measurement of each carrier derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.7A.0.1-1 and 7.7A.0.1-2.For the UE which supports inter-band 2DL CA configuration in Table 7.3.2_1.3-1 and Table 7.3A.2.0.4.2.1-1, $P_{Interferer}$ power defined in Table 7.7A.0.1-2 is increased by the amount given by $\Delta R_{IB,c}$ in Table 7.3.2_1.3-1 and Table 7.3A.2.0.4.2.1-1.

7.7A.2 Spurious response for 3DL CA

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- The content of sub-clause 7.6A.3 is FFS.
- The content of clause "7.6A.3.2.4.1 Initial Conditions" for Out-of-band blocking for 3DL CA has not been defined yet.

7.7A.2.1 Test Purpose

Spurious response for 3DL CA verifies the receiver's ability to receive a wanted 3DL carrier aggregated signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency at which a response is obtained i.e. for which the out of band blocking limit as specified in sub-clause 7.6A.3 is not met.

The lack of the spurious response ability decreases the coverage area when other unwanted interfering signal exists at any other frequency.

7.7A.2.2 Test Applicability

This test case applies to all types of NR UE release 15 and forward that support 3DL CA.

7.7A.2.3 Minimum Conformance Requirements

The minimum conformance requirements are defined in clause 7.7A.0.

7.7A.2.4 Test Description

7.7A.2.4.1 Initial Conditions

The initial conditions shall be the same as in clause 7.6A.3.2.4.1 in order to test spurious responses obtained in clause 7.6A.3.2 under the same conditions.

7.7A.2.4.2 Test Procedure

Same test procedure as sub-clause 7.7A.1.4.2 with the following exceptions:

Step 1, 2 and 4 of Test Procedure as in clause 7.7A.1.4.2 is replaced by:

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Test Configuration Table [FFS] in Clause [7.6A.3] on both PCC and SCCs. 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 Test Configuration Table [FFS] in Clause [7.6A.3] on both PCC and SCCs. Since the UE has no payload data to send, the UE sends uplink MAC padding bits on the UL RMC.

4. Set the downlink signal level according to Table 7.7A.0.1-1 for both carriers. Send uplink power control commands to the UE (less or equal to 1dB step size should be used), to ensure that for at least the duration of the throughput measurement:
   The PCC output power is within $-P_W \pm P_W$ dB of (target level in Table 7.7A.0.1-1 + 10log(P_L_{CRB}/N_{RB_alloc})), for carrier frequency $f \leq 3.0$GHz,
   or within $-P_W \pm P_W$ dB of (target level in Table 7.7A.0.1-1 + 10log(P_L_{CRB}/N_{RB_alloc})) for carrier frequency 3.0GHz < $f \leq 4.2$GHz.
   The SCCs output power is within $-P_W \pm P_W$ dB of (target level in Table 7.7A.0.1-1 + 10log(S_L_{CRB}/N_{RB_alloc})), for carrier frequency $f \leq 3.0$GHz,
   or within $-P_W \pm P_W$ dB of (target level in Table 7.7A.0.1-1 + 10log(S_L_{CRB}/N_{RB_alloc})) for carrier frequency 3.0GHz < $f \leq 4.2$GHz.

   P_W is the power window according to Table 7.7A.1.4.2-1 for the carrier frequency f and the channel bandwidth BW.

7.7A.2.4.3 Message Contents

Same message contents as sub-clause 7.7A.1.4.3.

7.7A.2.5 Test Requirement

The throughput measurement of each carrier derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.7A.0.1-1 and 7.7A.0.1-2.For the UE which supports inter-band 3DL CA configuration in Table 7.3.2_1.3-1 and Table 7.3A.2.0.4.2.2-1, $P_{Interferer}$ power defined in Table 7.7A.0.1-2 is increased by the amount given by $\Delta R_{IB,c}$ in Table 7.3.2_1.3-1 and Table 7.3A.2.0.4.2.2-1.

7.7A.3 Spurious response for 4DL CA

Editor's note: This clause is incomplete. The following aspects are either missing or not yet determined:

- The content of sub-clause 7.6A.3 is FFS.

- Table [7.3A.2.0.4.2.3-1] $\Delta R_{IB,c}$ due to CA (four bands) has not been defined yet.

- The content of clause “7.6A.3.3.4.1 Initial Conditions” for Out-of-band blocking for 4DL CA has not been defined yet.

7.7A.3.1 Test Purpose

Spurious response for 4DL CA verifies the receiver's ability to receive a wanted 4DL carrier aggregated signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency at which a response is obtained i.e. for which the out of band blocking limit as specified in sub-clause 7.6A.3 is not met.

The lack of the spurious response ability decreases the coverage area when other unwanted interfering signal exists at any other frequency.

7.7A.3.2 Test Applicability

This test case applies to all types of NR UE release 15 and forward that support 4DL CA.

7.7A.3.3 Minimum Conformance Requirements

The minimum conformance requirements are defined in clause 7.7A.0.

7.7A.3.4 Test Description

7.7A.3.4.1 Initial Conditions

The initial conditions shall be the same as in clause 7.6A.3.3.4.1 in order to test spurious responses obtained in clause 7.6A.3.3 under the same conditions.

7.7A.3.4.2 Test Procedure

Same test procedure as sub-clause 7.7A.2.4.2.

7.7A.3.4.3 Message Contents

Same message contents as sub-clause 7.7A.1.4.3.

7.7A.3.5 Test Requirement

The throughput measurement of each carrier derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.7A.0.1-1 and 7.7A.0.1-2.For the UE which supports inter-band 4DL CA configuration in Table 7.3.2_1.3-1 and Table [7.3A.2.0.4.2.3-1], $P_{Interferer}$ power defined in Table 7.7A.0.1-2 is increased by the amount given by $\Delta R_{IB,c}$ in Table 7.3.2_1.3-1 and Table [7.3A.2.0.4.2.3-1].

7.7.1 Test Purpose

Spurious response is a measure of the ability of the receiver to receive a wanted signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency for which a response is obtained, i.e. for which the out-of-band blocking limit as specified in subclause 7.6.3 is not met.

The lack of the spurious response ability decreases the coverage area when other unwanted interfering signal exists at any other frequency.

7.7.2 Test Applicability

This test applies to all types of NR UE release 15 and forward.

7.7.3 Minimum Conformance Requirements

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters for the wanted signal as specified in Table 7.7.3-1 for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz and in Table 7.7.3-1a for NR bands with F_{DL_high} ≥ 3300 MHz and F_{UL_high} ≥ 3300 MHz and for the interferer as specified in Table 7.7.3-2. The said relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal. For operating bands with an unpaired DL part (as noted in Table 5.5-1), the requirements only apply for carriers assigned in the paired part.

Table 7.7.3-1: Spurious response parameters for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz

RX parameter	Units	Channel bandwidth				
		5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6	6	7	9	10
RX parameter	**Units**	**Channel bandwidth**				
		30 MHz	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	11	12	13	14	15
RX parameter	**Units**	**Channel bandwidth**				
		90 MHz	**100 MHz**			
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	15.5	16			
NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.						

Table 7.7.3-1a: Spurious response parameters for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

RX parameter	Units	Channel bandwidth				
		10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6	7	9	9	9
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	9	9	9	9	
NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.						

Table 7.7.3-2: Spurious response

Parameter	Unit	Level
$P_{Interferer}$ (CW)	dBm	-44
$F_{Interferer}$	MHz	Spurious response frequencies

The normative reference for this requirement is TS 38.101-1 [2] clause 7.7.

7.7.4 Test Description

7.7.4.1 Initial Conditions

The initial conditions shall be the same as in clause 7.6.3.4.1 in order to test spurious responses obtained in clause 7.6.3 under the same conditions.

7.7.4.2 Test Procedure

1. SS transmits PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to Table 7.6.3.4.1-1. 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 7.6.3.4.1-1. Since the UE has no payload and no loopback data to send, the UE transmits uplink MAC padding bits on the UL RMC.

3. Set the parameters of the CW signal generator for an interfering signal according to Table 7.7.5-2. The spurious frequencies are taken from records in the final step of test procedures in clause 7.6.3.4.2.

4. Set the downlink signal level according to the table 7.7.5-1 or 7.7.5-1a. Send uplink power control commands to the UE (less or equal to1 dB step size should be used), to ensure that the UE output power is within - $P_W \pm P_W$ dB of the target power level in table 7.7.5-1 or 7.7.5-1a for NR bands for at least the duration of the throughput measurement. P_W is the power window according to Table 7.7.5-3 for the carrier frequency f and the channel bandwidth BW.

5. For the spurious frequency, measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2.

7.7.4.3 Message Contents

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

7.7.5 Test Requirement

The throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters for the wanted signal as specified in Table 7.7.5-1 for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz and in Table 7.7.5-1a for NR bands with $F_{DL\_high} \geq$ 3300 MHz and $F_{UL\_high} \geq$ 3300 MHz and for the interferer as specified in Table 7.7.5-2.

Table 7.7.5-1: Spurious response parameters for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz

RX parameter	Units	Channel bandwidth				
		5 MHz	10 MHz	15 MHz	20 MHz	25 MHz
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6	6	7	9	10
RX parameter	Units	Channel bandwidth				
		30 MHz	40 MHz	50 MHz	60 MHz	80 MHz
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	11	12	13	14	15
RX parameter	Units	Channel bandwidth				
		90 MHz	100 MHz			
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	15.5	16			
NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.						

Table 7.7.5-1a: Spurious response parameters for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

RX parameter	Units	Channel bandwidth				
		10 MHz	15 MHz	20 MHz	40 MHz	50 MHz
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6	7	9	9	9
RX parameter	Units	Channel bandwidth				
		60 MHz	80 MHz	90 MHz	100 MHz	
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	9	9	9	9	
NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.						

Table 7.7.5-2: Spurious response

Parameter	Unit	Level
$P_{Interferer}$ (CW)	dBm	-44
$F_{Interferer}$	MHz	Spurious response frequencies

Table 7.7.5-3 Power Window (dB) for Spurious Response

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	1.4	1.7	2
20MHz < BW ≤ 40MHz	1.4	1.7	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.3
Note: Power Window setting comprises two quantities, UE Power tolerance and test system power measurement;			

7.7D Spurious response for UL-MIMO

7.7D.1 Test Purpose

Spurious response verifies the ability of the UE that support UL-MIMO to receive a wanted signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency at which a response is obtained i.e. for which the out of band blocking for UL-MIMO limit as specified in sub-clause 7.6D.3 is not met.

The lack of the spurious response ability decreases the coverage area when other unwanted interfering signal exists at any other frequency.

7.7D.2 Test Applicability

This test applies to all types of NR UE release 15 and forward that support UL-MIMO.

7.7D.3 Minimum Conformance Requirements

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in Clause 7.7D.3 shall be met with the UL-MIMO configurations specified in Table 6.2D.1.4.1-1 in Clause 6.2 D.1 UE maximum output power for UL-MIMO. For UL-MIMO, the parameter P_{CMAX_L} is defined as the total transmitter power over the two transmitter antenna connectors.

The normative reference for this requirement is TS 38.101-1 [2] clause 7.7D.

7.7D.4 Test Description

7.7D.4.1 Initial Conditions

The initial conditions shall be the same as in clause 7.6D.3.4.1 in order to test spurious responses obtained in clause 7.6D.3 under the same conditions.

7.7D.4.2 Test Procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Test Configuration Table 7.6D.3.4.1-1 in Clause 7.6D.3. 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 Test Configuration Table 7.6D.3.4.1-1 in Clause 7.6D.3. 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 condition 2TX_UL_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.

3. Set the parameters of the CW signal generator for an interfering signal according to Table 7.7D.5-2. The spurious frequencies are taken from records in the final step of test procedures in clause 7.6D.3.4.2.

4. Set the downlink signal level according to the Table 7.7D.5-1. Send uplink power control commands to the UE (less or equal to 1dB step size should be used), to ensure that the UE output power is within +0, - 3.4 dB of the target level in table 7.7D.5-1 for carrier frequency f ≤ 3.0GHz or within +0, -4.0 dB of the target level for carrier frequency 3.0GHz < f ≤ 4.2GHz, for at least the duration of the throughput measurement.

5. For the spurious frequency, measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2.

7.7D.4.3 Message Contents

Message contents are according to TS 38.508-1 [5] clause 4.6 ensuring Table 4.6.3-182 with condition 2TX_UL_MIMO.

7.7D.5 Test Requirement

The throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3 with parameters specified in Tables 7.7D.5-1 and 7.7D.5-2.

Table 7.7D.5-1: Spurious response parameters

RX parameter	Units	Channel bandwidth				
		10 MHz	15 MHz	20 MHz	40 MHz	50 MHz
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	6	7	9	9	9
RX parameter	**Units**	**Channel bandwidth**				
		60 MHz	**80 MHz**	**90 MHz**	**100 MHz**	
Power in transmission bandwidth configuration	dBm	REFSENS + channel specific value below				
	dB	9	9	9	9	
Note 1: The transmitter shall be set to 4dB below P_{CMAX_L} with P_{CMAX_L} as defined in clause 6.2.4. Note 2: The reference measurement channel is specified in Annex A.3 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.						

Table 7.7D.5-2: Spurious Response

Parameter	Unit	Level
$P_{Interferer}$ (CW)	dBm	-44
$F_{Interferer}$	MHz	Spurious response frequencies

7.8 Intermodulation characteristics

7.8.1 General

Intermodulation response rejection is a measure of the capability of the receiver to receiver a wanted signal on its assigned channel frequency in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal

7.8.2 Wide band Intermodulation

7.8.2.1 Test purpose

Intermodulation response tests the UE's ability to receive data with a given average throughput for a specified reference measurement channel, in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal, under conditions of ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the coverage area when two or more interfering signals exist which have a specific frequency relationship to the wanted signal.

7.8.2.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

7.8.2.3 Minimum conformance requirements

The wide band intermodulation requirement is defined using a CW carrier and modulated NR signal as interferer 1 and interferer 2 respectively.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.8.2.3-1 for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz and Table 7.8.2.3-2 for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal. For operating bands with an unpaired DL part (as noted in Table 5.2-1), the requirements only apply for carriers assigned in the paired part.

Table 7.8.2-1: Wide band intermodulation parameters for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz

Rx parameter	Units	Channel bandwidth											
		5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
P_w in Transmission Bandwidth Configuration, per CC	dBm	REFSENS + channel bandwidth specific value below											
		6	6	7	9	10	11	12	13	14	15	15	16
$P_{Interferer\ 1}$ (CW)	dBm	-46											
$P_{Interferer\ 2}$ (Modulated)	dBm	-46											
$BW_{Interferer\ 2}$	MHz	5											
$F_{Interferer\ 1}$ (Offset)	MHz	-BW/2 – 7.5 / +BW/2 + 7.5											
$F_{Interferer\ 2}$ (Offset)	MHz	$2*F_{Interferer\ 1}$											

NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.
NOTE 2: Reference measurement channel is specified in Annexes A.2.2, A.2.3, A.3.2, and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1).
NOTE 3: The modulated interferer consists of the Reference measurement channel specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1 and 15 kHz SCS.
NOTE 4: The $F_{interferer\ 1}$ (offset) is the frequency separation of the centre frequency of the carrier closest to the interferer and the centre frequency of the CW interferer and $F_{interferer\ 2}$ (offset) is the frequency separation of the centre frequency of the carrier closest to the interferer and the centre frequency of the modulated interferer.

Table 7.8.2-2: Wide band intermodulation parameters for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

Rx parameter	Units	Channel bandwidth							
		10 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
P_w in Transmission Bandwidth Configuration, per CC	dBm	REFSENS + 6							
$P_{Interferer\ 1}$ (CW)	dBm	-46							
$P_{Interferer\ 2}$ (Modulated)	dBm	-46							
$BW_{Interferer\ 2}$	MHz	BW							
$F_{Interferer\ 1}$ (Offset)	MHz	-2BW / +2BW							
$F_{Interferer\ 2}$ (Offset)	MHz	$2*F_{Interferer\ 1}$							

NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.
NOTE 2: Reference measurement channel is specified in Annexes A.2.2, A.2.3, A.3.2, and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1).
NOTE 3: The modulated interferer consists of the Reference measurement channel specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1 and the same SCS as the wanted signal.
NOTE 4: The $F_{interferer\ 1}$ (offset) is the frequency separation of the centre frequency of the carrier closest to the interferer and the centre frequency of the CW interferer and $F_{interferer\ 2}$ (offset) is the frequency separation of the centre frequency of the carrier closest to the interferer and the centre frequency of the modulated interferer.

The normative reference for this requirement is TS 38.101-1 [2] clause 7.8.2.

7.8.2.4 Test description

7.8.2.4.1 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 channel bandwidth and sub-carrier spacing, are shown in table 7.8.2.4.1-1. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. Configuration of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.8.2.4.1-1: Test Configuration Table

Default 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		Highest		
Test Parameters				
	Downlink Configuration		**Uplink Configuration**	
Test ID	**Mod'n**	**RB allocation**	**Mod'n**	**RB allocation**
1	CP-OFDM QPSK	NOTE 1	DFT-s-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3.2.4.1-1.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.4.3 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 , C.3.1 , and uplink signals according to Annex G.0, G.1, G.2, G.3.1.
4. The DL and UL Reference Measurement channels are set according to Table 7.5.4.1-1.
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 content are defined in clause 7.5.4.3.

7.8.2.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 7.8.2.4.1-1. 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 7.8.2.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
3. Set the Downlink signal level to the value as defined in Table 7.8.2.5-1. Send Uplink power control commands to the UE (less or equal to 1dB step size should be used), to ensure that the UE output power is within $-P_W \pm P_W$ dB of the target level in Table 7.8.2.5-1. P_W is the power window according to Table 7.8.2-3 for the carrier frequency f and the channel bandwidth BW.
4. Set the Interfering signal levels to the values as defined in Table 7.8.2.5-1 and frequency below the wanted signal.
5. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G.2.
6. Repeat steps from 3 to 5, using an interfering signal above the wanted signal at step 4.

7.8.2.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 with DFT-s-OFDM condition in Table 4.6.3-118 PUSCH-Config.

7.8.2.5 Test requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Table 7.8.2.5-1 for the specified wanted signal mean power in the presence of two interfering signals.

Table 7.8.2.5-1: Wide band intermodulation parameters for NR bands with F_{DL_high} < 2700 MHz and F_{UL_high} < 2700 MHz

Rx parameter	Units	Channel bandwidth											
		5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
P_w in Transmission Bandwidth Configuration, per CC	dBm	REFSENS + channel bandwidth specific value below											
		6	6	7	9	10	11	12	13	14	15	15	16
$P_{Interferer\ 1}$ (CW)	dBm	-46											
$P_{Interferer\ 2}$ (Modulated)	dBm	-46											
$BW_{Interferer\ 2}$	MHz	5											
$F_{Interferer\ 1}$ (Offset)	MHz	-BW/2 – 7.5 / +BW/2 + 7.5											
$F_{Interferer\ 2}$ (Offset)	MHz	2*$F_{Interferer\ 1}$											

NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.
NOTE 2: Reference measurement channel is specified in Annexes A.2.2, A.2.3, A.3.2, and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1).
NOTE 3: The modulated interferer consists of the Reference measurement channel specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1 and 15 kHz SCS.
NOTE 4: The $F_{interferer\ 1}$ (offset) is the frequency separation of the centre frequency of the carrier closest to the interferer and the centre frequency of the CW interferer and $F_{interferer\ 2}$ (offset) is the frequency separation of the centre frequency of the carrier closest to the interferer and the centre frequency of the modulated interferer.

Table 7.8.2-2: Wide band intermodulation parameters for NR bands with F_{DL_low} ≥ 3300 MHz and F_{UL_low} ≥ 3300 MHz

Rx parameter	Units	Channel bandwidth							
		10 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
P_w in Transmission Bandwidth Configuration, per CC	dBm	REFSENS + 6							
$P_{Interferer\ 1}$ (CW)	dBm	-46							
$P_{Interferer\ 2}$ (Modulated)	dBm	-46							
$BW_{Interferer\ 2}$	MHz	BW							
$F_{Interferer\ 1}$ (Offset)	MHz	-2BW / +2BW							
$F_{Interferer\ 2}$ (Offset)	MHz	2*$F_{Interferer\ 1}$							

NOTE 1: The transmitter shall be set to 4dB below $P_{CMAX\_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2-3 with $P_{CMAX\_L,f,c}$ defined in clause 6.2.4.
NOTE 2: Reference measurement channel is specified in Annexes A.2.2, A.2.3, A.3.2, and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1).
NOTE 3: The modulated interferer consists of the Reference measurement channel specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1 and the same SCS as the wanted signal.
NOTE 4: The $F_{interferer\ 1}$ (offset) is the frequency separation of the centre frequency of the carrier closest to the interferer and the centre frequency of the CW interferer and $F_{interferer\ 2}$ (offset) is the frequency separation of the centre frequency of the carrier closest to the interferer and the centre frequency of the modulated interferer.

Table 7.8.2-3: Power Window (dB) for Wideband Intermodulation

	f ≤ 3GHz	3GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6GHz
BW ≤ 20MHz	1.4	1.7	2.0
20MHz < BW ≤ 40MHz	1.4	1.7	2.2
40MHz < BW ≤ 100MHz	2.1	2.3	2.3

7.8D Intermodulation characteristics for UL-MIMO

7.8D.1 General

Intermodulation response rejection for UL-MIMO is a measure of the capability of the receiver of an UE that support UL-MIMO to receive a wanted signal on its assigned channel frequency in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal.

7.8D.2 Wide band Intermodulation for UL-MIMO

7.8D.2.1 Test purpose

Wide band Intermodulation for UL-MIMO tests the ability of UE that support UL-MIMO to receive data with a given average throughput for a specified reference measurement channel, in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal, under conditions of ideal propagation and no added noise.

An UE unable to meet the throughput requirement under these conditions will decrease the coverage area when two or more interfering signals exist which have a specific frequency relationship to the wanted signal.

7.8D.2.2 Test applicability

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

7.8D.2.3 Minimum conformance requirements

For UE(s) with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements in subclause 7.8 shall be met with the UL-MIMO configurations described in sub-clause 6.2D.1. For UL-MIMO, the parameter P_{CMAX_L} is defined as the total transmitter power over the two transmit antenna connectors.

The normative reference for this requirement is TS 38.101-1 [2] clause 7.8D.

7.8D.2.4 Test description

7.8D.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 channel bandwidth and sub-carrier spacing, are shown in table 7.8D.2.4.1-1. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.8D.2.4.1-1: Test Configuration Table

Default 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	Highest			
Test Parameters				
	Downlink Configuration		**Uplink Configuration**	
Test ID	**Mod'n**	**RB allocation**	**Mod'n**	**RB allocation**
1	CP-OFDM QPSK	NOTE 1	CP-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3D.2.4.1-1.				

1. Connect the SS and interfering sources to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.4.6 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, C.3.1, and uplink signals according to Annex G.0, G.1, G.2, G.3.1.

4. The DL and UL Reference Measurement channels are set according to Table 7.8D.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 content are defined in clause 7.8D.2.4.3.

7.8D.2.4.2 Test procedure

Same test procedure as specified in 7.8.2.4.2 with the following exceptions:

P_W is the power window according to Table 7.8D.2.5-1 for the carrier frequency f and the channel bandwidth BW.

7.8D.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.7.8D.2.5

Test requirement

Same test requirement as specified in 7.8.2.5 with the following exceptions:

The power window table is replaced by Table 7.8D.2.5-1.

Table 7.8D.2.5-1: Power Window (dB) for Wide band Intermodulation for UL-MIMO

	f ≤ 3GHz	**3GHz < f ≤ 4.2GHz**	**4.2GHz < f ≤ 6GHz**
BW ≤ 20MHz	1.7	2.1	2.5
20MHz < BW ≤ 40MHz	1.7	2.1	2.8
40MHz < BW ≤ 100MHz	2.7	3.0	3.0
NOTE: Power Window comprises two parts, UE Power step tolerance and test system power measurement uncertainty.			

7.9 Spurious emissions

The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the UE antenna connector.

7.9.1 Test purpose

Test verifies the UE's spurious emissions meet the requirements described in clause 7.9.3.

Excess spurious emissions increase the interference to other systems.

7.9.2 Test applicability

This test applies to all types of NR UE release 15 and forward.

7.9.3 Minimum conformance requirements

The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the UE antenna connector.

The power of any narrow band CW spurious emission shall not exceed the maximum level specified in Table 7.9.3-1

Table 7.9.3-1: General receiver spurious emission requirements

Frequency range	Measurement bandwidth	Maximum level	NOTE
30 MHz ≤ f < 1 GHz	100 kHz	-57 dBm	
1 GHz ≤ f ≤ 12.75 GHz	1 MHz	-47 dBm	
12.75 GHz ≤ f ≤ 5th harmonic of the upper frequency edge of the DL operating band in GHz	1 MHz	-47 dBm	2
12.75 GHz – 26 GHz	1 MHz	-47dBm	3
NOTE 1: Unused PDCCH resources are padded with resource element groups with power level given by PDCCH_RA/RB as defined in Annex C.3.1. NOTE 2: Applies for Band that the upper frequency edge of the DL Band more than 2.69 GHz. NOTE 3: Applies for Band that the upper frequency edge of the DL Band more than 5.2 GHz.			

The normative reference for this requirement is TS 38.101-1 [2] clause 7.9.

7.9.4 Test description

7.9.4.1 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 7.9.4.1-1. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. Configuration of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.9.4.1-1: Test Configuration Table

Default 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	Highest			
Test SCS as specified in Table 5.3.5-1	Highest			
Test Parameters				
	Downlink Configuration		**Uplink Configuration**	
Test ID	**Mod'n**	**RB allocation**	**Mod'n**	**RB allocation**
1	N/A	0	N/A	0
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3.2.4.1-1.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure A.3.1.5 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 , C.3.1 , and uplink signals according to Annex G.0, G.1, G.2, G.3.1.

4. The DL and UL Reference Measurement channels are set according to Table 7.9.4.1-1.

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 content are defined in clause 7.5.4.3.

7.9.4.2 Test procedure

1. Sweep the spectrum analyzer (or equivalent equipment) over a frequency range and measure the average power of spurious emission.

2. Repeat step 1 for all NR Rx antennas of the UE.

7.9.4.3 Message contents

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

7.9.5 Test requirement

The measured spurious emissions derived in step 1), shall not exceed the maximum level specified in Table 7.9.5-1.

Table 7.9.5-1: General receiver spurious emission requirements

Frequency range	Measurement bandwidth	Maximum level	NOTE
30 MHz ≤ f < 1 GHz	100 kHz	-57 dBm	
1 GHz ≤ f ≤ 12.75 GHz	1 MHz	-47 dBm	
12.75 GHz ≤ f ≤ 5th harmonic of the upper frequency edge of the DL operating band in GHz	1 MHz	-47 dBm	2
12.75 GHz – 26 GHz	1 MHz	-47dBm	3
NOTE 1: Unused PDCCH resources are padded with resource element groups with power level given by PDCCH_RA/RB as defined in Annex C.3.1. NOTE 2: Applies for Band that the upper frequency edge of the DL Band more than 2.69 GHz. NOTE 3: Applies for Band that the upper frequency edge of the DL Band more than 5.2 GHz.			

7.9A Spurious emissions for CA

7.9A.0 Minimum conformance requirements

For inter-band carrier aggregation including an operating band without uplink band, the UE shall meet the Rx spurious emissions requirements specified in subclause 7.9 for each component carrier while all downlink carriers are active.

The normative reference for this requirement is TS 38.101-1 [2] clause 7.9A.3.

7.9A.1 Spurious emission for 2DL CA

Editor's note: This test case is not complete. Following aspects are either missing or not yet determined:

- The Figure [TBD] for TE diagram of connecting the SS to the UE antenna connectors as shown in TS 38.508-1 Annex A.

7.9A.1.1 Test Purpose

Test verifies the UE's spurious emissions meet the requirements described in clause 7.9A.1.3.

Excess spurious emissions increase the interference to other systems.

7.9A.1.2 Test Applicability

This test case applies to all types of NR UE release 15 and forward that support inter-band 2DL CA with a DL-only band.

7.9A.1.3 Minimum Conformance Requirements

The minimum conformance requirements are defined in clause 7.9A.0.

7.9A.1.4 Test Description

7.9A.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, and channel bandwidths based on NR CA bands specified in Table 5.5A.3-1. All of these configurations shall be tested with applicable test parameters for each CA Configuration, and are shown in Table 7.9A.1.4.1-1. 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 7.9A.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			Highest N_{RB_agg}			
Test SCS as specified in Table 5.3.5-1			Highest			
Test Parameters for CA Configurations						
Ch Configuration / N_{RB_agg}		**Downlink Configuration**			**Uplink Configuration**	
PCC N_{RB}	**SCCs N_{RB}**	**Mod'n**	**PCC & SCC RB allocation**		**Mod'n**	**PCC RB allocation**
100	100	N/A	0	0	N/A	0
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3.2.4.1-1.						

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [5] Annex A, in Figure [TBD] 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 for PCC are initially set up according to Annex C.0, C.1, C.2.
4. Propagation conditions are set according to Annex B.0.
5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity *NR* according to TS 38.508-1 [5] clause 4.5. Message contents are defined in clause 7.9A.1.4.3.

7.9A.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 6.5A.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. Sweep the spectrum analyzer (or equivalent equipment) over a frequency range and measure the average power of spurious emission. During measurement SS sends no uplink scheduling information to the UE.
5. Repeat step 1 for all NR Rx antennas of the UE.

7.9A.1.4.3 Message Contents

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

7.9A.1.5 Test Requirement

The measured spurious emissions derived in step 1), shall not exceed the maximum level specified in Table 7.9.5-1.

Annex A (normative): Measurement channels

A.1 General

The throughput values defined in the measurement channels specified in Annex A, are calculated and are valid per data stream (codeword). For multi-stream (more than one codeword) transmissions, the throughput referenced in the minimum requirements is the sum of throughputs of all data streams (code words).

The UE category entry in the definition of the reference measurement channel in Annex A is only informative and reveals the UE categories, which can support the corresponding measurement channel. Whether the measurement channel is used for testing a certain UE category or not is specified in the individual minimum requirements.

A.2 UL reference measurement channels

A.2.1 General

The measurement channels in the following subclauses are defined to derive the requirements in clause 6 (Transmitter Characteristics) and clause 7 (Receiver Characteristics). The measurement channels represent example configurations of physical channels for different data rates.

A.2.2 Reference measurement channels for FDD

A.2.2.1 DFT-s-OFDM Pi/2-BPSK

Table A.2.2.1-1: Reference Channels for DFT-s-OFDM Pi/2-BPSK for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	15	1	11	pi/2 BPSK	0	1/4	32	16	2	1	132	132
	5	15	12	11	pi/2 BPSK	0	1/4	384	16	2	1	1584	1584
	5	15	25	11	pi/2 BPSK	0	1/4	808	16	2	1	3300	3300
	10	15	25	11	pi/2 BPSK	0	1/4	808	16	2	1	3300	3300
	10	15	50	11	pi/2 BPSK	0	1/4	1544	16	2	1	6600	6600
	15	15	36	11	pi/2 BPSK	0	1/4	1128	16	2	1	4752	4752
	15	15	75	11	pi/2 BPSK	0	1/4	2408	16	2	1	9900	9900
	20	15	50	11	pi/2 BPSK	0	1/4	1544	16	2	1	6600	6600
	20	15	100	11	pi/2 BPSK	0	1/4	3104	16	2	1	13200	13200
	25	15	64	11	pi/2 BPSK	0	1/4	2024	16	2	1	8448	8448
	25	15	128	11	pi/2 BPSK	0	1/4	3976	24	2	2	16896	16896
	30	15	80	11	pi/2 BPSK	0	1/4	2472	16	2	1	10560	10560
	30	15	160	11	pi/2 BPSK	0	1/4	4872	24	2	2	21120	21120
	40	15	108	11	pi/2 BPSK	0	1/4	3368	16	2	1	14256	14256
	40	15	216	11	pi/2 BPSK	0	1/4	6664	24	2	2	28512	28512
	50	15	135	11	pi/2 BPSK	0	1/4	4104	24	2	2	17820	17820
	50	15	270	11	pi/2 BPSK	0	1/4	8448	24	2	3	35640	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.1-2: Reference Channels for DFT-s-OFDM Pi/2-BPSK for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	30	1	11	pi/2 BPSK	0	1/4	32	16	2	1	132	132
	5	30	5	11	pi/2 BPSK	0	1/4	160	16	2	1	660	660
	5	30	10	11	pi/2 BPSK	0	1/4	320	16	2	1	1320	1320
	10	30	12	11	pi/2 BPSK	0	1/4	384	16	2	1	1584	1584
	10	30	24	11	pi/2 BPSK	0	1/4	768	16	2	1	3168	3168
	15	30	18	11	pi/2 BPSK	0	1/4	576	16	2	1	2376	2376
	15	30	36	11	pi/2 BPSK	0	1/4	1128	16	2	1	4752	4752
	20	30	25	11	pi/2 BPSK	0	1/4	808	16	2	1	3300	3300
	20	30	50	11	pi/2 BPSK	0	1/4	1544	16	2	1	6600	6600
	25	30	32	11	pi/2 BPSK	0	1/4	1032	16	2	1	4224	4224
	25	30	64	11	pi/2 BPSK	0	1/4	2024	16	2	1	8448	8448
	30	30	36	11	pi/2 BPSK	0	1/4	1128	16	2	1	4752	4752
	30	30	75	11	pi/2 BPSK	0	1/4	2408	16	2	1	9900	9900
	40	30	50	11	pi/2 BPSK	0	1/4	1544	16	2	1	6600	6600
	40	30	100	11	pi/2 BPSK	0	1/4	3104	16	2	1	13200	13200
	50	30	64	11	pi/2 BPSK	0	1/4	2024	16	2	1	8448	8448
	50	30	128	11	pi/2 BPSK	0	1/4	3976	24	2	2	16896	16896
	60	30	81	11	pi/2 BPSK	0	1/4	2536	16	2	1	10692	10692
	60	30	162	11	pi/2 BPSK	0	1/4	5000	24	2	2	21384	21384
	80	30	108	11	pi/2 BPSK	0	1/4	3368	16	2	1	14256	14256
	80	30	216	11	pi/2 BPSK	0	1/4	6664	24	2	2	28512	28512
	90	30	120	11	pi/2 BPSK	0	1/4	3752	16	2	1	15840	15840
	90	30	243	11	pi/2 BPSK	0	1/4	7560	24	2	2	32076	32076
	100	30	135	11	pi/2 BPSK	0	1/4	4104	24	2	2	17820	17820
	100	30	270	11	pi/2 BPSK	0	1/4	8448	24	2	3	35640	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.1-3: Reference Channels for DFT-s-OFDM Pi/2-BPSK for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	10-100	60	1	11	pi/2 BPSK	0	1/4	32	16	2	1	132	132
	10	60	5	11	pi/2 BPSK	0	1/4	160	16	2	1	660	660
	10	60	10	11	pi/2 BPSK	0	1/4	320	16	2	1	1320	1320
	15	60	9	11	pi/2 BPSK	0	1/4	288	16	2	1	1188	1188
	15	60	18	11	pi/2 BPSK	0	1/4	576	16	2	1	2376	2376
	20	60	12	11	pi/2 BPSK	0	1/4	384	16	2	1	1584	1584
	20	60	24	11	pi/2 BPSK	0	1/4	768	16	2	1	3168	3168
	25	60	15	11	pi/2 BPSK	0	1/4	480	16	2	1	1980	1980
	25	60	30	11	pi/2 BPSK	0	1/4	984	16	2	1	3960	3960
	30	60	18	11	pi/2 BPSK	0	1/4	576	16	2	1	2376	2376
	30	60	36	11	pi/2 BPSK	0	1/4	1128	16	2	1	4752	4752
	40	60	25	11	pi/2 BPSK	0	1/4	808	16	2	1	3300	3300
	40	60	50	11	pi/2 BPSK	0	1/4	1544	16	2	1	6600	6600
	50	60	32	11	pi/2 BPSK	0	1/4	1032	16	2	1	4224	4224
	50	60	64	11	pi/2 BPSK	0	1/4	2024	16	2	1	8448	8448
	60	60	36	11	pi/2 BPSK	0	1/4	1128	16	2	1	4752	4752
	60	60	75	11	pi/2 BPSK	0	1/4	2408	16	2	1	9900	9900
	80	60	50	11	pi/2 BPSK	0	1/4	1544	16	2	1	6600	6600
	80	60	100	11	pi/2 BPSK	0	1/4	3104	16	2	1	13200	13200
	90	60	60	11	pi/2 BPSK	0	1/4	1864	16	2	1	7920	7920
	90	60	120	11	pi/2 BPSK	0	1/4	3752	16	2	1	15840	15840
	100	60	64	11	pi/2 BPSK	0	1/4	2024	16	2	1	8448	8448
	100	60	135	11	pi/2 BPSK	0	1/4	4104	24	2	2	17820	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.2.2 DFT-s-OFDM QPSK

Table A.2.2.2-1: Reference Channels for DFT-s-OFDM QPSK for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	15	1	11	QPSK	2	1/6	56	16	2	1	264	132
	5	15	12	11	QPSK	2	1/6	608	16	2	1	3168	1584
	5	15	20	11	QPSK	2	1/6	1032	16	2	1	5280	2640
	5	15	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	10	15	20	11	QPSK	2	1/6	1032	16	2	1	5280	2640
	10	15	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	10	15	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	15	15	20	11	QPSK	2	1/6	1032	16	2	1	5280	2640
	15	15	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	15	15	36	11	QPSK	2	1/6	1800	16	2	1	9504	4752
	15	15	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	15	15	75	11	QPSK	2	1/6	3752	16	2	1	19800	9900
	20	15	20	11	QPSK	2	1/6	1032	16	2	1	5280	2640
	20	15	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	20	15	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	20	15	100	11	QPSK	2	1/6	5000	24	2	2	26400	13200
	25	15	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	25	15	64	11	QPSK	2	1/6	3240	16	2	1	16896	8448
	25	15	128	11	QPSK	2	1/6	6408	24	2	2	33792	16896
	30	15	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	30	15	80	11	QPSK	2	1/6	3976	24	2	2	21120	10560
	30	15	160	11	QPSK	2	1/6	7944	24	2	3	42240	21120
	40	15	108	11	QPSK	2	1/6	5384	24	2	2	28512	14256
	40	15	216	11	QPSK	2	1/6	10752	24	2	3	57024	28512
	50	15	135	11	QPSK	2	1/6	6664	24	2	2	35640	17820
	50	15	270	11	QPSK	2	1/6	13320	24	2	4	71280	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.2-2: Reference Channels for DFT-s-OFDM QPSK for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	30	1	11	QPSK	2	1/6	56	16	2	1	264	132
	5	30	5	11	QPSK	2	1/6	256	16	2	1	1320	660
	5	30	10	11	QPSK	2	1/6	504	16	2	1	2640	1320
	10	30	12	11	QPSK	2	1/6	608	16	2	1	3168	1584
	10	30	24	11	QPSK	2	1/6	1192	16	2	1	6336	3168
	15	30	18	11	QPSK	2	1/6	928	16	2	1	4752	2376
	15	30	36	11	QPSK	2	1/6	1800	16	2	1	9504	4752
	20	30	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	20	30	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	25	30	32	11	QPSK	2	1/6	1608	16	2	1	8448	4224
	25	30	64	11	QPSK	2	1/6	3240	16	2	1	16896	8448
	30	30	36	11	QPSK	2	1/6	1800	16	2	1	9504	4752
	30	30	75	11	QPSK	2	1/6	3752	16	2	1	19800	9900
	40	30	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	40	30	100	11	QPSK	2	1/6	5000	24	2	2	26400	13200
	50	30	64	11	QPSK	2	1/6	3240	16	2	1	16896	8448
	50	30	128	11	QPSK	2	1/6	6408	24	2	2	33792	16896
	60	30	81	11	QPSK	2	1/6	4040	24	2	2	21384	10692
	60	30	162	11	QPSK	2	1/6	8064	24	2	3	42768	21384
	80	30	108	11	QPSK	2	1/6	5384	24	2	2	28512	14256
	80	30	216	11	QPSK	2	1/6	10752	24	2	3	57024	28512
	90	30	120	11	QPSK	2	1/6	5896	24	2	2	31680	15840
	90	30	243	11	QPSK	2	1/6	12040	24	2	4	64152	32076
	100	30	135	11	QPSK	2	1/6	6664	24	2	2	35640	17820
	100	30	270	11	QPSK	2	1/6	13320	24	2	4	71280	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.2-3: Reference Channels for DFT-s-OFDM QPSK for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	10-100	60	1	11	QPSK	2	1/6	56	16	2	1	264	132
	10	60	5	11	QPSK	2	1/6	256	16	2	1	1320	660
	10	60	10	11	QPSK	2	1/6	504	16	2	1	2640	1320
	15	60	9	11	QPSK	2	1/6	456	16	2	1	2376	1188
	15	60	18	11	QPSK	2	1/6	928	16	2	1	4752	2376
	20	60	12	11	QPSK	2	1/6	608	16	2	1	3168	1584
	20	60	24	11	QPSK	2	1/6	1192	16	2	1	6336	3168
	25	60	15	11	QPSK	2	1/6	768	16	2	1	3960	1980
	25	60	30	11	QPSK	2	1/6	1544	16	2	1	7920	3960
	30	60	18	11	QPSK	2	1/6	928	16	2	1	4752	2376
	30	60	36	11	QPSK	2	1/6	1800	16	2	1	9504	4752
	40	60	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	40	60	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	50	60	32	11	QPSK	2	1/6	1608	16	2	1	8448	4224
	50	60	64	11	QPSK	2	1/6	3240	16	2	1	16896	8448
	60	60	36	11	QPSK	2	1/6	1800	16	2	1	9504	4752
	60	60	75	11	QPSK	2	1/6	3752	16	2	1	19800	9900
	80	60	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	80	60	100	11	QPSK	2	1/6	5000	24	2	2	26400	13200
	90	60	60	11	QPSK	2	1/6	3104	16	2	1	15840	7920
	90	60	120	11	QPSK	2	1/6	5896	24	2	2	31680	15840
	100	60	64	11	QPSK	2	1/6	3240	16	2	1	16896	8448
	100	60	135	11	QPSK	2	1/6	6664	24	2	2	35640	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.2.3 DFT-s-OFDM 16QAM

Table A.2.2.3-1: Reference Channels for DFT-s-OFDM 16QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	15	1	11	16QAM	10	1/3	176	16	2	1	528	132
	5	15	12	11	16QAM	10	1/3	2088	16	2	1	6336	1584
	5	15	25	11	16QAM	10	1/3	4352	24	1	1	13200	3300
	10	15	25	11	16QAM	10	1/3	4352	24	1	1	13200	3300
	10	15	50	11	16QAM	10	1/3	8712	24	1	2	26400	6600
	15	15	36	11	16QAM	10	1/3	6272	24	1	1	19008	4752
	15	15	75	11	16QAM	10	1/3	13064	24	1	2	39600	9900
	20	15	50	11	16QAM	10	1/3	8712	24	1	2	26400	6600
	20	15	100	11	16QAM	10	1/3	17424	24	1	3	52800	13200
	25	15	64	11	16QAM	10	1/3	11272	24	1	2	33792	8448
	25	15	128	11	16QAM	10	1/3	22536	24	1	3	67584	16896
	30	15	80	11	16QAM	10	1/3	14088	24	1	2	42240	10560
	30	15	160	11	16QAM	10	1/3	28168	24	1	4	84480	21120
	40	15	108	11	16QAM	10	1/3	18960	24	1	3	57024	14256
	40	15	216	11	16QAM	10	1/3	37896	24	1	5	114048	28512
	50	15	135	11	16QAM	10	1/3	23568	24	1	3	71280	17820
	50	15	270	11	16QAM	10	1/3	47112	24	1	6	142560	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.3-2: Reference Channels for DFT-s-OFDM 16QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	5-50	30	1	11	16QAM	10	1/3	176	16	2	1	528	132
	5	30	5	11	16QAM	10	1/3	888	16	2	1	2640	660
	5	30	10	11	16QAM	10	1/3	1800	16	2	1	5280	1320
	10	30	12	11	16QAM	10	1/3	2088	16	2	1	6336	1584
	10	30	24	11	16QAM	10	1/3	4224	24	1	1	12672	3168
	15	30	18	11	16QAM	10	1/3	3240	16	2	1	9504	2376
	15	30	36	11	16QAM	10	1/3	6272	24	1	1	19008	4752
	20	30	25	11	16QAM	10	1/3	4352	24	1	1	13200	3300
	20	30	50	11	16QAM	10	1/3	8712	24	1	2	26400	6600
	25	30	32	11	16QAM	10	1/3	5632	24	1	1	16896	4224
	25	30	64	11	16QAM	10	1/3	11272	24	1	2	33792	8448
	30	30	36	11	16QAM	10	1/3	6272	24	1	1	19008	4752
	30	30	75	11	16QAM	10	1/3	13064	24	1	2	39600	9900
	40	30	50	11	16QAM	10	1/3	8712	24	1	2	26400	6600
	40	30	100	11	16QAM	10	1/3	17424	24	1	3	52800	13200
	50	30	64	11	16QAM	10	1/3	11272	24	1	2	33792	8448
	50	30	128	11	16QAM	10	1/3	22536	24	1	3	67584	16896
	60	30	81	11	16QAM	10	1/3	14088	24	1	2	42768	10692
	60	30	162	11	16QAM	10	1/3	28168	24	1	4	85536	21384
	80	30	108	11	16QAM	10	1/3	18960	24	1	3	57024	14256
	80	30	216	11	16QAM	10	1/3	37896	24	1	5	114048	28512
	90	30	120	11	16QAM	10	1/3	21000	24	1	3	63360	15840
	90	30	243	11	16QAM	10	1/3	43032	24	1	6	128304	32076
	100	30	135	11	16QAM	10	1/3	23568	24	1	3	71280	17820
	100	30	270	11	16QAM	10	1/3	47112	24	1	6	142560	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.3-3: Reference Channels for DFT-s-OFDM 16QAM for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	10-100	60	1	11	16QAM	10	1/3	176	16	2	1	528	132
	10	60	5	11	16QAM	10	1/3	888	16	2	1	2640	660
	10	60	10	11	16QAM	10	1/3	1800	16	2	1	5280	1320
	15	60	9	11	16QAM	10	1/3	1608	16	2	1	4752	1188
	15	60	18	11	16QAM	10	1/3	3240	16	2	1	9504	2376
	20	60	12	11	16QAM	10	1/3	2088	16	2	1	6336	1584
	20	60	24	11	16QAM	10	1/3	4224	24	1	1	12672	3168
	25	60	15	11	16QAM	10	1/3	2664	16	2	1	7920	1980
	25	60	30	11	16QAM	10	1/3	5248	24	1	1	15840	3960
	30	60	18	11	16QAM	10	1/3	3240	16	2	1	9504	2376
	30	60	36	11	16QAM	10	1/3	6272	24	1	1	19008	4752
	40	60	25	11	16QAM	10	1/3	4352	24	1	1	13200	3300
	40	60	50	11	16QAM	10	1/3	8712	24	1	2	26400	6600
	50	60	32	11	16QAM	10	1/3	5632	24	1	1	16896	4224
	50	60	64	11	16QAM	10	1/3	11272	24	1	2	33792	8448
	60	60	36	11	16QAM	10	1/3	6272	24	1	1	19008	4752
	60	60	75	11	16QAM	10	1/3	13064	24	1	2	39600	9900
	80	60	50	11	16QAM	10	1/3	8712	24	1	2	26400	6600
	80	60	100	11	16QAM	10	1/3	17424	24	1	3	52800	13200
	90	60	60	11	16QAM	10	1/3	10504	24	1	2	31680	7920
	90	60	120	11	16QAM	10	1/3	21000	24	1	3	63360	15840
	100	60	64	11	16QAM	10	1/3	11272	24	1	2	33792	8448
	100	60	135	11	16QAM	10	1/3	23568	24	1	3	71280	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.2.4 DFT-s-OFDM 64QAM

Table A.2.2.4-1: Reference Channels for DFT-s-OFDM 64QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	5	15	25	11	64QAM	18	1/2	9992	24	1	2	19800	3300
	10	15	50	11	64QAM	18	1/2	19968	24	1	3	39600	6600
	15	15	75	11	64QAM	18	1/2	30216	24	1	4	59400	9900
	20	15	100	11	64QAM	18	1/2	39936	24	1	5	79200	13200
	25	15	128	11	64QAM	18	1/2	51216	24	1	7	101376	16896
	30	15	160	11	64QAM	18	1/2	63528	24	1	8	126720	21120
	40	15	216	11	64QAM	18	1/2	86040	24	1	11	171072	28512
	50	15	270	11	64QAM	18	1/2	108552	24	1	13	213840	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.4-2: Reference Channels for DFT-s-OFDM 64QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	5	30	10	11	64QAM	18	1/2	3968	24	1	1	7920	1320
	10	30	24	11	64QAM	18	1/2	9480	24	1	2	19008	3168
	15	30	36	11	64QAM	18	1/2	14344	24	1	2	28512	4752
	20	30	50	11	64QAM	18	1/2	19968	24	1	3	39600	6600
	25	30	64	11	64QAM	18	1/2	25608	24	1	4	50688	8448
	30	30	75	11	64QAM	18	1/2	30216	24	1	4	59400	9900
	40	30	100	11	64QAM	18	1/2	39936	24	1	5	79200	13200
	50	30	128	11	64QAM	18	1/2	51216	24	1	7	101376	16896
	60	30	162	11	64QAM	18	1/2	64552	24	1	8	128304	21384
	80	30	216	11	64QAM	18	1/2	86040	24	1	11	171072	28512
	90	30	243	11	64QAM	18	1/2	96264	24	1	12	192456	32076
	100	30	270	11	64QAM	18	1/2	108552	24	1	13	213840	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.

Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].

Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.4-3: Reference Channels for DFT-s-OFDM 64QAM for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	10	60	10	11	64QAM	18	1/2	3968	24	1	1	7920	1320
	15	60	18	11	64QAM	18	1/2	7168	24	1	1	14256	2376
	20	60	24	11	64QAM	18	1/2	9480	24	1	2	19008	3168
	25	60	30	11	64QAM	18	1/2	12040	24	1	2	23760	3960
	30	60	36	11	64QAM	18	1/2	14344	24	1	2	28512	4752
	40	60	50	11	64QAM	18	1/2	19968	24	1	3	39600	6600
	50	60	64	11	64QAM	18	1/2	25608	24	1	4	50688	8448
	60	60	75	11	64QAM	18	1/2	30216	24	1	4	59400	9900
	80	60	100	11	64QAM	18	1/2	39936	24	1	5	79200	13200
	90	60	120	11	64QAM	18	1/2	48168	24	1	6	95040	15840
	100	60	135	11	64QAM	18	1/2	54296	24	1	7	106920	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.2.5 DFT-s-OFDM 256QAM

Table A.2.2.5-1: Reference Channels for DFT-s-OFDM 256QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	5	15	25	11	256QAM	20	2/3	17424	24	1	3	26400	3300
	10	15	50	11	256QAM	20	2/3	34816	24	1	5	52800	6600
	15	15	75	11	256QAM	20	2/3	53288	24	1	7	79200	9900
	20	15	100	11	256QAM	20	2/3	69672	24	1	9	105600	13200
	25	15	128	11	256QAM	20	2/3	90176	24	1	11	135168	16896
	30	15	160	11	256QAM	20	2/3	112648	24	1	14	168960	21120
	40	15	216	11	256QAM	20	2/3	151608	24	1	18	228096	28512
	50	15	270	11	256QAM	20	2/3	188576	24	1	23	285120	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.5-2: Reference Channels for DFT-s-OFDM 256QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	5	30	10	11	256QAM	20	2/3	7040	24	1	1	10560	1320
	10	30	24	11	256QAM	20	2/3	16896	24	1	3	25344	3168
	15	30	36	11	256QAM	20	2/3	25104	24	1	3	38016	4752
	20	30	50	11	256QAM	20	2/3	34816	24	1	5	52800	6600
	25	30	64	11	256QAM	20	2/3	45096	24	1	6	67584	8448
	30	30	75	11	256QAM	20	2/3	53288	24	1	7	79200	9900
	40	30	100	11	256QAM	20	2/3	69672	24	1	9	105600	13200
	50	30	128	11	256QAM	20	2/3	90176	24	1	11	135168	16896
	60	30	162	11	256QAM	20	2/3	114776	24	1	14	171072	21384
	80	30	216	11	256QAM	20	2/3	151608	24	1	18	228096	28512
	90	30	243	11	256QAM	20	2/3	172176	24	1	21	256608	32076
	100	30	270	11	256QAM	20	2/3	188576	24	1	23	285120	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.5-3: Reference Channels for DFT-s-OFDM 256QAM for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	10	60	10	11	256QAM	20	2/3	7040	24	1	1	10560	1320
	15	60	18	11	256QAM	20	2/3	12552	24	1	2	19008	2376
	20	60	24	11	256QAM	20	2/3	16896	24	1	3	25344	3168
	25	60	30	11	256QAM	20	2/3	21000	24	1	3	31680	3960
	30	60	36	11	256QAM	20	2/3	25104	24	1	3	38016	4752
	40	60	50	11	256QAM	20	2/3	34816	24	1	5	52800	6600
	50	60	64	11	256QAM	20	2/3	45096	24	1	6	67584	8448
	60	60	75	11	256QAM	20	2/3	53288	24	1	7	79200	9900
	80	60	100	11	256QAM	20	2/3	69672	24	1	9	105600	13200
	90	60	120	11	256QAM	20	2/3	83976	24	1	10	126720	15840
	100	60	135	11	256QAM	20	2/3	94248	24	1	12	142560	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.2.6 CP-OFDM QPSK

Table A.2.2.6-1: Reference Channels for CP-OFDM QPSK for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	5-50	15	1	11	QPSK	2	1/6	56	16	2	1	264	132
	5	15	13	11	QPSK	2	1/6	672	16	2	1	3432	1716
	5	15	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	10	15	26	11	QPSK	2	1/6	1288	16	2	1	6864	3432
	10	15	52	11	QPSK	2	1/6	2600	16	2	1	13728	6864
	15	15	40	11	QPSK	2	1/6	2024	16	2	1	10560	5280
	15	15	79	11	QPSK	2	1/6	3912	24	2	2	20856	10428
	20	15	53	11	QPSK	2	1/6	2664	16	2	1	13992	6996
	20	15	106	11	QPSK	2	1/6	5256	24	2	2	27984	13992
	25	15	67	11	QPSK	2	1/6	3368	16	2	1	17688	8844
	25	15	133	11	QPSK	2	1/6	6664	24	2	2	35112	17556
	30	15	80	11	QPSK	2	1/6	3976	24	2	2	21120	10560
	30	15	160	11	QPSK	2	1/6	7944	24	2	3	42240	21120
	40	15	108	11	QPSK	2	1/6	5384	24	2	2	28512	14256
	40	15	216	11	QPSK	2	1/6	10752	24	2	3	57024	28512
	50	15	135	11	QPSK	2	1/6	6664	24	2	2	35640	17820
	50	15	270	11	QPSK	2	1/6	13320	24	2	4	71280	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.6-2: Reference Channels for CP-OFDM QPSK for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	30	1	11	QPSK	2	1/6	56	16	2	1	264	132
	5	30	6	11	QPSK	2	1/6	304	16	2	1	1584	792
	5	30	11	11	QPSK	2	1/6	552	16	2	1	2904	1452
	10	30	12	11	QPSK	2	1/6	608	16	2	1	3168	1584
	10	30	24	11	QPSK	2	1/6	1192	16	2	1	6336	3168
	15	30	19	11	QPSK	2	1/6	984	16	2	1	5016	2508
	15	30	38	11	QPSK	2	1/6	1928	16	2	1	10032	5016
	20	30	26	11	QPSK	2	1/6	1288	16	2	1	6864	3432
	20	30	51	11	QPSK	2	1/6	2536	16	2	1	13464	6732
	25	30	33	11	QPSK	2	1/6	1672	16	2	1	8712	4356
	25	30	65	11	QPSK	2	1/6	3240	16	2	1	17160	8580
	30	30	39	11	QPSK	2	1/6	2024	16	2	1	10296	5148
	30	30	78	11	QPSK	2	1/6	3848	24	2	2	20592	10296
	40	30	53	11	QPSK	2	1/6	2664	16	2	1	13992	6996
	40	30	106	11	QPSK	2	1/6	5256	24	2	2	27984	13992
	50	30	67	11	QPSK	2	1/6	3368	16	2	1	17688	8844
	50	30	133	11	QPSK	2	1/6	6664	24	2	2	35112	17556
	60	30	81	11	QPSK	2	1/6	4040	24	2	2	21384	10692
	60	30	162	11	QPSK	2	1/6	8064	24	2	3	42768	21384
	80	30	109	11	QPSK	2	1/6	5384	24	2	2	28776	14388
	80	30	217	11	QPSK	2	1/6	10752	24	2	3	57288	28644
	90	30	123	11	QPSK	2	1/6	6152	24	2	2	32472	16236
	90	30	245	11	QPSK	2	1/6	12296	24	2	4	64680	32340
	100	30	137	11	QPSK	2	1/6	6792	24	2	2	36168	18084
	100	30	273	11	QPSK	2	1/6	13576	24	2	4	72072	36036

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.6-3: Reference Channels for CP-OFDM QPSK for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	10-100	60	1	11	QPSK	2	1/6	56	16	2	1	264	132
	10	60	6	11	QPSK	2	1/6	304	16	2	1	1584	792
	10	60	11	11	QPSK	2	1/6	552	16	2	1	2904	1452
	15	60	9	11	QPSK	2	1/6	456	16	2	1	2376	1188
	15	60	18	11	QPSK	2	1/6	928	16	2	1	4752	2376
	20	60	12	11	QPSK	2	1/6	608	16	2	1	3168	1584
	20	60	24	11	QPSK	2	1/6	1192	16	2	1	6336	3168
	25	60	16	11	QPSK	2	1/6	808	16	2	1	4224	2112
	25	60	31	11	QPSK	2	1/6	1544	16	2	1	8184	4092
	30	60	19	11	QPSK	2	1/6	984	16	2	1	5016	2508
	30	60	38	11	QPSK	2	1/6	1928	16	2	1	10032	5016
	40	60	26	11	QPSK	2	1/6	1288	16	2	1	6864	3432
	40	60	51	11	QPSK	2	1/6	2536	16	2	1	13464	6732
	50	60	33	11	QPSK	2	1/6	1672	16	2	1	8712	4356
	50	60	65	11	QPSK	2	1/6	3240	16	2	1	17160	8580
	60	60	40	11	QPSK	2	1/6	2024	16	2	1	10560	5280
	60	60	79	11	QPSK	2	1/6	3912	24	2	2	20856	10428
	80	60	54	11	QPSK	2	1/6	2664	16	2	1	14256	7128
	80	60	107	11	QPSK	2	1/6	5256	24	2	2	28248	14124
	90	60	61	11	QPSK	2	1/6	3104	16	2	1	16104	8052
	90	60	121	11	QPSK	2	1/6	6024	24	2	2	31944	15972
	100	60	68	11	QPSK	2	1/6	3368	16	2	1	17952	8976
	100	60	135	11	QPSK	2	1/6	6664	24	2	2	35640	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.2.7 CP-OFDM 16QAM

Table A.2.2.7-1: Reference Channels for CP-OFDM 16QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	15	1	11	16QAM	10	1/3	176	16	2	1	528	132
	5	15	13	11	16QAM	10	1/3	2280	16	2	1	6864	1716
	5	15	25	11	16QAM	10	1/3	4352	24	1	1	13200	3300
	10	15	26	11	16QAM	10	1/3	4480	24	1	1	13728	3432
	10	15	52	11	16QAM	10	1/3	9224	24	1	2	27456	6864
	15	15	40	11	16QAM	10	1/3	7040	24	1	1	21120	5280
	15	15	79	11	16QAM	10	1/3	13832	24	1	2	41712	10428
	20	15	53	11	16QAM	10	1/3	9224	24	1	2	27984	6996
	20	15	106	11	16QAM	10	1/3	18432	24	1	3	55968	13992
	25	15	67	11	16QAM	10	1/3	11784	24	1	2	35376	8844
	25	15	133	11	16QAM	10	1/3	23040	24	1	3	70224	17556
	30	15	80	11	16QAM	10	1/3	14088	24	1	2	42240	10560
	30	15	160	11	16QAM	10	1/3	28168	24	1	4	84480	21120
	40	15	108	11	16QAM	10	1/3	18960	24	1	3	57024	14256
	40	15	216	11	16QAM	10	1/3	37896	24	1	5	114048	28512
	50	15	135	11	16QAM	10	1/3	23568	24	1	3	71280	17820
	50	15	270	11	16QAM	10	1/3	47112	24	1	6	142560	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.7-2: Reference Channels for CP-OFDM 16QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	30	1	11	16QAM	10	1/3	176	16	2	1	528	132
	5	30	6	11	16QAM	10	1/3	1064	16	2	1	3168	792
	5	30	11	11	16QAM	10	1/3	1928	16	2	1	5808	1452
	10	30	12	11	16QAM	10	1/3	2088	16	2	1	6336	1584
	10	30	24	11	16QAM	10	1/3	4224	24	1	1	12672	3168
	15	30	19	11	16QAM	10	1/3	3368	16	2	1	10032	2508
	15	30	38	11	16QAM	10	1/3	6656	24	1	1	20064	5016
	20	30	26	11	16QAM	10	1/3	4480	24	1	1	13728	3432
	20	30	51	11	16QAM	10	1/3	8968	24	1	2	26928	6732
	25	30	33	11	16QAM	10	1/3	5760	24	1	1	17424	4356
	25	30	65	11	16QAM	10	1/3	11272	24	1	2	34320	8580
	30	30	39	11	16QAM	10	1/3	6784	24	1	1	20592	5148
	30	30	78	11	16QAM	10	1/3	13576	24	1	2	41184	10296
	40	30	53	11	16QAM	10	1/3	9224	24	1	2	27984	6996
	40	30	106	11	16QAM	10	1/3	18432	24	1	3	55968	13992
	50	30	67	11	16QAM	10	1/3	11784	24	1	2	35376	8844
	50	30	133	11	16QAM	10	1/3	23040	24	1	3	70224	17556
	60	30	81	11	16QAM	10	1/3	14088	24	1	2	42768	10692
	60	30	162	11	16QAM	10	1/3	28168	24	1	4	85536	21384
	80	30	109	11	16QAM	10	1/3	18960	24	1	3	57552	14388
	80	30	217	11	16QAM	10	1/3	37896	24	1	5	114576	28644
	90	30	123	11	16QAM	10	1/3	21504	24	1	3	64944	16236
	90	30	245	11	16QAM	10	1/3	43032	24	1	6	129360	32340
	100	30	137	11	16QAM	10	1/3	24072	24	1	3	72336	18084
	100	30	273	11	16QAM	10	1/3	48168	24	1	6	144144	36036

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.7-3: Reference Channels for CP-OFDM 16QAM for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	10-100	60	1	11	16QAM	10	1/3	176	16	2	1	528	132
	10	60	6	11	16QAM	10	1/3	1064	16	2	1	3168	792
	10	60	11	11	16QAM	10	1/3	1928	16	2	1	5808	1452
	15	60	9	11	16QAM	10	1/3	1608	16	2	1	4752	1188
	15	60	18	11	16QAM	10	1/3	3240	16	2	1	9504	2376
	20	60	12	11	16QAM	10	1/3	2088	16	2	1	6336	1584
	20	60	24	11	16QAM	10	1/3	4224	24	1	1	12672	3168
	25	60	16	11	16QAM	10	1/3	2792	16	2	1	8448	2112
	25	60	31	11	16QAM	10	1/3	5376	24	1	1	16368	4092
	30	60	19	11	16QAM	10	1/3	3368	16	2	1	10032	2508
	30	60	38	11	16QAM	10	1/3	6656	24	1	1	20064	5016
	40	60	26	11	16QAM	10	1/3	4480	24	1	1	13728	3432
	40	60	51	11	16QAM	10	1/3	8968	24	1	2	26928	6732
	50	60	33	11	16QAM	10	1/3	5760	24	1	1	17424	4356
	50	60	65	11	16QAM	10	1/3	11272	24	1	2	34320	8580
	60	60	40	11	16QAM	10	1/3	7040	24	1	1	21120	5280
	60	60	79	11	16QAM	10	1/3	13832	24	1	2	41712	10428
	80	60	54	11	16QAM	10	1/3	9480	24	1	2	28512	7128
	80	60	107	11	16QAM	10	1/3	18960	24	1	3	56496	14124
	90	60	61	11	16QAM	10	1/3	10760	24	1	2	32208	8052
	90	60	121	11	16QAM	10	1/3	21000	24	1	3	63888	15972
	100	60	68	11	16QAM	10	1/3	11784	24	1	2	35904	8976
	100	60	135	11	16QAM	10	1/3	23568	24	1	3	71280	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.2.8 CP-OFDM 64QAM

Table A.2.2.8-1: Reference Channels for CP-OFDM 64QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	MHz	KHz						Bits	Bits			Bits	
	5	15	25	11	64QAM	19	1/2	9992	24	1	2	19800	3300
	10	15	52	11	64QAM	19	1/2	21000	24	1	3	41184	6864
	15	15	79	11	64QAM	19	1/2	31752	24	1	4	62568	10428
	20	15	106	11	64QAM	19	1/2	42016	24	1	5	83952	13992
	25	15	133	11	64QAM	19	1/2	53288	24	1	7	105336	17556
	30	15	160	11	64QAM	19	1/2	63528	24	1	8	126720	21120
	40	15	216	11	64QAM	19	1/2	86040	24	1	11	171072	28512
	50	15	270	11	64QAM	19	1/2	108552	24	1	13	213840	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.8-2: Reference Channels for CP-OFDM 64QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	5	30	11	11	64QAM	19	1/2	4352	24	1	1	8712	1452
	10	30	24	11	64QAM	19	1/2	9480	24	1	2	19008	3168
	15	30	38	11	64QAM	19	1/2	15112	24	1	2	30096	5016
	20	30	51	11	64QAM	19	1/2	20496	24	1	3	40392	6732
	25	30	65	11	64QAM	19	1/2	26120	24	1	4	51480	8580
	30	30	78	11	64QAM	19	1/2	31240	24	1	4	61776	10296
	40	30	106	11	64QAM	19	1/2	42016	24	1	5	83952	13992
	50	30	133	11	64QAM	19	1/2	53288	24	1	7	105336	17556
	60	30	162	11	64QAM	19	1/2	64552	24	1	8	128304	21384
	80	30	217	11	64QAM	19	1/2	86040	24	1	11	171864	28644
	90	30	245	11	64QAM	19	1/2	98376	24	1	12	194040	32340
	100	30	273	11	64QAM	19	1/2	108552	24	1	13	216216	36036

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.8-3: Reference Channels for CP-OFDM 64QAM for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	10	60	11	11	64QAM	19	1/2	4352	24	1	1	8712	1452
	15	60	18	11	64QAM	19	1/2	7168	24	1	1	14256	2376
	20	60	24	11	64QAM	19	1/2	9480	24	1	2	19008	3168
	25	60	31	11	64QAM	19	1/2	12296	24	1	2	24552	4092
	30	60	38	11	64QAM	19	1/2	15112	24	1	2	30096	5016
	40	60	51	11	64QAM	19	1/2	20496	24	1	3	40392	6732
	50	60	65	11	64QAM	19	1/2	26120	24	1	4	51480	8580
	60	60	79	11	64QAM	19	1/2	31752	24	1	4	62568	10428
	80	60	107	11	64QAM	19	1/2	43032	24	1	6	84744	14124
	90	60	121	11	64QAM	19	1/2	48168	24	1	6	95832	15972
	100	60	135	11	64QAM	19	1/2	54296	24	1	7	106920	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.2.9 CP-OFDM 256QAM

Table A.2.2.9-1: Reference Channels for CP-OFDM 256QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	5	15	25	11	256QAM	20	2/3	17424	24	1	3	26400	3300
	10	15	52	11	256QAM	20	2/3	36896	24	1	5	54912	6864
	15	15	79	11	256QAM	20	2/3	55304	24	1	7	83424	10428
	20	15	106	11	256QAM	20	2/3	73776	24	1	9	111936	13992
	25	15	133	11	256QAM	20	2/3	94248	24	1	12	140448	17556
	30	15	160	11	256QAM	20	2/3	112648	24	1	14	168960	21120
	40	15	216	11	256QAM	20	2/3	151608	24	1	18	228096	28512
	50	15	270	11	256QAM	20	2/3	188576	24	1	23	285120	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.9-2: Reference Channels for CP-OFDM 256QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	5	30	11	11	256QAM	20	2/3	7680	24	1	1	11616	1452
	10	30	24	11	256QAM	20	2/3	16896	24	1	3	25344	3168
	15	30	38	11	256QAM	20	2/3	26632	24	1	4	40128	5016
	20	30	51	11	256QAM	20	2/3	35856	24	1	5	53856	6732
	25	30	65	11	256QAM	20	2/3	46104	24	1	6	68640	8580
	30	30	78	11	256QAM	20	2/3	55304	24	1	7	82368	10296
	40	30	106	11	256QAM	20	2/3	73776	24	1	9	111936	13992
	50	30	133	11	256QAM	20	2/3	94248	24	1	12	140448	17556
	60	30	162	11	256QAM	20	2/3	114776	24	1	14	171072	21384
	80	30	217	11	256QAM	20	2/3	151608	24	1	18	229152	28644
	90	30	245	11	256QAM	20	2/3	172176	24	1	21	258720	32340
	100	30	273	11	256QAM	20	2/3	192624	24	1	23	288288	36036

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.2.9-3: Reference Channels for CP-OFDM 256QAM for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	10	60	11	11	256QAM	20	2/3	7680	24	1	1	11616	1452
	15	60	18	11	256QAM	20	2/3	12552	24	1	2	19008	2376
	20	60	24	11	256QAM	20	2/3	16896	24	1	3	25344	3168
	25	60	31	11	256QAM	20	2/3	22032	24	1	3	32736	4092
	30	60	38	11	256QAM	20	2/3	26632	24	1	4	40128	5016
	40	60	51	11	256QAM	20	2/3	35856	24	1	5	53856	6732
	50	60	65	11	256QAM	20	2/3	46104	24	1	6	68640	8580
	60	60	79	11	256QAM	20	2/3	55304	24	1	7	83424	10428
	80	60	107	11	256QAM	20	2/3	75792	24	1	9	112992	14124
	90	60	121	11	256QAM	20	2/3	86040	24	1	11	127776	15972
	100	60	135	11	256QAM	20	2/3	94248	24	1	12	142560	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.3 Reference measurement channels for TDD

TDD slot patterns defined for reference sensitivity tests will be used for UL RMCs defined below.

A.2.3.1 DFT-s-OFDM Pi/2-BPSK

Table A.2.3.1-1: Reference Channels for DFT-s-OFDM Pi/2-BPSK for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 4 and 9	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 4 and 9 (Note 3)	Total number of bits per slot for slots 4 and 9	Total modulated symbols per slot for slots 4 and 9
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	15	1	11	pi/2 BPSK	0	1/4	32	16	2	1	132	132
	5	15	12	11	pi/2 BPSK	0	1/4	384	16	2	1	1584	1584
	5	15	25	11	pi/2 BPSK	0	1/4	808	16	2	1	3300	3300
	10	15	25	11	pi/2 BPSK	0	1/4	808	16	2	1	3300	3300
	10	15	50	11	pi/2 BPSK	0	1/4	1544	16	2	1	6600	6600
	15	15	36	11	pi/2 BPSK	0	1/4	1128	16	2	1	4752	4752
	15	15	75	11	pi/2 BPSK	0	1/4	2408	16	2	1	9900	9900
	20	15	50	11	pi/2 BPSK	0	1/4	1544	16	2	1	6600	6600
	20	15	100	11	pi/2 BPSK	0	1/4	3104	16	2	1	13200	13200
	25	15	64	11	pi/2 BPSK	0	1/4	2024	16	2	1	8448	8448
	25	15	128	11	pi/2 BPSK	0	1/4	3976	24	2	2	16896	16896
	30	15	80	11	pi/2 BPSK	0	1/4	2472	16	2	1	10560	10560
	30	15	160	11	pi/2 BPSK	0	1/4	4872	24	2	2	21120	21120
	40	15	108	11	pi/2 BPSK	0	1/4	3368	16	2	1	14256	14256
	40	15	216	11	pi/2 BPSK	0	1/4	6664	24	2	2	28512	28512
	50	15	135	11	pi/2 BPSK	0	1/4	4104	24	2	2	17820	17820
	50	15	270	11	pi/2 BPSK	0	1/4	8448	24	2	3	35640	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.1-2: Reference Channels for DFT-s-OFDM Pi/2-BPSK for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 8, 9, 18 and 19	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 8, 9, 18 and 19 (Note 3)	Total number of bits per slot for slots 8, 9, 18 and 19	Total modulated symbols per slot for slots 8, 9, 18 and 19
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	30	1	11	pi/2 BPSK	0	1/4	32	16	2	1	132	132
	5	30	5	11	pi/2 BPSK	0	1/4	160	16	2	1	660	660
	5	30	10	11	pi/2 BPSK	0	1/4	320	16	2	1	1320	1320
	10	30	12	11	pi/2 BPSK	0	1/4	384	16	2	1	1584	1584
	10	30	24	11	pi/2 BPSK	0	1/4	768	16	2	1	3168	3168
	15	30	18	11	pi/2 BPSK	0	1/4	576	16	2	1	2376	2376
	15	30	36	11	pi/2 BPSK	0	1/4	1128	16	2	1	4752	4752
	20	30	25	11	pi/2 BPSK	0	1/4	808	16	2	1	3300	3300
	20	30	50	11	pi/2 BPSK	0	1/4	1544	16	2	1	6600	6600
	25	30	32	11	pi/2 BPSK	0	1/4	1032	16	2	1	4224	4224
	25	30	64	11	pi/2 BPSK	0	1/4	2024	16	2	1	8448	8448
	30	30	36	11	pi/2 BPSK	0	1/4	1128	16	2	1	4752	4752
	30	30	75	11	pi/2 BPSK	0	1/4	2408	16	2	1	9900	9900
	40	30	50	11	pi/2 BPSK	0	1/4	1544	16	2	1	6600	6600
	40	30	100	11	pi/2 BPSK	0	1/4	3104	16	2	1	13200	13200
	50	30	64	11	pi/2 BPSK	0	1/4	2024	16	2	1	8448	8448
	50	30	128	11	pi/2 BPSK	0	1/4	3976	24	2	2	16896	16896
	60	30	81	11	pi/2 BPSK	0	1/4	2536	16	2	1	10692	10692
	60	30	162	11	pi/2 BPSK	0	1/4	5000	24	2	2	21384	21384
	80	30	108	11	pi/2 BPSK	0	1/4	3368	16	2	1	14256	14256
	80	30	216	11	pi/2 BPSK	0	1/4	6664	24	2	2	28512	28512
	90	30	120	11	pi/2 BPSK	0	1/4	3752	16	2	1	15840	15840
	90	30	243	11	pi/2 BPSK	0	1/4	7560	24	2	2	32076	32076
	100	30	135	11	pi/2 BPSK	0	1/4	4104	24	2	2	17820	17820
	100	30	270	11	pi/2 BPSK	0	1/4	8448	24	2	3	35640	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.1-3: Reference Channels for DFT-s-OFDM Pi/2-BPSK for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 16, 17, 18, 19, 36, 37, 38 and 39	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39 (Note 3)	Total number of bits per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39	Total modulated symbols per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39
Unit	MHz	KHz						Bits	Bits			Bits	
	10-100	60	1	11	pi/2 BPSK	0	1/4	32	16	2	1	132	132
	10	60	5	11	pi/2 BPSK	0	1/4	160	16	2	1	660	660
	10	60	10	11	pi/2 BPSK	0	1/4	320	16	2	1	1320	1320
	15	60	9	11	pi/2 BPSK	0	1/4	288	16	2	1	1188	1188
	15	60	18	11	pi/2 BPSK	0	1/4	576	16	2	1	2376	2376
	20	60	12	11	pi/2 BPSK	0	1/4	384	16	2	1	1584	1584
	20	60	24	11	pi/2 BPSK	0	1/4	768	16	2	1	3168	3168
	25	60	15	11	pi/2 BPSK	0	1/4	480	16	2	1	1980	1980
	25	60	30	11	pi/2 BPSK	0	1/4	984	16	2	1	3960	3960
	30	60	18	11	pi/2 BPSK	0	1/4	576	16	2	1	2376	2376
	30	60	36	11	pi/2 BPSK	0	1/4	1128	16	2	1	4752	4752
	40	60	25	11	pi/2 BPSK	0	1/4	808	16	2	1	3300	3300
	40	60	50	11	pi/2 BPSK	0	1/4	1544	16	2	1	6600	6600
	50	60	32	11	pi/2 BPSK	0	1/4	1032	16	2	1	4224	4224
	50	60	64	11	pi/2 BPSK	0	1/4	2024	16	2	1	8448	8448
	60	60	36	11	pi/2 BPSK	0	1/4	1128	16	2	1	4752	4752
	60	60	75	11	pi/2 BPSK	0	1/4	2408	16	2	1	9900	9900
	80	60	50	11	pi/2 BPSK	0	1/4	1544	16	2	1	6600	6600
	80	60	100	11	pi/2 BPSK	0	1/4	3104	16	2	1	13200	13200
	90	60	60	11	pi/2 BPSK	0	1/4	1864	16	2	1	7920	7920
	90	60	120	11	pi/2 BPSK	0	1/4	3752	16	2	1	15840	15840
	100	60	64	11	pi/2 BPSK	0	1/4	2024	16	2	1	8448	8448
	100	60	135	11	pi/2 BPSK	0	1/4	4104	24	2	2	17820	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.3.2 DFT-s-OFDM QPSK

Table A.2.3.2-1: Reference Channels for DFT-s-OFDM QPSK for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 4 and 9	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 4 and 9 (Note 3)	Total number of bits per slot for slots 4 and 9	Total modulated symbols per slot for slots 4 and 9
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	15	1	11	QPSK	2	1/6	56	16	2	1	264	132
	5	15	12	11	QPSK	2	1/6	608	16	2	1	3168	1584
	5	15	20	11	QPSK	2	1/6	1032	16	2	1	5280	2640
	5	15	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	10	15	20	11	QPSK	2	1/6	1032	16	2	1	5280	2640
	10	15	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	10	15	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	15	15	20	11	QPSK	2	1/6	1032	16	2	1	5280	2640
	15	15	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	15	15	36	11	QPSK	2	1/6	1800	16	2	1	9504	4752
	15	15	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	15	15	75	11	QPSK	2	1/6	3752	16	2	1	19800	9900
	20	15	20	11	QPSK	2	1/6	1032	16	2	1	5280	2640
	20	15	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	20	15	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	20	15	100	11	QPSK	2	1/6	5000	24	2	2	26400	13200
	25	15	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	25	15	64	11	QPSK	2	1/6	3240	16	2	1	16896	8448
	25	15	128	11	QPSK	2	1/6	6408	24	2	2	33792	16896
	30	15	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	30	15	80	11	QPSK	2	1/6	3976	24	2	2	21120	10560
	30	15	160	11	QPSK	2	1/6	7944	24	2	3	42240	21120
	40	15	108	11	QPSK	2	1/6	5384	24	2	2	28512	14256
	40	15	216	11	QPSK	2	1/6	10752	24	2	3	57024	28512
	50	15	135	11	QPSK	2	1/6	6664	24	2	2	35640	17820
	50	15	270	11	QPSK	2	1/6	13320	24	2	4	71280	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.2-2: Reference Channels for DFT-s-OFDM QPSK for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 8, 9, 18 and 19	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 8, 9, 18 and 19 (Note 3)	Total number of bits per slot for slots 8, 9, 18 and 19	Total modulated symbols per slot for slots 8, 9, 18 and 19
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	30	1	11	QPSK	2	1/6	56	16	2	1	264	132
	5	30	5	11	QPSK	2	1/6	256	16	2	1	1320	660
	5	30	10	11	QPSK	2	1/6	504	16	2	1	2640	1320
	10	30	12	11	QPSK	2	1/6	608	16	2	1	3168	1584
	10	30	24	11	QPSK	2	1/6	1192	16	2	1	6336	3168
	15	30	18	11	QPSK	2	1/6	928	16	2	1	4752	2376
	15	30	36	11	QPSK	2	1/6	1800	16	2	1	9504	4752
	20	30	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	20	30	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	25	30	32	11	QPSK	2	1/6	1608	16	2	1	8448	4224
	25	30	64	11	QPSK	2	1/6	3240	16	2	1	16896	8448
	30	30	36	11	QPSK	2	1/6	1800	16	2	1	9504	4752
	30	30	75	11	QPSK	2	1/6	3752	16	2	1	19800	9900
	40	30	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	40	30	100	11	QPSK	2	1/6	5000	24	2	2	26400	13200
	50	30	64	11	QPSK	2	1/6	3240	16	2	1	16896	8448
	50	30	128	11	QPSK	2	1/6	6408	24	2	2	33792	16896
	60	30	81	11	QPSK	2	1/6	4040	24	2	2	21384	10692
	60	30	162	11	QPSK	2	1/6	8064	24	2	3	42768	21384
	80	30	108	11	QPSK	2	1/6	5384	24	2	2	28512	14256
	80	30	216	11	QPSK	2	1/6	10752	24	2	3	57024	28512
	90	30	120	11	QPSK	2	1/6	5896	24	2	2	31680	15840
	90	30	243	11	QPSK	2	1/6	12040	24	2	4	64152	32076
	100	30	135	11	QPSK	2	1/6	6664	24	2	2	35640	17820
	100	30	270	11	QPSK	2	1/6	13320	24	2	4	71280	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.2-3: Reference Channels for DFT-s-OFDM QPSK for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 16, 17, 18, 19, 36, 37, 38 and 39	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39 (Note 3)	Total number of bits per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39	Total modulated symbols per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39
Unit	MHz	KHz						Bits	Bits			Bits	
	10-100	60	1	11	QPSK	2	1/6	56	16	2	1	264	132
	10	60	5	11	QPSK	2	1/6	256	16	2	1	1320	660
	10	60	10	11	QPSK	2	1/6	504	16	2	1	2640	1320
	15	60	9	11	QPSK	2	1/6	456	16	2	1	2376	1188
	15	60	18	11	QPSK	2	1/6	928	16	2	1	4752	2376
	20	60	12	11	QPSK	2	1/6	608	16	2	1	3168	1584
	20	60	24	11	QPSK	2	1/6	1192	16	2	1	6336	3168
	25	60	15	11	QPSK	2	1/6	768	16	2	1	3960	1980
	25	60	30	11	QPSK	2	1/6	1544	16	2	1	7920	3960
	30	60	18	11	QPSK	2	1/6	928	16	2	1	4752	2376
	30	60	36	11	QPSK	2	1/6	1800	16	2	1	9504	4752
	40	60	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	40	60	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	50	60	32	11	QPSK	2	1/6	1608	16	2	1	8448	4224
	50	60	64	11	QPSK	2	1/6	3240	16	2	1	16896	8448
	60	60	36	11	QPSK	2	1/6	1800	16	2	1	9504	4752
	60	60	75	11	QPSK	2	1/6	3752	16	2	1	19800	9900
	80	60	50	11	QPSK	2	1/6	2472	16	2	1	13200	6600
	80	60	100	11	QPSK	2	1/6	5000	24	2	2	26400	13200
	90	60	60	11	QPSK	2	1/6	3104	16	2	1	15840	7920
	90	60	120	11	QPSK	2	1/6	5896	24	2	2	31680	15840
	100	60	64	11	QPSK	2	1/6	3240	16	2	1	16896	8448
	100	60	135	11	QPSK	2	1/6	6664	24	2	2	35640	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.3.3 DFT-s-OFDM 16QAM

Table A.2.3.3-1: Reference Channels for DFT-s-OFDM 16QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 4 and 9	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 4 and 9 (Note 3)	Total number of bits per slot for slots 4 and 9	Total modulated symbols per slot for slots 4 and 9
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	15	1	11	16QAM	10	1/3	176	16	2	1	528	132
	5	15	12	11	16QAM	10	1/3	2088	16	2	1	6336	1584
	5	15	25	11	16QAM	10	1/3	4352	24	1	1	13200	3300
	10	15	25	11	16QAM	10	1/3	4352	24	1	1	13200	3300
	10	15	50	11	16QAM	10	1/3	8712	24	1	2	26400	6600
	15	15	36	11	16QAM	10	1/3	6272	24	1	1	19008	4752
	15	15	75	11	16QAM	10	1/3	13064	24	1	2	39600	9900
	20	15	50	11	16QAM	10	1/3	8712	24	1	2	26400	6600
	20	15	100	11	16QAM	10	1/3	17424	24	1	3	52800	13200
	25	15	64	11	16QAM	10	1/3	11272	24	1	2	33792	8448
	25	15	128	11	16QAM	10	1/3	22536	24	1	3	67584	16896
	30	15	80	11	16QAM	10	1/3	14088	24	1	2	42240	10560
	30	15	160	11	16QAM	10	1/3	28168	24	1	4	84480	21120
	40	15	108	11	16QAM	10	1/3	18960	24	1	3	57024	14256
	40	15	216	11	16QAM	10	1/3	37896	24	1	5	114048	28512
	50	15	135	11	16QAM	10	1/3	23568	24	1	3	71280	17820
	50	15	270	11	16QAM	10	1/3	47112	24	1	6	142560	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.3-2: Reference Channels for DFT-s-OFDM 16QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 8, 9, 18 and 19	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 8, 9, 18 and 19 (Note 3)	Total number of bits per slot for slots 8, 9, 18 and 19	Total modulated symbols per slot for slots 8, 9, 18 and 19
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	30	1	11	16QAM	10	1/3	176	16	2	1	528	132
	5	30	5	11	16QAM	10	1/3	888	16	2	1	2640	660
	5	30	10	11	16QAM	10	1/3	1800	16	2	1	5280	1320
	10	30	12	11	16QAM	10	1/3	2088	16	2	1	6336	1584
	10	30	24	11	16QAM	10	1/3	4224	24	1	1	12672	3168
	15	30	18	11	16QAM	10	1/3	3240	16	2	1	9504	2376
	15	30	36	11	16QAM	10	1/3	6272	24	1	1	19008	4752
	20	30	25	11	16QAM	10	1/3	4352	24	1	1	13200	3300
	20	30	50	11	16QAM	10	1/3	8712	24	1	2	26400	6600
	25	30	32	11	16QAM	10	1/3	5632	24	1	1	16896	4224
	25	30	64	11	16QAM	10	1/3	11272	24	1	2	33792	8448
	30	30	36	11	16QAM	10	1/3	6272	24	1	1	19008	4752
	30	30	75	11	16QAM	10	1/3	13064	24	1	2	39600	9900
	40	30	50	11	16QAM	10	1/3	8712	24	1	2	26400	6600
	40	30	100	11	16QAM	10	1/3	17424	24	1	3	52800	13200
	50	30	64	11	16QAM	10	1/3	11272	24	1	2	33792	8448
	50	30	128	11	16QAM	10	1/3	22536	24	1	3	67584	16896
	60	30	81	11	16QAM	10	1/3	14088	24	1	2	42768	10692
	60	30	162	11	16QAM	10	1/3	28168	24	1	4	85536	21384
	80	30	108	11	16QAM	10	1/3	18960	24	1	3	57024	14256
	80	30	216	11	16QAM	10	1/3	37896	24	1	5	114048	28512
	90	30	120	11	16QAM	10	1/3	21000	24	1	3	63360	15840
	90	30	243	11	16QAM	10	1/3	43032	24	1	6	128304	32076
	100	30	135	11	16QAM	10	1/3	23568	24	1	3	71280	17820
	100	30	270	11	16QAM	10	1/3	47112	24	1	6	142560	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.3-3: Reference Channels for DFT-s-OFDM 16QAM for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 16, 17, 18, 19, 36, 37, 38 and 39	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39 (Note 3)	Total number of bits per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39	Total modulated symbols per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39
Unit	MHz	KHz						Bits	Bits			Bits	
	10-100	60	1	11	16QAM	10	1/3	176	16	2	1	528	132
	10	60	5	11	16QAM	10	1/3	888	16	2	1	2640	660
	10	60	10	11	16QAM	10	1/3	1800	16	2	1	5280	1320
	15	60	9	11	16QAM	10	1/3	1608	16	2	1	4752	1188
	15	60	18	11	16QAM	10	1/3	3240	16	2	1	9504	2376
	20	60	12	11	16QAM	10	1/3	2088	16	2	1	6336	1584
	20	60	24	11	16QAM	10	1/3	4224	24	1	1	12672	3168
	25	60	15	11	16QAM	10	1/3	2664	16	2	1	7920	1980
	25	60	30	11	16QAM	10	1/3	5248	24	1	1	15840	3960
	30	60	18	11	16QAM	10	1/3	3240	16	2	1	9504	2376
	30	60	36	11	16QAM	10	1/3	6272	24	1	1	19008	4752
	40	60	25	11	16QAM	10	1/3	4352	24	1	1	13200	3300
	40	60	50	11	16QAM	10	1/3	8712	24	1	2	26400	6600
	50	60	32	11	16QAM	10	1/3	5632	24	1	1	16896	4224
	50	60	64	11	16QAM	10	1/3	11272	24	1	2	33792	8448
	60	60	36	11	16QAM	10	1/3	6272	24	1	1	19008	4752
	60	60	75	11	16QAM	10	1/3	13064	24	1	2	39600	9900
	80	60	50	11	16QAM	10	1/3	8712	24	1	2	26400	6600
	80	60	100	11	16QAM	10	1/3	17424	24	1	3	52800	13200
	90	60	60	11	16QAM	10	1/3	10504	24	1	2	31680	7920
	90	60	120	11	16QAM	10	1/3	21000	24	1	3	63360	15840
	100	60	64	11	16QAM	10	1/3	11272	24	1	2	33792	8448
	100	60	135	11	16QAM	10	1/3	23568	24	1	3	71280	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.3.4 DFT-s-OFDM 64QAM

Table A.2.3.4-1: Reference Channels for DFT-s-OFDM 64QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 4 and 9	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 4 and 9 (Note 3)	Total number of bits per slot for slots 4 and 9	Total modulated symbols per slot for slots 4 and 9
Unit	MHz	KHz						Bits	Bits			Bits	
	5	15	25	11	64QAM	18	1/2	9992	24	1	2	19800	3300
	10	15	50	11	64QAM	18	1/2	19968	24	1	3	39600	6600
	15	15	75	11	64QAM	18	1/2	30216	24	1	4	59400	9900
	20	15	100	11	64QAM	18	1/2	39936	24	1	5	79200	13200
	25	15	128	11	64QAM	18	1/2	51216	24	1	7	101376	16896
	30	15	160	11	64QAM	18	1/2	63528	24	1	8	126720	21120
	40	15	216	11	64QAM	18	1/2	86040	24	1	11	171072	28512
	50	15	270	11	64QAM	18	1/2	108552	24	1	13	213840	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.4-2: Reference Channels for DFT-s-OFDM 64QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 8, 9, 18 and 19	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 8, 9, 18 and 19 (Note 3)	Total number of bits per slot for slots 8, 9, 18 and 19	Total modulated symbols per slot for slots 8, 9, 18 and 19
Unit	MHz	KHz						Bits	Bits			Bits	
	5	30	10	11	64QAM	18	1/2	3968	24	1	1	7920	1320
	10	30	24	11	64QAM	18	1/2	9480	24	1	2	19008	3168
	15	30	36	11	64QAM	18	1/2	14344	24	1	2	28512	4752
	20	30	50	11	64QAM	18	1/2	19968	24	1	3	39600	6600
	25	30	64	11	64QAM	18	1/2	25608	24	1	4	50688	8448
	30	30	75	11	64QAM	18	1/2	30216	24	1	4	59400	9900
	40	30	100	11	64QAM	18	1/2	39936	24	1	5	79200	13200
	50	30	128	11	64QAM	18	1/2	51216	24	1	7	101376	16896
	60	30	162	11	64QAM	18	1/2	64552	24	1	8	128304	21384
	80	30	216	11	64QAM	18	1/2	86040	24	1	11	171072	28512
	90	30	243	11	64QAM	18	1/2	96264	24	1	12	192456	32076
	100	30	270	11	64QAM	18	1/2	108552	24	1	13	213840	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.4-3: Reference Channels for DFT-s-OFDM 64QAM for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 16, 17, 18, 19, 36, 37, 38 and 39	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39 (Note 3)	Total number of bits per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39	Total modulated symbols per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39
Unit	MHz	KHz						Bits	Bits			Bits	
	10	60	10	11	64QAM	18	1/2	3968	24	1	1	7920	1320
	15	60	18	11	64QAM	18	1/2	7168	24	1	1	14256	2376
	20	60	24	11	64QAM	18	1/2	9480	24	1	2	19008	3168
	25	60	30	11	64QAM	18	1/2	12040	24	1	2	23760	3960
	30	60	36	11	64QAM	18	1/2	14344	24	1	2	28512	4752
	40	60	50	11	64QAM	18	1/2	19968	24	1	3	39600	6600
	50	60	64	11	64QAM	18	1/2	25608	24	1	4	50688	8448
	60	60	75	11	64QAM	18	1/2	30216	24	1	4	59400	9900
	80	60	100	11	64QAM	18	1/2	39936	24	1	5	79200	13200
	90	60	120	11	64QAM	18	1/2	48168	24	1	6	95040	15840
	100	60	135	11	64QAM	18	1/2	54296	24	1	7	106920	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.3.5 DFT-s-OFDM 256QAM

Table A.2.3.5-1: Reference Channels for DFT-s-OFDM 256QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 4 and 9	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 4 and 9 (Note 3)	Total number of bits per slot for slots 4 and 9	Total modulated symbols per slot for slots 4 and 9
Unit	MHz	KHz						Bits	Bits			Bits	
	5	15	25	11	256QAM	20	2/3	17424	24	1	3	26400	3300
	10	15	50	11	256QAM	20	2/3	34816	24	1	5	52800	6600
	15	15	75	11	256QAM	20	2/3	53288	24	1	7	79200	9900
	20	15	100	11	256QAM	20	2/3	69672	24	1	9	105600	13200
	25	15	128	11	256QAM	20	2/3	90176	24	1	11	135168	16896
	30	15	160	11	256QAM	20	2/3	112648	24	1	14	168960	21120
	40	15	216	11	256QAM	20	2/3	151608	24	1	18	228096	28512
	50	15	270	11	256QAM	20	2/3	188576	24	1	23	285120	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.5-2: Reference Channels for DFT-s-OFDM 256QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 8, 9, 18 and 19	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 8, 9, 18 and 19 (Note 3)	Total number of bits per slot for slots 8, 9, 18 and 19	Total modulated symbols per slot for slots 8, 9, 18 and 19
Unit	MHz	KHz						Bits	Bits			Bits	
	5	30	10	11	256QAM	20	2/3	7040	24	1	1	10560	1320
	10	30	24	11	256QAM	20	2/3	16896	24	1	3	25344	3168
	15	30	36	11	256QAM	20	2/3	25104	24	1	3	38016	4752
	20	30	50	11	256QAM	20	2/3	34816	24	1	5	52800	6600
	25	30	64	11	256QAM	20	2/3	45096	24	1	6	67584	8448
	30	30	75	11	256QAM	20	2/3	53288	24	1	7	79200	9900
	40	30	100	11	256QAM	20	2/3	69672	24	1	9	105600	13200
	50	30	128	11	256QAM	20	2/3	90176	24	1	11	135168	16896
	60	30	162	11	256QAM	20	2/3	114776	24	1	14	171072	21384
	80	30	216	11	256QAM	20	2/3	151608	24	1	18	228096	28512
	90	30	243	11	256QAM	20	2/3	172176	24	1	21	256608	32076
	100	30	270	11	256QAM	20	2/3	188576	24	1	23	285120	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.5-3: Reference Channels for DFT-s-OFDM 256QAM for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 16, 17, 18, 19, 36, 37, 38 and 39	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39 (Note 3)	Total number of bits per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39	Total modulated symbols per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39
Unit	MHz	KHz						Bits	Bits			Bits	
	10	60	10	11	256QAM	20	2/3	7040	24	1	1	10560	1320
	15	60	18	11	256QAM	20	2/3	12552	24	1	2	19008	2376
	20	60	24	11	256QAM	20	2/3	16896	24	1	3	25344	3168
	25	60	30	11	256QAM	20	2/3	21000	24	1	3	31680	3960
	30	60	36	11	256QAM	20	2/3	25104	24	1	3	38016	4752
	40	60	50	11	256QAM	20	2/3	34816	24	1	5	52800	6600
	50	60	64	11	256QAM	20	2/3	45096	24	1	6	67584	8448
	60	60	75	11	256QAM	20	2/3	53288	24	1	7	79200	9900
	80	60	100	11	256QAM	20	2/3	69672	24	1	9	105600	13200
	90	60	120	11	256QAM	20	2/3	83976	24	1	10	126720	15840
	100	60	135	11	256QAM	20	2/3	94248	24	1	12	142560	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.3.6 CP-OFDM QPSK

Table A.2.3.6-1: Reference Channels for CP-OFDM QPSK for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 4 and 9	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 4 and 9 (Note 3)	Total number of bits per slot for slots 4 and 9	Total modulated symbols per slot for slots 4 and 9
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	15	1	11	QPSK	2	1/6	56	16	2	1	264	132
	5	15	13	11	QPSK	2	1/6	672	16	2	1	3432	1716
	5	15	25	11	QPSK	2	1/6	1256	16	2	1	6600	3300
	10	15	26	11	QPSK	2	1/6	1288	16	2	1	6864	3432
	10	15	52	11	QPSK	2	1/6	2600	16	2	1	13728	6864
	15	15	40	11	QPSK	2	1/6	2024	16	2	1	10560	5280
	15	15	79	11	QPSK	2	1/6	3912	24	2	2	20856	10428
	20	15	53	11	QPSK	2	1/6	2664	16	2	1	13992	6996
	20	15	106	11	QPSK	2	1/6	5256	24	2	2	27984	13992
	25	15	67	11	QPSK	2	1/6	3368	16	2	1	17688	8844
	25	15	133	11	QPSK	2	1/6	6664	24	2	2	35112	17556
	30	15	80	11	QPSK	2	1/6	3976	24	2	2	21120	10560
	30	15	160	11	QPSK	2	1/6	7944	24	2	3	42240	21120
	40	15	108	11	QPSK	2	1/6	5384	24	2	2	28512	14256
	40	15	216	11	QPSK	2	1/6	10752	24	2	3	57024	28512
	50	15	135	11	QPSK	2	1/6	6664	24	2	2	35640	17820
	50	15	270	11	QPSK	2	1/6	13320	24	2	4	71280	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.6-2: Reference Channels for CP-OFDM QPSK for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 8, 9, 18 and 19	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 8, 9, 18 and 19 (Note 3)	Total number of bits per slot for slots 8, 9, 18 and 19	Total modulated symbols per slot for slots 8, 9, 18 and 19
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	30	1	11	QPSK	2	1/6	56	16	2	1	264	132
	5	30	6	11	QPSK	2	1/6	304	16	2	1	1584	792
	5	30	11	11	QPSK	2	1/6	552	16	2	1	2904	1452
	10	30	12	11	QPSK	2	1/6	608	16	2	1	3168	1584
	10	30	24	11	QPSK	2	1/6	1192	16	2	1	6336	3168
	15	30	19	11	QPSK	2	1/6	984	16	2	1	5016	2508
	15	30	38	11	QPSK	2	1/6	1928	16	2	1	10032	5016
	20	30	26	11	QPSK	2	1/6	1288	16	2	1	6864	3432
	20	30	51	11	QPSK	2	1/6	2536	16	2	1	13464	6732
	25	30	33	11	QPSK	2	1/6	1672	16	2	1	8712	4356
	25	30	65	11	QPSK	2	1/6	3240	16	2	1	17160	8580
	30	30	39	11	QPSK	2	1/6	2024	16	2	1	10296	5148
	30	30	78	11	QPSK	2	1/6	3848	24	2	2	20592	10296
	40	30	53	11	QPSK	2	1/6	2664	16	2	1	13992	6996
	40	30	106	11	QPSK	2	1/6	5256	24	2	2	27984	13992
	50	30	67	11	QPSK	2	1/6	3368	16	2	1	17688	8844
	50	30	133	11	QPSK	2	1/6	6664	24	2	2	35112	17556
	60	30	81	11	QPSK	2	1/6	4040	24	2	2	21384	10692
	60	30	162	11	QPSK	2	1/6	8064	24	2	3	42768	21384
	80	30	109	11	QPSK	2	1/6	5384	24	2	2	28776	14388
	80	30	217	11	QPSK	2	1/6	10752	24	2	3	57288	28644
	90	30	123	11	QPSK	2	1/6	6152	24	2	2	32472	16236
	90	30	245	11	QPSK	2	1/6	12296	24	2	4	64680	32340
	100	30	137	11	QPSK	2	1/6	6792	24	2	2	36168	18084
	100	30	273	11	QPSK	2	1/6	13576	24	2	4	72072	36036

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.6-3: Reference Channels for CP-OFDM QPSK for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 16, 17, 18, 19, 36, 37, 38 and 39	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39 (Note 3)	Total number of bits per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39	Total modulated symbols per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39
Unit	MHz	KHz						Bits	Bits			Bits	
	10-100	60	1	11	QPSK	2	1/6	56	16	2	1	264	132
	10	60	6	11	QPSK	2	1/6	304	16	2	1	1584	792
	10	60	11	11	QPSK	2	1/6	552	16	2	1	2904	1452
	15	60	9	11	QPSK	2	1/6	456	16	2	1	2376	1188
	15	60	18	11	QPSK	2	1/6	928	16	2	1	4752	2376
	20	60	12	11	QPSK	2	1/6	608	16	2	1	3168	1584
	20	60	24	11	QPSK	2	1/6	1192	16	2	1	6336	3168
	25	60	16	11	QPSK	2	1/6	808	16	2	1	4224	2112
	25	60	31	11	QPSK	2	1/6	1544	16	2	1	8184	4092
	30	60	19	11	QPSK	2	1/6	984	16	2	1	5016	2508
	30	60	38	11	QPSK	2	1/6	1928	16	2	1	10032	5016
	40	60	26	11	QPSK	2	1/6	1288	16	2	1	6864	3432
	40	60	51	11	QPSK	2	1/6	2536	16	2	1	13464	6732
	50	60	33	11	QPSK	2	1/6	1672	16	2	1	8712	4356
	50	60	65	11	QPSK	2	1/6	3240	16	2	1	17160	8580
	60	60	40	11	QPSK	2	1/6	2024	16	2	1	10560	5280
	60	60	79	11	QPSK	2	1/6	3912	24	2	2	20856	10428
	80	60	54	11	QPSK	2	1/6	2664	16	2	1	14256	7128
	80	60	107	11	QPSK	2	1/6	5256	24	2	2	28248	14124
	90	60	61	11	QPSK	2	1/6	3104	16	2	1	16104	8052
	90	60	121	11	QPSK	2	1/6	6024	24	2	2	31944	15972
	100	60	68	11	QPSK	2	1/6	3368	16	2	1	17952	8976
	100	60	135	11	QPSK	2	1/6	6664	24	2	2	35640	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.3.7 CP-OFDM 16QAM

Table A.2.3.7-1: Reference Channels for CP-OFDM 16QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 4 and 9	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 4 and 9 (Note 3)	Total number of bits per slot for slots 4 and 9	Total modulated symbols per slot for slots 4 and 9
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	15	1	11	16QAM	10	1/3	176	16	2	1	528	132
	5	15	13	11	16QAM	10	1/3	2280	16	2	1	6864	1716
	5	15	25	11	16QAM	10	1/3	4352	24	1	1	13200	3300
	10	15	26	11	16QAM	10	1/3	4480	24	1	1	13728	3432
	10	15	52	11	16QAM	10	1/3	9224	24	1	2	27456	6864
	15	15	40	11	16QAM	10	1/3	7040	24	1	1	21120	5280
	15	15	79	11	16QAM	10	1/3	13832	24	1	2	41712	10428
	20	15	53	11	16QAM	10	1/3	9224	24	1	2	27984	6996
	20	15	106	11	16QAM	10	1/3	18432	24	1	3	55968	13992
	25	15	67	11	16QAM	10	1/3	11784	24	1	2	35376	8844
	25	15	133	11	16QAM	10	1/3	23040	24	1	3	70224	17556
	30	15	80	11	16QAM	10	1/3	14088	24	1	2	42240	10560
	30	15	160	11	16QAM	10	1/3	28168	24	1	4	84480	21120
	40	15	108	11	16QAM	10	1/3	18960	24	1	3	57024	14256
	40	15	216	11	16QAM	10	1/3	37896	24	1	5	114048	28512
	50	15	135	11	16QAM	10	1/3	23568	24	1	3	71280	17820
	50	15	270	11	16QAM	10	1/3	47112	24	1	6	142560	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.7-2: Reference Channels for CP-OFDM 16QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 8, 9, 18 and 19	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 8, 9, 18 and 19 (Note 3)	Total number of bits per slot for slots 8, 9, 18 and 19	Total modulated symbols per slot for slots 8, 9, 18 and 19
Unit	MHz	KHz						Bits	Bits			Bits	
	5-50	30	1	11	16QAM	10	1/3	176	16	2	1	528	132
	5	30	6	11	16QAM	10	1/3	1064	16	2	1	3168	792
	5	30	11	11	16QAM	10	1/3	1928	16	2	1	5808	1452
	10	30	12	11	16QAM	10	1/3	2088	16	2	1	6336	1584
	10	30	24	11	16QAM	10	1/3	4224	24	1	1	12672	3168
	15	30	19	11	16QAM	10	1/3	3368	16	2	1	10032	2508
	15	30	38	11	16QAM	10	1/3	6656	24	1	1	20064	5016
	20	30	26	11	16QAM	10	1/3	4480	24	1	1	13728	3432
	20	30	51	11	16QAM	10	1/3	8968	24	1	2	26928	6732
	25	30	33	11	16QAM	10	1/3	5760	24	1	1	17424	4356
	25	30	65	11	16QAM	10	1/3	11272	24	1	2	34320	8580
	30	30	39	11	16QAM	10	1/3	6784	24	1	1	20592	5148
	30	30	78	11	16QAM	10	1/3	13576	24	1	2	41184	10296
	40	30	53	11	16QAM	10	1/3	9224	24	1	2	27984	6996
	40	30	106	11	16QAM	10	1/3	18432	24	1	3	55968	13992
	50	30	67	11	16QAM	10	1/3	11784	24	1	2	35376	8844
	50	30	133	11	16QAM	10	1/3	23040	24	1	3	70224	17556
	60	30	81	11	16QAM	10	1/3	14088	24	1	2	42768	10692
	60	30	162	11	16QAM	10	1/3	28168	24	1	4	85536	21384
	80	30	109	11	16QAM	10	1/3	18960	24	1	3	57552	14388
	80	30	217	11	16QAM	10	1/3	37896	24	1	5	114576	28644
	90	30	123	11	16QAM	10	1/3	21504	24	1	3	64944	16236
	90	30	245	11	16QAM	10	1/3	43032	24	1	6	129360	32340
	100	30	137	11	16QAM	10	1/3	24072	24	1	3	72336	18084
	100	30	273	11	16QAM	10	1/3	48168	24	1	6	144144	36036

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.7-3: Reference Channels for CP-OFDM 16QAM for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 16, 17, 18, 19, 36, 37, 38 and 39	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39 (Note 3)	Total number of bits per slot for slots 416, 17, 18, 19, 36, 37, 38 and 39	Total modulated symbols per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39
Unit	MHz	KHz						Bits	Bits			Bits	
	10-100	60	1	11	16QAM	10	1/3	176	16	2	1	528	132
	10	60	6	11	16QAM	10	1/3	1064	16	2	1	3168	792
	10	60	11	11	16QAM	10	1/3	1928	16	2	1	5808	1452
	15	60	9	11	16QAM	10	1/3	1608	16	2	1	4752	1188
	15	60	18	11	16QAM	10	1/3	3240	16	2	1	9504	2376
	20	60	12	11	16QAM	10	1/3	2088	16	2	1	6336	1584
	20	60	24	11	16QAM	10	1/3	4224	24	1	1	12672	3168
	25	60	16	11	16QAM	10	1/3	2792	16	2	1	8448	2112
	25	60	31	11	16QAM	10	1/3	5376	24	1	1	16368	4092
	30	60	19	11	16QAM	10	1/3	3368	16	2	1	10032	2508
	30	60	38	11	16QAM	10	1/3	6656	24	1	1	20064	5016
	40	60	26	11	16QAM	10	1/3	4480	24	1	1	13728	3432
	40	60	51	11	16QAM	10	1/3	8968	24	1	2	26928	6732
	50	60	33	11	16QAM	10	1/3	5760	24	1	1	17424	4356
	50	60	65	11	16QAM	10	1/3	11272	24	1	2	34320	8580
	60	60	40	11	16QAM	10	1/3	7040	24	1	1	21120	5280
	60	60	79	11	16QAM	10	1/3	13832	24	1	2	41712	10428
	80	60	54	11	16QAM	10	1/3	9480	24	1	2	28512	7128
	80	60	107	11	16QAM	10	1/3	18960	24	1	3	56496	14124
	90	60	61	11	16QAM	10	1/3	10760	24	1	2	32208	8052
	90	60	121	11	16QAM	10	1/3	21000	24	1	3	63888	15972
	100	60	68	11	16QAM	10	1/3	11784	24	1	2	35904	8976
	100	60	135	11	16QAM	10	1/3	23568	24	1	3	71280	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.3.8 CP-OFDM 64QAM

Table A.2.3.8-1: Reference Channels for CP-OFDM 64QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 4 and 9	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 4 and 9 (Note 3)	Total number of bits per slot for slots 4 and 9	Total modulated symbols per slot for slots 4 and 9
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	5	15	25	11	64QAM	19	1/2	9992	24	1	2	19800	3300
	10	15	52	11	64QAM	19	1/2	21000	24	1	3	41184	6864
	15	15	79	11	64QAM	19	1/2	31752	24	1	4	62568	10428
	20	15	106	11	64QAM	19	1/2	42016	24	1	5	83952	13992
	25	15	133	11	64QAM	19	1/2	53288	24	1	7	105336	17556
	30	15	160	11	64QAM	19	1/2	63528	24	1	8	126720	21120
	40	15	216	11	64QAM	19	1/2	86040	24	1	11	171072	28512
	50	15	270	11	64QAM	19	1/2	108552	24	1	13	213840	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.8-2: Reference Channels for CP-OFDM 64QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 8, 9, 18 and 19	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 8, 9, 18 and 19 (Note 3)	Total number of bits per slot for slots 8, 9, 18 and 19	Total modulated symbols per slot for slots 8, 9, 18 and 19
Unit	MHz	KHz						Bits	Bits			Bits	
	5	30	11	11	64QAM	19	1/2	4352	24	1	1	8712	1452
	10	30	24	11	64QAM	19	1/2	9480	24	1	2	19008	3168
	15	30	38	11	64QAM	19	1/2	15112	24	1	2	30096	5016
	20	30	51	11	64QAM	19	1/2	20496	24	1	3	40392	6732
	25	30	65	11	64QAM	19	1/2	26120	24	1	4	51480	8580
	30	30	78	11	64QAM	19	1/2	31240	24	1	4	61776	10296
	40	30	106	11	64QAM	19	1/2	42016	24	1	5	83952	13992
	50	30	133	11	64QAM	19	1/2	53288	24	1	7	105336	17556
	60	30	162	11	64QAM	19	1/2	64552	24	1	8	128304	21384
	80	30	217	11	64QAM	19	1/2	86040	24	1	11	171864	28644
	90	30	245	11	64QAM	19	1/2	98376	24	1	12	194040	32340
	100	30	273	11	64QAM	19	1/2	108552	24	1	13	216216	36036

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.8-3: Reference Channels for CP-OFDM 64QAM for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 16, 17, 18, 19, 36, 37, 38 and 39	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39 (Note 3)	Total number of bits per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39	Total modulated symbols per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39
Unit	MHz	KHz						Bits	Bits			Bits	
	10	60	11	11	64QAM	19	1/2	4352	24	1	1	8712	1452
	15	60	18	11	64QAM	19	1/2	7168	24	1	1	14256	2376
	20	60	24	11	64QAM	19	1/2	9480	24	1	2	19008	3168
	25	60	31	11	64QAM	19	1/2	12296	24	1	2	24552	4092
	30	60	38	11	64QAM	19	1/2	15112	24	1	2	30096	5016
	40	60	51	11	64QAM	19	1/2	20496	24	1	3	40392	6732
	50	60	65	11	64QAM	19	1/2	26120	24	1	4	51480	8580
	60	60	79	11	64QAM	19	1/2	31752	24	1	4	62568	10428
	80	60	107	11	64QAM	19	1/2	43032	24	1	6	84744	14124
	90	60	121	11	64QAM	19	1/2	48168	24	1	6	95832	15972
	100	60	135	11	64QAM	19	1/2	54296	24	1	7	106920	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.2.3.9 CP-OFDM 256QAM

Table A.2.3.9-1: Reference Channels for CP-OFDM 256QAM for 15kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 4 and 9	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 4 and 9 (Note 3)	Total number of bits per slot for slots 4 and 9	Total modulated symbols per slot for slots 4 and 9
Unit	MHz	KHz						Bits	Bits			Bits	
	5	15	25	11	256QAM	20	2/3	17424	24	1	3	26400	3300
	10	15	52	11	256QAM	20	2/3	36896	24	1	5	54912	6864
	15	15	79	11	256QAM	20	2/3	55304	24	1	7	83424	10428
	20	15	106	11	256QAM	20	2/3	73776	24	1	9	111936	13992
	25	15	133	11	256QAM	20	2/3	94248	24	1	12	140448	17556
	30	15	160	11	256QAM	20	2/3	112648	24	1	14	168960	21120
	40	15	216	11	256QAM	20	2/3	151608	24	1	18	228096	28512
	50	15	270	11	256QAM	20	2/3	188576	24	1	23	285120	35640

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.9-2: Reference Channels for CP-OFDM 256QAM for 30kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 8, 9, 18 and 19	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 8, 9, 18 and 19 (Note 3)	Total number of bits per slot for slots 8, 9, 18 and 19	Total modulated symbols per slot for slots 8, 9, 18 and 19
Unit	**MHz**	**KHz**						**Bits**	**Bits**			**Bits**	
	5	30	11	11	256QAM	20	2/3	7680	24	1	1	11616	1452
	10	30	24	11	256QAM	20	2/3	16896	24	1	3	25344	3168
	15	30	38	11	256QAM	20	2/3	26632	24	1	4	40128	5016
	20	30	51	11	256QAM	20	2/3	35856	24	1	5	53856	6732
	25	30	65	11	256QAM	20	2/3	46104	24	1	6	68640	8580
	30	30	78	11	256QAM	20	2/3	55304	24	1	7	82368	10296
	40	30	106	11	256QAM	20	2/3	73776	24	1	9	111936	13992
	50	30	133	11	256QAM	20	2/3	94248	24	1	12	140448	17556
	60	30	162	11	256QAM	20	2/3	114776	24	1	14	171072	21384
	80	30	217	11	256QAM	20	2/3	151608	24	1	18	229152	28644
	90	30	245	11	256QAM	20	2/3	172176	24	1	21	258720	32340
	100	30	273	11	256QAM	20	2/3	192624	24	1	23	288288	36036

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

Table A.2.3.9-3: Reference Channels for CP-OFDM 256QAM for 60kHz SCS

Parameter	Channel bandwidth	Subcarrier Spacing	Allocated resource blocks	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Target Coding Rate	Payload size for slots 16, 17, 18, 19, 36, 37, 38 and 39	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39 (Note 3)	Total number of bits per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39	Total modulated symbols per slot for slots 16, 17, 18, 19, 36, 37, 38 and 39
Unit	MHz	KHz						Bits	Bits			Bits	
	10	60	11	11	256QAM	20	2/3	7680	24	1	1	11616	1452
	15	60	18	11	256QAM	20	2/3	12552	24	1	2	19008	2376
	20	60	24	11	256QAM	20	2/3	16896	24	1	3	25344	3168
	25	60	31	11	256QAM	20	2/3	22032	24	1	3	32736	4092
	30	60	38	11	256QAM	20	2/3	26632	24	1	4	40128	5016
	40	60	51	11	256QAM	20	2/3	35856	24	1	5	53856	6732
	50	60	65	11	256QAM	20	2/3	46104	24	1	6	68640	8580
	60	60	79	11	256QAM	20	2/3	55304	24	1	7	83424	10428
	80	60	107	11	256QAM	20	2/3	75792	24	1	9	112992	14124
	90	60	121	11	256QAM	20	2/3	86040	24	1	11	127776	15972
	100	60	135	11	256QAM	20	2/3	94248	24	1	12	142560	17820

Note 1: PUSCH mapping Type-A and single-symbol DM-RS configuration Type-1 with 2 additional DM-RS symbols, such that the DM-RS positions are set to symbols 2, 7, 11. DMRS is [TDM'ed] with PUSCH data.
Note 2: MCS Index is based on MCS table 5.1.3.1-2 defined in TS 38.214 [12].
Note 3: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)

A.3 DL reference measurement channels

A.3.1 General

Unless otherwise stated, Tables A.3.2.2-1, A.3.2.2-2, A.3.2.2-3, A.3.3.2-1, A.3.3.2-2 and A.3.3.2-3 are applicable for measurements of the Receiver Characteristics (clause 7) with the exception of subclauses 7.4 (Maximum input level).

Unless otherwise stated, Tables A.3.2.3-1, A.3.2.3-2, A.3.2.3-3, A.3.3.3-1, A.3.3.3-2 and A.3.3.3-3 are applicable for subclauses 7.4 (Maximum input level) and for UE not supporting PDSCH 256QAM,

Unless otherwise stated, Tables A.3.2.4-1, A.3.2.4-2, A.3.2.4-3, A.3.3.4-1, A.3.3.4-2 and A.3.3.4-3 are applicable for subclauses 7.4 (Maximum input level) and for UE supporting PDSCH 256QAM,

Unless otherwise stated, Tables A.3.2.2-1, A.3.2.2-2, A.3.2.2-3, A.3.3.2-1, A.3.3.2-2 and A.3.3.2-3 also apply for the modulated interferer used in Clauses 7.5, 7.6 and 7.8 with test specific bandwidths.

Table A.3.1-1: Common reference channel parameters

Parameter	Unit	Value
CORESET frequency domain allocation		Full BW
CORESET time domain allocation		2 OFDM symbols at the begin of each slot
PDSCH mapping type		Type A
PDSCH start symbol index (S)		2
Number of consecutive PDSCH symbols (L)		12
PDSCH PRB bundling	PRBs	2
Dynamic PRB bundling		false
Overhead value for TBS determination		0
First DMRS position for Type A PDSCH mapping		2
DMRS type		Type 1
Number of additional DMRS		2
FDM between DMRS and PDSCH		Disable
TRS configuration		2 slots, periodicity 10 ms, offset 0
PTRS configuration		PTRS is not configured

A.3.2 DL reference measurement channels for FDD

A.3.2.1 General

Table A.3.2.1-1: Additional reference channels parameters for FDD

Parameter	Unit	Value
Number of HARQ Processes		4
K1 value		2 for all slots

A.3.2.2 FRC for receiver requirements for QPSK

Table A.3.2.2-1: Fixed reference channel for receiver requirements (SCS 15 kHz, FDD, QPSK 1/3)

Parameter	Unit	Value							
Channel bandwidth	MHz	5	10	15	20	25	30	40	50
Subcarrier spacing	kHz	15	15	15	15	15	15	15	15
Subcarrier spacing configuration μ		0	0	0	0	0	0	0	0
Allocated resource blocks		25	52	79	106	133	[160]	216	270
Subcarriers per resource block		12	12	12	12	12	12	12	12
Allocated slots per Frame		9	9	9	9	9	9	9	9
MCS Index		4	4	4	4	4	4	4	4
MCS Table for TBS determination		64QAM							
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK
Target Coding Rate		1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1
Information Bit Payload per Slot									
For Slot 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,3,4,5,6,7,8,9	Bits	1672	3368	5120	6912	8712	10504	14088	17424
Transport block CRC	Bits	16	16	24	24	24	24	24	24
LDPC base graph		2	2	1	1	1	1	1	1
Number of Code Blocks per Slot									
For Slot 0	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,3,4,5,6,7,8,9	CBs	1	1	1	1	2	2	2	3
Binary Channel Bits per Slot									
For Slot 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,3,4,5,6,7,8,9	Bits	5400	11232	17064	22896	28728	34560	46656	58320
Max. Throughput averaged over 1 frame	Mbps	1.504	3.031	4.608	6.220	7.841	9.454	12.679	15.682
Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1. Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). Note 3: SS/PBCH block is transmitted in slot #0 of each frame. Note 4: Slot i is slot index per frame, QPSK 1/3.									

Table A.3.2.2-2: Fixed reference channel for receiver requirements (SCS 30 kHz, FDD, QPSK 1/3)

Parameter	Unit	Value											
Channel bandwidth	MHz	5	10	15	20	25	30	40	50	60	80	90	100
Subcarrier spacing configuration μ		1	1	1	1	1	1	1	1	1	1	1	1
Allocated resource blocks		11	24	38	51	65	[78]	106	133	162	217	245	273
Subcarriers per resource block		12	12	12	12	12	12	12	12	12	12	12	12
Allocated slots per Frame		19	19	19	19	19	19	19	19	19	19	19	19
MCS Index		4	4	4	4	4	4	4	4	4	4	4	4
MCS Table for TBS determination		64QAM											
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK
Target Coding Rate		1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1	1	1	1	1
Information Bit Payload per Slot													
For Slot 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,…,19	Bits	736	1608	2472	3368	4224	4992	6912	8712	10504	14088	15880	17928
Transport block CRC	Bits	16	16	16	16	24	24	24	24	24	24	24	24
LDPC base graph		2	2	2	2	1	1	1	1	1	1	1	1
Number of Code Blocks per Slot													
For Slot 0	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,…,19	CBs	1	1	1	1	1	1	1	2	2	2	2	3
Binary Channel Bits per Slot													
For Slot 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,…,19	Bits	2376	5184	8208	11016	14040	16848	22896	28728	34992	46872	52920	58968
Max. Throughput averaged over 1 frame	Mbps	1.398	3.055	4.697	6.399	8.025	9.485	13.133	16.553	19.958	26.767	30.172	34.063
Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1. Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). Note 3: SS/PBCH block is transmitted in slot #0 of each frame. Note 4: Slot i is slot index per frame.													

Table A.3.2.2-3: Fixed reference channel for receiver requirements (SCS 60 kHz, FDD, QPSK 1/3)

Parameter	Unit	Value										
Channel bandwidth	MHz	10	15	20	25	30	40	50	60	80	90	100
Subcarrier spacing configuration μ		2	2	2	2	2	2	2	2	2	2	2
Allocated resource blocks		11	18	24	31	38	51	65	79	107	121	135
Subcarriers per resource block		12	12	12	12	12	12	12	12	12	12	12
Allocated slots per Frame		38	38	38	38	38	38	38	38	38	38	38
MCS Index		4	4	4	4	4	4	4	4	4	4	4
MCS Table for TBS Determination		64QAM										
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK
Target Coding Rate		1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1	1	1	1
Information Bit Payload per Slot												
For Slot 0,1	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 2,…,39	Bits	736	1192	1608	2024	2472	3368	4224	5120	6912	7808	8712
Transport block CRC	Bits	16	16	16	16	16	16	24	24	24	24	24
LDPC base graph		2	2	2	2	2	2	1	1	1	1	1
Number of Code Blocks per Slot												
For Slot 0,1	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 2,…,39	CBs	1	1	1	1	1	1	1	1	1	1	2
Binary Channel Bits per Slot												
For Slot 0,1	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 2,…,39	Bits	2376	3888	5184	6696	8208	11016	14040	17064	23112	26136	29160
Max. Throughput averaged over 1 frame	Mbps	2.870	4.649	6.271	7.894	9.641	13.135	16.474	19.968	26.957	30.451	33.977
NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1. NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit). NOTE 3: SS/PBCH block is transmitted in slot #0 of each frame. NOTE 4: Slot i is slot index per frame.												

A.3.2.3 FRC for maximum input level for 64QAM

Table A.3.2.3-1: Fixed reference channel for maximum input level receiver requirements (SCS 15 kHz, FDD, 64QAM)

Parameter	Unit	Value							
Channel bandwidth	MHz	5	10	15	20	25	30	40	50
Subcarrier spacing	kHz	15	15	15	15	15	15	15	15
Subcarrier spacing configuration μ		0	0	0	0	0	0	0	0
Allocated resource blocks		25	52	79	106	133	[160]	216	270
Subcarriers per resource block		12	12	12	12	12	12	12	12
Allocated slots per Frame		9	9	9	9	9	9	9	9
MCS Index		24	24	24	24	24	24	24	24
MCS Table for TBS determination		64QAM							
Modulation		64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM
Target Coding Rate		3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1
Information Bit Payload per Slot									
For Slot 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,3,4,5,6,7,8,9	Bits	12296	25608	38936	52224	64552	77896	106576	131176
Transport block CRC	Bits	24	24	24	24	24	24	24	24
LDPC base graph		1	1	1	1	1	1	1	1
Number of Code Blocks per Slot									
For Slot 0	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,3,4,5,6,7,8,9	CBs	2	4	5	7	8	10	13	16
Binary Channel Bits per Slot									
For Slot 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,3,4,5,6,7,8,9	Bits	16200	33696	51192	68688	86184	103680	139968	174960
Max. Throughput averaged over 1 frame	Mbps	11.066	23.047	35.042	47.002	58.097	70.106	95.918	118.058

NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1.
NOTE 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit).
NOTE 3: SS/PBCH block is transmitted in slot 0 of each frame
NOTE 4: Slot i is slot index per frame

Table A.3.2.3-2: Fixed reference channel for maximum input level receiver requirements (SCS 30 kHz, FDD, 64QAM)

Parameter	Unit	Value										
Channel bandwidth	MHz	5	10	15	20	25	30	40	50	60	80	100
Subcarrier spacing configuration μ		1	1	1	1	1	1	1	1	1	1	1
Allocated resource blocks		11	24	38	51	65	[78]	106	133	162	217	273
Subcarriers per resource block		12	12	12	12	12	12	12	12	12	12	12
Allocated slots per Frame		19	19	19	19	19	19	19	19	19	19	19
MCS Index		24	24	24	24	24	24	24	24	24	24	24
MCS Table for TBS determination		64QAM										
Modulation		64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM
Target Coding Rate		3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1	1	1	1
Information Bit Payload per Slot												
For Slot 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,…,19	Bits	5376	11784	18432	25104	31752	37896	52224	64552	79896	106576	135296
Transport block CRC	Bits	24	24	24	24	24	24	24	24	24	24	24
LDPC base graph		1	1	1	1	1	1	1	1	1	1	1
Number of Code Blocks per Slot												
For Slot 0	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,…,19	CBs	1	2	3	3	4	5	7	8	10	13	17
Binary Channel Bits per Slot												
For Slot 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,…,19	Bits	7128	15552	24624	33048	42120	50544	68688	86184	104976	140616	176904
Max. Throughput averaged over 1 frame	Mbps	10.214	22.390	35.021	47.698	60.329	72.002	99.226	122.649	151.802	202.494	257.062
Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1 Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) Note 3: SS/PBCH block is transmitted in slot 0 of each frame. Note 4: Slot i is slot index per frame.												

Table A.3.2.3-3: Fixed Reference Channel for Maximum input level receiver requirements (SCS 60 kHz, FDD, 64QAM)

Parameter	Unit	Value									
Channel bandwidth	MHz	10	15	20	25	30	40	50	60	80	100
Subcarrier spacing configuration μ		2	2	2	2	2	2	2	2	2	2
Allocated resource blocks		11	18	24	31	[38]	51	65	79	107	135
Subcarriers per resource block		12	12	12	12	12	12	12	12	12	12
Allocated slots per Frame		38	38	38	38	38	38	38	38	38	38
MCS Index		24	24	24	24	24	24	24	24	24	24
MCS Table for TBS determination		64QAM									
Modulation		64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM
Target Coding Rate		3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1	1	1
Information Bit Payload per Slot											
For Slot 0,1	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 2,…,39	Bits	5376	8712	11784	15112	18432	25104	31752	38936	52224	65576
Transport block CRC	Bits	24	24	24	24	24	24	24	24	24	24
LDPC base graph		1	1	1	1	1	1	1	1	1	1
Number of Code Blocks per Slot											
For Slot 0,1	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 2,…,39	CBs	1	2	2	2	3	3	4	5	7	8
Binary Channel Bits per Slot											
For Slot 0,1	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 2,…,39	Bits	7128	11664	15552	20088	24624	33048	42120	51192	69336	87480
Max. Throughput averaged over 1 frame	Mbps	20.429	33.106	44.779	57.426	70.042	95.395	120.658	147.957	198.451	249.189

Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1.
Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)
Note 3: SS/PBCH block is transmitted in slot #0 of each frame.
Note 4: Slot i is slot index per frame.

A.3.2.4 FRC for maximum input level for 256 QAM

Table A.3.2.4-1: Fixed reference channel for maximum input level receiver requirements (SCS 15 kHz, FDD, 256QAM)

Parameter	Unit	Value							
Channel bandwidth	MHz	5	10	15	20	25	30	40	50
Subcarrier spacing	kHz	15	15	15	15	15	15	15	15
Subcarrier spacing configuration μ		0	0	0	0	0	0	0	0
Allocated resource blocks		25	52	79	106	133	[160]	216	270
Subcarriers per resource block		12	12	12	12	12	12	12	12
Allocated slots per Frame		9	9	9	9	9	9	9	9
MCS Index		23	23	23	23	23	23	23	23
MCS Table for TBS determination		256QAM							
Modulation		256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM
Target Coding Rate		4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1
Information Bit Payload per Slot									
For Slot 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,3,4,5,6,7,8,9	Bits	16896	34816	53288	71688	90176	108552	143400	180376
Transport block CRC	Bits	24	24	24	24	24	24	24	24
LDPC base graph		1	1	1	1	1	1	1	1
Number of Code Blocks per Slot									
For Slot 0	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,3,4,5,6,7,8,9	CBs	3	5	7	9	12	14	18	23
Binary Channel Bits per Slot									
For Slot 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,3,4,5,6,7,8,9	Bits	21600	44928	68256	91584	114912	138240	186624	233280
Max. Throughput averaged over 1 frame	Mbps	15.206	31.334	47.959	64.519	81.158	97.697	129.060	162.338
Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1. Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) Note 3: SS/PBCH block is transmitted in slot 0 of each frame. Note 4: Slot i is slot index per frame.									

Table A.3.2.4-2: Fixed reference channel for maximum input level receiver requirements (SCS 30 kHz, FDD, 256QAM)

Parameter	Unit	Value										
Channel bandwidth	MHz	5	10	15	20	25	30	40	50	60	80	100
Subcarrier spacing configuration μ		1	1	1	1	1	1	1	1	1	1	1
Allocated resource blocks		11	24	38	51	65	[78]	106	133	162	217	273
Subcarriers per resource block		12	12	12	12	12	12	12	12	12	12	12
Allocated slots per Frame		19	19	19	19	19	19	19	19	19	19	19
MCS Index		23	23	23	23	23	23	23	23	23	23	23
MCS Table for TBS determination		256QAM										
Modulation		256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM
Target Coding Rate		4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1	1	1	1
Information Bit Payload per Slot												
For Slot 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,…,19	Bits	7424	16136	25608	33816	44040	52224	71688	90176	108552	147576	184424
Transport block CRC	Bits	24	24	24	24	24	24	24	24	24	24	24
LDPC base graph		1	1	1	1	1	1	1	1	1	1	1
Number of Code Blocks per Slot												
For Slot 0	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,…,19	CBs	1	3	4	5	6	7	9	12	14	19	23
Binary Channel Bits per Slot												
For Slot 0	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,…,19	Bits	9504	20736	32832	44064	56160	67392	91584	114912	139968	187488	235872
Max. Throughput averaged over 1 frame	Mbps	14.106	30.658	48.655	64.250	83.676	99.226	136.207	171.334	206.249	280.394	350.406

Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1.
Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)
Note 3: SS/PBCH block is transmitted in slot 0 of each frame.
Note 4: Slot i is slot index per frame.

Table A.3.2.4-3: Fixed reference channel for maximum input level receiver requirements (SCS 60 kHz, FDD, 256QAM)

Parameter	Unit	Value									
Channel bandwidth	MHz	10	15	20	25	30	40	50	60	80	100
Subcarrier spacing configuration μ		2	2	2	2	2	2	2	2	2	2
Allocated resource blocks		11	18	24	31	[38]	51	65	79	107	135
Subcarriers per resource block		12	12	12	12	12	12	12	12	12	12
Allocated slots per Frame		38	38	38	38	38	38	38	38	38	38
MCS Index		23	23	23	23	23	23	23	23	23	23
MCS Table for TBS determination		256QAM									
Modulation		256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM
Target Coding Rate		4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1	1	1
Information Bit Payload per Slot											
For Slot 0,1	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 2,…,39	Bits	7424	12040	16136	21000	25608	33816	44040	53288	71688	90176
Transport block CRC	Bits	24	24	24	24	24	24	24	24	24	24
LDPC base graph		1	1	1	1	1	1	1	1	1	1
Number of Code Blocks per Slot											
For Slot 0,1	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 2,…,39	CBs	1	2	3	3	4	5	6	7	9	12
Binary Channel Bits per Slot											
For Slot 0,1	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 2,…,39	Bits	9504	15552	20736	26784	32832	44064	56160	68256	92448	116640
Max. Throughput averaged over 1 frame	Mbps	28.211	45.752	61.317	79.800	97.310	128.501	167.352	202.494	272.414	342.669

Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1.
Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)
Note 3: SS/PBCH block is transmitted in slot #0 of each frame.
Note 4: Slot i is slot index per frame.

A.3.3 DL reference measurement channels for TDD

A.3.3.1 General

Table A.3.3.1-1: Additional reference channels parameters for TDD

Parameter		Value		
		SCS 15 kHz (μ=0)	**SCS 30 kHz (μ=1)**	**SCS 60 kHz (μ=2)**
UL-DL configuration	referenceSubcarrierSpacing	15 kHz	30 kHz	60 kHz
	dl-UL-TransmissionPeriodicity	5 ms	5 ms	5 ms
	nrofDownlinkSlots	3	7	14
	nrofDownlinkSymbols	10	6	12
	nrofUplinkSlot	1	2	4
	nrofUplinkSymbols	2	4	8
Number of HARQ Processes		8	8	16
K1 value		K1 = 4 if mod(i,5) = 0 K1 =3 if mod(i,5) = 1 K1 =2 if mod(i,5) = 2 where i is slot index per frame; i = {0,…,9}	K1 =8 if mod(i,10) = 0 K1 =7 if mod(i,10) = 1 K1 =6 if mod(i,10) = 2 K1 =5 if mod(i,10) = 3 K1 =4 if mod(i,10) = 4 K1 =3 if mod(i,10) = 5 K1 =2 if mod(i,10) = 6 where i is slot index per frame; i = {0,…,19}	K1 = 13 if mod(i,20) = 2 K1 = 12 if mod(i,20) = 3 K1 = 11 if mod(i,20) = 4 K1 = 10 if mod(i,20) = 5 K1 = 9 if mod(i,20) = 6 K1 = 8 if mod(i,20) = 7 K1 = 7 if mod(i,20) = 8 K1 = 6 if mod(i,20) = 9 K1 = 6 if mod(i,20) = 10 K1 = 6 if mod(i,20) = 11 K1 = 6 if mod(i,20) = 12 K1 = 6 if mod(i,20) = 13 where i is slot index per frame; i = {0,…,39}

A.3.3.2 FRC for receiver requirements for QPSK

Table A.3.3.2-1: Fixed reference channel for receiver requirements (SCS 15 kHz, TDD, QPSK 1/3)

Parameter	Unit	Value							
Channel bandwidth	MHz	5	10	15	20	25	30	40	50
Subcarrier spacing	kHz	15	15	15	15	15	15	15	15
Subcarrier spacing configuration μ		0	0	0	0	0	0	0	0
Allocated resource blocks		25	52	79	106	133	[160]	216	270
Subcarriers per resource block		12	12	12	12	12	12	12	12
Allocated slots per Frame		5	5	5	5	5	5	5	5
MCS Index		4	4	4	4	4	4	4	4
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK
Target Coding Rate		1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1
Information Bit Payload per Slot									
For Slots 0,3,4,8,9	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,5,6,7	Bits	1672	3368	5120	6912	8712	10504	14088	17424
Transport block CRC	Bits	16	16	24	24	24	24	24	24
LDPC base graph		2	2	1	1	1	1	1	1
Number of Code Blocks per Slot									
For Slots 0,3,4,8,9	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,5,6,7	CBs	1	1	1	1	2	2	2	3
Binary Channel Bits per Slot									
For Slots 0,3,4,8,9	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,5,6,7	Bits	5400	11232	17064	22896	28728	34560	46656	58320
Max. Throughput averaged over 1 frame	Mbps	0.836	1.684	2.560	3.456	4.356	5.252	7.044	8.712

Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.
Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)
Note 3: SS/PBCH block is transmitted in slot 0 of each frame.
Note 4: Slot i is slot index per frame.

Table A.3.3.2-2: Fixed reference channel for receiver requirements (SCS 30 kHz, TDD, QPSK 1/3)

Parameter	Unit	Value										
Channel bandwidth	MHz	5	10	15	20	25	30	40	50	60	80	100
Subcarrier spacing configuration μ		1	1	1	1	1	1	1	1	1	1	1
Allocated resource blocks		11	24	38	51	65	78	106	133	162	217	273
Subcarriers per resource block		12	12	12	12	12	12	12	12	12	12	12
Allocated slots per Frame		13	13	13	13	13	13	13	13	13	13	13
MCS Index		4	4	4	4	4	4	4	4	4	4	4
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK
Target Coding Rate		1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1	1	1	1
Information Bit Payload per Slot												
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19}	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19}	Bits	736	1608	2472	3368	4224	4992	6912	8712	10504	14088	17928
Transport block CRC	Bits	16	16	16	16	24	24	24	24	24	24	24
LDPC base graph		2	2	2	2	1	1	1	1	1	1	1
Number of Code Blocks per Slot												
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19}	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19}	CBs	1	1	1	1	1	1	1	2	2	2	3
Binary Channel Bits per Slot												
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19}	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19}	Bits	2376	5184	8208	11016	14040	16848	22896	28728	34992	46872	58968
Max. Throughput averaged over 1 frame	Mbps	0.957	2.090	3.214	4.378	5.491	6.490	8.986	11.326	13.655	18.314	23.306

Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.
Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)
Note 3: SS/PBCH block is transmitted in slot #0 of each frame.
Note 4: Slot i is slot index per frame.

Table A.3.3.2-3: Fixed reference channel for receiver requirements (SCS 60 kHz, TDD, QPSK 1/3)

Parameter	Unit	Value									
Channel bandwidth	MHz	10	15	20	25	30	40	50	60	80	100
Subcarrier spacing configuration μ		2	2	2	2	2	2	2	2	2	2
Allocated resource blocks		11	18	24	31	38	51	65	79	107	135
Subcarriers per resource block		12	12	12	12	12	12	12	12	12	12
Allocated slots per Frame		26	26	26	26	26	26	26	26	26	26
MCS Index		4	4	4	4	4	4	4	4	4	4
Modulation		QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK
Target Coding Rate		1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3	1/3
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1	1	1
Information Bit Payload per Slot											
For Slots 0,1 and Slot i, if mod(i, 20) = {14, 15, 16, 17, 18, 19} for i from {0,…,39}	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 20) = {0,…,13} for i from {2,…,39}	Bits	736	1192	1608	2024	2472	3368	4224	5120	6912	8712
Transport block CRC	Bits	16	16	16	16	16	16	24	24	24	24
LDPC base graph		2	2	2	2	2	2	1	1	1	1
Number of Code Blocks per Slot											
For Slots 0,1 and Slot i, if mod(i, 20) = {14, 15, 16, 17, 18, 19} for i from {0,…,39}	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 20) = {0,…,13} for i from {2,…,39}	CBs	1	1	1	1	1	1	1	1	1	2
Binary Channel Bits per Slot											
For Slots 0,1 and Slot i, if mod(i, 20) = {14, 15, 16, 17, 18, 19} for i from {0,…,39}	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0,…,13} for i from {2,…,39}	Bits	2376	3888	5184	6696	8208	11016	14040	17064	23112	29160
Max. Throughput averaged over 1 frame	Mbps	1.914	3.099	4.181	5.262	6.427	8.757	10.982	13.312	17.961	22.651
Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1. Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) Note 3: SS/PBCH block is transmitted in slot #0 of each frame. Note 4: Slot i is slot index per frame.											

A.3.3.3 FRC for maximum input level for 64QAM

Table A.3.3.3-1: Fixed reference channel for maximum input level receiver requirements (SCS 15 kHz, TDD, 64QAM)

Parameter	Unit	Value							
Channel bandwidth	MHz	5	10	15	20	25	30	40	50
Subcarrier spacing	kHz	15	15	15	15	15	15	15	15
Subcarrier spacing configuration μ		0	0	0	0	0	0	0	0
Allocated resource blocks		25	52	79	106	133	[160]	216	270
Subcarriers per resource block		12	12	12	12	12	12	12	12
Allocated slots per Frame		5	5	5	5	5	5	5	5
MCS Index		24	24	24	24	24	24	24	24
Modulation		64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM
Target Coding Rate		3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1
Information Bit Payload per Slot									
For Slots 0,3,4,8,9	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,5,6,7	Bits	12296	25608	38936	52224	64552	77896	106576	131176
Transport block CRC	Bits	24	24	24	24	24	24	24	24
LDPC base graph		1	1	1	1	1	1	1	1
Number of Code Blocks per Slot									
For Slots 0,3,4,8,9	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,5,6,7	CBs	2	4	5	7	8	10	13	16
Binary Channel Bits per Slot									
For Slots 0,3,4,8,9	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,5,6,7	Bits	16200	33696	51192	68688	86184	103680	139968	174960
Max. Throughput averaged over 1 frame	Mbps	6.148	12.804	19.468	26.112	32.276	38.948	53.288	65.588

Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.
Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)
Note 3: SS/PBCH block is transmitted in slot 0 of each frame.
Note 4: Slot i is slot index per frame.

Table A.3.3.3-2: Fixed reference channel for maximum input level receiver requirements (SCS 30 kHz, TDD, 64QAM)

Parameter	Unit	Value										
Channel bandwidth	MHz	5	10	15	20	25	30	40	50	60	80	100
Subcarrier spacing configuration μ		1	1	1	1	1	1	1	1	1	1	1
Allocated resource blocks		11	24	38	51	65	78	106	133	162	217	273
Subcarriers per resource block		12	12	12	12	12	12	12	12	12	12	12
Allocated slots per Frame		13	13	13	13	13	13	13	13	13	13	13
MCS Index		24	24	24	24	24	24	24	24	24	24	24
Modulation		64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM
Target Coding Rate		3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1	1	1	1
Information Bit Payload per Slot												
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19}	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19}	Bits	5376	11784	18432	25104	31752	37896	52224	64552	79896	106576	135296
Transport block CRC	Bits	24	24	24	24	24	24	24	24	24	24	24
LDPC base graph		1	1	1	1	1	1	1	1	1	1	1
Number of Code Blocks per Slot												
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19}	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19}	CBs	1	2	3	3	4	5	7	8	10	13	17
Binary Channel Bits per Slot												
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19}	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19}	Bits	7128	15552	24624	33048	42120	50544	68688	86184	104976	140616	176904
Max. Throughput averaged over 1 frame	Mbps	6.989	15.319	23.962	32.635	41.278	49.265	67.891	83.918	103.865	138.549	175.885
Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1. Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) Note 3: SS/PBCH block is transmitted in slot #0 of each frame. Note 4: Slot i is slot index per frame.												

Table A.3.3.3-3: Fixed reference channel for maximum input level receiver requirements (SCS 60 kHz, TDD, 64QAM)

Parameter	Unit	Value									
Channel bandwidth	MHz	10	15	20	25	30	40	50	60	80	100
Subcarrier spacing configuration μ		2	2	2	2	2	2	2	2	2	2
Allocated resource blocks		11	18	24	31	38	51	65	79	107	135
Subcarriers per resource block		12	12	12	12	12	12	12	12	12	12
Allocated slots per Frame		26	26	26	26	26	26	26	26	26	26
MCS Index		24	24	24	24	24	24	24	24	24	24
Modulation		64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM	64 QAM
Target Coding Rate		3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1	1	1
Information Bit Payload per Slot											
For Slots 0,1 and Slot i, if mod(i, 20) = {14, 15, 16, 17, 18, 19} for i from {0,…,39}	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0,…,13} for i from {2,…,39}	Bits	5376	8712	11784	15112	18432	25104	31752	38936	52224	65576
Transport block CRC	Bits	24	24	24	24	24	24	24	24	24	24
LDPC base graph		1	1	1	1	1	1	1	1	1	1
Number of Code Blocks per Slot											
For Slots 0,1 and Slot i, if mod(i, 20) = {14, 15, 16, 17, 18, 19} for i from {0,…,39}	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0, …,13} for i from {2,…,39}	CBs	1	2	2	2	3	3	4	5	7	8
Binary Channel Bits per Slot											
For Slots 0,1 and Slot i, if mod(i, 20) = {14, 15, 16, 17, 18, 19} for i from {0,…,39}	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0, …,13} for i from {2,…,39}	Bits	7128	11664	15552	20088	24624	33048	42120	51192	69336	87480
Max. Throughput averaged over 1 frame	Mbps	13.978	22.651	30.638	39.291	47.923	65.270	82.555	101.234	135.782	170.498
Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1. Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) Note 3: SS/PBCH block is transmitted in slot #0 of each frame. Note 4: Slot i is slot index per frame.											

A.3.3.4 FRC for maximum input level for 256 QAM

Table A.3.3.4-1: Fixed reference channel for maximum input level receiver requirements (SCS 15 kHz, TDD, 256QAM)

Parameter	Unit	Value							
Channel bandwidth	MHz	5	10	15	20	25	30	40	50
Subcarrier spacing	kHz	15	15	15	15	15	15	15	15
Subcarrier spacing configuration μ		0	0	0	0	0	0	0	0
Allocated resource blocks		25	52	79	106	133	[160]	216	270
Subcarriers per resource block		12	12	12	12	12	12	12	12
Allocated slots per Frame		5	5	5	5	5	5	5	5
MCS Index		23	23	23	23	23	23	23	23
Modulation		256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM
Target Coding Rate		4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1
Information Bit Payload per Slot									
For Slots 0,3,4,8,9	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,5,6,7	Bits	16896	34816	53288	71688	90176	108552	143400	180376
Transport block CRC	Bits	24	24	24	24	24	24	24	24
LDPC base graph		1	1	1	1	1	1	1	1
Number of Code Blocks per Slot									
For Slots 0,3,4,8,9	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,5,6,7	CBs	3	5	7	9	12	14	18	23
Binary Channel Bits per Slot									
For Slots 0,3,4,8,9	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slots 1,2,5,6,7	Bits	21600	44928	68256	91584	114912	138240	186624	233280
Max. Throughput averaged over 1 frame	Mbps	8.448	17.408	26.644	35.844	45.088	54.276	71.700	90.188

Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.
Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit)
Note 3: SS/PBCH block is transmitted in slot 0 of each frame.
Note 4: Slot i is slot index per frame.

Table A.3.3.4-2: Fixed Reference channel for maximum input level receiver requirements (SCS 30 kHz, TDD, 256QAM)

Parameter	Unit	Value										
Channel bandwidth	MHz	5	10	15	20	25	30	40	50	60	80	100
Subcarrier spacing configuration μ		1	1	1	1	1	1	1	1	1	1	1
Allocated resource blocks		11	24	38	51	65	78	106	133	162	217	273
Subcarriers per resource block		12	12	12	12	12	12	12	12	12	12	12
Allocated slots per Frame		13	13	13	13	13	13	13	13	13	13	13
MCS Index		23	23	23	23	23	23	23	23	23	23	23
Modulation		256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM
Target Coding Rate		4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1	1	1	1
Information Bit Payload per Slot												
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19}	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19}	Bits	7424	16136	25608	33816	44040	52224	71688	90176	108552	147576	184424
Transport block CRC	Bits	24	24	24	24	24	24	24	24	24	24	24
LDPC base graph		1	1	1	1	1	1	1	1	1	1	1
Number of Code Blocks per Slot												
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19}	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19}	CBs	1	1	1	1	1	1	1	2	2	2	3
Binary Channel Bits per Slot												
For Slots 0 and Slot i, if mod(i, 10) = {7,8,9} for i from {0,…,19}	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {0,1,2,3,4,5,6} for i from {1,…,19}	Bits	9504	20736	32832	44064	56160	67392	91584	114912	139968	187488	235872
Max. Throughput averaged over 1 frame	Mbps	9.651	20.977	33.290	43.961	57.252	67.891	93.194	117.229	141.118	191.849	239.751
Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1. Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) Note 3: SS/PBCH block is transmitted in slot #0 of each frame. Note 4: Slot i is slot index per frame.												

Table A.3.3.4-3: Fixed reference channel for maximum input level receiver requirements (SCS 60 kHz, TDD, 256QAM)

Parameter	Unit	Value									
Channel bandwidth	MHz	10	15	20	25	30	40	50	60	80	100
Subcarrier spacing configuration μ		2	2	2	2	2	2	2	2	2	2
Allocated resource blocks		11	18	24	31	38	51	65	79	107	135
Subcarriers per resource block		12	12	12	12	12	12	12	12	12	12
Allocated slots per Frame		26	26	26	26	26	26	26	26	26	26
MCS Index		23	23	23	23	23	23	23	23	23	23
Modulation		256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM	256 QAM
Target Coding Rate		4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5
Maximum number of HARQ transmissions		1	1	1	1	1	1	1	1	1	1
Information Bit Payload per Slot											
For Slots 0,1 and Slot i, if mod(i, 20) = {14, 15, 16, 17, 18, 19} for i from {0,…,39}	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 20) = {0,…,13 } for i from {2,…,39}	Bits	7424	12040	16136	21000	25608	33816	44040	53288	71688	90176
Transport block CRC	Bits	24	24	24	24	24	24	24	24	24	24
LDPC base graph		1	1	1	1	1	1	1	1	1	1
Number of Code Blocks per Slot											
For Slots 0,1 and Slot i, if mod(i, 20) = {14, 15, 16, 17, 18, 19} for i from {0,…,39}	CBs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0, …,13} for i from {2,…,39}	CBs	1	2	3	3	4	5	6	7	9	12
Binary Channel Bits per Slot											
For Slots 0,1 and Slot i, if mod(i, 20) = {14, 15, 16, 17, 18, 19} for i from {0,…,39}	Bits	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0, …,13} for i from {2,…,39}	Bits	9504	15552	20736	26784	32832	44064	56160	68256	92448	116640
Max. Throughput averaged over 1 frame	Mbps	19.302	31.304	41.954	54.600	66.581	87.922	114.50	138.54	186.38	234.45
Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1. Note 2: If more than one Code Block is present, an additional CRC sequence of L = 24 Bits is attached to each Code Block (otherwise L = 0 Bit) Note 3: SS/PBCH block is transmitted in slot #0 of each frame. Note 4: Slot i is slot index per frame.											

A.4 CSI reference measurement channels

TBD

A.5 OFDMA Channel Noise Generator (OCNG)

A.5.1 OCNG Patterns for FDD

A.5.1.1 OCNG FDD pattern 1: Generic OCNG FDD Pattern for all unused REs

Table A.5.1.1-1: OP.1 FDD: Generic OCNG FDD Pattern for all unused REs

OCNG Distribution / OCNG Parameters	Control Region (Core Set)	Data Region
Resources allocated	All unused REs (Note 1)	All unused REs (Note 2)
Structure	PDCCH	PDSCH
Content	Uncorrelated pseudo random QPSK modulated data	Uncorrelated pseudo random QPSK modulated data
Transmission scheme for multiple antennas ports transmission	Single Tx port transmission	Spatial multiplexing using any precoding matrix with dimensions same as the precoding matrix for PDSCH
Subcarrier Spacing	Same as for RMC PDCCH in the active BWP	Same as for RMC PDSCH in the active BWP
Power Level	Same as for RMC PDCCH	Same as for RMC PDSCH
Note 1: All unused REs in the active CORESETS appointed by the search spaces in use. Note 2: Unused available REs refer to REs in PRBs not allocated for any physical channels, CORESETs, synchronization signals or reference signals in channel bandwidth.		

A.5.2 OCNG Patterns for TDD

A.5.2.1 OCNG TDD pattern 1: Generic OCNG TDD Pattern for all unused REs

Table A.5.2.1-1: OP.1 TDD: Generic OCNG TDD Pattern for all unused REs

OCNG Distribution / OCNG Parameters	Control Region (Core Set)	Data Region
Resources allocated	All unused REs (Note 1)	All unused REs (Note 2)
Structure	PDCCH	PDSCH
Content	Uncorrelated pseudo random QPSK modulated data	Uncorrelated pseudo random QPSK modulated data
Transmission scheme for multiple antennas ports transmission	Single Tx port transmission	Spatial multiplexing using any precoding matrix with dimensions same as the precoding matrix for PDSCH
Subcarrier Spacing	Same as for RMC PDCCH in the active BWP	Same as for RMC PDSCH in the active BWP
Power Level	Same as for RMC PDCCH	Same as for RMC PDSCH
Note 1: All unused REs in the active CORESETS appointed by the search spaces in use. Note 2: Unused available REs refer to REs in PRBs not allocated for any physical channels, CORESETs, synchronization signals or reference signals in channel bandwidth.		

Annex B (normative): Propagation Conditions

The propagation conditions and channel models for various environments are specified. For each environment a propagation model is used to evaluate the propagation pathless due to the distance. Channel models are formed by combining delay profiles with a Doppler spectrum, with the addition of correlation properties in the case of a multi-antenna scenario.

B.0 No interference

The downlink connection between the System Simulator and the UE is without Additive White Gaussian Noise, and has no fading or multipath effects.

Annex C (normative): Downlink physical channels

C.0 Downlink signal levels

The downlink power settings in Table C.0-1 is used unless otherwise specified in a test case.

If the UE has more than one Rx antenna, the downlink signal is applied to each one. All UE Rx antennas shall be connected.

If the UE has one Rx antenna, the downlink signal is applied to it.

Table C.0-1: Default Downlink power levels for NR

SCS (kHz)		**Unit**	**Channel bandwidth**											
			5 MHz	**10 MHz**	**15 MHz**	**20 MHz**	**25 MHz**	**30 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**90 MHz**	**100 MHz**
15	Number of RBs		25	50	75	100	128	160	215	270	N/A	N/A	N/A	N/A
	Channel BW power	dBm	-60	-57	-55	-54	-53	-52	-51	-50	N/A	N/A	N/A	N/A
30	Number of RBs		10	24	36	50	64	75	100	128	162	216	243	270
	Channel BW power	dBm	-61	-57	-55	-54	-53	-52	-51	-50	-49	-48	-47	-47
60	Number of RBs		N/A	10	18	24	30	36	50	64	75	100	120	135
	Channel BW power	dBm	N/A	-58	-56	-54	-53	-52	-51	-50	-49	-48	-47	-47
	RS EPRE	dBm/15kHz	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85	-85
	Note 1: The channel bandwidth powers are informative, based on -85dBm/15kHz SS/PBCH SSS EPRE, then scaled according to the number of RBs and rounded to the nearest integer dBm value. Full RE allocation with no boost or deboost is assumed. Note 2: The power level is specified at each UE Rx antenna. Note 3: DL level is applied for any of the Subcarrier Spacing configuration ( ) with the same power spectrum density of -85dBm/15kHz.													

The default signal level uncertainty is +/-3dB at each test port, for any level specified. If the uncertainty value is critical for the test purpose, a tighter uncertainty is specified for the related test case in Annex F

C.1 General

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

C.2 Setup

Table C.2-1 describes the downlink Physical Channels that are required for connection set up.

Table C.2-1: Downlink Physical Channels required for connection set-up

Physical Channel
PBCH
SSS
PSS
PDCCH
PDSCH
PBCH DMRS
PDCCH DMRS
PDSCH DMRS
CSI-RS

C.3 Connection

C.3.1 Measurement of Receiver Characteristics

Unless otherwise stated, Table C.3.1-1 is applicable for measurements on the Receiver Characteristics (clause 7).

Table C.3.1-1: Downlink Physical Channels transmitted during a connection (FDD and TDD)

Parameter	Unit	Value
SSS transmit power	W	Test specific
EPRE ratio of PSS to SSS	dB	0
EPRE ratio of PBCH DMRS to SSS	dB	0
EPRE ratio of PBCH to PBCH DMRS	dB	0
EPRE ratio of PDCCH DMRS to SSS	dB	0
EPRE ratio of PDCCH to PDCCH DMRS	dB	0
EPRE ratio of PDSCH DMRS to SSS (Note 1)	dB	3
EPRE ratio of PDSCH to PDSCH DMRS (Note 1)	dB	-3
EPRE ratio of CSI-RS to SSS	dB	0
EPRE ratio of PTRS to PDSCH	dB	Test specific
EPRE ratio of OCNG DMRS to SSS	dB	0
EPRE ratio of OCNG to OCNG DMRS (Note 1)	dB	0
Note 1: No boosting is applied to any of the channels except PDSCH DMRS. For PDSCH DMRS, 3 dB power boosting is applied assuming DMRS Type 1 configuration when DMRS and PDSCH are TDM'ed and only half of the DMRS REs are occupied. Note 2: Number of DMRS CDM groups without data for PDSCH DMRS configuration for OCNG is set to 1.		

Annex D (normative): Characteristics of the Interfering Signal

D.1 General

Some RF performance requirements for the NR UE receiver are defined with interfering signals present in addition to the wanted signal.

For NR bands with F_{DL_high}< 2700 MHz and F_{UL_high}< 2700 MHz, a modulated 5MHz full bandwidth NR down link signal, and in some cases an additional CW signal, are used as interfering signal.

For NR bands with F_{DL_low}≥ 3300 MHz and F_{UL_low}≥ 3300 MHz, a modulated NR downlink signal which equals to channel bandwidth of the wanted signal for Single Carrier case and Inter-band CA case is used as interfering. For intra-band contiguous CA Bandwidth Class C case, a modulated NR downlink signal which equals to the aggregated channel bandwidth of the wanted signal is used. For intra-band contiguous CA Bandwidth Class D and E case, a modulated 50MHz NR downlink signal is used. And in some cases, an additional CW signal is used.

D.2 Interference signals

Table D.2-1 describes the modulated interferer for different channel bandwidth options for NR band lower than 2700MHz.

Table D.2-1: Description of modulated NR interferer for NR bands with F_{DL_high}< 2700 MHz and F_{UL_high}< 2700 MHz

	Channel bandwidth					
	5 MHz	**10MHz**	**15 MHz**	**20 MHz**	**25 MHz**	**30 MHz**
RB	NOTE1					
$BW_{Interferer}$	5 MHz					
	Channel bandwidth					
	40 MHz	**50 MHz**	**60 MHz**	**80 MHz**	**90 MHz**	**100 MHz**
RB	NOTE1					
$BW_{Interferer}$	5 MHz					
NOTE 1: The RB configured for interfering signal is the same as maximum RB number defined in Table 5.3.2-1 for each sub-carrier spacing.						

Table D.2-2 and Table D.2-3 describe the modulated interferer for different channel bandwidth options for NR band higher than 3300MHz.

Table D.2-2: Description of modulated NR interferer for NR bands with F_{DL_low}≥ 3300 MHz and F_{UL_low}≥ 3300 MHz

	Channel bandwidth								
	10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**90 MHz**	**100 MHz**
RB	NOTE1								
$BW_{Interferer}$	10 MHz	15 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
NOTE 1: The RB configured for interfering signal is the same as maximum RB number defined in Table 5.3.2-1 for each sub-carrier spacing.									

Table D.2-3: Description of modulated NR interferer for NR bands with F_{DL_low}≥ 3300 MHz and F_{UL_low}≥ 3300 MHz for Intra-band contiguous CA

	Aggregated Channel bandwidth of Bandwidth Class C								Bandwidth Class D/E
	110 MHz	120 MHz	130 MHz	140 MHz	150 MHz	160 MHz	180 MHz	200 MHz	
RB(SCS=30 kHz)	Note 1								133
RB(SCS=60 kHz)	Note 1								65
$BW_{Interferer}$	110 MHz	120 MHz	130 MHz	140 MHz	150 MHz	160 MHz	180 MHz	200 MHz	50MHz
NOTE 1: The interfering signal shall be configured in the same way as the aggregated bandwidth of the wanted signal. The RB configurations for each component carrier are defined in Table 5.3.2-1 for each sub-carrier spacing.									

Annex E (normative): Global In-Channel TX-Test

Note: Clauses E.2.2 to E.5.9.3 are descriptions, which assume no power ramping adjacent to the measurement period.

E.1 General

The global in-channel TX test enables the measurement of all relevant parameters that describe the in-channel quality of the output signal of the TX under test in a single measurement process.

The parameters describing the in-channel quality of a transmitter, however, are not necessarily independent. The algorithm chosen for description inside this annex places particular emphasis on the exclusion of all interdependencies among the parameters.

E.2 Signals and results

E.2.1 Basic principle

The process is based on the comparison of the actual **output signal of the TX under test**, received by an ideal receiver, with a **reference signal**, that is generated by the measuring equipment and represents an ideal error free received signal. All signals are represented as equivalent (generally complex) baseband signals.

The description below uses numbers as examples. These numbers are taken from FDD with normal CP length and 100 MHz bandwidth with 30 kHz SCS. The application of the text below, however, is not restricted to this frame structure and bandwidth.

E.2.2 Output signal of the TX under test

The output signal of the TX under test is acquired by the measuring equipment and stored for further processing. It is sampled at a sampling rate of 122.88 Mbps. In the time domain it comprises at least 10 uplink subframes. The measurement period is derived by concatenating the correct number of individual uplink slots until the correct measurement period is reached. The output signal is named z(ν). Each slot is modelled as a signal with the following parameters: demodulated data content, carrier frequency, amplitude and phase for each subcarrier, timing, carrier leakage.

NOTE 1: TDD

Since the uplink subframes are not continuous, *n* slots should be extracted from more than 1 continuous radio frame where

$$n = \begin{cases} 10, \text{ for 15 kHz SCS} \\ 20, \text{ for 30 kHz SCS} \\ 40, \text{ for 60 kHz SCS} \end{cases}.$$

E.2.3 Reference signal

Two types of reference signal are defined:

The reference signal $i_1(\nu)$ is constructed by the measuring equipment according to the relevant TX specifications, using the following parameters: demodulated data content, nominal carrier frequency, nominal amplitude and phase for each subcarrier, nominal timing, no carrier leakage. It is represented as a sequence of samples at a sampling rate of 122.88 Msps in the time domain.

The reference signal $i_2(\nu)$ is constructed by the measuring equipment according to the relevant TX specifications, using the following parameters: restricted data content: nominal reference symbols, (all modulation symbols for user data symbols are set to 0V), nominal carrier frequency, nominal amplitude and phase for each applicable subcarrier, nominal timing, no carrier leakage. It is represented as a sequence of samples at a sampling rate of 122.88 Msps in the time domain.

NOTE: The PUCCH is off during the time under test.

E.2.4 Measurement results

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

- Carrier Frequency error
- EVM (Error Vector Magnitude)
- Carrier leakage
- Unwanted emissions, falling into non allocated resource blocks.
- EVM equalizer spectrum flatness

E.2.5 Measurement points

The unwanted emission falling into non-allocated RB(s) is calculated directly after the FFT as described below. In contrast to this, the EVM for the allocated RB(s) is calculated after the IDFT for DFT-s-OFDM or after the Tx-Rx chain equalizer for CP-OFDM. The samples after the TX-RX chain equalizer are used to calculate EVM equalizer spectrum flatness. Carrier frequency error and carrier leakage is calculated in the block “RF correction”.

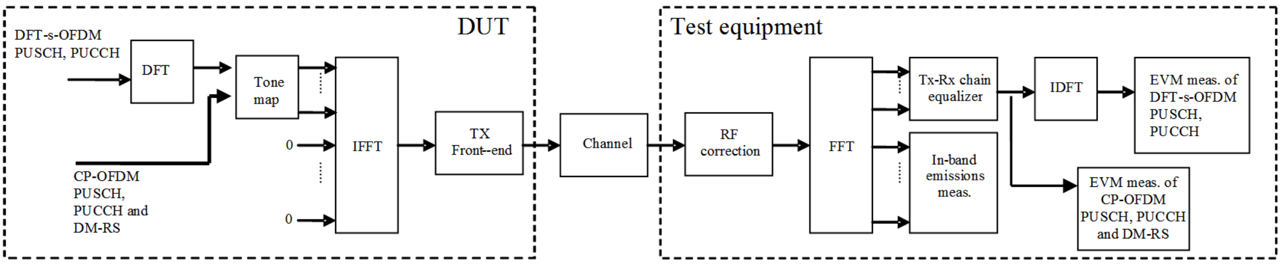

Figure E.2.5-1: EVM measurement points

E.3 Signal processing

E.3.1 Pre FFT minimization process

Before applying the pre-FFT minimization process, $z(\nu)$ and $i(\nu)$ are portioned into n pieces, comprising one slot each, where n is as defined in Annex E.2.2

Each slot is processed separately. Sample timing, Carrier frequency and carrier leakage in $z(\nu)$ are jointly varied in order to minimise the difference between $z(\nu)$ and $i(\nu)$. Best fit (minimum difference) is achieved when the RMS difference value between $z(\nu)$ and $i(\nu)$ is an absolute minimum.

The carrier frequency variation and the IQ variation are the measurement results: Carrier Frequency Error and Carrier leakage.

From the acquired samples *n* carrier frequencies and *n* carrier leakages can be derived.

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

NOTE 2: The algorithm would allow deriving Carrier Frequency error and Sample Frequency error of the TX under test separately. However there are no requirements for Sample Frequency error. Hence the algorithm models the RF and the sample frequency commonly (not independently). It returns one error and does not distinguish between both.

After this process the samples z(ν) are called $z^0(\nu)$.

E.3.2 Timing of the FFT window

The FFT window length is 4096 samples per OFDM symbol. 14 FFTs (57344 samples) cover less than the acquired number of samples (61440 samples). The position in time for FFT must be determined.

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

Centre of the reduced window, called $\Delta\tilde{c}$, $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2.

The timing of the measured signal is determined in the pre FFT domain as follows, using $z^0(\nu)$ and $i_2(\nu)$:

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

2. In the Reference Signal $i_2(\nu)$ the timing is known.

3. Correlation between (1.) and (2.) will result in a correlation peak. The meaning of the correlation peak is approx. the “impulse response” of the TX filter. The meaning of “impulse response” assumes that the autocorrelation of the reference signal $i_2(\nu)$ is a Dirac peak and that the correlation between the reference signal $i_2(\nu)$ and the data in the measured signal is 0. The correlation peak, (the highest, or in case of more than one, the earliest) indicates the timing in the measured signal.

From the acquired samples, *n* timings can be derived, where *n* is as defined in Annex E.2.2.

For all calculations, except EVM, the number of samples in $z^0(\nu)$ is reduced to 14 blocks of samples, comprising 4096 samples (FFT width) and starting with $\Delta\tilde{c}$ in each OFDM symbol including the demodulation reference signal.

For the EVM calculation the output signal under test is reduced to 28 blocks of samples, comprising 4096 samples (FFT width) and starting with $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2 in each OFDM symbol including the demodulation reference signal.

The number of samples, used for FFT is reduced compared to $z^0(\nu)$. This subset of samples is called z’(ν).

The timing of the centre $\Delta\tilde{c}$ with respect to the different CP length in a slot is as follows: (FDD, normal CP length)

$\Delta\tilde{c}$ is on T_f=144 (=CP/2) within the CP of length 288 FFT samples (in OFDM symbols except 0 and 28 (=7 · 2^{μ}), where symbol 0 is the first symbol of each subframe) for 100 MHz channel bandwidth and SCS = 30 kHz.

$\Delta\tilde{c}$ is on T_f=176 (=320-144) within the CP of length 320 (in OFDM symbol 0 and 28 (=7 · 2^{μ}), where symbol 0 is the first symbol of each subframe) for 100 MHz channel bandwidth and SCS = 30 kHz.

E.3.3 Post FFT equalisation

Perform 14 FFTs on z'(v), one for each OFDM symbol in a slot using the timing $\Delta\tilde{c}$, including the demodulation reference symbol. The result is an array of samples, 14 in the time axis t times 4096 in the frequency axis f. The samples represent the data symbols (in OFDM-symbol 0,1,3,4,5,6,8,9,10,12,13 in each slot) and demodulation reference symbols (OFDM symbol 2, 7, 11 in each slot) in the allocated RBs and inband emissions in the non-allocated RBs within the transmission BW.

Only the allocated resource blocks in the frequency domain are used for equalisation.

The nominal demodulation reference symbols and nominal data symbols are used to equalize the measured data symbols. (Location for equalization see Figure E.2.5-1)

NOTE: The nomenclature inside this note is local and not valid outside.

The nominal data symbols are created by a demodulation process. The location to gain the demodulated data symbols is "EVM" in Figure E.2.5-1. For CP-OFDM, the process described in Annex E.5 can be applied. A demodulation process as follows is recommended for DFT-s-OFDM:

1. Equalize the measured data symbols using the reference symbols for equalisation. Result: Equalized data symbols
2. Only for DFT-s-OFDM, iDFT transform the equalized data symbols: Result: Equalized data symbols
3. Decide for the nearest constellation point: Result: Nominal data symbols
4. Only for DFT-s-OFDM, DFT transform the nominal data symbols: Result: Nominal data symbols

At this stage we have an array of Measured data-Symbols and reference-Symbols (MS(f,t))

versus an array of Nominal data-Symbols and reference Symbols (NS(f,t))

(complex, the arrays comprise 11 data symbols and 3 demodulation reference symbol in the time axis and the number of allocated subcarriers in the frequency axis.)

MS(f,t) and NS(f,t) are processed with a least square (LS) estimator, to derive one equalizer coefficient per time slot and per allocated subcarrier. EC(f) is defined as

$$EC(f) = \frac{\sum_{t=0}^{13} NS(f,t)^* NS(f,t)}{\sum_{t=0}^{13} NS(f,t)^* MS(f,t)}.$$

With * denoting complex conjugation.

EC(f) are used to equalize the DFT-coded data symbols. The measured DFT-coded data and the references symbols are equalized by:

$$Z'(f,t) = MS(f,t) \cdot EC(f)$$

With · denoting multiplication.

Z'(f,t), restricted to the data symbol (excluding t=2,7,11) is used to calculate EVM, as described in E.4.1.

EC(f) is used in E.4.4.1 to calculate EVM equalizer spectral flatness.

NOTE: The post FFT minimisation process is done over 14 symbols (11 DFT-coded data symbols and 3 reference symbols).

The samples of the non-allocated resource blocks within the transmission bandwidth configuration in the post FFT domain are called Y(f,t) (f covering the non-allocated subcarriers within the transmission bandwidth configuration, t covering the OFDM symbols during 1 slot).

E.4 Derivation of the results

E.4.1 EVM

For EVM create two sets of Z'(f,t)., according to the timing " $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2" using the equalizer coefficients from E.3.3.

Perform the iDFTs on Z'(f,t) in the case of DFT-s-OFDM waveform. The IDFT-decoding preserves the meaning of t but transforms the variable f (representing the allocated sub carriers) into another variable g, covering the same count and representing the demodulated symbols. The samples in the post IDFT domain are called iZ'(g, t). The equivalent ideal samples are called iI(g,t). Those samples of Z'(f,t), carrying the reference symbols (=symbol 2,7,11) are not iDFT processed.

The EVM is the difference between the ideal waveform and the measured and equalized waveform for the allocated RB(s)

$$EVM = \sqrt{\frac{\sum_{t\in T}\sum_{g\in G}\left|iZ'(g,t)-iI(g,t)\right|^2}{|G|\cdot|T|\cdot P_0}},$$

where

t covers the count of demodulated symbols with the considered modulation scheme being active within the measurement period, (i.e. symbol 0,1,3,4,5,6,8,9,10,12,13 in each slot, →|T|=11)

g covers the count of demodulated symbols with the considered modulation scheme being active within the allocated bandwidth. (|G|=12* L_{CRBs} (with L_{CRBs} : number of allocated resource blocks)).

$iZ'(g,t)$ are the samples of the signal evaluated for the EVM.

$iI(g,t)$ is the ideal signal reconstructed by the measurement equipment, and

P_0 is the average power of the ideal signal. For normalized modulation symbols P_0 is equal to 1.

From the acquired samples *2n* EVM values can be derived, *n* values for the timing $\Delta\tilde{c}$ –W/2 and *n* values for the timing $\Delta\tilde{c}$ +W/2 where *n* is as defined in Annex E.2.2.

E.4.2 Averaged EVM

EVM is averaged over all basic EVM measurements.

The averaging comprises *n* UL slots

$$\overline{EVM} = \sqrt{\frac{1}{n}\sum_{i=1}^{n} EVM_i^2}$$

where *n* is as defined in Annex E.2.2for PUCCH, PUSCH.

The averaging is done separately for timing $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2 leading to $\overline{\mathrm{EVM}}_\mathrm{l}$ and $\overline{\mathrm{EVM}}_\mathrm{h}$

$EVM_{\mathrm{final}} = \max(\overline{\mathrm{EVM}}_\mathrm{l}, \overline{\mathrm{EVM}}_h)$ is compared against the test requirements.

E.4.3 In-band emissions measurement

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks.

Explanatory Note:

The inband emission measurement is only meaningful with allocated RB(s) next to non-allocated RB. The allocated RB(s) are necessary but not under test. The non-allocated RBs are under test. The RB allocation for this test is as follows: The allocated RB(s) are at one end of the channel BW, leaving the other end unallocated. The number of allocated RB(s) is smaller than half of the number of RBs, available in the channel BW. This means that the vicinity of the carrier in the centre is unallocated.

There are 3 types of inband emissions:

1. General
2. IQ image
3. Carrier leakage

Carrier leakage are inband emissions next to the carrier.

IQ image are inband emissions symmetrically (with respect to the carrier) on the other side of the allocated RBs.

General are applied to all unallocated RBs.

For each evaluated RB, the minimum requirement is calculated as the higher of P_{RB} - 30 dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply.

In specific the following combinations:

- Power (General)
- Power (General + Carrier leakage)
- Power (General + IQ Image)

 1 and 2 is expressed in terms of power in one non allocated RB under test, normalized to the average power of an allocated RB (unit dB).

 3 is expressed in terms of power in one non allocated RB, normalized to the power of all allocated RBs. (unit dBc).

This is the reason for two formulas *Emissions* $_{relative}$.

Create one set of Y(t,f) per slot according to the timing " $\Delta\tilde{c}$ "

For the non-allocated RBs below the in-band emissions are calculated as follows

$$Emissions_{absolute}(\Delta_{RB}) = \begin{cases} \dfrac{1}{|T_s|}\sum_{t\in T_s} \sum_{\max(f_{\min},(c_l+12\cdot\Delta_{RB}*\Delta f))}^{c_l+(12\cdot\Delta_{RB}+11)*\Delta f} |Y(t,f)|^2, \Delta_{RB} < 0 \\ \dfrac{1}{|T_s|}\sum_{t\in T_s} \sum_{c_h+(12\cdot\Delta_{RB}-11)*\Delta f}^{\min(f_{\max},(c_h+12\cdot\Delta_{RB}*\Delta f))} |Y(t,f)|^2, \Delta_{RB} > 0 \end{cases},$$

where

the upper formula represents the in band emissions below the allocated frequency block and the lower one the in band emissions above the allocated frequency block.

T_s is a set of $|T_s|$ DFT-s-OFDM symbols with the considered modulation scheme being active within the measurement period,

Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB} = 1$ for the first upper or $\Delta_{RB} = -1$ for the first lower adjacent RB),

$f_{\min}$ and $f_{\max}$ are the lower and upper edge of the UL transmission BW configuration,

c_l and c_h are the lower and upper edge of the allocated BW,

Δf is the SCS, and

$Y(t, f)$ is the frequency domain signal evaluated for in-band emissions as defined in the subsection E.3.3

The allocated RB power per RB and the total allocated RB power are given by:

$$P_{RB} = \frac{1}{|T_s| \cdot L_{CRBs}} \sum_{t \in T_S} \sum_{c_1}^{c_1 + (12 \cdot L_{CRBs} - 1) \cdot \Delta f} |\mathrm{MS}(t, f)|^2 [\mathrm{dBm}/(12\Delta f)]$$

$$P_{All-RBs} = \frac{1}{|T_s|} \sum_{t \in T_S} \sum_{\mathrm{c_l}}^{\mathrm{c_l} + (12 \cdot L_{CRBs} - 1)^* \Delta f} |\mathrm{MS}(t, f)|^2 \ [\mathrm{dBm}]$$

The relative in-band emissions, applicable for General and IQ image, are given by:

$$Emissions_{relative}(\Delta_{RB}) = 10 \cdot \log_{10} \left(\frac{Emissions_{absolute}(\Delta_{RB})}{\frac{1}{|T_S| \cdot L_{CRBs}} \sum_{t \in T_S} \sum_{c_l}^{c_l + (12 \cdot L_{CRBs} - 1) \cdot \Delta f} |\mathrm{MS}(t, f)|^2} \right) [\mathrm{dB}] =$$

$$= Emissions_{absolute}(\Delta_{RB}) [\mathrm{dBm}/12\Delta f] - P_{RB} [dBm/12\Delta f]$$

where

L_{CRBs} is the number of allocated resource blocks,

and

$\mathrm{MS}(t, f)$ is the frequency domain samples for the allocated bandwidth, as defined in the subsection E.3.3.

The relative in-band emissions, applicable for carrier leakage, is given by:

$$Emissions_{relative} = 10 \cdot \log_{10} \left(\frac{Emissions_{absolute}(DCRB)}{\frac{1}{|T_s|} \sum_{t \in T_s} \sum_{\mathrm{c_l}}^{\mathrm{c_l} + (12 \cdot L_{CRBs} - 1) \cdot \Delta f} |\mathrm{MS}(t, f)|^2} \right) [\mathrm{dBc}]$$

$$= Emissions_{absolute}(DCRB) [\mathrm{dBm}/12\Delta f] - P_{All-RBs} \ [\mathrm{dBm}]$$

where DCRB is one RB or one pair of RBs, depending whether the DC carrier is inside an RB or in-between two RBs.

Although an exclusion period may be applicable in the time domain, when evaluating EVM, the inband emissions measurement interval is defined over one complete slot in the time domain.

From the acquired samples *n* functions for general in band emissions and IQ image inband emissions can be derived, where *n* is as defined in Annex E.2.2. *n* values or *n* pairs of carrier leakage inband emissions can be derived. They are compared against different limits after the final averaging:

The in-band emissions are averaged over the *n* samples (equivalent to 10 UL subframes):

$$\overline{Emissions}_{absolute}(\Delta_{RB}) = \frac{1}{n}\sum_{i=1}^{n} Emissions_{absolute,i}(\Delta_{RB})$$

$$\overline{Emissions}_{relative}(\Delta_{RB}) = 10*\log_{10}\left(\frac{1}{n}\sum_{i=1}^{n} 10^{Emissions_{relative,i}(\Delta_{RB})/10}\right) \quad [dB]$$

$$\overline{Emissions}_{relative} = 10*\log_{10}\left(\frac{1}{n}\sum_{i=1}^{n} 10^{Emissions_{relative,i}/10}\right) \quad [dBc]$$

E.4.4 EVM equalizer

E.4.4.1 EVM equalizer spectrum flatness

For EVM equalizer spectrum flatness use EC(f) as defined in E.3.3. Note, EC(f) represents equalizer coefficient $f \in F$, f is the allocated subcarriers within the transmission bandwidth (($|F|$=12* L_{CRBs})

From the acquired samples *n* functions EC(f) can be derived, where *n* is as defined in Annex E.2.2.

EC(f) is broken down to 2 functions:

$$\mathrm{EC}_1(\mathrm{f}),\ f \in Range\ \ 1$$

$$\mathrm{EC}_2(\mathrm{f}),\ f \in Range\ \ 2$$

Where Range 1 and Range 2 are as defined for Clause 6.4.2.4 in Table 6.4.2.4.5-1 for normal condition and Table 6.4.2.4.5-2 for extreme condition and for Clause 6.4.2.5 as in Table 6.4.2.5.5-1.

The following peak to peak ripple is calculated:

$\mathrm{RP}_1 = 20*\log(\max(|\mathrm{EC}_1(\mathrm{f})|)/\min(|\mathrm{EC}_1(\mathrm{f})|))$,which denote the maximum ripple in Range 1

$\mathrm{RP}_2 = 20*\log(\max(|\mathrm{EC}_2(\mathrm{f})|)/\min(|\mathrm{EC}_2(\mathrm{f})|))$,which denote the maximum ripple in Range 2

$\mathrm{RP}_{12} = 20*\log(\max(|\mathrm{EC}_1(\mathrm{f})|)/\min(|\mathrm{EC}_2(\mathrm{f})|))$,which denote the maximum ripple between the upper side of Range 1 and lower side of Range 2

$\mathrm{RP}_{21} = 20*\log(\max(|\mathrm{EC}_2(\mathrm{f})|)/\min(|\mathrm{EC}_1(\mathrm{f})|))$,which denote the maximum ripple between the upper side of Range 2 and lower side of Range 1

E.4.4.2 EVM equalizer spectral shaping filter

The calculation of the impulse response of the spectral shaping filter is based on EC(f) as defined in E.3.3. Note that EC(f) represents complex valued equalizer coefficient with $f \in F$, where f is the allocated subcarriers within the transmission bandwidth ($|F|$=12* L_{CRBs}).

EC'(f) is the corrected version of EC(f) by shifting by T_f. T_f is as defined in Clause E.3.2.

The impulse responses are the IDFT transformed equalizer coefficients:

$a(\tau) = IDFT\left\{\dfrac{1}{EC'(f)}\right\}$, where f is the frequency of the M allocated subcarriers.

The impulse response is normalized to its first value.

$$\tilde{a}(\tau) = \frac{a(\tau)}{a(0)}$$

This is equivalent to defining the 0dB as $20log_{10}\left|\tilde{a}_t(0)\right|$.

From the acquired samples, n functions $\tilde{a}(\tau)$ can be derived, where n is as defined in Annex E.2.2.

Note, that this method provides reasonable results only in the case of full allocations.

E.4.5 Frequency error and Carrier leakage

See E.3.1.

E.4.6 EVM of Demodulation reference symbols (EVM_{DMRS})

For the purpose of EVM_{DMRS}, the steps E.2.2 to E.4.2 are repeated 6 times, constituting 6 EVM_{DMRS} sub-periods. The only purpose of the repetition is to cover the longer gross measurement period of EVM_{DMRS} ($6 \cdot n$ time slots) and to derive the FFT window timing per sub-period.

The bigger of the EVM results in one n TS period corresponding to the timing $\Delta\tilde{c}$ –W/2 or $\Delta\tilde{c}$ +W/2 is compared against the limit, where n is as defined in Annex E.2.2. (Clause E.4.2) This timing is re-used for EVM_{DMRS} in the equivalent EVM_{DMRS} sub-period.

For EVM the demodulation reference symbols are excluded, while the data symbols are used. For EVM_{DMRS} the data symbols are excluded, while the demodulation references symbols are used. This is illustrated in figure E.4.6-1

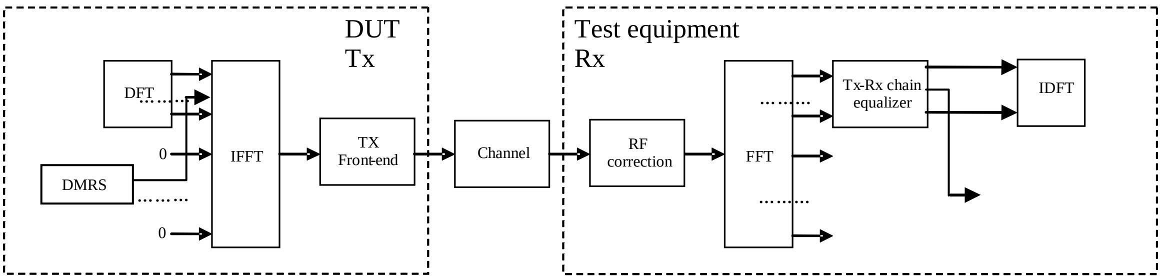

Figure E.4.6-1: EVM_{DMRS} measurement points

Re-use the following formula from E.3.3:

$$Z'(f,t) = MS(f,t) \cdot EC(f)$$

To calculate EVM_{DMRS} , the data symbol (t=0,1,3,4,5,6,8,9,10,12,13) in Z'(f,t) are excluded and only the reference symbols (t=2,7,11) is used.

The EVM_{DMRS} is the difference between the ideal waveform and the measured and equalized waveform for the allocated RB(s)

$$EVM_{DMRS} = \sqrt{\frac{\sum_{t \in T} \sum_{f \in F} \left| Z'(f,t) - I(f,t) \right|^2}{|T| \cdot P_0 \cdot |F|}},$$

where

t covers the count of demodulation reference symbols (i.e. symbols 2,7,11 in each slot, so count=3)

f covers the count of demodulation reference symbols within the allocated bandwidth. (|F|=12* L_{CRBs} (with L_{CRBs} : number of allocated resource blocks)).

$Z'(f,t)$ are the samples of the signal evaluated for the EVM $_{DMRS}$

$I(f,t)$ is the ideal signal reconstructed by the measurement equipment, and

P_0 is the average power of the ideal signal. For normalized modulation symbols P_0 is equal to 1.

n such results are generated per measurement sub-period, where *n* is as defined in Annex E.2.2.

E.4.6.1 1st average for EVM DMRS

EVM $_{DMRS}$ is averaged over all basic EVM $_{DMRS}$ measurements in one sub-period

The averaging comprises *n* UL slots

$$1stEVM_{DMRS} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(EVM_{DMRS,i}\right)^2},$$

where *n* is as defined in Annex E.2.2.

The timing is taken from the EVM for the data. 6 of those results are achieved from the samples. In general the timing is not the same for each result.

E.4.6.2 Final average for EVM DMRS

$$finalEVM_{DMRS} = \sqrt{\frac{1}{6}\sum_{i=1}^{6}\left(1stEVM_{DMRS,i}\right)^2}$$

E.5 EVM and inband emissions for PUCCH

For the purpose of worst case testing, the PUCCH shall be located on the edges of the Transmission Bandwidth Configuration.

The EVM for PUCCH (EVM_{PUCCH}) is averaged over *n* slots, where *n* is as defined in Annex E.2.2

.

At least *n* TSs shall be transmitted by the UE without power change. SRS multiplexing shall be avoided during this period. The following transition periods are applicable: One OFDM symbol on each side of the slot border (instant of band edge alternation).

The description below is generic in the sense that all 5 PUCCH formats are covered. Although the number of OFDM symbols in one slot can be different from 14 (depending on the format, configuration and cyclic prefix length), the text below uses 14 without excluding the others.

E.5.1 Basic principle

The basic principle is the same as described in E.2.1

E.5.2 Output signal of the TX under test

The output signal of the TX under test is processed same as described in E.2.2

E.5.3 Reference signal

The reference signal is defined same as in E.2.3. Same as in E.2.3, $i_1(\nu)$ is the ideal reference for EVM_{PUCCH} and $i_2(\nu)$ is used to estimate the FFT window timing.

Note PUSCH is off during the PUCCH measurement period.

E.5.4 Measurement results

The measurement results are:

- EVM_{PUCCH}
- Inband emissions with the sub-results: General in-band emission, IQ image (according to: 38.101. Annex F.4, Clause starting with: "At this stage the ….")

E.5.5 Measurement points

The measurement points are illustrated in Figure E.2.5-1.

E.5.6 Pre FFT minimization process

The pre FFT minimisation process is the same as describes in clause E.3.1.

NOTE: although an exclusion period for EVM_{PUCCH} is applicable in E.5.9.1, the pre FFT minimisation process is done over the complete slot.

RF error, and carrier leakage are necessary for best fit of the measured signal towards the ideal signal in the pre FFT domain. However they are not used to compare them against the limits.

E.5.7 Timing of the FFT window

Timing of the FFT window is estimated with the same method as described in E.3.2.

E.5.8 Post FFT equalisation

The post FFT equalisation is described separately without reference to E.3.3:

Perform 14 FFTs on z'(ν), one for each OFDM symbol in a slot using the timing $\Delta\tilde{c}$, including the demodulation reference symbol. The result is an array of samples, 14 in the time axis t times 4096 in the frequency axis f. The samples represent the OFDM symbols (data and reference symbols) in the allocated RBs and inband emissions in the non-allocated RBs within the transmission BW.

Only the allocated resource blocks in the frequency domain are used for equalisation.

The nominal reference symbols and **nominal** OFDM data symbols are used to equalize the measured data symbols.

Note: (The nomenclature inside this note is local and not valid outside)

The nominal OFDM data symbols are created by a demodulation process. A demodulation process as follows is recommended:

1. Equalize the measured OFDM data symbols using the reference symbols for equalisation. Result: Equalized OFDM data symbols

2. Decide for the nearest constellation point, however not independent for each subcarrier in the RB. 12 constellation points are decided dependent, using the applicable CAZAC sequence. Result: Nominal OFDM data symbols

At this stage we have an array of Measured data-Symbols and reference-Symbols (MS(f,t))

versus an array of Nominal data-Symbols and reference Symbols (NS(f,t))

The arrays comprise in sum 14 data and reference symbols, depending on the PUCCH format, in the time axis and the number of allocated sub-carriers in the frequency axis.

MS(f,t) and NS(f,t) are processed with a least square (LS) estimator, to derive one equalizer coefficient per time slot and per allocated subcarrier. EC(f)

$$EC(f) = \frac{\sum_{t=0}^{13} NS(f,t)^{*} NS(f,t)}{\sum_{t=0}^{13} MS(f,t)^{*} NS(f,t)}$$

With * denoting complex conjugation.

EC(f) are used to equalize the OFDM data together with the demodulation reference symbols by:

$$Z'(f,t) = MS(f,t) \cdot EC(f)$$

With · denoting multiplication.

Z'(f,t) is used to calculate EVM_{PUCCH}, as described in E.5.9 1

NOTE: although an exclusion period for EVM_{PUCCH} is applicable in E.5.9.1, the post FFT minimisation process is done over 14 OFDM symbols.

The samples of the non-allocated resource blocks within the transmission bandwidth configuration in the post FFT domain are called Y(f,t) (f covering the non-allocated subcarriers within the transmission bandwidth configuration, t covering the OFDM symbols during 1 slot).

E.5.9 Derivation of the results

E.5.9.1 EVM_{PUCCH}

For EVM_{PUCCH} create two sets of Z'(f,t)., according to the timing " $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2" using the equalizer coefficients from E.5.8

The EVM_{PUCCH} is the difference between the ideal waveform and the measured and equalized waveform for the allocated RB(s)

$$EVM_{PUCCH} = \sqrt{\frac{\sum_{t \in T} \sum_{f \in F} \left| Z'(f,t) - I(f,t) \right|^2}{|T| \cdot P_0 \cdot |F|}},$$

where

the OFDM symbols next to slot boarders (instant of band edge alternation) are excluded:

t covers less than the count of demodulated symbols in the slot (|T|= 12)

f covers the count of subcarriers within the allocated bandwidth. (|F|=12)

$Z'(f,t)$ are the samples of the signal evaluated for the EVM_{PUCCH}

$I(f,t)$ is the ideal signal reconstructed by the measurement equipment, and

P_0 is the average power of the ideal signal. For normalized modulation symbols P_0 is equal to 1.

From the acquired samples 2*n* EVM_{PUCCH} value can be derived, *n* values for the timing $\Delta\tilde{c}$ –W/2 and *n* values for the timing $\Delta\tilde{c}$ +W/2, where *n* is as defined in Annex E.2.2.

E.5.9.2 Averaged EVM_{PUCCH}

EVM_{PUCCH} is averaged over all basic EVM_{PUCCH} measurements

The averaging comprises *n* UL slots

$$\overline{EVM}_{PUCCH} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(EVM_{PUCCH,i}\right)^2},$$

where *n* is as defined in Annex E.2.2.

The averaging is done separately for timing $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2 leading to $\overline{EVM}_{PUCCH,low}$ and $\overline{EVM}_{PUCCH,high}$

$EVM_{PUCCH,final} = \max(\overline{EVM}_{PUCCH,low}, \overline{EVM}_{PUCCH,high})$ is compared against the test requirements.

E.5.9.3 In-band emissions measurement

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks

Create one set of Y(t,f) per slot according to the timing "$\Delta\tilde{c}$"

For the non-allocated RBs the in-band emissions are calculated as follows

$$Emissions_{absolute}(\Delta_{RB}) = \begin{cases} \frac{1}{|T_s|}\sum_{t \in T_s} \sum_{\max(f_{\min},(c_l+12\cdot\Delta_{RB}*\Delta f))}^{c_l+(12\cdot\Delta_{RB}+11)*\Delta f} |Y(t,f)|^2, \Delta_{RB} < 0 \\ \frac{1}{|T_s|}\sum_{t \in T_s} \sum_{c_h+(12\cdot\Delta_{RB}-11)*\Delta f}^{\min(f_{\max},(c_h+12\cdot\Delta_{RB}*\Delta f))} |Y(t,f)|^2, \Delta_{RB} > 0 \end{cases},$$

where

the upper formula represents the inband emissions below the allocated frequency block and the lower one the inband emissions above the allocated frequency block.

T_s is a set of $|T_s|$ OFDM symbols in the measurement period,

Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB} = 1$ for the first upper or $\Delta_{RB} = -1$ for the first lower adjacent RB),

$f_{\min}$ and $f_{\max}$ are the lower and upper edge of the UL UE channel bandwidth

c_l and c_h are the lower and upper edge of the allocated BW,

Δf is the SCS, and

$Y(t, f)$ is the frequency domain signal evaluated for in-band emissions as defined in the subsection E.5.8

The relative in-band emissions are, given by

$$Emissions_{relative}(\Delta_{RB}) = 10 * \log_{10} \frac{Emissions_{absolute}(\Delta_{RB})}{\frac{1}{|T_s| \cdot L_{CRBs}} \sum_{t \in T_s} \sum_{c_l}^{c_l + (12 \cdot L_{CRBs} - 1) * \Delta f} |\mathrm{MS}(t, f)|^2} [dB]$$

where

L_{CRBs} is the number of allocated RBs,

and $\mathrm{MS}(t, f)$ is the frequency domain samples for the allocated bandwidth, as defined in the subsection E.5.8

Although an exclusion period for EVM is applicable in E.5.9.1, the inband emissions measurement interval is defined over one complete slot in the time domain.

From the acquired samples *n* functions for inband emissions can be derived, where *n* is as defined in Annex E.2.2.

The in-band emissions are averaged over the *n* samples (equivalent to 10 UL subframes) with the same PUCCH position to prevent averaging of allocated and non-allocated RBs due to PUCCH frequency hopping:

$$\overline{Emissions}_{absolute}(\Delta_{RB}) = \frac{1}{n} \sum_{i=1}^{n} Emissions_{absolute,i}(\Delta_{RB})$$

$$\overline{Emissions}_{relative}(\Delta_{RB}) = 10 * \log_{10} \left(\frac{1}{n} \sum_{i=1}^{n} 10^{Emissions_{relative,i}(\Delta_{RB})/10} \right) \quad [dB]$$

Since the PUCCH allocation is always on the upper or lower band-edge, the opposite of the allocated one represents the IQ image, and the remaining inner RBs represent the general inband emissions. They are compared against different limits.

E.6 EVM for PRACH

The description below is generic in the sense that all PRACH formats are covered. The numbers, used in the text below are taken from PRACH format#0 without excluding the other formats. The sampling rate for PRACH is assumed as , 30.72 Msps in the time domain.

E.6.1 Basic principle

The basic principle is the same as described in E.2.1

E.6.2 Output signal of the TX under test

The output signal of the TX under test is processed same as described in E.2.2

The measurement period is different since 2 PRACH preambles are recorded for long preamble formats as defined in Table 6.3.3.1-1 in [8] and 10 preambles are recorded for short preamble formats as defined in Table 6.3.3.1-2 in [8].

E.6.3 Reference signal

The test description in 6.4.2.1.4.1 is based on non-contention based access:

- PRACH configuration index (responsible for Preamble format, System frame number and subframe number)
- Preamble ID
- Preamble power

signalled to the UE, defines the reference signal unambiguously, such that no demodulation process is necessary to gain the reference signal.

The reference signal i(v) is constructed by the measuring equipment according to the relevant TX specifications, using the following parameters: the applicable Zadoff Chu sequence, nominal carrier frequency, nominal amplitude and phase for each subcarrier, nominal timing, no carrier leakage. It is represented as a sequence of samples at a sampling rate of 122.88 Msps in the time domain.

E.6.4 Measurement results

The measurement result is:

- EVMPRACH

E.6.5 Measurement points

The measurement points are illustrated in the figure below:

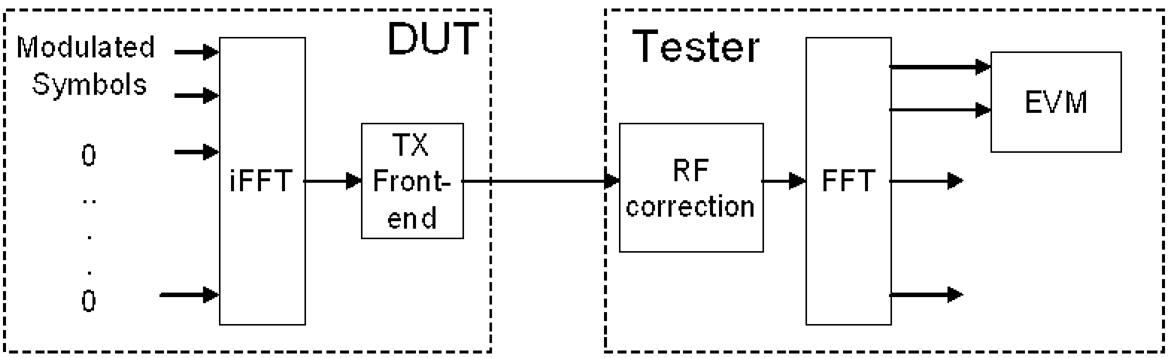

Figure E.6.5-1:Measurement points

E.6.6 Pre FFT minimization process

The pre-FFT minimization process is applied to each PRACH preamble separately. The time period for the pre- FFT minimisation process includes the complete CP and Zadoff-Chu sequence (in other words, the power transition period is per definition outside of this time period) Sample timing, Carrier frequency and carrier leakage in z(ν) are jointly varied in order to minimise the difference between z(ν) and i(ν). Best fit (minimum difference) is achieved when the RMS difference value between z(ν) and i(ν) is an absolute minimum.

After this process the samples z(ν) are called $z^0(\nu)$.

RF error, and carrier leakage are necessary for best fit of the measured signal towards the ideal signal in the pre FFT domain. However they are not used to compare them against the limits.

E.6.7 Timing of the FFT window

The FFT window length is 24576 samples for preamble format 0, however in the measurement period at least 27744 samples are taken. The position in time for FFT must be determined.

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

The reference instant for the FFT start is the centre of the reduced window, called $\Delta\tilde{c}$,

EVM is measured at the following two instants: $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2.

The timing of the measured signal $z^0(\nu)$ with respect to the ideal signal i(ν) is determined in the pre FFT domain as follows:

Correlation between $z^0(\nu)$ and i(ν) will result in a correlation peak. The meaning of the correlation peak is approx. the "impulse response" of the TX filter. The correlation peak, (the highest, or in case of more than one, the earliest) indicates the timing in the measured signal with respect to the ideal signal.

W is different for different preamble formats and shown in Table E.6.7-1 for $L_{\mathrm{RA}} = 839$ and $\Delta f^{\mathrm{RA}} \in \{1.25, 5\}$ kHz in Table E.6.7-2 for $L_{\mathrm{RA}} = 139$ and $\Delta f^{\mathrm{RA}} = 15 \cdot 2^{\mu}$ kHz where $\mu \in \{0,1,2\}$.

Table E.6.7-1: EVM window length for PRACH formats for $L_{\mathrm{RA}} = 839$

Preamble format	Cyclic prefix length N_{cp}	Nominal FFT size[1]	EVM window length *W* in FFT samples	Ratio of *W* to CP*
0	3168	24576	2307	72.8%
1	21024	24576	20163	95.9%
2	4688	24576	3827	81.6%
3	3168	6144	2952	93.2%
Note 1: The use of other FFT sizes is possible as long as appropriate scaling of the window length is applied Note 2: These percentages are informative				

Table E.6.7-2: EVM window length for PRACH formats for $L_{\mathrm{RA}} = 139$

Preamble format	Cyclic prefix length N_{cp}	Nominal FFT size[1]	EVM window length *W* in FFT samples	Ratio of *W* to CP*
A1	$288{\cdot}2^{-\mu}$	$2048{\cdot}2^{-\mu}$	$144{\cdot}2^{-\mu}$	50.0%
A2	$576{\cdot}2^{-\mu}$	$2048{\cdot}2^{-\mu}$	$432{\cdot}2^{-\mu}$	75.0%
A3	$864{\cdot}2^{-\mu}$	$2048{\cdot}2^{-\mu}$	$720{\cdot}2^{-\mu}$	83.3%
B1	$216{\cdot}2^{-\mu}$	$2048{\cdot}2^{-\mu}$	$72{\cdot}2^{-\mu}$	33.3%
B2	$360{\cdot}2^{-\mu}$	$2048{\cdot}2^{-\mu}$	$216{\cdot}2^{-\mu}$	60.0%
B3	$504{\cdot}2^{-\mu}$	$2048{\cdot}2^{-\mu}$	$360{\cdot}2^{-\mu}$	71.4%
B4	$936{\cdot}2^{-\mu}$	$2048{\cdot}2^{-\mu}$	$792{\cdot}2^{-\mu}$	84.6%
C0	$1240{\cdot}2^{-\mu}$	$2048{\cdot}2^{-\mu}$	$1096{\cdot}2^{-\mu}$	88.4%
C2	$2048{\cdot}2^{-\mu}$	$2048{\cdot}2^{-\mu}$	$1904{\cdot}2^{-\mu}$	93.0%
Note 1: The use of other FFT sizes is possible as long as appropriate scaling of the window length is applied Note 2: These percentages are informative				

The number of samples, used for FFT is reduced compared to $z^0(\nu)$. This subset of samples is called z' (ν).

EVM is based on Nominal FFT size samples per PRACH preamble and demodulated symbol.

E.6.8 Post FFT equalisation

Equalisation is not applicable for the PRACH.

E.6.9 Derivation of the results

E.6.9.1 EVM$_{\mathrm{PRACH}}$

Perform FFT on z'(ν) and i(ν) using the FFT timing $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2.

For format 2 and 3 the first and the repeated preamble sequence are FFT-converted separately. using the standard FFT length of 2048.

The EVM$_{\mathrm{PRACH}}$ is the difference between the ideal waveform and the measured and equalized waveform for the allocated RB(s).

$$EVM_{PRACH} = \sqrt{\frac{\sum_{t\in T}\sum_{f\in F}\left|Z'(f,t) - I(f,t)\right|^2}{|T|\cdot P_0\cdot|F|}}$$

,

where

t covers the count of demodulated symbols in the slot.

f covers the count of demodulated symbols within the allocated bandwidth.

$Z'(f,t)$ are the samples of the signal evaluated for the EVM$_{\mathrm{PRACH}}$

$I(f,t)$ is the ideal signal reconstructed by the measurement equipment, and

P_0 is the average power of the ideal signal. For normalized modulation symbols P_0 is equal to 1.

From the acquired samples 2*m* EVM_{PRACH} values can be derived, *m* values for the timing $\Delta\tilde{c}$ –W/2 and *m* values for the timing $\Delta\tilde{c}$ +W/2, where *m* is the number of recorded preambles as defined in Annex E.6.2.

E.6.9.2 Averaged EVM_{PRACH}

The PRACH EVM, EVM_{PRACH}, is averaged over *m* preamble sequence measurements.

$$\overline{EVM}_{\mathrm{PRACH}} = \sqrt{\frac{1}{m}\sum_{i=1}^{m}\left(EVM_{\mathrm{PRACH},i}\right)^2},$$

where *m* is the number of recorded preambles as defined in Annex E.6.2.The averaging is done separately for timing $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2 leading to $\overline{EVM}_{PRACH,low}$ and $\overline{EVM}_{PRACH,high}$

$EVM_{PRACH,final} = \max(\overline{EVM}_{PRACH,low}, \overline{EVM}_{PRACH,high})$ is compared against the test requirements.

Annex F (normative): Measurement uncertainties and Test Tolerances

F.1 Acceptable uncertainty of Test System (normative)

The maximum acceptable uncertainty of the Test System is specified below for each test, where appropriate. The Test System shall enable the stimulus signals in the test case to be adjusted to within the specified range, and the equipment under test to be measured with an uncertainty not exceeding the specified values. All ranges and uncertainties are absolute values, and are valid for a confidence level of 95 %, unless otherwise stated.

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

For RF tests it should be noted that the uncertainties in clause F.1 apply to the Test System operating into a nominal 50 ohm load and do not include system effects due to mismatch between the DUT and the Test System.

The downlink signal uncertainties apply at each receiver antenna connector.

F.1.1 Measurement of test environments

The measurement accuracy of the UE test environments defined in TS 38.508-1 [5] subclause 4.1, Test environments shall be

- Pressure ±5 kPa.
- Temperature ±2 degrees.
- Relative Humidity ±5 %.
- DC Voltage ±1,0 %.
- AC Voltage ±1,5 %.
- Vibration 10 %.
- Vibration frequency 0,1 Hz.

The above values shall apply unless the test environment is otherwise controlled and the specification for the control of the test environment specifies the uncertainty for the parameter.

F.1.2 Measurement of transmitter

Table F.1.2-1: Maximum Test System Uncertainty for transmitter tests

Subclause	Maximum Test System Uncertainty	Derivation of Test System Uncertainty
6.2.1 UE maximum output power	f ≤ 3.0GHz ±0.7 dB, BW ≤ 40MHz ±1.4 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.0 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±1.3 dB, BW ≤ 20MHz ±1.5 dB, 20MHz < BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz	
6.2.2 Maximum Power Reduction (MPR)	f ≤ 3.0GHz ±0.7 dB, BW ≤ 40MHz ±1.4 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.0 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±1.3 dB, BW ≤ 20MHz ±1.5 dB, 20MHz < BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz	
6.2.3 UE additional maximum output power reduction	f ≤ 3.0GHz ±0.7 dB, BW ≤ 40MHz ±1.4 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.0 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±1.3 dB, BW ≤ 20MHz ±1.5 dB, 20MHz < BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz	
6.2.4 Configured transmitted power	f ≤ 3.0GHz ±0.7 dB, BW ≤ 40MHz ±1.4 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.0 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±1.3 dB, BW ≤ 20MHz ±1.5 dB, 20MHz < BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz	
6.2A.1.1 UE maximum output power for CA (2UL CA)	For Inter-band CA MAX (MU_{CC1}, MU_{CC2})	MU_{CCX} is MU of each UL CC specified in single UL case 6.2.1.
6.2A.2.1 UE maximum output power reduction for CA (2UL CA)	For Inter-band CA MAX (MU_{CC1}, MU_{CC2})	MU_{CCX} is MU of each UL CC specified in single UL case 6.2.2.
6.2A.3.1 UE additional maximum output power reduction CA (2UL CA)	For Inter-band CA MAX (MU_{CC1}, MU_{CC2})	MU_{CCX} is MU of each UL CC specified in single UL case 6.2.3.
6.2A.4.1 Configured transmitted power for CA (2UL CA)	For Inter-band CA MAX (MU_{CC1}, MU_{CC2})	MU_{CCX} is MU of each UL CC specified in single UL case 6.2.4.
6.2C.1 Configured transmitted power for SUL	Same as 6.2.1	

6.2D.1 UE maximum output power for UL-MIMO	Same as 6.2.1 for the sum of power at each of UE antenna connector	MU is for the sum of power at each of UE antenna connector, and is the same as the MU of single antenna port in 6.2.1 with SNR assumption reduced by 3dB compared to the single antenna case.
6.2D.2 UE maximum output power reduction for UL-MIMO	Same as 6.2.2 for the sum of power at each of UE antenna connector	MU is for the sum of power at each of UE antenna connector, and is the same as the MU of single antenna port in 6.2.2 with SNR assumption reduced by 3dB compared to the single antenna case.
6.2D.3 UE additional maximum output power reduction for UL-MIMO	Same as 6.2.3 for the sum of power at each of UE antenna connector	MU is for the sum of power at each of UE antenna connector, and is the same as the MU of single antenna port in 6.2.3 with SNR assumption reduced by 3dB compared to the single antenna case.
6.2D.4 Configured transmitted power for UL-MIMO	Same as 6.2.4 for the sum of power at each of UE antenna connector	MU is for the sum of power at each of UE antenna connector, and is the same as the MU of single antenna port in 6.2.4 with SNR assumption reduced by 3dB compared to the single antenna case.
6.3.1 Minimum output power	f ≤ 3.0GHz ±1.0 dB, BW ≤ 40MHz ±1.4 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.3 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±1.5 dB, BW ≤ 40MHz ±1.8 dB, 40MHz < BW ≤ 100MHz	
6.3.2 Transmit OFF power	f ≤ 3.0GHz ±1.5 dB, BW ≤ 40MHz ±1.7 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.8 dB, BW ≤ 40MHz ±1.9 dB, 40MHz < BW ≤ 80MHz ±2.2 dB, 80MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±2.0 dB, BW ≤ 20MHz ±2.1 dB, 20MHz < BW ≤ 80MHz ±2.2 dB, 80MHz < BW ≤ 100MHz	
6.3.3.2 General ON/OFF time mask	f ≤ 3.0GHz ±1.5 dB, BW ≤ 40MHz ±1.7 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.8 dB, BW ≤ 40MHz ±1.9 dB, 40MHz < BW ≤ 80MHz ±2.2 dB, 80MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±2.0 dB, BW ≤ 20MHz ±2.1 dB, 20MHz < BW ≤ 80MHz ±2.2 dB, 80MHz < BW ≤ 100MHz	

6.3.3.4 PRACH time mask	f ≤ 3.0GHz ±1.5 dB, BW ≤ 40MHz ±1.7 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.8 dB, BW ≤ 40MHz ±1.9 dB, 40MHz < BW ≤ 80MHz ±2.2 dB, 80MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±2.0 dB, BW ≤ 20MHz ±2.1 dB, 20MHz < BW ≤ 80MHz ±2.2 dB, 80MHz < BW ≤ 100MHz	
6.3.3.6 SRS time mask	f ≤ 3.0GHz ±1.5 dB, BW ≤ 40MHz ±1.7 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.8 dB, BW ≤ 40MHz ±1.9 dB, 40MHz < BW ≤ 80MHz ±2.2 dB, 80MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±2.0 dB, BW ≤ 20MHz ±2.1 dB, 20MHz < BW ≤ 80MHz ±2.2 dB, 80MHz < BW ≤ 100MHz	
6.3.4.2 Absolute power tolerance	f ≤ 3.0GHz ±1.0 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.4 dB, BW ≤ 40MHz ±1.9 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±2.0 dB, BW ≤ 20MHz ±2.1 dB, 20MHz < BW ≤ 40MHz ±2.2 dB, 80MHz < BW ≤ 100MHz	Test System uncertainty = SQRT (UL Meas Uncer^2 + DL Meas Uncer^2)
6.3.4.3 Power Control Relative power tolerance	±0.7 dB, BW ≤ 40MHz ±1.0 dB, 40MHz < f ≤ 100MHz	
6.3.4.4 Aggregate power tolerance	±0.7 dB, BW ≤ 40MHz ±1.0 dB, 40MHz < f ≤ 100MHz	
6.3D.1 Minimum output power for UL-MIMO	Same as 6.3.1 for the sum of power at each of UE antenna connector	MU is for the sum of power at each of UE antenna connector, and is the same as the MU of single antenna port in 6.3.1 with SNR assumption reduced by 3dB compared to the single antenna case.
6.3D.2 Transmit OFF power for UL-MIMO	Same as 6.3.2 for each antenna	
6.3D.3 Transmit ON/OFF time mask for UL-MIMO	Same as 6.3.3.2 for each antenna	
6.3D.4.1 Absolute Power tolerance	Same as 6.3.4.2 for the sum of power at each of UE antenna connector	MU is for the sum of power at each of UE antenna connector, and is the same as the MU of single antenna port in 6.3.4.2 with SNR assumption reduced by 3dB compared to the single antenna case.
6.3D.4.2 Relative Power tolerance	±0.9 dB, BW ≤ 40MHz ±1.4 dB, 40MHz < f ≤ 100MHz	MU is for the sum of power at each of UE antenna connector

6.3D.4.3 Aggregate Power tolerance	Same as 6.3.4.4 for the sum of power at each of UE antenna connector	MU is for the sum of power at each of UE antenna connector, and is the same as the MU of single antenna port in 6.3.4.4 with SNR assumption reduced by 3dB compared to the single antenna case.
6.4.1 Frequency Error	±15 Hz, f ≤ 3.0GHz ±36 Hz, f > 3.0GHz DL Signal level: ±0.7 dB, f ≤ 3.0GHz ±1.0 dB, 3.0GHz < f ≤ 4.2GHz ±1.5 dB, 4.2GHz < f ≤ 6.0GHz	
6.4.2.1 Error Vector Magnitude	For up to 256QAM: f ≤ 6.0GHz, BW ≤ 100MHz 15 dBm < P_{UL} PUSCH, PUCCH, PRACH: ±1.5 % -25 dBm < P_{UL} ≤ 15 dBm PUSCH, PUCCH, PRACH: ±2.5 % -40dBm ≤ P_{UL} ≤ -25dBm PUSCH, PUCCH, PRACH: ±3.0 %	
6.4.2.2 Carrier Leakage	f ≤ 3.0GHz ±0.8 dB, BW ≤ 40MHz ±1.5 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±0.8 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±1.0 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz	
6.4.2.3 In-band emissions	f ≤ 3.0GHz ±0.8 dB, BW ≤ 40MHz ±1.5 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±0.8 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±1.0 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz	
6.4.2.4 EVM equalizer spectrum flatness	±1.4 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz	
6.4.2.5 EVM equalizer spectrum flatness for Pi/2 BPSK	Same as 6.4.2.4	
6.4D.1 Frequency error for UL-MIMO	Same as 6.4.1 for each antenna	
6.4D.2.1 Error Vector Magnitude for UL-MIMO	Same as 6.4.2.1 for each antenna	
6.4D.2.2 Carrier leakage for UL-MIMO	Same as 6.4.2.2 for each antenna	
6.4D.2.3 In-band emissions for UL-MIMO	Same as 6.4.2.3 for each antenna	
6.4D.2.4 EVM equalizer spectrum flatness for UL-MIMO	Same as 6.4.2.4 for each antenna	
6.4D.3 Time alignment error for UL-MIMO	±25ns	
6.4D.4 Requirements for Coherent UL MIMO	FFS	
6.5.1 Occupied bandwidth	1.5% of channel bandwidth	
6.5C.1 Occupied bandwidth for SUL	Same as 6.5.1	

6.5.2.2 Spectrum Emission Mask	±1.5 dB, f ≤ 3.0GHz ±1.8 dB, 3.0GHz < f ≤ 4.2GHz ±2.0 dB, 4.2GHz < f ≤ 6.0GHz	
6.5C.2.2 Spectrum Emission Mask for SUL	Same as 6.5.2.2	
6.5.2.3 Additional spectrum emission mask	±1.5 dB, f ≤ 3.0GHz ±1.8 dB, 3.0GHz < f ≤ 4.2GHz ±2.0 dB, 4.2GHz < f ≤ 6.0GHz	
6.5C.2.3 Additional spectrum emission mask for SUL	Same as 6.5.2.3	
6.5.2.4.1 NR ACLR	±0.8 dB, f ≤ 4.0GHz ±1.0 dB, 4.0GHz < f ≤ 6.0GHz	
6.5C.2.4.1 NR ACLR for SUL	Same 6.5.2.4.1	
6.5.2.4.2 UTRA ACLR	±0.8 dB, f ≤ 4.0GHz ±1.0 dB, 4.0GHz < f ≤ 6.0GHz	
6.5C.2.4.2 UTRA ACLR for SUL	Same as 6.5.2.4.2	
6.5.3.1 General spurious emissions	for results > -60 dBm: ±2.0 dB, 9kHz < f ≤ 3GHz ±2.5 dB, 3GHz < f ≤ 4GHz ±4.0 dB, 4GHz < f ≤ 19GHz ±6.0 dB, 19GHz < f ≤ 26GHz	
6.5C.3.1 General spurious emissions for SUL	Same as 6.5.3.1	
6.5.3.2 Spurious emission for UE co-existence	for results > -60 dBm: ±2.0 dB, 9kHz < f ≤ 3GHz ±2.5 dB, 3GHz < f ≤ 4GHz ±4.0 dB, 4GHz < f ≤ 19GHz ±6.0 dB, 19GHz < f ≤ 26GHz	
6.5C.3.2 Spurious emission for UE co-existence for SUL	Same as 6.5.3.2	
6.5.3.3 Additional spurious emissions	for results > -60 dBm: ±2.0 dB, 9kHz < f ≤ 3GHz ±2.5 dB, 3GHz < f ≤ 4GHz ±4.0 dB, 4GHz < f ≤ 19GHz ±6.0 dB, 19GHz < f ≤ 26GHz	
6.5C.3.3 Additional spurious emissions for SUL	Same as 6.5.3.3	
6.5.4 Transmit intermodulation	f ≤ 3.0GHz ±2.7 dB, BW ≤ 40MHz ±3.1 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±3.7 dB, BW ≤ 40MHz ±4.0 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±5.1 dB, BW ≤ 40MHz ±5.3 dB, 40MHz < BW ≤ 100MHz	Overall system uncertainty comprises four quantities: 1. Wanted signal setting error 2. CW Interferer level error 3. Wanted signal meas. error 4. Intermodulation product measurement error The relative level of the wanted signal and the CW interferer has 2 x effect on the intermodulation product. Items 1, 2, 3 and 4 are assumed to be uncorrelated so can be root sum squared to provide the combined effect. Test System uncertainty = SQRT [(2 x SQRT (Wanted setting_error^2 + CW_level_error^2)) ^{2} + Wanted_level_meas error^2 + Intermodulation product measurement error^2]
6.5C.4 Transmit intermodulation for SUL	Same as 6.5.4	

6.5D.1 Occupied bandwidth for UL-MIMO	Same as 6.5.1 for each antenna	
6.5D.2.2 Spectrum emission mask for UL-MIMO	Same as 6.5.2.2 for each antenna	
6.5D.2.3 Additional spectrum emission mask for UL-MIMO	Same as 6.5.2.3 for each antenna	
6.5D.2.4.1 NR ACLR for UL-MIMO	Same as 6.5.2.4.1 for each antenna	
6.5D.2.4.2 UTRA ACLR for UL-MIMO	Same as 6.5.2.4.2 for each antenna	
6.5D.3.1 General spurious emissions for UL-MIMO	Same as 6.5.3.1 for each antenna	
6.5D.3.2 Spurious emissions for UE co-existence for UL-MIMO	Same as 6.5.3.2 for each antenna	
6.5D.3.3 Additional spurious emissions for UL MIMO	Same as 6.5.3.3 for each antenna	
6.5D.4 Transmit intermodulation for UL-MIMO	Same as 6.5.4 for each antenna	

F.1.3 Measurement of receiver

Table F.1.3-1: Maximum Test System Uncertainty for receiver tests

Subclause	Maximum Test System Uncertainty	Derivation of Test System Uncertainty
7.3.2 Reference sensitivity power level	±0.7 dB, f ≤ 3.0GHz ±1.0 dB, 3.0GHz < f ≤ 4.2GHz ±1.5 dB, 4.2GHz < f ≤ 6GHz	
7.3.2_1 Reference sensitivity level with 4 Rx antenna ports	±0.7 dB, f ≤ 3.0GHz ±1.0 dB, 3.0GHz < f ≤ 4.2GHz ±1.5 dB, 4.2GHz < f ≤ 6GHz	
7.3C.2 Reference sensitivity power level	Same as 7.3.2	
7.3D Reference sensitivity for MIMO	Same as 7.3.2	
7.4 Maximum input level	Downlink power ±0.7 dB, f ≤ 3.0GHz ±1.0 dB, 3.0GHz < f ≤ 4.2GHz ±1.5 dB, 4.2GHz < f ≤ 6GHz Uplink power measurement f ≤ 3.0GHz ±0.7 dB, BW ≤ 40MHz ±1.4 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.0 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±1.3 dB, BW ≤ 20MHz ±1.5 dB, 20MHz < BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz	
7.4D Maximum input level for UL-MIMO	Downlink power same as 7.4 Uplink power measurement same as 6.2D.1	The overall UL power is the linear sum of the output powers over all Tx antenna connectors
7.5 Adjacent channel selectivity	ACS value ±1.6 dB, f ≤ 3.0GHz ±2.3 dB, 3.0GHz < f ≤ 4.2GHz ±3.0 dB, 4.2GHz < f ≤ 6.0GHz Uplink power measurement f ≤ 3.0GHz ±0.7 dB, BW ≤ 40MHz ±1.4 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.0 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±1.3 dB, BW ≤ 20MHz ±1.5 dB, 20MHz < BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz	Overall ACS uncertainty comprises three quantities: 1. Wanted signal level error 2. Interferer signal level error 3. Additional impact of interferer ACLR Items 1 and 2 are assumed to be uncorrelated so can be root sum squared to provide the ratio error of the two signals. The interferer ACLR effect is systematic, and is added arithmetically. Test System uncertainty = [SQRT (wanted_level_error^2 + interferer_level_error^2)] + ACLR effect.
7.5D Adjacent channel selectivity for UL-MIMO	ACS value same as 7.5 Uplink power measurement same as 6.2D.1	The overall UL power is the linear sum of the output powers over all Tx antenna connectors

7.6.2 Inband Blocking	Blocking ±1.6 dB, f ≤ 3.0GHz ±2.3 dB, 3.0GHz < f ≤ 4.2GHz ±3.0 dB, 4.2GHz < f ≤ 6.0GHz Uplink power measurement f ≤ 3.0GHz ±0.7 dB, BW ≤ 40MHz ±1.4 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.0 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±1.3 dB, BW ≤ 20MHz ±1.5 dB, 20MHz < BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz	Overall blocking uncertainty can have these contributions: 1. Wanted signal level error 2. Interferer signal level error 3. Interferer ACLR 4. Interferer broadband noise Items 1 and 2 are assumed to be uncorrelated so can be root sum squared to provide the ratio error of the two signals. The Interferer ACLR or Broadband noise effect is systematic, and is added arithmetically. Test System uncertainty = [SQRT (wanted_level_error^2 + interferer_level_error^2)] + ACLR effect + Broadband noise effect. In-band blocking, using modulated interferer: Broadband noise not applicable
7.6.3 Out-of-band blocking	Wanted signal, f ≤ 3.0GHz ±2.0 dB, Blocking, 1MHz < $f_{interferer}$ ≤ 3GHz ±3.9 dB, Blocking, 3GHz < $f_{interferer}$ ≤ 12.75GHz Wanted signal, 3.0GHz < f ≤ 4.2GHz ±2.2 dB, Blocking, 1MHz < $f_{interferer}$ ≤ 3GHz ±4.0 dB, Blocking, 3GHz < $f_{interferer}$ ≤ 12.75GHz Wanted signal, 4.2GHz < f ≤ 6GHz ±2.6 dB, Blocking, 1MHz < $f_{interferer}$ ≤ 3GHz ±4.2 dB, Blocking, 3GHz < $f_{interferer}$ ≤ 12.75GHz Uplink power measurement f ≤ 3.0GHz ±0.7 dB, BW ≤ 40MHz ±1.4 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.0 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±1.3 dB, BW ≤ 20MHz ±1.5 dB, 20MHz < BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz	Out of band blocking, using CW interferer: Interferer ACLR not applicable Impact of interferer Broadband noise 0.8dB Figures are combined to give Test System uncertainty, using formula given for 7.6.2
7.6.4 Narrow band blocking	Blocking ± 2.0dB, f ≤ 3.0GHz ± 2.4dB, 3.0GHz < f ≤ 4.2GHz ± 3.1dB, 4.2GHz < f ≤ 6.0GHz Uplink power measurement f ≤ 3.0GHz ±0.7 dB, BW ≤ 40MHz ±1.4 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.0 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±1.3 dB, BW ≤ 20MHz ±1.5 dB, 20MHz < BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz	Narrow band blocking, using CW interferer: Interferer ACLR not applicable Impact of interferer Broadband noise 0.8dB Figures are combined to give Test System uncertainty, using formula given for 7.6.2
7.6D.2 Inband blocking for UL MIMO	Blocking same as 7.6.2 Uplink power measurement same as 6.2D.1	The overall UL power is the linear sum of the output powers over all Tx antenna connectors

7.6D.3 Out-of-band blocking for UL MIMO	Wanted signal same as 7.6.3 Uplink power measurement same as 6.2D.1	The overall UL power is the linear sum of the output powers over all Tx antenna connectors
7.6D.4 Narrow-band blocking for UL MIMO	Blocking same as 7.6.4 Uplink power measurement same as 6.2D.1	The overall UL power is the linear sum of the output powers over all Tx antenna connectors
7.7 Spurious response	Same as 7.6.3	Same as 7.6.3
7.7D Spurious response for UL-MIMO	Same as 7.7 Uplink power measurement same as 6.2D.1	The overall UL power is the linear sum of the output powers over all Tx antenna connectors
7.8.2 Wide band Intermodulation	Intermodulation ± 2.3dB, f ≤ 3.0GHz ± 3.1dB, 3.0GHz < f ≤ 4.2GHz ± 4.3dB, 4.2GHz < f ≤ 6.0GHz Uplink power measurement f ≤ 3.0GHz ±0.7 dB, BW ≤ 40MHz ±1.4 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 4.2GHz ±1.0 dB, BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz 4.2GHz < f ≤ 6.0GHz ±1.3 dB, BW ≤ 20MHz ±1.5 dB, 20MHz < BW ≤ 40MHz ±1.6 dB, 40MHz < BW ≤ 100MHz	Overall intermodulation uncertainty comprises three quantities: 1. Wanted signal level error 2. CW Interferer level error 3. Modulated Interferer level error Effect of interferer ACLR has not been included as modulated interferer has larger frequency offset The effect of the closer CW signal has twice the effect. Items 1, 2 and 3 are assumed to be uncorrelated so can be root sum squared to provide the combined effect of the three signals. Test System uncertainty = SQRT [(2 x CW_level_error)^2 +(mod interferer_level_error)^2 +(wanted signal_level_error)^2]
7.8D Intermodulation characteristics for UL-MIMO	Intermodulation same as 7.8.2 Uplink power measurement same as 6.2D.1	The overall UL power is the linear sum of the output powers over all Tx antenna connectors
7.9 Spurious emissions	for results > -60 dBm: ±2.0 dB, 9kHz < f ≤ 3GHz ±2.5 dB, 3GHz < f ≤ 4GHz ±4.0 dB, 4GHz < f ≤ 19GHz ±6.0 dB, 19GHz < f ≤ 26GHz	

F.2 Interpretation of measurement results (normative)

The measurement results returned by the Test System are compared – without any modification – against the Test Requirements. The Test Requirement is defined as a threshold considered in a test to assess compliance of the device; it might be either equal (“Shared Risk” principle) or relaxed (“Never fail a good DUT” principle) compared to the corresponding core specification value by an amount defined in Annex F.3 as Test Tolerance.

The “Shared Risk” and the “Never fail a good DUT” principles are defined in Rec. ITU-R M.1545.

The actual measurement uncertainty of the Test System for the measurement of each parameter shall be included in the test report.

The recorded value for the Test System uncertainty shall be, for each measurement, equal to or lower than the appropriate figure in clause F.1 of the present document.

If the Test System for a test is known to have a measurement uncertainty greater than that specified in clause F.1, it is still permitted to use this apparatus provided that an adjustment is made value as follows:

Any additional uncertainty in the Test System over and above that specified in clause F.1 shall be used to tighten the Test Requirement, making the test harder to pass. For some tests, for example receiver tests, this may require modification of stimulus signals. This procedure will ensure that a Test System not compliant with clause F.1does not increase the chance of passing a device under test where that device would otherwise have failed the test if a Test System compliant with clause F.1 had been used.

F.3 Test Tolerance and Derivation of Test Requirements (informative)

The Test Requirements in the present document have been calculated by relaxing the Minimum Requirements of the core specification using the Test Tolerances defined in this clause. When the Test Tolerance is zero, the Test Requirement will be the same as the Minimum Requirement. When the Test Tolerance is non-zero, the Test Requirements will differ from the Minimum Requirements, and the formula used for the relaxation is given in this clause.

The Test Tolerances are derived from Test System uncertainties, regulatory requirements and criticality to system performance. As a result, the Test Tolerances may sometimes be set to zero.

The test tolerances should not be modified for any reason e.g. to take account of commonly known test system errors (such as mismatch, cable loss, etc.).

The downlink Test Tolerances apply at each receiver antenna connector.

F.3.1 Measurement of test environments

The UE test environments are set to the values defined in TS 38.508-1 subclause 4.1, without any relaxation. The applied Test Tolerance is therefore zero.

F.3.2 Measurement of transmitter

Table F.3.2-1: Derivation of Test Requirements (Transmitter tests)

Sub clause	Test Tolerance (TT)	Formula for test requirement
6.2.1 UE maximum output power	f ≤ 3.0GHz 0.7 dB, BW ≤ 40MHz 1.0 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 6.0GHz 1.0 dB, BW ≤ 100MHz	Upper limit + TT, Lower limit - TT
6.2.2 Maximum Power Reduction (MPR)	f ≤ 3.0GHz 0.7 dB, BW ≤ 40MHz 1.0 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 6.0GHz 1.0 dB, BW ≤ 100MHz	Upper limit + TT, Lower limit - TT
6.2.3 UE additional maximum output power reduction	f ≤ 3.0GHz 0.7 dB, BW ≤ 40MHz 1.0 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 6.0GHz 1.0 dB, BW ≤ 100MHz	Upper limit + TT, Lower limit - TT
6.2.4 Configured transmitted power	f ≤ 3.0GHz 0.7 dB, BW ≤ 40MHz 1.0 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 6.0GHz 1.0 dB, BW ≤ 100MHz	Upper limit + TT, Lower limit - TT
6.2A.1.1 UE maximum output power for CA (2UL CA)	For Inter-band CA MAX (TT_{CC1}, TT_{CC2})	TT_{CCX} is TT of each UL CC specified in single UL case 6.2.1.
6.2A.2.1 UE maximum output power reduction for CA (2UL CA)	For Inter-band CA MAX (TT_{CC1}, TT_{CC2})	TT_{CCX} is TT of each UL CC specified in single UL case 6.2.2.
6.2A.3.1 UE additional maximum output power reduction CA (2UL CA)	For Inter-band CA MAX (TT_{CC1}, TT_{CC2})	TT_{CCX} is TT of each UL CC specified in single UL case 6.2.3.
6.2A.4.1 Configured transmitted power for CA (2UL CA)	For Inter-band CA MAX (TT_{CC1}, TT_{CC2})	TT_{CCX} is TT of each UL CC specified in single UL case 6.2.4.
6.2C.1 Configured transmitted power for SUL	Same as 6.2.1	Same as 6.2.1
6.2D.1 UE maximum output power for UL-MIMO	Same as 6.2.1 for the sum of power at each of UE antenna connector	Same as 6.2.1 Uplink power measurement applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
6.2D.2 UE maximum output power reduction for UL-MIMO	Same as 6.2.2 for the sum of power at each of UE antenna connector	Same as 6.2.2 Uplink power measurement applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
6.2D.3 UE additional maximum output power reduction for UL-MIMO	Same as 6.2.3 for the sum of power at each of UE antenna connector	Same as 6.2.3 Uplink power measurement applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
6.2D.4 Configured transmitted power for UL-MIMO	Same as 6.2.4 for the sum of power at each of UE antenna connector	Same as 6.2.4 Uplink power measurement applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors

6.3.1 Minimum output power	f ≤ 3.0GHz 1.0 dB, BW ≤ 40MHz 1.3 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 6.0GHz 1.3 dB, BW ≤ 100MHz	Minimum requirement + TT
6.3.2 Transmit OFF power	f ≤ 3.0GHz 1.5 dB, BW ≤ 40MHz 1.7 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 6.0GHz 1.8 dB, BW ≤ 100MHz	Minimum requirement + TT
6.3.3.2 General ON/OFF time mask	f ≤ 3.0GHz 1.5 dB, BW ≤ 40MHz 1.7 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 6.0GHz 1.8 dB, BW ≤ 100MHz	OFF Power: Minimum requirement + TT ON Power: Upper limit + TT, Lower limit - TT
6.3.3.4 PRACH time mask	f ≤ 3.0GHz 1.5 dB, BW ≤ 40MHz 1.7 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 6.0GHz 1.8 dB, BW ≤ 100MHz	OFF Power: Minimum requirement + TT ON Power: Upper limit + TT, Lower limit - TT
6.3.3.6 SRS time mask	f ≤ 3.0GHz 1.5 dB, BW ≤ 40MHz 1.7 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 6.0GHz 1.8 dB, BW ≤ 100MHz	OFF Power: Minimum requirement + TT ON Power: Upper limit + TT, Lower limit - TT
6.3.4.2 Absolute power tolerance	UL Power ≥ 0dBm TDD SCS 60kHz: [TBD] dB due to 0.25ms measurement time Otherwise: f ≤ 3.0GHz 1.0 dB, BW ≤ 40MHz 1.4 dB, 40MHz < BW ≤ 100MHz 3.0GHz < f ≤ 6.0GHz 1.4 dB, BW ≤ 100MHz	Upper limit + TT, Lower limit – TT
6.3.4.3 Power Control Relative power tolerance	0.7 dB, BW ≤ 100MHz	Upper limit + TT, Lower limit – TT
6.3.4.4 Aggregate power tolerance	TBD	Upper limit + TT, Lower limit – TT
6.3D.1 Minimum output power for UL-MIMO	Same as 6.3.1 for the sum of power at each of UE antenna connector	Same as 6.3.1 Uplink power measurement applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
6.3D.2 Transmit OFF power for UL-MIMO	Same as 6.3.2 for each antenna	Same as 6.3.2 Uplink power measurement applies to each Tx antenna connector
6.3D.3 Transmit ON/OFF time mask for UL-MIMO	Same as 6.3.3.2 for each antenna	Same as 6.3.3 Uplink power measurement applies to each Tx antenna connector
6.3D.4.1 Absolute Power tolerance	Same as 6.3.4.2 for the sum of power at each of UE antenna connector	Same as 6.3.4.2 Uplink power measurement applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors

6.3D.4.2 Relative Power tolerance	FFS	Same as 6.3.4.3 Uplink power measurement applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
6.3D.4.3 Aggregate Power tolerance	Same as 6.3.4.4 for the sum of power at each of UE antenna connector	Same as 6.3.4.4 Uplink power measurement applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
6.4.1 Frequency Error	15 Hz	Modulated carrier frequency: Upper limit + TT, Lower limit – TT DL power: REFSENS + TT
6.4.2.1 Error Vector Magnitude	For up to 64QAM 0% For 256QAM f ≤ 6.0GHz, BW ≤ 100MHz 0.3%, 15dBm < P_{UL} 0.8%, -25dBm < P_{UL} ≤ 15dBm, 1.1%, -40dBm ≤ P_{UL} ≤ -25dBm	Minimum requirement + TT
6.4.2.2 Carrier Leakage	0.8 dB, BW ≤ 100MHz	Minimum requirement + TT
6.4.2.3 In-band emissions	0.8 dB, BW ≤ 100MHz	Minimum requirement + TT
6.4.2.4 EVM equalizer spectrum flatness	1.4 dB, BW ≤ 100MHz	Minimum requirement + TT
6.4.2.5 EVM equalizer spectrum flatness for Pi/2 BPSK	Same as 6.4.2.4	Minimum requirement + TT
6.4D.1 Frequency error for UL-MIMO	Same as 6.4.1 for each antenna	Same as 6.4.1
6.4D.2.1 Error Vector Magnitude for UL-MIMO	Same as 6.4.2.1 for each antenna	Same as 6.4.2.1 Uplink power measurement window applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
6.4D.2.2 Carrier leakage for UL-MIMO	Same as 6.4.2.2 for each antenna	Same as 6.4.2.2 Uplink power measurement window applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
6.4D.2.3 In-band emissions for UL-MIMO	Same as 6.4.2.3 for each antenna	Same as 6.4.2.3 Uplink power measurement window applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
6.4D.2.4 EVM equalizer spectrum flatness for UL-MIMO	Same as 6.4.2.4 for each antenna	Same as 6.4.2.4
6.4D.3 Time alignment error for UL-MIMO	25ns	Minimum Requirement + TT
6.4D.4 Requirements for Ccoherent UL MIMO	FFS	FFS
6.4A.1.1 Frequency error for CA (2UL CA)	TBD	Modulated carrier frequency: Upper limit + TT, Lower limit – TT
6.4A.2.1.1 Error Vector Magnitude for CA (2UL CA)	For up to 64QAM 0% For 256QAM TBD	Minimum requirement + TT
6.4A.2.2.1 Carrier leakage for CA (2UL CA)	TBD	Minimum requirement + TT

6.4A.2.3.1 In-band emissions for CA (2UL CA)	TBD	Minimum requirement + TT
6.5.1 Occupied bandwidth	0 kHz	Minimum requirement + TT
6.5.2.2 Spectrum Emission Mask	1.5 dB, f ≤ 3.0GHz 1.8 dB, 3.0GHz < f ≤ 6.0GHz	Minimum requirement + TT
6.5.2.3 Additional spectrum emission mask	1.5 dB, f ≤ 3.0GHz 1.8 dB, 3.0GHz < f ≤ 6.0GHz	Minimum requirement + TT
6.5.2.4.1 NR ACLR	Absolute requirement 0 dB Relative requirement 0.8 dB	Absolute requirement ACLR Minimum Requirement + TT Relative requirement ACLR Minimum Requirement - TT
6.5.2.4.2 UTRA ACLR	Same as 6.5.2.4.1	Same as 6.5.2.4.1
6.5.3.1 General spurious emissions	0 dB	Minimum requirement + TT
6.5.3.2 Spurious emission for UE co-existence	0 dB	Minimum requirement + TT
6.5.3.3 Additional spurious emissions	0 dB	Minimum requirement + TT
6.5.4 Transmit intermodulation	0 dB	CW interferer Minimum Requirement - TT
6.5A.2.2.1 Spectrum emission mask for CA (2UL CA)	TBD	Minimum requirement + TT
6.5A.2.4.1.1 NR ACLR for CA (2UL CA)	TBD	Same as 6.5.2.4.1
6.5A.2.4.2.1 UTRA ACLR for CA (2UL CA)	TBD	Same as 6.5.2.4.2
6.5A.3.1.1 General spurious emissions for CA (2UL CA)	0 dB	Minimum requirement + TT
6.5A.3.2.1 Spurious emissions for UE co-existence for CA (2UL CA)	0 dB	Minimum requirement + TT
6.5A.4.1 Transmit intermodulation for CA (2UL CA)	0 dB	CW interferer Minimum Requirement - TT
6.5C.1 Occupied bandwidth for SUL	Same as 6.5.1	Same as 6.5.1
6.5C.2.2 Spectrum Emission Mask for SUL	Same as 6.5.2.2	Same as 6.5.2.2
6.5C.2.3 Additional spectrum emission mask for SUL	Same as 6.5.2.3	Same as 6.5.2.3
6.5C.2.4.1 NR ACLR for SUL	Same as 6.5.2.4.1	Same as 6.5.2.4.1
6.5C.2.4.2 UTRA ACLR for SUL	Same as 6.5.2.4.2	Same as 6.5.2.4.2
6.5C.3.1 General spurious emissions for SUL	Same as 6.5.3.1	Same as 6.5.3.1
6.5C.3.2 Spurious emission for UE co-existence for SUL	Same as 6.5.3.2	Same as 6.5.3.2
6.5C.3.3 Additional spurious emissions for SUL	Same as 6.5.3.3	Same as 6.5.3.3
6.5C.4 Transmit intermodulation for SUL	Same as 6.5.4	Same as 6.5.4
6.5D.1 Occupied bandwidth for UL-MIMO	Same as 6.5.1 for each antenna	Same as 6.5.1
6.5D.2.2 Spectrum emission mask for UL-MIMO	Same as 6.5.2.2 for each antenna	Same as 6.5.2.2
6.5D.2.3 Additional spectrum emission mask for UL-MIMO	Same as 6.5.2.3 for each antenna	Same as 6.5.2.3
6.5D.2.4.1 NR ACLR for UL-MIMO	Same as 6.5.2.4.1 for each antenna	Same as 6.5.2.4.1

6.5D.2.4.2 UTRA ACLR for UL-MIMO	Same as 6.5.2.4.2 for each antenna	Same as 6.5.2.4.2
6.5D.3.1 General spurious emissions for UL-MIMO	Same as 6.5.3.1 for each antenna	Same as 6.5.3.1
6.5D.3.2 Spurious emissions for UE co-existence for UL-MIMO	Same as 6.5.3.2 for each antenna	Same as 6.5.3.2
6.5D.3.3 Additional spurious emissions for UL MIMO	Same as 6.5.3.3 for each antenna	Same as 6.5.3.3
6.5D.4 Transmit intermodulation for UL-MIMO	Same as 6.5.4 for each antenna	Same as 6.5.4

F.3.3 Measurement of receiver

Table F.3.3-1: Derivation of Test Requirements (Receiver tests)

Sub clause	Test Tolerance (TT)	Formula for test requirement
7.3.2 Reference sensitivity power level	0.7 dB, f ≤ 3.0GHz 1.0 dB, 3.0GHz < f ≤ 6.0GHz	Reference sensitivity power level + TT T-put limit unchanged
7.3.2_1 Reference sensitivity level with 4 Rx antenna ports	0.7 dB, f ≤ 3.0GHz 1.0 dB, 3.0GHz < f ≤ 6.0GHz	Reference sensitivity power level + TT T-put limit unchanged
7.3C.2 Reference sensitivity power level	Same as 7.3.2	Same as 7.3.2
7.3D Reference sensitivity for MIMO	Same as 7.3.2	Same as 7.3.2
7.4 Maximum input level	0.7 dB, f ≤ 3.0GHz 1.0 dB, 3.0GHz < f ≤ 6.0GHz	Maximum input level - TT
7.4D Maximum input level for UL-MIMO	Same as 7.4	Same as 7.4 Uplink power measurement window applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
7.5 Adjacent channel selectivity	0 dB <u>Uplink power</u> <u>f ≤ 3.0GHz</u> 0.7 dB, BW ≤ 40MHz 1.0 dB, 40MHz < BW ≤ 100MHz <u>3.0GHz < f ≤ 6.0GHz</u> 1.0 dB, BW ≤ 100MHz	Wanted signal power + TT Interferer signal power unchanged T-put limit unchanged
7.5D Adjacent channel selectivity for UL-MIMO	Same as 7.5	Same as 7.5 Uplink power measurement window applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
7.6.2 Inband Blocking	0 dB <u>Uplink power</u> <u>f ≤ 3.0GHz</u> 0.7 dB, BW ≤ 40MHz 1.0 dB, 40MHz < BW ≤ 100MHz <u>3.0GHz < f ≤ 6.0GHz</u> 1.0 dB, BW ≤ 100MHz	Wanted signal power + TT Interferer signal power unchanged T-put limit unchanged
7.6.3 Out-of-band blocking	0 dB	Wanted signal power + TT Interferer signal power unchanged T-put limit unchanged
7.6.4 Narrow band blocking	0 dB	Wanted signal power + TT Interferer signal power unchanged T-put limit unchanged
7.6D.2 Inband blocking for UL MIMO	Same as 7.6.2	Same as 7.6.2 Uplink power measurement window applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
7.6D.3 Out-of-band blocking for UL MIMO	Same as 7.6.3	Same as 7.6.3 Uplink power measurement window applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors

7.6D.4 Narrow-band blocking for UL MIMO	Same as 7.6.4	Same as 7.6.4 Uplink power measurement window applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
7.7 Spurious response	0 dB	Wanted signal power + TT Interferer signal power unchanged T-put limit unchanged
7.7D Spurious response for UL-MIMO	Same as 7.7	Same as 7.7 Uplink power measurement window applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
7.8.2 Wide band Intermodulation	0 dB	Wanted signal power +TT CW Interferer signal power unchanged Modulated Interferer signal power unchanged T-put limit unchanged
7.8D Intermodulation characteristics for UL-MIMO	Same as 7.8.2	Same as 7.8.2 Uplink power measurement window applies to overall UL power, which is the linear sum of the output powers over all Tx antenna connectors
7.9 Spurious emissions	0 dB	Minimum requirement + TT

Annex G (normative): Uplink Physical Channels

G.0 Uplink Signal Levels

Uplink signal power is a UE figure, which is configured by the Test System by means of:

RRC messages (IE-s), such as:

- PUSCH-PowerControl
- PUCCH-PowerControl
- RACH-ConfigGeneric
- SRS-Config

and L1/2 Power control commands (TPC).

The uplink power settings are specified in the test case.

Otherwise, the uplink power settings result from the default RRC messages described in 3GPP TS 38.508 [5], and appropriate TPC-s, which are sent to the UE to transmit with an UL power level necessary for maintaining the call during the test.

G.1 General

This annex specifies the uplink physical channels that are needed for setting a connection and channels that are needed during a connection. Table G.1-1 describes the mapping of uplink physical channels and signals to physical resources

Table G.1-1: Mapping of uplink physical channels and signals to physical resources

Physical channel	Time Domain Location	Frequency Domain Location	Note
PRACH	Allowed by the parameter prach-ConfigurationIndex provided by higher layers	Allowed by the parameter msg1-FrequencyStart provided by higher layers	Mapping rule is specified in TS 38.211 [8] Section 6.3.3
DMRS	For DMRS on PUCCH format 1: Every other symbols i.e., 0, 2, 4... For DMRS on PUCCH format 2: All the PUCCH symbols For DMRS on PUCCH format 3,4: PUCCH length dependent For One symbol DMRS on PUSCH: Symbol 2,7 and 11 of each slot	DMRS on CP-OFDM PUSCH: Specified by the parameters *dmrs-Type* provided by higher layers. DMRS on DFT-OFDM PUSCH: Allowed for DMRS configuration type1 DMRS on PUCCH: PUCCH bandwidth dependent.	Mapping rule of DMRS for PUCCH is specified in TS 38.211 [8] Section 6.4.1.3 Mapping rule of DMRS for PUSCH is specified in TS 38.211 [8] Sections 6.4.1.1, 6.4.1.2
PUCCH	For PUCCH Format 0: 1 ~ 2 symbols each slot, specified by the parameters of nrofSymbols and startingSymbolIndex in PUCCH-format0 provided by the higher layer. For PUCCH Format 1: 4 ~ 14 symbols each slot, specified by the parameters of nrofSymbols and those of startingSymbolIndex of PUCCH-format1 provided by the higher layer. For PUCCH Format 2, 1 ~ 2 symbols each slot, specified by the parameters of nrofSymbols and startingSymbolIndex in PUCCH-format2 provided by the higher layer. For PUCCH Format 3: 4 ~ 14 symbols each slot, allowed by the parameters of nrofSymbols and startingSymbolIndex in PUCCH-format3, provided by the higher layer. For PUCCH Format 4: 4 ~ 14 symbols each slot, specified by the parameters of nrofSymbols and startingSymbolIndex in PUCCH-format4, provided by higher layer.	For PUCCH Format 0, 1 1 RB, the position specified by the parameters of startingPRB and intraSlotFrequencyHopping in the corresponding PUCCH-Resource provided by the higher layer. For PUCCH Format 2, 3: 1~16 RBs, specified by the parameter of nrofPRBs in PUCCH-format2 and PUCCH-format3 respectively; additionally the position specified by the parameters of startingPRB and intraSlotFrequencyHopping in the corresponding PUCCH-Resource provided by the higher layer. For PUCCH Format 4 1 RB, the position specified by the parameters of startingPRB and intraSlotFrequencyHopping in the corresponding PUCCH-Resource provided by the higher layer	Mapping rule is specified in TS 38.211 [8] Section 6.3.2 and 38.213 [9] Section 9.2
PUSCH	All remaining uplink symbols of each slot not allocated to DMRS	RBs allocated according to Reference Measurement channel in Annex A.2	Mapping rule is specified in TS 38.211 [8] Section 6.3 and 38.214 [12] Section 6.1
SRS	1, 2, or 4 symbols among the last 6 symbols in each SRS transmission slot specified by the parameters of resourceMapping, and resourceType in SRS-Config provided by the higher layer.	RBs specified by the ue-specific parameters of freqDomainPosition, freqDomainShift and freqHopping in SRS-Config provided by the higher layer.	Mapping rule is specified in TS 38.211 [8] Section 6.4.1.4.3

G.2 Set-up

Table G.2-1 describes the uplink physical channels that are required for connection set up.

Table G.2-1: Uplink Physical Channels required for connection set-up

Physical Channel
PRACH
PUCCH
PUSCH
PUCCH DMRS
PUSCH DMRS
SRS

In case of supplementary test, Table G.2-2 describes the supplementary uplink physical channels that are required for connection set-up, and unless stated otherwise, there is no other uplink physical channels configured on the NON-SUL carrier except PRACH.

Table G.2-2: Supplementary Uplink Physical Channels required for connection set-up

Physical Channel
PRACH
DMRS
PUCCH
PUSCH

G.3 Connection

The following clauses describes the uplink physical channels that are transmitted during a connection i.e., when measurements are done.

G.3.0 Measurement of Transmitter Characteristics

As specified in the test case. Otherwise:

- PUSCH + DMRS for PUSCH (and DMRS) measurements.
- PUCCH + DMRS for PUCCH (and DMRS) measurements.
- PRACH for PRACH measurements.

SRS for SRS measurements.

G.3.1 Measurement of Receiver Characteristics

As specified in the test case. Otherwise:

- PUSCH + DMRS for measurements with uplink interference configured.
- PUCCH + DMRS for measurements without uplink interference configured.

G.3.2 Measurement of Performance Requirements

As specified in the test case. Otherwise:

PUCCH + DMRS for measurements without CSI feedback, or with CSI feedback in PUCCH mode.

PUSCH + DMRS for measurements with CSI feedback in PUSCH mode.

Annex H (normative): Statistical Testing

H.1 General

FFS.

H.2 Statistical testing of receiver characteristics

H.2.1 General

The test of receiver characteristics is twofold.

1. A signal or a combination of signals is offered to the RX port(s) of the receiver.
2. The ability of the receiver to demodulate /decode this signal is verified by measuring the throughput.

In (2) is the statistical aspect of the test and is treated here.

The minimum requirement for all receiver tests is >95% of the maximum throughput.

All receiver tests are performed in static propagation conditions. No fading conditions are applied.

H.2.2 Mapping throughput to error ratio

a) The measured information bit throughput R is defined as the sum (in kilobits) of the information bit payloads successfully received during the test interval, divided by the duration of the test interval (in seconds).

b) In measurement practice the UE indicates successfully received information bit payload by signalling an ACK to the SS.
If payload is received, but damaged and cannot be decoded, the UE signals a NACK.

c) Only the ACK and NACK signals, not the data bits received, are accessible to the SS.
The number of bits is known in the SS from knowledge of what payload was sent.

d) For the reference measurement channel, applied for testing, the number of bits is different in different subframes, however in a radio frame it is fixed during one test.

e) The time in the measurement interval is composed of successfully received subframes (ACK), unsuccessfully received subframes (NACK) and no reception at all (DTX-subframes).

f) DTX-subframes may occur regularly according the applicable reference measurement channel (regDTX).
In real live networks this is the time when other UEs are served. In TDD these are the UL and special subframes.
regDTX vary from test to test but are fixed within the test.

g) Additional DTX-subframes occur statistically when the UE is not responding ACK or NACK where it should. (statDTX)
This may happen when the UE was not expecting data or decided that the data were not intended for it.

The pass / fail decision is done by observing the:

- number of NACKs
- number of ACKs and
- number of statDTXs (regDTX is implicitly known to the SS)

The ratio (NACK + statDTX)/(NACK+ statDTX + ACK)is the Error Ratio (ER). Taking into account the time consumed by the ACK, NACK, and DTX-TTIs (regular and statistical), ER can be mapped unambiguously to throughput for any single reference measurement channel test.

H.2.3 Design of the test

The test is defined by the following design principles (see clause H.x, Theory….):

1. The early decision concept is applied.
2. A second limit is introduced: Bad DUT factor M>1
3. To decide the test pass:

   Supplier risk is applied based on the Bad DUT quality

   To decide the test fail

   Customer Risk is applied based on the specified DUT quality

The test is defined by the following parameters:

1. Limit ER = 0.05 (Throughput limit = 95%)
2. Bad DUT factor M=1.5 (selectivity)
3. Confidence level CL = 95% (for specified DUT and Bad DUT-quality)

H.2.4 Numerical definition of the pass fail limits

Table H.2.4-1: pass fail limits

ne	ns_p	ns_f	ne	ns_p	ns_f	ne	ns_p	ns_f	ne	ns_p	ns_f
0	67	NA	39	763	500	78	1366	1148	117	1951	1828
1	95	NA	40	778	516	79	1381	1166	118	1965	1845
2	119	NA	41	794	532	80	1396	1183	119	1980	1863
3	141	NA	42	810	548	81	1412	1200	120	1995	1881
4	162	NA	43	826	564	82	1427	1217	121	2010	1899
5	183	NA	44	842	580	83	1442	1234	122	2025	1916
6	202	NA	45	858	596	84	1457	1252	123	2039	1934
7	222	NA	46	873	612	85	1472	1269	124	2054	1952
8	241	NA	47	889	629	86	1487	1286	125	2069	1969
9	259	NA	48	905	645	87	1502	1303	126	2084	1987
10	278	76	49	920	661	88	1517	1321	127	2099	2005
11	296	88	50	936	678	89	1532	1338	128	2113	2023
12	314	100	51	952	694	90	1547	1355	129	2128	2040
13	332	113	52	967	711	91	1562	1373	130	2143	2058
14	349	126	53	983	727	92	1577	1390	131	2158	2076
15	367	140	54	998	744	93	1592	1407	132	2172	2094
16	384	153	55	1014	760	94	1607	1425	133	2187	2111
17	401	167	56	1029	777	95	1623	1442	134	2202	2129
18	418	181	57	1045	793	96	1637	1459	135	2217	2147
19	435	195	58	1060	810	97	1652	1477	136	2231	2165
20	452	209	59	1076	827	98	1667	1494	137	2246	2183
21	469	224	60	1091	844	99	1682	1512	138	2261	2201
22	486	238	61	1106	860	100	1697	1529	139	2275	2218
23	503	253	62	1122	877	101	1712	1547	140	2290	2236
24	519	268	63	1137	894	102	1727	1564	141	2305	2254
25	536	283	64	1153	911	103	1742	1582	142	2320	2272
26	552	298	65	1168	928	104	1757	1599	143	2334	2290
27	569	313	66	1183	944	105	1772	1617	144	2349	2308
28	585	328	67	1199	961	106	1787	1634	145	2364	2326
29	602	343	68	1214	978	107	1802	1652	146	2378	2344
30	618	359	69	1229	995	108	1817	1669	147	2393	2361
31	634	374	70	1244	1012	109	1832	1687	148	2408	2379
32	650	389	71	1260	1029	110	1847	1704	149	2422	2397
33	667	405	72	1275	1046	111	1861	1722	150	2437	2415
34	683	421	73	1290	1063	112	1876	1740	151	2452	2433
35	699	436	74	1305	1080	113	1891	1757	152	2466	2451
36	715	452	75	1321	1097	114	1906	1775	153*)	NA	2469
37	731	468	76	1336	1114	115	1921	1793			
38	747	484	77	1351	1131	116	1936	1810	*) note 2 in H.2.5		

NOTE 1: The first column is the number of errors (ne = number of NACK + statDTX)

NOTE 2: The second column is the number of samples for the pass limit (ns_p, ns=Number of Samples= number of NACK + statDTX + ACK)

NOTE 3: The third column is the number of samples for the fail limit (ns_f)

H.2.5 Pass fail decision rules

The pass fail decision rules apply for a single test, comprising one component in the test vector. The overall Pass /Fail conditions are defined in clause H.2.6and H.2A.6

Having observed 0 errors, pass the test at 67+ samples, otherwise continue

Having observed 1 error, pass the test at 95+ otherwise continue

Having observed 2 errors, pass the test at 119+ samples, otherwise continue

Etc. etc.

Having observed 151 errors, pass the test at 2452+ samples, fail the test at 2433- samples, otherwise continue

Having observed 152 errors, pass the test at 2466+ samples, fail the test at 2451- samples.

Where x+ means: x or more, x- means x or less

NOTE 1: an ideal DUT passes after 67 samples. The maximum test time is 2466 samples.

NOTE 2: It is allowed to deviate from the early decision concept by postponing the decision (pass/fail or continue). Postponing the decision to or beyond the end of Table H.2.4-1 requires a pass fail decision against the test limit: pass the DUT for ER<0.0618, otherwise fail.

Annex I: Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2017-08	RAN5#76	R5-175705	-	-	-	Draft skeleton	0.0.1
2018-01	RAN5#1-5G-NR Adhoc	R5-180068 R5-180069 R5-180070 R5-180071 R5-180072 R5-180073 R5-180075 R5-180076 R5-180077 R5-180078 R5-180079	-	-	-	Implementation of pCRs to TS 38.521-1 V0.1.0	0.1.0
2018-01	RAN5#78	R5-181506 R5-181507 R5-181670 R5-181671 R5-181672 R5-181676 R5-181677 R5-181678 R5-181679 R5-181685 R5-181686 R5-181698 R5-181699 R5-181700	-	-	-	Implementation of pCRs to TS 38.521-1 V0.2.0	0.2.0
2018-03	RAN5#2-5G-NR Adhoc	R5-181759	-	-	-	Update TS 38.521-1 to align with new structure of TS 38.101-1 based on endorsed CR R4-1802403	0.3.0
2018-04	RAN5#2-5G-NR Adhoc	R5-81976	-	-	-	3GU mismatch	0.3.1
2018-04	RAN5#2-5G-NR Adhoc	R5-181771 R5-181833 R5-181842 R5-182000 R5-182002 R5-182003 R5-182004 R5-182005 R5-182020 R5-182021 R5-182026	-	-	-	Implementation of pCRs to TS 38.521-1 V0.4.0 Add clause 4.4 Test point analysis	0.4.0
2018-07	RAN5#79	R5-182768 R5-182973 R5-183702 R5-183703 R5-183704 R5-183705 R5-183906 R5-183936 R5-183280 R5-183923 R5-183953 R5-183954 R5-183955 R5-183956 R5-183957 R5-183958 R5-183959 R5-183960	-	-	-	Implementation of pCRs to TS 38.521-1 V0.5.0	0.5.0
2018-07	RAN5#79	R5-183960 R5-183279	-	-	-	Corrected Table numbering issues in subclause 6.5.2.4.1.4.2 Test procedure to capture R5-183960 changes into draft TS 38.521-1 v0.5.1	0.5.1
2018-07	RAN5#79	R5-182363	-	-	-	withdrawn	1.0.0

2018-08	RAN5#80	R5-185321 R5-184298 R5-185305 R5-185322 R5-185323 R5-185495 R5-185444 R5-185565 R5-185445 R5-185524 R5-184572 R5-185390 R5-184574 R5-185521 R5-185408 R5-184822 R5-185446 R5-185324 R5-185447 R5-185411 R5-185413 R5-185496 R5-185414 R5-185415 R5-185325 R5-185500 R5-185501 R5-185312 R5-185326 R5-185315 R5-185317 R5-185327 R5-185320	-	-	-	Implementation of pCRs to TS 38.521-1 V1.0.1	1.0.1
2018-09	RAN#81	-	-	-	-	raised to v15.0.0 with editorial changes only	15.0.0
2018-12	RAN#82	R5-186604	0072	-	F	5G_FR1 Text update for 7.3 Reference sensitivity	15.1.0
2018-12	RAN#82	R5-186605	0073	-	F	5R_FR1 Text Update for 6.5.3.1_General spurious emissions	15.1.0
2018-12	RAN#82	R5-186606	0074	-	F	5R FR1 Text Update for 6.5.3.2 Spurious emission for UE co-existence	15.1.0
2018-12	RAN#82	R5-186670	0078	-	F	Updating test case 6.2.3 UE additional maximum output power reduction	15.1.0
2018-12	RAN#82	R5-186671	0079	-	F	Updating test case 6.5.2.3 Additional spectrum emission mask	15.1.0
2018-12	RAN#82	R5-186680	0080	-	F	Update of test case 6.5.2.4.2, UTRA ACLR in 38.521-1	15.1.0
2018-12	RAN#82	R5-186736	0084	-	F	Update of FR1 Transmit OFF power	15.1.0
2018-12	RAN#82	R5-186774	0088	-	F	Addition of 6.3D.1 Minimum output power for UL-MIMO	15.1.0
2018-12	RAN#82	R5-186776	0089	-	F	Addition of 6.3D.2 Transmit OFF power for UL-MIMO	15.1.0
2018-12	RAN#82	R5-186781	0090	-	F	Addition of 6.3D.3 Transmit ON/OFF time mask for UL-MIMO	15.1.0
2018-12	RAN#82	R5-186901	0091	-	F	Update SEM requirements to TS 38.101-1 v15.3.0	15.1.0
2018-12	RAN#82	R5-186902	0092	-	F	Update ACS and inband blocking test cases in TS 38.521-1	15.1.0
2018-12	RAN#82	R5-187034	0107	-	F	Adding edge allocation into common uplink configuration in 6.1	15.1.0
2018-12	RAN#82	R5-187038	0109	-	F	Update test points for multiple FR1 test cases	15.1.0
2018-12	RAN#82	R5-187149	0111	-	F	Updated to Annexes for FR1 tests	15.1.0
2018-12	RAN#82	R5-187150	0112	-	F	General clauses updated for TS38.521-1	15.1.0
2018-12	RAN#82	R5-187376	0120	-	F	Update of 6.2.1 MOP	15.1.0
2018-12	RAN#82	R5-187378	0122	-	F	Update of 6.3.1 Minimum Output Power	15.1.0
2018-12	RAN#82	R5-187379	0123	-	F	Update of 6.3.3.2 General ON/OFF time mask	15.1.0
2018-12	RAN#82	R5-187380	0124	-	F	Addition of 6.2D.1 MOP for MIMO	15.1.0
2018-12	RAN#82	R5-187381	0125	-	F	Addition of 6.2D.2 MPR for MIMO	15.1.0
2018-12	RAN#82	R5-187382	0126	-	F	Addition of 6.2D.4 Configured Output Power for MIMO	15.1.0
2018-12	RAN#82	R5-187383	0127	-	F	Addition of 6.4D.1 Frequency error for MIMO	15.1.0
2018-12	RAN#82	R5-187384	0128	-	F	Addition of 6.4D.2.1 EVM for MIMO	15.1.0
2018-12	RAN#82	R5-187385	0129	-	F	Addition of 6.4D.2.2 Carrier Leakage for MIMO	15.1.0
2018-12	RAN#82	R5-187386	0130	-	F	Addition of 6.4D.2.3 In-band emissions for MIMO	15.1.0
2018-12	RAN#82	R5-187387	0131	-	F	Addition of 6.4D.2.4 EVM equalizer spectrum flatness for MIMO	15.1.0
2018-12	RAN#82	R5-187395	0132	-	F	Update of test case 6.2.3 UE A-MPR, general	15.1.0
2018-12	RAN#82	R5-187397	0133	-	F	Update of test case 6.2.3 UE A-MPR, NS_04	15.1.0
2018-12	RAN#82	R5-187399	0134	-	F	Update of test case test case 6.5.2.3 Additional spectrum emission mask, NS_04	15.1.0
2018-12	RAN#82	R5-187421	0136	-	F	Introduction of TC 6.5D.1 Occupied bandwidth for UL MIMO	15.1.0
2018-12	RAN#82	R5-187422	0137	-	F	Introduction of TC 6.5D.2.2 Spectrum Emission Mask for UL MIMO	15.1.0
2018-12	RAN#82	R5-187423	0138	-	F	Introduction of TC 6.5D.2.3 Additional Spectrum Emission Mask for UL MIMO	15.1.0
2018-12	RAN#82	R5-187424	0139	-	F	Introduction of TC 6.5D.2.4.1 NR ACLR for UL MIMO	15.1.0
2018-12	RAN#82	R5-187425	0140	-	F	Introduction of TC 6.5D.2.4.2 UTRA ACLR for UL MIMO	15.1.0
2018-12	RAN#82	R5-187429	0144	-	F	Introduction of TC 6.5D.4 Transmit intermodulation for UL MIMO	15.1.0

2018-12	RAN#82	R5-187431	0146	-	F	Introduction of TC 7.4D Maximum input level for UL-MIMO	15.1.0
2018-12	RAN#82	R5-187432	0147	-	F	Updating of 6.2C.1 Configured transmitted power for SUL	15.1.0
2018-12	RAN#82	R5-187433	0148	-	F	Introduction of TC 6.5C.1 Occupied bandwidth for SUL	15.1.0
2018-12	RAN#82	R5-187434	0149	-	F	Introduction of TC 6.5C.2.2 Spectrum Emission Mask for SUL	15.1.0
2018-12	RAN#82	R5-187435	0150	-	F	Introduction of TC 6.5C.2.3 Additional Spectrum Emission Mask for SUL	15.1.0
2018-12	RAN#82	R5-187436	0151	-	F	Introduction of TC 6.5C.2.4.1 NR ACLR for SUL	15.1.0
2018-12	RAN#82	R5-187437	0152	-	F	Introduction of TC 6.5C.2.4.2 UTRA ACLR for SUL	15.1.0
2018-12	RAN#82	R5-187438	0153	-	F	Introduction of TC 6.5C.3.2 General spurious emissions for SUL	15.1.0
2018-12	RAN#82	R5-187439	0154	-	F	Introduction of TC 6.5C.3.3 Spurious Emission for UE co-existence for SUL	15.1.0
2018-12	RAN#82	R5-187440	0155	-	F	Introduction of TC 6.5C.3.4 Additional Spurious Emission for SUL	15.1.0
2018-12	RAN#82	R5-187455	0158	-	F	Updating test case 6.3.4.2 Absolute Power Tolerance	15.1.0
2018-12	RAN#82	R5-187456	0159	-	F	Updating test case 6.3.4.4 Aggregate Power Tolerance	15.1.0
2018-12	RAN#82	R5-187560	0162	-	F	Update to Table 5.3.5-1 in TS 38.521-1	15.1.0
2018-12	RAN#82	R5-187585	0164	-	F	Update of transmit signal quality test cases in 38.521-1	15.1.0
2018-12	RAN#82	R5-187615	0167	-	F	Introduction of TC 6.5D.3.1 General spurious emissions for UL MIMO	15.1.0
2018-12	RAN#82	R5-187616	0168	-	F	Introduction of TC 6.5D.3.2 Spurious Emission for UE co-existence for UL MIMO	15.1.0
2018-12	RAN#82	R5-187617	0169	-	F	Introduction of TC 6.5D.3.3 Additional Spurious Emission for UL MIMO	15.1.0
2018-12	RAN#82	R5-187618	0170	-	F	Updating of Uplink channel for SUL in Annex G	15.1.0
2018-12	RAN#82	R5-187804	0069	1	F	Editorial Cleaning up for description of test requirement in clause 6	15.1.0
2018-12	RAN#82	R5-187805	0063	1	F	Introduction of TC 7.7D Spurious response for UL-MIMO	15.1.0
2018-12	RAN#82	R5-187807	0113	1	F	Introduction of receiver spurious emission tests for FR1 SA	15.1.0
2018-12	RAN#82	R5-187810	0114	1	F	Introduction of wideband intermodulation tests for FR1 SA	15.1.0
2018-12	RAN#82	R5-187811	0145	1	F	Introduction of TC 7.3D Reference sensitivity for UL-MIMO	15.1.0
2018-12	RAN#82	R5-187812	0085	1	F	Update of operating bands and channel arrangement to TS 38.521-1	15.1.0
2018-12	RAN#82	R5-187888	0121	1	F	Update of 6.2.4 Configured Output Power	15.1.0
2018-12	RAN#82	R5-187890	0156	1	F	Introduction of TC 6.5C.4 Transmit intermodulation for SUL	15.1.0
2018-12	RAN#82	R5-187892	0108	1	F	Removing the Editor's notes of SA messages and procedures for all FR1 test cases	15.1.0
2018-12	RAN#82	R5-187893	0083	1	F	Update of FR1 6.2.2 MPR	15.1.0
2018-12	RAN#82	R5-187894	0086	1	F	Addition of Time alignment error for UL-MIMO to TS38.521-1	15.1.0
2018-12	RAN#82	R5-187895	0115	1	F	Introduction of New FR1 test case 6.3.3.6 SRS time mask	15.1.0
2018-12	RAN#82	R5-187896	0116	1	F	5G_FR1 Text update for 6.5.3.3 Additional Spurious emission	15.1.0
2018-12	RAN#82	R5-187897	0161	1	F	Update of test case 6.3.4.3, Power Control Relative power tolerance in 38.521-1	15.1.0
2018-12	RAN#82	R5-187898	0165	1	F	Addition of EVM equalizer spectral flatness test case 6.4.2.5 to TS 38.521-1	15.1.0
2018-12	RAN#82	R5-187899	0099	1	F	Introduction of test case for Frequency error for CA	15.1.0
2018-12	RAN#82	R5-187900	0100	1	F	Introduction of test cases for Transmit modulation quality for CA	15.1.0
2018-12	RAN#82	R5-187901	0101	1	F	Introduction of test case for Spectrum emission mask for Inter-band CA	15.1.0
2018-12	RAN#82	R5-187902	0102	1	F	Introduction of test case for NR ACLR for Inter-band CA	15.1.0
2018-12	RAN#82	R5-187903	0103	1	F	Introduction of test case for UTRA ACLR for Inter-band CA	15.1.0
2018-12	RAN#82	R5-187904	0104	1	F	Introduction of test case for General spurious emissions for Inter-band CA	15.1.0
2018-12	RAN#82	R5-187905	0105	1	F	Introduction of test case for Spurious emission for UE co-existence for CA	15.1.0
2018-12	RAN#82	R5-187906	0106	1	F	Introduction of test case for Transmit intermodulation for Inter-band CA	15.1.0
2018-12	RAN#82	R5-187911	0118	1	F	Addition of notes to clarify test point selection into general section of TS 38.521-1	15.1.0
2018-12	RAN#82	R5-187914	0163	1	F	Update of Global In-channel Tx Test Annex in 38.521-1	15.1.0
2018-12	RAN#82	R5-187915	0082	1	F	Introduction of FR1 7.4 Maximum input level	15.1.0
2018-12	RAN#82	R5-188032	0075	1	F	Addition of 6.3D.4.1 Absolute Power tolerance for UL-MIMO	15.1.0
2018-12	RAN#82	R5-188033	0076	1	F	Addition of 6.3D.4.2 Relative Power Tolerance for UL-MIMO	15.1.0
2018-12	RAN#82	R5-188034	0077	1	F	Addition of 6.3D.4.3 Aggregate Power tolerance for UL-MIMO	15.1.0
2018-12	RAN#82	R5-188035	0110	1	F	Update to FR1 test case 6.3.3.4 PRACH time mask	15.1.0
2018-12	RAN#82	R5-188206	0117	1	F	Introduction of New FR1 test case 6.3.3.7 PUSCH-PUCCH and PUSCH-SRS time masks	15.1.0
2018-12	RAN#82	R5-188207	0071	1	F	5G_FR1 Text update for 7.3A Reference sensitivity for CA	15.1.0
2018-12	RAN#82	R5-188208	0067	2	F	Updates of MU in TS 38.521-1 Annex F during RAN5#81	15.1.0
2018-12	RAN#82	R5-188209	0068	2	F	Updates of TT in TS 38.521-1 Annex F during RAN5#81	15.1.0
2018-12	RAN#82	R5-188210	0097	1	F	TDD configuration for UE Tx test in FR1	15.1.0
2018-12	RAN#82	R5-188211	0119	1	F	Core alignment CR to capture TS 38.101-1 updates during RAN4#89	15.1.0
2019-03	RAN#83	R5-191034	0228	-	F	Update Clause 2 of TS 38.521-1	15.2.0
2019-03	RAN#83	R5-191035	0229	-	F	Update Clause 3.2 of TS 38.521-1	15.2.0
2019-03	RAN#83	R5-191039	0232	-	F	Correction to TC 6.4A.2.1.1 Error Vector Magnitude for CA (2UL CA)	15.2.0

2019-03	RAN#83	R5-191088	0244	-	F	Editorial cleaning up of test configuration tables in TS 38.521-1	15.2.0
2019-03	RAN#83	R5-191089	0245	-	F	Editorial correction of core alignment in TS 38.521-1	15.2.0
2019-03	RAN#83	R5-191090	0246	-	F	Updates of TT in TS38.521-1 Annex F during RAN5#NR4	15.2.0
2019-03	RAN#83	R5-191156	0247	-	F	General clauses updated for TS38.521-1	15.2.0
2019-03	RAN#83	R5-191244	0249	-	F	Editorial change in 6.5.2.1 general section	15.2.0
2019-03	RAN#83	R5-191245	0250	-	F	Update ACS and Inband Blocking test cases in TS38.521-1	15.2.0
2019-03	RAN#83	R5-191258	0251	-	F	Update to FR1 test case 6.5.4 Transmit intermodulation	15.2.0
2019-03	RAN#83	R5-191262	0252	-	F	Update of TC 7.6.3_Out-of-band blocking	15.2.0
2019-03	RAN#83	R5-191264	0253	-	F	Introduction of TC 7.6.4 Narrow-band blocking	15.2.0
2019-03	RAN#83	R5-191265	0254	-	F	Introduction of TC 7.7 Spurious response	15.2.0
2019-03	RAN#83	R5-191338	0256	-	F	Update of test case 6.3.4.3, Power Control Relative power tolerance in 38.521-1	15.2.0
2019-03	RAN#83	R5-191465	0257	-	F	Correction of FR1 6.2.2 Maximum Power Reduction (MPR)	15.2.0
2019-03	RAN#83	R5-191506	0262	-	F	Shared Risk clarification in TS 38.521-1	15.2.0
2019-03	RAN#83	R5-191526	0263	-	F	Update to FR1 test case 6.3.3.6 SRS time mask	15.2.0
2019-03	RAN#83	R5-191675	0267	-	F	Addition of MU and TT for NR FR1 UL-MIMO test cases	15.2.0
2019-03	RAN#83	R5-191815	0272	-	F	OBW test procedure update for 38.521-1	15.2.0
2019-03	RAN#83	R5-191846	0277	-	F	FR1 Text update for 6.5.3.1 General spurious emission	15.2.0
2019-03	RAN#83	R5-191848	0278	-	F	Correction of errors in Table 6.1-1 of 38.521-1	15.2.0
2019-03	RAN#83	R5-191849	0279	-	F	FR1 Text update for 7.3C Reference sensitivity power level for SUL	15.2.0
2019-03	RAN#83	R5-191852	0280	-	F	FR1 Text update for 6.5.3.2 Spurious emission for UE co-existence	15.2.0
2019-03	RAN#83	R5-191854	0281	-	F	FR1 Text update for 7.3.2 Reference sensitivity power level	15.2.0
2019-03	RAN#83	R5-192088	0317	-	F	Test mode and test loop function activation in SA Tx RF test cases in TS 38.521-1	15.2.0
2019-03	RAN#83	R5-192089	0318	-	F	Test mode and test loop function activation in SA Rx RF test cases in TS 38.521-1	15.2.0
2019-03	RAN#83	R5-192121	0320	-	F	Update of Global In-channel Tx Test Annex for FR1	15.2.0
2019-03	RAN#83	R5-192402	0266	1	F	Update of FR1 6.2.4 Configured transmitted power	15.2.0
2019-03	RAN#83	R5-192407	0294	1	F	Update of time alignment error for UL MIMO FR1 6.4D.3	15.2.0
2019-03	RAN#83	R5-192408	0295	1	F	Introduction of TC 6.4D.4	15.2.0
2019-03	RAN#83	R5-192409	0309	1	F	Update of FR1 6.2.1 MOP	15.2.0
2019-03	RAN#83	R5-192411	0310	1	F	Update of FR1 6.3.1 Minimum Output Power	15.2.0
2019-03	RAN#83	R5-192412	0311	1	F	Addition of FR1 6.3A.1 minimum output power for CA	15.2.0
2019-03	RAN#83	R5-192413	0321	1	F	Update of transmit signal quality test cases for FR1	15.2.0
2019-03	RAN#83	R5-192414	0231	1	F	Introduction of TC 7.7A.0 Minimum conformance requirements	15.2.0
2019-03	RAN#83	R5-192416	0240	1	F	Update to Wideband Intermodulation for SA FR1	15.2.0
2019-03	RAN#83	R5-192417	0241	1	F	Updates to 7.9 spurious emission for SA in FR1	15.2.0
2019-03	RAN#83	R5-192418	0259	1	F	Introduction of FR1 7.6D.3 Out-of-band blocking for UL-MIMO	15.2.0
2019-03	RAN#83	R5-192419	0260	1	F	Introduction of FR1 7.6D.4 Narrow band blocking for UL-MIMO	15.2.0
2019-03	RAN#83	R5-192420	0261	1	F	Introduction of FR1 7.8D.2 Wide band Intermodulation for UL-MIMO	15.2.0
2019-03	RAN#83	R5-192421	0276	1	F	Correction of FR1 7.4 Maximum input level	15.2.0
2019-03	RAN#83	R5-192510	0322	1	F	Asymmetric CH BWs test configuration for Reference Sensitivity	15.2.0
2019-03	RAN#83	R5-192544	0230	1	F	Correction to TC 6.4A.2.2 Carrier leakage for CA	15.2.0
2019-03	RAN#83	R5-192545	0248	1	F	Update of test case 6.5.2.4.2, UTRA ACLR in 38.521-1	15.2.0
2019-03	RAN#83	R5-192547	0273	1	F	Update of FR1 6.2D.1 MOP for MIMO	15.2.0
2019-03	RAN#83	R5-192548	0275	1	F	Update of 6.2D.4 Configured Output Power for MIMO	15.2.0
2019-03	RAN#83	R5-192549	0284	1	F	Update of FR1 test case 6.3D.1 Minimum output power for UL-MIMO	15.2.0
2019-03	RAN#83	R5-192550	0296	1	F	Update of TC 6.5D.1	15.2.0
2019-03	RAN#83	R5-192551	0297	1	F	Update of TC 6.5D.2.2	15.2.0
2019-03	RAN#83	R5-192553	0298	1	F	Introduction of TC 6.5D.2.3	15.2.0
2019-03	RAN#83	R5-192554	0299	1	F	Update of TC 6.5D.2.4.1	15.2.0
2019-03	RAN#83	R5-192555	0300	1	F	Update of TC 6.5D.2.4.2	15.2.0
2019-03	RAN#83	R5-192556	0301	1	F	Update of 6.5D.3.1	15.2.0
2019-03	RAN#83	R5-192557	0302	1	F	Update of 6.5D.3.2	15.2.0
2019-03	RAN#83	R5-192558	0303	1	F	Update of 6.5D.3.3	15.2.0
2019-03	RAN#83	R5-192559	0304	1	F	Update of 6.5D.4	15.2.0
2019-03	RAN#83	R5-192561	0313	1	F	Addition of FR1 6.3A.3 Transmit ON/OFF time mask for CA	15.2.0
2019-03	RAN#83	R5-192562	0325	1	F	Update of FR1 6.2D.2 MPR for MIMO	15.2.0
2019-03	RAN#83	R5-192563	0233	1	F	Introduction of TC 7.7A.1 Spurious response for 2DL CA	15.2.0
2019-03	RAN#83	R5-192564	0234	1	F	Introduction of TC 7.7A.2 Spurious response for 3DL CA	15.2.0
2019-03	RAN#83	R5-192565	0235	1	F	Introduction of TC 7.7A.3 Spurious response for 4DL CA	15.2.0
2019-03	RAN#83	R5-192566	0258	1	F	Introduction of FR1 7.6D.2 Inband blocking for UL-MIMO	15.2.0
2019-03	RAN#83	R5-192567	0285	1	F	Update on TC 6.4A.1.1 Frequency error for CA	15.2.0
2019-03	RAN#83	R5-192570	0286	1	F	Update on TCs in section 6.4A.2 Transmit modulation quality for CA	15.2.0
2019-03	RAN#83	R5-192576	0287	1	F	Update on TC 6.5A.2.2.1 Spectrum emission mask for CA	15.2.0
2019-03	RAN#83	R5-192577	0288	1	F	Update on TC 6.5A.2.4.1.1 NR ACLR for CA	15.2.0
2019-03	RAN#83	R5-192578	0289	1	F	Update on TC 6.5A.2.4.2.1 UTRA ACLR for CA	15.2.0
2019-03	RAN#83	R5-192579	0290	1	F	Update on TC 6.5A.3.1.1 General spurious emissions for CA	15.2.0
2019-03	RAN#83	R5-192580	0291	1	F	Update on TC 6.5A.3.2.1 Spurious emissions for UE co-existence for CA	15.2.0
2019-03	RAN#83	R5-192581	0292	1	F	Update on TC 6.5A.4.1 TX IM for CA	15.2.0
2019-03	RAN#83	R5-192583	0268	1	F	Addition of 7.5A.0 Minimum conformance requirements	15.2.0

2019-03	RAN#83	R5-192584	0269	1	F	Addition of 7.5A.1 Adjacent channel selectivity for 2DL CA	15.2.0
2019-03	RAN#83	R5-192585	0270	1	F	Addition of 7.5A.2 Adjacent channel selectivity for 3DL CA	15.2.0
2019-03	RAN#83	R5-192586	0271	1	F	Addition of 7.5A.3 Adjacent channel selectivity for 4DL CA	15.2.0
2019-03	RAN#83	R5-192587	0282	1	F	FR1 Text update for 7.3A.2 Reference sensitivity power level for CA	15.2.0
2019-03	RAN#83	R5-192588	0283	1	F	FR1 Text update for 7.3.2_1 Reference sensitivity level with 4 Rx antenna ports	15.2.0
2019-03	RAN#83	R5-192589	0305	1	F	Update of 7.3D.2	15.2.0
2019-03	RAN#83	R5-192590	0306	1	F	Update of TC 7.4D	15.2.0
2019-03	RAN#83	R5-192591	0307	1	F	Introduction of TC 7.5D	15.2.0
2019-03	RAN#83	R5-192592	0324	1	F	Update of TC 7.7D Spurious response for UL-MIMO	15.2.0
2019-03	RAN#83	R5-192593	0243	1	F	Updates of TT in TS38.521-1 Annex F during RAN5#82	15.2.0
2019-03	RAN#83	R5-192594	0265	1	F	Correction of HARQ-ACK transmission timing for DL RMC for FR1 TDD SCS=60kHz	15.2.0
2019-03	RAN#83	R5-192597	0319	1	F	Updating test case 7.3.2 Reference sensitivity power level Table 7.3.2.4.1-3	15.2.0
2019-03	RAN#83	R5-192598	0323	1	F	Update OBW, SEM and ACLR in TS 38.521-1	15.2.0
2019-03	RAN#83	R5-192682	0236	1	F	Introduction of TC 7.9A.0 Minimum conformance requirements	15.2.0
2019-03	RAN#83	R5-192683	0237	1	F	Introduction of TC 7.9A.1 Spurious emission for 2DL CA	15.2.0
2019-03	RAN#83	R5-192685	0312	2	F	Addition of FR1 6.3A.2 Transmit OFF power for CA	15.2.0
2019-03	RAN#83	R5-192693	0293	1	F	Introduction of Annex on Characteristics of the Interfering Signal FR1	15.2.0
2019-03	RAN#83	R5-192837	0326	1	F	Update of operating bands and channel arrangement to TS 38.521-1	15.2.0
2019-03	RAN#83	-	-	-	-	Editorial correction of references to TS 38.508-1 clause 4.6 tables	15.2.0
2019-06	RAN#84	R5-193535	0389	-	F	Update of test case 6.5.2.4.2, UTRA ACLR in 38.521-1	15.3.0
2019-06	RAN#84	R5-193536	0390	-	F	Update of test case 6.3.4.3, Power Control Relative power tolerance	15.3.0
2019-06	RAN#84	R5-193567	0394	-	F	Correction of 38.521-1 7.6D.2	15.3.0
2019-06	RAN#84	R5-193569	0395	-	F	Correction of 38.521-1 7.6D.3	15.3.0
2019-06	RAN#84	R5-193571	0396	-	F	Correction of 38.521-1 7.6D.4	15.3.0
2019-06	RAN#84	R5-193573	0397	-	F	Correction of 38.521-1 7.8D.2	15.3.0
2019-06	RAN#84	R5-193574	0398	-	F	Correction of 38.521-1 6.2.2	15.3.0
2019-06	RAN#84	R5-193585	0400	-	F	Update of TC 7.7A.0 Spurious response for CA	15.3.0
2019-06	RAN#84	R5-193586	0401	-	F	Correction of section number for UE diagram in Initial conditions of 38.521-1 Clause 6	15.3.0
2019-06	RAN#84	R5-193589	0404	-	F	Correction of section number for UE diagram in Initial conditions of 38.521-1 Clause 7	15.3.0
2019-06	RAN#84	R5-193593	0405	-	F	Unify Outer_1RB and Edge_1RB in Test Configuration Table of 38.521-1	15.3.0
2019-06	RAN#84	R5-193753	0413	-	F	Update of 6.3D Output power dynamics for UL-MIMO	15.3.0
2019-06	RAN#84	R5-193915	0417	-	F	Update of NR FR1 6.2.3 A-MPR NS_04	15.3.0
2019-06	RAN#84	R5-193917	0418	-	F	Update of SA FR1 RF 6.5D.2.3	15.3.0
2019-06	RAN#84	R5-193918	0419	-	F	Update of SA FR1 RF 6.5D.2.4.2	15.3.0
2019-06	RAN#84	R5-193920	0420	-	F	Update of SA FR1 RF 6.5D.3.3	15.3.0
2019-06	RAN#84	R5-193930	0421	-	F	Addition of NR FR1 6.2D.3 A-MPR for UL-MIMO	15.3.0
2019-06	RAN#84	R5-193955	0423	-	F	Update of clause 5 to TS 38.521-1	15.3.0
2019-06	RAN#84	R5-194125	0425	-	F	Update Out of band emission test cases in TS 38.521-1	15.3.0
2019-06	RAN#84	R5-194126	0426	-	F	Update ACS and Inbanblocking interferer definition in TS 38.521-1	15.3.0
2019-06	RAN#84	R5-194161	0428	-	F	Update of test case 6.2.3 UE A-MPR, NS_35	15.3.0
2019-06	RAN#84	R5-194162	0429	-	F	Update of test case 6.5.2.3; Additional spectrum emission mask	15.3.0
2019-06	RAN#84	R5-194226	0435	-	F	Correction to In-band emission test case	15.3.0
2019-06	RAN#84	R5-194228	0437	-	F	Correction to PRACH configurations	15.3.0
2019-06	RAN#84	R5-194256	0439	-	F	Correction to FR1 Reference Sensitivity	15.3.0
2019-06	RAN#84	R5-194268	0440	-	F	Update of 7.5A.0 Minimum conformance requirements	15.3.0
2019-06	RAN#84	R5-194304	0442	-	F	Correction to time domain allocation of DMRS	15.3.0
2019-06	RAN#84	R5-194305	0443	-	F	Updating 7.8.2 Wide band Intermodulation	15.3.0
2019-06	RAN#84	R5-194307	0445	-	F	Correction to ON/OFF time mask test	15.3.0
2019-06	RAN#84	R5-194308	0446	-	F	Correction to carrier leakage and in-band emission tests	15.3.0
2019-06	RAN#84	R5-194312	0447	-	F	FR1 Update for 7.3A Reference sensitivity for CA	15.3.0
2019-06	RAN#84	R5-194313	0448	-	F	FR1 Update for 7.3.2 Reference sensitivity power level	15.3.0
2019-06	RAN#84	R5-194314	0449	-	F	FR1 Update for 7.3.3 Ref sensitivity ?RIB,c	15.3.0
2019-06	RAN#84	R5-194315	0450	-	F	FR1 Update for 7.3C Reference sensitivity for SUL	15.3.0
2019-06	RAN#84	R5-194316	0451	-	F	FR1 Update for 6.5.3.2 Spurious emission for UE co-existence	15.3.0
2019-06	RAN#84	R5-194377	0454	-	F	FR1 Update for 6.5.3.3 Additional spurious emissions	15.3.0
2019-06	RAN#84	R5-194383	0455	-	F	Update of 7.5A.2 Adjacent channel selectivity for 3DL CA	15.3.0
2019-06	RAN#84	R5-194905	0414	1	F	Update of 6.3D.4.1 Absolute Power tolerance for UL-MIMO	15.3.0
2019-06	RAN#84	R5-194906	0415	1	F	Update of 6.3D.4.2 Relative Power Tolerance for UL-MIMO	15.3.0
2019-06	RAN#84	R5-194908	0465	1	F	Update of TC 6.3A.3 Transmit ON/OFF time mask for CA	15.3.0
2019-06	RAN#84	R5-194910	0463	1	F	Update of TC 6.3A.1 Minimum output power for CA FR1	15.3.0
2019-06	RAN#84	R5-194911	0434	1	F	Update of 6.2.3 for UE additional maximum output power reduction	15.3.0
2019-06	RAN#84	R5-194912	0430	1	F	Update of test case 6.2.3 UE A-MPR FR1, general part and minimum requirements	15.3.0
2019-06	RAN#84	R5-194915	0438	1	F	Correction to SRS time mask test	15.3.0

2019-06	RAN#84	R5-194916	0444	1	F	Correction to transmit signal quality test cases	15.3.0
2019-06	RAN#84	R5-194917	0461	1	F	Introduction of 6.2A.4.0.2 TIB for CA into Rel-15	15.3.0
2019-06	RAN#84	R5-194918	0468	1	F	Update of transmit signal quality test cases for FR1	15.3.0
2019-06	RAN#84	R5-194919	0407	1	F	Update of TC 7.9A.1 Spurious emissions for 2DL CA	15.3.0
2019-06	RAN#84	R5-194920	0456	1	F	Update of 7.5A.3 Adjacent channel selectivity for 4DL CA	15.3.0
2019-06	RAN#84	R5-194921	0469	1	F	Correction to FR1 Reference Sensitivity test configurations with n70	15.3.0
2019-06	RAN#84	R5-194922	0431	1	F	Update of clause 3 to TS 38.521-1	15.3.0
2019-06	RAN#84	R5-194923	0432	1	F	Update of clause 4 to TS 38.521-1	15.3.0
2019-06	RAN#84	R5-194924	0433	1	F	Update of clause 5 for operating bands and channel arrangement	15.3.0
2019-06	RAN#84	R5-194925	0452	1	F	General clause updated for FR1 spec	15.3.0
2019-06	RAN#84	R5-194926	0467	1	F	Update of Global In-channel Tx Test Annex for FR1	15.3.0
2019-06	RAN#84	R5-194957	0392	1	F	Updates of MU and TT in TS 38.521-1 Annex F during RAN5#NR5	15.3.0
2019-06	RAN#84	R5-194973	0402	1	F	Update of TC 7.9A.0 Spurious emissions for CA	15.3.0
2019-06	RAN#84	R5-194974	0403	1	F	Update of TC 7.7D Spurious response for UL-MIMO	15.3.0
2019-06	RAN#84	R5-195090	0470	1	F	Update of FR1 ON_ON time mask test cases	15.3.0
2019-06	RAN#84	R5-195092	0441	1	F	Update of 7.5A.1 Adjacent channel selectivity for 2DL CA	15.3.0
2019-06	RAN#84	R5-195140	0416	1	F	Update of 6.3D.4.3 Aggregate Power tolerance for UL-MIMO	15.3.0
2019-06	RAN#84	R5-195142	0422	1	F	Addition of TT values for NR FR1 UL-MIMO test cases	15.3.0
2019-06	RAN#84	R5-195143	0457	1	F	Introduction of Occupied bandwidth for Inter-band CA in NR SA FR1	15.3.0
2019-06	RAN#84	R5-195144	0458	1	F	Update of 6.4D.3 Time alignment error for UL-MIMO FR1	15.3.0
2019-06	RAN#84	R5-195145	0464	1	F	Update of TC 6.3A.2 Transmit OFF power for CA FR1	15.3.0
2019-06	RAN#84	R5-195198	0436	1	F	Correction to power control test cases	15.3.0
2019-06	RAN#84	R5-195403	0459	1	F	Addition of 6.2A.1.3 FR1 MOP for inter-band CA	15.3.0
2019-06	RAN#84	R5-195430	0393	1	F	Updates of MU and TT in TS 38.521-1	15.3.0
2019-06	RAN#84	R5-195431	0424	1	F	Core alignment with TS 38.101-1	15.3.0

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