3GPP TS 38.521-2 V16.2.0 (2019-12)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
NR;
User Equipment (UE) conformance specification;
Radio transmission and reception;
Part 2: Range 2 Standalone
(Release 16)

A GLOBAL INITIATIVE

Keywords
3GPP, New Radio

3GPP

Postal address

3GPP support office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet
http://www.3gpp.org

Contents

Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

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3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

The present document is part 2 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 [13]: NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Range 1 Standalone;

3GPP TS 38.521-2: 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 conformance specification; Radio transmission and reception; Part 4: Performance;

3GPP TS 38.522 [16]: NR; User Equipment (UE) conformance specification; Applicability of radio transmission, radio reception and radio resource management test cases;

3GPP TS 38.533 [17]: NR; User Equipment (UE) conformance specification; Radio resource management (RRM);

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 2 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 References

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*.

[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 TR 38.810: "Study on test methods for New Radio".

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

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

[8] FCC 47 CFR Part 30: "UPPER MICROWAVE FLEXIBLE USE SERVICE, §30.202 Power limits".

[9] 3GPP TS 38.211: "NR; Physical channels and modulation".

[10] 3GPP TS 38.508-1: "5GS; User Equipment (UE) conformance specification; Part 1: Common test environment".

[11] 3GPP TS 38.508-2: "5GS; User Equipment (UE) conformance specification; Part 2: Common Implementation Conformance Statement (ICS) proforma".

[12] 3GPP TS 38.509: "5GS; Special conformance testing functions for User Equipment (UE)".

[13] 3GPP TS 38.521-1: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Range 1 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 conformance specification; Radio transmission and reception; Part 4: Performance".

[16] 3GPP TS 38.522: "NR; User Equipment (UE) conformance specification; Applicability of radio transmission, radio reception and radio resource management test cases".

[17] 3GPP TS 38.533: "NR; User Equipment (UE) conformance specification; Radio resource management (RRM)".

[18] 3GPP TS 38.300: "NR; Overall description; Stage 2".

[19] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[20] 3GPP TR 38.903: "NR; Derivation of test tolerances and measurement uncertainty for User Equipment (UE) conformance tests ".

[21] 3GPP TR 38.905: "NR; Derivation of test points for radio transmission and reception conformance test cases".

[22] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[23] 3GPP TS 38.214: "NR; Physical layer procedures for data".

[24] 3GPP TS 38.215: "NR; Physical layer measurements".

[25] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".

[26] 3GPP TS 38.306: “NR; User Equipment (UE) radio access capabilities”.

[27] IEEE Std 149: "IEEE Standard Test Procedures for Antennas", IEEE.

[28] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 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 TR 21.905 [1].

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

Beam correspondence: the ability of the UE to select a suitable beam for UL transmission based on DL measurements with or without relying on UL beam sweeping.

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.

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

EIRP(Link=Link angle, Meas=beam peak direction): measurement of the EIRP of the UE such that the measurement angle is aligned with the beam peak direction within an acceptable measurement error uncertainty.

EIRP(Link=Link angle, Meas=Link angle): measurement of the UE such that the link angle is aligned with the measurement angle. EIRP (indicator to be measured) can be replaced by EIS, Frequency, EVM, carrier Leakage, In-band emission and OBW. Beam peak search grids, TX beam peak direction, and RX beam peak direction can be selected to describe Link.

EIS (equivalent isotropic sensitivity): sensitivity for an isotropic directivity device equivalent to the sensitivity of the discussed device exposed to an incoming wave from a defined AoA

NOTE 1: The sensitivity is the minimum received power level at which specific requirement is met.

NOTE 2: Isotropic directivity is equal in all directions (i.e. 0 dBi).

Fallback group: Group of carrier aggregation bandwidth classes for which it is mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration. It is not mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration that belongs to a different fallback group.

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.

Link angle: a DL-signal AoA from the view point of the UE, as described in Annex N.

Measurement angle: the angle of measurement of the desired metric from the view point of the UE, as described in Annex N.

radiated interface boundary: operating band specific radiated requirements reference point where the radiated requirements apply.

RX beam peak direction: direction where the maximum total component of RSRP and thus best total component of EIS is found.

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.

TRP(Link=Link angle): measurement of the TRP of the UE such that the measurement angle is aligned with the beam peak direction within an acceptable measurement uncertainty. TX beam peak direction and RX beam peak direction can be selected to describe Link.

NOTE: For requirements based on EIRP/EIS, the radiated interface boundary is associated to the far-field region.

TX beam peak direction: direction where the maximum total component of EIRP is found.

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.

3.2 Symbols

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

$\Delta EIRP_{BC}$ The beam correspondence tolerance, where $\Delta EIRP_{BC} = EIRP_2 – EIRP_1$
ΔF_{Global} Granularity of the global frequency raster

ΔF_{Raster} Band dependent channel raster granularity
Δf_{OOB} Δ Frequency of Out Of Band emission
$\Delta MB_{P,n}$ Allowed relaxation to each, minimum peak EIRP and reference sensitivity due to support for multi-band operation, per band in a combination of supported bands
$\Delta MB_{S,n}$ Allowed relaxation to each, EIRP spherical coverage and EIS spherical coverage due to support for multi-band operation, per band in a combination of supported bands
Δ_{RB} The starting frequency offset between the allocated RB and the measured non-allocated RB

ΔR_{IB}	Allowed reference sensitivity relaxation due to support for inter-band CA operation
$\sum MB_P$	Total allowed relaxation to each, minimum peak EIRP and reference sensitivity due to support for multi-band operation, for all bands in a combination of supported bands
$\sum MB_S$	Total allowed relaxation to each, EIRP spherical coverage and EIS spherical coverage due to support for multi-band operation, for all bands in a combination of supported bands
$BW_{Channel}$	Channel bandwidth
$BW_{Channel\_CA}$	Aggregated channel bandwidth, expressed in MHz.
BW_{GB}	max($BW_{GB,Channel(k)}$)
$BW_{GB,Channel(k)}$	Minimum guardband defined in subclause 5.3A.2 of carrier k
$BW_{interferer}$	Bandwidth of the interferer
Ceil(x)	Rounding upwards; ceil(x) is the smallest integer such that ceil(x) ≥ x
$EIRP_{max}$	The applicable maximum EIRP as specified in sub-clause 6.2.1
$EIRP_1$	The measured total EIRP based on the beam the UE chooses autonomously (corresponding beam) to transmit in the direction of the incoming DL signal, which is based on beam correspondence without relying on UL beam sweeping
$EIRP_2$	The measured total EIRP based on the beam yielding highest EIRP in a given direction, which is based on beam correspondence with relying on UL beam sweeping
F_C	*RF reference frequency* for the carrier center 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.
$F_{C, high}$	The Fc of the highest carrier, expressed in MHz.
$F_{C, low}$	The Fc of the lowest carrier, expressed in MHz.
F_{DL_high}	The highest frequency of the downlink *operating band*
F_{DL_low}	The lowest frequency of the downlink *operating band*
$F_{edge,block,high}$	The upper sub-block edge, where $F_{edge,block,high} = F_{C,block,high} + F_{offset, high}$.
$F_{edge,block,low}$	The lower sub-block edge, where $F_{edge,block,low} = F_{C,block,low} - F_{offset, low}$.
$F_{edge, high}$	The upper edge of *Aggregated Channel Bandwidth*, expressed in MHz. $F_{edge, high} = F_{C, high} + F_{offset, high}$.
$F_{edge, low}$	The lower edge of *Aggregated Channel Bandwidth*, expressed in MHz. $F_{edge, low} = F_{C, low} - F_{offset, low}$.
$F_{Interferer}$	Frequency of the interferer
$F_{Interferer}$ (offset)	Frequency offset of the interferer (between the center frequency of the interferer and the carrier frequency of the carrier measured)
$F_{Ioffset}$	Frequency offset of the interferer (between the center frequency of the interferer and the closest edge of the carrier measured)
Floor(x)	Rounding downwards; floor(x) is the greatest integer such that floor(x) ≤ x
F_{OOB}	The boundary between the NR out of band emission and spurious emission domains
$F_{offset, high}$	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_{REF}	RF reference frequency
$F_{REF-Offs}$	Offset used for calculating F_{REF}
F_{UL_high}	The highest frequency of the uplink *operating band*
F_{UL_low}	The lowest frequency of the uplink *operating band*
F_{UL_Meas}	The sub-carrier frequency for which the equalizer coefficient is evaluated
F_center	The center frequency of an allocated block of PRBs
$GB_{Channel}$	Minimum guardband 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
$L_{CRB,Max}$	Maximum number of RB for a given Channel bandwidth and sub-carrier spacing
Max()	The largest of given numbers
Min()	The smallest of given numbers
$MPR_{f,c}$	Maximum output power reduction for carrier *f* of serving cell *c*
MPR_{narrow}	Maximum output power reduction due to narrow PRB allocation
MPR_{WT}	Maximum power reduction due to modulation orders, transmit bandwidth configurations, waveform types
NR_{ACLR}	NR ACLR
N_{RB}	Transmission bandwidth configuration, expressed in units of resource blocks
$N_{RB,high}$	Transmission bandwidth configurations according to Table 5.3.2-1 for the highest assigned component carrier in section 5.3A.1

$N_{RB,low}$	Transmission bandwidth configurations according to Table 5.3.2-1 for the lowest 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}
n_{PRB}	Physical resource block number
P_{CMAX}	The configured maximum UE output power
$P_{CMAX,f,c}$	The configured maximum UE output power for carrier *f* of serving cell *c*
$P_{Interferer}$	Modulated mean power of the interferer
P_{int}	The intermediate power point as defined in table 6.3.4.2-2
P_{max}	The maximum UE output power as specified in sub-clause 6.2.1
P_{min}	The minimum UE output power as specified in sub-clause 6.3.1
$P_{PowerClass}$	Nominal UE power class (i.e., no tolerance) as specified in sub-clause 6.2.1
P_{RB}	The transmitted power per allocated RB, measured in dBm
$P_{TMAX,f,c}$	The measured total radiated power for carrier *f* of serving cell *c*
P_{UMAX}	The measured configured maximum UE output power
Pw	Power of a wanted DL signal
$P\text{-}MPR_{f,c}$	The Power Management UE Maximum Power Reduction for carrier *f* of serving cell *c*
RB_{start}	Indicates the lowest RB index of transmitted resource blocks
SCS_{high}	SCS for the highest assigned component carrier in section 5.3A.1
SCS_{low}	SCS for the lowest assigned component carrier in section 5.3A.1
SS_{REF}	SS block reference frequency position
TRP_{max}	The maximum TRP for the UE power class as specified in sub-clause 6.2.1
T(ΔP)	The tolerance T(ΔP) for applicable values of ΔP (values in dB)

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 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 TR 21.905 [1].

ACLR	Adjacent Channel Leakage Ratio
ACS	Adjacent Channel Selectivity
AoA	Angle of Arrival
A-MPR	Additional Maximum Power Reduction
BCS	Bandwidth Combination Set
BPSK	Binary Phase-Shift Keying
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 X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable NR *operating band*
CC	Component Carrier
CDF	Cumulative Distribution Function
CP-OFDM	Cyclic Prefix-OFDM
CW	Continuous Wave
DFT-s-OFDM	Discrete Fourier Transform-spread-OFDM
DL	Downlink
DM-RS	Demodulation Reference Signal
DTX	Discontinuous Transmission
DUT	Device Under Test
EIRP	Effective Isotropic Radiated Power
EIS	Effective Isotropic Sensitivity
EVM	Error Vector Magnitude
FR	Frequency Range
FWA	Fixed Wireless Access
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

MPR	Allowed maximum power reduction
NR	New Radio
NR-ARFCN	NR Absolute Radio Frequency Channel Number
OCNG	OFDMA Channel Noise Generator
OOB	Out-of-band
OTA	Over The Air
PRB	Physical Resource Block
P-MPR	Power Management Maximum Power Reduction
QAM	Quadrature Amplitude Modulation
RB	Resource Blocks
REFSENS	Reference Sensitivity
RF	Radio Frequency
RIB	Radiated Interface Boundary
RMS	Root Mean Square (value)
RSRP	Reference Signal Receiving Power
Rx	Receiver
SCS	Subcarrier Spacing
SEM	Spectrum Emission Mask
SRS	Sounding Reference Symbol
SS	Synchronization Symbol
TDD	Time Division Duplex
TPC	Transmission Power Control
TRP	Total Radiated Power
Tx	Transmitter
UE	User Equipment
UL	Uplink
UL MIMO	Uplink Multiple Antenna transmission

4 General

4.1 Relationship between minimum requirements and test requirements

The TS 38.101-2 [3] is a Single-RAT specification for NR UE, covering RF characteristics and minimum performance requirements. Conformance to the TS 38.101-2 [3] is demonstrated by fulfilling the test requirements specified in the present document.

The Minimum Requirements given in TS 38.101-2 [3] make no allowance for measurement uncertainty (MU). The measurement uncertainty defines in TR 38.903 [20]. The present document defines test tolerances (TT). These test tolerances are individually calculated for each test. The test tolerances are used to relax the minimum requirements in this specification 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 [6].

4.2 Applicability of minimum requirements

a) In TS 38.101-2 [3] 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 slot format indicated by TDD-UL-DL-ConfigurationCommon and TDD-UL-DL-ConfigurationDedicated in the PCell and SCells for NR SA.

A terminal which supports CA or DC configurations, which include FR2 intra-band CA combinations with multiple subblocks, where at least one of the subblocks consists of a contiguous CA combination, is not required to support all possible fallback combinations but can directly fall back to a single FR2 carrier. Deactivating carriers within the CA or DC combination is still possible.

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
NOTE: Suffix D in this specification represents either polarized UL MIMO or spatial UL MIMO. RF requirements are same. If UE supports both kinds of UL MIMO, then RF requirements only need to be verified under either polarized or spatial UL MIMO.	

4.4 Test point 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 [21] clause 4.2.

4.5 Applicability and test coverage rules

The applicability and test coverage rules for Standalone and EN-DC capable devices shall include the following:

If a test case for a FR2 NR band in a device is tested in NSA mode for non-exceptional requirement as per TS 38.521-3 [14], it shall fulfil the coverage requirement for that test case for standalone FR2 test requirements for that NR band and need not be retested.

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 FR2 operating bands.

5.2 Operating bands

NR is designed to operate in the FR2 operating bands defined in Table 5.2-1.

Table 5.2-1: NR operating bands in FR2

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
n257	26500 MHz – 29500 MHz	26500 MHz – 29500 MHz	TDD
n258	24250 MHz – 27500 MHz	24250 MHz – 27500 MHz	TDD
n260	37000 MHz – 40000 MHz	37000 MHz – 40000 MHz	TDD
n261	27500 MHz – 28350 MHz	27500 MHz – 28350 MHz	TDD

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 FR2.

Table 5.2A.1-1: Intra-band contiguous CA operating bands in FR2

NR CA Band	NR Band (Table 5.2-1)
CA_n257B	n257
CA_n257D	n257
CA_n257E	n257
CA_n257F	n257
CA_n257G	n257
CA_n257H	n257
CA_n257I	n257
CA_n257J	n257
CA_n257K	n257
CA_n257L	n257
CA_n257M	n257
CA_n260B	n260
CA_n260C	n260
CA_n260D	n260
CA_n260E	n260
CA_n260F	n260
CA_n260G	n260
CA_n260H	n260
CA_n260I	n260
CA_n260J	n260
CA_n260K	n260
CA_n260L	n260
CA_n260M	n260
CA_n260O	n260
CA_n260P	n260
CA_n260Q	n260
CA_n261B	n261
CA_n261C	n261
CA_n261D	n261
CA_n261E	n261
CA_n261F	n261
CA_n261G	n261
CA_n261H	n261
CA_n261I	n261
CA_n261J	n261
CA_n261K	n261
CA_n261L	n261
CA_n261M	n261
CA_n261O	n261
CA_n261P	n261
CA_n261Q	n261

5.2A.2 Void

5.2D Operating bands for UL MIMO

NR UL MIMO is designed to operate in the operating bands defined in Table 5.2D-1.

Table 5.2D-1: NR UL MIMO operating bands

UL MIMO operating band (Table 5.2-1)
n257
n258
n260
n261

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 transmission bandwidth configuration is shown in Figure 5.3.1-1.

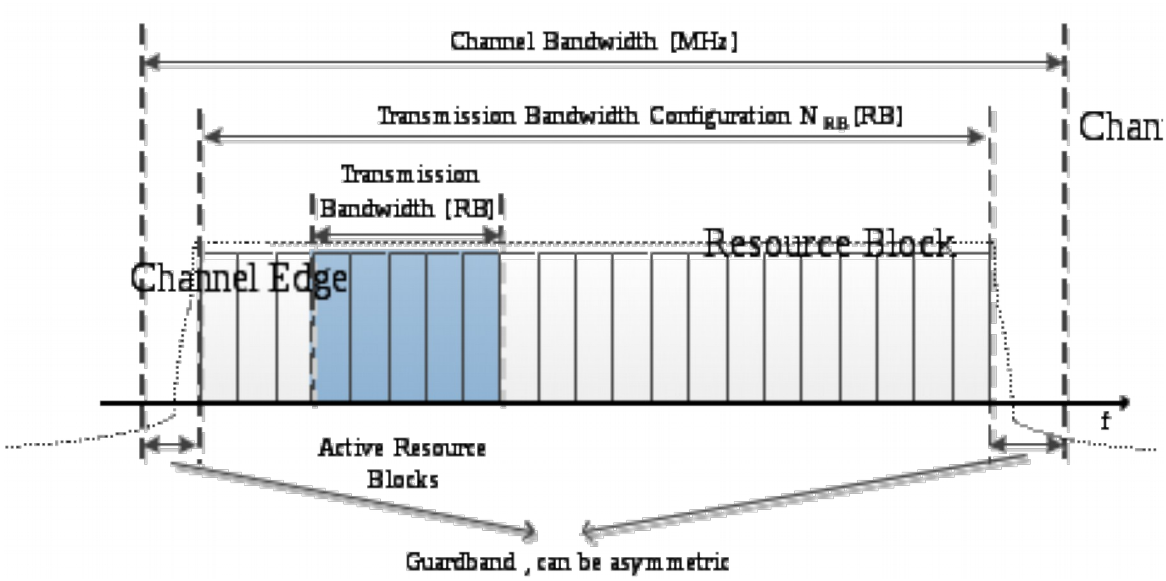

Figure 5.3.1-1: Definition of channel bandwidth and transmission bandwidth configuration for one NR channel

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)	50 MHz	100 MHz	200 MHz	400 MHz
	N_{RB}	N_{RB}	N_{RB}	N_{RB}
60	66	132	264	N/A
120	32	66	132	264

5.3.3 Minimum guardband and transmission bandwidth configuration

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

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

SCS (kHz)	50 MHz	100 MHz	200 MHz	400 MHz
60	1210	2450	4930	N/A
120	1900	2420	4900	9860

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

The minimum guardband of receiving BS SCS 240 kHz SS/PBCH block for each UE channel bandwidth is specified in table 5.3.3-2 for FR2.

Table: 5.3.3-2: Minimum guardband (kHz) of SCS 240 kHz SS/PBCH block

SCS (kHz)	100 MHz	200 MHz	400 MHz
240	3800	7720	15560

NOTE: The minimum guardband in Table 5.3.3-2 is applicable only when the SCS 240 kHz SS/PBCH block is received adjacent to the edge of the UE channel bandwidth within which the SS/PBCH block is located.

Figure 5.3.3-1: Void

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

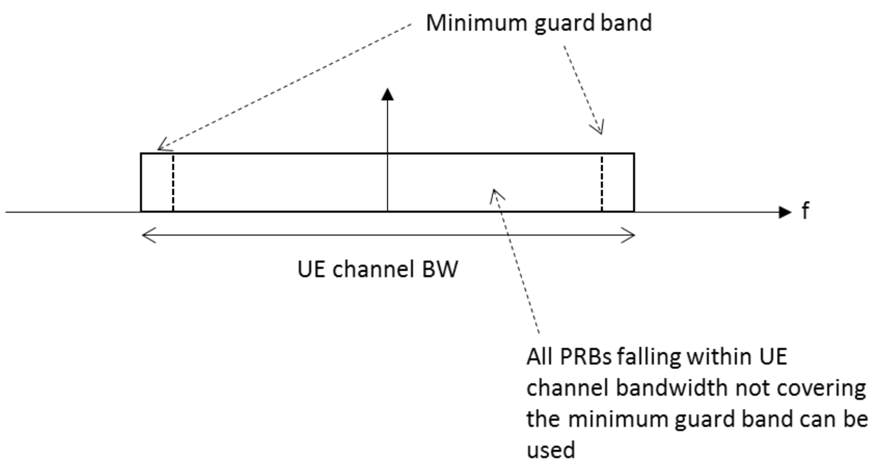

Figure 5.3.3-2: UE PRB utilization

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

If multiple numerologies are multiplexed in the same symbol and the UE channel bandwidth is >200 MHz, the minimum guardband applied adjacent to 60 kHz SCS shall be the same as the minimum guardband defined for 120 kHz SCS for the same UE channel bandwidth.

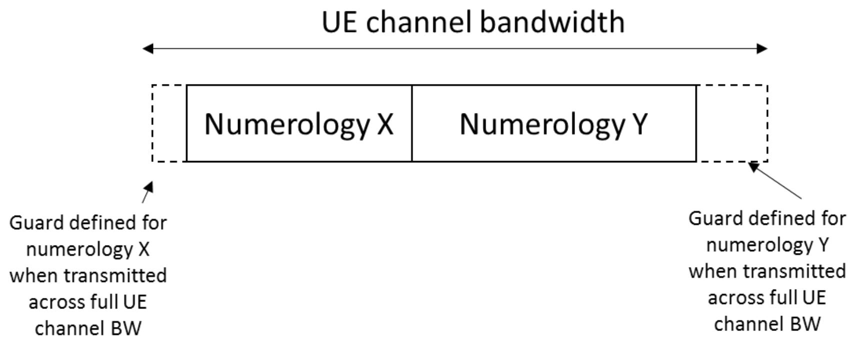

Figure 5.3.3-3: Guardband definition when transmitting multiple numerologies

NOTE: Figure 5.3.3-3 is not intended to imply the size of any guard between the two numerologies. Inter-numerology guardband 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 [9], 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* [19] and will fulfil the minimum UE guardband requirement specified in Section 5.3.3.

5.3.5 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

Operating band / SCS / UE channel bandwidth					
Operating band	**SCS kHz**	**50 MHz**	**100 MHz**	**200 MHz**	**400[2] MHz**
n257	60	Yes	Yes	Yes	N/A
	120	Yes	Yes	Yes	Yes
n258	60	Yes	Yes	Yes	N/A
	120	Yes	Yes	Yes	Yes
n260	60	Yes	Yes	Yes	N/A
	120	Yes	Yes	Yes	Yes
n261	60	Yes	Yes	Yes	N/A
	120	Yes	Yes	Yes	Yes
NOTE 1: For test configuration tables from the transmitter and receiver tests in Section 6 and 7 that refer to this table and indicate test SCS to use, if referenced SCS 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 2: This UE channel bandwidth is optional in this release of the specification.					

5.3A UE Channel bandwidth for CA

5.3A.1 General

TBD

5.3A.2 Minimum guardband 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.2-1.

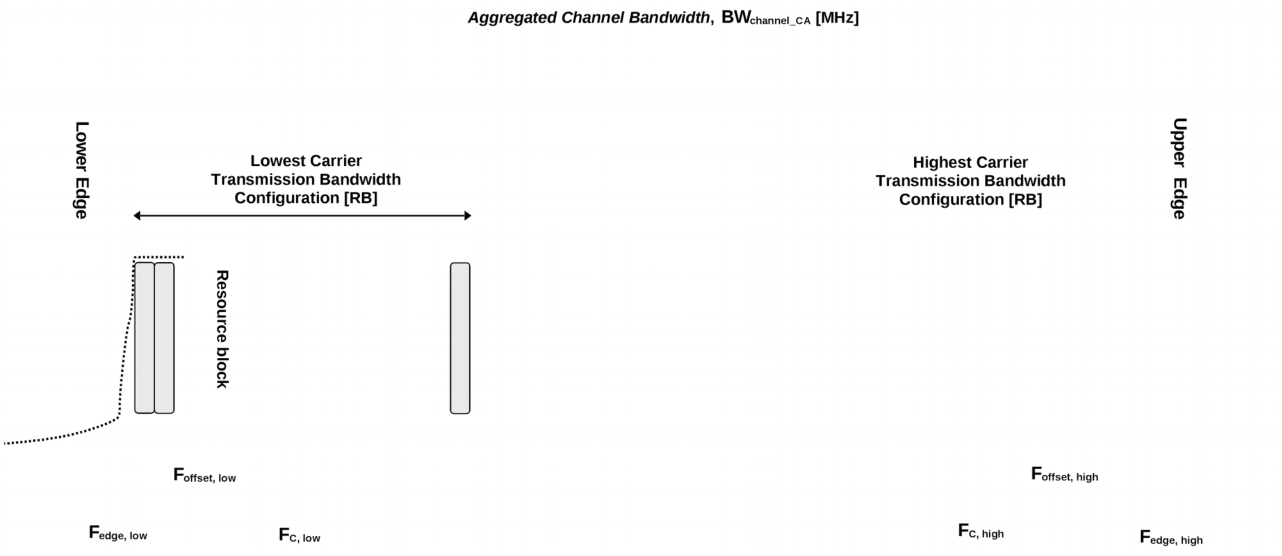

Figure 5.3A.2-1: Definition of *Aggregated Channel Bandwidth* for intra-band carrier aggregation

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 guardband 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.2-2.

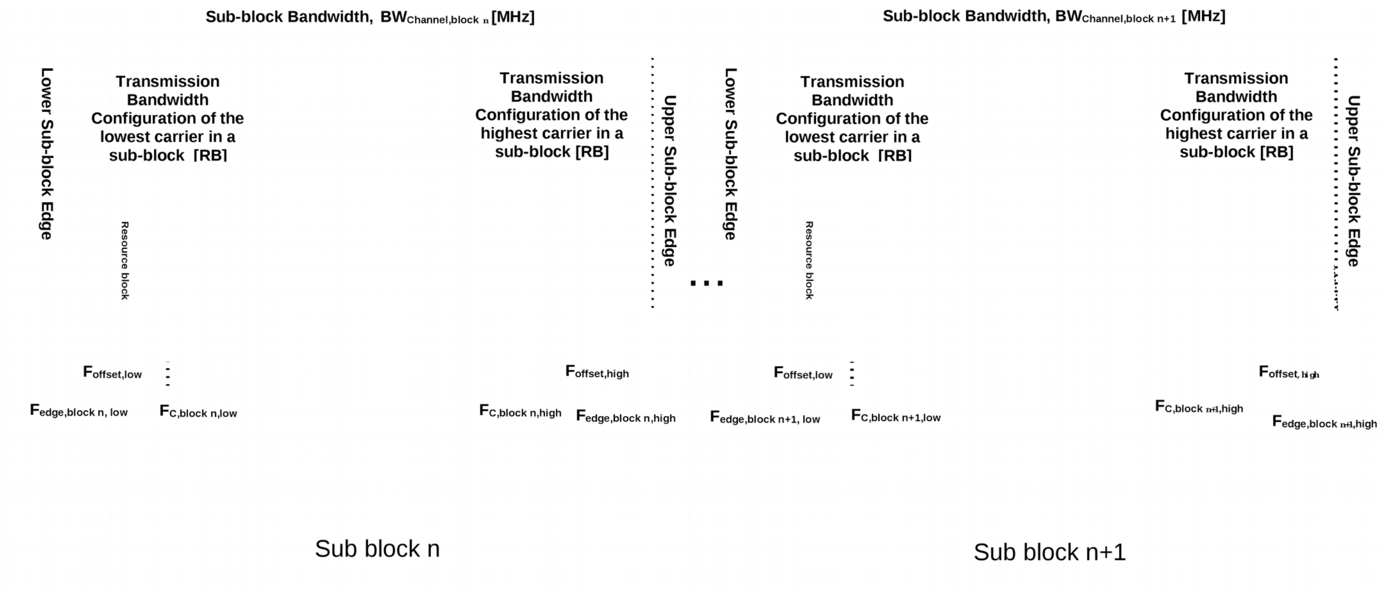

Figure 5.3A.2-2: Definition of sub-block bandwidth for intra-band non-contiguous spectrum

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 guardband 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

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

5.3A.3 RB alignment with different numerologies for CA

TBD

5.3A.4 UE channel bandwidth per operating band for CA

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, UE can indicate support of several bandwidth combination sets per carrier aggregation configuration. The requirements are applicable only when Uplink CCs are configured within the frequency range between lower edge of lowest downlink component carrier and upper edge of highest downlink component carrier.

For intra-band non-contiguous downlink carrier aggregation, a carrier aggregation configuration is a single operating band supporting two or more sub-blocks, each supporting a carrier aggregation bandwidth class. The requirements are applicable only when Uplink CCs are configured within the frequency range between lower edge of lowest downlink component carrier and upper edge of highest downlink component carrier.

Frequency separation class specified in Table 5.3A.4-2 indicates the maximum frequency span between lower edge of lowest component carrier and upper edge of highest component carrier that UE can support per band in downlink or uplink respectively.

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	$BW_{Channel} \le 400$ MHz	1	1,2,3,4
B	400 MHz < $BW_{Channel\_CA} \le 800$ MHz	2	1
C	800 MHz < $BW_{Channel\_CA} \le 1200$ MHz	3	
D	200 MHz < $BW_{Channel\_CA} \le 400$ MHz	2	2
E	400 MHz < $BW_{Channel\_CA} \le 600$ MHz	3	
F	600 MHz < $BW_{Channel\_CA} \le 800$ MHz	4	
G	100 MHz < $BW_{Channel\_CA} \le 200$ MHz	2	3
H	200 MHz < $BW_{Channel\_CA} \le 300$ MHz	3	
I	300 MHz < $BW_{Channel\_CA} \le 400$ MHz	4	
J	400 MHz < $BW_{Channel\_CA} \le 500$ MHz	5	
K	500 MHz < $BW_{Channel\_CA} \le 600$ MHz	6	
L	600 MHz < $BW_{Channel\_CA} \le 700$ MHz	7	
M	700 MHz < $BW_{Channel\_CA} \le 800$ MHz	8	
O	100 MHz $\le BW_{Channel_CA} \le$200 MHz	2	4
P	150 MHz $\le BW_{Channel_CA} \le$300 MHz	3	
Q	200 MHz $\le BW_{Channel\_CA} \le$ 400 MHz	4	

NOTE 1: Maximum supported component carrier bandwidths for fallback groups 1, 2, 3 and 4 are 400 MHz, 200 MHz, 100 MHz and 100 MHz respectively.

NOTE 2: It is mandatory for a UE to be able to fall back to lower order CA bandwidth class configuration within a fallback group. It is not mandatory for a UE to be able to fall back to lower order CA bandwidth class configuration that belongs to a different fallback group.

Table 5.3A.4-2: Frequency separation classes

Frequency separation class	Frequency separation (Fs)
I	Fs ≤ 800 MHz
II	Fs ≤ 1200 MHz
III	Fs ≤ 1400 MHz

5.3D Channel bandwidth for UL MIMO

The requirements specified in subclause 5.3 are applicable to UE supporting UL MIMO.

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 60 kHz channel raster,

Nominal Channel spacing = $(BW_{Channel(1)} + BW_{Channel(2)})/2$ + {-20 kHz, 0 kHz, 20 kHz} for ΔF_{Raster} equals to 60 kHz

Nominal Channel spacing = $(BW_{Channel(1)} + BW_{Channel(2)})/2$ + {-40 kHz, 0 kHz, 40 kHz} for ΔF_{Raster} equals to 120 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 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 frequency is designated by an NR Absolute Radio Frequency Channel Number (NR-ARFCN) in the range [2016667...3279165] 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}
24250 – 100000	60	24250.08	2016667	2016667 – 3279165

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}.

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

5.4.2.2 Channel raster to resource element mapping

The mapping between the RF reference frequency on 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

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

k , n_{PRB} , N_{RB} are as defined in TS 38.211[9].

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 60 kHz channel raster above 24 GHz, $\Delta F_{Raster} = I \times \Delta F_{Global}$, 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 is equal to the higher ΔF_{Raster} and the SSB SCS(*subcarrierspacingCommon*) that is equal to or larger than the higher ΔF_{Raster}.

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

Operating Band	ΔF_{Raster} (kHz)	Uplink and Downlink Range of N_{REF} (First – <Step size> – Last)
n257	60	2054166 – <1> – 2104165
	120	2054167 – <2> – 2104165
n258	60	2016667 – <1> – 2070832
	120	2016667 – <2> – 2070831
n260	60	2229166 – <1> – 2279165
	120	2229167 – <2> – 2279165
n261	60	2070833 – <1> – 2084999
	120	2070833 – <2> – 2084999

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
24250 – 100000 MHz	24250.08 MHz + N * 17.28 MHz, N = 0: 4383	22256+ N	22256 – 26639

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	$n_{PRB} = 10$

k, n_{PRB}, are as defined in TS 38.211 [9].

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)
n257	120 kHz	Case D	22388 - <1> - 22558
	240 kHz	Case E	22390 - <2> - 22556
n258	120 kHz	Case D	22257 - <1> - 22443
	240 kHz	Case E	22258 - <2> - 22442
n260	120 kHz	Case D	22995 - <1> - 23166
	240 kHz	Case E	22996 - <2> - 23164
n261	120 kHz	Case D	22446 - <1> - 22492
	240 kHz	Case E	22446 - <2> - 22490
NOTE 1: SS Block pattern is defined in subclause 4.1 in TS 38.213 [22].			

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 60kHz channel raster:

$$\text{Nominal channel spacing} = \left\lfloor \frac{BW_{Channel(1)} + BW_{Channel(2)} - 2\left|GB_{Channel(1)} - GB_{Channel(2)}\right|}{0.06 * 2^{n+1}} \right\rfloor 0.06 * 2^{n} \text{ [MHz]}$$

with

$$n = \mu_0 - 2$$

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, μ_o is the largest μ value among the subcarrier spacing configurations supported in the operating band for both of the channel bandwidths according to Table 5.3.5-1, and $GB_{Channel(i)}$ is the minimum guardband for channel bandwidth *i* according to Table 5.3.3-1 for the said μ value, with μ as defined in TS 38.211 [9].

The channel spacing for intra-band contiguous carrier aggregation can be adjusted to any multiple of 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.

5.5 Configurations

5.5A Configurations for CA

5.5A.1 Configurations for intra-band contiguous CA

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

NR CA configuration / Bandwidth combination set / Fallback group												
NR CA configuration	**Uplink CA configurations**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**Maximum aggregated BW (MHz)**	**BCS**	**Fallback group**
CA_n257B	CA_n257B	50, 100, 200, 400	400							800	0	1
CA_n257D	CA_n257D	50, 100, 200,	200							400	0	
CA_n257E	CA_n257E	50, 100, 200,	200	200						600	0	2
CA_n257F	CA_n257F	50, 100, 200,	200	200	200					800	0	
CA_n257G	CA_n257G	100	100							200	0	
CA_n257H	CA_n257H	100	100	100						300	0	
CA_n257I	CA_n257I	100	100	100	100					400	0	
CA_n257J	CA_n257J	100	100	100	100	100				500	0	3
CA_n257K	CA_n257K	100	100	100	100	100	100			600	0	
CA_n257L	CA_n257L	100	100	100	100	100	100	100		700	0	
CA_n257M	CA_n257M	100	100	100	100	100	100	100	100	800	0	
CA_n260B	CA_n260B	50, 100, 200, 400	400							800	0	1
CA_n260C	CA_n260B	50, 100, 200, 400	400	400						1200	0	
CA_n260D	CA_n260D	50, 100, 200	200							400	0	
CA_n260E	CA_n260E	50, 100, 200	200	200						600	0	2
CA_n260F	CA_n260F	50, 100, 200	200	200	200					800	0	
CA_n260G	CA_n260G	100	50, 100							200	0	3
CA_n260H	CA_n260H	100	100	50, 100						300	0	

NR CA configuration / Bandwidth combination set / Fallback group												
NR CA configuration	Uplink CA configurations	CBW (MHz)	CBW (MHz)	CBW (MHz)	CBW (MHz)	CBW (MHz)	CBW (MHz)	CBW (MHz)	CBW (MHz)	Maximum aggregated BW (MHz)	BCS	Fallback group
CA_n260I	CA_n260I	100	100	100	50, 100					400	0	
CA_n260J	CA_n260J	100	100	100	100	50, 100				500	0	
CA_n260K	CA_n260K	100	100	100	100	100	50, 100			600	0	
CA_n260L	CA_n260L	100	100	100	100	100	100	50, 100		700	0	
CA_n260M	CA_n260M	100	100	100	100	100	100	100	50, 100	800	0	
CA_n260O	CA_n260O	50, 100	50, 100							200	0	4
CA_n260P	CA_n260P	50, 100	50, 100	50, 100						300	0	
CA_n260Q	CA_n260Q	50, 100	50, 100,	50, 100	50, 100					400	0	
CA_n261B	CA_n261B	50, 100, 200, 400	400							800	0	1
CA_n261C	CA_n261B	50	400	400						850[1]	0	
CA_n261D	CA_n261D	50, 100, 200	200							400	0	2
CA_n261E	CA_n261E	50, 100, 200	200	200						600	0	
CA_n261F	CA_n261F	50, 100, 200	200	200	200					800	0	
CA_n261G	CA_n261G	100	50, 100							200	0	3
CA_n261H	CA_n261H	100	100	50, 100						300	0	
CA_n261I	CA_n261I	100	100	100	50, 100					400	0	
CA_n261J	CA_n261J	100	100	100	100	50, 100				500	0	
CA_n261K	CA_n261K	100	100	100	100	100	50, 100			600	0	
CA_n261L	CA_n261L	100	100	100	100	100	100	50, 100		700	0	
CA_n261M	CA_n261M	100	100	100	100	100	100	100	50, 100	800	0	

NR CA configuration / Bandwidth combination set / Fallback group												
NR CA configuration	Uplink CA configurations	CBW (MHz)	CBW (MHz)	CBW (MHz)	CBW (MHz)	CBW (MHz)	CBW (MHz)	CBW (MHz)	CBW (MHz)	Maximum aggregated BW (MHz)	BCS	Fallback group
CA_n261O	CA_n261O	50, 100	50, 100							200	0	4
CA_n261P	CA_n261P	50, 100	50, 100	50, 100						300	0	
CA_n261Q	CA_n261Q	50, 100	50, 100,	50, 100	50, 100					400	0	

NOTE 1: The maximum bandwidth of band n261 is 850MHz.
NOTE 2: For the NR CA configuration with more than two component carries, the bandwidths in a BCS which may introduce combinations more than requested unintentionally should be listed in a row separately.

5.5A.2 Configurations for intra-band non-contiguous CA

Configurations listed in this clause apply to downlink carrier aggregation only.

Table 5.5A.2-1: NR CA configurations with single CA bandwidth class defined for intra-band non-contiguous CA

			NR CA configuration / Bandwidth combination set						
			Component carriers in order of increasing carrier frequency						
NR configuration	Uplink CA configurations	SCS	CBW (MHz)	CBW (MHz)	CBW (MHz)	CBW (MHz)	CBW (MHz)	Maximum aggregated bandwidth (MHz)	BCS
CA_n257(2A)	-	60	50, 100, 200	50, 100, 200				400	0
		120	50, 100, 200, 400	50, 100, 200, 400				800	
CA_n260(2A)	-	60	50, 100, 200	50, 100, 200				400	0
		120	50, 100, 200, 400	50, 100, 200, 400				800	
CA_n260(3A)	-	60	50, 100, 200	50, 100, 200	50, 100, 200			600	0
		120	50, 100, 200, 400	50, 100, 200, 400	50, 100, 200, 400			1200	
CA_n260(4A)	-	60	50, 100, 200	50, 100, 200	50, 100, 200	50, 100, 200		800	0
		120	50, 100, 200, 400	50, 100, 200, 400	50, 100, 200, 400	50, 100, 200, 400		1600	
CA_n261(2A)	-	60	50, 100, 200	50, 100, 200				400	0
		120	50, 100, 200, 400	50, 100, 200, 400				800	
CA_n261(3A)	-	60	50, 100, 200	50, 100, 200	50, 100, 200			600	0
		120	50, 100, 200, 400	50, 100, 200, 400	50, 100, 200, 400			750	
CA_n261(4A)	-	60	50, 100, 200	50, 100, 200	50, 100, 200	50, 100, 200		700	0
		120	50, 100, 200, 400	50, 100, 200, 400	50, 100, 200, 400	50, 100, 200, 400		700	

NOTE 1: Void
NOTE 2: The maximum frequency span including frequency gaps in between non-contiguous component carriers shall not exceed 1400 MHz for all CA configurations in the current release of specifications.
NOTE 3: Parameter value accounts for both, the constraint in NOTE 2, and the minimum frequency gaps in between non-contiguous component carriers.

Table 5.5A.2-2: NR CA configurations and bandwidth combination sets for intra-band non-contiguous CA

NR CA configuration / Bandwidth combination set											
CA configuration	**Uplink CA configurations**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**Maximum aggregated bandwidth (MHz)**	**BCS**
CA_n260(A-I)	CA_n260I	See CA_n260 Channel Bandwidth in Table 5.3.5-1	See CA_n260I BCS0 in Table 5.5A.1-1							800	0
CA_n260(D-G)	CA_n260D-CA_n260G	See CA_n260D BCS0 in Table 5.5A.1-1		See CA_n260G BCS0 in Table 5.5A.1-1						600	0
CA_n260(D-H)	CA_n260D CA_n260H-	See CA_n260D BCS0 in Table 5.5A.1-1		See CA_n260H BCS0 in Table 5.5A.1-1						700	0
CA_n260(D-I)	CA_n260D CA_n260I-	See CA_n260D BCS0 in Table 5.5A.1-1		See CA_n260I BCS0 in Table 5.5A.1-1						800	0
CA_n260(D-O)	CA_n260D CA_n260O-	See CA_n260D BCS0 in Table 5.5A.1-1		See CA_n260O BCS0 in Table 5.5A.1-1						600	0
CA_n260(D-P)	CA_n260D CA_n260P-	See CA_n260D BCS0 in Table 5.5A.1-1		See CA_n260P BCS0 in Table 5.5A.1-1						700	0
CA_n260(D-Q)	CA_n260D CA_n260Q-	See CA_n260D BCS0 in Table 5.5A.1-1		See CA_n260Q BCS0 in Table 5.5A.1-1						800	0
CA_n260(E-O)	CA_n260E CA_n260O-	See CA_n260O BCS0 in Table 5.5A.1-1		See CA_n260E BCS0 in Table 5.5A.1-1						800	0
CA_n260(E-P)	CA_n260E CA_n260P-	See CA_n260E BCS0 in Table 5.5A.1-1			See CA_n260P BCS0 in Table 5.5A.1-1					900	0
CA_n260(E-Q)	CA_n260E CA_n260Q-	See CA_n260E BCS0 in Table 5.5A.1-1			See CA_n260Q BCS0 in Table 5.5A.1-1					1000	0
CA_n260(G-I)	CA_n260G CA_n260I -	See CA_n260G BCS0 in Table 5.5A.1-1		See CA_n260I BCS0 in Table 5.5A.1-1						600	0
CA_n261(D-G)	CA_n261D CA_n261G-	See CA_n261D BCS0 in Table 5.5A.1-1		See CA_n261G BCS0 in Table 5.5A.1-1						600	0
CA_n261(D-H)	CA_n261D CA_n261H-	See CA_n261D BCS0 in Table 5.5A.1-1		See CA_n261H BCS0 in Table 5.5A.1-1						700	0
CA_n261(D-I)	CA_n261D CA_n261I-	See CA_n261D BCS0 in Table 5.5A.1-1		See CA_n261I BCS0 in Table 5.5A.1-1						800	0
CA_n261(D-O)	CA_n261D CA_n261O-	See CA_n261D BCS0 in Table 5.5A.1-1		See CA_n261O BCS0 in Table 5.5A.1-1						600	0
CA_n261(D-P)	CA_n261D CA_n261P-	See CA_n261D BCS0 in Table 5.5A.1-1		See CA_n261P BCS0 in Table 5.5A.1-1						700	0

NR CA configuration / Bandwidth combination set											
CA configuration	**Uplink CA configurations**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**CBW (MHz)**	**Maximum aggregated bandwidth (MHz)**	**BCS**
CA_n261(D-Q)	CA_n261D CA_n261Q-	See CA_n261D BCS0 in Table 5.5A.1-1		See CA_n261Q BCS0 in Table 5.5A.1-1						800	0
CA_n261(E-O)	CA_n261E CA_n261O-	See CA_n261E BCS0 in Table 5.5A.1-1			See CA_n261O BCS0 in Table 5.5A.1-1					800	0
CA_n261(E-P)	CA_n261E CA_n261P-	See CA_n261E BCS0 in Table 5.5A.1-1			See CA_n261P BCS0 in Table 5.5A.1-1					800	0
CA_n261(E-Q)	CA_n261E CA_n261Q-	See CA_n261E BCS0 in Table 5.5A.1-1			See CA_n261Q BCS0 in Table 5.5A.1-1					800	0
NOTE 1: (Void) NOTE 2: The maximum frequency span including the frequency gap in between non-contiguous component carriers shall not exceed 1400 MHz for all CA configurations in the current release of specifications.											

5.5D Configurations for UL MIMO

The requirements specified in subclause 5.5 are applicable to UE supporting UL MIMO.

6 Transmitter characteristics

6.1 General

Editor's Note: Test configurations/environments that require new spherical scan shall be included in test procedure section and identifying such scenarios is currently FFS and owned by RAN5.

Unless otherwise stated, the transmitter characteristics are specified over the air (OTA) with a single or multiple transmit chains.

For Tx test cases the identified beam peak direction can be stored and reused for a device under test in various configurations/environments for the full duration of device testing as long as beam peak direction is the same.

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.

For conformance testing of all test cases in this specification, the UE under test shall disable UL Tx diversity schemes.

Table 6.1-1: Common Uplink Configuration PC2, for PC3 and PC4

Channel Bandwidth	SCS(kHz)	OFDM	RB allocation					
			Outer_Full	Outer_1RB_Left	Outer_1RB_Right	Inner_Full (Note 1)	Inner_1RB_Left	Inner_1RB_Right
50MHz	60	DFT-s	64@0	1@0	1@65	20@22	1@22	1@43
		CP	66@0	1@0	1@65	22@22	1@22	1@43
	120	DFT-s	32@0	1@0	1@31	10@11	1@11	1@21
		CP	32@0	1@0	1@31	11@11	1@11	1@21
100MHz	60	DFT-s	128@0	1@0	1@131	40@44	1@44	1@87
		CP	132@0	1@0	1@131	44@44	1@44	1@87
	120	DFT-s	64@0	1@0	1@65	20@22	1@22	1@43
		CP	66@0	1@0	1@65	22@22	1@22	1@43
200MHz	60	DFT-s	256@0	1@0	1@263	81@88	1@88	1@175
		CP	264@0	1@0	1@263	88@88	1@88	1@175
	120	DFT-s	128@0	1@0	1@131	40@44	1@44	1@87
		CP	132@0	1@0	1@131	44@44	1@44	1@87
400MHz	60	DFT-s	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
	120	DFT-s	256@0	1@0	1@263	64@66	1@66	1@197
		CP	264@0	1@0	1@263	64@66	1@66	1@197
Note 1: RB allocation is left aligned within inner region								

Table 6.1-2: Common Uplink Configuration for PC1

Channel Bandwidth	SCS(kHz)	OFDM	RB allocation					
			Outer_Full	Outer_1RB_Left	Outer_1RB_Right	Inner_Full (Note 1)	Inner_1RB_Left	Inner_1RB_Right
50MHz	60	DFT-s	64@0	1@0	1@65	32@16	1@1	1@64
		CP	66@0	1@0	1@65	33@16	1@1	1@64
	120	DFT-s	32@0	1@0	1@31	16@8	1@1	1@30
		CP	32@0	1@0	1@31	16@8	1@1	1@30
100MHz	60	DFT-s	128@0	1@0	1@131	64@33	1@1	1@130
		CP	132@0	1@0	1@131	66@33	1@1	1@130
	120	DFT-s	64@0	1@0	1@65	32@16	1@1	1@64
		CP	66@0	1@0	1@65	33@16	1@1	1@64
200MHz	60	DFT-s	256@0	1@0	1@263	128@66	1@1	1@262
		CP	264@0	1@0	1@263	132@66	1@1	1@262
	120	DFT-s	128@0	1@0	1@131	64@33	1@1	1@130
		CP	132@0	1@0	1@131	66@33	1@1	1@130
400MHz	60	DFT-s	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
	120	DFT-s	256@0	1@0	1@263	128@66	1@1	1@262
		CP	264@0	1@0	1@263	132@66	1@1	1@262
Note 1: RB allocation is left aligned within inner region.								

6.2 Transmit power

6.2.1 UE maximum output power

6.2.1.0 General

Note : Power class 1, 2, 3, and 4 are specified based on the assumption of certain UE types with specific device architectures. The UE types can be found in Table 6.2.1.0-1.

Table 6.2.1.0-1: Assumption of UE Types

UE Power class	UE type
1	Fixed wireless access (FWA) UE
2	Vehicular UE
3	Handheld UE
4	High power non-handheld UE

6.2.1.1 UE maximum output power - EIRP and TRP

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

- Measurement Uncertainties and Test Tolerances are FFS for power class 1, 2 and 4.
- The following aspects of the clause are for future consideration:
    - Test Procedures for EIRP beam peak Extreme Conditions are FFS

6.2.1.1.1 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.

6.2.1.1.2 Test applicability

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

6.2.1.1.3 Minimum conformance requirements

6.2.1.1.3.1 UE maximum output power for power class 1

The following requirements define the maximum output power radiated by the UE for any transmission bandwidth within the channel bandwidth for non-CA configuration, unless otherwise stated. The period of measurement shall be at least one sub frame (1ms). The requirement is verified with the test metric of EIRP (Link=Beam peak search grids, Meas=Link angle).

Table 6.2.1.1.3.1-1: UE minimum peak EIRP for power class 1

Operating band	Min peak EIRP (dBm)
n257	40.0
n258	40.0
n260	38.0
n261	40.0
NOTE 1: Minimum peak EIRP is defined as the lower limit without tolerance	

The maximum output power values for TRP and EIRP are found in Table 6.2.1.1.3.1-2 below. The maximum allowed EIRP is derived from regulatory requirements [8]. The requirements are verified with the test metrics of TRP (Link=TX beam peak direction) in beam locked mode and EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 6.2.1.1.3.1-2: UE maximum output power limits for power class 1

Operating band	Max TRP (dBm)	Max EIRP (dBm)
n257	35	55
n258	35	55
n260	35	55
n261	35	55

The minimum EIRP at the 85th percentile of the distribution of radiated power measured over the full sphere around the UE is defined as the spherical coverage requirement and is found in Table 6.2.1.1.3.1-3 below. The requirement is verified with the test metric of EIRP (Link=Beam peak search grids, Meas=Link angle).

Table 6.2.1.1.3.1-3: UE spherical coverage for power class 1

Operating band	Min EIRP at 85%-tile CDF (dBm)
n257	32.0
n258	32.0
n260	30.0
n261	32.0
NOTE 1: Minimum EIRP at 85%-tile CDF is defined as the lower limit without tolerance NOTE 2: The requirements in this table are verified only under normal temperature conditions as defined in Annex E.2.1.	

6.2.1.1.3.2 UE maximum output power for power class 2

The following requirements define the maximum output power radiated by the UE for any transmission bandwidth within the channel bandwidth for non-CA configuration, unless otherwise stated. The period of measurement shall be at least one sub frame (1ms). The requirement is verified with the test metric of EIRP (Link=Beam peak search grids, Meas=Link angle).

Table 6.2.1.1.3.2-1: UE minimum peak EIRP for power class 2

Operating band	Min peak EIRP (dBm)
n257	29
n258	29
n261	29
NOTE 1: Minimum peak EIRP is defined as the lower limit without tolerance	

The maximum output power values for TRP and EIRP are found in Table 6.2.1.1.3.2-2 below. The maximum allowed EIRP is derived from regulatory requirements [8]. The requirements are verified with the test metrics of TRP (Link=TX beam peak direction) in beam locked mode and EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 6.2.1.1.3.2-2: UE maximum output power limits for power class 2

Operating band	Max TRP (dBm)	Max EIRP (dBm)
n257	23	43
n258	23	43
n261	23	43

The minimum EIRP at the 60th percentile of the distribution of radiated power measured over the full sphere around the UE is defined as the spherical coverage requirement and is found in Table 6.2.1.1.3.2-3 below. The requirement is verified with the test metric of EIRP (Link=Beam peak search grids, Meas=Link angle).

Table 6.2.1.1.3.2-3: UE spherical coverage for power class 2

Operating band	Min EIRP at 60%-tile CDF (dBm)
n257	18.0
n258	18.0
n261	18.0
NOTE 1: Minimum EIRP at 60%-tile CDF is defined as the lower limit without tolerance NOTE 2: The requirements in this table are verified only under normal temperature conditions as defined in Annex E.2.1.	

6.2.1.1.3.3 UE maximum output power for power class 3

The following requirements define the maximum output power radiated by the UE for any transmission bandwidth within the channel bandwidth for non-CA configuration, unless otherwise stated. The period of measurement shall be at least one sub frame (1ms). The requirement is verified with the test metric of total component of EIRP (Link=Beam peak search grids, Meas=Link angle). The requirement for the UE which supports a single FR2 band is specified in Table 6.2.1.1.3.3-1. The requirement for the UE which supports multiple FR2 bands is specified in both Table 6.2.1.1.3.3-1 and Table 6.2.1.1.3.3-4.

Table 6.2.1.1.3.3-1: UE minimum peak EIRP for power class 3

Operating band	Min peak EIRP (dBm)
n257	22.4
n258	22.4
n260	20.6
n261	22.4
NOTE 1: Minimum peak EIRP is defined as the lower limit without tolerance NOTE 2: Void	

The maximum output power values for TRP and EIRP are found on the Table 6.2.1.1.3.3-2. The max allowed EIRP is derived from regulatory requirements [8]. The requirements are verified with the test metrics of TRP (Link=TX beam peak direction) in beam locked mode and the total component of EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 6.2.1.1.3.3-2: UE maximum output power limits for power class 3

Operating band	Max TRP (dBm)	Max EIRP (dBm)
n257	23	43
n258	23	43
n260	23	43
n261	23	43

The minimum EIRP at the 50th percentile of the distribution of radiated power measured over the full sphere around the UE is defined as the spherical coverage requirement and is found in Table 6.2.1.1.3.3-3 below. The requirement is verified with the test metric of the total component of EIRP, as defined in [5] (Link=Beam peak search grids, Meas=Link angle). The requirement for the UE which supports a single FR2 band is specified in Table 6.2.1.1.3.3-3. The requirement for the UE which supports multiple FR2 bands is specified in both Table 6.2.1.1.3.3-3 and Table 6.2.1.1.3.3-4.

Table 6.2.1.1.3.3-3: UE spherical coverage for power class 3

Operating band	Min EIRP at 50^{t}%-tile CDF (dBm)
n257	11.5
n258	11.5
n260	8
n261	11.5
NOTE 1: Minimum EIRP at 50 %-tile CDF is defined as the lower limit without tolerance NOTE 2: Void NOTE 3: The requirements in this table are verified only under normal temperature conditions as defined in Annex E.2.1.	

For the UEs that support multiple FR2 bands, minimum requirement for peak EIRP and EIRP spherical coverage in Tables 6.2.1.1.3.3-1 and 6.2.1.1.3.3-3 shall be decreased per band, respectively, by the peak EIRP relaxation parameter $\Delta MB_{P,n}$ and EIRP spherical coverage relaxation parameter $\Delta MB_{S,n}$.

Table 6.2.1.1.3.3-4: UE multi-band relaxation factors for power class 3

Supported bands	$\sum MB_P$ (dB)	$\sum MB_S$ (dB)
n257, n258	≤ 1.3	≤ 1.25
n257, n260	≤ 1.0	≤ 0.75[3]
n258, n260	≤ 1.0	≤ 0.75[3]
n258, n261	≤ 1.0	≤ 1.25
n260, n261	0.0	≤ 0.75[2]
n257, n258, n260	≤ 1.7	≤ 1.75[3]
n257, n258, n261	≤ 1.7	≤ 1.75
n257, n260, n261	≤ 0.5	≤ 1.25[3]
n258, n260, n261	≤ 1.5	≤ 1.25[3]
n257, n258, n260, n261	≤ 1.7	≤ 1.75[3]
NOTE 1: The requirements in this table are applicable to UEs which support only the indicated bands NOTE 2: For supported bands n260 + n261, $\Delta MB_{S,n}$ is not applied for band n260 NOTE 3: For n260, maximum applicable $\Delta MB_{S,n}$ is 0.4 dB		

6.2.1.1.3.4 UE maximum output power for power class 4

The following requirements define the maximum output power radiated by the UE for any transmission bandwidth within the channel bandwidth for non-CA configuration, unless otherwise stated. The period of measurement shall be at least one sub frame (1ms). The requirement is verified with the test metric of EIRP (Link=Beam peak search grids, Meas=Link angle).

Table 6.2.1.1.3.4-1: UE minimum peak EIRP for power class 4

Operating band	Min peak EIRP (dBm)
n257	34
n258	34
n260	31
n261	34
NOTE 1: Minimum peak EIRP is defined as the lower limit without tolerance	

The maximum output power values for TRP and EIRP are found in Table 6.2.1.1.3.4-2 below. The maximum allowed EIRP is derived from regulatory requirements [8]. The requirements are verified with the test metrics of TRP (Link=TX beam peak direction) in beam locked mode and EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 6.2.1.1.3.4-2: UE maximum output power limits for power class 4

Operating band	Max TRP (dBm)	Max EIRP (dBm)
n257	23	43
n258	23	43
n260	23	43
n261	23	43

The minimum EIRP at the 20^{th} percentile of the distribution of radiated power measured over the full sphere around the UE is defined as the spherical coverage requirement and is found in Table 6.2.1.1.3.4-3 below. The requirement is verified with the test metric of EIRP (Link=Beam peak search grids, Meas=Link angle).

Table 6.2.1.1.3.4-3: UE spherical coverage for power class 4

Operating band	Min EIRP at 20%-tile CDF (dBm)
n257	25
n258	25
n260	19
n261	25
NOTE 1: Minimum EIRP at 20%-tile CDF is defined as the lower limit without tolerance NOTE 2: The requirements in this table are verified only under normal temperature conditions as defined in Annex E.2.1.	

The normative reference for this requirement is TS 38.101-2 [3] clause 6.2.1.

6.2.1.1.4 Test description

6.2.1.1.4.1 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, 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 subcarrier spacing, are shown in table 6.2.1.1.4.1-1. 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 6.2.1.1.4.1-1: Test Configuration Table

Default Conditions					
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal, TL/VL, TL/VH, TH/VL, TH/VH (NOTE 2)		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1]			Low range, Mid Range, High range		
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause [4.3.1]			Lowest, 100 MHz, Highest		
Test SCS as specified in Table 5.3.5-1			120 kHz		
Test Parameters					
Test ID	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
		Default	N/A	**Modulation**	**RB allocation (NOTE 1)**
1	50			DFT-s-OFDM QPSK	Inner_Full
2	100				
3	200				
4	400				
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1. NOTE 2: Test environment for UE Max TRP is normal only.					

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.2 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.2.1.1.4.1-1.

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 [10] clause 4.5. Message contents are defined in clause 6.2.1.1.4.3

6.2.1.1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format [0_1] for C_RNTI to schedule the UL RMC according to Table 6.2.1.1.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Messages to configure the appropriate uplink modulation in section 6.2.1.1.4.3.
2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 msec starting from the first TPC command in this step to ensure that the UE transmits at its maximum output power.
3. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (Note 1) for the UE Tx beam selection to complete.
4. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.
5. Measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Tables 6.2.1.1.5-1 to 6.2.1.1.5-4. EIRP test procedure is defined in Annex K.1.3. The measuring duration is one active uplink subframe. EIRP is calculated considering both polarizations, theta and phi.
6. Measure TRP of the transmitted signal for the assigned NR channel with a rectangular measurement filter with bandwidths according to Table 6.5.2.3.5-1. Total radiated power is measured according to TRP measurement procedure defined in Annex K.1.7 and measurement grid specified in Annex M.4. TRP is calculated considering both polarizations, theta and phi.
7. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.2.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.2.1.1.5 Test requirement

The EIRP derived in step 4 and TRP derived in step 5 shall not exceed the values specified in Table 6.2.1.1.5-1 to Table 6.2.1.1.5-4.

Table 6.2.1.1.5-1: UE maximum output test requirements for power class 1

Operating band	Max TRP (dBm)	Max EIRP (dBm)	Min peak EIRP (dBm)
n257	35+TT	55	40.0-TT
n258	35+TT	55	40.0-TT
n260	35+TT	55	38.0-TT
n261	35+TT	55	40.0-TT

Table 6.2.1.1.5-2: UE maximum output test requirements for power class 2

Operating band	Max TRP (dBm)	Max EIRP (dBm)	Min peak EIRP (dBm)
n257	23+TT	43	29-TT
n258	23+TT	43	29-TT
n260			
n261	23+TT	43	29-TT

Table 6.2.1.1.5-3: UE maximum output test requirements for power class 3 for single band UE or multiband UE declaring MB_p = 0 in all FR2 bands

Operating band	Max TRP (dBm)	Max EIRP (dBm)	Min peak EIRP (dBm)
n257	23+TT	43	22.4-TT
n258	23+TT	43	22.4-TT
n260	23+TT	43	20.6-TT
n261	23+TT	43	22.4-TT

Table 6.2.1.1.5-3a: UE maximum output test requirements for power class 3 for multi band UE declaring MB_p>0 in any FR2 band

ID	Supported FR2 bands set	Test requirement (dB) (Note 1)				Maximum sum of MB_p, $\sum MB_P$ (dB) (Note 3)	Comments
		n257	n258	n260	n261		
1	n257, n258	22.4-TT-MB_p	22.4-TT-MB_p			1.3	
2	n257, n260	22.4-TT-MB_p		20.6-TT-MB_p		1.0	
3	n258, n260		22.4-TT-MB_p	20.6-TT-MB_p		1.0	
4	n258, n261		22.4-TT-MB_p		22.4-TT-MB_p	1.0	
5	n260, n261					0.0	No relaxation factor allowed
6	n257, n258, n260	22.4-TT-MB_p	22.4-TT-MB_p	20.6-TT-MB_p		1.7	
7	n257, n258, n261	22.4-TT-MB_p	22.4-TT-MB_p		22.4-TT-MB_p	1.7	
8	n257, n260, n261	22.4-TT-MB_p		20.6-TT-MB_p	22.4-TT-MB_p	0.5	
9	n258, n260, n261		22.4-TT-MB_p	20.6-TT-MB_p	22.4-TT-MB_p	1.5	
10	n257, n258, n260, n261	22.4-TT-MB_p	22.4-TT-MB_p	20.6-TT-MB_p	22.4-TT-MB_p	1.7	

Note 1: MB_p is the Multiband Relaxation factor declared by the UE for the tested band in table A.4.3.9-2 of TS38.508-2. This declaration shall fulfil the requirements in clause 6.2.1.1.3.3.
Note 2: All UE supported bands needs to be tested to ensure the multiband relaxation declaration is compliant
Note 3: Max allowed sum of MB_p over all supported FR2 bands as defined in clause 6.2.1.1.3.3

Table 6.2.1.1.5-3b: Test Tolerance (Max TRP for Power class 3)

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	2.65 dB	2.77 dB

Table 6.2.1.1.5-3c: Test Tolerance (Min peak EIRP for Power class 3)

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	2.87 dB	2.87 dB

Table 6.2.1.1.5-4: UE maximum output power test requirements for power class 4

Operating band	Max TRP (dBm)	Max EIRP (dBm)	Min peak EIRP (dBm)
n257	23+TT	43	34-TT
n258	23+TT	43	34-TT
n260	23+TT	43	31-TT
n261	23+TT	43	34-TT

6.2.1.2 UE maximum output power - Spherical coverage

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

Measurement Uncertainties and Test Tolerances are FFS for power class 1, 2 and 4.

6.2.1.2.1 Test purpose

To verify that the spatial coverage of the UE in expected directions is acceptable.

6.2.1.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that support beam correspondence without UL beam sweeping.

6.2.1.2.3 Minimum conformance requirements

Minimum conformance requirements are defined in clause 6.2.1.1.3.

6.2.1.2.4 Test description

6.2.1.2.4.1 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 subcarrier spacing, are shown in table 6.2.1.2.4.1-1. 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 6.2.1.2.4.1-1: Test Configuration Table

Default Conditions					
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]				Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1]				Low range, Mid Range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause [4.3.1]				Lowest, Highest	
Test SCS as specified in Table 5.3.5-1				120 kHz	
Test Parameters					
Test ID	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
		Default	N/A	**Modulation**	**RB allocation (NOTE 1)**
1	50			DFT-s-OFDM QPSK	Inner_Full
2	100				
3	200				
4	400				
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.					

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.2 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.2.1.2.4.1-1.

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 [10] clause 4.5. Message contents are defined in clause 6.2.1.2.4.3

6.2.1.2.4.2 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 6.2.1.2.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Messages to configure the appropriate uplink modulation in section 6.2.1.2.4.3.

2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 msec to ensure that the UE transmits at its maximum output power.

3. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (Note 1) for the UE Tx beam selection to complete.

4. Measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration. Repeat EIRP measurements for all directions in the sphere according to EIRP measurement procedure defined in Annex K.1.3. After a rotation, allow TBD ms for UE to find the best beam to use. The measuring duration is one active uplink subframe. EIRP is calculated considering both polarizations, theta and phi.

5. Calculate a cumulative distribution function for the measured EIRP values.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.2.1.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.2.1.2.5 Test requirement

The defined %-tile EIRP in measurement distribution derived in step 5 shall exceed the values specified in Table 6.2.1.2.5-1 to Table 6.2.1.2.5-4.

Table 6.2.1.2.5-1: UE spherical coverage for power class 1

Operating band	Min EIRP at 85%-tile CDF (dBm)
n257	32.0-TT
n258	32.0-TT
n260	30.0-TT
n261	32.0-TT

Table 6.2.1.2.5-2: UE spherical coverage for power class 2

Operating band	Min EIRP at 60%-tile CDF (dBm)
n257	18.0-TT
n258	18.0-TT
n260	
n261	18.0-TT

Table 6.2.1.2.5-3: UE spherical coverage for power class 3 for single band UE or multiband UE declaring MB_s = 0 in all FR2 bands

Operating band	Min EIRP at 50%-tile CDF (dBm)
n257	11.5-TT
n258	11.5-TT
n260	8-TT
n261	11.5-TT

Table 6.2.1.2.5-3a: UE spherical coverage for power class 3 for multi band UE declaring MB_s>0 in any FR2 band

ID	Supported FR2 bands set	Test requirement (dB) (Note 1)				Maximum sum of MB_s, $\sum MB_s$ (dB) (Note 3)	Comments
		n257	n258	n260	n261		
1	n257, n258	11.5-TT-MB_s	11.5-TT-MB_s			1.25	
2	n257, n260	11.5-TT-MB_s		8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
3	n258, n260		11.5-TT-MB_s	8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
4	n258, n261		11.5-TT-MB_s		11.5-TT-MB_s	1.25	
5	n260, n261			8-TT-MB_s	11.5-TT-MBs	0.75	No relaxation allowed for n260
6	n257, n258, n260	11.5-TT-MB_s	11.5-TT-MB_s	8-TT-MB_s		1.75	Maximum 0.4 dB relaxation allowed for n260
7	n257, n258, n261	11.5-TT-MB_s	11.5-TT-MB_s		11.5-TT-MB_s	1.75	
8	n257, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
9	n258, n260, n261		11.5-TT-MB_s	8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
10	n257, n258, n260, n261	11.5-TT-MB_s	11.5-TT-MB_s	8-TT-MB_s	11.5-TT-MB_s	1.75	Maximum 0.4 dB relaxation allowed for n260
Note 1: MB_s is the Multiband Relaxation factor declared by the UE for the tested band in table A.4.3.9-3 of TS38.508-2. This declaration shall fulfil the requirements in clause 6.2.1.1.3.3. Note 2: All UE supported bands needs to be tested to ensure the multiband relaxation declaration is compliant Note 3: Max allowed sum of MB_s over all supported FR2 bands as defined in clause 6.2.1.1.3.3							

Table 6.2.1.2.5-3b: Test Tolerance (UE spherical coverage for Power class 3)

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	2.58 dB	2.58 dB

Table 6.2.1.2.5-4: UE spherical coverage for power class 4

Operating band	Min EIRP at 20%-tile CDF (dBm)
n257	25
n258	25
n260	19
n261	25

6.2.2 UE maximum output power reduction

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

- Measurement Uncertainties and Test Tolerances are FFS.
- Measurement grid for PC1/2/4 in Annex M.4 is FFS.

6.2.2.0 General

The requirements in section 6.2.2 only apply when both UL and DL of a UE are configured for single CC operation, and they are of the same bandwidth. A UE may reduce its maximum output power due to modulation orders, transmit bandwidth configurations, waveform types and narrow allocations. This Maximum Power Reduction (MPR) is defined in subclauses below. The allowed MPR for SRS, PUCCH formats 0, 1, 3 and 4, and PRACH shall be as specified for QPSK modulated DFT-s-OFDM of equivalent RB allocation. The allowed MPR for PUCCH format 2 shall be as specified for QPSK modulated CP-OFDM of equivalent RB allocation. When the maximum output power of a UE is modified by MPR, the power limits specified in subclause 6.2.4 apply.

For a UE that is configured for single CC operation with different channel bandwidths in UL and DL, the requirements in section 6.2A.2 apply.

For all power classes, the waveform defined by BW = 100 MHz, SCS = 120 kHz, DFT-S-OFDM QPSK, 20RB23 is the reference waveform with 0 dB MPR and is used for the power class definition.

6.2.2.1 Test purpose

The number of RB identified in 6.2.2.3 is based on meeting the requirements for 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 UE release 15 and forward.

6.2.2.3 Minimum conformance requirements

6.2.2.3.1 UE maximum output power reduction for power class 1

For power class 1, MPR for contiguous allocations is defined as:

$$MPR = \max(MPR_{WT}, MPR_{narrow})$$

Where,

MPR_{narrow} = 14.4 dB, when $BW_{alloc,RB} \leq 1.44$ MHz, MPR_{narrow} = 10 dB, when 1.44 MHz < $BW_{alloc,RB} \leq 10.8$ MHz, where $BW_{alloc,RB}$ is the bandwidth of the RB allocation size.

MPR_{WT} is the maximum power reduction due to modulation orders, transmission bandwidth configurations listed in table 5.3.2-1, and waveform types. MPR_{WT} is defined in Tables 6.2.2.3.1-1 and 6.2.2.3.1-2.

Table 6.2.2.3.1-1: MPR_{WT} for power class 1, $BW_{channel} \leq 200$ MHz

Modulation		MPR_{WT} (dB), $BW_{channel} \leq 200$ MHz		
		Outer RB allocations	Inner RB allocations	
			Region 1	Region 2
DFT-s-OFDM	Pi/2 BPSK	≤ 5.5	0.0	≤ 3.0
	QPSK	≤ 6.5	0.0	≤ 3.0
	16 QAM	≤ 6.5	≤ 4.0	≤ 4.0
	64 QAM	≤ 6.5	≤ 5.0	≤ 5.0
CP-OFDM	QPSK	≤ 7.0	≤ 4.5	≤ 4.5
	16 QAM	≤ 7.0	≤ 5.5	≤ 5.5
	64 QAM	≤ 7.5	≤ 7.5	≤ 7.5

6.2.2.3.1-2: MPR_{WT} for power class 1, $BW_{channel}$ = 400 MHz

Modulation		MPR_{WT} (dB), $BW_{channel}$ = 400 MHz		
		Outer RB allocations	Inner RB allocations	
			Region 1	Region 2
DFT-s-OFDM	P/2 BPSK	≤ 5.5	0.0	≤ 3.0
	QPSK	≤ 6.5	0.0	≤ 3.5
	16 QAM	≤ 6.5	≤ 4.5	≤ 4.5
	64 QAM	≤ 6.5	≤ 6.5	≤ 6.5
CP-OFDM	QPSK	≤ 7.0	≤ 5.0	≤ 5.0
	16 QAM	≤ 7.0	≤ 6.5	≤ 6.5
	64 QAM	≤ 9.0	≤ 9.0	≤ 9.0

Where the following parameters are defined to specify valid RB allocation ranges for RB allocations regions in Tables 6.2.2.3.1-1 and 6.2.2.3.1-2:

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

$$RB_{end} = RB_{Start} + L_{CRB} - 1$$

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

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

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

An RB allocation is an Outer RB allocation if

$$RB_{Start} < RB_{Start,Low} \text{ OR } RB_{Start} > RB_{Start,High} \text{ OR } L_{CRB} > \text{Ceil}(N_{RB}/2)$$

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

An RB allocation belonging to table 6.2.2.3.1-1 is a Region 1 inner RB allocation if

$RB_{start} \geq \text{Ceil}(1/3\ N_{RB})$ AND $RB_{end} < \text{Ceil}(2/3\ N_{RB})$

An RB allocation belonging to table 6.2.2.3.1-2 is a Region 1 inner RB allocation if

$$RB_{start} \geq \text{Ceil}(1/4\ N_{RB}) \text{ AND } RB_{end} < \text{Ceil}(3/4\ N_{RB}) \text{ AND } L_{CRB} \leq \text{Ceil}(1/4\ N_{RB})$$

An RB allocation is a Region 2 inner allocation if it is NOT an Outer allocation AND NOT a Region 1 inner allocation.

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 38.101-2 [3] clause 6.2.2.1.

6.2.2.3.2 UE maximum output power reduction for power class 2

For power class 2, MPR specified in subclause 6.2.3.3 applies.

Table 6.2.2.3.2-1: Void

The normative reference for this requirement is TS 38.101-2 [3] clause 6.2.2.2.

6.2.2.3.3 UE maximum output power reduction for power class 3

For power class 3, MPR for contiguous allocations is defined as:

$$MPR = \max(MPR_{WT}, MPR_{narrow})$$

Where,

MPR_{narrow} = 2.5 dB, when $L_{CRB} \leq 1.44$ MHz, and $0 \leq RB_{start} < \text{Ceil}(1/3\ N_{RB})$ or $\text{Ceil}(2/3 N_{RB}) \leq RB_{start} \leq N_{RB}\text{-}L_{CRB}$, where N_{RB} is the maximum transmission bandwidth configuration defined in Table 5.3.2-1.

MPR_{WT} is the maximum power reduction due to modulation orders, transmission bandwidth configurations listed in Table 5.3.2-1, and waveform types. MPR_{WT} is defined in Table 6.2.2.3.3-1 and Table 6.2.2.3.3-2.

Table 6.2.2.3.3-1: MPR_{WT} for power class 3, BWchannel ≤ 200 MHz

Modulation		MPR_{WT}, $BW_{channel}$ ≤ 200 MHz	
		Inner RB allocations, Region 1	Edge RB allocations
DFT-s-OFDM	Pi/2 BPSK	0.0	≤ 2.0
	QPSK	0.0	≤ 2.0
	16QAM	≤ 3.0	≤ 3.5
	64QAM	≤ 5.0	≤ 5.5
CP-OFDM	QPSK	≤ 3.5	≤ 4.0
	16QAM	≤ 5.0	≤ 5.0
	64QAM	≤ 7.5	≤ 7.5

Table 6.2.2.3.3-2: MPR_{WT} for power class 3, $BW_{channel}$ = 400 MHz

Modulation		MPR_{WT}, $BW_{channel}$ = 400 MHz	
		Inner RB allocations, Region 1	**Edge RB allocations**
DFT-s-OFDM	**Pi/2 BPSK**	0.0	≤ 3.0
	QPSK	0.0	≤ 3.0
	16QAM	≤ 4.5	≤ 4.5
	64QAM	≤ 6.5	≤ 6.5
CP-OFDM	**QPSK**	≤ 5.0	≤ 5.0
	16QAM	≤ 6.5	≤ 6.5
	64QAM	≤ 9.0	≤ 9.0

Where the following parameters are defined to specify valid RB allocation ranges for RB allocations in Tables 6.2.2.3.3-1 and 6.2.2.3.3-2:

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

$$RB_{end} = RB_{Start} + L_{CRB} - 1$$

An RB allocation belonging to table 6.2.2.3.3-1 is a Region 1 inner RB allocation if

$$RB_{start} \geq \text{Ceil}(1/3\ N_{RB})\ \text{AND}\ RB_{end} < \text{Ceil}(2/3\ N_{RB})$$

An RB allocation belonging to table 6.2.2.3.3-2 is a Region 1 inner RB allocation if

$$RB_{start} \geq \text{Ceil}(1/4\ N_{RB})\ \text{AND}\ RB_{end} < \text{Ceil}(3/4\ N_{RB})\ \text{AND}\ L_{CRB} \leq \text{Ceil}(1/4\ N_{RB})$$

An RB allocation is an Edge allocation if it is NOT a Region 1 inner allocation.

The normative reference for this requirement is TS 38.101-2 [3] clause 6.2.2.3.

6.2.2.3.4 UE maximum output power reduction for power class 4

For power class 4, MPR specified in sub-clause 6.2.2.3.3 applies.

Table 6.2.2.3.4-1: Void

The normative reference for this requirement is TS 38.101-2 [3] clause 6.2.2.4.

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, 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 subcarrier spacing, are shown in Table 6.2.2.4.1-1 to Table 6.2.2.4.1-9. 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 (Power Class 1, MPR_{narrow})

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1					Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1					Low range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1					Lowest and Highest	
Test SCS as specified in Table 5.3.5-1					120kHz	
Test Parameters						
Test ID	**Freq**	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
				N/A for Maximum Power Reduction (MPR) test case	**Modulation**	**RB allocation (NOTE 1)**
1	Low	Default	Default		CP-OFDM 64 QAM	Outer_1RB_Left
2	High				CP-OFDM 64 QAM	Outer_1RB_Right
3	Low				CP-OFDM 64 QAM	2@0
4	High				CP-OFDM 64 QAM	2@N_{RB}-2
5	Low				CP-OFDM 64 QAM	7@0
6	High				CP-OFDM 64 QAM	7@N_{RB}-7
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-2.						

Table 6.2.2.4.1-2: Test Configuration Table (Power Class 1, MPR_{WT}, BWchannel ≤ 200 MHz)

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1					Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1					Low range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1					Lowest and Highest supported channel bandwidth that ≤ 200 MHz	
Test SCS as specified in Table 5.3.5-1					120kHz	
Test Parameters						
Test ID	**Freq**	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
					Modulation	**RB allocation (NOTE 1)**
1	Low	Default	Default	N/A for Maximum Power Reduction (MPR) test case	DFT-s-OFDM PI/2 BPSK	8@0
2	High				DFT-s-OFDM PI/2 BPSK	8@N_{RB}-8
3	Default				DFT-s-OFDM PI/2 BPSK	Outer_Full
4	Default				DFT-s-OFDM QPSK	Inner_Full
5	Default				DFT-s-OFDM 16 QAM	Inner_Full
6	Low				DFT-s-OFDM 64 QAM	8@0
7	High				DFT-s-OFDM 64 QAM	8@N_{RB}-8
8	Default				DFT-s-OFDM 64 QAM	Outer_Full
9	Default				DFT-s-OFDM 64 QAM	Inner_Full
10	Default				CP-OFDM QPSK	Inner_Full
11	Low				CP-OFDM 16 QAM	8@0
12	High				CP-OFDM 16 QAM	8@N_{RB}-8
13	Default				CP-OFDM 16 QAM	Outer_Full
14	Default				CP-OFDM 16 QAM	Inner_Full
15	Low				CP-OFDM 64 QAM	8@0
16	High				CP-OFDM 64 QAM	8@N_{RB}-8
17	Default				CP-OFDM 64 QAM	Outer_Full
NOTE 1: The specific configuration of each RF allocation is defined in clause 6.1-2.						

Table 6.2.2.4.1-3: Test Configuration Table (Power Class 1, MPR_{WT}, BWchannel = 400 MHz)

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1					Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1					Low range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1					400 MHz	
Test SCS as specified in Table 5.3.5-1					120kHz	
Test Parameters						
Test ID	**Freq**	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
					Modulation	**RB allocation (NOTE 1)**
1	Low	Default	Default	N/A for Maximum Power Reduction (MPR) test case	DFT-s-OFDM PI/2 BPSK	8@0
2	High				DFT-s-OFDM PI/2 BPSK	8@N_{RB}-8
3	Default				DFT-s-OFDM PI/2 BPSK	Outer_Full
4	Default				DFT-s-OFDM PI/2 BPSK	Inner_Full
5	Default				DFT-s-OFDM QPSK	Inner_Full
6	Default				DFT-s-OFDM 16 QAM	Inner_Full
7	Low				DFT-s-OFDM 64 QAM	8@0
8	High				DFT-s-OFDM 64 QAM	8@N_{RB}-8
9	Default				DFT-s-OFDM 64 QAM	Outer_Full
10	Default				CP-OFDM QPSK	Inner_Full
11	Low				CP-OFDM 16 QAM	8@0
12	High				CP-OFDM 16 QAM	8@N_{RB}-8
13	Default				CP-OFDM 16 QAM	Outer_Full
14	Default				CP-OFDM 16 QAM	Inner_Full
15	Low				CP-OFDM 64 QAM	8@0
16	High				CP-OFDM 64 QAM	8@N_{RB}-8
17	Default				CP-OFDM 64 QAM	Outer_Full
NOTE 1: The specific configuration of each RF allocation is defined in clause 6.1-2.						

Table 6.2.2.4.1-4: Void

Table 6.2.2.4.1-5: Void

Table 6.2.2.4.1-6: Void

Table 6.2.2.4.1-7: Test Configuration Table (Power Class 2, 3 and 4, $MPR_{narrow,}$ BWchannel ≤ 200 MHz)

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1					Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1					Low range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1					Lowest and Highes supported channel bandwidth that ≤ 200 MHz t	
Test SCS as specified in Table 5.3.5-1					120kHz	
Test Parameters						
Test ID	**Freq**	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
					Modulation	**RB allocation (NOTE 1)**
1	Low	Default	Default	N/A for Maximum Power Reduction (MPR) test case	DFT-s-OFDM QPSK	Outer_1RB_Left
2	High				DFT-s-OFDM QPSK	Outer_1RB_Right
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.						

Table 6.2.2.4.1-8: Test Configuration Table (Power Class 2, 3 and 4, MPR_{WT}, BWchannel ≤ 200 MHz)

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1					Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1					Low range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1					Lowest and Highest supported channel bandwidth that ≤ 200 MHz	
Test SCS as specified in Table 5.3.5-1					120kHz	
Test Parameters						
Test ID	**Freq**	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
					Modulation	**RB allocation (NOTE 1)**
1	Default	Default	Default	N/A for Maximum Power Reduction (MPR) test case	DFT-s-OFDM QPSK	Outer_Full
2	Default				DFT-s-OFDM 16 QAM	Inner_Full
3	Low				DFT-s-OFDM 16 QAM	Outer_1RB_Left
4	High				DFT-s-OFDM 16 QAM	Outer_1RB_Right
5	Default				DFT-s-OFDM 16 QAM	Outer_Full
6	Default				DFT-s-OFDM 64 QAM	Inner_Full
7	Low				DFT-s-OFDM 64 QAM	Outer_1RB_Left
8	High				DFT-s-OFDM 64 QAM	Outer_1RB_Right
9	Default				DFT-s-OFDM 64 QAM	Outer_Full
10	Default				CP-OFDM QPSK	Inner_Full
11	Low				CP-OFDM QPSK	Outer_1RB_Left
12	High				CP-OFDM QPSK	Outer_1RB_Right
13	Default				CP-OFDM QPSK	Outer_Full
14	Low				CP-OFDM 16 QAM	Outer_1RB_Left
15	High				CP-OFDM 16 QAM	Outer_1RB_Right
16	Default				CP-OFDM 16 QAM	Outer_Full
17	Low				CP-OFDM 64 QAM	Outer_1RB_Left
18	High				CP-OFDM 64 QAM	Outer_1RB_Right
19	Default				CP-OFDM 64 QAM	Outer_Full
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.						

Table 6.2.2.4.1-9: Test Configuration Table (Power Class 2, 3 and 4, MPR_{WT}, BWchannel = 400 MHz)

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1				Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1				Low range, High range		
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1				400 MHz		
Test SCS as specified in Table 5.3.5-1				120kHz		
Test Parameters						
Test ID	**Freq**	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
					Modulation	**RB allocation (NOTE 1)**
1	Low	Default	Default	N/A for Maximum Power Reduction (MPR) test case	DFT-s-OFDM QPSK	Outer_1RB_Left
2	High				DFT-s-OFDM QPSK	Outer_1RB_Right
3	Default				DFT-s-OFDM QPSK	Outer_Full
4	Low				DFT-s-OFDM 16 QAM	Outer_1RB_Left
5	High				DFT-s-OFDM 16 QAM	Outer_1RB_Right
6	Default				DFT-s-OFDM 16 QAM	Outer_Full
7	Low				DFT-s-OFDM 64 QAM	Outer_1RB_Left
8	High				DFT-s-OFDM 64 QAM	Outer_1RB_Right
9	Default				DFT-s-OFDM 64 QAM	Outer_Full
10	Low				CP-OFDM QPSK	Outer_1RB_Left
11	High				CP-OFDM QPSK	Outer_1RB_Right
12	Default				CP-OFDM QPSK	Outer_Full
13	Low				CP-OFDM 16 QAM	Outer_1RB_Left
14	High				CP-OFDM 16 QAM	Outer_1RB_Right
15	Default				CP-OFDM 16 QAM	Outer_Full
16	Low				CP-OFDM 64 QAM	Outer_1RB_Left
17	High				CP-OFDM 64 QAM	Outer_1RB_Right
18	Default				CP-OFDM 64 QAM	Outer_Full
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.						

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

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

4. The UL Reference Measurement channels are set according to Table 6.2.2.4.1-1 to Table 6.2.2.4.1-9.

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

6. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On*, Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [10] clause 4.5. Message contents are defined in clause 6.2.2.4.3.

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 to Table 6.2.2.4.1-9. 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 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. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.

4. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

5. Measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in 6.2.2.5. EIRP test procedure is defined in Annex K.1.3. The measuring duration is one active uplink subframe. EIRP is calculated considering both polarizations, theta and phi.

6. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

NOTE 2: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.2.2.4.1-1 to Table 6.2.2.4.1-9, send an NR RRCReconfiguration message according to TS 38.508-1 [10] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

6.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.2.2.5 Test requirement

The maximum output power, derived in step 5 shall be within the range prescribed by the nominal maximum output power and tolerance in following tables.

Table 6.2.2.5-1: UE Power Class test requirements for Power Class 1 (for Bands n257, n258, n261)

Test Configuration Table	Test ID	$P_{Powerclass}$	$MPR_{f,c}$	$T(MPR_{f,c})$	Lower limit (dBm)	Upper limit (dBm)
Table 6.2.2.4.1-1	1	40	14.4	7	18.6-TT	55
	2	40	14.4	7	18.6-TT	55
	3	40	10	5	25-TT	55
	4	40	10	5	25-TT	55
	5	40	10	5	25-TT	55
	6	40	10	5	25-TT	55
Table 6.2.2.4.1-2	1	40	5.5	5	29.5-TT	55
	2	40	5.5	5	29.5-TT	55
	3	40	5.5	5	29.5-TT	55
	4	40	3	2	35-TT	55
	5	40	4	3	33-TT	55
	6	40	6.5	5	28.5-TT	55
	7	40	6.5	5	28.5-TT	55
	8	40	6.5	5	28.5-TT	55
	9	40	5	4	31-TT	55
	10	40	4.5	4	31.5-TT	55
	11	40	7	5	28-TT	55
	12	40	7	5	28-TT	55
	13	40	7	5	28-TT	55
	14	40	5.5	5	29.5-TT	55
	15	40	7.5	5	27.5-TT	55
	16	40	7.5	5	27.5-TT	55
	17	40	7.5	5	27.5-TT	55
Table 6.2.2.4.1-3	1	40	5.5	5	29.5-TT	55
	2	40	5.5	5	29.5-TT	55
	3	40	5.5	5	29.5-TT	55
	4	40	3	2	35-TT	55
	5	40	3.5	3	33.5-TT	55
	6	40	4.5	4	31.5-TT	55
	7	40	6.5	5	28.5-TT	55
	8	40	6.5	5	28.5-TT	55
	9	40	6.5	5	28.5-TT	55
	10	40	5	4	31-TT	55
	11	40	7	5	28-TT	55
	12	40	7	5	28-TT	55
	13	40	7	5	28-TT	55
	14	40	6.5	5	28.5-TT	55
	15	40	9	5	26-TT	55
	16	40	9	5	26-TT	55
	17	40	9	5	26-TT	55

Table 6.2.2.5-1a: UE Power Class test requirements for Power Class 1 (for Bands n260)

Test Configuration Table	Test ID	$P_{Powerclass}$	$MPR_{f,c}$	$T(MPR_{f,c})$	Lower limit (dBm)	Upper limit (dBm)
Table 6.2.2.4.1-1	1	38	14.4	7	16.6-TT	55
	2	38	14.4	7	16.6-TT	55
	3	38	10	5	23-TT	55
	4	38	10	5	23-TT	55
	5	38	10	5	23-TT	55
	6	38	10	5	23-TT	55
Table 6.2.2.4.1-2	1	38	5.5	5	27.5-TT	55
	2	38	5.5	5	27.5-TT	55
	3	38	5.5	5	27.5-TT	55
	4	38	3	2	33-TT	55
	5	38	4	3	31-TT	55
	6	38	6.5	5	26.5-TT	55
	7	38	6.5	5	26.5-TT	55
	8	38	6.5	5	26.5-TT	55
	9	38	5	4	29-TT	55
	10	38	4.5	4	29.5-TT	55
	11	38	7	5	26-TT	55
	12	38	7	5	26-TT	55
	13	38	7	5	26-TT	55
	14	38	5.5	5	27.5-TT	55
	15	38	7.5	5	25.5-TT	55
	16	38	7.5	5	25.5-TT	55
	17	38	7.5	5	25.5-TT	55
Table 6.2.2.4.1-3	1	38	5.5	5	27.5-TT	55
	2	38	5.5	5	27.5-TT	55
	3	38	5.5	5	27.5-TT	55
	4	38	3	2	33-TT	55
	5	38	3.5	3	31.5-TT	55
	6	38	4.5	4	29.5-TT	55
	7	38	6.5	5	26.5-TT	55
	8	38	6.5	5	26.5-TT	55
	9	38	6.5	5	26.5-TT	55
	10	38	5	4	29-TT	55
	11	38	7	5	26-TT	55
	12	38	7	5	26-TT	55
	13	38	7	5	26-TT	55
	14	38	6.5	5	26.5-TT	55
	15	38	9	5	24-TT	55
	16	38	9	5	24-TT	55
	17	38	9	5	24-TT	55

Table 6.2.2.5-2: UE Power Class test requirements for Power Class 2

Test Configuration Table	Test ID	$P_{Powerclass}$	$MPR_{f,c}$	$T(MPR_{f,c})$	Lower limit (dBm)	Upper limit (dBm)
Table 6.2.2.4.1-7	1	29	2.5	2	24.5-TT	43
	2	29	2.5	2	24.5-TT	43
Table 6.2.2.4.1-8	1	29	2	1.5	25.5-TT	43
	2	29	3	2	24-TT	43
	3	29	3.5	3	22.5-TT	43
	4	29	3.5	3	22.5-TT	43
	5	29	3.5	3	22.5-TT	43
	6	29	5	4	20-TT	43
	7	29	5.5	5	18.5-TT	43
	8	29	5.5	5	18.5-TT	43
	9	29	5.5	5	18.5-TT	43
	10	29	3.5	3	22.5-TT	43
	11	29	4	3	22-TT	43
	12	29	4	3	22-TT	43
	13	29	4	3	22-TT	43
	14	29	5	4	20-TT	43
	15	29	5	4	20-TT	43
	16	29	5	4	20-TT	43
	17	29	7	5	17-TT	43
	18	29	7	5	17-TT	43
	19	29	7	5	17-TT	43
Table 6.2.2.4.1-9	1	29	3	2	24-TT	43
	2	29	3	2	24-TT	43
	3	29	3	2	24-TT	43
	4	29	4.5	4	20.5-TT	43
	5	29	4.5	4	20.5-TT	43
	6	29	4.5	4	20.5-TT	43
	7	29	6.5	5	17.5-TT	43
	8	29	6.5	5	17.5-TT	43
	9	29	6.5	5	17.5-TT	43
	10	29	5	4	20-TT	43
	11	29	5	4	20-TT	43
	12	29	5	4	20-TT	43
	13	29	6.5	5	17.5-TT	43
	14	29	6.5	5	17.5-TT	43
	15	29	6.5	5	17.5-TT	43
	16	29	9	5	15-TT	43
	17	29	9	5	15-TT	43
	18	29	9	5	15-TT	43

Table 6.2.2.5-3: UE Power Class test requirements for Power Class 3 (n257, 258, 261)

Test Configuration Table	Test ID	$P_{Powerclass}$	$MPR_{f,c}$	$T(MPR_{f,c})$	Lower limit (dBm)	Upper limit (dBm)
Table 6.2.2.4.1-7	1	22.4	2.5	2	17.9-TT-$\Delta MB_{P,n}$	43
	2	22.4	2.5	2	17.9-TT-$\Delta MB_{P,n}$	43
Table 6.2.2.4.1-8	1	22.4	2	1.5	18.9-TT-$\Delta MB_{P,n}$	43
	2	22.4	3	2	17.4-TT-$\Delta MB_{P,n}$	43
	3	22.4	3.5	3	15.9-TT-$\Delta MB_{P,n}$	43
	4	22.4	3.5	3	15.9-TT-$\Delta MB_{P,n}$	43
	5	22.4	3.5	3	15.9-TT-$\Delta MB_{P,n}$	43
	6	22.4	5	4	13.4-TT-$\Delta MB_{P,n}$	43
	7	22.4	5.5	5	11.9-TT-$\Delta MB_{P,n}$	43
	8	22.4	5.5	5	11.9-TT-$\Delta MB_{P,n}$	43
	9	22.4	5.5	5	11.9-TT-$\Delta MB_{P,n}$	43
	10	22.4	3.5	3	15.9-TT-$\Delta MB_{P,n}$	43
	11	22.4	4	3	15.4-TT-$\Delta MB_{P,n}$	43
	12	22.4	4	3	15.4-TT-$\Delta MB_{P,n}$	43
	13	22.4	4	3	15.4-TT-$\Delta MB_{P,n}$	43
	14	22.4	5	4	13.4-TT-$\Delta MB_{P,n}$	43
	15	22.4	5	4	13.4-TT-$\Delta MB_{P,n}$	43
	16	22.4	5	4	13.4-TT-$\Delta MB_{P,n}$	43
	17	22.4	7	5	10.4-TT-$\Delta MB_{P,n}$	43
	18	22.4	7	5	10.4-TT-$\Delta MB_{P,n}$	43
	19	22.4	7	5	10.4-TT-$\Delta MB_{P,n}$	43
Table 6.2.2.4.1-9	1	22.4	3	2	17.4-TT-$\Delta MB_{P,n}$	43
	2	22.4	3	2	17.4-TT-$\Delta MB_{P,n}$	43
	3	22.4	3	2	17.4-TT-$\Delta MB_{P,n}$	43
	4	22.4	4.5	4	13.9-TT-$\Delta MB_{P,n}$	43
	5	22.4	4.5	4	13.9-TT-$\Delta MB_{P,n}$	43
	6	22.4	4.5	4	13.9-TT-$\Delta MB_{P,n}$	43
	7	22.4	6.5	5	10.9-TT-$\Delta MB_{P,n}$	43
	8	22.4	6.5	5	10.9-TT-$\Delta MB_{P,n}$	43
	9	22.4	6.5	5	10.9-TT-$\Delta MB_{P,n}$	43
	10	22.4	5	4	13.4-TT-$\Delta MB_{P,n}$	43
	11	22.4	5	4	13.4-TT-$\Delta MB_{P,n}$	43
	12	22.4	5	4	13.4-TT-$\Delta MB_{P,n}$	43
	13	22.4	6.5	5	10.9-TT-$\Delta MB_{P,n}$	43
	14	22.4	6.5	5	10.9-TT-$\Delta MB_{P,n}$	43
	15	22.4	6.5	5	10.9-TT-$\Delta MB_{P,n}$	43
	16	22.4	9	5	8.4-TT-$\Delta MB_{P,n}$	43
	17	22.4	9	5	8.4-TT-$\Delta MB_{P,n}$	43
	18	22.4	9	5	8.4-TT-$\Delta MB_{P,n}$	43

Note 1: $\Delta MB_{P,n}$ is the Multiband Relaxation factor declared by the UE for the tested band in table A.4.3.9-2 of TS38.508-2. This declaration shall fulfil the requirements in clause 6.2.1.1.3.3.
Note 2: All UE supported bands needs to be tested to ensure the multiband relaxation declaration is compliant.
Note 3: Max allowed sum of $\Delta MB_{P,n}$ over all supported FR2 bands as defined in clause 6.2.1.1.3.3.
Note 4: $\Delta MB_{P,n}$ is 0 for single band UE.

Table 6.2.2.5-3a: UE Power Class test requirements for Power Class 3 (n260)

Test Configuration Table	Test ID	$P_{Powerclass}$	$MPR_{f,c}$	$T(MPR_{f,c})$	Lower limit (dBm)	Upper limit (dBm)
Table 6.2.2.4.1-7	1	20.6	2.5	2	16.1-TT-$\Delta MB_{P,n}$	43
	2	20.6	2.5	2	16.1-TT-$\Delta MB_{P,n}$	43
Table 6.2.2.4.1-8	1	20.6	2	1.5	17.1-TT-$\Delta MB_{P,n}$	43
	2	20.6	3	2	15.6-TT-$\Delta MB_{P,n}$	43
	3	20.6	3.5	3	14.1-TT-$\Delta MB_{P,n}$	43
	4	20.6	3.5	3	14.1-TT-$\Delta MB_{P,n}$	43
	5	20.6	3.5	3	14.1-TT-$\Delta MB_{P,n}$	43
	6	20.6	5	4	11.6-TT-$\Delta MB_{P,n}$	43
	7	20.6	5.5	5	10.1-TT-$\Delta MB_{P,n}$	43
	8	20.6	5.5	5	10.1-TT-$\Delta MB_{P,n}$	43
	9	20.6	5.5	5	10.1-TT-$\Delta MB_{P,n}$	43
	10	20.6	3.5	3	14.1-TT-$\Delta MB_{P,n}$	43
	11	20.6	4	3	13.6-TT-$\Delta MB_{P,n}$	43
	12	20.6	4	3	13.6-TT-$\Delta MB_{P,n}$	43
	13	20.6	4	3	13.6-TT-$\Delta MB_{P,n}$	43
	14	20.6	5	4	11.6-TT-$\Delta MB_{P,n}$	43
	15	20.6	5	4	11.6-TT-$\Delta MB_{P,n}$	43
	16	20.6	5	4	11.6-TT-$\Delta MB_{P,n}$	43
	17	20.6	7	5	8.6-TT-$\Delta MB_{P,n}$	43
	18	20.6	7	5	8.6-TT-$\Delta MB_{P,n}$	43
	19	20.6	7	5	8.6-TT-$\Delta MB_{P,n}$	43
Table 6.2.2.4.1-9	1	20.6	3	2	15.6-TT-$\Delta MB_{P,n}$	43
	2	20.6	3	2	15.6-TT-$\Delta MB_{P,n}$	43
	3	20.6	3	2	15.6-TT-$\Delta MB_{P,n}$	43
	4	20.6	4.5	4	12.1-TT-$\Delta MB_{P,n}$	43
	5	20.6	4.5	4	12.1-TT-$\Delta MB_{P,n}$	43
	6	20.6	4.5	4	12.1-TT-$\Delta MB_{P,n}$	43
	7	20.6	6.5	5	9.1-TT-$\Delta MB_{P,n}$	43
	8	20.6	6.5	5	9.1-TT-$\Delta MB_{P,n}$	43
	9	20.6	6.5	5	9.1-TT-$\Delta MB_{P,n}$	43
	10	20.6	5	4	11.6-TT-$\Delta MB_{P,n}$	43
	11	20.6	5	4	11.6-TT-$\Delta MB_{P,n}$	43
	12	20.6	5	4	11.6-TT-$\Delta MB_{P,n}$	43
	13	20.6	6.5	5	9.1-TT-$\Delta MB_{P,n}$	43
	14	20.6	6.5	5	9.1-TT-$\Delta MB_{P,n}$	43
	15	20.6	6.5	5	9.1-TT-$\Delta MB_{P,n}$	43
	16	20.6	9	5	6.6-TT-$\Delta MB_{P,n}$	43
	17	20.6	9	5	6.6-TT-$\Delta MB_{P,n}$	43
	18	20.6	9	5	6.6-TT-$\Delta MB_{P,n}$	43

Note 1: $\Delta MB_{P,n}$ is the Multiband Relaxation factor declared by the UE for the tested band in table A.4.3.9-2 of TS38.508-2. This declaration shall fulfil the requirements in clause 6.2.1.1.3.3.
Note 2: All UE supported bands needs to be tested to ensure the multiband relaxation declaration is compliant.
Note 3: Max allowed sum of $\Delta MB_{P,n}$ over all supported FR2 bands as defined in clause 6.2.1.1.3.3.
Note 4: $\Delta MB_{P,n}$ is 0 for single band UE.

Table 6.2.2.5-4: UE Power Class test requirements for Power Class 4 (n257, 258, 261)

Test Configuration Table	Test ID	$P_{Powerclass}$	$MPR_{f,c}$	$T(MPR_{f,c})$	Lower limit (dBm)	Upper limit (dBm)
Table 6.2.2.4.1-7	1	34	2.5	2	29.5-TT	43
	2	34	2.5	2	29.5-TT	43
Table 6.2.2.4.1-8	1	34	2	1.5	30.5-TT	43
	2	34	3	2	29-TT	43
	3	34	3.5	3	27.5-TT	43
	4	34	3.5	3	27.5-TT	43
	5	34	3.5	3	27.5-TT	43
	6	34	5	4	25-TT	43
	7	34	5.5	5	23.5-TT	43
	8	34	5.5	5	23.5-TT	43
	9	34	5.5	5	23.5-TT	43
	10	34	3.5	3	27.5-TT	43
	11	34	4	3	27-TT	43
	12	34	4	3	27-TT	43
	13	34	4	3	27-TT	43
	14	34	5	4	25-TT	43
	15	34	5	4	25-TT	43
	16	34	5	4	25-TT	43
	17	34	7	5	22-TT	43
	18	34	7	5	22-TT	43
	19	34	7	5	22-TT	43
Table 6.2.2.4.1-9	1	34	3	2	29-TT	43
	2	34	3	2	29-TT	43
	3	34	3	2	29-TT	43
	4	34	4.5	4	25.5-TT	43
	5	34	4.5	4	25.5-TT	43
	6	34	4.5	4	25.5-TT	43
	7	34	6.5	5	22.5-TT	43
	8	34	6.5	5	22.5-TT	43
	9	34	6.5	5	22.5-TT	43
	10	34	5	4	25-TT	43
	11	34	5	4	25-TT	43
	12	34	5	4	25-TT	43
	13	34	6.5	5	22.5-TT	43
	14	34	6.5	5	22.5-TT	43
	15	34	6.5	5	22.5-TT	43
	16	34	9	5	20-TT	43
	17	34	9	5	20-TT	43
	18	34	9	5	20-TT	43

Table 6.2.2.5-4a: UE Power Class test requirements for Power Class 4 (n260)

Test Configuration Table	Test ID	$P_{Powerclass}$	$MPR_{f,c}$	$T(MPR_{f,c})$	Lower limit (dBm)	Upper limit (dBm)
Table 6.2.2.4.1-7	1	31	2.5	2	26.5-TT	43
	2	31	2.5	2	26.5-TT	43
Table 6.2.2.4.1-8	1	31	2	1.5	27.5-TT	43
	2	31	3	2	26-TT	43
	3	31	3.5	3	24.5-TT	43
	4	31	3.5	3	24.5-TT	43
	5	31	3.5	3	24.5-TT	43
	6	31	5	4	22-TT	43
	7	31	5.5	5	20.5-TT	43
	8	31	5.5	5	20.5-TT	43
	9	31	5.5	5	20.5-TT	43
	10	31	3.5	3	24.5-TT	43
	11	31	4	3	24-TT	43
	12	31	4	3	24-TT	43
	13	31	4	3	24-TT	43
	14	31	5	4	22-TT	43
	15	31	5	4	22-TT	43
	16	31	5	4	22-TT	43
	17	31	7	5	19-TT	43
	18	31	7	5	19-TT	43
	19	31	7	5	19-TT	43
Table 6.2.2.4.1-9	1	31	3	2	26-TT	43
	2	31	3	2	26-TT	43
	3	31	3	2	26-TT	43
	4	31	4.5	4	22.5-TT	43
	5	31	4.5	4	22.5-TT	43
	6	31	4.5	4	22.5-TT	43
	7	31	6.5	5	19.5-TT	43
	8	31	6.5	5	19.5-TT	43
	9	31	6.5	5	19.5-TT	43
	10	31	5	4	22-TT	43
	11	31	5	4	22-TT	43
	12	31	5	4	22-TT	43
	13	31	6.5	5	19.5-TT	43
	14	31	6.5	5	19.5-TT	43
	15	31	6.5	5	19.5-TT	43
	16	31	9	5	17-TT	43
	17	31	9	5	17-TT	43
	18	31	9	5	17-TT	43

6.2.3 UE maximum output power with additional requirements

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

- Measurement Uncertainties and Test Tolerances are FFS.

- - No test points are defined since there is no configuration where A-MPR is bigger than MPR
- Multiband relaxation is not considered in test requirements

6.2.3.1 Test purpose

Additional spectrum emission requirements can be signalled by the network to indicate that the UE shall also meet additional requirements in a specific deployment scenario. To meet these additional requirements, Additional Maximum Power Reduction A-MPR is allowed for the output power.

6.2.3.2 Test applicability

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

NOTE: This test case can't be performed due to lack of appropriate test points.

6.2.3.3 Minimum conformance requirements

6.2.3.3.1 General

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 field freqBandIndicatorNR) and an associated value of additionalSpectrumEmission in the relevant RRC information elements

To meet these additional requirements, additional maximum power reduction (A-MPR) is allowed for the maximum output power as specified in subclause 6.2.1.1.3. Unless stated otherwise, an A-MPR of 0 dB shall be used.

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. The mapping of NR frequency band numbers and values of and the *additionalSpectrumEmission* to network signalling labels is specified in Table 6.2.3.3.1-2. Unless otherwise stated, the allowed total back off is maximum of A-MPR and MPR specified in subclause 6.2.2.

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

Network Signalling value	Requirements (subclause)	NR Band	Channel bandwidth (MHz)	Resources Blocks (N_{RB})	A-MPR (dB)
NS_200					N/A
NS_201	6.5.3.2.2	n258			6.2.3.2

Table 6.2.3.3.1-2: Mapping of Network Signalling label

NR Band	Value of additionalSpectrumEmission / NS number							
	0	1	2	3	4	5	6	7
n257	NS_200							
n258	NS_200	NS_201						
n260	NS_200							
n261	NS_200							
NOTE: additionalSpectrumEmission corresponds to an information element of the same name defined in sub-clause 6.3.2 of TS 38.331 [19].								

The normative reference for this requirement is TS 38.101-2 [3] clause 6.2.3.1.

6.2.3.3.2 A-MPR for NS_201

6.2.3.3.2.1 A-MPR for NS_201 for power class 1

Table 6.2.3.3.2.1-1: AMPR for NS_201 for power class 1

Offset Frequency	Channel Bandwidth, MHz		
	50, 100, 200	400	
	Outer	Outer	Inner
0 MHz	3.0	5.0	3.5
>100 MHz, <=300 MHz	1.5	2.5	3.5
>300 MHz	0	0	0
NOTE 1: The Offset frequency is defined as the frequency from the lower band edge to the lower channel edge. NOTE 2: The back off applied is the max(MPR, AMPR), where the MPR is defined in [Table 6.2.2.1-1] NOTE 3: Any undefined region, MPR applies			

6.2.3.3.2.2 A-MPR for NS_201 for power class 2

For power class 2, A-MPR specified in subclause 6.2.3.3.2.3 applies

6.2.3.3.2.3 A-MPR for NS_201 for power class 3

Table 6.2.3.3.2.3-1: AMPR for NS_201 for power class 3

Offset Frequency	Channel Bandwidth, MHz
	400
	Outer RB allocations
0 MHz	≤ 1.5
> 100 MHz, ≤ 300 MHz	0
> 300 MHz	0
NOTE 1: The Offset frequency is defined as the frequency from the lower band edge to the lower channel edge. NOTE 2: The back off applied is the max(MPR, AMPR), where the MPR is defined in Table 6.2.2.3.3-1 NOTE 3: Any undefined region, MPR applies	

The normative reference for this requirement is TS 38.101-2 [3] clause 6.2.3.2.

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 Subscriber Station (SS) to take with the UE to reach the correct measurement state.

Table 6.2.3.4.1-1: Test configuration table for NS_201

FFS

Note: No test points are defined since there is no configuration where A-MPR is bigger than MPR

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.1.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

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

4. The DL and UL Reference Measurement channels are set according to Table 6.2.3.4.1-1.
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 [10] 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 Table 6.2.1.1.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Messages to configure the appropriate uplink modulation in section 6.2.1.1.4.3.
2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 msec starting from the first TPC command in this step to ensure that the UE transmits at its maximum output power.
3. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K. Allow at least BEAM_SELECT_WAIT_TIME (Note 1) for the UE Tx beam selection to complete.
4. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.
5. Measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3.1.5-1. EIRP test procedure is defined in Annex K. The measuring duration is one active uplink subframe. EIRP is calculated considering both polarizations, theta and phi.
6. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6, with the following exceptions for each network signalled value.

1. Information element AdditionalSpectrumEmission for NR can be set in SIB1 according to TS 38.331[19]. 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: *AdditionalSpectrumEmission: A*dditional spurious emissions test requirement

Derivation Path: TS 38.508-1 [10] clause 4.6.3, Table 4.6.3-1			
Information Element	**Value/remark**	**Comment**	**Condition**
AdditionalSpectrumEmission	1 (NS_201)	for band n258	

6.2.3.5 Test requirement

The UE EIRP derived in step 5 shall not exceed the values specified in Table 6.2.3.5-1.

Table 6.2.3.5-1: UE Power Class 1 test requirements (network signalled value "NS_201")

Note: No test points are defined since there is no configuration where A-MPR is bigger than MPR

Table 6.2.3.5-2: UE Power Class 2 and 3 test requirements (network signalled value "NS_201")

Note: No test points are defined since there is no configuration where A-MPR is bigger than MPR

6.2.4 Configured transmitted power

6.2.4.1 Test purpose

To verify the UE transmitted power $P_{UMAX,f,c}$ is within the range defined prescribed by the specified nominal maximum output power and tolerance.

6.2.4.2 Test applicability

The requirements of this test are covered in test cases 6.2.1 Maximum output power, 6.2.2 Maximum output power reduction and 6.2.3 UE maximum output power with additional requirements to all types of NR UE release 15 and forward.

6.2.4.3 Minimum conformance requirements

The UE can configure its maximum output power. The configured UE maximum output power $P_{CMAX,f,c}$ for carrier f of a serving cell c is defined as that available to the reference point of a given transmitter branch that corresponds to the reference point of the higher-layer filtered RSRP measurement as specified in TS 38.215 [24].

The configured UE maximum output power $P_{CMAX,f,c}$ for carrier *f* of a serving cell *c* shall be set such that the corresponding measured peak EIRP $P_{UMAX,f,c}$ is within the following bounds

$P_{Powerclass}$ – MAX(MAX($MPR_{f,c}$, A- $MPR_{f,c}$,) + $\Delta MB_{P,n}$, P-$MPR_{f,c}$) – MAX{T(MAX($MPR_{f,c}$, A- $MPR_{f,c}$,)), T(P-$MPR_{f,c}$)} ≤ $P_{UMAX,f,c}$ ≤ $EIRP_{max}$

while the corresponding measured total radiated power $P_{TMAX,f,c}$ is bounded by

$$P_{TMAX,f,c} \leq TRP_{max}$$

with $P_{Powerclass}$ the UE power class as specified in sub-clause 6.2.1.1.3, $EIRP_{max}$ the applicable maximum EIRP as specified in sub-clause 6.2.1.1.3, $MPR_{f,c}$ as specified in sub-clause 6.2.2.3, A-$MPR_{f,c}$ as specified in sub-clause 6.2.3.3, $\Delta MB_{P,n}$ the peak EIRP relaxation as specified in section 6.2.1.1.3 and TRP_{max} the maximum TRP for the UE power class as specified in sub-clause 6.2.1.1.3.

maxUplinkDutyCycle-FR2 as defined in TS 38.306 [14] is the UEcapability to facilitate to electromagnetic power density exposure requirements.

If the field of UE capability *maxUplinkDutyCycle-FR2* is present and the percentage of uplink symbols transmitted within any 1 s evaluation period is larger than maxUplinkDutyCycle-FR2, the UE follows the uplink scheduling and can apply P-$MPR_{f,c}$.

If the field of UE capability *maxUplinkDutyCycle-FR2* is absent, the compliance to electromagnetic power density exposure requirements are ensured by means of scaling down the power density or by other means.

P-$MPR_{f,c}$ is the allowed maximum output power reduction. The UE shall apply P-$MPR_{f,c}$ for carrier f of serving cell c only for the cases described below. For UE conformance testing P-$MPR_{f,c}$ shall be 0 dB.

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

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

NOTE 2: P-$MPR_{f,c}$ and *maxUplinkDutyCycle-FR2* may impact the maximum uplink performance for the selected UL transmission path.

The tolerance T(ΔP) for applicable values of ΔP (values in dB) is specified in Table 6.2.4.3-1.

Table 6.2.4.3-1: $P_{UMAX,f,c}$ tolerance

Operating Band	ΔP (dB)	Tolerance T(ΔP) (dB)
n257, n258, n260, n261	ΔP = 0	0
	0 < ΔP ≤ 2	[1.5]
	2 < ΔP ≤ 3	[2.0]
	3 < ΔP ≤ 4	[3.0]
	4 < ΔP ≤ 5	[4.0]
	5 < ΔP ≤ 10	[5.0]
	10 < ΔP ≤ 15	[7.0]
	15 < ΔP ≤ X	[8.0]
NOTE: X is the value such that $P_{umax,f,c}$ lower bound, $P_{Powerclass}$ - ΔP – T(ΔP) = minimum output power specified in subclause 6.3.1		

6.2.4.4 Test description

This test is covered by clause 6.2.1 Maximum output power, 6.2.2 Maximum output power reduction and 6.2.3 UE maximum output power with additional requirements.

6.2.4.5 Test requirements

This test is covered by clause 6.2.1 Maximum output power, 6.2.2 Maximum output power reduction and 6.2.3 UE maximum output power with additional requirements.

6.2A Transmit power for CA

6.2A.1 UE maximum output power for CA

6.2A.1.0 Minimum conformance requirements

For downlink intra-band contiguous and non-contiguous carrier aggregation with a single uplink component carrier configured in the NR band, the maximum output power is specified in subclause 6.2.1.1.3.

For uplink intra-band contiguous carrier aggregation for any CA bandwidth class, the maximum output power is specified in subclause 6.2.1.1.3.

Power class 3 is default power class.

6.2A.1.1 UE maximum output power - EIRP and TRP for CA

6.2A.1.1.1 UE maximum output power - EIRP and TRP for CA (2UL CA)

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

- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances are FFS for power class 1, 2 and 4.
- Test Procedures for EIRP beam peak Extreme Conditions are FFS.

6.2A.1.1.1.1 Test purpose

To verify that the power of any UE emission shall not exceed specified lever for the specified channel bandwidth for CA under the deployment scenarios where additional requirements are specified.

6.2A.1.1.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 2UL CA.

6.2A.1.1.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause6.2A.1.0.

6.2A.1.1.1.4 Test description

6.2A.1.1.1.4.1 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, and channel bandwidths based on NR operating bands specified in table5.5A.1-1, 5.5A.2-1 and 5.5A.2-2. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and subcarrier spacing, are shown in table 6.2A.1.1.1.4.1-1. 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.1.1.1.4.1-1: Intra-band Contiguous CA Test Configuration Table

Default Conditions					
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal, TL/VL, TL/VH, TH/VL, TH/VH (NOTE 2)		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes			Low and High range		
Test CC Combination setting (aggregated BW of the CA configuration) as specified in Table 5.5A.1-1 for the CA Configuration across bandwidth combination sets supported by the UE			Highest aggregated BW of the CA configuration		
Test SCS as specified in Table 5.3.5-1			120 kHz		
Test Parameters					
CA Configuration / Aggregated BW			**Downlink Configuration**	**Uplink Configuration**	
Test ID	**CC & Mapping (NOTE 4)**	**CBW (MHz)**	**RB allocation**	**Modulation**	**RB allocation (NOTE 1)**
1	PCC/CC1	100	N/A for this test	DFT-s-OFDM QPSK	Inner Full
	SCC/CC2	100		-	-
2	PCC/CC1	200		DFT-s-OFDM QPSK	Inner Full
	SCC/CC2	200		-	-
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1. NOTE 2: Test environment for UE Max TRP is normal only. NOTE 3: CA Configuration Test cumulative aggregated BW settings are checked separately for each CA Configuration, which applicable aggregated channel bandwidths are specified in Table 5.5A.1-1. NOTE 4: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10].					

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.2 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.2A.1.1.1.4.1-1.

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 [10] clause 4.5. Message contents are defined in clause 6.2A.1.1.1.4.3

6.2A.1.1.1.4.2 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 [10] subclause 5.5.1. Message contents are defined in clause 6.2A.1.1.1.4.3.
3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [x], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], 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.1.1.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Messages to configure the appropriate uplink modulation in section 6.2A.1.1.1.4.3.
5. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 msec starting from the first TPC command in this step to ensure that the UE transmits at its maximum output power.
6. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (Note 1) for the UE Tx beam selection to complete.
7. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.
8. Measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.2A.1.1.1.5-1. EIRP test procedure is defined in Annex K.1.3. The measuring duration is one active uplink subframe. EIRP is calculated considering both polarizations, theta and phi.
9. Measure TRP of the transmitted signal for the assigned NR channel with a rectangular measurement filter with bandwidths according to Table 6.2A.1.1.1.5-1. Total radiated power is measured according to TRP measurement procedure defined in Annex K.1.7 and measurement grid specified in Annex M.4. TRP is calculated considering both polarizations, theta and phi.
10. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.2A.1.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.2A.1.1.1.5 Test Requirements

The EIRP derived in step 8 and TRP derived in step 9 shall not exceed the values specified in Table 6.2A.1.1.1.5-1 to Table 6.2A.1.1.1.5-4.Table 6.2A.1.1.1.5-1: Intra-band Contiguous CA UE maximum output test requirements for power class 1

UL CA configuration	Max TRP (dBm)	Max EIRP (dBm)	Min peak EIRP (dBm)
CA_n257D	35+TT	55	40-TT
CA_n257G	35+TT	55	40-TT
CA_n260D	35+TT	55	38-TT
CA_n260G	35+TT	55	38-TT
CA_n260O	35+TT	55	38-TT
CA_n261D	35+TT	55	40-TT
CA_n261G	35+TT	55	40-TT
CA_n261O	35+TT	55	40-TT

Table 6.2A.1.1.1.5-2: Intra-band Contiguous CA UE maximum output test requirements for power class 2

UL CA configuration	Max TRP (dBm)	Max EIRP (dBm)	Min peak EIRP (dBm)
CA_n257D	23+TT	43	29-TT
CA_n257G	23+TT	43	29-TT
CA_n261D	23+TT	43	29-TT
CA_n261G	23+TT	43	29-TT
CA_n261O	23+TT	43	29-TT

Table 6.2A.1.1.1.5-3: Intra-band Contiguous CA UE maximum output test requirements for power class 3

UL CA configuration	Max TRP (dBm)	Max EIRP (dBm)	Min peak EIRP (dBm)
CA_n257D	23+TT	43	22.4-TT
CA_n257G	23+TT	43	22.4-TT
CA_n260D	23+TT	43	20.6-TT
CA_n260G	23+TT	43	20.6-TT
CA_n260O	23+TT	43	20.6-TT
CA_n261D	23+TT	43	22.4-TT
CA_n261G	23+TT	43	22.4-TT
CA_n261O	23+TT	43	22.4-TT

Table 6.2A.1.1.1.5-3a: UE maximum output test requirements for power class 3 for multi band UE declaring MBp>0 in any FR2 band

ID	Supported FR2 bands set	Test requirement (dB) (Note 1)				Maximum sum of MB_p, $\sum MB_P$ (dB) (Note 3)	Comments
		CA_n257D/G	CA_n258	CA_n260D/G/O	CA_n261D/G/O		
1	n257, n258	22.4-TT-MB_p				1.3	
2	n257, n260	22.4-TT-MB_p		20.6-TT-MB_p		1.0	
3	n258, n260			20.6-TT-MB_p		1.0	
4	n258, n261				22.4-TT-MB_p	1.0	
5	n260, n261					0.0	No relaxation factor allowed
6	n257, n258, n260	22.4-TT-MB_p		20.6-TT-MB_p		1.7	
7	n257, n258, n261	22.4-TT-MB_p			22.4-TT-MB_p	1.7	
8	n257, n260, n261	22.4-TT-MB_p		20.6-TT-MB_p	22.4-TT-MB_p	0.5	
9	n258, n260, n261			20.6-TT-MB_p	22.4-TT-MB_p	1.5	
10	n257, n258, n260, n261	22.4-TT-MB_p		20.6-TT-MB_p	22.4-TT-MB_p	1.7	

Note 1: MB_p is the Multiband Relaxation factor declared by the UE for the tested band in table A.4.3.9-2 of TS38.508-2. This declaration shall fulfil the requirements in clause 6.2.1.1.3.3.
Note 2: All UE supported bands needs to be tested to ensure the multiband relaxation declaration is compliant
Note 3: Max allowed sum of MB_p over all supported FR2 bands as defined in clause 6.2.1.1.3.3

Table 6.2A.1.1.1.5-3b: Test Tolerance (Max TRP for Power class 3) (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	2.65 dB	2.77 dB

Table 6.2A.1.1.1.5-3c: Test Tolerance (Min peak EIRP for Power class 3) (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30cm	2.87 dB	2.87 dB

Table 6.2A.1.1.1.5-4: Intra-band Contiguous CA UE maximum output test requirements for power class 4

UL CA configuration	Max TRP (dBm)	Max EIRP (dBm)	Min peak EIRP (dBm)
CA_n257D	23+TT	43	34-TT
CA_n257G	23+TT	43	34-TT
CA_n260B	23+TT	43	31-TT
CA_n260D	23+TT	43	31-TT
CA_n260G	23+TT	43	31-TT
CA_n260O	23+TT	43	31-TT
CA_n261B	23+TT	43	34-TT
CA_n261D	23+TT	43	34-TT
CA_n261G	23+TT	43	34-TT
CA_n261O	23+TT	43	34-TT

6.2A.1.1.2 UE maximum output power - EIRP and TRP for CA (3UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.2A.1.1.2.1 Test purpose

To verify that the power of any UE emission shall not exceed specified lever for the specified channel bandwidth for CA under the deployment scenarios where additional requirements are specified.

6.2A.1.1.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA.

6.2A.1.1.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.2A.1.1.0.

6.2A.1.1.2.4 Test description

Same as in clause 6.2A.1.1.1.4 with following exceptions:

- Instead of Table 6.2A.1.1.1.4.1-1→ use Table 6.2A.1.1.2.4.1-1.
- Instead of clause 6.2A.1.1.1.4.3→ use clause 6.2A.1.1.2.4.3.
- Instead of Table 6.2A.1.1.1.5-1→ use Table 6.2A.1.1.2.5-1.

Table 6.2A.1.1.2.4.1-1: Test Configuration Table [TBD]

6.2A.1.1.2.5 Test Requirements

The EIRP derived in step 8 and TRP derived in step 9 shall not exceed the values specified in Table 6.2A.1.1.2.5-1.

Table 6.2A.1.1.2.5-1: UE maximum output test requirements for power class 3

CA configuration	Max TRP (dBm)	Max EIRP (dBm)	Min peak EIRP (dBm)
CA_n257H	23+TT	43	22.4-TT

Table 6.2A.1.1.2.5-1a: Test Tolerance (Max TRP for Power class 3) (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	2.65 dB	2.77 dB

Table 6.2A.1.1.2.5-1b: Test Tolerance (Min peak EIRP for Power class 3) (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	2.87 dB	2.87 dB

6.2A.1.1.3 UE maximum output power - EIRP and TRP for CA (4UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.2A.1.1.3.1 Test purpose

To verify that the power of any UE emission shall not exceed specified lever for the specified channel bandwidth for CA under the deployment scenarios where additional requirements are specified.

6.2A.1.1.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA.

6.2A.1.1.3.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.2A.1.1.0.

6.2A.1.1.3.4 Test description

6.2A.1.1.3.4.1 Initial condition

Same as in clause 6.2A.1.1.1.4 with following exceptions:

- Instead of Table 6.2A.1.1.1.4.1-1→ use Table 6.2A.1.1.3.4.1-1.
- Instead of clause 6.2A.1.1.1.4.3→ use clause 6.2A.1.1.3.4.3.
- Instead of Table 6.2A.1.1.1.5-1→ use Table 6.2A.1.1.3.5-1.

Table 6.2A.1.1.3.4.1-1: Test Configuration Table

[TBD]

6.2A.1.1.3.5 Test Requirements

The EIRP derived in step 8 and TRP derived in step 9 shall not exceed the values specified in Table 6.2A.1.1.3.5-1.

Table 6.2A.1.1.3.5-1: UE maximum output test requirements for power class 3

CA configuration	Max TRP (dBm)	Max EIRP (dBm)	Min peak EIRP (dBm)
CA_n257I	23+TT	43	22.4-TT

Table 6.2A.1.1.3.5-1a: Test Tolerance (Max TRP for Power class 3) (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	2.65 dB	2.77 dB

Table 6.2A.1.1.3.5-1b: Test Tolerance (Min peak EIRP for Power class 3) (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	2.87 dB	2.87 dB

6.2A.1.2 UE maximum output power - Spherical coverage

6.2A.1.2.1 Spherical coverage for CA (2UL CA)

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

- Measurement Uncertainties and Test Tolerances are FFS.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

6.2A.1.2.1.1 Test purpose

To verify that the spatial coverage of the UE for CA in expected directions is acceptable.

6.2A.1.2.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 2UL CA.

6.2A.1.2.1.3 Minimum conformance requirements

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

6.2A.1.2.1.4 Test description

6.2A.1.2.1.4.1 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, and channel bandwidths based on NR operating bands specified in table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and subcarrier spacing, are shown in table 6.2A.1.2.1.4.1-1. 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 6.2A.1.2.1.4.1-1: Intra-band Contiguous CA Test Configuration Table (single CC requirement)

Default Conditions					
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal, TL/VL, TL/VH, TH/VL, TH/VH (NOTE 2)		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes			Low and High range		
Test CC Combination setting (aggregated BW of the CA configuration) as specified in Table 5.5A.1-1 for the CA Configuration across bandwidth combination sets supported by the UE			Highest aggregated BW (≤ 400 MHz aggregated channel bandwidth)		
Test SCS as specified in Table 5.3.5-1			120 kHz		
Test Parameters					
CA Configuration / Aggregated BW			**Downlink Configuration**	**Uplink Configuration**	
Test ID	**CC & Mapping (NOTE 4)**	**CBW (MHz)**	**RB allocation**	**Modulation**	**RB allocation (NOTE 1)**
1	PCC/CC1	100	N/A for this test	DFT-s-OFDM QPSK	Inner Full
	SCC/CC2	100		-	-
2	PCC/CC1	200		DFT-s-OFDM QPSK	Inner Full
	SCC/CC2	200		-	-
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1. NOTE 2: CA Configuration Test cumulative aggregated BW settings are checked separately for each CA Configuration, which applicable aggregated channel bandwidths are specified in Table 5.5A.1-1. NOTE 3: If the UE supports multiple CC Combinations in the CA Configuration with the same cumulative aggregated BW, only the combination with the lowest PCC ChBW is tested. NOTE 4: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10].					

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals for PCC are initially set up according to Annex C.0, C.1 and C.3.0 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.
4. The UL Reference Measurement channels are set according to Table 6.2A.1.2.1.4.1-1.

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 [10] clause 4.5. Message contents are defined in clause 6.2A.1.2.1.4.3

6.2A.1.2.1.4.2 Test procedure

1. Configure PCC and SCC according to Annex C.0, C.1, C.2 and Annex C.3.0 for all downlink physical channels.
2. The SS shall configure SCC as per TS 38.508-1 [10] clause 5.5.1 Procedure to configure SCC(s) for NR RF CA testing. Message contents are defined in clause 6.2A.1.2.1.4.3.
3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321, clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], 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.1.2.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Messages to configure the appropriate uplink modulation in section 6.2A.1.2.1.4.3.
5. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 msec to ensure that the UE transmits at its maximum output power.
6. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (Note 1) for the UE Tx beam selection to complete.
7. Measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration. Repeat EIRP measurements for all directions in the sphere according to EIRP measurement procedure defined in Annex K.1.3. After a rotation, allow at least BEAM_SELECT_WAIT_TIME (Note 1) for UE to find the best beam to use. The measuring duration is one active uplink subframe. EIRP is calculated considering both polarizations, theta and phi.
8. Calculate a cumulative distribution function for the measured EIRP values.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.2A.1.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.2A.1.2.1.5 Test requirement

The defined %-tile EIRP in measurement distribution derived in step 8 shall exceed the values specified in Table 6.2A.1.2.1.5-1 to Table 6.2A.1.2.1.5-4.

Table 6.2A.1.2.1.5-1: Intra-band Contiguous CA UE spherical coverage for power class 1

Operating band	Min EIRP at 85%-tile CDF (dBm)
CA_n257D	32.0-TT
CA_n257G	32.0-TT
CA_n260D	30.0-TT
CA_n260G	30.0-TT
CA_n260O	30.0-TT
CA_n261D	32.0-TT
CA_n261G	32.0-TT
CA_n261O	32.0-TT

Table 6.2A.1.2.1.5-2: Intra-band Contiguous CA UE spherical coverage for power class 2

Operating band	Min EIRP at 60%-tile CDF (dBm)
CA_n257D	18.0-TT
CA_n257G	18.0-TT
CA_n261D	18.0-TT
CA_n261G	18.0-TT
CA_n261O	18.0-TT

Table 6.2A.1.2.1.5-3: Intra-band Contiguous CA UE spherical coverage for power class 3 for single band UE or multiband UE declaring MB_s = 0 in all FR2 bands

Operating band	Min EIRP at 50t%-tile CDF (dBm)
CA_n257D	11.5-TT
CA_n257G	11.5-TT
CA_n260D	8-TT
CA_n260G	8-TT
CA_n260O	8-TT
CA_n261D	11.5-TT
CA_n261G	11.5-TT
CA_n261O	11.5-TT

Table 6.2A.1.2.1.5-3a: UE spherical coverage for power class 3 for multi band UE declaring MB_s>0 in any FR2 band

ID	Supported FR2 bands set	Test requirement (dB) (Note 1)				Maximum sum of MB_s, $\sum MB_s$ (dB) (Note 3)	Comments
		CA_n257D/G	CA_n258	CA_n260D/G/O	CA_n261D/G/O		
1	n257, n258	11.5-TT-MB_s				1.25	
2	n257, n260	11.5-TT-MB_s		8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
3	n258, n260			8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
4	n258, n261				11.5-TT-MB_s	1.25	
5	n260, n261			8-TT-MB_s	11.5-TT-MBs	0.75	No relaxation allowed for n260
6	n257, n258, n260	11.5-TT-MB_s		8-TT-MB_s		1.75	Maximum 0.4 dB relaxation allowed for n260
7	n257, n258, n261	11.5-TT-MB_s			11.5-TT-MB_s	1.75	
8	n257, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
9	n258, n260, n261			8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
10	n257, n258, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.75	Maximum 0.4 dB relaxation allowed for n260

Note 1: MB_s is the Multiband Relaxation factor declared by the UE for the tested band in table A.4.3.9-3 of TS38.508-2. This declaration shall fulfil the requirements in clause 6.2.1.1.3.3.
Note 2: All UE supported bands needs to be tested to ensure the multiband relaxation declaration is compliant
Note 3: Max allowed sum of MB_s over all supported FR2 bands as defined in clause 6.2.1.1.3.3

Table 6.2A.1.2.1.5-4: Intra-band Contiguous CA UE spherical coverage for power class 4

Operating band	Min EIRP at 20%-tile CDF (dBm)
CA_n257D	25-TT
CA_n257G	25-TT
CA_n260D	19-TT
CA_n260G	19-TT
CA_n260O	19-TT
CA_n261D	25-TT
CA_n261G	25-TT
CA_n261O	25-TT

Table 6.2A.1.2.1.5-5: Test Tolerance (Spherical coverage) (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	FFS	FFS

6.2A.1.2.2 Spherical coverage for CA (3UL CA)

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

- Measurement Uncertainties and Test Tolerances are FFS.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

6.2A.1.2.2.1 Test purpose

To verify that the spatial coverage of the UE for CA in expected directions is acceptable.

6.2A.1.2.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA.

6.2A.1.2.2.3 Minimum conformance requirements

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

6.2A.1.2.2.4 Test description

6.2A.1.2.2.4.1 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, and channel bandwidths based on NR operating bands specified in table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and subcarrier spacing, are shown in table 6.2A.1.2.2.4.1-1. 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 6.2A.1.2.2.4.1-1: Intra-band Contiguous CA Test Configuration Table (single CC requirement)

Default Conditions					
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal, TL/VL, TL/VH, TH/VL, TH/VH (NOTE 2)		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes			Low and High range		
Test CC Combination setting (aggregated BW of the CA configuration) as specified in Table 5.5A.1-1 for the CA Configuration across bandwidth combination sets supported by the UE			Highest aggregated BW (≤ 400 MHz aggregated channel bandwidth)		
Test SCS as specified in Table 5.3.5-1			120 kHz		
Test Parameters					
CA Configuration / Aggregated BW			**Downlink Configuration**	**Uplink Configuration**	
Test ID	**CC & Mapping (NOTE 4)**	**CBW (MHz)**	**RB allocation**	**Modulation**	**RB allocation (NOTE 1)**
1	PCC/CC1	100	N/A for this test	DFT-s-OFDM QPSK	Inner Full
	SCC/CC2	100		-	-
	SCC/CC3	100		-	-
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1. NOTE 2: CA Configuration Test cumulative aggregated BW settings are checked separately for each CA Configuration, which applicable aggregated channel bandwidths are specified in Table 5.5A.1-1. NOTE 3: If the UE supports multiple CC Combinations in the CA Configuration with the same cumulative aggregated BW, only the combination with the lowest PCC ChBW is tested. NOTE 4: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10].					

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals for PCC are initially set up according to Annex C.0, C.1 and C.3.0 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.2A.1.2.2.4.1-1.

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 [10] clause 4.5. Message contents are defined in clause 6.2A.1.2.2.4.3

6.2A.1.2.2.4.2 Test procedure

1. Configure PCC and SCCs according to Annex C.0, C.1, C.2 and Annex C.3.0 for all downlink physical channels.

2. The SS shall configure SCCs as per TS 38.508-1 [10] clause 5.5.1 Procedure to configure SCC(s) for NR RF CA testing. Message contents are defined in clause 6.2A.1.2.2.4.3.

3. SS activates SCCs by sending the activation MAC CE (Refer TS 38.321[x], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], 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.1.2.2.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Messages to configure the appropriate uplink modulation in section 6.2A.1.2.2.4.3.

5. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 msec to ensure that the UE transmits at its maximum output power.

6. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (Note 1) for the UE Tx beam selection to complete.

7. Measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration. Repeat EIRP measurements for all directions in the sphere according to EIRP measurement procedure defined in Annex K.1.3. After a rotation, allow at least BEAM_SELECT_WAIT_TIME (Note 1) for UE to find the best beam to use. The measuring duration is one active uplink subframe. EIRP is calculated considering both polarizations, theta and phi.

8. Calculate a cumulative distribution function for the measured EIRP values.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.2A.1.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.2A.1.2.2.5 Test requirement

The defined %-tile EIRP in measurement distribution derived in step 8 shall exceed the values specified in Table 6.2A.1.2.2.5-1 to Table 6.2A.1.2.2.5-4.

Table 6.2A.1.2.2.5-1: Intra-band Contiguous CA UE spherical coverage for power class 1

Operating band	Min EIRP at 85%-tile CDF (dBm)
CA_n257H	32.0-TT
CA_n260H	30.0-TT
CA_n260P	30.0-TT
CA_n261H	32.0-TT
CA_n261P	32.0-TT

Table 6.2A.1.2.2.5-2: Intra-band Contiguous CA UE spherical coverage for power class 2

Operating band	Min EIRP at 60%-tile CDF (dBm)
CA_n257H	18.0-TT
CA_n261H	18.0-TT
CA_n261P	18.0-TT

Table 6.2A.1.2.2.5-3: Intra-band Contiguous CA UE spherical coverage for power class 3 for single band UE or multiband UE declaring MB_s = 0 in all FR2 bands

Operating band	Min EIRP at 50%-tile CDF (dBm)
CA_n257H	11.5-TT
CA_n260H	8-TT
CA_n260P	8-TT
CA_n261H	11.5-TT
CA_n261P	11.5-TT

Table 6.2A.1.2.2.5-3a: UE spherical coverage for power class 3 for multi band UE declaring MB_s>0 in any FR2 band

ID	Supported FR2 bands set	Test requirement (dB) (Note 1)				Maximum sum of MB_s, $\sum MB_s$ (dB) (Note 3)	Comments
		CA_n257H	CA_n258	CA_n260H/P	CA_n261H/P		
1	n257, n258	11.5-TT-MB_s				1.25	
2	n257, n260	11.5-TT-MB_s		8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
3	n258, n260			8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
4	n258, n261				11.5-TT-MB_s	1.25	
5	n260, n261			8-TT-MB_s	11.5-TT-MBs	0.75	No relaxation allowed for n260
6	n257, n258, n260	11.5-TT-MB_s		8-TT-MB_s		1.75	Maximum 0.4 dB relaxation allowed for n260
7	n257, n258, n261	11.5-TT-MB_s			11.5-TT-MB_s	1.75	
8	n257, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
9	n258, n260, n261			8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
10	n257, n258, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.75	Maximum 0.4 dB relaxation allowed for n260
Note 1: MB_s is the Multiband Relaxation factor declared by the UE for the tested band in table A.4.3.9-3 of TS38.508-2. This declaration shall fulfil the requirements in clause 6.2.1.1.3.3. Note 2: All UE supported bands needs to be tested to ensure the multiband relaxation declaration is compliant Note 3: Max allowed sum of MB_s over all supported FR2 bands as defined in clause 6.2.1.1.3.3							

Table 6.2A.1.2.2.5-4: Intra-band Contiguous CA UE spherical coverage for power class 4

Operating band	Min EIRP at 20%-tile CDF (dBm)
CA_n257H	25-TT
CA_n260H	19-TT
CA_n260P	19-TT
CA_n261H	25-TT
CA_n261P	25-TT

Table 6.2A.1.2.2.5-5: Test Tolerance (Spherical coverage) (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	FFS	FFS

6.2A.1.2.3 Spherical coverage for CA (4UL CA)

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

- Measurement Uncertainties and Test Tolerances are FFS.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

6.2A.1.2.3.1 Test purpose

To verify that the spatial coverage of the UE for CA in expected directions is acceptable.

6.2A.1.2.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA.

6.2A.1.2.3.3 Minimum conformance requirements

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

6.2A.1.2.3.4 Test description

6.2A.1.2.3.4.1 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, and channel bandwidths based on NR operating bands specified in table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and subcarrier spacing, are shown in table 6.2A.1.2.3.4.1-1. 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 6.2A.1.2.3.4.1-1: Intra-band Contiguous CA Test Configuration Table (single CC requirement)

Default Conditions					
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes, and PCC and SCC are mapped onto physical frequencies according to Table 6.1-2			Low and High range		
Test CC Combination setting (cumulative aggregated BW of the CA configuration) as specified in Table 5.5A.1-1 for the CA Configuration across bandwidth combination sets supported by the UE			Highest aggregated BW (≤ 400 MHz aggregated channel bandwidth)		
Test SCS as specified in Table 5.3.5-1			120 kHz		
Test Parameters					
CA Configuration / Aggregated BW			**Downlink Configuration**	**Uplink Configuration**	
Test ID	**CC & Mapping (NOTE 4)**	ChBw	**RB allocation**	**Modulation**	**RB allocation (NOTE 1)**
1	PCC/CC1	100	N/A for this test	DFT-s-OFDM QPSK	Inner Full
	SCC/CC2	100		-	-
	SCC/CC3	100		-	-
	SCC/CC4	100		-	-
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1. NOTE 2: CA Configuration Test cumulative aggregated BW settings are checked separately for each CA Configuration, which applicable aggregated channel bandwidths are specified in Table 5.5A.1-1. NOTE 3: If the UE supports multiple CC Combinations in the CA Configuration with the same cumulative aggregated BW, only the combination with the lowest PCC ChBW is tested. NOTE 4: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10].					

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals for PCC are initially set up according to Annex C.2 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.2A.1.2.3.4.1-1.

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 [10] clause 4.5. Message contents are defined in clause 6.2A.1.2.3.4.3

6.2A.1.2.3.4.2 Test procedure

1. Configure PCC and SCC according to Annex C.0, C.1, C.2 and Annex C.3.0 for all downlink physical channels.
2. The SS shall configure SCC as per TS 38.508-1 [10] clause 5.5.1 Procedure to configure SCC(s) for NR RF CA testing. Message contents are defined in clause 6.2A.1.2.3.4.3.
3. SS activates SCCs by sending the activation MAC CE (Refer TS 38.321, clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], 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.1.2.3.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Messages to configure the appropriate uplink modulation in section 6.2A.1.2.3.4.3.
5. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 msec to ensure that the UE transmits at its maximum output power.
6. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (Note 1) for the UE Tx beam selection to complete.
7. Measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration. Repeat EIRP measurements for all directions in the sphere according to EIRP measurement procedure defined in Annex K.1.3. After a rotation, allow at least BEAM_SELECT_WAIT_TIME (Note 1) for UE to find the best beam to use. The measuring duration is one active uplink subframe. EIRP is calculated considering both polarizations, theta and phi.
8. Calculate a cumulative distribution function for the measured EIRP values.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.2A.1.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.2A.1.2.3.5 Test requirement

The defined %-tile EIRP in measurement distribution derived in step 8 shall exceed the values specified in Table 6.2A.1.2.3.5-1 to Table 6.2A.1.2.3.5-4.

Table 6.2A.1.2.3.5-1: Intra-band Contiguous CA UE spherical coverage for power class 1

Operating band	Min EIRP at 85%-tile CDF (dBm)
CA_n257I	32.0-TT
CA_n260I	30.0-TT
CA_n260Q	30.0-TT
CA_n261I	32.0-TT
CA_n261Q	32.0-TT

Table 6.2A.1.2.3.5-2: Intra-band Contiguous CA UE spherical coverage for power class 2

Operating band	Min EIRP at 60%-tile CDF (dBm)
CA_n257I	32.0-TT
CA_n261I	32.0-TT
CA_n261Q	32.0-TT

Table 6.2A.1.2.3.5-3: Intra-band Contiguous CA UE spherical coverage for power class 3 for single band UE or multiband UE declaring MB_s = 0 in all FR2 bands

Operating band	Min EIRP at 50%-tile CDF (dBm)
CA_n257I	11.5-TT
CA_n260I	8-TT
CA_n260Q	8-TT
CA_n261I	11.5-TT
CA_n261Q	11.5-TT

Table 6.2A.1.2.3.5-3a: UE spherical coverage for power class 3 for multi band UE declaring MB_s>0 in any FR2 band

ID	Supported FR2 bands set	Test requirement (dB) (Note 1)				Maximum sum of MB_s, $\sum MB_s$ (dB) (Note 3)	Comments
		CA_n257I	CA_n258	CA_n260I/Q	CA_n261I/Q		
1	n257, n258	11.5-TT-MB_s				1.25	
2	n257, n260	11.5-TT-MB_s		8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
3	n258, n260			8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
4	n258, n261				11.5-TT-MB_s	1.25	
5	n260, n261			8-TT-MB_s	11.5-TT-MBs	0.75	No relaxation allowed for n260
6	n257, n258, n260	11.5-TT-MB_s		8-TT-MB_s		1.75	Maximum 0.4 dB relaxation allowed for n260
7	n257, n258, n261	11.5-TT-MB_s			11.5-TT-MB_s	1.75	
8	n257, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
9	n258, n260, n261			8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
10	n257, n258, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.75	Maximum 0.4 dB relaxation allowed for n260

Note 1: MB_s is the Multiband Relaxation factor declared by the UE for the tested band in table A.4.3.9-3 of TS38.508-2. This declaration shall fulfil the requirements in clause 6.2.1.1.3.3.
Note 2: All UE supported bands needs to be tested to ensure the multiband relaxation declaration is compliant
Note 3: Max allowed sum of MB_s over all supported FR2 bands as defined in clause 6.2.1.1.3.3

Table 6.2A.1.2.3.5-4: Intra-band Contiguous CA UE spherical coverage for power class 4

Operating band	Min EIRP at 20%-tile CDF (dBm)
CA_n257I	25-TT
CA_n260I	19-TT
CA_n260Q	19-TT
CA_n261I	25-TT
CA_n261Q	25-TT

Table 6.2A.1.2.3.5-5: Test Tolerance (Spherical coverage) (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	FFS	FFS

6.2A.1.2.4 Spherical coverage for CA (5UL CA)

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

- Measurement Uncertainties and Test Tolerances are FFS.

- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

6.2A.1.2.4.1 Test purpose

To verify that the spatial coverage of the UE for CA in expected directions is acceptable.

6.2A.1.2.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 5UL CA.

6.2A.1.2.4.3 Minimum conformance requirements

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

6.2A.1.2.4.4 Test description

Same as in clause 6.2A.1.2.1.4 with following exceptions:

- Instead of Table 6.2A.1.1.2.4.1-1→ use Table 6.2A.1.2.4.4.1-1.
- Instead of Table 6.2A.1.2.1.5-1 to 5→ use Table 6.2A.1.2.4.5-1 to 5.

Table 6.2A.1.2.4.4.1-1: Test Configuration Table

FFS

6.2A.1.2.4.5 Test requirement

The defined %-tile EIRP in measurement distribution derived in step 8 shall exceed the values specified in Table 6.2A.1.2.4.5-1 to Table 6.2A.1.2.4.5-4.

Table 6.2A.1.2.4.5-1: Intra-band Contiguous CA UE spherical coverage for power class 1

Operating band	Min EIRP at 85%-tile CDF (dBm)
CA_n257J	32.0-TT
CA_n260J	30.0-TT
CA_n261J	32.0-TT

Table 6.2A.1.2.4.5-2: Intra-band Contiguous CA UE spherical coverage for power class 2

Operating band	Min EIRP at 60%-tile CDF (dBm)
CA_n257J	18.0-TT
CA_n261J	18.0-TT

Table 6.2A.1.2.4.5-3: Intra-band Contiguous CA UE spherical coverage for power class 3 for single band UE or multiband UE declaring MB_s = 0 in all FR2 bands

Operating band	Min EIRP at 50t%-tile CDF (dBm)
CA_n257J	11.5-TT
CA_n260J	8-TT
CA_n261J	11.5-TT

Table 6.2A.1.2.4.5-3a: UE spherical coverage for power class 3 for multi band UE declaring MB_s>0 in any FR2 band

ID	Supported FR2 bands set	Test requirement (dB) (Note 1)				Maximum sum of MB_s, $\sum MB_s$ (dB) (Note 3)	Comments
		CA_n257J	CA_n258	CA_n260J	CA_n261J		
1	n257, n258	11.5-TT-MB_s				1.25	
2	n257, n260	11.5-TT-MB_s		8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
3	n258, n260			8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
4	n258, n261				11.5-TT-MB_s	1.25	
5	n260, n261			8-TT-MB_s	11.5-TT-MBs	0.75	No relaxation allowed for n260
6	n257, n258, n260	11.5-TT-MB_s		8-TT-MB_s		1.75	Maximum 0.4 dB relaxation allowed for n260
7	n257, n258, n261	11.5-TT-MB_s			11.5-TT-MB_s	1.75	
8	n257, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
9	n258, n260, n261			8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
10	n257, n258, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.75	Maximum 0.4 dB relaxation allowed for n260
Note 1: MB_s is the Multiband Relaxation factor declared by the UE for the tested band in table A.4.3.9-3 of TS38.508-2. This declaration shall fulfil the requirements in clause 6.2.1.1.3.3.							
Note 2: All UE supported bands needs to be tested to ensure the multiband relaxation declaration is compliant							
Note 3: Max allowed sum of MB_s over all supported FR2 bands as defined in clause 6.2.1.1.3.3							

Table 6.2A.1.2.4.5-4: Intra-band Contiguous CA UE spherical coverage for power class 4

Operating band	Min EIRP at 20%-tile CDF (dBm)
CA_n257J	25-TT
CA_n260J	19-TT
CA_n261J	25-TT

Table 6.2A.1.2.4.5-5: Test Tolerance (Spherical coverage) (400MHz < Aggregated BW ≤ 800MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	FFS	FFS

6.2A.1.2.5 Spherical coverage for CA (6UL CA)

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

- Measurement Uncertainties and Test Tolerances are FFS.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

6.2A.1.2.5.1 Test purpose

To verify that the spatial coverage of the UE for CA in expected directions is acceptable.

6.2A.1.2.5.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 6UL CA.

6.2A.1.2.5.3 Minimum conformance requirements

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

6.2A.1.2.5.4 Test description

Same as in clause 6.2A.1.2.1.4 with following exceptions:

- Instead of Table 6.2A.1.1.2.4.1-1→ use Table 6.2A.1.2.5.4.1-1.
- Instead of Table 6.2A.1.2.1.5-1 to 5→ use Table 6.2A.1.2.5.5-1 to 5.

Table 6.2A.1.2.5.4.1-1: Test Configuration Table

FFS

6.2A.1.2.5.5 Test requirement

The defined %-tile EIRP in measurement distribution derived in step 8 shall exceed the values specified in Table 6.2A.1.2.5.5-1 to Table 6.2A.1.2.5.5-4.

Table 6.2A.1.2.5.5-1: Intra-band Contiguous CA UE spherical coverage for power class 1

Operating band	Min EIRP at 85%-tile CDF (dBm)
CA_n257K	32.0-TT
CA_n260K	30.0-TT
CA_n261K	32.0-TT

Table 6.2A.1.2.5.5-2: Intra-band Contiguous CA UE spherical coverage for power class 2

Operating band	Min EIRP at 60%-tile CDF (dBm)
CA_n257K	18.0-TT
CA_n261K	18.0-TT

Table 6.2A.1.2.5.5-3: Intra-band Contiguous CA UE spherical coverage for power class 3 for single band UE or multiband UE declaring MB_s = 0 in all FR2 bands

Operating band	Min EIRP at 50%-tile CDF (dBm)
CA_n257K	11.5-TT
CA_n260K	8-TT
CA_n261K	11.5-TT

Table 6.2A.1.2.5.5-3a: UE spherical coverage for power class 3 for multi band UE declaring MB_s>0 in any FR2 band

ID	Supported FR2 bands set	Test requirement (dB) (Note 1)				Maximum sum of MB_s, $\sum MB_s$ (dB) (Note 3)	Comments
		CA_n257J	CA_n258	CA_n260J	CA_n261J		
1	n257, n258	11.5-TT-MB_s				1.25	
2	n257, n260	11.5-TT-MB_s		8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
3	n258, n260			8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
4	n258, n261				11.5-TT-MB_s	1.25	
5	n260, n261			8-TT-MB_s	11.5-TT-MBs	0.75	No relaxation allowed for n260
6	n257, n258, n260	11.5-TT-MB_s		8-TT-MB_s		1.75	Maximum 0.4 dB relaxation allowed for n260
7	n257, n258, n261	11.5-TT-MB_s			11.5-TT-MB_s	1.75	
8	n257, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
9	n258, n260, n261			8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
10	n257, n258, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.75	Maximum 0.4 dB relaxation allowed for n260

Note 1: MB_s is the Multiband Relaxation factor declared by the UE for the tested band in table A.4.3.9-3 of TS38.508-2. This declaration shall fulfil the requirements in clause 6.2.1.1.3.3.
Note 2: All UE supported bands needs to be tested to ensure the multiband relaxation declaration is compliant
Note 3: Max allowed sum of MB_s over all supported FR2 bands as defined in clause 6.2.1.1.3.3

Table 6.2A.1.2.5.5-4: Intra-band Contiguous CA UE spherical coverage for power class 4

Operating band	Min EIRP at 20%-tile CDF (dBm)
CA_n257K	25-TT
CA_n260K	19-TT
CA_n261K	25-TT

Table 6.2A.1.2.5.5-5: Test Tolerance (Spherical coverage) (400MHz < Aggregated BW ≤ 800MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	FFS	FFS

6.2A.1.2.6 Spherical coverage for CA (7UL CA)

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

- Measurement Uncertainties and Test Tolerances are FFS.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

6.2A.1.2.6.1 Test purpose

To verify that the spatial coverage of the UE for CA in expected directions is acceptable.

6.2A.1.2.6.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 7UL CA.

6.2A.1.2.6.3 Minimum conformance requirements

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

6.2A.1.2.6.4 Test description

Same as in clause 6.2A.1.2.1.4 with following exceptions:

- Instead of Table 6.2A.1.1.2.4.1-1→ use Table 6.2A.1.2.6.4.1-1.
- Instead of Table 6.2A.1.2.1.5-1 to Table 6.2A.1.2.1.5-5→ use Table 6.2A.1.2.6.5-1 to Table 6.2A.1.2.6.5-5.

Table 6.2A.1.2.6.4.1-1: Test Configuration Table

FFS

6.2A.1.2.6.5 Test requirement

The defined %-tile EIRP in measurement distribution derived in step 8 shall exceed the values specified in Table 6.2A.1.2.6.5-1 to Table 6.2A.1.2.6.5-4.

Table 6.2A.1.2.6.5-1: Intra-band Contiguous CA UE spherical coverage for power class 1

Operating band	Min EIRP at 85%-tile CDF (dBm)
CA_n257L	32.0-TT
CA_n260L	30.0-TT
CA_n261L	32.0-TT

Table 6.2A.1.2.6.5-2: Intra-band Contiguous CA UE spherical coverage for power class 2

Operating band	Min EIRP at 60%-tile CDF (dBm)
CA_n257L	18.0-TT
CA_n261L	18.0-TT

Table 6.2A.1.2.6.5-3: Intra-band Contiguous CA UE spherical coverage for power class 3 for single band UE or multiband UE declaring MB_s = 0 in all FR2 bands

Operating band	Min EIRP at 50%-tile CDF (dBm)
CA_n257L	11.5-TT
CA_n260L	8-TT
CA_n261L	11.5-TT

Table 6.2A.1.2.6.5-3a: UE spherical coverage for power class 3 for multi band UE declaring MB_s>0 in any FR2 band

ID	Supported FR2 bands set	Test requirement (dB) (Note 1)				Maximum sum of MB_s, $\sum MB_s$ (dB) (Note 3)	Comments
		CA_n257L	CA_n258	CA_n260L	CA_n261L		
1	n257, n258	11.5-TT-MB_s				1.25	
2	n257, n260	11.5-TT-MB_s		8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
3	n258, n260			8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
4	n258, n261				11.5-TT-MB_s	1.25	
5	n260, n261			8-TT-MB_s	11.5-TT-MBs	0.75	No relaxation allowed for n260
6	n257, n258, n260	11.5-TT-MB_s		8-TT-MB_s		1.75	Maximum 0.4 dB relaxation allowed for n260
7	n257, n258, n261	11.5-TT-MB_s			11.5-TT-MB_s	1.75	
8	n257, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
9	n258, n260, n261			8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
10	n257, n258, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.75	Maximum 0.4 dB relaxation allowed for n260

Note 1: MB_s is the Multiband Relaxation factor declared by the UE for the tested band in table A.4.3.9-3 of TS38.508-2. This declaration shall fulfil the requirements in clause 6.2.1.1.3.3.
Note 2: All UE supported bands needs to be tested to ensure the multiband relaxation declaration is compliant
Note 3: Max allowed sum of MB_s over all supported FR2 bands as defined in clause 6.2.1.1.3.3

Table 6.2A.1.2.6.5-4: Intra-band Contiguous CA UE spherical coverage for power class 4

Operating band	Min EIRP at 20%-tile CDF (dBm)
CA_n257L	25-TT
CA_n260L	19-TT
CA_n261L	25-TT

Table 6.2A.1.2.6.5-5: Test Tolerance (Spherical coverage) (400MHz < Aggregated BW ≤ 800MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	FFS	FFS

6.2A.1.2.7 Spherical coverage for CA (8UL CA)

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

- Measurement Uncertainties and Test Tolerances are FFS.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

6.2A.1.2.7.1 Test purpose

To verify that the spatial coverage of the UE for CA in expected directions is acceptable.

6.2A.1.2.7.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 8UL CA.

6.2A.1.2.7.3 Minimum conformance requirements

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

6.2A.1.2.7.4 Test description

Same as in clause 6.2A.1.2.1.4 with following exceptions:

- Instead of Table 6.2A.1.1.2.4.1-1→ use Table 6.2A.1.2.7.4.1-1.
- Instead of Table 6.2A.1.2.1.5-1 to Table 6.2A.1.2.1.5-5→ use Table 6.2A.1.2.7.5-1 to Table 6.2A.1.2.7.5-5.

Table 6.2A.1.2.7.4.1-1: Test Configuration Table

FFS

6.2A.1.2.7.5 Test requirement

The defined %-tile EIRP in measurement distribution derived in step 8 shall exceed the values specified in Table 6.2A.1.2.7.5-1 to Table 6.2A.1.2.7.5-4.

Table 6.2A.1.2.7.5-1: Intra-band Contiguous CA UE spherical coverage for power class 1

Operating band	Min EIRP at 85%-tile CDF (dBm)
CA_n257M	32.0-TT
CA_n260M	30.0-TT
CA_n261M	32.0-TT

Table 6.2A.1.2.7.5-2: Intra-band Contiguous CA UE spherical coverage for power class 2

Operating band	Min EIRP at 60%-tile CDF (dBm)
CA_n257M	18.0-TT
CA_n261M	18.0-TT

Table 6.2A.1.2.7.5-3: Intra-band Contiguous CA UE spherical coverage for power class 3 for single band UE or multiband UE declaring MB_s = 0 in all FR2 bands

Operating band	Min EIRP at 50%-tile CDF (dBm)
CA_n257M	11.5-TT
CA_n260M	8-TT
CA_n261M	11.5-TT

Table 6.2A.1.2.7.5-3a: UE spherical coverage for power class 3 for multi band UE declaring MB_s>0 in any FR2 band

ID	Supported FR2 bands set	Test requirement (dB) (Note 1)				Maximum sum of MB_s, $\sum MB_s$ (dB) (Note 3)	Comments
		CA_n257M	CA_n258	CA_n260M	CA_n261M		
1	n257, n258	11.5-TT-MB_s				1.25	
2	n257, n260	11.5-TT-MB_s		8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
3	n258, n260			8-TT-MB_s		0.75	Maximum 0.4 dB relaxation allowed for n260
4	n258, n261				11.5-TT-MB_s	1.25	
5	n260, n261			8-TT-MB_s	11.5-TT-MBs	0.75	No relaxation allowed for n260
6	n257, n258, n260	11.5-TT-MB_s		8-TT-MB_s		1.75	Maximum 0.4 dB relaxation allowed for n260
7	n257, n258, n261	11.5-TT-MB_s			11.5-TT-MB_s	1.75	
8	n257, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
9	n258, n260, n261			8-TT-MB_s	11.5-TT-MB_s	1.25	Maximum 0.4 dB relaxation allowed for n260
10	n257, n258, n260, n261	11.5-TT-MB_s		8-TT-MB_s	11.5-TT-MB_s	1.75	Maximum 0.4 dB relaxation allowed for n260
Note 1: MB_s is the Multiband Relaxation factor declared by the UE for the tested band in table A.4.3.9-3 of TS38.508-2. This declaration shall fulfil the requirements in clause 6.2.1.1.3.3. Note 2: All UE supported bands needs to be tested to ensure the multiband relaxation declaration is compliant Note 3: Max allowed sum of MB_s over all supported FR2 bands as defined in clause 6.2.1.1.3.3							

Table 6.2A.1.2.7.5-4: Intra-band Contiguous CA UE spherical coverage for power class 4

Operating band	Min EIRP at 20%-tile CDF (dBm)
CA_n257M	25-TT
CA_n260M	19-TT
CA_n261M	25-TT

Table 6.2A.1.2.7.5-5: Test Tolerance (Spherical coverage) (400MHz < Aggregated BW ≤ 800MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	FFS	FFS

6.2A.2 UE maximum output power reduction for CA

6.2A.2.0 Minimum conformance requirements

6.2A.2.0.1 General

The UE is defined to be configured for CA operation when it has at least one of UL or DL configured for CA. In CA operation, the UE may reduce its maximum output power due to higher order modulations and transmit bandwidth configurations. This Maximum Power Reduction (MPR) is defined in subclauses below.

The cumulative aggregated channel bandwidth is defined as the frequency band from the lowest edge of the lowest CC to the upper edge of the highest CC of all UL and DL configured CCs. When the maximum output power of a UE is modified by MPR, the power limits specified in subclause 6.2A.4.0 apply.

The requirements in the following subclauses are only applicable to intra-band contiguous uplink CA, with the aggregated channel bandwidth up to 800 MHz.

6.2A.2.0.2 Maximum output power reduction for power class 1

For power class 1, MPR for UL contiguous allocations within the cumulative aggregated bandwidth is defined as:

$$MPR_{C\_CA} = \max(MPR_{WT\_C\_CA}, MPR_{narrow})$$

Where,

MPR_{narrow} = 14.4 dB, when $BW_{alloc,RB}$ is less than or equal to 1.44 MHz, MPR_{narrow} = 10 dB, when 1.44 MHz < $BW_{alloc,RB}$ ≤ 10.8 MHz, where $BW_{alloc,RB}$ is the bandwidth of the RB allocation size.

$MPR_{WT\_C\_CA}$ is the maximum power reduction due to modulation orders, transmit bandwidth configurations, and waveform types. $MPR_{WT\_contiguous}$ is defined in Table 6.2A.2.2-1.

Table 6.2A.2.0-1: Maximum power reduction ($MPR_{WT\_C\_CA}$) for UE power class 1

Waveform Type		Cumulative aggregated channel bandwidth		
		< 400 MHz	≥ 400 MHz and < 800 MHz	≥ 800 MHz and ≤ 1400 MHz
DFT-s-OFDM	Pi/2 BPSK	≤ 5.5[1]	7.7[1]	[8.2]
	QPSK	≤ 6.5[1]	8.7[1]	[9.7]
	16 QAM	≤ 6.5	8.7	[9.2]
	64 QAM	≤ 9.0	10.7	[11.2]
CP-OFDM	QPSK	≤ 6.5	8.7	[8.7]
	16 QAM	≤ 6.5	8.7	[8.7]
	64 QAM	≤ 9.0	10.7	[11.2]
NOTE 1: The following condition applies only when the cumulative aggregated BW of the CA configuration ≤ 400MHz. For a contiguous RB allocation in a single CC of the CA configuration, the single CC MPR of subclause 6.2.2.1 applies. The cumulative aggregated bandwidth shall be used as $BW_{channel}$ in Tables 6.2.2.1-1 and 6.2.2.1-2. The applicable column in Tables 6.2.2.1-1 and 6.2.2.1-2 shall be determined based on the transmission bandwidth of the CA allocation in relation to the allocation regions defined in the tables.				

When different waveform types exist across CCs, the requirement is set by the waveform type used in the configuration with the largest MPR_{C_CA}.

For non-contiguous RB allocations, the following rule for MPR applies:

$$MPR = \max(MPR_{C\_CA}, -10*A + [14.4])$$

Where:

$A = N_{RB\_alloc} / N_{RB\_agg\_C}$.

N_{RB_alloc} is the total number of allocated UL RBs

$N_{RB\_agg\_C}$ is the number of the aggregated RBs within the fully allocated cumulative aggregated channel bandwidth

6.2A.2.0.3 Maximum output power reduction for power class 2

For power class 2, MPR specified in sub-clause 6.2A.2.0.4 applies.

Table 6.2A.2.0.3-1: (Void)

6.2A.2.0.4 Maximum output power reduction for power class 3

For power class 3, MPR for UL contiguous allocations within the cumulative aggregated bandwidth is denoted as MPR_{C_CA} and is defined in Table 6.2A.2.4-1.

Table 6.2A.2.0.4-1: Maximum power reduction (MPR_{C_CA}) for UE power class 3

		Cumulative aggregated bandwidth configuration		
		< 400 MHz	≥ 400 MHz and < 800 MHz	≥ 800 MHz and ≤ 1400 MHz
DFT-s-OFDM	Pi/2 BPSK	≤ 5.0[1]	≤ 7.7[1]	≤ [8.2]
	QPSK	≤ 5.0[1]	≤ 7.7[1]	≤ [8.2]
	16 QAM	≤ 6.5	≤ 8.7	≤ [9.3]
	64 QAM	≤ 9.0	≤ 10.7	≤ [11.2]
CP-OFDM	QPSK	≤ 5.0	≤ 7.5	≤ [8.0]
	16 QAM	≤ 6.5	≤ 8.7	≤ [9.2]
	64 QAM	≤ 9.0	≤ 10.7	≤ [11.2]
NOTE 1: The following condition applies only when the cumulative aggregated BW of the CA configuration ≤ 400 MHz. For a contiguous RB allocation in a single CC of the CA configuration, the single CC MPR of subclause 6.2.2.1 applies. The cumulative aggregated bandwidth shall be used as $BW_{channel}$ in Tables 6.2.2.1-1 and 6.2.2.1-2. The applicable column in Tables 6.2.2.1-1 and 6.2.2.1-2 shall be determined based on the transmission bandwidth of the CA allocation in relation to the allocation regions defined in the tables.				

When different waveform types exist across CCs, the requirement is set by the waveform type used in the configuration with the highest contiguous MPR.

For non-contiguous RB allocations, the following rule for MPR applies:

$$MPR = \max(MPR_{C\_CA}, -10*A + 7.0)$$

Where:

$A = N_{RB\_alloc} / N_{RB\_agg\_C}$.

N_{RB_alloc} is the total number of allocated UL RBs

$N_{RB\_agg\_C}$ is the number of the aggregated RBs within the fully allocated cumulative aggregated channel bandwidth

6.2A.2.0.5 Maximum output power reduction for power class 4

For power class 4, MPR specified in sub-clause 6.2A.2.0.4 applies.

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

6.2A.2.1 UE maximum output power reduction for CA (2UL CA)

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

- Measurement Uncertainties and Test Tolerances are FFS for power class 1, 2 and 4.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz and intra-band non-contiguous CA are TBD.
- Whether to further divide this test case considering the number of DL CC is FFS
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- TP analysis needs further update to relect the selection of applicable cumulative aggregated BW
- Following aspects are pending RAN4

  Minimum requirements for cumulative aggregated bandwidth >=800MHz are within brackets

  T(MPR) in 6.2A.4 configured output power is within brackets.

6.2A.2.1.1 Test purpose

The number of RB identified in 6.2.2.3 is based on meeting the requirements for the maximum power reduction (MPR) due to Cubic Metric (CM).

6.2A.2.1.2 Test applicability

The requirements of this test apply to all types of NR UE release 15 and forward supporting 2UL CA.

6.2A.2.1.3 Minimum conformance requirements

The normative reference for this requirement is TS 38.101-2 [3] clause 6.2A.2.0.

6.2A.2.1.4 Test description

6.2A.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, and CC combinations based on NR operating bands specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2. All of these configurations shall be tested with applicable test parameters for each CA configuration and subcarrier spacing, are shown in table 6.2A.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 6.2A.2.1.4.1-1: Intra-band Contiguous UL CA Test Configuration Table (Power Class 1, MPR_{narrow})

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal			
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes			Refer to "Test frequency" column			
Test CC Combination setting (aggregated BW of the CA configuration) as specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE			Highest aggregated channel bandwidth of the CA configuration			
Test SCS as specified in Table 5.3.5-1			120 kHz			
Test Parameters						
Test ID	**CC & Mapping (NOTE 2)**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation (NOTE 1)**
Default Test Settings for a CA_nXB, CA_nXD, CA_nXG, CA_nXO Configuration						
1	PCC/CC1	Default	Low	N/A for this test	CP-OFDM 64QAM	Outer_1RB_Left
	SCC/CC2		Low		-	-
2	PCC/CC1		High		CP-OFDM 64QAM	Outer_1RB_Right
	SCC/CC2		High		-	-
3	PCC/CC1		Low		CP-OFDM 64QAM	7@0
	SCC/CC2		Low		-	-
4	PCC/CC1		High		CP-OFDM 64QAM	7@N_{RB}-7
	SCC/CC2		High		-	-
Default Test Settings for a CA_nX(D-G)_UL_nXD, CA_nX(D-G)_UL_nXG, CA_nX(D-O)_UL_nXD, CA_nX(D-O)_UL_nXO Configuration						
1	PCC/CC1	Default	Low	N/A for this test	CP-OFDM 64QAM	Outer_1RB_Left
	SCC1/CC2		Low		-	-
	Wgap		Max Wgap		N/A	N/A
	SCC2/CC3		Low		N/A	N/A
	SCC3/CC4		Low		N/A	N/A
2	PCC/CC1		High		CP-OFDM 64QAM	Outer_1RB_Right
	SCC1/CC2		High		-	-
	Wgap		Max Wgap		N/A	N/A
	SCC2/CC3		High		N/A	N/A
	SCC3/CC4		High		N/A	N/A
3	PCC/CC1		Low		CP-OFDM 64QAM	7@0
	SCC1/CC2		Low		-	-
	Wgap		Max Wgap		N/A	N/A
	SCC2/CC3		Low		N/A	N/A
	SCC3/CC4		Low		N/A	N/A
4	PCC/CC1		High		CP-OFDM 64QAM	7@N_{RB}-7
	SCC1/CC2		High		-	-
	Wgap		Max Wgap		N/A	N/A
	SCC2/CC3		High		N/A	N/A
	SCC3/CC4		High		N/A	N/A
Default Test Settings for a CA_nX(D-H)_UL_nXD, CA_nX(D-P)_UL_nXD, CA_nX(E-O)_UL_nXO Configuration						
1	PCC/CC1	Default	Low	N/A for this test	CP-OFDM 64QAM	Outer_1RB_Left
	SCC1/CC2		Low		-	-
	Wgap		Max Wgap		N/A	N/A
	SCC2/CC3		Low		N/A	N/A
	SCC3/CC4		Low		N/A	N/A
	SCC4/CC5		Low		N/A	N/A
2	PCC/CC1		High		CP-OFDM 64QAM	Outer_1RB_Right
	SCC1/CC2		High		-	-
	Wgap		Max Wgap		N/A	N/A

	SCC2/CC3		High		N/A	N/A
	SCC3/CC4		High		N/A	N/A
	SCC4/CC5		High		N/A	N/A
3	PCC/CC1		Low		CP-OFDM 64QAM	7@0
	SCC1/CC2		Low		-	-
	Wgap		Max Wgap		N/A	N/A
	SCC2/CC3		Low		N/A	N/A
	SCC3/CC4		Low		N/A	N/A
	SCC4/CC5		Low		N/A	N/A
4	PCC/CC1		High		CP-OFDM 64QAM	7@N_{RB}-7
	SCC1/CC2		High		-	-
	Wgap		Max Wgap		N/A	N/A
	SCC2/CC3		High		N/A	N/A
	SCC3/CC4		High		N/A	N/A
	SCC4/CC5		High		N/A	N/A
Default Test Settings for a CA_nX(D-I)_UL_nXD, CA_nX(D-Q)_UL_nXD, CA_nX(G-I)_UL_nXG Configuration						
1	PCC/CC1	Default	Low	N/A for this test	CP-OFDM 64QAM	Outer_1RB_Left
	SCC1/CC2		Low		-	-
	Wgap		Max Wgap		N/A	N/A
	SCC2/CC3		Low		N/A	N/A
	SCC3/CC4		Low		N/A	N/A
	SCC4/CC5		Low		N/A	N/A
	SCC5/CC6		Low		N/A	N/A
2	PCC/CC1		High		CP-OFDM 64QAM	Outer_1RB_Right
	SCC1/CC2		High		-	-
	Wgap		Max Wgap		N/A	N/A
	SCC2/CC3		High		N/A	N/A
	SCC3/CC4		High		N/A	N/A
	SCC4/CC5		High		N/A	N/A
	SCC5/CC6		High		N/A	N/A
3	PCC/CC1		Low		CP-OFDM 64QAM	7@0
	SCC1/CC2		Low		-	-
	Wgap		Max Wgap		N/A	N/A
	SCC2/CC3		Low		N/A	N/A
	SCC3/CC4		Low		N/A	N/A
	SCC4/CC5		Low		N/A	N/A
	SCC5/CC6		Low		N/A	N/A
4	PCC/CC1		High		CP-OFDM 64QAM	7@N_{RB}-7
	SCC1/CC2		High		-	-
	Wgap		Max Wgap		N/A	N/A
	SCC2/CC3		High		N/A	N/A
	SCC3/CC4		High		N/A	N/A
	SCC4/CC5		High		N/A	N/A
	SCC5/CC6		High		N/A	N/A
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10].						

Table 6.2A.2.1.4.1-2: Intra-band Contiguous UL CA Test Configuration Table (Power Class 1, single CC MPR requirement)

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal			
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes			Lowest range, Highest range			
Test CC Combination setting (aggregated BW of the CA configuration) as specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE			Highest aggregated channel bandwidth of the CA configuration			
Test SCS as specified in Table 5.3.5-1			120 kHz			
Test Parameters						
Test ID	**CC & Mapping (NOTE 2)**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation**
Default Test Settings for a CA_nXG, CA_nXO Configuration (Cumulative aggregated BWchannel <= 200MHz)						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM PI/2 BPSK	Outer_Full
	SCC/CC2				-	-
2	PCC/CC1				DFT-s-OFDM QPSK	Inner_Full
	SCC/CC2				-	-
Default Test Settings for a CA_nXD Configuration (Cumulative aggregated BWchannel <= 400MHz)						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM PI/2 BPSK	Outer_Full
	SCC/CC2				-	-
2	PCC/CC1				DFT-s-OFDM PI/2 BPSK	Inner_Full
	SCC/CC2				-	-
3	PCC/CC1				DFT-s-OFDM QPSK	Inner_Full
	SCC/CC2				-	-
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10]. NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.						

Table 6.2A.2.1.4.1-3: Intra-band Contiguous UL CA Test Configuration Table (Power Class 1, MPR_{C_CA})

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal			
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes			For intra-band contiguous CA: Mid range. For intra-band non-contiguous CA: Lowest range with Max Wgap, Highest range with Max Wgap.			
Test CC Combination setting (aggregated BW of the CA configuration) as specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE			Highest aggregated channel bandwidth of the CA configuration			
Test SCS as specified in Table 5.3.5-1			120 kHz			
Test Parameters						
Test ID	**CC& Mapping (NOTE 2)**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation**
Default Test Settings for a CA_nXB, CA_nXC_UL_nXB Configuration (800MHz <= Cumulative aggregated BWchannel <= 1400MHz)						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC/CC2				DFT-s-OFDM Pi/2 BPSK	Outer_Full
2	PCC/CC1				DFT-s-OFDM QPSK	Outer_Full
	SCC/CC2				DFT-s-OFDM QPSK	Outer_Full
3	PCC/CC1				DFT-s-OFDM 16QAM	Outer_Full
	SCC/CC2				DFT-s-OFDM 16QAM	Outer_Full
4	PCC/CC1				CP-OFDM 16QAM	Outer_Full
	SCC/CC2				CP-OFDM 16QAM	Outer_Full
5	PCC/CC1				CP-OFDM 64QAM	Outer_Full
	SCC/CC2				CP-OFDM 64QAM	Outer_Full
Default Test Settings for a CA_nXD Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC/CC2				DFT-s-OFDM Pi/2 BPSK	Outer_Full
2	PCC/CC1				CP-OFDM 16QAM	Outer_Full
	SCC/CC2				CP-OFDM 16QAM	Outer_Full
3	PCC/CC1				CP-OFDM 64QAM	Outer_Full
	SCC/CC2				CP-OFDM 64QAM	Outer_Full
Default Test Settings for a CA_nXB Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	PCC/CC1	200MHz	Default	N/A for this test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC/CC2	400MHz			DFT-s-OFDM Pi/2 BPSK	Outer_Full
2	PCC/CC1	200MHz			CP-OFDM 16QAM	Outer_Full
	SCC/CC2	400MHz			CP-OFDM 16QAM	Outer_Full
3	PCC/CC1	200MHz			CP-OFDM 64QAM	Outer_Full
	SCC/CC2	400MHz			CP-OFDM 64QAM	Outer_Full
Default Test Settings for a CA_nXG, CA_nXO Configuration (Cumulative aggregated BWchannel < 400MHz)						
1	PCC/CC1	Default	Default	N/A for this	DFT-s-OFDM Pi/2 BPSK	Outer_Full

	SCC/CC2			test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
2	PCC/CC1				CP-OFDM 16QAM	Outer_Full
	SCC/CC2				CP-OFDM 16QAM	Outer_Full
3	PCC/CC1				CP-OFDM 64QAM	Outer_Full
	SCC/CC2				CP-OFDM 64QAM	Outer_Full
Default Test Settings for a CA_nXD Configuration (Cumulative aggregated BWchannel < 400MHz)						
1	PCC/CC1	100MHz	Default	N/A for this	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC/CC2	200MHz		test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
2	PCC/CC1	100MHz			CP-OFDM 16QAM	Outer_Full
	SCC/CC2	200MHz			CP-OFDM 16QAM	Outer_Full
3	PCC/CC1	100MHz			CP-OFDM 64QAM	Outer_Full
	SCC/CC2	200MHz			CP-OFDM 64QAM	Outer_Full
Default Test Settings for a CA_nX(D-G)_UL_nXD, CA_nX(D-G)_UL_nXG, CA_nX(D-O)_UL_nXD, CA_nX(D-O)_UL_nXO Configuration (800MHz <= Cumulative aggregated BWchannel <= 1400MHz)						
1	PCC/CC1	Default	Default	N/A for this	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC1/CC2			test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
2	PCC/CC1				DFT-s-OFDM QPSK	Outer_Full
	SCC1/CC2				DFT-s-OFDM QPSK	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
3	PCC/CC1				DFT-s-OFDM 16QAM	Outer_Full
	SCC1/CC2				DFT-s-OFDM 16QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
4	PCC/CC1				CP-OFDM 16QAM	Outer_Full
	SCC1/CC2				CP-OFDM 16QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
5	PCC/CC1				CP-OFDM 64QAM	Outer_Full
	SCC1/CC2				CP-OFDM 64QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
Default Test Settings for a CA_nX(D-H)_UL_nXD, CA_nX(D-P)_UL_nXD, CA_nX(E-O)_UL_nXO Configuration (800MHz <= Cumulative aggregated BWchannel <= 1400MHz)						
1	PCC/CC1	Default	Default	N/A for this	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC1/CC2			test	DFT-s-OFDM Pi/2 BPSK	Outer_Full

	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
2	PCC/CC1				DFT-s-OFDM QPSK	Outer_Full
	SCC1/CC2				DFT-s-OFDM QPSK	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
3	PCC/CC1				DFT-s-OFDM 16QAM	Outer_Full
	SCC1/CC2				DFT-s-OFDM 16QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
4	PCC/CC1				CP-OFDM 16QAM	Outer_Full
	SCC1/CC2				CP-OFDM 16QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
5	PCC/CC1				CP-OFDM 64QAM	Outer_Full
	SCC1/CC2				CP-OFDM 64QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
Default Test Settings for a CA_nX(D-I)_UL_nXD, CA_nX(D-Q)_UL_nXD, CA_nX(G-I)_UL_nXG Configuration (800MHz <= Cumulative aggregated BWchannel <= 1400MHz)						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC1/CC2				DFT-s-OFDM Pi/2 BPSK	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
	SCC5/CC6				N/A	N/A
2	PCC/CC1				DFT-s-OFDM QPSK	Outer_Full
	SCC1/CC2				DFT-s-OFDM QPSK	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
	SCC5/CC6				N/A	N/A
3	PCC/CC1				DFT-s-OFDM 16QAM	Outer_Full
	SCC1/CC2				DFT-s-OFDM 16QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
	SCC5/CC6				N/A	N/A

4	PCC/CC1				CP-OFDM 16QAM	Outer_Full
	SCC1/CC2				CP-OFDM 16QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
	SCC5/CC6				N/A	N/A
5	PCC/CC1				CP-OFDM 64QAM	Outer_Full
	SCC1/CC2				CP-OFDM 64QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
	SCC5/CC6				N/A	N/A
Default Test Settings for a CA_nX(D-G)_UL_nXD, CA_nX(D-O)_UL_nXD Configuration (400MHz <= Cumulative aggregated BWchannel <800MHz)						
1	PCC/CC1	200MHz	Default	N/A for this test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC1/CC2	200MHz			DFT-s-OFDM Pi/2 BPSK	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
2	PCC/CC1	200MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
3	PCC/CC1	200MHz			CP-OFDM 64QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 64QAM	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
Default Test Settings for a CA_nX(D-G)_UL_nXG, CA_nX(D-O)_UL_nXO Configuration (400MHz <= Cumulative aggregated BWchannel <800MHz)						
1	PCC/CC1	100MHz	Default	N/A for this test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC1/CC2	100MHz			DFT-s-OFDM Pi/2 BPSK	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	200MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
2	PCC/CC1	100MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	200MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
3	PCC/CC1	100MHz			CP-OFDM 64QAM	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM 64QAM	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	200MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
Default Test Settings for a CA_nX(D-H)_UL_nXD, CA_nX(D-P)_UL_nXD, Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						

1	PCC/CC1	200MHz	Default	N/A for this test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC1/CC2	200MHz			DFT-s-OFDM Pi/2 BPSK	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
2	PCC/CC1	200MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
3	PCC/CC1	200MHz			CP-OFDM 64QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 64QAM	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
Default Test Settings for a CA_nX(O-E)_UL_nXO Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	PCC/CC1	100MHz	Default	N/A for this test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC1/CC2	100MHz			DFT-s-OFDM Pi/2 BPSK	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
	SCC4/CC5	200MHz			N/A	N/A
2	PCC/CC1	100MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
	SCC4/CC5	200MHz			N/A	N/A
3	PCC/CC1	100MHz			CP-OFDM 64QAM	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM 64QAM	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
	SCC4/CC5	200MHz			N/A	N/A
Default Test Settings for a CA_nX(D-I)_UL_nXD, CA_nX(D-Q)_UL_nXD Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	PCC/CC1	100MHz	Default	N/A for this test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC1/CC2	200MHz			DFT-s-OFDM Pi/2 BPSK	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
2	PCC/CC1	100MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	90MHz			N/A	N/A

	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
3	PCC/CC1	100MHz			CP-OFDM 64QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 64QAM	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
Default Test Settings for a CA_nX(G-I)_UL_nXG Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	PCC/CC1	100MHz	Default	N/A for this test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC1/CC2	100MHz			DFT-s-OFDM Pi/2 BPSK	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
2	PCC/CC1	100MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
3	PCC/CC1	100MHz			CP-OFDM 64QAM	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM 64QAM	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
Default Test Settings for a CA_nX(D-O)_UL_nXD Configuration (Cumulative aggregated BWchannel <400MHz)						
1	PCC/CC1	50MHz	Default	N/A for this test	DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC1/CC2	200MHz			DFT-s-OFDM Pi/2 BPSK	Outer_Full
	Wgap	40MHz			N/A	N/A
	SCC2/CC3	50MHz			N/A	N/A
	SCC3/CC4	50MHz			N/A	N/A
2	PCC/CC1	50MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	40MHz			N/A	N/A
	SCC2/CC3	50MHz			N/A	N/A
	SCC3/CC4	50MHz			N/A	N/A
3	PCC/CC1	50MHz			CP-OFDM 64QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 64QAM	Outer_Full
	Wgap	40MHz			N/A	N/A
	SCC2/CC3	50MHz			N/A	N/A
	SCC3/CC4	50MHz			N/A	N/A
Default Test Settings for a CA_nX(D-O)_UL_nXO Configuration (Cumulative aggregated BWchannel <400MHz)						
1	PCC/CC1	50MHz	Default	N/A for this	N/A	N/A

	SCC1/CC2	200MHz		test	N/A	N/A
	Wgap	40MHz			N/A	N/A
	SCC2/CC3	50MHz			DFT-s-OFDM Pi/2 BPSK	Outer_Full
	SCC3/CC4	50MHz			DFT-s-OFDM Pi/2 BPSK	Outer_Full
2	PCC/CC1	50MHz			N/A	N/A
	SCC1/CC2	200MHz			N/A	N/A
	Wgap	40MHz			N/A	N/A
	SCC2/CC3	50MHz			CP-OFDM 16QAM	Outer_Full
	SCC3/CC4	50MHz			CP-OFDM 16QAM	Outer_Full
3	PCC/CC1	50MHz			N/A	N/A
	SCC1/CC2	200MHz			N/A	N/A
	Wgap	40MHz			N/A	N/A
	SCC2/CC3	50MHz			CP-OFDM 64QAM	Outer_Full
	SCC3/CC4	50MHz			CP-OFDM 64QAM	Outer_Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10].						

Table 6.2A.2.1.4.1-4: Intra-band Contiguous UL CA Test Configuration Table (Power Class 1, Non-contiguous allocation)

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal			
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes			For intra-band contiguous CA: Mid range. For intra-band non-contiguous CA: Lowest range with Max Wgap, Highest range with Max Wgap.			
Test CC Combination setting (aggregated BW of the CA configuration) as specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE			Highest aggregated channel bandwidth of the CA configuration			
Test SCS as specified in Table 5.3.5-1			120 kHz			
Test Parameters						
Test ID	**CC & Mapping (NOTE 2)**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation**
Default Test Settings for a CA_nXB, CA_nXD, CA_XG, CA_nXO Configuration						
1	PCC/CC1	Default	Default	N/A for this test	CP-OFDM 64QAM	Outer_1RB_Left
	SCC/CC2				CP-OFDM 64QAM	Outer_1RB_Right
2	PCC/CC1				DFT-s-OFDM Pi/2 BPSK	[Outer_0.9_Left]
	SCC/CC2				DFT-s-OFDM Pi/2 BPSK	[Outer_0.9_Right]
3	PCC/CC1				DFT-s-OFDM Pi/2 QPSK	[Outer_0.9_Left]
	SCC/CC2				DFT-s-OFDM Pi/2 QPSK	[Outer_0.9_Right]
Default Test Settings for a CA_nX(D-G), CA_nX(D-O) Configuration						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_1RB_Left
	SCC1/CC2				DFT-s-OFDM QPSK	Outer_1RB_Right
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
2	PCC/CC1				DFT-s-OFDM Pi/2 BPSK	[Outer_0.9_Left]
	SCC1/CC2				DFT-s-OFDM Pi/2 BPSK	[Outer_0.9_Right]
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
3	PCC/CC1				DFT-s-OFDM Pi/2 QPSK	[Outer_0.9_Left]
	SCC1/CC2				DFT-s-OFDM Pi/2 QPSK	[Outer_0.9_Right]
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10].						

Table 6.2A.2.1.4.1-5: Intra-band Contiguous UL CA Test Configuration Table (Power Class 2, 3 and 4, single CC MPR requirement)

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal			
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes			Lowest range, Highest range			
Test CC Combination setting (aggregated BW of the CA configuration) as specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE			Highest aggregated channel bandwidth of the CA configuration			
Test SCS as specified in Table 5.3.5-1			120 kHz			
Test Parameters						
Test ID	**CC & Mapping (NOTE 2)**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation**
Default Test Settings for a CA_nXG, CA_nXO Configuration (Cumulative aggregated BWchannel <= 200MHz)						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM QPSK	Inner_Full
	SCC/CC2				-	-
2	PCC/CC1				DFT-s-OFDM QPSK	Outer_Full
	SCC/CC2				-	-
Default Test Settings for a CA_nXD Configuration (Cumulative aggregated BWchannel <= 400MHz)						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM QPSK	Inner_Full
	SCC/CC2				-	-
2	PCC/CC1				DFT-s-OFDM QPSK	Outer_Full
	SCC/CC2				-	-
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10].						

Table 6.2A.2.1.4.1-6: Intra-band Contiguous UL CA Test Configuration Table (Power Class 2, 3 and 4, MPR_{C_CA})

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal			
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes			For intra-band contiguous CA: Mid range. For intra-band non-contiguous CA: Lowest range with Max Wgap, Highest range with Max Wgap.			
Test CC Combination setting (aggregated BW of the CA configuration) as specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE			Highest aggregated channel bandwidth of the CA configuration			
Test SCS as specified in Table 5.3.5-1			120 kHz			
Test Parameters						
Test ID	**CC & Mapping (NOTE 2)**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation**
Default Test Settings for a CA_nXB, nXC_UL_nXB Configuration (800MHz <= Cumulative aggregated BWchannel <= 1400MHz)						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_Full
	SCC/CC2				DFT-s-OFDM QPSK	Outer_Full
2	PCC/CC1				DFT-s-OFDM 16QAM	Outer_Full
	SCC/CC2				DFT-s-OFDM 16QAM	Outer_Full
3	PCC/CC1				CP-OFDM QPSK	Outer_Full
	SCC/CC2				CP-OFDM QPSK	Outer_Full
4	PCC/CC1				CP-OFDM 16QAM	Outer_Full
	SCC/CC2				CP-OFDM 16QAM	Outer_Full
5	PCC/CC1				CP-OFDM 64QAM	Outer_Full
	SCC/CC2				CP-OFDM 64QAM	Outer_Full
Default Test Settings for a CA_nXD Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_Full
	SCC/CC2				DFT-s-OFDM QPSK	Outer_Full
2	PCC/CC1				CP-OFDM QPSK	Outer_Full
	SCC/CC2				CP-OFDM QPSK	Outer_Full
3	PCC/CC1				CP-OFDM 16QAM	Outer_Full
	SCC/CC2				CP-OFDM 16QAM	Outer_Full
4	PCC/CC1				CP-OFDM 64QAM	Outer_Full
	SCC/CC2				CP-OFDM 64QAM	Outer_Full
Default Test Settings for a CA_nXB Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	PCC/CC1	200MHz	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_Full
	SCC/CC2	400MHz			DFT-s-OFDM QPSK	Outer_Full
2	PCC/CC1	200MHz			CP-OFDM QPSK	Outer_Full
	SCC/CC2	400MHz			CP-OFDM QPSK	Outer_Full
3	PCC/CC1	200MHz			CP-OFDM 16QAM	Outer_Full

	SCC/CC2	400MHz			CP-OFDM 16QAM	Outer_Full
4	PCC/CC1	200MHz			CP-OFDM 64QAM	Outer_Full
	SCC/CC2	400MHz			CP-OFDM 64QAM	Outer_Full
Default Test Settings for a CA_nXG, CA_nXO Configuration (Cumulative aggregated BWchannel < 400MHz)						
1	PCC/CC1	Default	Default	N/A for this test	CP-OFDM QPSK	Outer_Full
	SCC/CC2				CP-OFDM QPSK	Outer_Full
2	PCC/CC1				CP-OFDM 16QAM	Outer_Full
	SCC/CC2				CP-OFDM 16QAM	Outer_Full
3	PCC/CC1				CP-OFDM 64QAM	Outer_Full
	SCC/CC2				CP-OFDM 64QAM	Outer_Full
Default Test Settings for a CA_nXD Configuration (Cumulative aggregated BWchannel < 400MHz)						
1	PCC/CC1	100MHz	Default	N/A for this test	CP-OFDM QPSK	Outer_Full
	SCC/CC2	200MHz			CP-OFDM QPSK	Outer_Full
2	PCC/CC1	100MHz			CP-OFDM 16QAM	Outer_Full
	SCC/CC2	200MHz			CP-OFDM 16QAM	Outer_Full
3	PCC/CC1	100MHz			CP-OFDM 64QAM	Outer_Full
	SCC/CC2	200MHz			CP-OFDM 64QAM	Outer_Full
Default Test Settings for a CA_nX(D-G))_UL_nXD, CA_nX(D-G)_UL_nXG, CA_nX(D-O)_UL_nXD, CA_nX(D-O)_UL_nXO Configuration (800MHz <= Cumulative aggregated BWchannel <= 1400MHz)						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_Full
	SCC1/CC2				DFT-s-OFDM QPSK	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
2	PCC/CC1				DFT-s-OFDM 16QAM	Outer_Full
	SCC1/CC2				DFT-s-OFDM 16QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
3	PCC/CC1				CP-OFDM QPSK	Outer_Full
	SCC1/CC2				CP-OFDM QPSK	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
4	PCC/CC1				CP-OFDM 16QAM	Outer_Full
	SCC1/CC2				CP-OFDM 16QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
5	PCC/CC1				CP-OFDM 64QAM	Outer_Full
	SCC1/CC2				CP-OFDM 64QAM	Outer_Full
	Wgap				N/A	N/A

	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
Default Test Settings for a CA_nX(D-H)_UL_nXD, CA_nX(D-P)_UL_nXD, CA_nX(E-O)_UL_nXO Configuration (800MHz <= Cumulative aggregated BWchannel <= 1400MHz)						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_Full
	SCC1/CC2				DFT-s-OFDM QPSK	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
2	PCC/CC1				DFT-s-OFDM 16QAM	Outer_Full
	SCC1/CC2				DFT-s-OFDM 16QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
3	PCC/CC1				CP-OFDM QPSK	Outer_Full
	SCC1/CC2				CP-OFDM QPSK	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
4	PCC/CC1				CP-OFDM 16QAM	Outer_Full
	SCC1/CC2				CP-OFDM 16QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
5	PCC/CC1				CP-OFDM 64QAM	Outer_Full
	SCC1/CC2				CP-OFDM 64QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
Default Test Settings for a CA_nX(D-I)_UL_nXD, CA_nX(D-Q)_UL_nXD, CA_nX(G-I)_UL_nXG Configuration (800MHz <= Cumulative aggregated BWchannel <= 1400MHz)						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_Full
	SCC1/CC2				DFT-s-OFDM QPSK	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
	SCC5/CC6				N/A	N/A
2	PCC/CC1				DFT-s-OFDM 16QAM	Outer_Full
	SCC1/CC2				DFT-s-OFDM 16QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
	SCC5/CC6				N/A	N/A
3	PCC/CC1				CP-OFDM QPSK	Outer_Full

	SCC1/CC2				CP-OFDM QPSK	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
	SCC5/CC6				N/A	N/A
4	PCC/CC1				CP-OFDM 16QAM	Outer_Full
	SCC1/CC2				CP-OFDM 16QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
	SCC5/CC6				N/A	N/A
5	PCC/CC1				CP-OFDM 64QAM	Outer_Full
	SCC1/CC2				CP-OFDM 64QAM	Outer_Full
	Wgap				N/A	N/A
	SCC2/CC3				N/A	N/A
	SCC3/CC4				N/A	N/A
	SCC4/CC5				N/A	N/A
	SCC5/CC6				N/A	N/A
Default Test Settings for a CA_nX(D-G)_UL_nXD, CA_nX(D-O)_UL_nXD Configuration (400MHz <= Cumulative aggregated BWchannel <800MHz)						
1	PCC/CC1	200MHz	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_Full
	SCC1/CC2	200MHz			DFT-s-OFDM QPSK	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
2	PCC/CC1	200MHz			CP-OFDM QPSK	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM QPSK	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
3	PCC/CC1	200MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
4	PCC/CC1	200MHz			CP-OFDM 64QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 64QAM	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
Default Test Settings for a CA_nX(D-G)_UL_nXG, CA_nX(D-O)_UL_nXO Configuration (400MHz <= Cumulative aggregated BWchannel <800MHz)						
1	PCC/CC1	100MHz	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_Full
	SCC1/CC2	100MHz			DFT-s-OFDM QPSK	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	200MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
2	PCC/CC1	100MHz			CP-OFDM QPSK	Outer_Full

	SCC1/CC2	100MHz			CP-OFDM QPSK	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	200MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
3	PCC/CC1	100MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	200MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
4	PCC/CC1	100MHz			c	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM 64QAM	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	200MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
Default Test Settings for a CA_nX(D-H)_UL_nXD, CA_nX(D-P)_UL_nXD, Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	PCC/CC1	200MHz	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_Full
	SCC1/CC2	200MHz			DFT-s-OFDM QPSK	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
2	PCC/CC1	200MHz			CP-OFDM QPSK	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM QPSK	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
3	PCC/CC1	200MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
4	PCC/CC1	200MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
Default Test Settings for a CA_nX(O-E)_UL_nXO Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	PCC/CC1	100MHz	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_Full
	SCC1/CC2	100MHz			DFT-s-OFDM QPSK	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
	SCC4/CC5	200MHz			N/A	N/A
2	PCC/CC1	100MHz			CP-OFDM QPSK	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM QPSK	Outer_Full

	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
	SCC4/CC5	200MHz			N/A	N/A
3	PCC/CC1	100MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
	SCC4/CC5	200MHz			N/A	N/A
4	PCC/CC1	100MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	200MHz			N/A	N/A
	SCC4/CC5	200MHz			N/A	N/A
Default Test Settings for a CA_nX(D-I)_UL_nXD, CA_nX(D-Q)_UL_nXD Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	PCC/CC1	100MHz	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_Full
	SCC1/CC2	200MHz			DFT-s-OFDM QPSK	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
2	PCC/CC1	100MHz			CP-OFDM QPSK	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM QPSK	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
3	PCC/CC1	100MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
4	PCC/CC1	100MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	90MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
Default Test Settings for a CA_nX(G-I)_UL_nXG Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	PCC/CC1	100MHz	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_Full
	SCC1/CC2	100MHz			DFT-s-OFDM QPSK	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A

	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
2	PCC/CC1	100MHz			CP-OFDM QPSK	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM QPSK	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
3	PCC/CC1	100MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
4	PCC/CC1	100MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	100MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	190MHz			N/A	N/A
	SCC2/CC3	100MHz			N/A	N/A
	SCC3/CC4	100MHz			N/A	N/A
	SCC4/CC5	100MHz			N/A	N/A
	SCC5/CC6	100MHz			N/A	N/A
Default Test Settings for a CA_nX(D-O)_UL_nXD Configuration (Cumulative aggregated BWchannel <400MHz)						
1	PCC/CC1	50MHz	Default	N/A for this test	CP-OFDM QPSK	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM QPSK	Outer_Full
	Wgap	40MHz			N/A	N/A
	SCC2/CC3	50MHz			N/A	N/A
	SCC3/CC4	50MHz			N/A	N/A
2	PCC/CC1	50MHz			CP-OFDM 16QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 16QAM	Outer_Full
	Wgap	40MHz			N/A	N/A
	SCC2/CC3	50MHz			N/A	N/A
	SCC3/CC4	50MHz			N/A	N/A
3	PCC/CC1	50MHz			CP-OFDM 64QAM	Outer_Full
	SCC1/CC2	200MHz			CP-OFDM 64QAM	Outer_Full
	Wgap	40MHz			N/A	N/A
	SCC2/CC3	50MHz			N/A	N/A
	SCC3/CC4	50MHz			N/A	N/A
Default Test Settings for a CA_nX(D-O)_UL_nXO Configuration (Cumulative aggregated BWchannel <400MHz)						
1	PCC/CC1	50MHz	Default	N/A for this test	N/A	N/A
	SCC1/CC2	200MHz			N/A	N/A
	Wgap	40MHz			N/A	N/A
	SCC2/CC3	50MHz			CP-OFDM QPSK	Outer_Full
	SCC3/CC4	50MHz			CP-OFDM QPSK	Outer_Full
2	PCC/CC1	50MHz			N/A	N/A
	SCC1/CC2	200MHz			N/A	N/A
	Wgap	40MHz			N/A	N/A
	SCC2/CC3	50MHz			CP-OFDM 16QAM	Outer_Full
	SCC3/CC4	50MHz			CP-OFDM 16QAM	Outer_Full
3	PCC/CC1	50MHz			N/A	N/A
	SCC1/CC2	200MHz			N/A	N/A
	Wgap	40MHz			N/A	N/A

	SCC2/CC3	50MHz			CP-OFDM 64QAM	Outer_Full
	SCC3/CC4	50MHz			CP-OFDM 64QAM	Outer_Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10].						

Table 6.2A.2.1.4.1-7: Intra-band Contiguous UL CA Test Configuration Table (Power Class 2, 3 and 4, Non-contiguous allocation)

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal			
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes			Mid range			
Test CC Combination setting (aggregated BW of the CA configuration) as specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE			Highest aggregated channel bandwidth of the CA configuration			
Test SCS as specified in Table 5.3.5-1			120 kHz			
Test Parameters						
Test ID	CC **& Mapping (NOTE 2)**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation**
Default Test Settings for a CA_XG, CA_nXO Configuration (Cumulative aggregated BWchannel < 400MHz)						
1	PCC/CC1	Default	Default	N/A for this test	DFT-s-OFDM QPSK	Outer_1RB_Left
	SCC/CC2				DFT-s-OFDM QPSK	Outer_1RB_Right
2	PCC/CC1				DFT-s-OFDM Pi/2 BPSK	[Outer_0.9_Left]
	SCC/CC2				DFT-s-OFDM Pi/2 BPSK	[Outer_0.9_Right]
3	PCC/CC1				DFT-s-OFDM Pi/2 QPSK	[Outer_0.9_Left]
	SCC/CC2				DFT-s-OFDM Pi/2 QPSK	[Outer_0.9_Right]
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1. NOTE 2: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10].						

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.
4. The UL Reference Measurement channels are set according to Table 6.2A.2.1.4.1-1 to Table 6.2A.2.1.4.1-7.
5. Propagation conditions are set according to Annex B.0
6. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On*, Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [10] clause 4.5. Message contents are defined in clause 6.2A.2.1.4.3.

6.2A.2.1.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 and Annex C.3.0 for all downlink physical channels
2. The SS shall configure SCC as per TS 38.508-1 [10] subclause 5.5.1 Procedure to configure SCC(s) for NR RF CA testing. Message contents are defined in subclause 6.2A.2.1.4.3.
3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321, clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], 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.2.1.4.1-1 to Table 6.2A.2.1.4.1-7. 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 uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 msec starting from the first TPC command in this step to ensure that the UE transmits at its maximum output power.
6. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.
7. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.
8. Measure UE EIRP in the Tx beam peak direction in the accumulative aggregated channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in 6.2A.2.1.5. EIRP test procedure is defined in Annex K.1.3. The measuring duration is one active uplink subframe. EIRP is calculated considering both polarizations, theta and phi.
9. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

NOTE 2: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.2A.2.1.4.1-1 to Table 6.2A.2.1.4.1-7, send an NR RRCReconfiguration message according to TS 38.508-1 [10] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

6.2A.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6. In test procedure step 1, for SCC configuration there are no additional message contents.

6.2A.2.1.5 Test requirement

The EIRP derived in step 8 shall be within the range prescribed by the nominal maximum output power and tolerance in the applicable table from Table 6.2A.2.1.5-1 to Table 6.2A.2.1.5-17.

Table 6.2A.2.1.5-1: MPR requirements for Intra-band Contiguous UL CA (Power Class 1, MPR_{narrow})

Test ID	Band	Min peak EIRP (dBm)	MPR (dB)	T(MPR) (dB)	Lower limit (dBm)	Upper limit (dBm)
1	n257, n258, n261	40.0	14.4	[7.0]	[18.6]-TT	55
1	n260	38.0	14.4	[7.0]	[16.6]-TT	55
2	n257, n258, n261	40.0	14.4	[7.0]	[18.6]-TT	55
2	n260	38.0	14.4	[7.0]	[16.6]-TT	55
3	n257, n258, n261	40.0	10	[5]	[25.0]-TT	55
3	n260	38.0	10	[5]	[23.0]-TT	55
4	n257, n258, n261	40.0	10	[5]	[25.0]-TT	55
4	n260	38.0	10	[5]	[23.0]-TT	55
NOTE 1: TT for each band and accumulative aggregated bandwidth is specified in Table 6.2A.2.1.5-5.						

Table 6.2A.2.1.5-2: MPR requirements for Intra-band Contiguous UL CA (Power Class 1, single CC MPR requirement)

Test ID	Band	Min peak EIRP (dBm)	MPR (dB)	T(MPR) (dB)	Lower limit (dBm)	Upper limit (dBm)
Test requirements for a CA_nXG, CA_nXO Configuration (Cumulative aggregated BWchannel <= 200MHz)						
1	n257, n258, n261	40.0	5.5	[5.0]	[29.5]-TT	55
1	n260	38.0	5.5	[5.0]	[27.5]-TT	55
2	n257, n258, n261	40.0	3.0	[2.0]	[35.0]-TT	55
2	n260	38.0	3.0	[2.0]	[33.0]-TT	55
Test requirements for a CA_nXD Configuration (Cumulative aggregated BWchannel <= 400MHz)						
1	n257, n258, n261	40.0	5.5	[5.0]	[29.5]-TT	55
1	n260	38.0	5.5	[5.0]	[27.5]-TT	55
2	n257, n258, n261	40.0	3.0	[2.0]	[35.0]-TT	55
2	n260	38.0	3.0	[2.0]	[33.0]-TT	55
3	n257, n258, n261	40.0	3.5	[3.0]	[33.5]-TT	55
3	n260	38.0	3.5	[3.0]	[31.5]-TT	55
NOTE 1: TT for each band and accumulative aggregated bandwidth is specified in Table 6.2A.2.1.5-5.						

Table 6.2A.2.1.5-3: MPR requirements for Intra-band Contiguous UL CA (Power Class 1, MPR_{C_CA})

Test ID	Band	Min peak EIRP (dBm)	MPR (dB)	T(MPR) (dB)	Lower limit (dBm)	Upper limit (dBm)
Test requirements for a CA_nXB, CA_nXC_UL_nXB Configuration (800MHz <= Cumulative aggregated BWchannel <= 1400MHz)						
1	n257, n258, n261	40.0	[8.2]	[5.0]	[26.8]-TT	55
1	n260	38.0	[8.2]	[5.0]	[24.8]-TT	55
2	n257, n258, n261	40.0	[9.7]	[5.0]	[25.3]-TT	55
2	n260	38.0	[9.7]	[5.0]	[23.3]-TT	55
3	n257, n258, n261	40.0	[9.2]	[5.0]	[25.8]-TT	55
3	n260	38.0	[9.2]	[5.0]	[23.8]-TT	55
4	n257, n258, n261	40.0	[8.7]	[5.0]	[26.3]-TT	55
4	n260	38.0	[8.7]	[5.0]	[24.3]-TT	55
5	n257, n258, n261	40.0	[11.2]	[7.0]	[21.8]-TT	55
5	n260	38.0	[11.2]	[7.0]	[19.8]-TT	55
Test requirements for a CA_nXD, CA_nXB Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	n257, n258, n261	40.0	7.7	[5.0]	[27.3]-TT	55
1	n260	38.0	7.7	[5.0]	[25.3]-TT	55
2	n257, n258, n261	40.0	8.7	[5.0]	[26.3]-TT	55
2	n260	38.0	8.7	[5.0]	[24.3]-TT	55
3	n257, n258, n261	40.0	10.7	[7.0]	[22.3]-TT	55
3	n260	38.0	10.7	[7.0]	[20.3]-TT	55
Test requirements for a CA_nXG, CA_nXO, CA_nXD Configuration (Cumulative aggregated BWchannel < 400MHz)						
1	n257, n258, n261	40.0	5.5	[5.0]	[29.5]-TT	55
1	n260	38.0	5.5	[5.0]	[27.5]-TT	55
2	n257, n258, n261	40.0	6.5	[5.0]	[28.5]-TT	55
2	n260	38.0	6.5	[5.0]	[26.5]-TT	55
3	n257, n258, n261	40.0	9.0	[5.0]	[26.0]-TT	55
3	n260	38.0	9.0	[5.0]	[24.0]-TT	55
Test requirements for a CA_nX(D-G)_UL_nXD, CA_nX(D-G)_UL_nXG, CA_nX(D-O)_UL_nXD, CA_nX(D-O)_UL_nXO, CA_nX(D-H)_UL_nXD, CA_nX(D-P)_UL_nXD, CA_nX(E-O)_UL_nXO, CA_nX(D-I)_UL_nXD, CA_nX(D-Q)_UL_nXD, CA_nX(G-I)_UL_nXG Configuration (800MHz <= Cumulative aggregated BWchannel <= 1400MHz)						
1	n257, n258, n261	40.0	[8.2]	[5.0]	[26.8] –TT	55
1	n260	38.0	[8.2]	[5.0]	[24.8] –TT	55
2	n257, n258, n261	40.0	[9.7]	[5.0]	[25.3] –TT	55
2	n260	38.0	[9.7]	[5.0]	[23.3] –TT	55

3	n257, n258, n261	40.0	[9.2]	[5.0]	[25.8] –TT	55
3	n260	38.0	[9.2]	[5.0]	[23.8] –TT	55
4	n257, n258, n261	40.0	[8.7]	[5.0]	[26.3] –TT	55
4	n260	38.0	[8.7]	[5.0]	[24.3] –TT	55
5	n257, n258, n261	40.0	[11.2]	[7.0]	[21.8] –TT	55
5	n260	38.0	[11.2]	[7.0]	[19.8] –TT	55
Test requirements for a CA_nX(D-G)_UL_nXD, CA_nX(D-O)_UL_nXD, CA_nX(D-G)_UL_nXG, CA_nX(D-O)_UL_nXO, CA_nX(D-H)_UL_nXD, CA_nX(D-P)_UL_nXD, CA_nX(O-E)_UL_nXO, CA_nX(D-I)_UL_nXD, CA_nX(D-Q)_UL_nXD, CA_nX(G-I)_UL_nXG Configuration (400MHz <= Cumulative aggregated BWchannel <800MHz)						
1	n257, n258, n261	40.0	7.7	[5.0]	[27.3]-TT	55
1	n260	38.0	7.7	[5.0]	[25.3]-TT	55
2	n257, n258, n261	40.0	8.7	[5.0]	[26.3]-TT	55
2	n260	38.0	8.7	[5.0]	[24.3]-TT	55
3	n257, n258, n261	40.0	10.7	[7.0]	[22.3]-TT	55
3	n260	38.0	10.7	[7.0]	[20.3]-TT	55
Test requirements for a CA_nX(D-O)_UL_nXD, CA_nX(D-O)_UL_nXO Configuration (Cumulative aggregated BWchannel <400MHz)						
1	n257, n258, n261	40.0	5.5	[5.0]	[29.5]-TT	55
1	n260	38.0	5.5	[5.0]	[27.5]-TT	55
2	n257, n258, n261	40.0	6.5	[5.0]	[28.5]-TT	55
2	n260	38.0	6.5	[5.0]	[26.5]-TT	55
3	n257, n258, n261	40.0	9.0	[5.0]	[26.0]-TT	55
3	n260	38.0	9.0	[5.0]	[24.0]-TT	55
NOTE 1: TT for each band and accumulative aggregated bandwidth is specified in Table 6.2A.2.1.5-5.						

Table 6.2A.2.1.5-4: MPR requirements for Intra-band Contiguous UL CA (Power Class 1, Non-contiguous allocation)

Test ID	Band	Min peak EIRP (dBm)	MPR (dB)	T(MPR) (dB)	Lower limit (dBm)	Upper limit (dBm)
Test requirements for a CA_nXB, CA_nXD, CA_XG, CA_nXO Configuration						
1	n257, n258, n261	40.0	[14.4]	[7.0]	[18.6] –TT	55
1	n260	38.0	[14.4]	[7.0]	[16.6] –TT	55
2	n257, n258, n261	FFS	FFS	FFS	FFS	FFS
2	n260	FFS	FFS	FFS	FFS	FFS
3	n257, n258, n261	FFS	FFS	FFS	FFS	FFS
3	n260	FFS	FFS	FFS	FFS	FFS
Test requirements for a CA_nX(D-G), CA_nX(D-O) Configuration						
1	n257, n258, n261	40.0	[14.4]	[7.0]	[18.6] –TT	55
1	n260	38.0	[14.4]	[7.0]	[16.6] –TT	55
2	n257, n258, n261	FFS	FFS	FFS	FFS	FFS
2	n260	FFS	FFS	FFS	FFS	FFS
3	n257, n258, n261	FFS	FFS	FFS	FFS	FFS
3	n260	FFS	FFS	FFS	FFS	FFS
NOTE 1: TT for each band and accumulative aggregated bandwidth is specified in Table 6.2A.2.1.5-5.						

Table 6.2A.2.1.5-5: Test Tolerance (MPR for CA for Power class 1)

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Table 6.2A.2.1.5-6: MPR requirements for Intra-band Contiguous UL CA (Power Class 2, single CC MPR requirement)

Test ID	Band	Min peak EIRP (dBm)	MPR (dB)	T(MPR) (dB)	Lower limit (dBm)	Upper limit (dBm)
Test requirements for a CA_nXG, CA_nXO Configuration (Cumulative aggregated BWchannel <= 200MHz)						
1	n257, n258, n261	29	0	0	29.0-TT	43
2	n257, n258, n261	29	2	[1.5]	[25.5]-TT	43
Test requirements for a CA_nXD Configuration (Cumulative aggregated BWchannel <= 400MHz)						
1	n257, n258, n261	29	0	0	29.0-TT	43
2	n257, n258, n261	29	3	[2.0]	[24.0]-TT	43
NOTE 1: TT for each band and accumulative aggregated bandwidth is specified in Table 6.2A.2.1.5-9.						

Table 6.2A.2.1.5-7: MPR requirements for Intra-band Contiguous UL CA (Power Class 2, MPR_{C_CA})

Test ID	Band	Min peak EIRP (dBm)	MPR (dB)	T(MPR) (dB)	Lower limit (dBm)	Upper limit (dBm)
Test requirements for a CA_nXB, nXC_UL_nXB Configuration (800MHz <= Cumulative aggregated BWchannel <= 1400MHz)						
1	n257, n258, n261	29	[8.2]	[5.0]	[15.8]-TT	43
2	n257, n258, n261	29	[9.3]	[5.0]	[14.7]-TT	43
3	n257, n258, n261	29	[8.0]	[5.0]	[16.0]-TT	43
4	n257, n258, n261	29	[9.2]	[5.0]	[14.8]-TT	43
5	n257, n258, n261	29	[11.2]	[7.0]	[10.8]-TT	43
Test requirements for a CA_nXD, CA_nXB Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	n257, n258, n261	29	7.7	[5.0]	[16.3]-TT	43
2	n257, n258, n261	29	7.5	[5.0]	[16.5]-TT	43
3	n257, n258, n261	29	8.7	[5.0]	[15.3]-TT	43
4	n257, n258, n261	29	10.7	[7.0]	[11.3]-TT	43
Test requirements for a CA_nXG, CA_nXO, CA_nXD Configuration (Cumulative aggregated BWchannel < 400MHz)						
1	n257, n258, n261	29	5	[4.0]	[20.0]-TT	43
2	n257, n258, n261	29	6.5	[5.0]	[17.5]-TT	43
3	n257, n258, n261	29	9	[5.0]	[15.0]-TT	43
Test requirements for a CA_nX(D-G))_UL_nXD, CA_nX(D-G)_UL_nXG, CA_nX(D-O)_UL_nXD, CA_nX(D-O)_UL_nXO, CA_nX(D-H)_UL_nXD, CA_nX(D-P)_UL_nXD, CA_nX(E-O)_UL_nXO, CA_nX(D-I)_UL_nXD, CA_nX(D-Q)_UL_nXD, CA_nX(G-I)_UL_nXG Configuration (800MHz <= Cumulative aggregated BWchannel <= 1400MHz)						
1	n257, n258, n261	29	[8.2]	[5.0]	[15.8]-TT	43
2	n257, n258, n261	29	[9.3]	[5.0]	[14.7]-TT	43
3	n257, n258, n261	29	[8.0]	[5.0]	[16.0]-TT	43
4	n257, n258, n261	29	[9.2]	[5.0]	[14.8]-TT	43
5	n257, n258, n261	29	[11.2]	[7.0]	[10.8]-TT	43
Test requirements for a CA_nX(D-G)_UL_nXD, CA_nX(D-O)_UL_nXD, CA_nX(D-G)_UL_nXG, CA_nX(D-O)_UL_nXO, CA_nX(D-H)_UL_nXD, CA_nX(D-P)_UL_nXD, CA_nX(O-E)_UL_nXO, CA_nX(D-I)_UL_nXD, CA_nX(D-Q)_UL_nXD, CA_nX(G-I)_UL_nXG Configuration (400MHz <= Cumulative aggregated BWchannel < 800MHz)						
1	n257, n258, n261	29	7.7	[5.0]	[16.3]-TT	43
2	n257, n258, n261	29	7.5	[5.0]	[16.5]-TT	43
3	n257, n258, n261	29	8.7	[5.0]	[15.3]-TT	43
4	n257, n258, n261	29	10.7	[7.0]	[11.3]-TT	43
Test requirements for a CA_nX(D-O)_UL_nXD, CA_nX(D-O)_UL_nXO Configuration (Cumulative aggregated BWchannel < 400MHz)						
1	n257, n258, n261	29	7.7	[5.0]	[16.3]-TT	43
2	n257, n258, n261	29	7.5	[5.0]	[16.5]-TT	43
3	n257, n258, n261	29	8.7	[5.0]	[15.3]-TT	43

NOTE 1: TT for each band and accumulative aggregated bandwidth is specified in Table 6.2A.2.1.5-9.

Table 6.2A.2.1.5-8: MPR requirements for Intra-band Contiguous UL CA (Power Class 2, Non-contiguous allocation)

Test ID	Band	Min peak EIRP (dBm)	MPR (dB)	T(MPR) (dB)	Lower limit (dBm)	Upper limit (dBm)
Test requirements for a CA_nXB, CA_nXD, CA_XG, CA_nXO Configuration						
1	n257, n258, n261	29	7	[5.0]	[17.0] –TT	43
2	n257, n258, n261	FFS	FFS	FFS	FFS	FFS
3	n257, n258, n261	FFS	FFS	FFS	FFS	FFS
NOTE 1: TT for each band and accumulative aggregated bandwidth is specified in Table 6.2A.2.1.5-9.						

Table 6.2A.2.1.5-9: Test Tolerance (MPR for CA for Power class 2)

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Table 6.2A.2.1.5-10: MPR requirements for Intra-band Contiguous UL CA (Power Class 3, single CC MPR requirement)

Test ID	Band	Min peak EIRP (dBm)	MPR (dB)	T(MPR) (dB)	Lower limit (dBm)	Upper limit (dBm)
Test requirements for a CA_nXG, CA_nXO Configuration (Cumulative aggregated BWchannel <= 200MHz)						
1	n257, n258, n261	22.4	0	0	22.4-TT	43
1	n260	20.6	0	0	20.6-TT	43
2	n257, n258, n261	22.4	2	[1.5]	[18.9]-TT	43
2	n260	20.6	2	[1.5]	[17.1]-TT	43
Test requirements for a CA_nXD Configuration (Cumulative aggregated BWchannel <= 400MHz)						
1	n257, n258, n261	22.4	0	0	22.4-TT	43
1	n260	20.6	0	0	20.6-TT	43
2	n257, n258, n261	22.4	3	[2.0]	[17.4]-TT	43
2	n260	20.6	3	[2.0]	[15.6]-TT	43
NOTE 1: TT for each band and accumulative aggregated bandwidth is specified in Table 6.2A.2.1.5-13.						

Table 6.2A.2.1.5-11: MPR requirements for Intra-band Contiguous UL CA (Power Class 3, MPR_{C_CA})

Test ID	Band	Min peak EIRP (dBm)	MPR (dB)	T(MPR) (dB)	Lower limit (dBm)	Upper limit (dBm)
Test requirements for a CA_nXB, nXC_UL_nXB Configuration (Cumulative aggregated BWchannel <= 1400MHz)						
1	n257, n258, n261	22.4	[8.2]	[5.0]	[9.2]-TT	43
1	n260	20.6	[8.2]	[5.0]	[7.4]-TT	43
2	n257, n258, n261	22.4	[9.3]	[5.0]	[8.1]-TT	43
2	n260	20.6	[9.3]	[5.0]	[6.3]-TT	43
3	n257, n258, n261	22.4	[8.0]	[5.0]	[9.4]-TT	43
3	n260	20.6	[8.0]	[5.0]	[7.6]-TT	43
4	n257, n258, n261	22.4	[9.2]	[5.0]	[8.2]-TT	43
4	n260	20.6	[9.2]	[5.0]	[6.4]-TT	43
5	n257, n258, n261	22.4	[11.2]	[7.0]	[4.2]-TT	43
5	n260	20.6	[11.2]	[7.0]	[2.4]-TT	43
Test requirements for a CA_nXD, CA_nXB Configuration (Cumulative aggregated BWchannel < 800MHz)						
1	n257, n258, n261	22.4	7.7	[5.0]	[9.7]-TT	43
1	n260	20.6	7.7	[5.0]	[7.9]-TT	43
2	n257, n258, n261	22.4	7.5	[5.0]	[9.9]-TT	43
2	n260	20.6	7.5	[5.0]	[8.1]-TT	43
3	n257, n258, n261	22.4	8.7	[5.0]	[8.7]-TT	43
3	n260	20.6	8.7	[5.0]	[6.9]-TT	43
4	n257, n258, n261	22.4	10.7	[7.0]	[4.7]-TT	43
4	n260	20.6	10.7	[7.0]	[2.9]-TT	43
Test requirements for a CA_nXG, CA_nXO, CA_nXD Configuration (Cumulative aggregated BWchannel < 400MHz)						
1	n257, n258, n261	22.4	5	[4.0]	[13.4]-TT	43
1	n260	20.6	5	[4.0]	[11.6]-TT	43
2	n257, n258, n261	22.4	6.5	[5.0]	[10.9]-TT	43
2	n260	20.6	6.5	[5.0]	[9.1]-TT	43
3	n257, n258, n261	22.4	9	[5.0]	[8.4]-TT	43
3	n260	20.6	9	[5.0]	[6.6]-TT	43
Test requirements for a CA_nX(D-G))_UL_nXD, CA_nX(D-G)_UL_nXG, CA_nX(D-O)_UL_nXD, CA_nX(D-O)_UL_nXO, CA_nX(D-H)_UL_nXD, CA_nX(D-P)_UL_nXD, CA_nX(E-O)_UL_nXO, CA_nX(D-I)_UL_nXD, CA_nX(D-Q)_UL_nXD, CA_nX(G-I)_UL_nXG Configuration (Cumulative aggregated BWchannel <= 1400MHz)						
1	n257, n258, n261	22.4	[8.2]	[5.0]	[9.2]-TT	43
1	n260	20.6	[8.2]	[5.0]	[7.4]-TT	43
2	n257, n258, n261	22.4	[9.3]	[5.0]	[8.1]-TT	43

2	n260	20.6	[9.3]	[5.0]	[6.3]-TT	43
3	n257, n258, n261	22.4	[8.0]	[5.0]	[9.4]-TT	43
3	n260	20.6	[8.0]	[5.0]	[7.6]-TT	43
4	n257, n258, n261	22.4	[9.2]	[5.0]	[8.2]-TT	43
4	n260	20.6	[9.2]	[5.0]	[6.4]-TT	43
5	n257, n258, n261	22.4	[11.2]	[7.0]	[4.2]-TT	43
5	n260	20.6	[11.2]	[7.0]	[2.4]-TT	43
Test requirements for a CA_nX(D-G)_UL_nXD, CA_nX(D-O)_UL_nXD, CA_nX(D-G)_UL_nXG, CA_nX(D-O)_UL_nXO, CA_nX(D-H)_UL_nXD, CA_nX(D-P)_UL_nXD, CA_nX(O-E)_UL_nXO, CA_nX(D-I)_UL_nXD, CA_nX(D-Q)_UL_nXD, CA_nX(G-I)_UL_nXG Configuration (Cumulative aggregated BWchannel < 800MHz)						
1	n257, n258, n261	22.4	7.7	[5.0]	[9.7]-TT	43
1	n260	20.6	7.7	[5.0]	[7.9]-TT	43
2	n257, n258, n261	22.4	7.5	[5.0]	[9.9]-TT	43
2	n260	20.6	7.5	[5.0]	[8.1]-TT	43
3	n257, n258, n261	22.4	8.7	[5.0]	[8.7]-TT	43
3	n260	20.6	8.7	[5.0]	[6.9]-TT	43
4	n257, n258, n261	22.4	10.7	[7.0]	[4.7]-TT	43
4	n260	20.6	10.7	[7.0]	[2.9]-TT	43
Test requirements for a CA_nX(D-O)_UL_nXD, CA_nX(D-O)_UL_nXO Configuration (Cumulative aggregated BWchannel < 400MHz)						
1	n257, n258, n261	22.4	5	[4.0]	[13.4]-TT	43
1	n260	20.6	5	[4.0]	[11.6]-TT	43
2	n257, n258, n261	22.4	6.5	[5.0]	[10.9]-TT	43
2	n260	20.6	6.5	[5.0]	[9.1]-TT	43
3	n257, n258, n261	22.4	9	[5.0]	[8.4]-TT	43
3	n260	20.6	9	[5.0]	[6.6]-TT	43
NOTE 1: TT for each band and accumulative aggregated bandwidth is specified in Table 6.2A.2.1.5-13.						

Table 6.2A.2.1.5-12: MPR requirements for Intra-band Contiguous UL CA (Power Class 3, Non-contiguous allocation)

Test ID	Band	Min peak EIRP (dBm)	MPR (dB)	T(MPR) (dB)	Lower limit (dBm)	Upper limit (dBm)
Test requirements for a CA_nXB, CA_nXD, CA_XG, CA_nXO Configuration						
1	n257, n258, n261	22.4	7	[5.0]	[10.4]-TT	43
1	n260	20.6	7	[5.0]	[8.6]-TT	43
2	n257, n258, n261	FFS	FFS	FFS	FFS	FFS
2	n260	FFS	FFS	FFS	FFS	FFS
3	n257, n258, n261	FFS	FFS	FFS	FFS	FFS
3	n260	FFS	FFS	FFS	FFS	FFS
NOTE 1: TT for each band and accumulative aggregated bandwidth is specified in Table 6.2A.2.1.5-13.						

Table 6.2A.2.1.5-13: Test Tolerance (MPR for CA for Power class 3)

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Table 6.2A.2.1.5-14: MPR requirements for Intra-band Contiguous UL CA (Power Class 4, single CC MPR requirement)

Test ID	Band	Min peak EIRP (dBm)	MPR (dB)	T(MPR) (dB)	Lower limit (dBm)	Upper limit (dBm)
Test requirements for a CA_nXG, CA_nXO Configuration (Cumulative aggregated BWchannel <= 200MHz)						
1	n257, n258, n261	34	0	0	34.0-TT	43
1	n260	31	0	0	31.0-TT	43
2	n257, n258, n261	34	2	[1.5]	[30.5]-TT	43
2	n260	31	2	[1.5]	[27.5]-TT	43
Test requirements for a CA_nXD Configuration (Cumulative aggregated BWchannel <= 400MHz)						
1	n257, n258, n261	34	0	0	34.0-TT	43
1	n260	31	0	0	31.0-TT	43
2	n257, n258, n261	34	3	[2.0]	[29.0]-TT	43
2	n260	31	3	[2.0]	[26.0]-TT	43
NOTE 1: TT for each band and accumulative aggregated bandwidth is specified in Table 6.2A.2.1.5-17.						

Table 6.2A.2.1.5-15: MPR requirements for Intra-band Contiguous UL CA (Power Class 4, MPR_{C_CA})

Test ID	Band	Min peak EIRP (dBm)	MPR (dB)	T(MPR) (dB)	Lower limit (dBm)	Upper limit (dBm)
Test requirements for a CA_nXB, nXC_UL_nXB Configuration (Cumulative aggregated BWchannel <= 1400MHz)						
1	n257, n258, n261	34	[8.2]	[5.0]	[20.8]-TT	43
1	n260	31	[8.2]	[5.0]	[17.8]-TT	43
2	n257, n258, n261	34	[9.3]	[5.0]	[19.7]-TT	43
2	n260	31	[9.3]	[5.0]	[16.7]-TT	43
3	n257, n258, n261	34	[8.0]	[5.0]	[21.0]-TT	43
3	n260	31	[8.0]	[5.0]	[18.0]-TT	43
4	n257, n258, n261	34	[9.2]	[5.0]	[19.8]-TT	43
4	n260	31	[9.2]	[5.0]	[16.8]-TT	43
5	n257, n258, n261	34	[11.2]	[7.0]	[15.8]-TT	43
5	n260	31	[11.2]	[7.0]	[12.8]-TT	43
Test requirements for a CA_nXD, CA_nXB Configuration (Cumulative aggregated BWchannel < 800MHz)						
1	n257, n258, n261	34	7.7	[5.0]	[21.3]-TT	43
1	n260	31	7.7	[5.0]	[18.3]-TT	43
2	n257, n258, n261	34	7.5	[5.0]	[21.5]-TT	43
2	n260	31	7.5	[5.0]	[18.5]-TT	43
3	n257, n258, n261	34	8.7	[5.0]	[20.3]-TT	43
3	n260	31	8.7	[5.0]	[17.3]-TT	43
4	n257, n258, n261	34	10.7	[7.0]	[16.3]-TT	43
4	n260	31	10.7	[7.0]	[13.3]-TT	43
Test requirements for a CA_nXG, CA_nXO, CA_nXD Configuration (Cumulative aggregated BWchannel < 400MHz)						
1	n257, n258, n261	34	5	[4.0]	[25.0]-TT	43
1	n260	31	5	[4.0]	[22.0]-TT	43
2	n257, n258, n261	34	6.5	[5.0]	[22.5]-TT	43
2	n260	31	6.5	[5.0]	[19.5]-TT	43
3	n257, n258, n261	34	9	[5.0]	[20.0]-TT	43
3	n260	31	9	[5.0]	[17.0]-TT	43
Test requirements for a CA_nX(D-G))_UL_nXD, CA_nX(D-G)_UL_nXG, CA_nX(D-O)_UL_nXD, CA_nX(D-O)_UL_nXO, CA_nX(D-H)_UL_nXD, CA_nX(D-P)_UL_nXD, CA_nX(E-O)_UL_nXO, CA_nX(D-I)_UL_nXD, CA_nX(D-Q)_UL_nXD, CA_nX(G-I)_UL_nXG Configuration (Cumulative aggregated BWchannel <= 1400MHz)						
1	n257, n258, n261	34	[8.2]	[5.0]	[20.8]-TT	43
1	n260	31	[8.2]	[5.0]	[17.8]-TT	43
2	n257, n258, n261	34	[9.3]	[5.0]	[19.7]-TT	43

2	n260	31	[9.3]	[5.0]	[16.7]-TT	43
3	n257, n258, n261	34	[8.0]	[5.0]	[21.0]-TT	43
3	n260	31	[8.0]	[5.0]	[18.0]-TT	43
4	n257, n258, n261	34	[9.2]	[5.0]	[19.8]-TT	43
4	n260	31	[9.2]	[5.0]	[16.8]-TT	43
5	n257, n258, n261	34	[11.2]	[7.0]	[15.8]-TT	43
5	n260	31	[11.2]	[7.0]	[12.8]-TT	43
Test requirements for a CA_nX(D-G)_UL_nXD, CA_nX(D-O)_UL_nXD, CA_nX(D-G)_UL_nXG, CA_nX(D-O)_UL_nXO, CA_nX(D-H)_UL_nXD, CA_nX(D-P)_UL_nXD, CA_nX(O-E)_UL_nXO, CA_nX(D-I)_UL_nXD, CA_nX(D-Q)_UL_nXD, CA_nX(G-I)_UL_nXG Configuration (Cumulative aggregated BWchannel < 800MHz)						
1	n257, n258, n261	34	7.7	[5.0]	[21.3]-TT	43
1	n260	31	7.7	[5.0]	[18.3]-TT	43
2	n257, n258, n261	34	7.5	[5.0]	[21.5]-TT	43
2	n260	31	7.5	[5.0]	[18.5]-TT	43
3	n257, n258, n261	34	8.7	[5.0]	[20.3]-TT	43
3	n260	31	8.7	[5.0]	[17.3]-TT	43
4	n257, n258, n261	34	10.7	[7.0]	[16.3]-TT	43
4	n260	31	10.7	[7.0]	[13.3]-TT	43
Test requirements for a CA_nX(D-O)_UL_nXD, CA_nX(D-O)_UL_nXO Configuration (Cumulative aggregated BWchannel < 400MHz)						
1	n257, n258, n261	34	5	[4.0]	[25.0]-TT	43
1	n260	31	5	[4.0]	[22.0]-TT	43
2	n257, n258, n261	34	6.5	[5.0]	[22.5]-TT	43
2	n260	31	6.5	[5.0]	[19.5]-TT	43
3	n257, n258, n261	34	9	[5.0]	[20.0]-TT	43
3	n260	31	9	[5.0]	[17.0]-TT	43
NOTE 1: TT for each band and accumulative aggregated bandwidth is specified in Table 6.2A.2.1.5-17.						

Table 6.2A.2.1.5-16: MPR requirements for Intra-band Contiguous UL CA (Power Class 4, Non-contiguous allocation)

Test ID	Band	Min peak EIRP (dBm)	MPR (dB)	T(MPR) (dB)	Lower limit (dBm)	Upper limit (dBm)
Test requirements for a CA_nXB, CA_nXD, CA_XG, CA_nXO Configuration						
1	n257, n258, n261	34	7	[5.0]	[22.0]-TT	43
1	n260	31	7	[5.0]	[19.0]-TT	43
2	n257, n258, n261	FFS	FFS	FFS	FFS	FFS
2	n260	FFS	FFS	FFS	FFS	FFS
3	n257, n258, n261	FFS	FFS	FFS	FFS	FFS
3	n260	FFS	FFS	FFS	FFS	FFS
NOTE 1: TT for each band and accumulative aggregated bandwidth is specified in Table 6.2A.2.1.5-17.						

Table 6.2A.2.1.5-17: Test Tolerance (MPR for CA for Power class 4)

FFS

6.2A.3 UE maximum output power with additional requirements for CA

FFS

6.2A.4 Configured transmitted power for CA

6.2A.4.0 Minimum conformance requirements

A UE configured with carrier aggregation can configure its maximum output power for each uplink carrier *f* of activated serving cell *c* and its total configured output power P_{CMAX}. The definition of the configured UE maximum output power $P_{CMAX,f,c}$ for each carrier *f* of a serving cell *c* is used for power headroom reporting for carrier *f* of serving cell *c* only and is in accordance with that specified in clause 6.2.4 with parameters MPR, A-MPR and P-MPR replaced with those specified below. The total configured power P_{CMAX} in a transmission occasion is the sum of the configured power for carrier *f* of serving cell *c* with non-zero granted transmission power in the respective reference point.

For uplink intra-band contiguous carrier aggregation, MPR is specified in subclause 6.2A.2. P_{CMAX} is calculated under the assumption that power spectral density for each RB in each component carrier is same.

The total configured UE maximum output power P_{CMAX} shall be set such that the corresponding measured total peak EIRP P_{UMAX} is within the following bounds

$$P_{Powerclass} – MAX(MAX(MPR, A\_MPR),P\text{-}MPR) – MAX\{T(MAX(MPR, A\_MPR)),T(P\text{-}MPR)\} \le P_{UMAX} \le EIRP_{max}$$

with $P_{Powerclass}$ the UE power class as specified in sub-clause 6.2A.1, $EIRP_{max}$ the applicable maximum EIRP as specified in sub-clause 6.2A.1, MPR as specified in sub-clause 6.2A.2, A-MPR as specified in sub-clause 6.2A.3, P-MPR the power management term for the UE as described in 6.2.4 and TRP_{max} the maximum TRP for the UE power class as specified in sub-clause 6.2A.1.

P_{UMAX} is defined as $10*\log10(\sum p_{UMAX,f(i),c(j)})$ for each carrier f (i=1…n) and serving cell c (j=1…m) where $p_{UMAX,f(i),c(j)}$ is linear value of $P_{UMAX,f(i),c(j)}$

The tolerance T(ΔP) for applicable values of ΔP (values in dB) is specified in Table 6.2A.4-1.

Table 6.2A.4-1: P_{UMAX} tolerance

Operating Band	ΔP (dB)	Tolerance T(ΔP) (dB)
n257, n258, n260, n261	ΔP = 0	0
	0 < ΔP ≤ 2	[1.5]
	2 < ΔP ≤ 3	[2.0]
	3 < ΔP ≤ 4	[3.0]
	4 < ΔP ≤ 5	[4.0]
	5 < ΔP ≤ 10	[5.0]
	10 < ΔP ≤ 15	[7.0]
	15 < ΔP ≤ X	[8.0]
NOTE: X is the value such that P_{umax} lower bound, $P_{Powerclass}$ - ΔP – T(ΔP) = minimum output power specified in subclause 6.3A.1		

The normative reference for this requirement is TS 38.101-2 [3] clause 6.2A.4.

6.2A.4.1 Configured transmitted power for CA (2UL CA)

6.2A.4.1.1 Test purpose

To verify the UE transmitted power P_{UMAX} is within the range defined prescribed by the specified nominal maximum output power and tolerance.

6.2A.4.1.2 Test applicability

The requirements of this test are covered in test cases 6.2A.1.1.1 UE maximum output power - EIRP and TRP for CA (2UL CA), 6.2A.2.1 Maximum output power reduction for CA (2UL CA) and 6.2A.3.1 UE maximum output power with additional requirements for CA (2UL CA) to all types of NR UE release 15 and forward supporting 2UL CA.

6.2A.4.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.2A.4.0.

6.2A.4.1.4 Test description

This test is covered by clause 6.2A.1.1.1 UE maximum output power - EIRP and TRP for CA (2UL CA), 6.2A.2.1 Maximum output power reduction for CA (2UL CA) and 6.2A.3.1 UE maximum output power with additional requirements for CA (2UL CA).

6.2A.4.1.5 Test requirements

This test is covered by clause 6.2A.1.1.1 UE maximum output power - EIRP and TRP for CA (2UL CA), 6.2A.2.1 Maximum output power reduction for CA (2UL CA) and 6.2A.3.1 UE maximum output power with additional requirements for CA (2UL CA).

6.2D Transmit power for UL MIMO

6.2D.1 UE maximum output power for UL MIMO

FFS

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

FFS

6.2D.3 UE maximum output power with additional requirements for UL MIMO

FFS

6.2D.4 Configured transmitted power for UL MIMO

6.2D.4.1 Test purpose

To verify the UE transmitted power $P_{UMAX,f,c}$ is within the range defined prescribed by the specified nominal maximum output power and tolerance.

6.2D.4.2 Test applicability

The requirements of this test are covered in test cases 6.2D.1 UE Maximum output power for UL MIMO, 6.2D.2 UE maximum output power reduction forUL MIMO and 6.2D.3 UE Maximum output power with additional requirements for UL MIMO to all types of NR UE release 15 and forward that supports UL MIMO.

6.2D.4.3 Minimum conformance requirements

For UE configured with ULMIMO, the configured maximum output power $P_{CMAX,c}$ for serving cell c is defined as sum of all streams and is bound by limits set in section 6.2.4.

The normative reference for this requirement is TS 38.101-2 [3] clause 6.2D.4.

6.2D.4.4 Test description

This test is covered by clause 6.2D.1 UE Maximum output power for UL MIMO, 6.2D.2 UE maximum output power reduction forUL MIMO and 6.2D.3 UE Maximum output power with additional requirements for UL MIMO.

6.2D.4.5 Test requirements

This test is covered by clause 6.2D.1 UE Maximum output power for UL MIMO, 6.2D.2 UE maximum output power reduction forUL MIMO and 6.2D.3 UE Maximum output power with additional requirements for UL MIMO.

6.3 Output power dynamics

6.3.1 Minimum output power

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

- Measurement Uncertainty and Test Tolerances are FFS.
- Measurement period is pending RAN4.
- Testing of extreme conditions for FR2 is FFS.

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 EIRP in the channel bandwidth for all transmit bandwidth configurations (resource blocks) when the power is set to a minimum value.

6.3.1.3.1 Minimum output power for power class 1

For power class 1 UE, the minimum output power shall not exceed the values specified in Table 6.3.1.3.1-1 for each operating band supported. The minimum power is verified in beam locked mode with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 6.3.1.3.1-1: Minimum output power for power class 1

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	4	47.52
	100	4	95.04
	200	4	190.08
	400	4	380.16

6.3.1.3.2 Minimum output power for power class 2, 3, and 4

The minimum output power shall not exceed the values specified in Table 6.3.1.3.2-1 for each operating band supported. The minimum power is verified in beam locked mode with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 6.3.1.3.2-1: Minimum output power for power class 2, 3, and 4

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	-13	47.52
	100	-13	95.04
	200	-13	190.08
	400	-13	380.16
NOTE 1: n260 is not applied for power class 2.			

The normative reference for this requirement is TS 38.101-2 [3] 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 5.2-1. 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 6.3.1.4.1-1. 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 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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	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. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] clause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex G.0, G.1 and 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 [10] 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. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.

4. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

5. Measure UE EIRP in the Tx beam peak direction in the measurement bandwidth specified in Table 6.3.1.5-1 and Table 6.3.1.5-2 for the specific channel bandwidth under test. EIRP test procedure is defined in Annex K.1.3. The measuring duration is [one active uplink subframe]. EIRP is calculated considering both polarizations, theta and phi. For TDD, only slots consisting of only UL symbols are under test.

6. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.3.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.3.1.5 Test requirement

The maximum EIRP, derived in step 5 shall not exceed the values specified in Table 6.3.1.5-1 and Table 6.3.1.5-2.

Table 6.3.1.5-1: Minimum output power for power class 1

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	4+TT	47.52
	100	4+TT	95.04
	200	4+TT	190.08
	400	4+TT	380.16

Table 6.3.1.5-2: Minimum output power for power class 2, 3, and 4

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	-13+TT	47.52
	100	-13+TT	95.04
	200	-13+TT	190.08
	400	-13+TT	380.16

6.3.2 Transmit OFF power

Editor's note: This test case is not complete. Following aspects are either missing or not yet determined:

- Measurement grid for PC1/2/4 in Annex M.4 is TBD.

- The testability of this test case is pending further analysis on relaxation of the requirement.

- MU is left FFS.

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

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

6.3.2.3 Minimum conformance requirement

The transmit OFF power is defined as the TRP in the channel bandwidth when the transmitter is OFF. The transmitter is considered OFF when the UE is not allowed to transmit on any of its ports.

The transmit OFF power shall not exceed the values specified in Table 6.3.2.3-1 for each operating band supported. The requirement is verified with the test metric of TRP (Link=TX beam peak direction).

Table 6.3.2.3-1: Transmit OFF power

Operating band	Channel bandwidth / Transmit OFF power (dBm) / measurement bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257, n258, n259,n261	-35	-35	-35	-35
	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz

The normative reference for this requirement is TS 38.101-2 [3] 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

6.3.2.4.1 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 5.2-1. 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 6.3.2.4.1-1. 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 6.3.2.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 38.508-1 [10] subclause 4.1			Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1			Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1			Lowest	
Test SCS as specified in Table 5.3.5-1.			Highest	
Test Parameters				
	Downlink Configuration		**Uplink Configuration**	
Test ID	Modulation	RB allocation	**Modulation**	**RB allocation**
1	**N/A**	**0**	**N/A**	**0**

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

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

4. The UL Reference Measurement Channels are set according to Table 6.3.2.4.1-1.

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 [10] clause 4.5. Message contents are defined in clause 6.3.2.4.3.

6.3.2.4.2 Test procedure

1. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE) for the UE Tx beam selection to complete.

2. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

3. Measure UE TRP for the assigned NR channel with a rectangular measurement filter with bandwidths according to Table 6.3.2.5-1. Total radiated power is measured according to TRP measurement procedure defined in Annex K. TRP is calculated considering both polarizations, theta and phi.

NOTE : The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.3.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

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

Operating band	Channel bandwidth / Transmit OFF power (dBm) / measurement bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257, n258, n261	-35+21.4	-35+24.4	-35+27.4	-35+30.4
	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
n258, n261	-35+[21.4]	-35+[24.4]	-35+[27.4]	-35+[30.4]
	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
n260	-35+[24.1]	-35+[27.1]	-35+[30.1]	-35+[33.1]
	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
NOTE 1: Core requirement cannot be tested due to testability issue and test requirement includes relaxation to achieve impact from test system noise to measurement result = 1.0 dB (Minimum requirement + relaxation).				

6.3.3 Transmit ON/OFF time mask

6.3.3.1 General

The transmit ON/OFF time mask defines the transient period(s) allowed

- between transmit OFF power and transmit ON power symbols (transmit ON/OFF)

- between continuous ON-power transmissions when 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.

The transmit ON/OFF time mask is defined as a directional requirement. The requirement is verified in beam locked mode at beam peak direction. The maximum allowed EIRP OFF power level is -30dBm at beam peak direction. The requirement is verified with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

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

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

- Measurement Uncertainty and Test Tolerances are FFS.
- Testability of OFF power needs further study.
- The method of setting UE transmitted power is FFS.
- TP analysis is FFS

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 ON/OFF time mask defines the transient period(s) allowed

- between transmit OFF power and transmit ON power symbols (transmit ON/OFF)

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

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 transmit ON/OFF time mask is defined as a directional requirement. The requirement is verified in beam locked mode at beam peak direction. The maximum allowed EIRP OFF power level is -30dBm at beam peak direction. The requirement is verified with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle)

The general ON/OFF time mask defines the observation period allowed between transmit OFF and ON power. ON/OFF scenarios include: contiguous, and non-contiguous transmission, etc.

The OFF power measurement period is defined in a duration of at least one slot excluding any transient periods. The ON power is defined as the mean power over one slot excluding any transient period.

Figure 6.3.3.2.3-1: General ON/OFF time mask for NR UL transmission in FR2

The normative reference for this requirement is TS 38.101-2 [3] 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 5.2-1. 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 6.3.3.2.4.1-1. 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 6.3.3.2.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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	N/A for maximum 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. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex G.0, G.1 and G.3.0.
4. The UL Reference Measurement Channels are 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 [10] 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 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 6.3.3.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

2. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 4) for the UE Tx beam selection to complete.

3. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

4. For UE transmission OFF power, measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3.3.2.5-1. EIRP test procedure is defined in Annex K.1.3. The period of the measurement shall be the slot prior to the PUSCH transmission, excluding a transient period of 5 µs in the end of the slot and any DL periods. EIRP is calculated considering both polarizations, theta and phi.

5. For UE transmission ON power, measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3.3.2.5-2. EIRP test procedure is defined in Annex K. The period of the measurement shall be one slot with PUSCH transmission. EIRP is calculated considering both polarizations, theta and phi. For TDD, only slots consisting of only UL symbols are under test.

6. For UE transmission OFF power, measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3.3.2.5-1. EIRP test procedure is defined in Annex K.1.3 The period of the measurement shall be the slot following the PUSCH transmission, excluding a transient period of 5 µs at the beginning of the slot and any DL periods. EIRP is calculated considering both polarizations, theta and phi.

7. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

6.3.3.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 with following exceptions.

Table 6.3.3.2.4.3-1: *PUSCH-ConfigCommon*

Derivation Path: TS 38.508-1[10], Table 4.6.3-119			
Information Element	**Value/remark**	**Comment**	**Condition**
PUSCH-ConfigCommon ::= SEQUENCE {			
tpc-Accumulation	disabled		
p0-AlphaSets SEQUENCE (SIZE (1..maxNrofP0-PUSCH-AlphaSets)) OF SEQUENCE {	1 entry		
p0-NominalWithGrant	-102		50MHz
	-106		100MHz
	-108		200MHz
	-112		400MHz
alpha	alpha1		
}			
}			

Table 6.3.3.2.4.3-2: ServingCellConfigCommon

Derivation Path: 38.508-1[5], Table 4.6.3-168			
Information Element	**Value/remark**	**Comment**	**Condition**
ServingCellConfigCommon ::= SEQUENCE {			
ss-PBCH-BlockPower	1		SCS_60kHz
	4		SCS_120kHz
}			

Condition	Explanation
SCS_60kHz	SCS=60kHz for SS/PBCH block
SCS_120kHz	SCS=120kHz for SS/PBCH block

6.3.3.2.5 Test requirement

The requirement for the EIRP measured in steps 4, 5 and 6 of the test procedure shall not exceed the values specified in Table 6.3.3.2.5-1 and 6.3.3.2.5-2.

Table 6.3.3.2.5-1: Test requirement of OFF power of General ON/OFF time mask

	Channel bandwidth / minimum output power / measurement bandwidth			
	50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
Transmit OFF power	≤ -30+TT dBm			
Transmission OFF Measurement bandwidth	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz

Table 6.3.3.2.5-2: Test requirement of ON power of General ON/OFF time mask

	SCS	Channel bandwidth / measurement bandwidth			
	[kHz]	**50 MHz**	**100 MHz**	**200 MHz**	**400 MHz**
Expected Transmission ON power for DFT-s-OFDM	60	22.1	[21.1]	22.1	N/A
	120	22.1	[21.1]	22.1	21.1
Power tolerance		± (14+TT)dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3.2.3, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2.1.3.					

Table 6.3.3.2.5-3: Test Tolerance for OFF power

FFS

Table 6.3.3.2.5-4: Test Tolerance for ON power

FFS

6.3.3.3 Transmit power time mask for slot and short or long 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

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

- Message contents are not complete
- Measurement uncertainty and Test tolerance are not complete
- Test requirements are not complete
- PRACH configuration index is not complete
- The further investigation is essential that how does beamforming affect the initial access procedure
- Testability needs further analysis on relaxation of the requirement

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 transmit ON/OFF time mask is defined as a directional requirement. The requirement is verified in beam locked mode at beam peak direction. The maximum allowed EIRP OFF power level is -30dBm at beam peak direction. The requirement is verified with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

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

Format	SCS	Measurement period
A_1	60 kHz	0.035677 ms
	120 kHz	0.017839 ms
A_2	60 kHz	0.071354 ms
	120 kHz	0.035677 ms
A_3	60 kHz	0.107031 ms
	120 kHz	0.053516 ms
B_1	60 kHz	0.035091 ms
	120 kHz	0.0175455 ms
B_4	60 kHz	0.207617 ms
	120 kHz	0.103809 ms
A_1/B_1	60 kHz	0.035677 ms for front X1 occasion 0.035091 ms for last occasion X1 = [2,5]
	120 kHz	0.017839 ms for front X1occasion 0.017546 ms for last occasion X1 = [2,5]
A_2/B_2	60 kHz	0.071354 ms for front X2 occasion 0.069596 ms for last occasion X2 = [1,2]
	120 kHz	0.035677 ms for front X2 occasion 0.034798 ms for last occasion X2 = [1,2]
A_3/B_3	60 kHz	0.107031 ms for first occasion 0.104101 ms for second occasion
	120 kHz	0.053515 ms for first occasion 0.052050 ms for second occasion
C_0	60 kHz	0.026758 ms
	120 kHz	0.013379 ms
C_2	60 kHz	0.083333 ms
	120 kHz	0.0416667 ms
NOTE: For PRACH on PRACH occasion start from begin of 0ms or 0.5ms boundary, the measurement period will plus 0.032552µs		

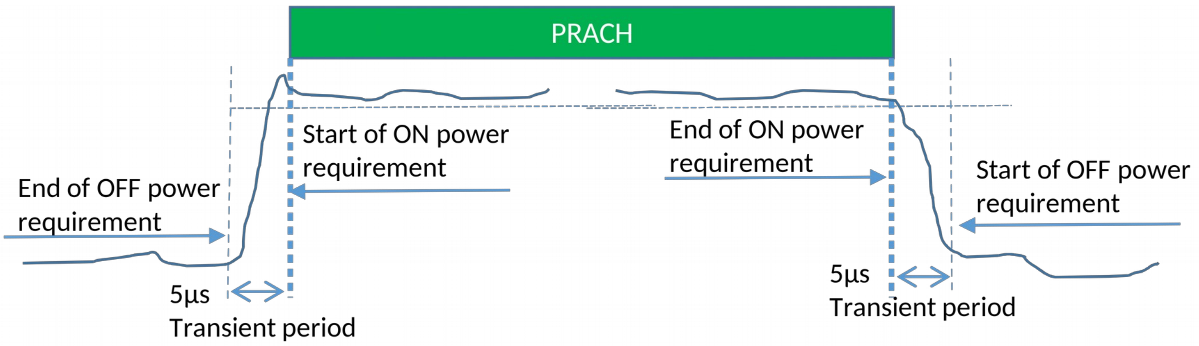


Figure 6.3.3.4.3-1: PRACH ON/OFF time mask

The normative reference for this requirement is TS 38.101-2 [3] 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 A.2. 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 [10] subclause 4.1	TBD
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1	Mid range
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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
PRACH preamble format	
PRACH Configuration Index	[0]

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0 , and uplink signals according to Annex G.0, G.1 and 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 [10] clause 4.5. Message contents are defined in clause 6.3.3.4.4.3.

6.3.3.4.4.2 Test procedure

1. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.
2. 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. The UE shall send the signalled preamble to the SS.
4. For UE transmission OFF power, measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3.3.4.5-1. EIRP test procedure is defined in Annex K.1.3. The period of the measurement shall be the slot prior to the PRACH transmission, excluding a transient period of 5 μs in the end of the slot and any DL periods. EIRP is calculated considering both polarizations, theta and phi.
5. For UE transmission ON power, measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3.3.4.5-1 . EIRP test procedure is defined in Annex K.1.3. The period of the measurement shall be the slot during the PRACH preamble transmission. EIRP is calculated considering both polarizations, theta and phi. For TDD, only slots consisting of only UL symbols are under test.
6. For UE transmission OFF power, measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3.3.2.5-1. EIRP test procedure is defined in Annex K.1.3. The period of the measurement shall be the slot following the PUSCH transmission, excluding a transient period of 5 μs at the beginning of the slot and any DL periods. EIRP is calculated considering both polarizations, theta and phi.

NOTE 1: The BEAM_SELEECT_WAIT_TIME default value is defined in Annex K.1.1.

6.3.3.4.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 with following exceptions:

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

Derivation Path: TS 38.508-1[5], Table 4.6.3-128			
Information Element	**Value/remark**	**Comment**	**Condition**
RACH-ConfigCommon::= SEQUENCE {			
rach-ConfigGeneric	RACH-ConfigGeneric		
totalNumberOfRA-Preambles	Not present		
ssb-perRACH-OccasionAndCB-PreamblesPerSSB CHOICE {			
one	n4		FR2
}			
groupBconfigured	Not present		
ra-ContentionResolutionTimer	sf64		
rsrp-ThresholdSSB	RSRP-Range		
rsrp-ThresholdSSB-SUL	Not present		
	RSRP-Range		SUL
prach-RootSequenceIndex CHOICE {			
l139	Set according to table 4.4.2-2 for the NR Cell.		PRACH Format A3
}			
msg1-SubcarrierSpacing	SubcarrierSpacing		
restrictedSetConfig	unrestrictedSet		
msg3-transformPrecoder	Not present	transform precoding is disabled for Msg3 PUSCH transmission and any PUSCH transmission scheduled with DCI format 0_0	
}			

Table 6.3.3.4.4.3-2: *RACH-ConfigGeneric:* PRACH measurement

Derivation Path: TS 38.508-1[5], Table 4.6.3-130			
Information Element	**Value/remark**	**Comment**	**Condition**
RACH-ConfigGeneric ::= SEQUENCE {			
prach-ConfigurationIndex	[TBD]	Unpaired Spectrum	PRACH Format A3
msg1-FDM	one		FR2
msg1-FrequencyStart	0		
zeroCorrelationZoneConfig	15		
preambleReceivedTargetPower	[TBD]		PRACH Format A3
preambleTransMax	n7		
powerRampingStep	dB0		
ra-ResponseWindow	sl20		
}			

Table 6.3.3.4.4.3-3: *ServingCellConfigCommonSIB: PR*ACH measurement

Derivation Path: TS 38.508-1[5], Table 4.6.3-169			
Information Element	**Value/remark**	**Comment**	**Condition**
ServingCellConfigCommonSIB ::= SEQUENCE {			
downlinkConfigCommon	DownlinkConfigCommon SIB		
uplinkConfigCommon	UplinkConfigCommonSIB		
supplementaryUplink	Not present		
	UplinkConfigCommonSIB		SUL
n-TimingAdvanceOffset	Not present		
ssb-PositionsInBurst SEQUENCE {			
inOneGroup	'1000 0000'B		
groupPresence	Not present		
}			
tdd-UL-DL-ConfigurationCommon	TDD-UL-DL-ConfigCommon		FR2_TDD
ss-PBCH-BlockPower	[TBD]		
}			

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 / Output Power [dBm] / measurement bandwidth			
	50MHz	**100MHz**	**200MHz**	**400MHz**
Transmit OFF power	≤ [-35+relaxation]			
Transmission OFF Measurement bandwidth	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
Expected PRACH Transmission ON Measured power	FFS	FFS	FFS	FFS
ON power tolerance FFS	FFS	FFS	FFS	FFS
NOTE 1: Core requirement cannot be tested due to testability issue and test requirement includes relaxation to achieve SNR = [10] dB (Minimum requirement + relaxation).				

Table 6.3.3.4.5-2: Relaxations for OFF power

Operating band	50 MHz	100 MHz	200 MHz	400 MHz
n257, n258, n261	[14.9] dB	[17.9] dB	[20.9] dB	[23.9] dB
n260	[24.1] dB	[27.1] dB	[30.1] dB	[33.1] dB

Table 6.3.3.4.5-3: Relaxations for ON power

FFS

6.3.3.5 Void

6.3.3.6 SRS time mask

FFS

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 and are defined as a directional requirement. The requirements are verified in beam locked mode on beam peak direction.

6.3.4.2 Absolute power tolerance

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

- Measurement Uncertainty and Test Tolerances are FFS.
- Testing of extreme conditions for FR2 is FFS.
- TP analysis is FFS.
- UE transmitted power for PC 1, 2 and 4 are FFS

6.3.4.2.1 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.

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 20 ms.

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 20 ms. The tolerance includes the channel estimation error RSRP estimate.

The minimum requirements 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 6.3.1.3 (‘P_{min}’) and the maximum output power as specified in sub-clause 6.2.1.1 as minimum peak EIRP (‘P_{max}’). The intermediate power point ‘P_{int}’ is defined in table 6.3.4.2.3-2

Table 6.3.4.2.3-1: Absolute power tolerance

Power Range	Tolerance
$P_{int} \geq P \geq P_{min}$	± 14.0 dB
$P_{max} \geq P > P_{int}$	± 12.0 dB

Table 6.3.4.2.3-2: Intermediate power point

Power Parameter	Value
P_{int}	P_{max} – 12.0 dB

The normative reference for this requirement is TS 38.101-2 [3] clause 6.3.4.2.

6.3.4.2.4 Test description

6.3.4.2.4.1 Initial condition

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.2-1. 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 6.3.4.2.4.1-1. 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 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Mid range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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	N/A for absolute power tolerance 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. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] clause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex G.0, G.1 and G.3.0.
4. The UL Reference Measurement Channel is set according to Table 6.3.4.2.4.1-1.
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* according to TS 38.508-1 [10] clause 4.5. Message contents are defined in clause 6.3.4.2.4.3.

6.3.4.2.4.2 Test procedure

1. Configure the UE transmitted output power to test point 1 in section 6.3.4.2.4.3.

2. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.

3. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

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

5. Measure UE EIRP of the first subframe in the Tx beam peak direction in the measurement bandwidth specified in Table 6.3.1.5-1 and Table 6.3.1.5-2 for the specific channel bandwidth under test. EIRP test procedure is defined in Annex K. The measuring duration is one active uplink subframe. EIRP is calculated considering both polarizations, theta and phi. For TDD slots with transient periods are not under test.

6. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

7. Repeat test steps 1~6 for measurement of test point 2~3. The timing of the execution between the two test points shall be larger than 20ms.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.3.4.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 with following exceptions:

Table 6.3.4.2.4.3-1: PUSCH-PowerControl (Test point 1) for power class 3

Derivation Path: TS 38.508-1 [10], Table 4.3.3-91			
Information Element	**Value/remark**	**Comment**	**Condition**
PUSCH-PowerControl ::= SEQUENCE {			
tpc-Accumulation	disabled		
p0-AlphaSets SEQUENCE (SIZE (1..maxNrofP0-PUSCH-AlphaSets)) OF SEQUENCE {	1 entry		
p0	-116		50MHz
	-120		100MHz
	-122		200MHz
	-126		400MHz
alpha	alpha1		
}			
}			

Table 6.3.4.2.4.3-2: PUSCH-PowerControl (Test point 2) for power class 3

Derivation Path: TS 38.508-1 [10], Table 4.3.3-91			
Information Element	**Value/remark**	**Comment**	**Condition**
PUSCH-PowerControl ::= SEQUENCE {			
tpc-Accumulation	disabled		
p0-AlphaSets SEQUENCE (SIZE (1..maxNrofP0-PUSCH-AlphaSets)) OF SEQUENCE {	1 entry		
p0	-112		50MHz
	-116		100MHz
	-118		200MHz
	-122		400MHz
alpha	alpha1		
}			
}			

Table 6.3.4.2.4.3-3: PUSCH-PowerControl (Test point 3) for power class 3

Derivation Path: TS 38.508-1 [10], Table 4.3.3-91			
Information Element	**Value/remark**	**Comment**	**Condition**
PUSCH-PowerControl ::= SEQUENCE {			
tpc-Accumulation	disabled		
p0-AlphaSets SEQUENCE (SIZE (1..maxNrofP0-PUSCH-AlphaSets)) OF SEQUENCE {	1 entry		
p0	-102		50MHz
	-106		100MHz
	-118		200MHz
	-112		400MHz
alpha	alpha1		
}			
}			

Table 6.3.4.2.4.3-4: ServingCellConfigCommon

Derivation Path: 38.508-1[5], Table 4.6.3-168			
Information Element	**Value/remark**	**Comment**	**Condition**
ServingCellConfigCommon ::= SEQUENCE {			
ss-PBCH-BlockPower	1		SCS_60kHz
	4		SCS_120kHz
}			

Condition	Explanation
SCS_60kHz	SCS=60kHz for SS/PBCH block
SCS_120kHz	SCS=120kHz for SS/PBCH block

6.3.4.2.5 Test requirement

The measured EIRP in step 5 and 7 shall not to exceed the values specified in Table 6.3.4.2.5-1 to 6.3.4.2.5-3.

Table 6.3.4.2.5-1: Absolute power tolerance: test point 1 for power class 3

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
Expected Measured power	60kHz	8.1	7.1	8.1	N/A
	120kHz	8.1	7.1	8.1	7.1
Power tolerance		± (14+TT)dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3.2.3, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2.1.3.					

Table 6.3.4.2.5-2: Absolute power tolerance: test point 2 for power class 3

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
Expected Measured power	60kHz	12.1	11.1	12.1	N/A
	120kHz	12.1	11.1	12.1	11.1
Power tolerance		± (12+TT)dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3.2.3, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2.1.3.					

Table 6.3.4.2.5-3: Absolute power tolerance: test point 3 for power class 3

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	22.1	[21.1]	22.1	N/A
	120kHz	22.1	[21.1]	22.1	21.1
Power tolerance		± (12+TT)dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3.2.3, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2.1.3.					

Table 6.3.4.2.5-4: Test Tolerance (Test point 1)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	FFS	FFS

Table 6.3.4.2.5-5: Test Tolerance (Test point 2)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	FFS	FFS

6.3.4.3 Relative power tolerance

Editor's note: The following items are missing or incomplete:

- Test requirement is within square brackets (38.101-2 dependent)
- MU and TT not defined
- Starting power at ramp up/ramp down/alternating sub-test is TBD (6.3.4.3 MU dependent)
- Testability of test points needs further analysis, based on MU outcome

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 relatively to the power of the most recently transmitted reference sub-frame if the transmission gap between these sub-frames is 20 ms.

6.3.4.3.2 Test applicability

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

6.3.4.3.3 Minimum conformance requirements

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 Pint as defined in sub-clause 6.3.4.3-2. The minimum requirements specified in Table 6.3.4.3-2 apply when the power of the target and reference sub-frames are within the power range bounded by Pint as defined in sub-clause 6.3.4.2 and the measured P_{UMAX} as defined in sub-clause 6.2.4.

Table 6.3.4.3.3-1: Relative power tolerance, $P_{int} \geq P \geq P_{min}$

Power step ΔP (Up or down) (dB)	All combinations of PUSCH and PUCCH, PUSCH/PUCCH and SRS transitions between sub-frames, PRACH (dB)
ΔP < 2	[±5.0]
2 ≤ ΔP < 3	[±6.0]
3 ≤ ΔP < 4	[±7.0]
4 ≤ ΔP < 10	[±8.0]
10 ≤ ΔP < 15	[±10.0]
15 ≤ ΔP	[±11.0]

Table 6.3.4.3.3-2: Relative power tolerance, $P_{UMAX} \geq P > P_{int}$

Power step ΔP (Up or down) (dB)	All combinations of PUSCH and PUCCH, PUSCH/PUCCH and SRS transitions between sub-frames, PRACH (dB)
ΔP < 2	[±3.0]
2 ≤ ΔP < 3	[±4.0]
3 ≤ ΔP < 4	[±5.0]
4 ≤ ΔP < 10	[±6.0]
10 ≤ ΔP < 15	[±8.0]
15 ≤ ΔP	[±9.0]

The normative reference for this requirement is TS 38.101-2 [3] 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, 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 subcarrier spacing, are shown in table 6.3.4.3.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3.4.3.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 38.508-1 [10] subclause 4.3.1			Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1			Low Range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1			100MHz	
Test SCS as specified in TS 38.508-1 [10] subclause 4.3.1			60kHz	
Test Parameters				
Ch BW	**Downlink Configuration**		**Uplink Configuration**	
	Modulation	**RB Allocation**	**Modulation**	**RB allocation (NOTE 1)**
100MHz	N/A for Relative power tolerance test case		DFT-s-OFDM pi/2 BPSK	See Table 6.3.4.3.5-1 See Table 6.3.4.3.5-2 See Table 6.3.4.3.5-3
Note 1: The starting resource block shall be RB# 1.				

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.2 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.
4. The UL Reference Measurement channels are set according to Table 6.3.4.3.4.1-1.
5. Propagation conditions are set according to Annex B.0
6. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On* according to TS 38.508-1 [10] 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 6.3.4.3.4.2-3.

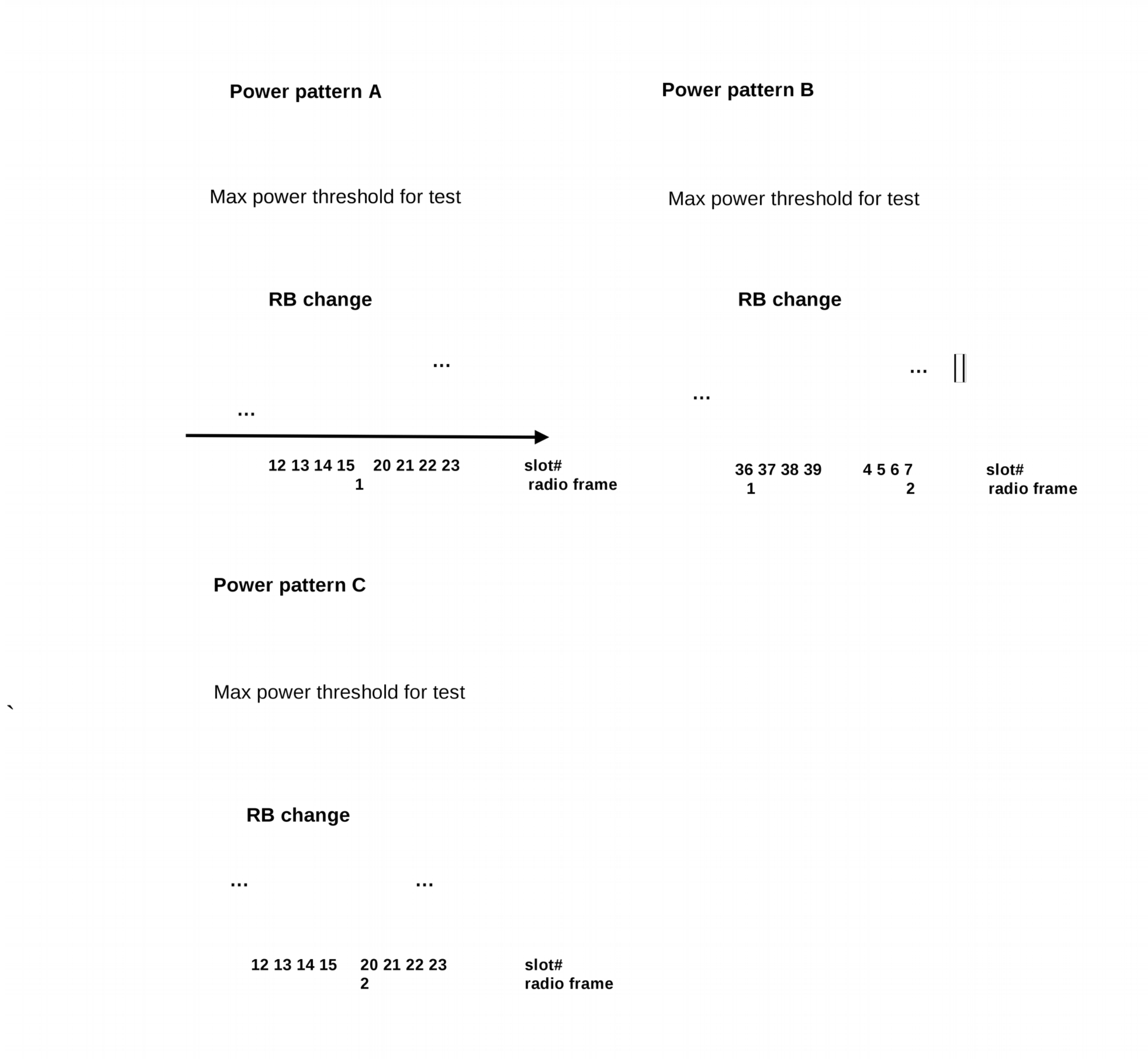


Figure 6.3.4.3.4.2-1: TDD ramping up test power patterns, SCS 60kHz

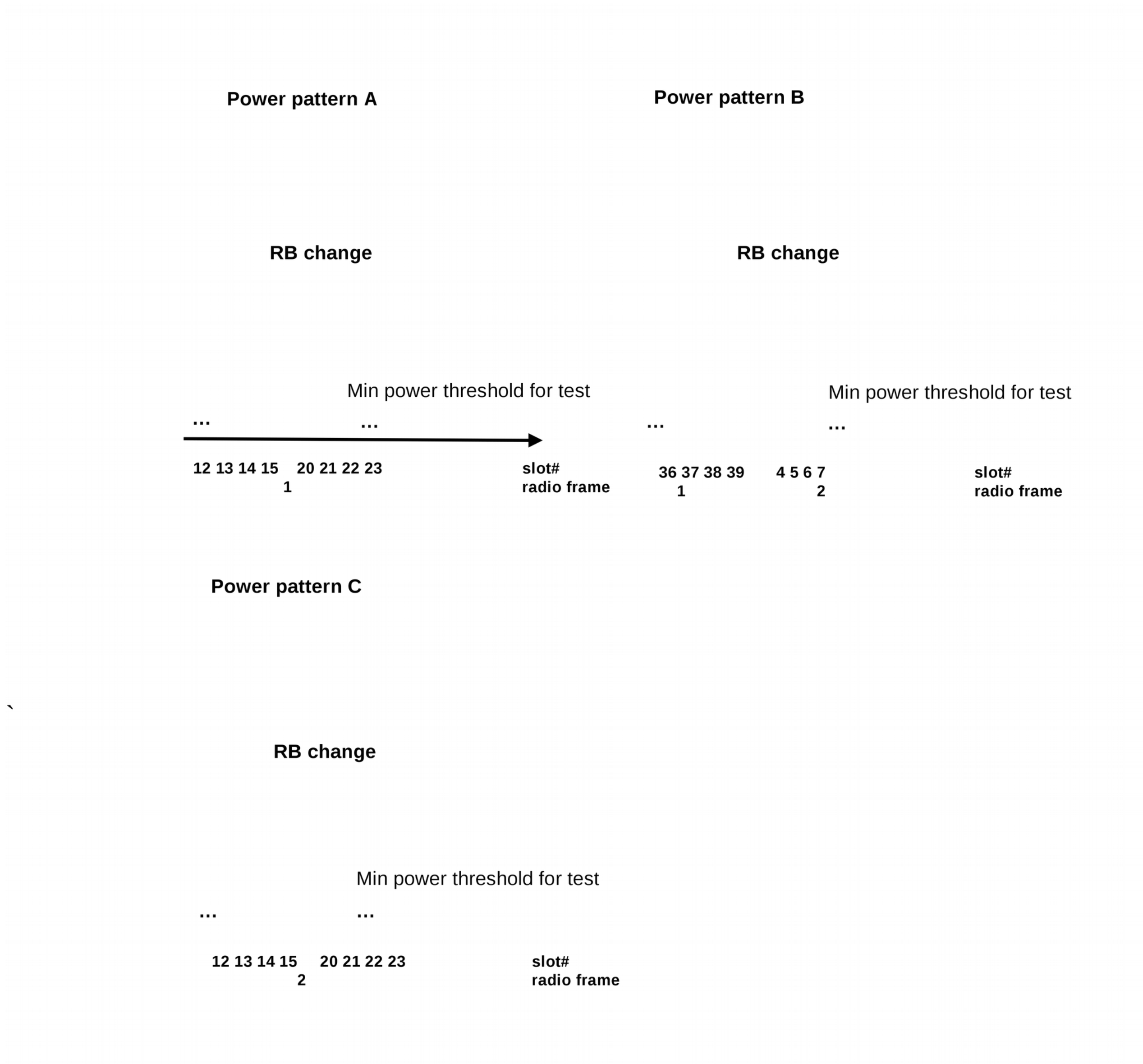


Figure 6.3.4.3.4.2-2: TDD ramping down test power patterns, SCS 60kHz

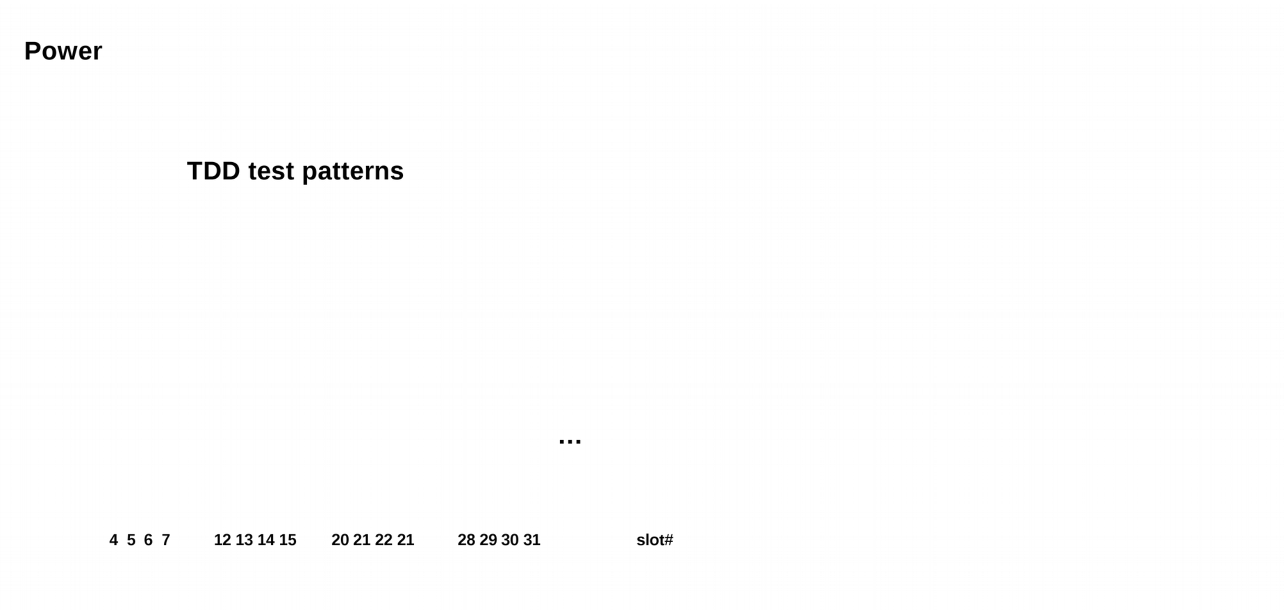


Figure 6.3.4.3.4.2-3: Alternating Test Power patterns, SCS 60kHz

1. Sub test: ramping up pattern

    1.1 Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.

    1.2 SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

    1.3 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 TBD dBm +/- TBD dB

    1.3 Schedule the UE's PUSCH data transmission as described in Figure 6.3.4.3.4.2-1 (TDD) pattern A: Uplink RB allocation as defined in table 6.3.4.3.5-1. On the PDCCH format 0_1 for the scheduling of the PUSCH the SS will transmit +1dB TPC commands over a sequence of 75 (note1) active uplink slots to ensure that the UE reaches maximum power threshold. 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.

    1.4 Measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, to verify the UE relative power control meet test requirements in 6.3.4.3.5. EIRP test procedure is defined in Annex K. EIRP is calculated considering both polarizations, theta and phi. Measurement of the power is not required in slot after the mean power has exceeded the maximum power threshold. For power transients between slots, transient periods of 40us between slots are excluded. For ON/OFF or OFF/ON transients, transient periods of 20 us at the beginning of the slot are excluded.

    1.5 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 to force different 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 TBD dBm +/- TBD dB

    2.2. Schedule the UE's PUSCH data transmission as described in Figure 6.3.4.3.4.2-2 (TDD) pattern A: Uplink RB allocation as defined in table 6.3.4.3.5-1. On the PDCCH format 0_1 for the scheduling of the PUSCH the SS will transmit -1dB TPC commands over a sequence of 75 (note1) active uplink slots to ensure that the

UE reaches minimum power threshold. 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 UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, to verify the UE relative power control meet test requirements in 6.3.4.3.5. EIRP test procedure is defined in Annex K. EIRP is calculated considering both polarizations, theta and phi. Measurement of the power is not required in slot after the mean power has exceeded the maximum power threshold. For power transients between slots, transient periods of 40us between slots are excluded. For ON/OFF or OFF/ON transients, transient periods of 20 us at the beginning of the slot 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 different 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 TBD dBm +/- TBD 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 6.3.5.2.4.2-3 for 5 frames with an uplink RB allocation alternating pattern as defined in table 6.3.4.3.5-3 while transmitting 0dB TPC command for PUSCH via the PDCCH.

3.3. Measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, to verify the UE relative power control meet test requirements in 6.3.4.3.5. EIRP test procedure is defined in Annex K. EIRP is calculated considering both polarizations, theta and phi. Measurement of the power is not required in slot after the mean power has exceeded the maximum power threshold. For power transients between slots, transient periods of 40us between slots are excluded. For ON/OFF or OFF/ON transients, transient periods of 20 us at the beginning of the slot are excluded.

3.4 SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: These numbers of TPC commands are given as examples. The actual number of TPC commands transmitted in these steps shall be enough to ensure that the UE reaches the relevant maximum or minimum power threshold in each step, as shown in figure 6.3.4.3.4.2-1 thru 6.3.4.3.4.2-3.

6.3.4.3.4.3 Message contents

Message contents are according to TS 38.508-1 [10] 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-X.

Table 6.3.4.3.5-1: Test Requirements Relative Power Tolerance for Transmission, channel BW 100MHz, SCS 60kHz, ramp up sub-test

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]
1	Slots before RB change	105RBs	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
	RB change	105RBs to 128 RBs	TPC=+1dB	1.86	ΔP < 2dB	1.86 +/- [5.0] + TT (NOTE 1) 1.86 +/- [3.0] + TT (NOTE 2)
	Slots after RB change	Fixed = 128	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
2	Slots before RB change	90RBs	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
	RB change	90RBs to 128 RBs	TPC=+1dB	2.53	2dB ≤ ΔP < 3dB	2.53 +/- [6.0] + TT (NOTE 1) 2.53 +/- [4.0] + TT (NOTE 2)
	Slots after RB change	Fixed = 128	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
3	Slots before RB change	79RBs	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
	RB change	79RBs to 128 RBs	TPC=+1dB	3.10	3dB ≤ ΔP < 4dB	3,10 +/- [7.0] + TT (NOTE 1) 3,10 +/- [5.0] + TT (NOTE 2)
	Slots after RB change	Fixed = 128RBs	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
4	Slots before RB change	32RBs	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
	RB change	32RBs to 128 RBs	TPC=+1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- [8.0] + TT (NOTE 1) 7.02 +/- [6.0] + TT (NOTE 2)
	Slots after RB change	Fixed = 128	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
5	Slots before RB change	7RBs	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
	RB change	7RBs to 128 RBs	TPC=+1dB	13.62	10dB ≤ ΔP < 15dB	13.62 +/- [10.0] + TT (NOTE 1) 13.62 +/- [8.0] + TT (NOTE 2)
	Slots after RB change	Fixed = 128RBs	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
6	Slots before RB change	1RB	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
	RB change	1RB to 128 RBs	TPC=+1dB	22.07	15dB < ΔP	22.07 +/- [11.0] + TT (NOTE 1) 22.07 +/- [9.0] + TT (NOTE 2)
	Slots after RB change	Fixed = 128	TPC=+1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
NOTE 1: Applicable if Pint ≥ P ≥ Pmin. NOTE 2: Applicable if PUMAX ≥ P > Pint.						

Table 6.3.4.3.5-2: Test Requirements Relative Power Tolerance for Transmission, channel BW 100MHz, SCS 60kHz, ramp down sub-test

Sub-test ID	Applicable sub-frames	Uplink RB allocation	TPC command	Expected power step size (Down) ΔP [dB]	Power step size range (Down) ΔP [dB]	PUSCH [dB]
1	Slots before RB change	128RBs	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
	RB change	128RBs to 105 RBs	TPC=-1dB	1.86	ΔP < 2dB	1.86 +/- [5.0] + TT (NOTE 1) 1.86 +/- [3.0] + TT (NOTE 2)
	Slots after RB change	Fixed = 105	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
2	Slots before RB change	128RBs	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
	RB change	128RBs to 90 RBs	TPC=-1dB	2.53	2dB ≤ ΔP < 3dB	2.53 +/- [6.0] + TT (NOTE 1) 2.53 +/- [4.0] + TT (NOTE 2)
	Slots after RB change	Fixed = 90	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
3	Slots before RB change	128RBs	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
	RB change	128RBs to 79 RBs	TPC=-1dB	3.10	3dB ≤ ΔP < 4dB	3,10 +/- [7.0] + TT (NOTE 1) 3,10 +/- [5.0] + TT (NOTE 2)
	Slots after RB change	Fixed = 79RBs	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
4	Slots before RB change	128RBs	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
	RB change	128RBs to 32 RBs	TPC=-1dB	7.02	4dB ≤ ΔP < 10dB	7.02 +/- [8.0] + TT (NOTE 1) 7.02 +/- [6.0] + TT (NOTE 2)
	Slots after RB change	Fixed = 32	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
5	Slots before RB change	128RBs	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
	RB change	128RBs to 7 RBs	TPC=-1dB	13.62	10dB ≤ ΔP < 15dB	13.62 +/- [10.0] + TT (NOTE 1) 13.62 +/- [8.0] + TT (NOTE 2)
	Slots after RB change	Fixed = 7RBs	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
6	Slots before RB change	128RB	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
	RB change	128RB to 1 RBs	TPC=-1dB	22.07	15dB < ΔP	22.07 +/- [11.0] + TT (NOTE 1) 22.07 +/- [9.0] + TT (NOTE 2)
	Slots after RB change	Fixed = 1	TPC=-1dB	1	ΔP ≤ 1 dB	1 +/- [1.0] + TT
NOTE 1: Applicable if Pint ≥ P ≥ Pmin. NOTE 2: Applicable if PUMAX ≥ P > Pint.						

Table 6.3.4.3.5-3: Test Requirements Relative Power Tolerance for Transmission, channel BW 100MHz, SCS 60kHz, alternating sub-test

Sub-test ID	Uplink RB allocation	TPC command	Expected power step size (Up/Down) ΔP [dB]	Power step size range (Up/Down) ΔP [dB]	PUSCH [dB]
1	Alternating 105 and 128	TPC=0dB	0.86	ΔP < 2dB	0.86 +/- [5.0] + TT (NOTE 1) 0.86 +/- [3.0] + TT (NOTE 2)
2	Alternating 79 and 128	TPC=0dB	2.10	2dB ≤ ΔP < 3dB	2.10 +/- [6.0] + TT (NOTE 1) 2.10 +/- [4.0] + TT (NOTE 2)
3	Alternating 64 and 128	TPC=0dB	3.01	3dB ≤ ΔP < 4dB	3.01 +/- [7.0] + TT (NOTE 1) 3.01 +/- [5.0] + TT (NOTE 2)
4	Alternating 32 and 128	TPC=0dB	6.02	4dB ≤ ΔP < 10dB	6.02 +/- [8.0] + TT (NOTE 1) 6.02 +/- [6.0] + TT (NOTE 2)
5	Alternating 7 and 128	TPC=0dB	12.62	10dB ≤ ΔP < 15dB	12.62 +/- [10.0] + TT (NOTE 1) 12.62 +/- [8.0] + TT (NOTE 2)
6	Alternating 1 and 128	TPC=0dB	21.07	15dB < ΔP	21.07 +/- [11.0] + TT (NOTE 1) 21.07 +/- [9.0] + TT (NOTE 2)
NOTE 1: Applicable if Pint ≥ P ≥ Pmin. NOTE 2: Applicable if PUMAX ≥ P > Pint.					

6.3.4.4 Aggregate power tolerance

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

- SA Generic procedures with condition NR in TS 38.508-1 [10] is FFS.

- SA message contents in TS 38.508-1 [10] subclause 4.6 is FFS

- Measurement Uncertainty and Test Tolerances are FFS.

- The method of setting UE transmitted power is FFS.

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 during non-contiguous transmissions within 21ms in response to 0 dB TPC commands with respect to the first UE transmission and all other power control parameters as specified in 38.213 kept constant.

The minimum requirements specified in Table 6.3.4.4.3-1 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 P_{int} as defined in sub-clause 6.3.4.2. The minimum requirements specified in Table 6.3.4.4.3-2 apply when the power of the target and reference sub-frames are within the power range bounded by Pint as defined in sub-clause 6.3.4.2 and the maximum output power as specified in sub-clause 6.2.1.

Table 6.3.4.4.3-1: Aggregate power tolerance, $P_{int} \geq P \geq P_{min}$

TPC command	UL channel	Aggregate power tolerance within 21ms
0 dB	PUCCH	± [5.5] dB
0 dB	PUSCH	± [5.5] dB

Table 6.3.4.4.3-2: Aggregate power tolerance, $P_{max} \geq P \geq P_{int}$

TPC command	UL channel	Aggregate power tolerance within 21ms
0 dB	PUCCH	± [3.5] dB
0 dB	PUSCH	± [3.5] dB

The normative reference for this requirement is TS 38.101-2 [3] 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 subtest

Initial Conditions		
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Mid range
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1		Lowest, Mid and Highest
Test SCS as specified in Table 5.3.5-1		Lowest and 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 6.3.4.4.4.1-2: Test Configuration Table: PUSCH subtest

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Mid range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1		Lowest, Mid and Highest	
Test SCS as specified in Table 5.3.5-1		Lowest and 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		DFT-s-OFDM QPSK	Outer_Full
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.			

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] clause 4.4.3.

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

4. The UL Reference Measurement Channel is set according to Table 6.3.4.4.4.1-1 (for PUCCH subtest) and Table 6.3.4.4.4.1-2 (for PUSCH subtest).

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 [10] clause 4.5. Message contents are defined in clause 6.3.4.2.4.3.

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.

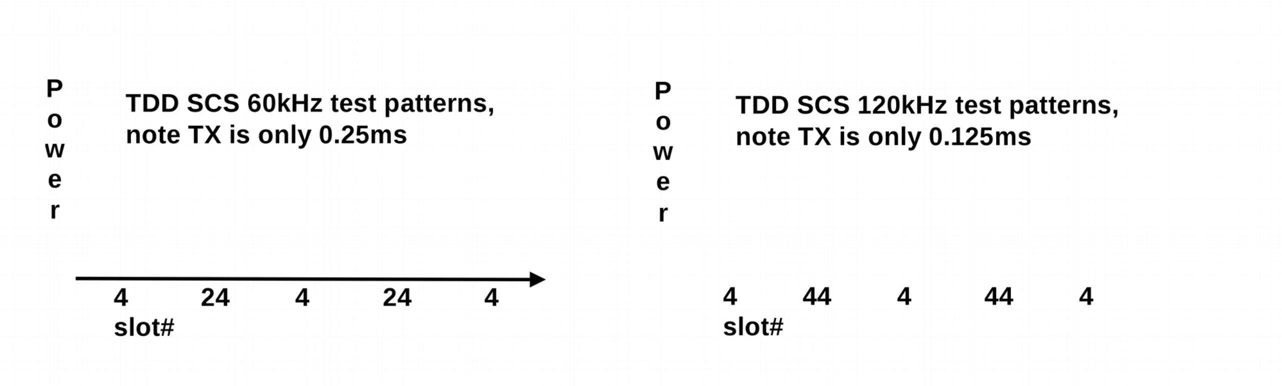


Figure 6.3.4.4.4.2-1: Test uplink transmission

1. PUCCH subtest:

1.1. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1.

1.2. 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 [TBD]dBm +/- [5.5+TT]dB for carrier frequency f ≤ 30.3GHz or at [TBD]dBm +/-[5.5+TT]dB for carrier frequency 30.3GHz < f.

1.3. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

1.4. Every [TBD] 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 slot. 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.

1.5. Measure the UE EIRP in the Tx beam peak direction of in the measurement bandwidth specified in Table 6.3.1.5-1 and Table 6.3.1.5-2 to verify the UE transmitted PUCCH power is maintained within 21ms. EIRP test procedure is defined in Annex K. The measuring duration is [TBD]. EIRP is calculated considering both polarizations, theta and phi. For TDD slots with transient periods are not under test.

1.6. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

1.7. Send the appropriate TPC commands for PUCCH to the UE to ensure that the UE transmits PUCCH at [TBD]dBm +/- [3.5+TT]dB for carrier frequency f ≤ 30.3GHz or at [TBD]dBm +/-[3.5+TT]dB for carrier frequency 30.3GHz < f.

1.8. Repeat test steps 1.3 to 1.6 for measurement.

2. PUSCH subtest:

2.1. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1.

2.2. 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 [TBD]dBm +/- [5.5+TT]dB for carrier frequency f ≤ 30.3GHz or at [TBD]dBm +/-[5.5+TT]dB for carrier frequency 30.3GHz < f.

2.3. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

2.4. Every [TBD] schedule the UE's PUSCH data transmission for 1 slot 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.

2.5. Measure the UE EIRP in the Tx beam peak direction of in the measurement bandwidth specified in Table 6.3.1.5-1 and Table 6.3.1.5-2 to verify the UE transmitted PUSCH power is maintained within 21ms. EIRP test procedure is defined in Annex K. The measuring duration is [TBD]. EIRP is calculated considering both polarizations, theta and phi. For TDD slots with transient periods are not under test.

2.6. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

2.7. Send the appropriate TPC commands for PUCCH to the UE to ensure that the UE transmits PUCCH at [TBD]dBm +/- [3.5+TT]dB for carrier frequency f ≤ 30.3GHz or at [TBD]dBm +/-[3.5+TT]dB for carrier frequency 30.3GHz < f.

2.8. Repeat test steps 2.3 to 2.6 for measurement.

6.3.4.4.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.3.4.4.5 Test requirement

The requirement for the power measurements made in step (1.5) and (2.5) of the test procedure shall not exceed the values specified in Table 6.3.4.4.5-1 and Table 6.3.4.4.5-2. The power measurement period shall be 1 slot.

Table 6.3.4.4.5-1: Power control tolerance ($P_{int} \geq P \geq P_{min}$)

TPC command	UL channel	Test requirement measured power
0 dB	PUCCH	Given [TBD] power measurements in the pattern, the 2nd, and later measurements shall be within ± [5.5+TT]dB of the 1st measurement.
0 dB	PUSCH	Given [TBD] power measurements in the pattern, the 2nd, and later measurements shall be within ± [5.5+TT]dB of the 1st measurement.
Note 1: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3.4.4.5-3.		

Table 6.3.4.4.5-2: Power control tolerance ($P_{max} \geq P > P_{int}$)

TPC command	UL channel	Test requirement measured power
0 dB	PUCCH	Given [TBD] power measurements in the pattern, the 2nd, and later measurements shall be within ± [3.5+TT]dB of the 1st measurement.
0 dB	PUSCH	Given [TBD] power measurements in the pattern, the 2nd, and later measurements shall be within ± [3.5+TT]dB of the 1st measurement.
Note 1: TT for each duplex, Sub-Carrier Spacing, frequency and channel bandwidth is specified in Table 6.3.4.4.5-4.		

Table 6.3.4.4.5-3: Test Tolerance ($P_{int} \geq P \geq P_{min}$)

[FFS]

Table 6.3.4.4.5-4: Test Tolerance ($P_{max} \geq P > P_{int}$)

[FFS]

6.3A Output power dynamics for CA

6.3A.1 Minimum output power for CA

FFS

6.3A.1.0 Minimum conformance requirements

For intra-band contiguous carrier aggregation, the minimum controlled output power of the UE is defined as the transmit power of the UE per component carrier, i.e., EIRP in the channel bandwidth of each component carrier for all transmit bandwidth configurations (resource blocks), when the power on both component carriers are set to a minimum value.

The minimum output power shall not exceed the values specified in Table 6.3A.1.0-1 and 6.3.A.1.0-2 for each operating band supported. The minimum power is verified in beam locked mode with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 6.3A.1.0-1: Minimum output power for CA for power class 1

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	4	47.52
	100	4	95.04
	200	4	190.08
	400	4	380.16

Table 6.3A.1.0-2: Minimum output power for CA for power class 2, 3 and 4

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	-13	47.52
	100	-13	95.04
	200	-13	190.08
	400	-13	380.16
NOTE 1: n260 is not applied for power class 2.			

The normative reference for this requirement is TS 38.101-2 [3] 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:

- Measurement Uncertainty and Test Tolerances are FFS.
- Measurement period is pending RAN4.
- The testability of this test case is pending further analysis on relaxation of the requirement.
- The test configuration would be revisited when testability issue is concluded.
- Applicability of UBF of single UL is FFS
- Applicability of Beam peak of single UL is FFS

6.3A.1.1.1 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 on each component carrier 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 intra-band contiguous 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 configuration specified in clause 5.5A.1-1. 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. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3A.1.1.4.1-1: Test Configuration Table

<table>
<tr><th colspan="7">Default Conditions</th></tr>
<tr><td colspan="4">Test Environment as specified in TS 38.508-1 [10] subclause 4.1</td><td colspan="3">Normal</td></tr>
<tr><td colspan="4">Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes, and PCC and SCCs are mapped onto physical frequencies according to Table 6.1-2.</td><td colspan="3">Low and High range</td></tr>
<tr><td colspan="4">Test CC combination setting as specified in subclause 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE.</td><td colspan="3">Lowest aggregated BW of the CA configuration
Highest aggregated BW of the CA configuration</td></tr>
<tr><td colspan="4">Test SCS as specified in Table 5.3.5-1.</td><td colspan="3">Highest</td></tr>
<tr><th colspan="7">Test Parameters</th></tr>
<tr><th>Test ID</th><th>CC</th><th>ChBw(MHz)</th><th>Test frequency</th><th>DL RB allocation</th><th>UL Modulation</th><th>UL RB allocation</th></tr>
<tr><td rowspan="2">1</td><td>PCC</td><td rowspan="2">Default</td><td rowspan="2">Default</td><td rowspan="2">N/A</td><td>DFT-s-OFDM QPSK</td><td>Outer_Full</td></tr>
<tr><td>SCC</td><td>DFT-s-OFDM QPSK</td><td>Outer_Full</td></tr>
<tr><td colspan="7">NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.</td></tr>
</table>

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] clause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex G.0, G.1 and 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 [10] 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.3.0 for all downlink physical channels.
2. The SS shall configure SCC as per TS 38.508-1 [10] clause 5.5.1. Message contents are defined in clause 6.3A.1.1.4.3
3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [TBD], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], clause 9.2).
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. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (Note 1) for the UE Tx beam selection to complete.
6. 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.
7. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

8. Measure UE EIRP of each component carrier in the Tx beam peak direction in the measurement bandwidth specified in Table 6.3A.1.1.5-1 for the specific channel bandwidth under test. EIRP test procedure is defined in Annex K. The measuring duration is [one active uplink subframe]. EIRP is calculated considering both polarizations, theta and phi. For TDD slots with transient periods are not under test.

9. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELEECT_WAIT_TIME default value is defined in Annex K.1.1.

6.3A.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 with following exception.

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

Derivation Path: TS 38.508-1 [10], Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED

6.3A.1.1.5 Test requirement

For each component carrier, the minimum EIRP shall not exceed the values specified in Table 6.3A.1.1.5-1 and 6.3A.1.1.5-2.

Table 6.3A.1.1.5-1: Minimum output power for 2UL CA for power class 1

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	4+TT	47.52
	100	4+TT	95.04
	200	4+TT	190.08
	400	4+TT	380.16

Table 6.3A.1.1.5-2: Minimum output power for 2UL CA for power class 2, 3 and 4

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	-13+TT	47.52
	100	-13+TT	95.04
	200	-13+TT	190.08
	400	-13+TT	380.16
NOTE 1: n260 is not applied for power class 2.			

Table 6.3A.1.1.5-3: Test Tolerance for Minimum output power for 2UL CA for Power class 1

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	FFS	FFS

Table 6.3A.1.1.5-4: Test Tolerance for Minimum output power for 2UL CA for Power class 2, 3 and 4

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	FFS	FFS

6.3A.1.2 Minimum output power for CA (3UL CA)

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

- Measurement Uncertainty and Test Tolerances are FFS.

- Measurement period is pending RAN4.
- The testability of this test case is pending further analysis on relaxation of the requirement.
- The test configuration would be revisited when testability issue is concluded.
- Applicability of UBF of single UL is FFS
- Applicability of Beam peak of single UL is FFS

6.3A.1.2.1 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 on each component carrier is set to a minimum value.

6.3A.1.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA.

6.3A.1.2.3 Minimum conformance requirements

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

6.3A.1.2.4 Test description

Same as in clause 6.3A.1.1.4 with following exceptions:

- Instead of Table 6.3A.1.1.4.1-1 → use Table 6.3A.1.2.4.1-1.
- Instead of clause 6.3A.1.1.4.3 → use clause 6.3A.1.2.4.3.
- Instead of Table 6.3A.1.1.5-1 and 6.3A.1.1.5-2 → use Table 6.3A.1.2.5-1 and 6.3A.1.2.5-2.

Table 6.3A.1.2.4.1-1: Test Configuration Table for 3UL CA

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1				Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes, and PCC and SCCs are mapped onto physical frequencies according to Table 6.1-2.				Low and High range		
Test CC combination setting as specified in subclause 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE.				Lowest aggregated BW of the CA configuration Highest aggregated BW of the CA configuration		
Test SCS as specified in Table 5.3.5-1.				Highest		
Test Parameters						
Test ID	**CC**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation**
1	PCC	Default	Default	N/A	DFT-s-OFDM QPSK	Outer_Full
	SCC1				DFT-s-OFDM QPSK	Outer_Full
	SCC2				DFT-s-OFDM QPSK	Outer_Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.						

6.3A.1.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 with following exception.

Table 6.3A.1.2.4.3-1: PUSCH-Config

Derivation Path: TS 38.508-1 [10], Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED

6.3A.1.2.5 Test requirement

For each component carrier, the minimum EIRP shall not exceed the values specified in Table 6.3A.1.2.5-1 and 6.3A.1.2.5-2.

Table 6.3A.1.2.5-1: Minimum output power for 3UL CA for power class 1

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	4+TT	47.52
	100	4+TT	95.04
	200	4+TT	190.08
	400	4+TT	380.16

Table 6.3A.1.2.5-2: Minimum output power for 3UL CA for power class 2, 3 and 4

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	-13+TT	47.52
	100	-13+TT	95.04
	200	-13+TT	190.08
	400	-13+TT	380.16
NOTE 1: n260 is not applied for power class 2.			

Table 6.3A.1.2.5-3: Test Tolerance for Minimum output power for 3UL CA for Power class 1

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	FFS	FFS

Table 6.3A.1.2.5-4: Test Tolerance for Minimum output power for 3UL CA for Power class 2, 3 and 4

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	FFS	FFS

6.3A.1.3 Minimum output power for CA (4UL CA)

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

- Measurement Uncertainty and Test Tolerances are FFS.
- Measurement period is pending RAN4.
- The testability of this test case is pending further analysis on relaxation of the requirement.
- The test configuration would be revisited when testability issue is concluded.
- Applicability of UBF of single UL is FFS
- Applicability of Beam peak of single UL is FFS

6.3A.1.3.1 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 on each component carrier is set to a minimum value.

6.3A.1.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA.

6.3A.1.3.3 Minimum conformance requirements

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

6.3A.1.3.4 Test description

Same as in clause 6.3A.1.1.4 with following exceptions:

- Instead of Table 6.3A.1.1.4.1-1 → use Table 6.3A.1.3.4.1-1.
- Instead of clause 6.3A.1.1.4.3 → use clause 6.3A.1.3.4.3.
- Instead of Table 6.3A.1.1.5-1 and 6.3A.1.1.5-2 → use Table 6.3A.1.3.5-1 and 6.3A.1.3.5-2.

Table 6.3A.1.3.4.1-1: Test Configuration Table for 3UL CA

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1				Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes, and PCC and SCCs are mapped onto physical frequencies according to Table 6.1-2.				Low and High range		
Test CC combination setting as specified in subclause 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE.				Lowest aggregated BW of the CA configuration Highest aggregated BW of the CA configuration		
Test SCS as specified in Table 5.3.5-1.				Highest		
Test Parameters						
Test ID	**CC**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation**
1	PCC	Default	Default	N/A	DFT-s-OFDM QPSK	Outer_Full
	SCC1				DFT-s-OFDM QPSK	Outer_Full
	SCC2				DFT-s-OFDM QPSK	Outer_Full
	SCC3				DFT-s-OFDM QPSK	Outer_Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.						

6.3A.1.3.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 with following exception.

Table 6.3A.1.3.4.3-1: PUSCH-Config

Derivation Path: TS 38.508-1 [10], Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED

6.3A.1.3.5 Test requirement

For each component carrier, the minimum EIRP shall not exceed the values specified in Table 6.3A.1.3.5-1 and 6.3A.1.3.5-2.

Table 6.3A.1.3.5-1: Minimum output power for 3UL CA for power class 1

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	4+TT	47.52
	100	4+TT	95.04
	200	4+TT	190.08
	400	4+TT	380.16

Table 6.3A.1.3.5-2: Minimum output power for 3UL CA for power class 2, 3 and 4

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	-13+TT	47.52
	100	-13+TT	95.04
	200	-13+TT	190.08
	400	-13+TT	380.16
NOTE 1: n260 is not applied for power class 2.			

Table 6.3A.1.3.5-3: Test Tolerance for Minimum output power for 4UL CA for Power class 1

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	FFS	FFS

Table 6.3A.1.3.5-4: Test Tolerance for Minimum output power for 4UL CA for Power class 2, 3 and 4

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	FFS	FFS

6.3A.2 Transmit OFF power for CA

6.3A.2.0 Minimum conformance requirements

For intra-band contiguous carrier aggregation, the transmit OFF power is defined as the TRP in the channel bandwidth per component carrier 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 shall not exceed the values specified in Table 6.3A.2.0-1 for each operating band supported.

Table 6.3A.2.0-1: Transmit OFF power for CA

Operating band	Channel bandwidth / Transmit OFF power (dBm) / measurement bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257, n258, n260, n261	-35	-35	-35	-35
	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz

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

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

- Test configuration table is TBD
- Connection diagram is TBD
- Test procedure is TBD

- The testability of this test case is pending further analysis on relaxation of the requirement.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.3A.2.1.1 Test purpose

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

6.3A.2.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 2UL CA.

6.3A.2.1.3 Minimum conformance requirements

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

6.3A.2.1.4 Test description

6.3A.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, and channel bandwidths based on NR operating bands specified in table 5.5A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and subcarrier spacing, are shown in table 6.3A.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 6.3A.2.1.4.1-1: Test Configuration Table [TBD]

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure [TBD] for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.2 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.
4. The UL Reference Measurement channels are set according to Table 6.3A.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 [10] clause 4.5. Message contents are defined in clause 6.3A.2.1.4.3

6.3A.2.1.4.2 Test procedure

TBD

6.3A.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.3A.2.1.5 Test Requirements

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

Table 6.3A.2.1.5-1: Transmit OFF power

Operating band	Channel bandwidth / Transmit OFF power (dBm) / measurement bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257, n258, n261	-35+[14.9]	-35+[17.9]	-35+[20.9]	-35+[23.9]
	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
n260	-35+[24.1]	-35+[27.1]	-35+[30.1]	-35+[33.1]
	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
NOTE 1: Core requirement cannot be tested due to testability issue and test requirement includes relaxation to achieve SNR = [10] dB (Minimum requirement + relaxation).				

6.3A.2.2 Transmit OFF power for CA (3UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Test procedure is TBD
- The testability of this test case is pending further analysis on relaxation of the requirement.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.3A.2.2.1 Test purpose

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

6.3A.2.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA.

6.3A.2.2.3 Minimum conformance requirements

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

6.3A.2.2.4 Test description

Same as in clause 6.3A.2.1.4 with following exceptions:

- Instead of Table 6.3A.2.1.4.1-1→ use Table 6.3A.2.2.4.1-1.

- Instead of clause 6.3A.2.1.4.3→ use clause 6.3A.2.2.4.3.
- Instead of Table 6.3A.2.1.5-1→ use Table 6.3A.2.2.5-1.

Table 6.3A.2.2.4.1-1: Test Configuration Table [TBD]

6.3A.2.2.5 Test Requirements

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

Table 6.3A.2.2.5-1: Transmit OFF power

Operating band	Channel bandwidth / Transmit OFF power (dBm) / measurement bandwidth			
	50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
n257, n258, n261	-35+[14.9]	-35+[17.9]	-35+[20.9]	-35+[23.9]
	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
n260	-35+[24.1]	-35+[27.1]	-35+[30.1]	-35+[33.1]
	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
NOTE 1: Core requirement cannot be tested due to testability issue and test requirement includes relaxation to achieve SNR = [10] dB (Minimum requirement + relaxation).				

6.3A.2.3 Transmit OFF power for CA (4UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Test procedure is TBD
- The testability of this test case is pending further analysis on relaxation of the requirement.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.3A.2.3.1 Test purpose

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

6.3A.2.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA.

6.3A.2.3.3 Minimum conformance requirements

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

6.3A.2.3.4 Test description

Same as in clause 6.3A.2.1.4 with following exceptions:

- Instead of Table 6.3A.2.1.4.1-1→ use Table 6.3A.2.3.4.1-1.
- Instead of clause 6.3A.2.1.4.3→ use clause 6.3A.2.3.4.3.
- Instead of Table 6.3A.2.1.5-1→ use Table 6.3A.2.3.5-1.

Table 6.3A.2.3.4.1-1: Test Configuration Table [TBD]

6.3A.2.3.5 Test Requirements

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

Table 6.3A.2.3.5-1: Transmit OFF power

Operating band	Channel bandwidth / Transmit OFF power (dBm) / measurement bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257, n258, n261	-35+[14.9]	-35+[17.9]	-35+[20.9]	-35+[23.9]
	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
n260	-35+[24.1]	-35+[27.1]	-35+[30.1]	-35+[33.1]
	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
NOTE 1: Core requirement cannot be tested due to testability issue and test requirement includes relaxation to achieve SNR = [10] dB (Minimum requirement + relaxation).				

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

6.3A.3.0 Minimum conformance requirements

For intra-band contiguous carrier aggregation, 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 38.101-2 [3] clause 6.3A.1.

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:

- Measurement Uncertainty and Test Tolerances are FFS.
- Test requirement of ON power is FFS.
- Testability of OFF power needs further study.
- The method of setting UE transmitted power is FFS.
- TP analysis is FFS
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

6.3A.3.1.1 Test purpose

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

The requirements of this test apply to all types of NR UE release 15 and forward supporting 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 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 CC combinations based on NR operating bands specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2. All of these configurations shall be tested with applicable test parameters for each CA configuration and subcarrier spacing, are shown in table 6.2A.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 6.3A.3.1.4.1-1: Intra-band Contiguous UL CA Test Configuration Table

Default Conditions							
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]					FFS		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes					FFS		
Test CC Combination setting (N_{RB_agg}) as specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE					FFS		
Test SCS as specified in Table 5.3.5-1					FFS		
Test Parameters							
Test ID	**CC**	**Band**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation**
Default Test Settings for a CA_XG, CA_nXO Configuration (Cumulative aggregated BWchannel < 400MHz)							
1							

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.
4. The UL Reference Measurement channels are 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 [10] clause 4.5. Message contents are defined in clause 6.2A.2.1.4.3.

6.3A.3.1.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2 and Annex C.3.0 for all downlink physical channels
2. The SS shall configure SCC as per TS 38.508-1 [10] subclause 5.5.1 Procedure to configure SCC(s) for NR RF CA testing. Message contents are defined in subclause 6.3A.3.1.4.3.

3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321, clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], 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.3.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

5. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.

6. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

7. For UE transmission OFF power, measure UE EIRP in the Tx beam peak direction for each component carrier in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3.3.2.5-1. EIRP test procedure is defined in Annex K. The period of the measurement shall be the slot prior to the PUSCH transmission, excluding a transient period of 5 µs in the end of the slot and any DL periods. EIRP is calculated considering both polarizations, theta and phi.

8. For UE transmission ON power, measure UE EIRP in the Tx beam peak direction for each component carrier in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3.3.2.5-2. EIRP test procedure is defined in Annex K. The period of the measurement shall be one slot with PUSCH transmission. EIRP is calculated considering both polarizations, theta and phi. For TDD slots with transient periods are not under test.

9. For UE transmission OFF power, measure UE EIRP in the Tx beam peak direction for each component carrier in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3.3.2.5-1. EIRP test procedure is defined in Annex K. The period of the measurement shall be the slot following the PUSCH transmission, excluding a transient period of 5 µs at the beginning of the slot and any DL periods. EIRP is calculated considering both polarizations, theta and phi.

10. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

NOTE 2: When switching to DFT-s-OFDM waveform, as specified in the test configuration table Table 6.3A.3.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [10] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

6.3A.3.1.4.3 Message contents

Message contents are according to TS 36.508 [7] clause 4.6 with the following exceptions:

Table 6.3A.3.1.4.3-1: *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		
}			

6.3A.3.1.5 Test requirements

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 6.3.3.2.5-1: Test requirement of OFF power of General ON/OFF time mask for 2UL CA

	Channel bandwidth / minimum output power / measurement bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
Transmit OFF power	≤ -30+TT dBm			
Transmission OFF Measurement bandwidth	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz

Table 6.3.3.2.5-2: Test requirement of ON power of General ON/OFF time mask for 2UL CA

	SCS [kHz]	Channel bandwidth / minimum output power / measurement bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Transmission ON Measured power for CP-OFDM	60	FFS	FFS	FFS	FFS
	120	FFS	FFS	FFS	FFS
Expected Transmission ON Measured power for DFT-s-OFDM	60	FFS	FFS	FFS	FFS
	120	FFS	FFS	FFS	FFS

Table 6.3.3.2.5-3: Test Tolerance for OFF power

FFS

Table 6.3.3.2.5-4: Test Tolerance for ON power

FFS

6.3A.4 Power control for CA

6.3A.4.1 General

The requirements in this section apply to a UE when it has at least one of UL or DL configured for CA operation. The requirements on power control accuracy in CA operation apply under normal conditions and are defined as a directional requirement. The requirements are verified in beam locked mode on beam peak direction. The requirements apply for one single PUCCH, PUSCH or SRS transmission of contiguous PRB allocation per configured UL CC with power setting in accordance with Clause 7.1 of [22]

6.3A.4.2 Absolute power tolerance for CA

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

- Measurement Uncertainty and Test Tolerances are proposed and put in brackets for further investigation.
- Test point 3 need to be further investigated for per CC, i.e., possibly lower TP3 value by 3 dB.

6.3A.4.2.0 Minimum conformance requirements

The absolute power tolerance is the ability of the UE transmitter to set its initial output power to a specific value for the first sub-frame at the start of a contiguous transmission or non-contiguous transmission with a transmission gap on each active component carriers larger than 20 ms. For SRS switching, the absolute power tolerance is the ability of the UE transmitter to set its initial output power to a specific value for the first sub-frame at the start of a contiguous transmission or non-contiguous transmission with a transmission gap on component carriers (to which SRS switching occurs) larger than 20 ms. The requirement can be tested by time aligning any transmission gaps on the component carriers. For intra-band contiguous CA, the absolute power control tolerance per configured UL CC is given in Tables 6.3.4.2.3-1 and 6.3.4.2.3-2.

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

6.3A.4.2.1.1 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.

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 20 ms.

6.3A.4.2.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 2UL CA and 2DL CA.

6.3A.4.2.1.3 Minimum conformance requirements

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

6.3A.4.2.1.4 Test description

6.3A.4.2.1.4.1 Initial condition

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

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

Table 6.3A.4.2.1.4.1-1: Test Configuration Table

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1				Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes, and PCC and SCCs are mapped onto physical frequencies according to Table 6.1-2.				Low and High range		
Test CC combination setting as specified in subclause 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE.				Highest aggregated BW of the CA configuration		
Test SCS as specified in Table 5.3.5-1.				Highest		
Test Parameters						
Test ID	**CC**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation (Note 1)**
1	PCC	Default	Default	N/A	DFT-s-OFDM QPSK	Outer_Full
	SCC				DFT-s-OFDM QPSK	Outer_Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.						

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] clause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2 and C.3.0, and uplink signals according to Annex G.0, G.1 and G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.3A.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 according to TS 38.508-1 [10] clause 4.5. Message contents are defined in clause 6.3A.4.2.1.4.3.

6.3A.4.2.1.4.2 Test procedure

1. Configure SCC according to Annex C.0, C.1, C.2, and C.3 for all downlink physical channels.
2. The SS shall configure SCC as per TS 38.508-1 [10] clause 5.5.1. Message contents are defined in clause 6.3A.4.2.1.4.3.
3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [28], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], clause9.2).
4. Configure the UE transmitted output power to test point 1 in section 6.3A.4.2.1.4.3.
5. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.
6. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.
7. 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 6.3.1.4.1-1 on PCC and SCC(s). Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
8. Measure UE EIRP of the first subframe of each component carrier in the Tx beam peak direction in the measurement bandwidth specified in Table 6.3A.4.2.1.5-1 through Table 6.3A.4.2.1.5-3 for the specific channel bandwidth under test. EIRP test procedure is defined in Annex K. The measuring duration is one active uplink subframe. EIRP is calculated considering both polarizations, theta and phi. For TDD slots with transient periods are not under test.
9. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.
10. Repeat test steps 1~9 for measurement for test point 2~3. The timing of the execution between each test point shall be larger than 20ms.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.3A.4.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 with following exceptions:

Table 6.3A.4.2.1.4.3-1: PUSCH-PowerControl (Test point 1) for power class 3

Derivation Path: TS 38.508-1 [10], Table 4.3.3-91			
Information Element	**Value/remark**	**Comment**	**Condition**
PUSCH-PowerControl ::= SEQUENCE {			
tpc-Accumulation	disabled		
p0-AlphaSets SEQUENCE (SIZE (1..maxNrofP0-PUSCH-AlphaSets)) OF SEQUENCE {	1 entry		
p0	-116		50MHz
	-120		100MHz
	-122		200MHz
	-126		400MHz
alpha	alpha1		
}			
}			

Table 6.3A.4.2.1.4.3-2: PUSCH-PowerControl (Test point 2) for power class 3

Derivation Path: TS 38.508-1 [10], Table 4.3.3-91			
Information Element	**Value/remark**	**Comment**	**Condition**
PUSCH-PowerControl ::= SEQUENCE {			
tpc-Accumulation	disabled		
p0-AlphaSets SEQUENCE (SIZE (1..maxNrofP0-PUSCH-AlphaSets)) OF SEQUENCE {	1 entry		
p0	-112		50MHz
	-116		100MHz
	-118		200MHz
	-122		400MHz
alpha	alpha1		
}			
}			

Table 6.3A.4.2.1.4.3-3: PUSCH-PowerControl (Test point 3) for power class 3

Derivation Path: TS 38.508-1 [10], Table 4.3.3-91			
Information Element	**Value/remark**	**Comment**	**Condition**
PUSCH-PowerControl ::= SEQUENCE {			
tpc-Accumulation	disabled		
p0-AlphaSets SEQUENCE (SIZE (1..maxNrofP0-PUSCH-AlphaSets)) OF SEQUENCE {	1 entry		
p0	-102		50MHz
	-106		100MHz
	-108		200MHz
	-112		400MHz
alpha	alpha1		
}			
}			

Table 6.3A.4.2.1.4.3-5: ServingCellConfigCommon

Derivation Path: 38.508-1[5], Table 4.6.3-168			
Information Element	**Value/remark**	**Comment**	**Condition**
ServingCellConfigCommon ::= SEQUENCE {			
ss-PBCH-BlockPower	1		SCS_60kHz
	4		SCS_120kHz
}			

Condition	Explanation
SCS_60kHz	SCS=60kHz for SS/PBCH block
SCS_120kHz	SCS=120kHz for SS/PBCH block

6.3A.4.2.1.5 Test requirement

The measured EIRP in step 7 and 9 shall not to exceed the values specified in Table 6.3A.4.2.1.5-1 through 6.3A.4.2.1.5-3.

Table 6.3A.4.2.1.5-1: Test Requirements of Absolute power tolerance (Test point 1) for power class 3

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	8.1	7.1	8.1	N/A
	120kHz	8.1	7.1	8.1	7.1
Power tolerance		± (14+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.1.5-4.					

Table 6.3A.4.2.1.5-2: Test Requirements of Absolute power tolerance (Test point 2) for power class 3

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	12.1	11.1	12.1	N/A
	120kHz	12.1	11.1	12.1	11.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.1.5-5.					

Table 6.3A.4.2.1.5-3: Test Requirements of Absolute power tolerance (Test point 3) for power class 3

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	22.1	[22.1]	22.1	N/A
	120kHz	22.1	[22.1]	22.1	21.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.1.5-5.					

Table 6.3A.4.2.1.5-4: Test Tolerance (Test point 1) for power class 3

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

Table 6.3A.4.2.1.5-5: Test Tolerance (Test point 2 and Test point 3) for power class 3

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

6.3A.4.2.2Absolute power tolerance for CA (3UL CA)

6.3A.4.2.2.1 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.

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 20 ms.

6.3A.4.2.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA and 3DL CA.

6.3A.4.2.2.3 Minimum conformance requirements

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

6.3A.4.2.2.4 Test description

6.3A.4.2.2.4.1 Initial condition

Same as in clause 6.3A.4.2.1.4.1with the following exceptions:

- Instead of Table 6.3A.4.2.1.4.1-1→ use Table 6.3A.4.2.2.4-1.
- Instead of Table 6.3A.4.2.1.5-1 through 6.3A.4.2.1.5-3→ use Table 6.3A.4.2.2.5-1 and 6.3A.4.2.2.5-3.

Table 6.3A.4.2.2.4-1: Test Configuration Table

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1				Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes, and PCC and SCCs are mapped onto physical frequencies according to Table 6.1-2.				Low and High range		
Test CC combination setting as specified in subclause 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE.				Highest aggregated BW of the CA configuration		
Test SCS as specified in Table 5.3.5-1.				Highest		
Test Parameters						
Test ID	**CC**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation (Note 1)**
1	PCC	Default	Default	N/A	DFT-s-OFDM QPSK	Outer_Full
	SCC1				DFT-s-OFDM QPSK	Outer_Full
	SCC2				DFT-s-OFDM QPSK	Outer_Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.						

6.3A.4.2.2.5 Test requirement

Same as in clause 6.3A.4.2.1.5 with the following exceptions:

- Instead of Table 6.3A.4.2.1.5-1 → use Table 6.3A.4.2.2.5-1.
- Instead of Table 6.3A.4.2.1.5-2 → use Table 6.3A.4.2.2.5-2.
- Instead of Table 6.3A.4.2.1.5-3 → use Table 6.3A.4.2.2.5-3.
- Instead of Table 6.3A.4.2.1.5-4 → use Table 6.3A.4.2.2.5-4.
- Instead of Table 6.3A.4.2.1.5-5 → use Table 6.3A.4.2.2.5-5.

Table 6.3A.4.2.2.5-1: Test Requirements of Absolute power tolerance (Test point 1)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	8.1	7.1	8.1	N/A
	120kHz	8.1	7.1	8.1	7.1
Power tolerance		± (14+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.2.5-4.					

Table 6.3A.4.2.2.5-2: Test Requirements of Absolute power tolerance (Test point 2)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	12.1	11.1	12.1	N/A
	120kHz	12.1	11.1	12.1	11.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.2.5-4.					

Table 6.3A.4.2.2.5-3: Test Requirements of Absolute power tolerance (Test point 3)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	22.1	[22.1]	22.1	N/A
	120kHz	22.1	[22.1]	22.1	21.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.2.5-4.					

Table 6.3A.4.2.2.5-4: Test Tolerance (Test point 1)

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

Table 6.3A.4.2.2.5-5: Test Tolerance (Test point 2 and Test point 3)

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

6.3A.4.2.3 Absolute power tolerance for CA (4UL CA)

6.3A.4.2.3.1 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.

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 20 ms.

6.3A.4.2.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA and 4DL CA.

6.3A.4.2.3.3 Minimum conformance requirements

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

6.3A.4.2.3.4 Test description

6.3A.4.2.3.4.1 Initial condition

Same as in clause 6.3A.4.2.1.4.1with the following exceptions:

- Instead of Table 6.3A.4.2.1.4.1-1→ use Table 6.3A.4.2.3.4-1.
- Instead of Table 6.3A.4.2.1.5-1 through 6.3A.4.2.1.5-3→ use Table 6.3A.4.2.3.5-1 and 6.3A.4.2.3.5-3.

Table 6.3A.4.2.3.4-1: Test Configuration Table

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1				Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes, and PCC and SCCs are mapped onto physical frequencies according to Table 6.1-2.				Low and High range		
Test CC combination setting as specified in subclause 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE.				Highest aggregated BW of the CA configuration		
Test SCS as specified in Table 5.3.5-1.				Highest		
Test Parameters						
Test ID	**CC**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation (Note 1)**
1	PCC	Default	Default	N/A	DFT-s-OFDM QPSK	Outer_Full
	SCC1				DFT-s-OFDM QPSK	Outer_Full
	SCC2				DFT-s-OFDM QPSK	Outer_Full
	SCC3				DFT-s-OFDM QPSK	Outer_Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.						

6.3A.4.2.3.5 Test requirement

Same as in clause 6.3A.4.2.1.5 with the following exceptions:

- Instead of Table 6.3S.4.2.1.5-1→ use Table 6.3A.4.2.3.5-1.
- Instead of Table 6.3S.4.2.1.5-2→ use Table 6.3A.4.2.3.5-2.
- Instead of Table 6.3S.4.2.1.5-3→ use Table 6.3A.4.2.3.5-3.
- Instead of Table 6.3A.4.2.1.5-4→ use Table 6.3A.4.2.3.5-4.
- Instead of Table 6.3A.4.2.1.5-5 → use Table 6.3A.4.2.3.5-5.

Table 6.3A.4.2.3.5-1: Test Requirements of Absolute power tolerance (Test point 1)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	8.1	7.1	8.1	N/A
	120kHz	8.1	7.1	8.1	7.1
Power tolerance		± (14+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.3.5-4.					

Table 6.3A.4.2.3.5-2: Test Requirements of Absolute power tolerance (Test point 2)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	12.1	11.1	12.1	N/A
	120kHz	12.1	11.1	12.1	11.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.3.5-4.					

Table 6.3A.4.2.3.5-3: Test Requirements of Absolute power tolerance (Test point 3)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	22.1	[22.1]	22.1	N/A
	120kHz	22.1	[22.1]	22.1	21.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.3.5-4.					

Table 6.3A.4.2.3.5-4: Test Tolerance (Test point 1)

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

Table 6.3A.4.2.3.5-5: Test Tolerance (Test point 2 and Test point 3)

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

6.3A.4.2.4 Absolute power tolerance for CA (5UL CA)

6.3A.4.2.4.1 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.

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 20 ms.

6.3A.4.2.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 5UL CA and 5DL CA.

6.3A.4.2.4.3 Minimum conformance requirements

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

6.3A.4.2.4.4 Test description

6.3A.4.2.4.4.1 Initial condition

Same as in clause 6.3A.4.2.1.4.1 with the following exceptions:

- Instead of Table 6.3A.4.2.1.4.1-1→ use Table 6.3A.4.2.4.4-1.
- Instead of Table 6.3A.4.2.1.5-1 through 6.3A.4.2.1.5-3→ use Table 6.3A.4.2.4.5-1 and 6.3A.4.2.4.5-3.

Table 6.3A.4.2.4.4-1: Test Configuration Table

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1				Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes, and PCC and SCCs are mapped onto physical frequencies according to Table 6.1-2.				Low and High range		
Test CC combination setting as specified in subclause 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE.				Highest aggregated BW of the CA configuration		
Test SCS as specified in Table 5.3.5-1.				Highest		
Test Parameters						
Test ID	**CC**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation (Note 1)**
1	PCC	Default	Default	N/A	DFT-s-OFDM QPSK	Outer_Full
	SCC1				DFT-s-OFDM QPSK	Outer_Full
	SCC2				DFT-s-OFDM QPSK	Outer_Full
	SCC3				DFT-s-OFDM QPSK	Outer_Full
	SCC4				DFT-s-OFDM QPSK	Outer_Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.						

6.3A.4.2.4.5 Test requirement

Same as in clause 6.3A.4.2.1.5 with the following exceptions:

- Instead of Table 6.3A.4.2.1.5-1→ use Table 6.3A.4.2.4.5-1.
- Instead of Table 6.3A.4.2.1.5-2→ use Table 6.3A.4.2.4.5-2.
- Instead of Table 6.3A.4.2.1.5-3→ use Table 6.3A.4.2.4.5-3.
- Instead of Table 6.3A.4.2.1.5-4→ use Table 6.3A.4.2.4.5-4.
- Instead of Table 6.3A.4.2.1.5-5 → use Table 6.3A.4.2.4.5-5.

Table 6.3A.4.2.4.5-1: Test Requirements of Absolute power tolerance (Test point 1)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	8.1	7.1	8.1	N/A
	120kHz	8.1	7.1	8.1	7.1
Power tolerance		± (14+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.4.5-4.					

Table 6.3A.4.2.4.5-2: Test Requirements of Absolute power tolerance (Test point 2)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	12.1	11.1	12.1	N/A
	120kHz	12.1	11.1	12.1	11.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.4.5-4.					

Table 6.3A.4.2.4.5-3: Test Requirements of Absolute power tolerance (Test point 3)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	22.1	[22.1]	22.1	N/A
	120kHz	22.1	[22.1]	22.1	21.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.4.5-4.					

Table 6.3A.4.2.4.5-4: Test Tolerance (Test point 1)

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

Table 6.3A.4.2.4.5-5: Test Tolerance (Test point 2 and Test point 3)

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

6.3A.4.2.5 Absolute power tolerance for CA (6UL CA)

6.3A.4.2.5.1 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.

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 20 ms.

6.3A.4.2.5.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 6UL CA and 6DL CA.

6.3A.4.2.5.3 Minimum conformance requirements

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

6.3A.4.2.5.4 Test description

6.3A.4.2.5.4.1 Initial condition

Same as in clause 6.3A.4.2.1.4.1with the following exceptions:

- Instead of Table 6.3A.4.2.1.4.1-1→ use Table 6.3A.4.2.5.4-1.
- Instead of Table 6.3A.4.2.1.5-1 through 6.3A.4.2.1.5-3→ use Table 6.3A.4.2.5.5-1 and 6.3A.4.2.5.5-3.

Table 6.3A.4.2.5.4-1: Test Configuration Table

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1				Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes, and PCC and SCCs are mapped onto physical frequencies according to Table 6.1-2.				Low and High range		
Test CC combination setting as specified in subclause 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE.				Highest aggregated BW of the CA configuration		
Test SCS as specified in Table 5.3.5-1.				Highest		
Test Parameters						
Test ID	**CC**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation (Note 1)**
1	PCC	Default	Default	N/A	DFT-s-OFDM QPSK	Outer_Full
	SCC1				DFT-s-OFDM QPSK	Outer_Full
	SCC2				DFT-s-OFDM QPSK	Outer_Full
	SCC3				DFT-s-OFDM QPSK	Outer_Full
	SCC4				DFT-s-OFDM QPSK	Outer_Full
	SCC5				DFT-s-OFDM QPSK	Outer_Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.						

6.3A.4.2.5.5 Test requirement

Same as in clause 6.3A.4.2.1.5 with the following exceptions:

- Instead of Table 6.3A.4.2.1.5-1→ use Table 6.3A.4.2.5.5-1.
- Instead of Table 6.3A.4.2.1.5-2→ use Table 6.3A.4.2.5.5-2.
- Instead of Table 6.3A.4.2.1.5-3→ use Table 6.3A.4.2.5.5-3.
- Instead of Table 6.3A.4.2.1.5-4→ use Table 6.3A.4.2.5.5-4.
- Instead of Table 6.3A.4.2.1.5-5 → use Table 6.3A.4.2.5.5-5.

Table 6.3A.4.2.5.5-1: Test Requirements of Absolute power tolerance (Test point 1)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
Expected Measured power	60kHz	8.1	7.1	8.1	N/A
	120kHz	8.1	7.1	8.1	7.1
Power tolerance		± (14+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.5.5-4.					

Table 6.3A.4.2.5.5-2: Test Requirements of Absolute power tolerance (Test point 2)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
Expected Measured power	60kHz	12.1	11.1	12.1	N/A
	120kHz	12.1	11.1	12.1	11.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.5.5-4.					

Table 6.3A.4.2.5.5-3: Test Requirements of Absolute power tolerance (Test point 3)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
Expected Measured power	60kHz	22.1	[22.1]	22.1	N/A
	120kHz	22.1	[22.1]	22.1	21.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.5.5-4.					

Table 6.3A.4.2.5.5-4: Test Tolerance (Test point 1 and Test point 2)

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

Table 6.3A.4.2.5.5-5: Test Tolerance (Test point 2 and Test point 3)

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

6.3A.4.2.6 Absolute power tolerance for CA (7UL CA)

6.3A.4.2.6.1 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.

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 20 ms.

6.3A.4.2.6.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 7UL CA and 7DL CA.

6.3A.4.2.6.3 Minimum conformance requirements

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

6.3A.4.2.6.4 Test description

6.3A.4.2.6.4.1 Initial condition

Same as in clause 6.3A.4.2.1.4.1 with the following exceptions:

- Instead of Table 6.3A.4.2.1.4.1-1→ use Table 6.3A.4.2.6.4-1.
- Instead of Table 6.3A.4.2.1.5-1 through 6.3A.4.2.1.5-3→ use Table 6.3A.4.2.6.5-1 and 6.3A.4.2.6.5-3.

Table 6.3A.4.2.6.4-1: Test Configuration Table

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1				Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes, and PCC and SCCs are mapped onto physical frequencies according to Table 6.1-2.				Low and High range		
Test CC combination setting as specified in subclause 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE.				Highest aggregated BW of the CA configuration		
Test SCS as specified in Table 5.3.5-1.				Highest		
Test Parameters						
Test ID	**CC**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation (Note 1)**
1	PCC	Default	Default	N/A	DFT-s-OFDM QPSK	Outer_Full
	SCC1				DFT-s-OFDM QPSK	Outer_Full
	SCC2				DFT-s-OFDM QPSK	Outer_Full
	SCC3				DFT-s-OFDM QPSK	Outer_Full
	SCC4				DFT-s-OFDM QPSK	Outer_Full
	SCC5				DFT-s-OFDM QPSK	Outer_Full
	SCC6				DFT-s-OFDM QPSK	Outer_Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.						

6.3A.4.2.6.5 Test requirement

Same as in clause 6.3A.4.2.1.5 with the following exceptions:

- Instead of Table 6.3A.4.2.1.5-1→ use Table 6.3A.4.2.6.5-1.
- Instead of Table 6.3A.4.2.1.5-2→ use Table 6.3A.4.2.6.5-2.
- Instead of Table 6.3A.4.2.1.5-3→ use Table 6.3A.4.2.6.5-3.
- Instead of Table 6.3A.4.2.1.5-4→ use Table 6.3A.4.2.6.5-4.

- **Instead of Table 6.3A.4.2.1.5-5 → use Table 6.3A.4.2.6.5-5.Table 6.3A.4.2.6.5-1: Test Requirements of Absolute power tolerance (Test point 1)**

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	7.1	8.1	7.1	N/A
	120kHz	7.1	8.1	7.1	8.1
Power tolerance		± (14+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.6.5-4.					

Table 6.3A.4.2.6.5-2: Test Requirements of Absolute power tolerance (Test point 2)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	12.1	11.1	12.1	N/A
	120kHz	12.1	11.1	12.1	11.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.6.5-4.					

Table 6.3A.4.2.6.5-3: Test Requirements of Absolute power tolerance (Test point 3)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Measured power	60kHz	22.1	[22.1]	22.1	N/A
	120kHz	22.1	[22.1]	22.1	21.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.6.5-4.					

Table 6.3A.4.2.6.5-4: Test Tolerance (Test point 1)

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

Table 6.3A.4.2.6.5-5: Test Tolerance (Test point 2 and Test point 3)

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

6.3A.4.2.7 Absolute power tolerance for CA (8UL CA)

6.3A.4.2.7.1 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.

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 20 ms.

6.3A.4.2.7.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 8UL CA.

6.3A.4.2.7.3 Minimum conformance requirements

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

6.3A.4.2.7.4 Test description

6.3A.4.2.7.4.1 Initial condition

Same as in clause 6.3A.4.2.1.4.1 with the following exceptions:

- Instead of Table 6.3A.4.2.1.4.1-1→ use Table 6.3A.4.2.7.4-1.
- Instead of Table 6.3A.4.2.1.5-1 through 6.3A.4.2.1.5-3→ use Table 6.3A.4.2.7.5-1 and 6.3A.4.2.7.5-3.

Table 6.3A.4.2.7.4-1: Test Configuration Table

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1				Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes, and PCC and SCCs are mapped onto physical frequencies according to Table 6.1-2.				Low and High range		
Test CC combination setting as specified in subclause 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2 for the CA Configuration across bandwidth combination sets supported by the UE.				Highest aggregated BW of the CA configuration		
Test SCS as specified in Table 5.3.5-1.				Highest		
Test Parameters						
Test ID	**CC**	**ChBw(MHz)**	**Test frequency**	**DL RB allocation**	**UL Modulation**	**UL RB allocation (Note 1)**
1	PCC	Default	Default	N/A	DFT-s-OFDM QPSK	Outer_Full
	SCC1				DFT-s-OFDM QPSK	Outer_Full
	SCC2				DFT-s-OFDM QPSK	Outer_Full
	SCC3				DFT-s-OFDM QPSK	Outer_Full
	SCC4				DFT-s-OFDM QPSK	Outer_Full
	SCC5				DFT-s-OFDM QPSK	Outer_Full
	SCC6				DFT-s-OFDM QPSK	Outer_Full
	SCC7				DFT-s-OFDM QPSK	Outer_Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.						

6.3A.4.2.7.5 Test requirement

Same as in clause 6.3A.4.2.1.5 with the following exceptions:

- Instead of Table 6.3A.4.2.1.5-1→ use Table 6.3A.4.2.7.5-1.
- Instead of Table 6.3A.4.2.1.5-2→ use Table 6.3A.4.2.7.5-2.

- Instead of Table 6.3A.4.2.1.5-3→ use Table 6.3A.4.2.7.5-3.
- Instead of Table 6.3A.4.2.1.5-4→ use Table 6.3A.4.2.7.5-4.
- Instead of Table 6.3A.4.2.1.5-5 → use Table 6.3A.4.2.7.5-5.

Table 6.3A.4.2.7.5-1: Test Requirements of Absolute power tolerance (Test point 1)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
Expected Measured power	60kHz	8.1	7.1	8.1	N/A
	120kHz	8.1	7.1	8.1	7.1
Power tolerance		± (14+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.7.5-4.					

Table 6.3A.4.2.7.5-2: Test Requirements of Absolute power tolerance (Test point 2)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
Expected Measured power	60kHz	12.1	11.1	12.1	N/A
	120kHz	12.1	11.1	12.1	11.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.7.5-4.					

Table 6.3A.4.2.7.5-3: Test Requirements of Absolute power tolerance (Test point 3)

	SCS	Channel bandwidth / expected output power (dBm)			
		50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
Expected Measured power	60kHz	22.1	[22.1]	22.1	N/A
	120kHz	22.1	[22.1]	22.1	21.1
Power tolerance		± (12+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3A.1, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2A.1. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3A.4.2.7.5-4.					

Table 6.3A.4.2.7.5-4: Test Tolerance (Test point 1)

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

Table 6.3A.4.2.7.5-5: Test Tolerance (Test point 2 and Test point 3)

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[FFS] dB	[FFS] dB
DUT ≤ 30 cm	[FFS] dB	[FFS] dB

6.3D Output power dynamics for UL MIMO

6.3D.1 Minimum output power for UL MIMO

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

- Measurement Uncertainty and Test Tolerances are FFS.
- Measurement period is pending RAN4.

6.3D.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.

6.3D.1.2 Test applicability

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

6.3D.1.3 Minimum conformance requirements

6.3D.1.3.1 Minimum output power for UL MIMO for power class 1

For UE supporting UL MIMO, the minimum controlled output power is defined as the EIRP, i.e. the sum of the power in the channel bandwidth for all transmit bandwidth configurations (resource blocks), when the UE power is set to a minimum value. The minimum output power shall not exceed the values specified in Table 6.3.1.3.1-1. The minimum power is verified in beam locked mode with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

6.3D.1.3.2 Minimum output power for UL MIMO for power class 2, 3 and 4

For UE supporting UL MIMO, the minimum controlled output power is defined as the EIRP, i.e. the sum of the power in the channel bandwidth for all transmit bandwidth configurations (resource blocks), when the UE power is set to a minimum value. The minimum output power shall not exceed the values specified in Table 6.3.1.3.2-1. The minimum power is verified in beam locked mode with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

The normative reference for this requirement is TS 38.101-2 [3] 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, 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 6.3D.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 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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	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. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] clause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex G.0, G.1 and 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 [10] 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 6.3.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The PDCCH DCI format 0_1 is specified with the condition 2TX_UL_MIMO in 38.508-1 [5] subclause 4.3.6.1.1.2.
2. Send continuously uplink power control "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. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1.
4. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.
5. Measure UE EIRP in the Tx beam peak direction in the measurement bandwidth specified in Table 6.3D.1.5-1 and Table 6.3D.1.5-2 for the specific channel bandwidth under test. EIRP test procedure is defined in Annex K. The measuring duration is [one active uplink subframe]. EIRP is calculated considering both polarizations, theta and phi. For TDD slots with transient periods are not under test.
6. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

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 EIRP, derived in step 5 shall not exceed the values specified in Table 6.3D.1.5-1 and Table 6.3D.1.5-2.

Table 6.3D.1.5-1: Minimum output power for power class 1

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	4+TT	47.52
	100	4+TT	95.04
	200	4+TT	190.08
	400	4+TT	380.16

Table 6.3D.1.5-2: Minimum output power for power class 2, 3, and 4

Operating band	Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
n257, n258, n260, n261	50	-13+TT	47.52
	100	-13+TT	95.04
	200	-13+TT	190.08
	400	-13+TT	380.16

6.3D.2 Transmit OFF power for UL MIMO

FFS

6.3D.3 Transmit ON/OFF time mask for UL MIMO

6.3D.3.1 General ON/OFF time mask for UL MIMO

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

- Measurement Uncertainty and Test Tolerances are FFS.
- Test requirement of ON power is FFS.
- Testability of OFF power needs further study.
- The method of setting UE transmitted power is FFS.
- TP analysis is FFS
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

6.3D.3.1.1 Test purpose

To verify that the general ON/OFF time mask meets the requirements given in 6.3D.3.1.5. Transmission of the wrong power increases interference to other channels, or increases transmission errors in the uplink channel.

6.3D.3.1.2 Test applicability

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

6.3D.3.1.3 Minimum conformance requirements

For UE supporting UL MIMO, the ON/OFF time mask requirements in subclause 6.3.3 apply. The requirements shall be met with the UL MIMO configurations specified in Table 6.2D.1.3.3-3.

The normative reference for this requirement is TS 38.101-2 [3] clause 6.3D.3.

6.3D.3.1.4 Test description

6.3D.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 5.2-1. 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 6.3D.3.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3D.3.1.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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	N/A for maximum 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. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

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

4. The UL Reference Measurement Channels are set according to Table 6.3D.3.1.4.1-1.

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

6. Ensure the UE is in State RRC_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On,* Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [10] clause 4.5. Message contents are defined in clause 6.3D.3.1.4.3.

6.3D.3.1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 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 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. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 4) for the UE Tx beam selection to complete.

3. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

4. For UE transmission OFF power, measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3D.3.1.5-1. EIRP test procedure is defined in Annex K. The period of the measurement shall be the slot prior to

the PUSCH transmission, excluding a transient period of 5 μs in the end of the slot and any DL periods. EIRP is calculated considering both polarizations, theta and phi.

5. For UE transmission ON power, measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3D.3.1.5-2. EIRP test procedure is defined in Annex K. The period of the measurement shall be one slot with PUSCH transmission. EIRP is calculated considering both polarizations, theta and phi. For TDD slots with transient periods are not under test.

6. For UE transmission OFF power, measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3D.3.1.5-1. EIRP test procedure is defined in Annex K. The period of the measurement shall be the slot following the PUSCH transmission, excluding a transient period of 5 μs at the beginning of the slot and any DL periods. EIRP is calculated considering both polarizations, theta and phi.

7. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

6.3D.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.

Table 6.3D.3.1.4.3-1: *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.3.1.5 Test requirement

Table 6.3D.3.1.5-1: Test requirement of OFF power of General ON/OFF time mask for UL MIMO

	Channel bandwidth / minimum output power / measurement bandwidth			
	50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
Transmit OFF power	≤ -30+TT dBm			
Transmission OFF Measurement bandwidth	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz

Table 6.3D.3.1.5-2: Test requirement of ON power of General ON/OFF time mask for UL MIMO

	SCS [kHz]	**Channel bandwidth / minimum output power / measurement bandwidth**			
		50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
Expected Transmission ON	60	FFS	FFS	FFS	FFS
Measured power for CP-OFDM	120	FFS	FFS	FFS	FFS

Table 6.3D.3.1.5-3: Test Tolerance for OFF power

FFS

Table 6.3D.3.1.5-4: Test Tolerance for ON power

FFS

6.3D.3.2 to 6.3D.3.3

6.3D.3.4 SRS time mask for UL MIMO

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

- OTA test procedure for UL-MIMO is still under investigation
- Measurement Uncertainty and Test Tolerances are FFS.
- Testability of OFF power needs further study.

6.3D.3.4.1 Test purpose

To verify that the SRS time mask for UL MIMO meets the requirements given in 6.3D.3.4.5.

The transmit ON/OFF time mask defines the transient period(s) allowed

- between transmit OFF power and transmit ON power symbols (transmit ON/OFF)

Unless otherwise stated the minimum requirements in clause 6 apply also in transient periods.

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

6.3D.3.4.2 Test applicability

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

6.3D.3.4.3 Minimum conformance requirements

The transmit ON/OFF time mask is defined as a directional requirement. The requirement is verified in beam locked mode at beam peak direction. The maximum allowed EIRP OFF power level is -30dBm at beam peak direction. The requirement is verified with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

In the case of a single SRS transmission, the ON power is defined as the mean power over the symbol duration excluding any transient period; Figure 6.3D.3.4.3-1.

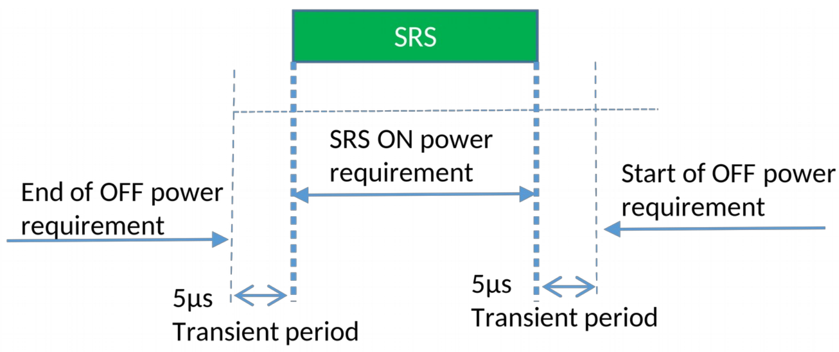


Figure 6.3D.3.4.3-1: Single SRS time mask for NR UL transmission

In the case of multiple consecutive SRS transmission, the ON power is defined as the mean power for each symbol duration excluding any transient period. See Figure 6.3D.3.4.3-2.

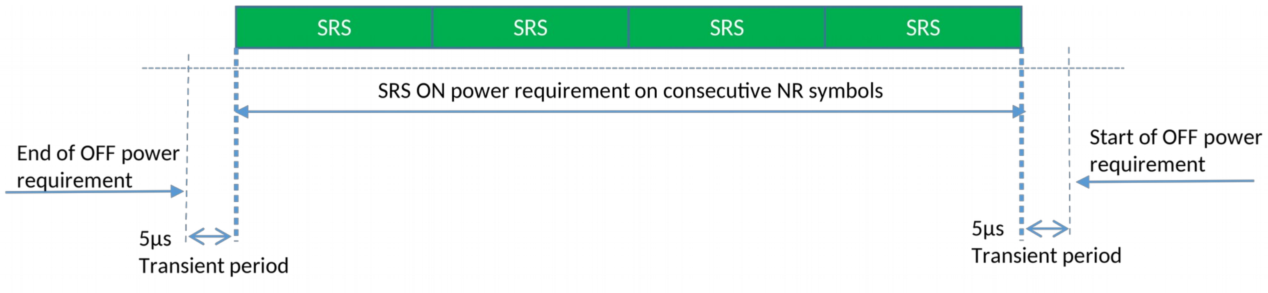


Figure 6.3D.3.4.3-2: Consecutive SRS time mask for the case when no power change is required

When power change between consecutive SRS transmissions is required, then Figure 6.3D.3.4.3-3 and 6.3D.3.4.3-4 apply.

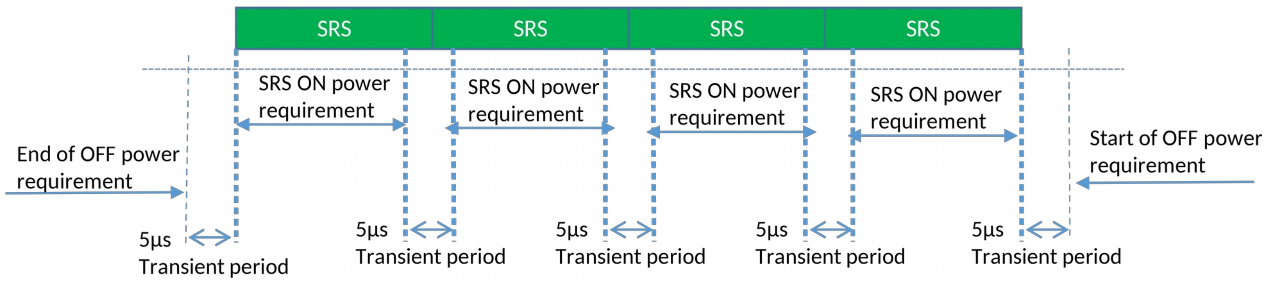


Figure 6.3D.3.4.3-3: Consecutive SRS time mask for the case when power change is required and when 60kHz SCS is used in FR2

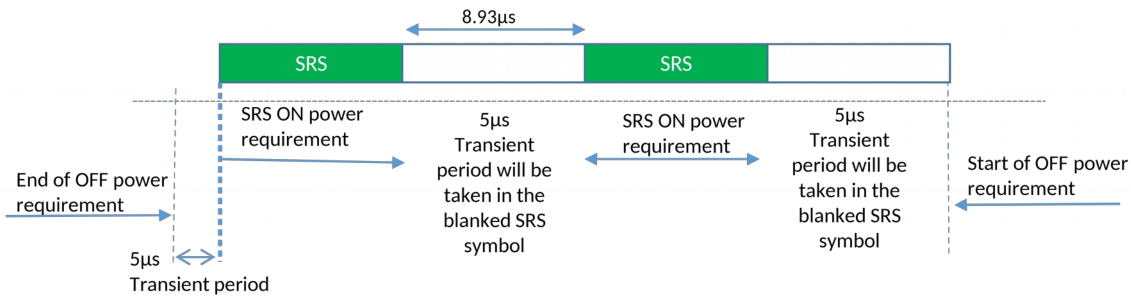


Figure 6.3D.3.4.3-4: Consecutive SRS time mask for the case when power change is required and when 120kHz SCS is used in FR2

The requirements shall be met with the UL MIMO configuration specified in Table 6.3D.3.4.3-1.

Table 6.3D.3.4.3-1: UL MIMO configuration

Transmission scheme	DCI format	Codebook Index
Codebook based uplink	DCI format 0_1	Codebook index 0

6.3D.3.4.4 Test description

6.3D.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 channel bandwidth and sub-carrier spacing, are shown in Table 6.3D.3.4.4.1-1. The details of the uplink and downlink reference measurement channels (RMCS) are specified in Annexes A.2 and A.3

Table 6.3D.3.4.4.1-1: Test Configuration Table

Initial Conditions					
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal,		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1]			Low range, Mid Range, High range		
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause [4.3.1]			Lowest, Mid, Highest		
Test SCS as specified in Table 5.3.5-1			Lowest, Highest		
Test Parameters					
Test ID	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
				Modulation	**RB allocation (NOTE 1)**
1	50	60kHz 120kHz	N/A for maximum output power test case	DFT-s-OFDM QPSK	Outer_Full
2	100	60kHz 120kHz			
3	200	60kHz 120kHz			
4	400	120kHz			
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.					

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure [FFS]. for TE diagram and section [FFS] for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1 and C3.0, and uplink signals according to Annex G.0, G.1 and G3.0.

4. The UL Reference Measurement Channels are set according to Table 6.3D.3.4.4.1-1.

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

6. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On*, Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [10] clause 4.5. Message contents are defined in clause 6.3D.3.4.4.3.

6.3D.3.4.4.2 Test procedure

1. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 4) for the UE Tx beam selection to complete.

2. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

3. The SS measure the UE transmission OFF power during the 10 OFDM symbols for 60k SCS and 10 OFDM symbols for 120k SCS, preceding the SRS symbol excluding a transient period of 5 µs.

4. For UE transmission OFF power, measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3D.3.4.4.1-1. EIRP test procedure is defined in Annex K.1.3. The period of the measurement shall be during the 10 OFDM symbols for 60k SCS and 10 OFDM symbols for 120k SCS, preceding the SRS symbol excluding a transient period of 5 µs. EIRP is calculated considering polarizations, theta and phi.

5. For UE transmission ON power, measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3D.3.4.4.1-1. EIRP test procedure is defined in Annex K.1.3. The period of the measurement shall be the SRS transmission during 4 OFDM symbols for 60k SCS and 4 OFDM symbols for 120k SCS. EIRP is calculated considering polarizations, theta and phi.

6. For UE transmission OFF power, measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.3D.3.4.4.1-1. EIRP test procedure is defined in Annex K.1.3. The period of the measurement shall be the slot following the SRS under test, excluding a transient period of 5 µs. EIRP is calculated considering polarizations, theta and phi.

6.3D.3.4.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 with following exceptions.

Table 6.3D.3.4.4.3-1: BWP-UplinkDedicated

Derivation Path: TS 38.508-1 [10], Table 4.6.3-15 srs-Config with condition DCI_0_1

Table 6.3D.3.4.4.3-2: *SRS-Config: SRS time mask for UL MIMO measurement*

Derivation Path: TS 38.331 [6], clause 6.3.2			
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	4		FR2
}			
}			
usage	codebook		
alpha	alpha1		
p0	-116		FR2_50MHz
	-120		FR2_100 MHz
	-122		FR2_200 MHz
	-126		FR2_400 MHz
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
ptrs-PortIndex	Not present		
transmissionComb CHOICE {			
n2 SEQUENCE {			
combOffset-n2	0		
cyclicShift-n2	0		
}			
}			
resourceMapping SEQUENCE {			
startPosition	0		
nrofSymbols	n4		SCS 60 kHz SCS 120 kHz
repetitionFactor	n1		
}			
freqDomainPosition	0		
freqDomainShift	0		
freqHopping SEQUENCE {			
c-SRS	17 (BW 50 MHz) 30 (BW 100 MHz) 59 (BW 200 MHz)		SCS 60 kHz
	9 (BW 50 MHz) 17 (BW 100 MHz) 30 (BW 200 MHz) 59 (BW 400 MHz)		SCS 120 kHz
b-SRS	0		
b-hop	0		
}			

groupOrSequenceHopping	groupHopping		
resourceType CHOICE {			
periodic SEQUENCE {			
periodicityAndOffset-p CHOICE {			
s120	16		SCS 60 kHz
s140	32		SCS 120 kHz
}			
}			
sequenceId	0		
spatialRelationInfo SEQUENCE {	SRS-SpatialRelationInfo		
servingCellId	Not present		
referenceSignal CHOICE {			
ssb-Index	SSB-Index		
}			
}			
}			
tpc-Accumulation	disabled		
}			

Table 6.3D.3.4.4.3-3: ServingCellConfigCommon

Derivation Path: 38.508-1[5], Table 4.6.3-168			
Information Element	**Value/remark**	**Comment**	**Condition**
ServingCellConfigCommon ::= SEQUENCE {			
ss-PBCH-BlockPower	1		SCS_60kHz
	4		SCS_120kHz
}			

Condition	Explanation
SCS_60kHz	SCS=60kHz for SS/PBCH block
SCS_120kHz	SCS=120kHz for SS/PBCH block

6.3D.3.4.5 Test requirement

The ON/OFF power of SRS time mask for UL MIMO shall not exceed the values specified in Table 6.3D.3.4.5-1 to Table 6.3D.3.4.5-4.

Table 6.3D.3.4.5-1: Test Tolerance of OFF power of SRS time mask for UL MIMO ON/OFF time mask

	Channel bandwidth/Opera Output Power [dBm] / measurement bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
Transmit OFF power	≤ -30+TT dBm			
Transmission OFF measurement bandwidth	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz

Table 6.3D.3.4.5-2: Test requirement of ON power of SRS for UL MIMO ON/OFF time mask

	SCS [kHz]	Channel bandwidth / measurement bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz
Expected Transmission ON power for DFT-s-OFDM	60	8.1 dBm	7.1 dBm	8.1 dBm	N/A
	120	8.1 dBm	7.1 dBm	8.1 dBm	7.1 dBm
ON Power tolerance		± (14+TT) dB			
Note 1: The lower power limit shall not exceed the minimum output power requirements defined in sub-clause 6.3.2.3, and the higher power limit shall not exceed the Max EIRP defined in sub-clause 6.2.1.3. Note 2: TT for each frequency and channel bandwidth is specified in Table 6.3D.3.4.5-3.					

Table 6.3D.3.4.5-3: Test Tolerance for SRS time mask for UL-MIMO OFF power

FFS

Table 6.3D.3.4.5-4: Test Tolerance for SRS time mask for UL-MIMO ON power

Test Metric	FR2a	FR2b
DUT ≤ 15 cm	[TBD] dB	[TBD] dB
DUT ≤ 30 cm	[TBD] dB	[TBD] dB

6.4 Transmit signal quality

6.4.1 Frequency error

Editor's note: The following aspects of the clause are for future consideration:

Testing of extreme conditions for FR2 is FFS.

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 msec compared to the carrier frequency received from the NR gNB.

The frequency error is defined as a directional requirement. The requirement is verified in beam locked mode with the test metric of Frequency (Link=TX beam peak direction, Meas=Link angle).

The normative reference for this requirement is TS 38.101-2 [3] 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 [10] subclause 4.1		Normal, [TL/NC, TH/NC]		
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Mid range		
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and section A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.2 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and 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 [10] clause 4.5. Message contents are defined in clause 6.4.1.4.3

6.4.1.4.2 Test procedure

1. Retrieve the LO position from the parameter txDirectCurrentLocation in UplinkTxDirectCurrent IE.

2. 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.

3. 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.

4. 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 for the UE to reach P_{UMAX} level.

5. Set the UE in the Inband Tx beam peak direction and apply the associated polarization for the DL, both found with a 3D EIRP scan as performed in Annex K.1.1. Connect the SS (System Simulator) with the DUT through the measurement antenna with polarization reference Pol_{Link} to form the TX beam towards the TX beam peak direction and respective polarization. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.

6. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

7. Measure the Frequency Error using Global In-Channel Tx-Test (Annex E) for the θ- and φ-polarization of the UL. For TDD, only slots consisting of only UL symbols are under test.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.4.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 with DFT-s-OFDM condition in Table 4.6.3-118 PUSCH-Config and with the exceptions in subclause 7.3.2.4.3 and Table 7.3.2.5-3.

6.4.1.5 Test requirement

The *n* frequency error Δf results for the θ-polarization or the *n* frequency error Δf results for the φ-polarization must fulfil the test requirement:

$$|\Delta f| \le (0.1 \text{ PPM} + 0.005 \text{ PPM}),$$

where

$$n = \begin{cases} 30, \text{ for 60 kHz SCS} \\ 60, \text{ for 120 kHz SCS} \end{cases}.$$

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.

All the requirements in 6.4.2 are defined as directional requirement. The requirements are verified in beam locked mode on beam peak direction, with parameter *maxRank* (as defined in TS 38.331 [19]) set to 1. The requirements are applicable to UL transmission from each configurable antenna port (as defined in TS 38.331 [19]) of UE, enabled one at a time.

6.4.2.1 Error vector magnitude

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

- Measurement Uncertainty and Test Tolerance are FFS.
- 38.101-2 Clause 6.3.4.3: Relative power tolerances are in square brackets.

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-clauses 6.4.2.4.3 and 6.4.2.5.3. 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 contain 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 the average EVM case, and 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 or Table 6.4.2.1.3-3 depending on UE power class. For EVM evaluation purposes, all 13 PRACH preamble formats and all 5 PUCCH formats are considered to have the same EVM requirement as QPSK modulated.

The measurement interval for the EVM determination is 10 subframes. The requirement is verified with the test metric of EVM (Link=TX beam peak direction, Meas=Link angle).

Table 6.4.2.1.3-1: Minimum requirements for error vector magnitude

Parameter	Unit	Average EVM level	Reference signal EVM level
Pi/2 BPSK	%	30.0	30.0
QPSK	%	17.5	17.5
16 QAM	%	12.5	12.5
64 QAM	%	8.0	8.0

Table 6.4.2.1.3-2: Parameters for Error Vector Magnitude for power class 1

Parameter	Unit	Level
UE EIRP	dBm	≥ 4
UE EIRP for UL 16QAM	dBm	≥ 7
UE EIRP for UL 64QAM	dBm	≥ 11
Operating conditions		Normal conditions

Table 6.4.2.1.3-3: Parameters for Error Vector Magnitude for power class 2, 3, and 4

Parameter	Unit	Level
UE EIRP	dBm	≥ -13
UE EIRP for UL 16QAM	dBm	≥ -10
UE EIRP for UL 64QAM	dBm	≥ -6
Operating conditions		Normal conditions

The normative reference for this requirement is TS 38.101-2 [3] 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 reference measurement channels (RMCs) are specified in Annex A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.2.1.4.1-1: Test Configuration Table for PUSCH

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1		Lowest, Highest	
Test SCS as specified in Table 5.3.5-1		Lowest, Highest	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
	N/A	**Modulation**	**RB allocation (NOTE 1)**
1		DFT-s-OFDM PI/2 BPSK	Inner_Full
2		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	Inner_Full
8		DFT-s-OFDM 64 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	Inner_Full
14		CP-OFDM 64 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.			

Table 6.4.2.1.4.1-2: Test Configuration Table for PUCCH

Initial Conditions				
Test Environment as specified in TS 38.508-1 [10] subclause 4.1			Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1			See Table 6.4.2.1.4.1-1	
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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**
1	CP-OFDM QPSK	Full RB (Note 1)	CP-OFDM	PUCCH format = Format 1 Length in OFDM symbols = 14
2	CP-OFDM QPSK	Full RB (Note 1)	DFT-s-OFDM	PUCCH format = Format 1 Length in OFDM symbols = 14
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 [10] subclause 4.1	Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1	See Table 6.4.2.1.4.1-1	
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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	
PRACH preamble format		
	FDD	TDD
PRACH Configuration Index	17	52
RS EPRE setting for test point 1 (dBm/15kHz)	-71	-65
RS EPRE setting for test point 2 (dBm/15kHz)	-86	-80

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, in Figure A.3.3.1.1 for TE diagram and section A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.2 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and 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 [10] 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 Retrieve the LO position from the parameter txDirectCurrentLocation in UplinkTxDirectCurrent IE.

1.2 SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.4.2.1.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

1.3 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 200 ms starting from the first TPC command in this step for the UE to reach [P_{UMAX} level].

1.4 Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 2) for the UE Tx beam selection to complete.

1.5 SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

1.6 Measure the EVM_θ, EVM_φ, $\overline{EVM}_{DMRS,\theta}$ and $\overline{EVM}_{DMRS,\varphi}$ using Global In-Channel Tx-Test (Annex E) for the θ- and φ-polarizations, respectively. For TDD, only slots consisting of only UL symbols are under test. Calculate $\overline{EVM}_{DMRS} = \min\left(\overline{EVM}_{DMRS,\theta}, \overline{EVM}_{DMRS,\varphi}\right)$ and $EVM = \min(EVM_\theta, EVM_\varphi)$.

1.7 SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

1.8 Send the appropriate TPC commands in the uplink scheduling information to the UE until UE EIRP is in the range $P_{req} + P_W \pm P_W$, where P_{req} is the power level specified in Tables 6.4.2.1.4.2-1 and 6.4.2.1.4.2-2 according to the modulation and power class. P_W is the power window according to Table 6.4.2.1.4.2-3 for the carrier frequency f and the channel bandwidth BW.

1.9 SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

1.10 Measure the EVM_θ, EVM_φ, $\overline{EVM}_{DMRS,\theta}$ and $\overline{EVM}_{DMRS,\varphi}$ using Global In-Channel Tx-Test (Annex E) for the θ- and φ-polarizations, respectively. For TDD, only slots consisting of only UL symbols are under test. Calculate $\overline{EVM}_{DMRS} = \min\left(\overline{EVM}_{DMRS,\theta}, \overline{EVM}_{DMRS,\varphi}\right)$ and $EVM = \min(EVM_\theta, EVM_\varphi)$.

1.11 SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

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 [10] 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.

NOTE 2: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

Table 6.4.2.1.4.2-1: Parameters for Error Vector Magnitude for power class 1

Parameter	Unit	Level
UE Output Power	dBm	4
UE output power for UL 16QAM	dBm	7
UE output power for UL 64QAM	dBm	11

Table 6.4.2.1.4.2-2: Parameters for Error Vector Magnitude for power class 2, 3, and 4

Parameter	Unit	Level
UE Output Power	dBm	-13
UE output power for UL 16QAM	dBm	-10
UE output power for UL 64QAM	dBm	-6

Table 6.4.2.1.4.2-3: Power Window (dB) for EVM PUSCH and PUCCH

TBD

Test procedure for PUCCH:

2.1 Retrieve the LO position from the parameter txDirectCurrentLocation in UplinkTxDirectCurrent IE.

2.2 PUCCH is set according to Table 6.4.2.1.4.1-2.

2.3 SS transmits PDSCH via PDCCH DCI format 0_1 for C_RNTI to transmit the DL RMC according to Table 6.4.2.1.4.1-2. The SS sends downlink MAC padding bits on the DL RMC. The transmission of PDSCH will make the UE send uplink ACK/NACK using PUCCH. There is no PUSCH transmission.

2.4 SS send appropriate TPC commands for PUCCH to the UE until the UE transmit PUCCH at [P_{UMAX} level]. Allow at least 200 ms starting from the first TPC command in this step for the UE to reach [P_{UMAX} level].

2.5 Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 2) for the UE Tx beam selection to complete.

2.6 SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

2.7 Measure PUCCH EVM_θ and PUCCH EVM_φ using Global In-Channel Tx-Test (Annex E). Calculate $\text{PUCCH EVM} = \min(\text{PUCCH EVM}_\theta, \text{PUCCH EVM}_\varphi)$.

2.8 SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

2.9 Send the appropriate TPC commands in the uplink scheduling information to the UE until UE EIRP is in the range $P_{req} + P_W \pm P_W$, where P_{req} is the power level specified in Tables 6.4.2.1.4.2-1 and 6.4.2.1.4.2-2 according to the modulation and power class. P_W is the power window according to Table 6.4.2.1.4.2-3 for the carrier frequency f and the channel bandwidth BW.

2.10 SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

2.11 Measure PUCCH EVM_θ and PUCCH EVM_φ using Global In-Channel Tx-Test (Annex E). Calculate $\text{PUCCH EVM} = \min(\text{PUCCH EVM}_\theta, \text{PUCCH EVM}_\varphi)$.

2.12 SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

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 [10] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

NOTE 2: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

Test procedure for PRACH:

3.1 Retrieve the LO position from the parameter txDirectCurrentLocation in UplinkTxDirectCurrent IE.

3.2 Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1.

3.3 The SS shall set RS EPRE according to Table 6.4.2.1.4.1-3.

3.4 PRACH is set according to Table 6.4.2.1.4.1-3.

3.5 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.

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

3.7 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.

3.8 The UE shall consider the random access response reception not successful then re-transmit the preamble with the calculated PRACH transmission power.

3.9 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_θ and EVM_φ in PRACH channel using Global In-Channel Tx-Test (Annex E). Calculate $\mathrm{EVM} = \min(\mathrm{EVM}_\theta, \mathrm{EVM}_\varphi)$.

6.4.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] 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.

The PUCCH EVM derived in Annex E.5.9.2 shall not exceed the values for QPSK in Table 6.4.2.1.5-1.

The PRACH EVM derived in Annex E.6.9.2 shall not exceed the values for QPSK in Table 6.4.2.1.5-1.

Table 6.4.2.1.5-1: Test requirements for Error Vector Magnitude

Parameter	Unit	Average EVM Level	Reference Signal EVM Level
Pi/2 BPSK	%	30+TT	30+TT
QPSK	%	17.5+TT	17.5+TT
16 QAM	%	12.5+TT	12.5+TT
64 QAM	%	8+TT	8+TT

6.4.2.2 Carrier leakage

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

- Measurement Uncertainty and Test Tolerance are FFS.
- 38.101-2 Clause 6.3.4.3: Relative power tolerances are in square brackets.

6.4.2.2.1 Test purpose

Carrier leakage expresses itself as unmodulated sine wave with the carrier frequency. It is an interference of approximately constant amplitude and independent of the amplitude of the wanted signal. Carrier leakage interferes with the sub carriers at its position (if allocated), especially, when their amplitude is small.

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. The carrier leakage requirement is defined for each component carrier. The measurement interval is one slot in the time domain. The relative carrier leakage power is a power ratio of the additive sinusoid waveform to the power in the modulated waveform.

The requirement is verified with the test metric of Carrier Leakage (Link=TX beam peak direction, Meas=Link angle).

When carrier leakage is contained inside the spectrum confined within the configured UL and DL CCs, the relative carrier leakage power shall not exceed the values specified in Table 6.4.2.2.3-1 for power class 1 UEs.

Table 6.4.2.2.3-1: Minimum requirements for relative carrier leakage power for power class 1

Parameters	Relative Limit (dBc)
EIRP > 17 dBm	-25
4 dBm ≤ EIRP ≤ 17 dBm	-20

When carrier leakage is contained inside the spectrum occupied by the configured UL CCs and DL CCs, the relative carrier leakage power shall not exceed the values specified in Table 6.4.2.2.3-2 for power class 2.

Table 6.4.2.2.3-2: Minimum requirements for relative carrier leakage power for power class 2

Parameters	Relative Limit (dBc)
EIRP > 6 dBm	-25
-13 dBm ≤ EIRP ≤ 6 dBm	-20

When carrier leakage is contained inside the spectrum occupied by the configured UL CCs and DL CCs, the relative carrier leakage power shall not exceed the values specified in Table 6.4.2.2.3-3 for power class 3 UEs.

Table 6.4.2.2.3-3: Minimum requirements for relative carrier leakage power for power class 3

Parameters	Relative Limit (dBc)
EIRP > 0 dBm	-25
-13 dBm ≤ EIRP ≤ 0 dBm	-20

When carrier leakage is contained inside the spectrum occupied by the configured UL CCs and DL CCs, the relative carrier leakage power shall not exceed the values specified in Table 6.4.2.2.3-4 for power class 4.

Table 6.4.2.2.3-4: Minimum requirements for relative carrier leakage power for power class 4

Parameters	Relative Limit (dBc)
EIRP > 11 dBm	-25
-13 dBm ≤ EIRP ≤11 dBm	-20

The normative reference for this requirement is TS 38.101-2[3] 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 reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.2.2.4.1-1: Test Configuration

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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_16RB_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_16RB_Left, use Inner_16RB_Right for UL RB allocation.			

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, in Figure A.3.3.1.1 for TE diagram and section A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex [TBD], and uplink signals according to Annex [TBD].

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 [10] 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. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.

3. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE EIRP is in the range $P_{req} + P_W \pm P_W$, where P_{req} is the power level specified in Tables 6.4.2.2.4.2-1 according to the power class. P_W is the power window according to Table 6.4.2.1.4.2-3 for the carrier frequency f and the channel bandwidth BW.

4. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

5. Measure carrier leakage using Global In-Channel Tx-Test (Annex E) for the θ- and ϕ-polarization. For TDD, only slots consisting of only UL symbols are under test.

6. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

7. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE EIRP is in the range $P_{req} + P_W \pm P_W$, where P_{req} is the power level specified in Tables 6.4.2.2.4.2-1 according to the power class. P_W is the power window according to Table 6.4.2.1.4.2-3 for the carrier frequency f and the channel bandwidth BW.

8 SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

9. Measure carrier leakage using Global In-Channel Tx-Test (Annex E) for the θ- and ϕ-polarization. For TDD, only slots consisting of only UL symbols are under test.

10 SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

Table 6.4.2.2.4.2-1: UE EIRP P_{req} (dBm) for carrier leakage

Power Class	P_{req} (dBm) for step 3	P_{req} (dBm) for step 7
Power Class 1	17	4
Power Class 2	6	-13
Power Class 3	0	-13
Power Class 4	11	-13

Table 6.4.2.2.4.2-2: Power Window (dB) for carrier leakage

TBD

6.4.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.4.2.2.5 Test requirement

For each of the *n* carrier leakage results derived in Annex E.3.1 for θ- and φ-polarization the total value is calculated according to

$$\mathrm{CarrLeak}_{\mathrm{Total}} = 10\log_{10}\left(10^{\mathrm{CarrLeak}_{\theta}/10} + 10^{\mathrm{CarrLeak}_{\varphi}/10}\right), \text{ where}$$

$$n = \begin{cases} 30, \text{ for 60 kHz SCS} \\ 60, \text{ for 120 kHz SCS} \end{cases}.$$

Each of the *n* total carrier leakage results $\mathrm{CarrLeak}_{\mathrm{Total}}$ shall not exceed the values in table 6.4.2.2.5-1 for power class 1 and table 6.4.2.2.5-3 for power class 3. Allocated RBs are not under test.

Table 6.4.2.2.5-1: Test requirements for relative carrier leakage power for power class 1

LO Leakage	Parameters UE EIRP	Relative limit (dBc)
	17 + P_W dBm ± P_W dB	-25 + TT
	4 + P_W dBm ± P_W dB	-20 + 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 are those that are enclosed in the RBs containing the DC frequency if N_{RB} is odd, or in the two RBs immediately adjacent to the DC frequency if N_{RB} is even, but excluding any allocated RB.
NOTE 3: N_{RB} is the Transmission Bandwidth Configuration (see Figure 5.3.3-1).
NOTE 4: All power levels are UE EIRP in beam peak direction.
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.

Table 6.4.2.2.5-2: Test requirements for relative carrier leakage power for power class 2

LO Leakage	Parameters UE EIRP	Relative limit (dBc)
	6 + P_W dBm ± P_W dB	-25 + TT
	-13 + P_W dBm ± P_W dB	-20 + 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 are those that are enclosed in the RBs containing the DC frequency if N_{RB} is odd, or in the two RBs immediately adjacent to the DC frequency if N_{RB} is even, but excluding any allocated RB.
NOTE 3: N_{RB} is the Transmission Bandwidth Configuration (see Figure 5.3.3-1).
NOTE 4: All power levels are UE EIRP in beam peak direction.
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.

Table 6.4.2.2.5-3: Test requirements for relative carrier leakage power for power class 3

LO Leakage	Parameters UE EIRP	Relative limit (dBc)
	0 + P_W dBm ± P_W dB	-25 + TT
	-13 + P_W dBm ± P_W dB	-20 + 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 are those that are enclosed in the RBs containing the DC frequency if N_{RB} is odd, or in the two RBs immediately adjacent to the DC frequency if N_{RB} is even, but excluding any allocated RB.
NOTE 3: N_{RB} is the Transmission Bandwidth Configuration (see Figure 5.3.3-1).
NOTE 4: All power levels are UE EIRP in beam peak direction.
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.

Table 6.4.2.2.5-4: Test requirements for relative carrier Leakage Power for power class 4

LO Leakage	Parameters UE EIRP	Relative limit (dBc)
	11 + P_W dBm ± P_W dB	-25 + TT
	-13 + P_W dBm ± P_W dB	-20 + 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 are those that are enclosed in the RBs containing the DC frequency if N_{RB} is odd, or in the two RBs immediately adjacent to the DC frequency if N_{RB} is even, but excluding any allocated RB.
NOTE 3: N_{RB} is the Transmission Bandwidth Configuration (see Figure 5.3.3-1).
NOTE 4: All power levels are UE EIRP in beam peak direction.
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.

6.4.2.3 In-band emissions

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

- Measurement Uncertainty and Test Tolerance are FFS.
- 38.101-2 Clause 6.3.4.3: Relative power tolerances are in square brackets.

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 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 in-band emission is defined as the average 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 identical to that of the EVM test.

The requirement is verified with the test metric of In-band emission (Link=TX beam peak direction, Meas=Link angle).

The relative in-band emission shall not exceed the values specified in Table 6.4.2.3.3-1 for power class 1 UEs.

The average of the in-band emission measurement over 10 sub-frames shall not exceed the values specified in Table 6.4.2.3.2-1 for power class 1, Table 6.4.2.3.3-2 for power class 2, Table 6.4.2.3.3-3 for power class 3 and Table 6.4.2.3.3-4 for power class 4 UEs.

Table 6.4.2.3.3-1: Requirements for in-band emissions for power class 1

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\begin{bmatrix} -25 - 10.\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20.\log_{10}(EVM) - 5.\frac{(\lvert\Delta_{RB}\rvert-1)}{L_{CRB}}, \\ -55.1dBm - P_{RB} \end{bmatrix}$		Any non-allocated (NOTE 2)
IQ Image	dB	-25	Output power > 27 dBm	Image frequencies (NOTES 2, 3)
		-20	Output power ≤ 27 dBm	
Carrier leakage	dBc	-25	Output power > 17 dBm	Carrier frequency (NOTES 4, 5)
		-20	4 dBm ≤ Output power ≤ 17 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} - 25 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. For pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD

NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier 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 in the RBs containing the DC 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 s the limit 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. Δ_{RB}= 1 or Δ_{RB}= -1 for the first adjacent RB outside of the allocated bandwidth).

NOTE 10: P_{RB} is the transmitted power per allocated RB, measured in dBm.

NOTE 11: All powers are EIRP in beam peak direction.

The relative in-band emission shall not exceed the values specified in Table 6.4.2.3.3-2 for power class 2.

Table 6.4.2.3.3-2: Requirements for in-band emissions for power class 2

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\begin{bmatrix} -25 - 10.\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20.\log_{10}(EVM) - 5.\frac{(\lvert\Delta_{RB}\rvert-1)}{L_{CRB}}, \\ -55.1dBm - P_{RB} \end{bmatrix}$		Any non-allocated (NOTE 2)
IQ Image	dB	-25	Output power > 16 dBm	Image frequencies (NOTES 2, 3)
		-20	Output power ≤ 16 dBm	
Carrier leakage	dBc	-25	Output power > 6 dBm	Carrier frequency (NOTES 4, 5)
		-20	-13 dBm ≤ Output power ≤ 6 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} - 25 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. For pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier 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 in the RBs containing the DC 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 s the limit 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. Δ_{RB}= 1 or Δ_{RB}= -1 for the first adjacent RB outside of the allocated bandwidth). NOTE 10: P_{RB} is the transmitted power per allocated RB, measured in dBm. NOTE 11: All powers are EIRP in beam peak direction.

The relative in-band emission shall not exceed the values specified in Table 6.4.2.3.3-3 for power class 3 UEs.

Table 6.4.2.3.3-3: Requirements for in-band emissions for power class 3

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\begin{bmatrix} -25 - 10.\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20.\log_{10}(EVM) - 5.\frac{(\lvert\Delta_{RB}\rvert - 1)}{L_{CRB}}, \\ -55.1dBm - P_{RB} \end{bmatrix}$		Any non-allocated (NOTE 2)
IQ Image	dB	-25	Output power > 10 dBm	Image frequencies (NOTES 2, 3)
		-20	Output power ≤ 10 dBm	
Carrier leakage	dBc	-25	Output power > 0 dBm	Carrier frequency (NOTES 4, 5)
		-20	-13 dBm ≤ Output power ≤ 0 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} - 25 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. For pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD
NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier 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 in the RBs containing the DC 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 s the limit 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. Δ_{RB}= 1 or Δ_{RB}= -1 for the first adjacent RB outside of the allocated bandwidth).
NOTE 10: P_{RB} is the transmitted power per allocated RB, measured in dBm.
NOTE 11: All powers are EIRP in beam peak direction.

The relative in-band emission shall not exceed the values specified in Table 6.4.2.3.3-4 for power class 4 UEs.

Table 6.4.2.3.3-4: Requirements for in-band emissions for power class 4

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\left[\begin{array}{c} -25 \ -10.\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20.\log_{10}(EVM) - \ 5.\frac{(\lvert\Delta_{RB}\rvert - 1)}{L_{CRB}}, \\ -55.1dBm - P_{RB} \end{array}\right]$		Any non-allocated (NOTE 2)
IQ Image	dB	-25	Output power > 21 dBm	Image frequencies (NOTES 2, 3)
		-20	Output power ≤ 21 dBm	
Carrier leakage	dBc	-25	Output power > 11 dBm	Carrier frequency (NOTES 4, 5)
		-20	-13 dBm ≤ Output power ≤11 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} - 25 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. For pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD
NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier 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 in the RBs containing the DC 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 s the limit 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. Δ_{RB}= 1 or Δ_{RB}= -1 for the first adjacent RB outside of the allocated bandwidth).
NOTE 10: P_{RB} is the transmitted power per allocated RB, measured in dBm.
NOTE 11: All powers are EIRP in beam peak direction.

The normative reference for this requirement is TS 38.101-2 [3] 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 reference measurement channels (RMCs) are specified in Annex A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex [TBD].

Table 6.4.2.3.4.1-1: Test Configuration Table for PUSCH

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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	Inner_16RB_Left
2		DFT-s-OFDM PI/2 BPSK	Inner_16RB_Right
3		CP-OFDM QPSK	Inner_16RB_Left
4		CP-OFDM QPSK	Inner_16RB_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 [10] subclause 4.1			See Table 6.4.2.3.4.1-1	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1			See Table 6.4.2.3.4.1-1	
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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**
1	CP-OFDM QPSK	Full RB (Note 1)	CP-OFDM	PUCCH format = Format 1 Length in OFDM symbols = 14
2	CP-OFDM QPSK	Full RB (Note 1)	DFT-s-OFDM	PUCCH format = Format 1 Length in OFDM symbols = 14
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.				

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, in Figure A.3.3.1.1 for TE diagram and section A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex [TBD], and uplink signals according to Annex [TBD].

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 [10] 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 Retrieve the LO position from the parameter txDirectCurrentLocation in UplinkTxDirectCurrent IE.

1.2 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 6.4.2.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

1.3 Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is $P_{req} + P_W \pm P_{W,}$ where P_{req} is the power level specified in Tables 6.4.2.3.4.2-1 according to the power class with power ID = 1. 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.

1.4 Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 2) for the UE Tx beam selection to complete.

1.5 SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

1.6 Measure In-band emission IE_θ, IE_φ using Global In-Channel Tx-Test (Annex E) for the θ- and φ-polarizations, respectively. For TDD, only slots consisting of only UL symbols are under test. Calculate $IE = IE_\theta + IE_\varphi$, where the calculation is based on linear power ratios.

1.7 SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

1.8 Repeat steps 1.3 through 1.6 until In-band emissions have been measured for all power IDs in Table 6.4.2.1.4.2-1.

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 [10] 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.

NOTE 2: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

Table 6.4.2.3.4.2-1: Parameters for In-band emissions

Power ID	Unit	Level for power class 1	Level for power class 2	Level for power class 3	Level for power class 4
1	dBm	27	16	10	21
2	dBm	17	6	0	11
3	dBm	4	-13	-13	-13

Table 6.4.2.3.4.2-2: Power Window (dB) for In-band emissions PUSCH and PUCCH

TBD

Test procedure for PUCCH:

2.1 Retrieve the LO position from the parameter txDirectCurrentLocation in UplinkTxDirectCurrent IE.

2.2 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.

2.3 Send the appropriate TPC commands in the uplink scheduling information for PUCCH to the UE until UE output power is $P_{req} + P_W \pm P_{W,}$ where P_{req} is the power level specified in Tables 6.4.2.3.4.2-1 according to the power class with power ID = 1. 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.

2.4 Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.

2.5 SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

2.6 Measure In-band emission IE_θ, IE_φ using Global In-Channel Tx-Test (Annex E) for the θ- and φ-polarizations, respectively. Calculate $IE = IE_\theta + IE_\varphi$, where the calculation is based on linear power ratios.

2.7 SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

2.8 Repeat steps 2.3 through 2.6 until In-band emissions have been measured for all power IDs in Table 6.4.2.1.4.2-1.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.4.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.4.2.3.5 Test requirement

The averaged in-band emissions result, derived in Annex E.4.3 shall not exceed the corresponding values in Table 6.4.2.3.5-1 for power class 1 UEs.

Table 6.4.2.3.5-1: Test requirements for in-band emissions for power class 1

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\left[\begin{array}{c} -25 - 10.\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20.\log_{10}(EVM) - 5.\frac{(\lvert\Delta_{RB}\rvert-1)}{L_{CRB}}, \\ -55.1dBm - P_{RB} \end{array}\right] + TT$		Any non-allocated (NOTE 2)
IQ Image	dB	-25+TT	Output power > 27 dBm	Image frequencies (NOTES 2, 3)
		-20+TT	Output power ≤ 27 dBm	
Carrier leakage	dBc	-25+TT	Output power > 17 dBm	Carrier frequency (NOTES 4, 5)
		-20+TT	4 dBm ≤ Output power ≤ 17 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} - 25 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. For pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD
NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier 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 in the RBs containing the DC 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 s the limit 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. Δ_{RB}= 1 or Δ_{RB}= -1 for the first adjacent RB outside of the allocated bandwidth).
NOTE 10: P_{RB} is the transmitted power per allocated RB, measured in dBm.
NOTE 11: All powers are EIRP in beam peak direction.

The averagedin-band emissions result, derived in Annex E.4.3 shall not exceed the corresponding values in Table 6.4.2.3.5-2 for power class 2 UEs.

Table 6.4.2.3.5-2: Test requirements for in-band emissions for power class 2

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\left[\begin{array}{c} -25-10.\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20.\log_{10}(EVM)-5.\frac{(\lvert\Delta_{RB}\rvert-1)}{L_{CRB}}, \\ -55.1dBm-P_{RB} \end{array}\right]+TT$		Any non-allocated (NOTE 2)
IQ Image	dB	-25 + TT	Output power > 16 dBm	Image frequencies (NOTES 2, 3)
		-20 + TT	Output power ≤ 16 dBm	
Carrier leakage	dBc	-25 + TT	Output power > 6 dBm	Carrier frequency (NOTES 4, 5)
		-20 + TT	-13 dBm ≤ Output power ≤ 6 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} - 25 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. For pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD
NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier 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 in the RBs containing the DC frequency if N_{RB} is odd, or in the two RBs immediately adjacent to the DC frequency if N_{RB} is even 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 s the limit 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. Δ_{RB}= 1 or Δ_{RB}= -1 for the first adjacent RB outside of the allocated bandwidth).
NOTE 10: P_{RB} is the transmitted power per allocated RB, measured in dBm.
NOTE 11: All powers are EIRP in beam peak direction.

The averaged in-band emissions result, derived in Annex E.4.3 shall not exceed the corresponding values in Table 6.4.2.3.5-3 for power class 3 UEs.

Table 6.4.2.3.5-3: Requirements for in-band emissions for power class 3

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\left[\begin{array}{c} -25 - 10.\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20.\log_{10}(EVM) - 5.\frac{(\lvert\Delta_{RB}\rvert - 1)}{L_{CRB}}, \\ -55.1dBm - P_{RB} \end{array}\right] + TT$		Any non-allocated (NOTE 2)
IQ Image	dB	-25+TT	Output power > 10 dBm	Image frequencies (NOTES 2, 3)
		-20+TT	Output power ≤ 10 dBm	
Carrier leakage	dBc	-25+TT	Output power > 0 dBm	Carrier frequency (NOTES 4, 5)
		-20+TT	-13 dBm ≤ Output power ≤ 0 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} - 25 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. For pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.

NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier 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 in the RBs containing the DC 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 s the limit 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. Δ_{RB}= 1 or Δ_{RB}= -1 for the first adjacent RB outside of the allocated bandwidth).

NOTE 10: P_{RB} is the transmitted power per allocated RB, measured in dBm.

NOTE 11: All powers are EIRP in beam peak direction.

The averagedin-band emissions result, derived in Annex E.4.3 shall not exceed the corresponding values in Table 6.4.2.3.5-4 for power class 3 UEs.

Table 6.4.2.3.5-4: Test requirements for in-band emissions for power class 4

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$\max\left[\begin{array}{c} -25 - 10.\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20.\log_{10}(EVM) - 5.\frac{(\lvert\Delta_{RB}\rvert - 1)}{L_{CRB}}, \\ -55.1dBm - P_{RB} \end{array}\right] + TT$		Any non-allocated (NOTE 2)
IQ Image	dB	-25 + TT	Output power > 21 dBm	Image frequencies (NOTES 2, 3)
		-20 + TT	Output power ≤ 21 dBm	
Carrier leakage	dBc	-25 + TT	Output power > 11 dBm	Carrier frequency (NOTES 4, 5)
		-20 + TT	-13 dBm ≤ Output power ≤11 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} - 25 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. For pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD

NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier 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 in the RBs containing the DC 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 s the limit 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. Δ_{RB}= 1 or Δ_{RB}= -1 for the first adjacent RB outside of the allocated bandwidth).

NOTE 10: P_{RB} is the transmitted power per allocated RB, measured in dBm.

NOTE 11: All powers are EIRP in beam peak direction.

6.4.2.4 EVM equalizer spectrum flatness

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

- Measurement Uncertainty and Test Tolerance are FFS.
- 38.101-2 Clause 6.3.4.3: Relative power tolerances are in square brackets.

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

For pi/2 BPSK modulation, the minimum requirements are defined in Clause 6.4.2.5.3.

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 requirements: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 (Table 6.4.2.4.3-1) must not be larger than 7 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 dB (see Figure 6.4.2.4.3-1).

The requirement is verified with the test metric of EVM SF (Link=TX beam peak direction, Meas=Link angle).

Table 6.4.2.4.3-1: Minimum requirements for EVM equalizer spectrum flatness (normal conditions)

Frequency range	Maximum ripple (dB)
$\lvert F_{UL\_Meas} - F_{center}\rvert \le X$ MHz (Range 1)	6 (p-p)
$\lvert F_{UL\_Meas} - F_{center}\rvert > X$ MHz (Range 2)	9 (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 the CC NOTE 3: X, in MHz, is equal to 30% of the CC bandwidth	

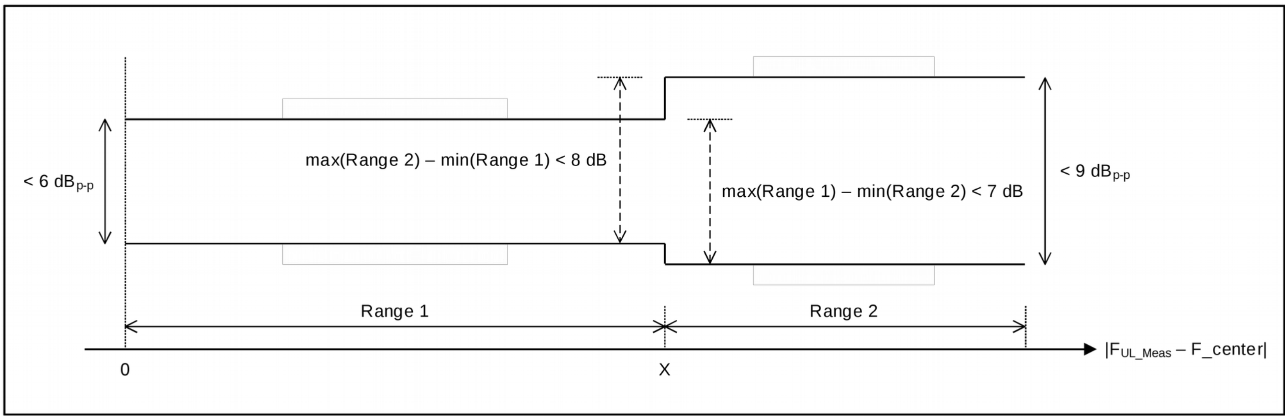


Figure 6.4.2.4.3-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated under normal conditions

The normative reference for this requirement is TS 38.101-2 [3] 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 reference measurement channels (RMCs) are specified in Annex A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex [TBD].

Table 6.4.2.4.4.1-1: Test Configuration

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex [TBD], and uplink signals according to Annex [TBD].

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 [10] clause 4.5. Message contents are defined in clause 6.4.2.4.4.3

6.4.2.4.4.2 Test procedure

1. Retrieve the LO position from the parameter txDirectCurrentLocation in UplinkTxDirectCurrent IE.

2. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format [0_1] for C_RNTI to schedule the UL RMC according to Table 6.4.2.4.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC

3. 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 200 ms for the UE to reach P_{UMAX} level.

4. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 2) for the UE Tx beam selection to complete.

5. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

6. Measure spectrum flatness using Global In-Channel Tx-Test (Annex E) for the θ- and φ-polarizations, respectively. For TDD, only slots consisting of only UL symbols are under test.

7. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

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 [10] 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.

NOTE 2: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.4.2.4.4.3 Message contents

Message contents are according to TS 38.508-1 [10] 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. The derived results shall not exceed the values in Figure 6.4.2.4.5-1: 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 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 requirements: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 (Table 6.4.2.4..5-1) must not be larger than 7 dB + TT, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 8 dB + TT (see Figure 6.4.2.4.5-1).

The UE passes the test when the derived results for at least one polarization fulfil the test requirements.

Table 6.4.2.4.5-1: Test requirements for EVM equalizer spectrum flatness (normal conditions)

Frequency range	Maximum ripple (dB)
$\lvert F_{UL\_Meas} - F_{center} \rvert \le$ X MHz (Range 1)	6 +TT (p-p)
$\lvert F_{UL\_Meas} - F_{center} \rvert >$ X MHz (Range 2)	9 + 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 the CC NOTE 3: X, in MHz, is equal to 30% of the CC bandwidth	

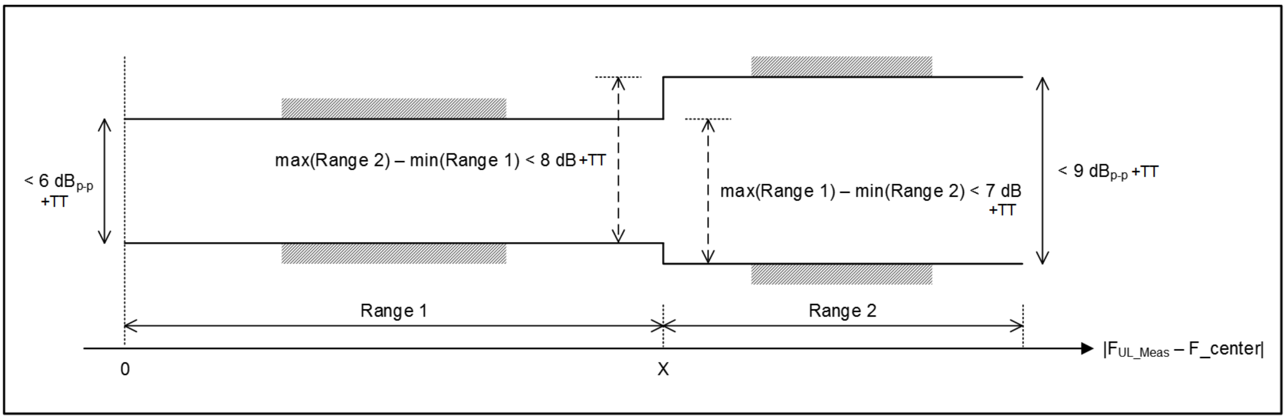


Figure 6.4.2.4.5-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated under normal conditions

6.4.2.5 EVM spectral flatness for pi/2 BPSK modulation

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

- Measurement Uncertainty and Test Tolerance are FFS.
- 38.101-2 Clause 6.3.4.3: Relative power tolerances are in square brackets..
- Whether and, if yes, how to test the requirement on shaping filter is FFS.

6.4.2.5.1 Test purpose

Same test purpose as in clause 6.4.2.4.1.

6.4.2.5.2 Test applicability

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

6.4.2.5.3 Minimum conformance requirements

These requirements are defined for pi/2 BPSK modulation. 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 centre 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 6.4.2.5-1 for description of X1, X2 and X3.		

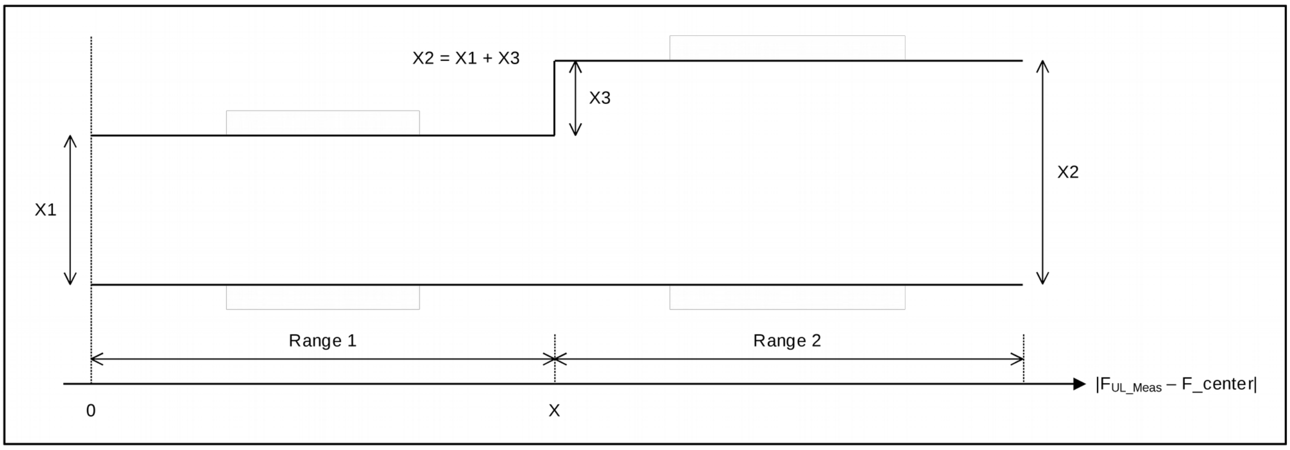


Figure 6.4.2.5.3-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation. F_{center} denotes the centre frequency of the allocated block of PRBs. F_alloc denotes the bandwidth of the PRB allocation

This requirement does not apply to other modulation types. The UE shall be allowed to employ spectral shaping for pi/2 BPSK. The shaping filter shall be restricted so that the impulse response of the transmit chain shall meet

$$\lvert \tilde{a}_t(t,0) \rvert \geq \lvert \tilde{a}_t(t,\tau) \rvert \quad \forall \tau \neq 0$$

$$20log_{10} \lvert \tilde{a}_t(t,\tau) \rvert < -15 \text{ dB} \quad 1 < \tau < M - 1,$$

Where:

$\lvert \tilde{a}_t(t,\tau) \rvert = IDFT\{ \lvert \tilde{a}_t(t,f) \rvert e^{j\varphi(t,f)} \}$,

f is the frequency of the M allocated subcarriers,

$\tilde{a}(t,f)$ and $\varphi(t,f)$ are the amplitude and phase response, respectively of the transmit chain

0dB reference is defined as $20log_{10} \lvert \tilde{a}_t(t,0) \rvert$

The normative reference for this requirement is TS 38.101-2 [3] clause 6.4.2.5.

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 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1		Lowest, Mid, Highest	
Test SCS as specified in TS 38.508-1 [10] subclause [TBD]		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. Retrieve the LO position from the parameter txDirecCurrentLocation in UplinkTxDirectCurrent IE.

2. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format [0_1] for C_RNTI to schedule the UL RMC according to Table 6.4.2.5.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC

3. 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 200 ms for the UE to reach P_{UMAX} level.

4. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.

5. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

6. Measure spectrum flatness using Global In-Channel Tx-Test (Annex E) for the θ- and φ-polarizations, respectively. For TDD, only slots consisting of only UL symbols are under test.

7. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.4.2.5.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.4.2.5.5 Test requirement

Each of the *n* spectrum flatness functions, shall derive four ripple results in Annex E.4.4. The derived results shall not exceed the values in Table 6.4.2.5.5-1 and Figure 6.4.2.5.5-1:

Table 6.4.2.5.5-1: Test requirement 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 centre 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 6.4.2.5-1 for description of X1, X2 and X3.		

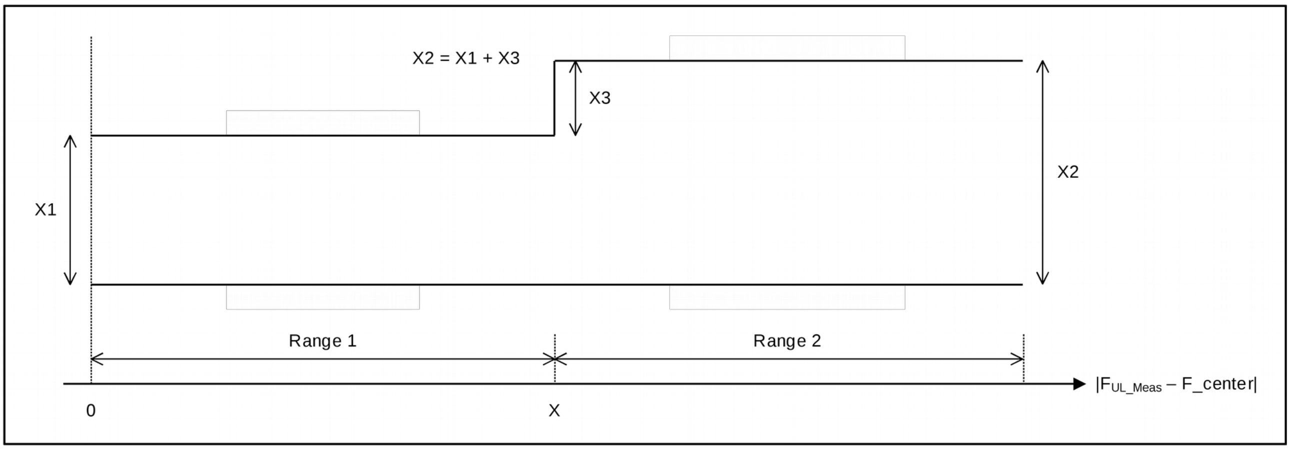


Figure 6.4.2.5.5-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation. F_{center} denotes the centre frequency of the allocated block of PRBs

The UE passes the test when the derived results for at least one polarization fulfil the test requirements.

6.4A Transmit signal quality for CA

6.4A.1 Frequency error for CA

6.4A.1.0 Minimum conformance requirements

The requirements in this subsection apply to UEs of all power classes.

For intra-band contiguous carrier aggregation, the UE modulated carrier frequencies per band shall be accurate to within ±0.1 PPM observed over a period of 1ms compared to the carrier frequency of primary component carrier received from the gNB.

The frequency error is defined as a directional requirement. The requirement is verified in beam locked mode on beam peak direction.

6.4A.1.1 Frequency error for CA (2UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.4A.1.1.1 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.

6.4A.1.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 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, and channel bandwidths based on NR operating bands specified in table 5.5A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and subcarrier spacing, are shown in table 6.4A.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 6.4A.1.1.4.1-1: Test Configuration Table

FFS

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure [TBD] for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.2 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.
4. The 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 [10] 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 [10] 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 [x], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], clause 9.3).

4. 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.

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 6.4.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

6. 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 for the UE to reach P_{UMAX} level.

7. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.

8. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.6. Measure the Frequency Error using Global In-Channel Tx-Test (Annex E) for the θ- and φ-polarization. For TDD, only slots consisting of only UL symbols are under test.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.4A.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.4A.1.1.5 Test Requirements

The *n* frequency error Δf results for the θ-polarization or the *n* frequency error Δf results for the φ-polarization must fulfil the test requirement:

$$|\Delta f| \leq (0.1 \text{ PPM} + 0.005 \text{ PPM}), \ \text{(for Aggregated BW} \leq 400\text{MHz)}$$

where

$$n = \begin{cases} 30, & \text{for 60 kHz SCS} \\ 60, & \text{for 120 kHz SCS} \end{cases}.$$

6.4A.1.2 Frequency error for CA (3UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.4A.1.2.1 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.

6.4A.1.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA.

6.4A.1.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.4A.1.0.

6.4A.1.2.4 Test description

Same as in clause 6.4A.1.1.4 with following exceptions:

- Instead of Table 6.4A.1.1.4.1-1→ use Table 6.4A.1.2.4.1-1.
- Instead of clause 6.4A.1.1.4.3→ use clause 6.4A.1.2.4.3.
- Instead of Table 6.4A.1.1.5-1→ use Table 6.4A.1.2.5-1.

Table 6.4A.1.2.4.1-1: Test Configuration Table

FFS

6.4A.1.2.5 Test Requirements

The *n* frequency error Δf results for the θ-polarization or the *n* frequency error Δf results for the φ-polarization must fulfil the test requirement:

$$|\Delta f| \le (0.1\ \text{PPM} + 0.005\ \text{PPM}),\ \ (\text{for Aggregated BW} \le 400\text{MHz})$$

where

$$n = \begin{cases} 30, \text{ for 60 kHz SCS} \\ 60, \text{ for 120 kHz SCS} \end{cases}.$$

6.4A.1.3 Frequency error for CA (4UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.

- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.4A.1.3.1 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.

6.4A.1.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA.

6.4A.1.3.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.4A.1.0.

6.4A.1.3.4 Test description

Same as in clause 6.4A.1.1.4 with following exceptions:

- Instead of Table 6.4A.1.1.4.1-1→ use Table 6.4A.1.3.4.1-1.
- Instead of clause 6.4A.1.1.4.3→ use clause 6.4A.1.3.4.3.
- Instead of Table 6.4A.1.1.5-1→ use Table 6.4A.1.3.5-1.

Table 6.4A.1.3.4.1-1: Test Configuration Table

FFS

6.4A.1.3.5 Test Requirements

The *n* frequency error Δf results for the θ-polarization or the *n* frequency error Δf results for the φ-polarization must fulfil the test requirement:

$$|\Delta f| \le (0.1\ \text{PPM} + 0.005\ \text{PPM}),\ \ (\text{for Aggregated BW} \le 400\text{MHz})$$

where

$$n = \begin{cases} 30, \text{ for 60 kHz SCS} \\ 60, \text{ for 120 kHz SCS} \end{cases}.$$

6.4A.2 Transmit modulation quality for CA

FFS.

6.4A.2.1 Error vector magnitude for CA

FFS.

6.4A.2.1.0 Minimum conformance requirements

The requirements in this subclause apply to UEs of all power classes. For intra-band contiguous carrier aggregation, the Error Vector Magnitude requirement of section 6.4.2.1 is defined for each component carrier. Requirements only apply with PRB allocation in one of the component carriers. Similar transmitter impairment removal procedures are applied for CA waveform before EVM calculation as is specified for non-CA waveform.

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:

- Measurement Uncertainty and Test Tolerance are FFS.
- 38.101-2 Clause 6.3.4.3: Relative power tolerances are in square brackets.
- Power window for PUSCH is FFS
- Test configuration table is FFS.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

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 subsection 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 FR2 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 Table 5.5A. All of these configurations shall be tested with applicable test parameters for each CA configuration, are shown in Table 6.4A.2.1.1.4.1-1. 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 6.4A.2.1.1.4.1-1: Test Configuration Table for 2UL CA

FFS

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, in Figure A.3.3.1.1 for TE diagram and section A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals for PCC are initially set up according to Annex C.0, C.1 and C.3, and uplink signals according to Annex G.0, G.1 and G.3.
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 [10] 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. Retrieve the LO position from the parameter txDirectCurrentLocation in UplinkTxDirectCurrent IE.
2. Configure SCC according to Annex C.0, C.1, C.3 for all downlink physical channels.
3. The SS shall configure SCC as per TS 38.508-1 [10] clause 5.5.1. Message contents are defined in clause 6.4A.2.1.1.4.3.
4. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [TBD], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], clause9.2).
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 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.
6. 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].
7. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 2) for the UE Tx beam selection to complete.
8. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.
9. Measure the EVM_θ, EVM_φ, $\overline{EVM}_{DMRS,\theta}$ and $\overline{EVM}_{DMRS,\varphi}$ on PCC using Global In-Channel Tx-Test (Annex E) for the θ- and φ-polarizations, respectively. For TDD, only slots consisting of only UL symbols are under test. Calculate $\overline{EVM}_{DMRS} = \min\left(\overline{EVM}_{DMRS,\theta}, \overline{EVM}_{DMRS,\varphi}\right)$ and $EVM = \min(EVM_\theta, EVM_\varphi)$.
10. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.
11. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE EIRP is in the range $P_{req} + P_W \pm P_W$, where P_{req} is the power level specified in Tables 6.4A.2.1.1.4.2-1 and 6.4A.2.1.1.4.2-2 according to the modulation and power class. P_W is the power window according to Table 6.4A.2.1.4.2-3 for the carrier frequency f and the channel bandwidth BW.
12. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.
13. Measure the EVM_θ, EVM_φ, $\overline{EVM}_{DMRS,\theta}$ and $\overline{EVM}_{DMRS,\varphi}$ on PCC using Global In-Channel Tx-Test (Annex E) for the θ- and φ-polarizations, respectively. For TDD, only slots consisting of only UL symbols are under test. Calculate $\overline{EVM}_{DMRS} = \min\left(\overline{EVM}_{DMRS,\theta}, \overline{EVM}_{DMRS,\varphi}\right)$ and $EVM = \min(EVM_\theta, EVM_\varphi)$.
14. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4A.2.1.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [10] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

NOTE 2: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

Table 6.4A.2.1.1.4.2-1: Parameters for Error Vector Magnitude for power class 1

Parameter	Unit	Level
UE Output Power	dBm	4
UE output power for UL 16QAM	dBm	7
UE output power for UL 64QAM	dBm	11

Table 6.4A.2.1.1.4.2-2: Parameters for Error Vector Magnitude for power class 2, 3, and 4

Parameter	Unit	Level
UE Output Power	dBm	-13
UE output power for UL 16QAM	dBm	-10
UE output power for UL 64QAM	dBm	-6

Table 6.4A.2.1.1.4.2-3: Power Window (dB) for EVM PUSCH

TBD

6.4A.2.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] 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 for CA

Parameter	Unit	Average EVM Level	Reference Signal EVM Level
Pi/2 BPSK	%	30+TT	30+TT
QPSK	%	17.5+TT	17.5+TT
16 QAM	%	12.5+TT	12.5+TT
64 QAM	%	8+TT	8+TT

Table 6.4A.2.1.1.5-2: Test Tolerance for Error Vector Magnitude for CA

Test Metric	FR2a	FR2b
Quiet Zone size ≤ 30 cm	FFS	FFS

6.4A.2.1.2 Error Vector magnitude for CA (3UL CA)

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

- Measurement Uncertainty and Test Tolerance are FFS.
- 38.101-2 Clause 6.3.4.3: Relative power tolerances are in square brackets.
- Power window for PUSCH is FFS.
- Test configuration table is FFS.

6.4A.2.1.2.1 Test Purpose

For 3UL 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.2.1.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA.

6.4A.2.1.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.4A.2.1.0

6.4A.2.1.2.4 Test description

Same as in clause 6.4A.2.1.1.4 with following exceptions:

- Instead of Table 6.4A.2.1.1.4.1-1 → use Table 6.4A.2.1.2.4.1-1.
- Instead of clause 6.4A.2.1.1.4.3 → use clause 6.4A.2.1.2.4.3.
- Instead of Table 6.4A.2.1.1.5-1 → use Table 6.4A.2.1.2.5-1.

Table 6.4A.2.1.2.4.1-1: Test Configuration Table for 3UL CA

FFS

6.4A.2.1.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.4A.2.1.2.5 Test requirement

The PUSCH EVM, derived in Annex E.4.2, shall not exceed the values in Table 6.4A.2.1.2.5-1.

The PUSCH $\overline{EVM}_{DMRS}$, derived in Annex E.4.6.2, shall not exceed the values in Table 6.4A.2.1.2.5-1 when embedded with data symbols of the respective modulation scheme.

Table 6.4A.2.1.2.5-1: Test requirements for Error Vector Magnitude

Parameter	Unit	Average EVM Level	Reference Signal EVM Level
Pi/2 BPSK	%	30+TT	30+TT
QPSK	%	17.5+TT	17.5+TT
16 QAM	%	12.5+TT	12.5+TT
64 QAM	%	8+TT	8+TT

6.4A.2.1.3 Error Vector magnitude for CA (4UL CA)

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

- Measurement Uncertainty and Test Tolerance are FFS.
- 38.101-2 Clause 6.3.4.3: Relative power tolerances are in square brackets.
- Power window for PUSCH is FFS.
- Test configuration table is FFS.

6.4A.2.1.3.1 Test Purpose

For 4UL 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.2.1.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA.

6.4A.2.1.3.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.4A.2.1.0

6.4A.2.1.3.4 Test description

Same as in clause 6.4A.2.1.1.4 with following exceptions:

- Instead of Table 6.4A.2.1.1.4.1-1 → use Table 6.4A.2.1.3.4.1-1.
- Instead of clause 6.4A.2.1.1.4.3 → use clause 6.4A.2.1.3.4.3.
- Instead of Table 6.4A.2.1.1.5-1 → use Table 6.4A.2.1.3.5-1.

Table 6.4A.2.1.3.4.1-1: Test Configuration Table for 4UL CA

FFS

6.4A.2.1.3.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.4A.2.1.3.5 Test requirement

The PUSCH EVM, derived in Annex E.4.2, shall not exceed the values in Table 6.4A.2.1.3.5-1.

The PUSCH $\overline{EVM}_{DMRS}$, derived in Annex E.4.6.2, shall not exceed the values in Table 6.4A.2.1.3.5-1 when embedded with data symbols of the respective modulation scheme.

Table 6.4A.2.1.3.5-1: Test requirements for Error Vector Magnitude

Parameter	Unit	Average EVM Level	Reference Signal EVM Level
Pi/2 BPSK	%	30+TT	30+TT
QPSK	%	17.5+TT	17.5+TT
16 QAM	%	12.5+TT	12.5+TT
64 QAM	%	8+TT	8+TT

6.4A.2.2 Carrier leakage for CA

6.4A.2.2.0 Minimum conformance requirements

6.4A.2.2.0.1 General

Carrier leakage is an additive sinusoid waveform. The carrier leakage requirement is defined for each component carrier and is measured on the component carrier with PRBs allocated. The measurement interval is one slot in the time domain.

Note: When UE has DL configured for non-contiguous CA, carrier leakage may land outside the spectrum occupied by all configured UL and DL CC.

The relative carrier leakage power is a power ratio of the additive sinusoid waveform and the modulated waveform. The requirement is verified with the test metric of Carrier Leakage (Link=TX beam peak direction, Meas=Link angle).

6.4A.2.2.0.2 Carrier leakage for power class 1

When carrier leakage is contained inside the spectrum occupied by all configured UL and DL CCs, the relative carrier leakage power shall not exceed the values specified in Table 6.4A.2.2.0.2-1 for power class 1 UEs.

Table 6.4A.2.2.0.2-1: Minimum requirements for relative carrier leakage for power class 1

Parameters	Relative Limit (dBc)
EIRP > 17 dBm	-25
4 dBm ≤ EIRP ≤ 17 dBm	-20

6.4A.2.2.0.3 Carrier leakage for power class 2

When carrier leakage is contained inside the spectrum occupied by all configured UL and DL CCs, the relative carrier leakage power shall not exceed the values specified in Table 6.4A.2.2.0.3-1 for power class 2.

Table 6.4A.2.2.0.3-1: Minimum requirements for relative carrier leakage power class 2

Parameters	Relative limit (dBc)
EIRP > 6 dBm	-25
-13 dBm ≤ EIRP ≤ 6 dBm	-20

6.4A.2.2.0.4 Carrier leakage for power class 3

When carrier leakage is contained inside the spectrum occupied by all configured UL and DL CCs, the relative carrier leakage power shall not exceed the values specified in Table 6.4A.2.2.0.4-1 for power class 3 UEs.

Table 6.4A.2.2.0.4-1: Minimum requirements for relative carrier leakage power class 3

Parameters	Relative limit (dBc)
Output power > 0 dBm	-25
-13 dBm ≤ Output power EIRP ≤ 0 dBm	-20

6.4A.2.2.0.5 Carrier leakage for power class 4

When carrier leakage is contained inside the spectrum occupied by all configured UL and DL CCs, the relative carrier leakage power shall not exceed the values specified in Table 6.4A.2.2.0.5-1 for power class 4 UEs.

Table 6.4A.2.2.0.5-1: Minimum requirements for relative carrier leakage power class 4

Parameters	Relative limit (dBc)
Output power > 11 dBm	-25
-13 dBm ≤ Output power EIRP ≤ 11 dBm	-20

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:

- Test procedure is incompleted due to power window is TBD
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA is TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

6.4A.2.2.1.1 Test purpose

Carrier leakage expresses itself as unmodulated sine wave with the carrier frequency. It is an interference of approximately constant amplitude and independent of the amplitude of the wanted signal. Carrier leakage interferes with the sub carriers at its position (if allocated), especially, when their amplitude is small.

The purpose of this test is to exercise the UE transmitter to verify its modulation quality in terms of carrier leakage.

6.4A.2.2.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 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, and CC combinations based on NR operating bands specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2. All of these configurations shall be tested with applicable test parameters for each CA configuration and subcarrier spacing, are shown in table 6.4A.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 6.4A.2.2.1.4.1-1: Intra-band Contiguous CA Test Configuration Table

Default Conditions					
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes			Low and High range		
Test CC Combination setting (aggregated BW of the CA configuration) as specified in Table 5.5A.1-1 for the CA Configuration across bandwidth combination sets supported by the UE			Lowest aggregated BW		
Test SCS as specified in Table 5.3.5-1			Lowest		
Test Parameters					
CA Configuration / Aggregated BW			**Downlink Configuration**	**Uplink Configuration**	
Test ID	**CC & Mapping (NOTE 5)**	**CBW (MHz)**	**RB allocation**	**Modulation**	**RB allocation (NOTE 1)**
1	PCC/CC1	50	N/A for this test	DFT-s-OFDM QPSK	Inner_16RB_Left
	SCC/CC2	50		DFT-s-OFDM QPSK	Inner_16RB_Left
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1. NOTE 2: CA Configuration Test cumulative aggregated BW settings are checked separately for each CA Configuration, which applicable aggregated channel bandwidths are specified in Table 5.5A.1-1. NOTE 3: If the UE supports multiple CC Combinations in the CA Configuration with the same cumulative aggregated BW, only the combination with the lowest PCC ChBW is tested. NOTE 4: When the signalled DC carrier position is at Inner_16RB_Left, use Inner_16RB_Right for UL RB allocation. NOTE 5: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10].					

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and 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 [10] 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 PCC and SCC according to Annex C.0, C.1, C.2 and Annex C.3.0 for all downlink physical channels.
2. The SS shall configure SCC as per TS 38.508-1 [10] clause 5.5.1 Procedure to configure SCC(s) for NR RF CA testing. 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, clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], 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 6.4A.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 EIRP is in the range $P_{req} + P_W \pm P_W$, where P_{req} is the power level specified in Tables 6.4A.2.2.1.4.2-1 according to the power class. P_W is the power window according to Table [TBD] for the carrier frequency f and the channel bandwidth BW.

6. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.

7. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

8. Measure carrier leakage on PCC using Global In-Channel Tx-Test (Annex E) for the θ- and ϕ-polarization. For TDD, only slots consisting of only UL symbols are under test.

9. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

10. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE EIRP is in the range $P_{req} + P_W \pm P_W$, where P_{req} is the power level specified in Tables 6.4A.2.2.1.4.2-1 according to the power class. P_W is the power window according to Table [TBD] for the carrier frequency f and the channel bandwidth BW.

11. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

12. Measure carrier leakage on PCC using Global In-Channel Tx-Test (Annex E) for the θ- and ϕ-polarization. For TDD, only slots consisting of only UL symbols are under test.

13. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

Table 6.4A.2.2.1.4.2-1: UE EIRP P_{req} (dBm) for carrier leakage

Power Class	P_{req} (dBm) for step 5	P_{req} (dBm) for step 10
Power Class 1	17	4
Power Class 2	6	-13
Power Class 3	0	-13
Power Class 4	11	-13

Table 6.4A.2.2.1.4.2-2: Power Window (dB) for carrier leakage

TBD

6.4A.2.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.4A.2.2.1.5 Test requirement

For each of the *n* carrier leakage results derived in Annex E.3.1 for θ- and φ-polarization the total value is calculated according to

$$\text{CarrLeak}_{\text{Total}} = 10\log_{10}\left(10^{\text{CarrLeak}_{\theta}/10} + 10^{\text{CarrLeak}_{\varphi}/10}\right)\text{, where}$$

$$n = \begin{cases} 30, \text{ for 60 kHz SCS} \\ 60, \text{ for 120 kHz SCS} \end{cases}.$$

Each of the *n* total carrier leakage results $CarrLeak_{Total}$ shall not exceed the values in table 6.4.2.2.5-1 for power class 1 table 6.4.2.2.5-2 for power class 2, table 6.4.2.2.5-3 for power class 3 and table 6.4.2.2.5-4 for power class 4. Allocated RBs are not under test.

6.4A.2.2.2 Carrier leakage for CA (3UL CA)

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

- Test procedure is incompleted due to power window is TBD
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA is TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

6.4A.2.2.2.1 Test purpose

Carrier leakage expresses itself as unmodulated sine wave with the carrier frequency. It is an interference of approximately constant amplitude and independent of the amplitude of the wanted signal. Carrier leakage interferes with the sub carriers at its position (if allocated), especially, when their amplitude is small.

The purpose of this test is to exercise the UE transmitter to verify its modulation quality in terms of carrier leakage.

6.4A.2.2.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA.

6.4A.2.2.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.4A.2.2.0.

6.4A.2.2.2.4 Test description

6.4A.2.2.2.4.1 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, and CC combinations based on NR operating bands specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2. All of these configurations shall be tested with applicable test parameters for each CA configuration and subcarrier spacing, are shown in table 6.4A.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 6.4A.2.2.2.4.1-1: Intra-band Contiguous CA Test Configuration Table

<table>
<tr><th colspan="6">Default Conditions</th></tr>
<tr><td colspan="3">Test Environment as specified in TS 38.508-1 [10] subclause [4.1]</td><td colspan="3">Normal</td></tr>
<tr><td colspan="3">Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes</td><td colspan="3">Low and High range</td></tr>
<tr><td colspan="3">Test CC Combination setting (aggregated BW of the CA configuration) as specified in Table 5.5A.1-1 for the CA Configuration across bandwidth combination sets supported by the UE</td><td colspan="3">Lowest aggregated BW</td></tr>
<tr><td colspan="3">Test SCS as specified in Table 5.3.5-1</td><td colspan="3">Lowest</td></tr>
<tr><th colspan="6">Test Parameters</th></tr>
<tr><th colspan="3">CA Configuration / Aggregated BW</th><th>Downlink Configuration</th><th colspan="2">Uplink Configuration</th></tr>
<tr><th>Test ID</th><th>CC & Mapping (NOTE 5)</th><th>CBW (MHz)</th><th>RB allocation</th><th>Modulation</th><th>RB allocation (NOTE 1)</th></tr>
<tr><td rowspan="3">1</td><td>PCC/CC1</td><td>50</td><td rowspan="3">N/A for this test</td><td>DFT-s-OFDM QPSK</td><td>Inner_16RB_Left</td></tr>
<tr><td>SCC/CC2</td><td>50</td><td>DFT-s-OFDM QPSK</td><td>Inner_16RB_Left</td></tr>
<tr><td>SCC/CC3</td><td>50</td><td>DFT-s-OFDM QPSK</td><td>Inner_16RB_Left</td></tr>
<tr><td colspan="6">NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.
NOTE 2: CA Configuration Test cumulative aggregated BW settings are checked separately for each CA Configuration, which applicable aggregated channel bandwidths are specified in Table 5.5A.1-1.
NOTE 3: If the UE supports multiple CC Combinations in the CA Configuration with the same cumulative aggregated BW, only the combination with the lowest PCC ChBW is tested.
NOTE 4: When the signalled DC carrier position is at Inner_16RB_Left, use Inner_16RB_Right for UL RB allocation.
NOTE 5: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10].</td></tr>
</table>

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.
4. The UL Reference Measurement channels are set according to Table 6.4A.2.2.2.4.1-1.
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 [10] clause 4.5. Message contents are defined in clause 6.4A.2.2.2.4.3

6.4A.2.2.2.4.2 Test procedure

1. Configure PCC and SCCs according to Annex C.0, C.1, C.2 and Annex C.3.0 for all downlink physical channels.
2. The SS shall configure SCCs as per TS 38.508-1 [10] clause 5.5.1 Procedure to configure SCC(s) for NR RF CA testing. Message contents are defined in clause 6.4A.2.2.2.4.3.
3. SS activates SCCs by sending the activation MAC CE (Refer TS 38.321, clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], 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 6.4A.2.2.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
5. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE EIRP is in the range $P_{req} + P_W \pm P_W$, where P_{req} is the power level specified in Tables 6.4A.2.2.2.4.2-1 according to the power

class. P_W is the power window according to Table [TBD] for the carrier frequency f and the channel bandwidth BW.

6. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.

7. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

8. Measure carrier leakage on PCC using Global In-Channel Tx-Test (Annex E) for the θ- and ϕ-polarization. For TDD, only slots consisting of only UL symbols are under test.

9. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

10. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE EIRP is in the range $P_{req} + P_W \pm P_W$, where P_{req} is the power level specified in Tables 6.4A.2.2.2.4.2-1 according to the power class. P_W is the power window according to Table [TBD] for the carrier frequency f and the channel bandwidth BW.

11. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

12. Measure carrier leakage on PCC using Global In-Channel Tx-Test (Annex E) for the θ- and ϕ-polarization. For TDD, only slots consisting of only UL symbols are under test.

13. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

Table 6.4A.2.2.2.4.2-1: UE EIRP P_{req} (dBm) for carrier leakage

Power Class	P_{req} (dBm) for step 5	P_{req} (dBm) for step 10
Power Class 1	17	4
Power Class 2	6	-13
Power Class 3	0	-13
Power Class 4	11	-13

Table 6.4A.2.2.2.4.2-2: Power Window (dB) for carrier leakage

TBD

6.4A.2.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.4A.2.2.2.5 Test requirement

For each of the *n* carrier leakage results derived in Annex E.3.1 for θ- and φ-polarization the total value is calculated according to

$$\mathrm{CarrLeak}_{\mathrm{Total}} = 10\log_{10}\left(10^{\mathrm{CarrLeak}_{\theta}/10} + 10^{\mathrm{CarrLeak}_{\varphi}/10}\right)$$, where

$$n = \begin{cases} 30, \text{ for 60 kHz SCS} \\ 60, \text{ for 120 kHz SCS} \end{cases}.$$

Each of the *n* total carrier leakage results $CarrLeak_{Total}$ shall not exceed the values in table 6.4.2.2.5-1 for power class 1, table 6.4.2.2.5-2 for power class 2, table 6.4.2.2.5-3 for power class 3 and table 6.4.2.2.5-4 for power class 4. Allocated RBs are not under test.

6.4A.2.2.3 Carrier leakage for CA (4UL CA)

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

- Test procedure is incompleted due to power window is TBD
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA is TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

6.4A.2.2.3.1 Test purpose

Carrier leakage expresses itself as unmodulated sine wave with the carrier frequency. It is an interference of approximately constant amplitude and independent of the amplitude of the wanted signal. Carrier leakage interferes with the sub carriers at its position (if allocated), especially, when their amplitude is small.

The purpose of this test is to exercise the UE transmitter to verify its modulation quality in terms of carrier leakage.

6.4A.2.2.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA.

6.4A.2.2.3.3 Minimum conformance requirements

The normative reference for this requirement is TS 38.101-2 [3] clause 6.4A.2.2.

6.4A.2.2.3.4 Test description

6.4A.2.2.3.4.1 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, and CC combinations based on NR operating bands specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2. All of these configurations shall be tested with applicable test parameters for each CA configuration and subcarrier spacing, are shown in table 6.4A.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 6.4A.2.2.3.4.1-1: Intra-band Contiguous CA Test Configuration Table

<table>
<tr><th colspan="6">Default Conditions</th></tr>
<tr><td colspan="3">Test Environment as specified in TS 38.508-1 [10] subclause [4.1]</td><td colspan="3">Normal</td></tr>
<tr><td colspan="3">Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1.2.3] for different CA bandwidth classes, and PCC and SCC are mapped onto physical frequencies according to Table 6.1-2</td><td colspan="3">Low and High range</td></tr>
<tr><td colspan="3">Test CC Combination setting (aggregated BW of the CA configuration) as specified in Table 5.5A.1-1 for the CA Configuration across bandwidth combination sets supported by the UE</td><td colspan="3">Lowest aggregated BW</td></tr>
<tr><td colspan="3">Test SCS as specified in Table 5.3.5-1</td><td colspan="3">Lowest</td></tr>
<tr><th colspan="6">Test Parameters</th></tr>
<tr><th colspan="3">CA Configuration / Aggregated BW</th><th>Downlink Configuration</th><th colspan="2">Uplink Configuration</th></tr>
<tr><th>Test ID</th><th>CC & Mapping (NOTE 5)</th><th>CBW (MHz)</th><th>RB allocation</th><th>Modulation</th><th>RB allocation (NOTE 1)</th></tr>
<tr><td rowspan="4">1</td><td>PCC/CC1</td><td>50</td><td rowspan="4">N/A for this test</td><td>DFT-s-OFDM QPSK</td><td>Inner_16RB_Left</td></tr>
<tr><td>SCC/CC2</td><td>50</td><td>DFT-s-OFDM QPSK</td><td>Inner_16RB_Left</td></tr>
<tr><td>SCC/CC3</td><td>50</td><td>DFT-s-OFDM QPSK</td><td>Inner_16RB_Left</td></tr>
<tr><td>SCC/CC4</td><td>50</td><td>DFT-s-OFDM QPSK</td><td>Inner_16RB_Left</td></tr>
<tr><td colspan="6">NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.
NOTE 2: CA Configuration Test cumulative aggregated BW settings are checked separately for each CA Configuration, which applicable aggregated channel bandwidths are specified in Table 5.5A.1-1.
NOTE 3: If the UE supports multiple CC Combinations in the CA Configuration with the same cumulative aggregated BW, only the combination with the lowest PCC ChBW is tested.
NOTE 4: When the signalled DC carrier position is at Inner_16RB_Left, use Inner_16RB_Right for UL RB allocation.
NOTE 5: PCC/CCi and SCC/CCj means PCC is on component carrier CCi and SCC is on component carrier CCj, with CCi or CCj frequencies defined in TS38.508-1 [10].</td></tr>
</table>

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.4A.2.2.3.4.1-1.

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 [10] clause 4.5. Message contents are defined in clause 6.4A.2.2.3.4.3

6.4A.2.2.3.4.2 Test procedure

1. Configure PCC and SCCs according to Annex C.0, C.1, C.2 and Annex C.3.0 for all downlink physical channels.

2. The SS shall configure SCCs as per TS 38.508-1 [10] clause 5.5.1 Procedure to configure SCC(s) for NR RF CA testing. Message contents are defined in clause 6.4A.2.2.3.4.3.

3. SS activates SCCs by sending the activation MAC CE (Refer TS 38.321, clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], 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 6.4A.2.2.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

5. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE EIRP is in the range $P_{req} + P_W \pm P_W$, where P_{req} is the power level specified in Tables 6.4A.2.2.3.4.2-1 according to the power class. P_W is the power window according to Table [TBD] for the carrier frequency f and the channel bandwidth BW.

6. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Tx beam selection to complete.

7. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

8. Measure carrier leakage on PCC using Global In-Channel Tx-Test (Annex E) for the θ- and ϕ-polarization. For TDD, only slots consisting of only UL symbols are under test.

9. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

10. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE EIRP is in the range $P_{req} + P_W \pm P_W$, where P_{req} is the power level specified in Tables 6.4A.2.2.3.4.2-1 according to the power class. P_W is the power window according to Table [TBD] for the carrier frequency f and the channel bandwidth BW.

11. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

12. Measure carrier leakage on PCC using Global In-Channel Tx-Test (Annex E) for the θ- and ϕ-polarization. For TDD, only slots consisting of only UL symbols are under test.

13. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

Table 6.4A.2.2.3.4.2-1: UE EIRP P_{req} (dBm) for carrier leakage

Power Class	P_{req} (dBm) for step 5	P_{req} (dBm) for step 10
Power Class 1	17	4
Power Class 2	6	-13
Power Class 3	0	-13
Power Class 4	11	-13

Table 6.4A.2.2.3.4.2-2: Power Window (dB) for carrier leakage

TBD

6.4A.2.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.4A.2.2.3.5 Test requirement

For each of the *n* carrier leakage results derived in Annex E.3.1 for θ- and φ-polarization the total value is calculated according to

$$\text{CarrLeak}_{\text{Total}} = 10\log_{10}\left(10^{\text{CarrLeak}_\theta/10} + 10^{\text{CarrLeak}_\varphi/10}\right), \text{ where}$$

$$n = \begin{cases} 30, \text{ for 60 kHz SCS} \\ 60, \text{ for 120 kHz SCS} \end{cases}.$$

Each of the *n* total carrier leakage results $\text{CarrLeak}_{\text{Total}}$ shall not exceed the values in table 6.4.2.2.5-1 for power class 1, table 6.4.2.2.5-2 for power class 2, table 6.4.2.2.5-3 for power class 3 and table 6.4.2.2.5-4 for power class 4. Allocated RBs are not under test.

6.4A.2.3 In-band emissions for CA

6.4A.2.3.0 Minimum conformance requirements

6.4A.2.3.0.1 General

Inband emission requirement is defined over the spectrum occupied by all configured UL and DL CCs. The measurement interval is as defined in section 6.4.2.4. The requirement is verified with the test metric of In-band emission (Link=TX beam peak direction, Meas=Link angle).

For intra-band contiguous carrier aggregation, the requirements in this clause apply with all component carriers active and with one single contiguous PRB allocation in one of uplink component carriers. The inband emission is defined as the interference falling into the non-allocated resource blocks for all component carriers.

6.4A.2.3.0.2 In-band emissions for power class 1

The relative in-band emission shall not exceed the values specified in Table 6.4A.2.3.0.2-1 for power class 1 UEs.

Table 6.4A.2.3.0.2-1: Requirements for in-band emissions for power class 1

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\left[\begin{array}{c} -25-10\cdot\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20\cdot\log_{10}(EVM)-5\cdot\frac{(\lvert\Delta_{RB}\rvert-1)}{L_{CRB}}, \\ -55.1dBm-P_{RB} \end{array}\right]$		Any non-allocated RB in allocated component carrier and not allocated component carriers (NOTE 2)
IQ Image	dB	-25	Output power > 27 dBm	Image frequencies (NOTES 2, 3)
		-20	Output power ≤ 27 dBm	
Carrier leakage	dBc	-25	Output power > 17 dBm	Carrier frequency (NOTES 4, 5)
		-20	4 dBm ≤ Output power ≤ 17 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} - 25 dB) and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} is defined in NOTE 9.
NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. For Pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.
NOTE 3: Image frequencies for UL CA are specified in relation to either UL or DL carrier frequency.
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 are those that are enclosed in the RBs containing the DC frequency, or in the two RBs immediately adjacent to the DC frequency but excluding any allocated RB.
NOTE 6: L_{CRB} is the Transmission Bandwidth for kth allocated component carrier (see Figure 5.3.3-1).
NOTE 7: EVM s the limit for the modulation format used in the allocated RBs.
NOTE 8: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. Δ_{RB} = 1 or Δ_{RB} = -1 for the first adjacent RB outside of the allocated bandwidth), and may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.
NOTE 9: P_{RB} is the transmitted power per allocated RB, measured in dBm.
NOTE 10: All powers are EIRP in beam peak direction.

6.4A.2.3.0.3 In-band emissions for power class 2

The relative in-band emission shall not exceed the values specified in Table 6.4A.2.3.0.3-1 for power class 2.

Table 6.4A.2.3.0.3-1: Requirements for in-band emissions for power class 2

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\left[\begin{array}{c} -25-10\cdot\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20\cdot\log_{10}(EVM)-\ 5\cdot\frac{(\lvert\Delta_{RB}\rvert-1)}{L_{CRB}}, \\ -55.1dBm-P_{RB} \end{array}\right]$		Any non-allocated RB in allocated component carrier and not allocated component carriers (NOTE 2)
IQ Image	dB	-25	Output power > 16 dBm	Image frequencies (NOTES 2, 3)
		-20	Output power ≤ 16 dBm	
Carrier leakage	dBc	-25	Output power > 6 dBm	Carrier frequency (NOTES 4, 5)
		-20	-13 dBm ≤ Output power ≤ 6 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} - 25 dB) and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} is defined in NOTE 9.

NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. For Pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.

NOTE 3: Image frequencies for UL CA are specified in relation to either UL or DL carrier frequency.

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 are those that are enclosed in the RBs containing the DC frequency, or in the two RBs immediately adjacent to the DC frequency but excluding any allocated RB.

NOTE 6: L_{CRB} is the Transmission Bandwidth for kth allocated component carrier (see Figure 5.3.3-1).

NOTE 7: EVM s the limit for the modulation format used in the allocated RBs.

NOTE 8: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. Δ_{RB} = 1 or Δ_{RB} = -1 for the first adjacent RB outside of the allocated bandwidth), and may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.

NOTE 9: P_{RB} is the transmitted power per allocated RB, measured in dBm.

NOTE 10: All powers are EIRP in beam peak direction.

6.4A.2.3.0.4 In-band emissions for power class 3

The relative in-band emission shall not exceed the values specified in Table 6.4A.2.3.0.4-1 for power class 3 UEs.

Table 6.4A.2.3.0.4-1: Requirements for in-band emissions for power class 3

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\left[\begin{array}{c} -25-10\cdot\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20\cdot\log_{10}(EVM)-\ 5\cdot\frac{(\lvert\Delta_{RB}\rvert-1)}{L_{CRB}}, \\ -55.1dBm-P_{RB} \end{array}\right]$		Any non-allocated RB in allocated component carrier and not allocated component carriers (NOTE 2)
IQ Image	dB	-25	Output power > 10 dBm	Image frequencies (NOTES 2, 3)
		-20	Output power ≤ 10 dBm	
Carrier leakage	dBc	-25	Output power > 0 dBm	Carrier frequency (NOTES 4, 5)
		-20	-13 dBm ≤ Output power ≤ 0 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} - 25 dB) and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} is defined in NOTE 9.
NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. For Pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.
NOTE 3: Image frequencies for UL CA are specified in relation to either UL or DL carrier frequency.
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 are those that are enclosed in the RBs containing the DC frequency, or in the two RBs immediately adjacent to the DC frequency but excluding any allocated RB.
NOTE 6: L_{CRB} is the Transmission Bandwidth for kth allocated component carrier (see Figure 5.3.3-1).
NOTE 7: EVM s the limit for the modulation format used in the allocated RBs.
NOTE 8: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. Δ_{RB} = 1 or Δ_{RB} = -1 for the first adjacent RB outside of the allocated bandwidth), and may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.
NOTE 9: P_{RB} is the transmitted power per allocated RB, measured in dBm.
NOTE 10: All powers are EIRP in beam peak direction.

6.4A.2.3.0.5 In-band emissions for power class 4

The relative in-band emission shall not exceed the values specified in Table 6.4A.2.3.0.5-1 for power class 4 UEs.

Table 6.4A.2.3.0.5-1: Requirements for in-band emissions for power class 4

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\left[\begin{array}{c} -25-10\cdot\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20\cdot\log_{10}(EVM)-5\cdot\frac{(\lvert\Delta_{RB}\rvert-1)}{L_{CRB}}, \\ -55.1dBm-P_{RB} \end{array}\right]$		Any non-allocated RB in allocated component carrier and not allocated component carriers (NOTE 2)
IQ Image	dB	-25	Output power > 21 dBm	Image frequencies (NOTES 2, 3)
		-20	Output power ≤ 21 dBm	
Carrier leakage	dBc	-25	Output power > 11 dBm	Carrier frequency (NOTES 4, 5)
		-20	-13 dBm ≤ Output power ≤ 11 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} - 25 dB) and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} is defined in NOTE 9.
NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. For pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.
NOTE 3: Image frequencies for UL CA are specified in relation to either UL or DL carrier frequency.
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 are those that are enclosed in the RBs containing the DC frequency, or in the two RBs immediately adjacent to the DC frequency but excluding any allocated RB.
NOTE 6: L_{CRB} is the Transmission Bandwidth for kth allocated component carrier (see Figure 5.3.3-1).
NOTE 7: EVM s the limit for the modulation format used in the allocated RBs.
NOTE 8: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. Δ_{RB} = 1 or Δ_{RB} = -1 for the first adjacent RB outside of the allocated bandwidth), and may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.
NOTE 9: P_{RB} is the transmitted power per allocated RB, measured in dBm.
NOTE 10: All powers are EIRP in beam peak direction.

6.4A.2.3.1 In-band emissions for CA (2UL CA)

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

- The test procedure is incomplete due to that power window for CA is TBD
- Measurement Uncertainty and Test Tolerance are FFS.
- Test configuration table is FFS.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

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.

The purpose of this test is to exercise the UE transmitter to verify its modulation quality in terms of in-band emissions.

6.4A.2.3.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 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, and CC combinations based on NR operating bands specified in Table 5.5A.1-1, 5.5A.2-1 and 5.5A.2-2. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and subcarrier spacing, are shown in table 6.4A.2.3.1.4.1-1. 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 6.4A.2.3.1.4.1-1: Test Configuration Table

FFS

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals for PCC are initially set up according to Annex C.0, C.1 and C.3.0 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and 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 [10] 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. Retrieve the LO position from the parameter txDirectCurrentLocation in UplinkTxDirectCurrent IE.
2. Configure SCC according to Annex C.0, C.1 and C.3.0 for all downlink physical channels.

3. The SS shall configure SCC as per TS 38.508-1 [10] clause 5.5.1. Procedure to configure SCC(s) for NR RF CA testing. Message contents are defined in clause 6.4A.2.3.1.4.3.

4. SS activates SCC by sending the activation MAC CE (Refer TS 38.321, clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], clause 9.3).

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.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.

6. Send the appropriate TPC commands in the uplink scheduling information to the UE until UE output power is $P_{req} + P_W \pm P_{W,}$ where P_{req} is the power level specified in Table 6.4A.2.3.1.4.2-1 according to the power class with power ID = 1. P_W is the power window according to Table [TBD] for the carrier frequency f and the channel bandwidth BW.

7. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 2) for the UE Tx beam selection to complete.

8. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition TxRx.

9. Measure In-band emission IE_θ, IE_φ on PCC using Global In-Channel Tx-Test (Annex E) for the θ- and φ-polarizations, respectively. Measure power spectral density on the SCC. For TDD, only slots consisting of only UL symbols are under test. Calculate $IE = IE_\theta + IE_\varphi$, where the calculation is based on linear power ratios.

10. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

11. Repeat steps 6 through 10 until In-band emissions have been measured for all power IDs in Table 6. 4A.2.3.1.4.2-1.

NOTE 1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4A.2.3.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [10] clause 4.6.3 Table 4.6.3-118 PUSCH-Config without CP-OFDM condition. When switching to CP-OFDM waveform, send an NR RRCReconfiguration message with CP-OFDM condition.

NOTE 2: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

Table 6.4A.2.3.1.4.2-1: Parameters for In-band emissions

Power ID	Unit	Level for power class 1	Level for power class 2	Level for power class 3	Level for power class 4
1	dBm	27	16	10	21
2	dBm	17	6	0	11
3	dBm	4	-13	-13	-13

Table 6.4A.2.3.1.4.2-2: Power Window (dB) for In-band emissions

TBD

6.4A.2.3.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.4A.2.3.1.5 Test requirement

The averaged in-band emissions result, derived in Annex E.4.3 shall not exceed the corresponding values in Table 6.4A.2.3.1.5-1 for power class 1 UEs.

Table 6.4A.2.3.1.5-1: Test Requirements for in-band emissions for power class 1

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\begin{bmatrix} -25-10\cdot\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20\cdot\log_{10}(EVM)-\ 5\cdot\frac{(\lvert\Delta_{RB}\rvert-1)}{L_{CRB}}, \\ -55.1dBm-P_{RB} \end{bmatrix}$+TT		Any non-allocated RB in allocated component carrier and not allocated component carriers (NOTE 2)
IQ Image	dB	-25+TT	Output power > 27 dBm	Image frequencies (NOTES 2, 3)
		-20+TT	Output power ≤ 27 dBm	
Carrier leakage	dBc	-25+TT	Output power > 17 dBm	Carrier frequency (NOTES 4, 5)
		-20+TT	4 dBm ≤ Output power ≤ 17 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} - 25 dB) and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} is defined in NOTE 9.

NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. For Pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.

NOTE 3: Image frequencies for UL CA are specified in relation to either UL or DL carrier frequency.

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 are those that are enclosed in the RBs containing the DC frequency, or in the two RBs immediately adjacent to the DC frequency but excluding any allocated RB.

NOTE 6: L_{CRB} is the Transmission Bandwidth for kth allocated component carrier (see Figure 5.3.3-1).

NOTE 7: EVM s the limit for the modulation format used in the allocated RBs.

NOTE 8: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. Δ_{RB} = 1 or Δ_{RB} = -1 for the first adjacent RB outside of the allocated bandwidth), and may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.

NOTE 9: P_{RB} is the transmitted power per allocated RB, measured in dBm.

NOTE 10: All powers are EIRP in beam peak direction.

The averaged in-band emissions result, derived in Annex E.4.3 shall not exceed the corresponding values in Table 6.4A.2.3.1.5-2 for power class 2 UEs.

Table 6.4A.2.3.1.5-2: Test Requirements for in-band emissions for power class 2

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\begin{bmatrix} -25-10\cdot\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right), \\ 20\cdot\log_{10}(EVM)-\ 5\cdot\frac{(\lvert\Delta_{RB}\rvert-1)}{L_{CRB}}, \\ -55.1dBm-P_{RB} \end{bmatrix}$+TT		Any non-allocated RB in allocated component carrier and not allocated component carriers (NOTE 2)
IQ Image	dB	-25+TT	Output power > 16 dBm	Image frequencies (NOTES 2, 3)
		-20+TT	Output power ≤ 16 dBm	
Carrier leakage	dBc	-25+TT	Output power > 6 dBm	Carrier frequency (NOTES 4, 5)
		-20+TT	-13 dBm ≤ Output power ≤ 6 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} - 25 dB) and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} is defined in NOTE 9.
NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. For Pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.
NOTE 3: Image frequencies for UL CA are specified in relation to either UL or DL carrier frequency.
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 are those that are enclosed in the RBs containing the DC frequency, or in the two RBs immediately adjacent to the DC frequency but excluding any allocated RB.
NOTE 6: L_{CRB} is the Transmission Bandwidth for kth allocated component carrier (see Figure 5.3.3-1).
NOTE 7: EVM s the limit for the modulation format used in the allocated RBs.
NOTE 8: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. Δ_{RB} = 1 or Δ_{RB} = -1 for the first adjacent RB outside of the allocated bandwidth), and may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.
NOTE 9: P_{RB} is the transmitted power per allocated RB, measured in dBm.
NOTE 10: All powers are EIRP in beam peak direction.

The averaged in-band emissions result, derived in Annex E.4.3 shall not exceed the corresponding values in Table 6.4A.2.3.1.5-3 for power class 3 UEs.

Table 6.4A.2.3.1.5-3: Test Requirements for in-band emissions for power class 3

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$\max\left[-25-10\cdot\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right),\ 20\cdot\log_{10}(EVM)-5\cdot\frac{(\lvert\Delta_{RB}\rvert-1)}{L_{CRB}},\ -55.1dBm-P_{RB}\right]+TT$		Any non-allocated RB in allocated component carrier and not allocated component carriers (NOTE 2)
IQ Image	dB	-25+TT	Output power > 10 dBm	Image frequencies (NOTES 2, 3)
		-20+TT	Output power ≤ 10 dBm	
Carrier leakage	dBc	-25+TT	Output power > 0 dBm	Carrier frequency (NOTES 4, 5)
		-20+TT	-13 dBm ≤ Output power ≤ 0 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} - 25 dB) and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} is defined in NOTE 9.
NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. For Pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.
NOTE 3: Image frequencies for UL CA are specified in relation to either UL or DL carrier frequency.
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 are those that are enclosed in the RBs containing the DC frequency, or in the two RBs immediately adjacent to the DC frequency but excluding any allocated RB.
NOTE 6: L_{CRB} is the Transmission Bandwidth for kth allocated component carrier (see Figure 5.3.3-1).
NOTE 7: EVM s the limit for the modulation format used in the allocated RBs.
NOTE 8: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. Δ_{RB} = 1 or Δ_{RB} = -1 for the first adjacent RB outside of the allocated bandwidth), and may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.
NOTE 9: P_{RB} is the transmitted power per allocated RB, measured in dBm.
NOTE 10: All powers are EIRP in beam peak direction.

The averaged in-band emissions result, derived in Annex E.4.3 shall not exceed the corresponding values in Table 6.4A.2.3.1.5-4 for power class 4 UEs.

Table 6.4A.2.3.1.5-4: Test Requirements for in-band emissions for power class 4

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$max\left[-25 - 10\cdot\log_{10}\left(\frac{N_{RB}}{L_{CRB}}\right),\ 20\cdot\log_{10}(EVM) - 5\cdot\frac{(\lvert\Delta_{RB}\rvert - 1)}{L_{CRB}},\ -55.1dBm - P_{RB} \right]$+TT		Any non-allocated RB in allocated component carrier and not allocated component carriers (NOTE 2)
IQ Image	dB	-25+TT	Output power > 21 dBm	Image frequencies (NOTES 2, 3)
		-20+TT	Output power ≤ 21 dBm	
Carrier leakage	dBc	-25+TT	Output power > 11 dBm	Carrier frequency (NOTES 4, 5)
		-20+TT	-13 dBm ≤ Output power ≤ 11 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} - 25 dB) and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} is defined in NOTE 9.
NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs. For pi/2 BPSK with Spectrum Shaping, the limit is expressed as a ratio of measured power in one non-allocated RB to the measured power in the allocated RB with highest PSD.
NOTE 3: Image frequencies for UL CA are specified in relation to either UL or DL carrier frequency.
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 are those that are enclosed in the RBs containing the DC frequency, or in the two RBs immediately adjacent to the DC frequency but excluding any allocated RB.
NOTE 6: L_{CRB} is the Transmission Bandwidth for kth allocated component carrier (see Figure 5.3.3-1).
NOTE 7: EVM s the limit for the modulation format used in the allocated RBs.
NOTE 8: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. Δ_{RB} = 1 or Δ_{RB} = -1 for the first adjacent RB outside of the allocated bandwidth), and may take non-integer values when the carrier spacing between the CCs is not a multiple of RB.
NOTE 9: P_{RB} is the transmitted power per allocated RB, measured in dBm.
NOTE 10: All powers are EIRP in beam peak direction.

6.4A.2.4 EVM equalizer spectrum flatness for CA

FFS.

6.4A.2.5 EVM spectral flatness for pi/2 BPSK modulation with spectrum shaping for CA

FFS.

6.4D Transmit signal quality for UL MIMO

FFS.

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 [7] 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.

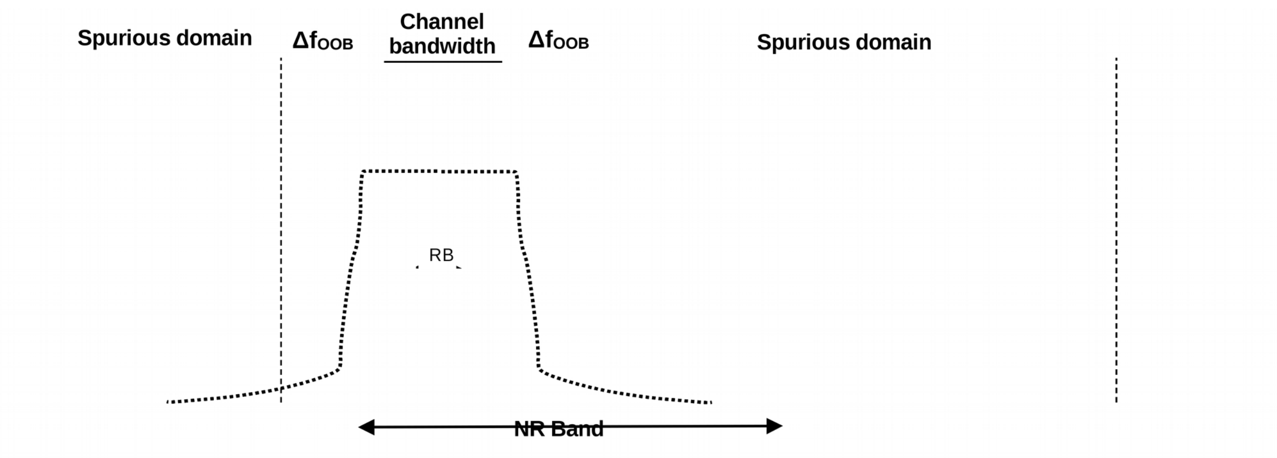


Figure 6.5-1: Transmitter RF spectrum

6.5.1 Occupied bandwidth

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

- Measurement Uncertainty FFS.

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 6.5.1.2-1.

The occupied bandwidth is defined as a directional requirement. The requirement is verified in beam locked mode on beam peak direction.

Table 6.5.1.2-1: Occupied channel bandwidth

	Occupied channel bandwidth / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
Channel bandwidth (MHz)	50	100	200	400

The normative reference for this requirement is TS 38.101-2 [3] 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, 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 subcarrier 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 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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.			

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.1.2.1 for TE diagram and section A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.1, and uplink signals according to Annex G.0, G.1 and G.3.1.
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 [10] clause 4.5. Message contents are defined in clause 6.5.1.4.3

6.5.1.4.2 Test procedure

1. Set the UE in the Tx beam peak direction found with a TX beam peak direction search as performed in Annex K.
2. SS sends uplink scheduling information for each UL HARQ process via PDSCH 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.
3. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 ms for the UE to reach maximum output power.
4. Measure the EIRP spectrum distribution within two times or more frequency 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). The measuring duration is one active uplink subframe. EIRP is captured from both polarizations, theta and phi.

5. Calculate the total EIRP from both polarizations, theta and phi, within the range of all frequencies measured in step 4 and save this value as "Total EIRP". EIRP measurement procedure is defined in Annex K.

6. Identify the measurement window whose centre is aligned on the centre of the channel for which the sum of the power measured in theta and phi polarization is 99% of the "Total EIRP".

7. The "Occupied Bandwidth" is the width of the measurement window obtained in step 6.

6.5.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] 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 / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
Channel bandwidth (MHz)	50	100	200	400

6.5.2 Out of band emission

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. Additional requirements to protect specific bands are also considered.

All out of band emissions for range 2 are TRP.

6.5.2.1 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 greater than (Δf_{OOB}) the spurious requirements in subclause 6.5.3 are applicable.

6.5.2.1.1 Test purpose

To verify that the power of any UE emission shall not exceed specified lever for the specified channel bandwidth.

6.5.2.1.2 Test applicability

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

6.5.2.1.3 Minimum conformance requirements

The power of any UE emission shall not exceed the levels specified in Table 6.5.2.1.3-1 for the specified channel bandwidth.

Table 6.5.2.1.3-1: General NR spectrum emission mask for Range 2.

Spectrum emission limit (dBm)/ Channel bandwidth					
Δf_{OOB} (MHz)	**50 MHz**	**100 MHz**	**200 MHz**	**400 MHz**	**Measurement bandwidth**
± 0-5	-5	-5	-5	-5	1 MHz
± 5-10	-13	-5	-5	-5	1 MHz
± 10-20	-13	-13	-5	-5	1 MHz
± 20-40	-13	-13	-13	-5	1 MHz
± 40-100	-13	-13	-13	-13	1 MHz
± 100-200		-13	-13	-13	1 MHz
± 200-400			-13	-13	1 MHz
± 400-800				-13	1 MHz

The normative reference for this requirement is TS 38.101-2 [3] clause 6.5.2.1.

6.5.2.1.4 Test description

6.5.2.1.4.1 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, 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 subcarrier spacing, are shown in table 6.5.2.1.4.1-1. 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 6.5.2.1.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Mid range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] 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 Spectrum Emission Mask test case	**Modulation**	**RB allocation (NOTE 1)**
1		DFT-s-OFDM PI/2 BPSK	Outer_1RB_Left
2		DFT-s-OFDM PI/2 BPSK	Outer_1RB_Right
3		DFT-s-OFDM PI/2 BPSK	Outer_Full
4		DFT-s-OFDM QPSK	Outer_1RB_Left
5		DFT-s-OFDM QPSK	Outer_1RB_Right
6		DFT-s-OFDM QPSK	Outer_Full
7		DFT-s-OFDM 16 QAM	Outer_1RB_Left
8		DFT-s-OFDM 16 QAM	Outer_1RB_Right
9		DFT-s-OFDM 16 QAM	Outer_Full
10		DFT-s-OFDM 64 QAM	Outer_1RB_Left
11		DFT-s-OFDM 64 QAM	Outer_1RB_Right
12		DFT-s-OFDM 64 QAM	Outer_Full
13		CP-OFDM QPSK	Outer_1RB_Left
14		CP-OFDM QPSK	Outer_1RB_Right
15		CP-OFDM QPSK	Outer_Full
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.			

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.1.2.1 for TE diagram and section A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.1, and uplink signals according to Annex G.0, G.1 and G.3.1.
4. The UL Reference Measurement channels are set according to Table 6.5.2.1.4.1-1.
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 [10] clause 4.5. Message contents are defined in clause 6.5.2.1.4.3

6.5.2.1.4.2 Test procedure

1. Set the UE in the Tx beam peak direction found with a TX beam peak direction search as performed in Annex K.
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 6.5.2.1.4.2-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
3. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 ms for the UE to reach maximum output power.

4. Measure the TRP of the transmitted signal with a measurement filter of bandwidths according to table 6.5.2.1.1.5-1. The centre frequency of the filter shall be stepped in continuous steps according to the same table. TRP shall be recorded for each step. The measurement period shall capture the active time slots. Total radiated power is measured according to TRP measurement procedure defined in Annex K. The measurement grid used for TRP measurement defined in Annex M. TRP is calculated considering both polarizations, theta and phi.

NOTE 1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.5.2.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [10] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

6.5.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5.2.1.5 Test requirement

The measured TRP of any UE emission derived in step 4, shall fulfil requirements in Table.6.5.2.1.5-1.

Table 6.5.2.1.5-1: General NR spectrum emission mask for Range 2

Spectrum emission limit (dBm)/ Channel bandwidth					
Δf_{OOB} (MHz)	**50 MHz**	**100 MHz**	**200 MHz**	**400 MHz**	**Measurement bandwidth**
± 0-5	-5 + TT	-5 + TT	-5 + TT	-5 + TT	1 MHz
± 5-10	-13 + TT	-5 + TT	-5 + TT	-5 + TT	1 MHz
± 10-20	-13 + TT	-13 + TT	-5 + TT	-5 + TT	1 MHz
± 20-40	-13 + TT	-13 + TT	-13 + TT	-5 + TT	1 MHz
± 40-100	-13 + TT	-13 + TT	-13 + TT	-13 + TT	1 MHz
± 100-200		-13 + TT	-13 + TT	-13 + TT	1 MHz
± 200-400			-13 + TT	-13 +TT	1 MHz
± 400-800				-13 + TT	1 MHz
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5.2.1.5-1a 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.					

Table 6.5.2.1.5-1a: Test Tolerance (Spectrum emission mask)

Test Metric	23.45GHz ≤ f ≤ 32.125GHz	32.125GHz < f ≤ 40.8GHz
IFF (Quiet Zone size ≤ 30 cm)	3.21 dB	3.46 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.

6.5.2.2 Void

6.5.2.3 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. ACLR requirement is specified for a scenario in which adjacent carrier is another NR channel.

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

- Measurement Uncertainties and Test Tolerances are FFS.

6.5.2.3.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5.2.3.2 Test applicability

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

6.5.2.3.3 Minimum conformance requirements

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. ACLR requirement is specified for a scenario in which adjacent carrier is another NR channel.

NR Adjacent Channel Leakage power Ratio (NR_{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 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 6.5.2.3.3-1.

If the measured adjacent channel power is greater than –35 dBm then the NRACLR shall be higher than the value specified in Table 6.5.2.3.3-1.

Table 6.5.2.3.3-1: General requirements for NR_{ACLR}

	Channel bandwidth / NR_{ACLR} / Measurement bandwidth			
	50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
NR_{ACLR} for band n257, n258	17 dB	17 dB	17 dB	17 dB
NR_{ACLR} for band n260	16 dB	16 dB	16 dB	16 dB
NR channel Measurement bandwidth	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
Adjacent channel centre frequency offset [MHz]	+50 / -50	+100.0 / -100.0	+200 / -200	+400 / -400

The normative reference for this requirement is TS 38.101-2 [3] clause 6.5.2.3.1.

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, 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 subcarrier spacing, are shown in table 6.5.2.3.4.1-1. 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 6.5.2.3.4.1-1: Test Configuration Table

Default Conditions						
Test Environment as specified in TS 38.508-1 [10] subclause 4.1					Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1					Low range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1					Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1					Lowest, Highest	
Test Parameters						
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				DFT-s-OFDM PI/2 BPSK	Outer_1RB_Left
2	High				DFT-s-OFDM PI/2 BPSK	Outer_1RB_Right
3	Default				DFT-s-OFDM PI/2 BPSK	Outer_Full
4	Low				DFT-s-OFDM QPSK	Outer_1RB_Left
5	High				DFT-s-OFDM QPSK	Outer_1RB_Right
6	Default				DFT-s-OFDM QPSK	Outer_Full
7	Low				DFT-s-OFDM 16 QAM	Outer_1RB_Left
8	High				DFT-s-OFDM 16 QAM	Outer_1RB_Right
9	Default				DFT-s-OFDM 16 QAM	Outer_Full
10	Default				DFT-s-OFDM 64 QAM	Outer_Full
11	Low				CP-OFDM QPSK	Outer_1RB_Left
12	High				CP-OFDM QPSK	Outer_1RB_Right
13	Default				CP-OFDM QPSK	Outer_Full
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.						

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.1.2.1 for TE diagram and section A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.1, and uplink signals according to Annex G.0, G.1 and G.3.1.
4. The UL Reference Measurement channels are set according to Table 6.5.2.3.4.1-1.
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 [10] clause 4.5. Message contents are defined in clause 6.5.2.3.4.3

6.5.2.3.4.2 Test procedure

1. Set the UE in the Tx beam peak direction found with a TX beam peak direction search as performed in Annex K.
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 6.5.2.3.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
3. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 ms for the UE to reach maximum output power.

4. Measure TRP of the transmitted signal for the assigned NR channel with a rectangular measurement filter with bandwidths according to Table 6.5.2.3.5-1. Total radiated power is measured according to TRP measurement procedure defined in Annex K and measurement grid specified in Annex M. TRP is calculated considering both polarizations, theta and phi.

5. Measure TRP of the first NR adjacent channel on both lower and upper side of the assigned NR channel, respectively using a rectangular measurement filter with bandwidths according to Table 6.5.2.3.5-1. Total radiated power is measured according to TRP measurement procedure defined in Annex K. The measurement grid used for TRP measurement defined in Annex M. TRP is calculated considering both polarizations, theta and phi.

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 6.5.2.3.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [10] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

6.5.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5.2.3.5 Test requirement

The measured NR ACLR, derived in step 6, shall be higher than the limits in table 6.5.2.3.5-1.

Table 6.5.2.3.5-1: General requirements for NR_{ACLR}

	Channel bandwidth / NR_{ACLR} / Measurement bandwidth			
	50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
NR_{ACLR} for band n257, n258	17 + TT dB	17 + TT dB	17 + TT dB	17 + TT dB
NR_{ACLR} for band n260	16 + TT dB	16 + TT dB	16 + TT dB	16 + TT dB
NR channel Measurement bandwidth	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
Adjacent channel centre frequency offset [MHz]	+50 / -50	+100.0 / -100.0	+200 / -200	+400 / -400
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5.2.3.5-1a				

Table 6.5.2.3.5-1a: Test Tolerance (Adjacent channel leakage ratio)

Test Metric	23.45GHz ≤ f ≤ 30.3GHz	30.3GHz < f ≤ 40.8GHz
IFF (Quiet Zone size ≤ 30 cm)	[4.6] dB	[5.0] 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. The spurious emission limits are specified in terms of general requirements in line with SM.329 [7] and *NR* operating band requirement to address UE co-existence. Spurious emissions are measured as TRP.

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.

6.5.3.1 Transmitter Spurious emissions

Editor's Note: This clause is complete. The following aspects of the clause are for future consideration:

- Testability issue for 6GHz ~ [12.75GHz] is identified. How to treat this frequency range is TBD.
- TRP Measurement uncertainty is TBD

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

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than F_{OOB} (MHz) in Table 6.5.3.1.3-1 starting from the edge of the assigned *NR* channel bandwidth. The spurious emission limits in Table 6.5.3.1.3-2 apply for all transmitter band configurations (NRB) and channel bandwidths. The requirement is verified in beam locked mode with the test metric of TRP (Link=TX beam peak direction).

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 spurious emission domain

Channel bandwidth	**50 MHz**	**100 MHz**	**200 MHz**	**400 MHz**
OOB boundary F_{OOB} (MHz)	100	200	400	800

The spurious emission limits in table 6.5.3.1.3-2 apply for all transmitter band configurations (RB) and channel bandwidths.

Table 6.5.3.1.3-2: Spurious emissions limits

Frequency Range	**Maximum Level**	**Measurement bandwidth**	NOTE
30 MHz ≤ f < 1000 MHz	-36 dBm	100 kHz	
1 GHz ≤ f < 12.75 GHz	-30 dBm	1 MHz	
12.75 GHz ≤ f ≤ 2nd harmonic of the upper frequency edge of the UL operating band in GHz	-13 dBm	1 MHz	

The normative reference for this requirement is TS 38.101-2 subclause 6.5.3.

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 Subscriber Station (SS) to take with the UE to reach the correct measurement state.

Table 6.5.3.1.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, High range (NOTE 2)	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1		Highest	
Test SCS as specified in Table 5.3.5-1		120kHz	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
	N/A for Spurious Emissions testing	**Modulation**	**RB allocation (NOTE 1)**
1		DFT-s -OFDM QPSK	Inner_Full
2		DFT-s -OFDM QPSK	Inner_1RB (NOTE 3)
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration. NOTE 2: When testing Low range test only in Frequency Range lower than (F_{UL_low} – Δf_{OOB}) and when testing High range test only in Frequency Range higher than (F_{UL_high} + Δf_{OOB}). NOTE 3: When testing Low range configure uplink RB to Inner_1RB_Left and when testing High range configure uplink RB to Inner_1RB_Right.			

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex G.0, G.1 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 [10] clause 4.5. Message contents are defined in clause 6.5.3.1.4.3.

6.5.3.1.4.2 Test procedure

1. Select any of the three Alignment Options (1, 2, or 3) from Tables J.2-1 through J.2-3 [3] to mount the DUT inside the QZ.

2. If the re-positioning concept is applied, position the device in DUT Orientation 1 if the maximum beam peak direction is within zenith angular range 0º≤θ≤90º for the alignment option selected in step 1; position the device in DUT Orientation 2 (either Options 1 or 2) if the maximum beam peak direction is within zenith angular range 90º<θ≤180º for DUT Orientation 1 for the alignment option selected in step 1. If the re-positioning concept is not applied, position the device in DUT Orientation 1.

3. SS sends uplink scheduling information for each UL HARQ process via PDSCH 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.

4. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200msec for the UE to reach P_{UMAX} .

5. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 3) for the UE Tx beam selection to complete.

6. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

7. Measure the spurious emissions as per steps outlined below with an exception to the procedure in Annex K if the re-positioning concept is applied (NOTE 4). Step (a) is optional and applicable only if SNR (test requirement level in Table 6.5.3.1.5-1 minus offset value minus noise floor of the test system) ≥ 0 dB is guaranteed.

   (a) Perform coarse TRP measurements to identify spurious emission frequencies and corresponding power level according to the procedures in Annex K, using coarse TRP measurement grid selection criteria as per Table M.4.5-3 in Annex M. The measurement is completed in both polarizations θ and ϕ over frequency range and measurement bandwidth according to Table 6.5.3.1.3-2. Optionally, a larger and non-constant measurement bandwidth than that of Table 6.5.3.1.3-2 may be applied. The measurement period shall capture the active time slots. For each spurious emission frequency with coarse TRP identified to be less than an offset dB from the TRP limit according to Table 6.5.3.1.3-2, continue with fine TRP procedures according to step (b).

   The offset value shall be the TRP measurement uncertainty at 95% confidence level including the effect of coarse grid measurement uncertainty element, excluding the influence of noise. Different coarse TRP grids and corresponding offset values may be used for different frequencies. The coarse TRP grid and offset values used shall be recorded in the test report.

Table 6.5.3.1.4.2-1: Typical offset values for coarse TRP measurement step 7(a)

Grid	Frequency Range	Offset Value
Constant Density	6 GHz ≤ f < 12.75 GHz	TBD
	12.75 GHz ≤ f ≤ 23.45GHz	TBD
	23.45 GHz ≤ f ≤ 40.8GHz	TBD
	40.8 GHz ≤ f ≤ 66GHz	TBD
Constant-Step Size	6 GHz ≤ f < 12.75 GHz	TBD
	12.75 GHz ≤ f ≤ 23.45GHz	TBD
	23.45 GHz ≤ f ≤ 40.8GHz	TBD
	40.8 GHz ≤ f ≤ 66GHz	TBD
NOTE 1: These offset values are the upper limit values when fine TRP measurement uncertainity of the test system is same as maximum test system uncertainity in Annex F and when using the coarse measurement grid with minimum number of points as specified in Table M.4.5-3. NOTE 2: It is allowed to use the offset values derived based on test system's actual measurement uncertainity budget and denser measurement grid as specified in Table M.4.5.3.		

   (b) Measure fine TRP measurements according to procedures in Annex K, using fine TRP measurement grid selection criteria as per Table M.4.5-3 in Annex M, for each of the spurious emission frequency identified in step (a). Apply a measurement bandwidth according to Table 6.5.3.1.3-2.

8. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The frequency range defined in Table 6.5.3.1.3-2 may be split into ranges. For each range a different test system, e.g. antenna and/or chamber, may be used. To pass the test case all verdicts of the frequency ranges must pass.

NOTE 2: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.5.3.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [10] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

NOTE 3: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

NOTE 4: If the (in-band) beam peak is within 0º≤θ≤90º: perform first hemispherical TRP scan (0º≤θ≤90º) in DUT Orientation 1 and second hemispherical TRP scan (90º>θ≥0º) in DUT Orientation 2. If the (in-band) beam peak is within 90º<θ≤180º: perform first hemispherical TRP scan (0º≤θ≤90º) in DUT Orientation 2 and second hemispherical TRP scan (90º>θ≥0º) in DUT Orientation 1. The DUT with UBF activated needs to be re-positioned during the test.

6.5.3.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] 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.

The maximum EIRP or TRP power of spurious emission, measured using RMS detector, shall not exceed the described value in Table 6.5.3.1.5-1.

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than F_{OOB} (MHz) in Table 6.5.3.1.3-1 starting from the edge of the assigned *NR* channel bandwidth. The spurious emission limits in Table 6.5.3.1.5-1 apply for all transmitter band configurations (NRB) 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 6.5.3.1.5-1: Spurious emissions test requirements

Frequency Range	Maximum Level	Measurement bandwidth	NOTE
6 GHz ≤ f < 12.75 GHz	-30 dBm	1 MHz	
12.75 GHz ≤ f ≤ 2nd harmonic of the upper frequency edge of the UL operating band in GHz	-13 dBm	1 MHz	
NOTE 1: Applies for Band n257, n258, n260			

6.5.3.2 Spurious emission band UE co-existence

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

- Testability issue for 6GHz ~ [12.75GHz] is identified. How to treat this frequency range is TBD.
- TRP Measurement uncertainty is TBD

6.5.3.2.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference when in co-existence with protected bands 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 co-existence with protected bands. The requirement is verified in beam locked mode with the test metric of TRP (Link=TX beam peak direction).

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.

The spurious emission UE co-existence limits in Table 6.5.3.2.3-1 apply for all transmitter band configurations (RB) and channel bandwidths.

Table 6.5.3.2.3-1: Spurious emissions UE co-existence limits

NR Band	Spurious emission						
	Protected band/frequency range	**Frequency range (MHz)**			**Maximum Level (dBm)**	**MBW (MHz)**	**NOTE**
n257	NR Band n260	F_{DL_low}	-	F_{DL_high}	-2	100	
	Frequency range	57000	-	66000	2	100	
n258	Frequency range	57000	-	66000	2	100	
n260	NR Band 257	F_{DL_low}	-	F_{DL_high}	-5	100	
	NR Band 261	F_{DL_low}	-	F_{DL_high}	-5	100	
	Frequency range	57000	-	66000	2	100	
n261	NR Band 260	F_{DL_low}	-	F_{DL_high}	-2	100	
	Frequency range	57000	-	66000	2	100	
NOTE 1: F_{DL_low} and F_{DL_high} refer to each NR frequency band specified in Table 5.2-1. NOTE 2: Void.							

The normative reference for this requirement is TS 38.101-2 subclause 6.5.3.1.

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 Subscriber Station (SS) to take with the UE to reach the correct measurement state.

Table 6.5.3.2.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, High range (NOTE 2)	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1		Highest	
Test SCS as specified in Table 5.3.5-1		120kHz	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for Spurious Emissions testing	DFT-s-OFDM QPSK	Inner_Full
2		DFT-s-OFDM QPSK	Inner_1RB (NOTE 3)
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration. NOTE 2: When testing Low range test only in Frequency Range lower than (F_{UL_low} – Δf_{OOB}) and when testing High range test only in Frequency Range higher than (F_{UL_high} + Δf_{OOB}). NOTE 3: When testing Low range configure uplink RB to Inner_1RB_Left and when testing High range configure uplink RB to Inner_1RB_Right.			

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex G.0, G.1 and 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* according to TS 38.508-1 [10] clause 4.5. Message contents are defined in clause 6.5.3.2.4.3.

6.5.3.2.4.2 Test procedure

1. Select any of the three Alignment Options (1, 2, or 3) from Tables J.2-1 through J.2-3 [3] to mount the DUT inside the QZ.

2. If the re-positioning concept is applied, position the device in DUT Orientation 1 if the maximum beam peak direction is within zenith angular range 0º≤θ≤90º for the alignment option selected in step 1; position the device in DUT Orientation 2 (either Options 1 or 2) if the maximum beam peak direction is within zenith angular range 90º<θ≤180º for DUT Orientation 1 for the alignment option selected in step 1. If the re-positioning concept is not applied, position the device in DUT Orientation 1.

3. SS sends uplink scheduling information for each UL HARQ process via PDSCH DCI format [0_1] for C_RNTI to schedule the UL RMC according to Table 6.5. 3.2.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

4. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200msec for the UE to reach P_{UMAX}.

5. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 3) for the UE Tx beam selection to complete.

6. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

7. Measure the spurious emissions as per steps outlined below with an exception to the procedure in Annex K if the re-positioning concept is applied (NOTE 4):

   (a) Perform coarse TRP measurements to identify spurious emission frequencies and corresponding power level according to the procedures in Annex K, using coarse TRP measurement grid selection criteria as per Table M.4.5-3 in Annex M. The measurement is completed in both polarizations θ and ϕ over frequency range and measurement bandwidth according to Table 6.5.3. 2.3-1. Optionally, a larger and non-constant measurement bandwidth than that of Table 6.5.3. 2.3-1 may be applied as long as the SNR (ratio of test limit to floor noise of test equipment) ≥ 10dB is guaranteed. The measurement period shall capture the active time slots. For each spurious emission frequency with coarse TRP identified to be less than an offset dB (NOTE 2) from the TRP limit according to Table 6.5.3. 2.3-1, continue with fine TRP procedures according to step (b).

   The offset value shall be the TRP measurement uncertainty at 95% confidence level including the effect of coarse grid measurement uncertainty element. Different coarse TRP grids and corresponding offset values may be used for different frequencies. The coarse TRP grid and offset values used shall be recorded in the test report.

   (b) Measure fine TRP measurements according to procedures in Annex K, using fine TRP measurement grid selection criteria as per Table M.4.5-3 in Annex M, for each of the spurious emission frequency identified in step (a). Apply a measurement bandwidth according to Table 6.5.3.2.3-1.

8. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The frequency range defined in Table 6.5.3. 2.3-1 may be split into ranges. For each range a different test system, e.g. antenna and/or chamber, may be used. To pass the test case all verdicts of the frequency ranges must pass.

NOTE 2: The coarse TRP measurement grid and corresponding offset dB value referred in step 5(a) above, for some valid grids can be found in TR 38.903 section B.18.

NOTE 3: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

NOTE 4: If the (in-band) beam peak is within 0º≤θ≤90º: perform first hemispherical TRP scan (0º≤θ≤90º) in DUT Orientation 1 and second hemispherical TRP scan (90º>θ≥0º) in DUT Orientation 2. If the (in-band) beam peak is within 90º<θ≤180º: perform first hemispherical TRP scan (0º≤θ≤90º) in DUT Orientation 2 and second hemispherical TRP scan (90º>θ≥0º) in DUT Orientation 1. The DUT with UBF activated needs to be re-positioned during the test.

6.5.3.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5.3.2.5 Test requirement

This clause specifies the requirements for the specified *NR* band for Transmitter Spurious emissions for UE co-existence requirement with frequency range as indicated in Table 6.5.3.2.5-1.

The maximum EIRP or TRP power of spurious emission for UE co-existence, measured using RMS detector, shall not exceed the described value in Table 6.5.3.2.5-1.

The spurious emission UE co-existence limits in Table 6.5.3.2.5-1 apply for all transmitter band configurations (NRB) 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 6.5.3.2.5-1: Spurious emissions UE co-existence test requirements

NR Band	Spurious emission						
	Protected band/frequency range	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
n257	NR Band n260	F_{DL_low}	-	F_{DL_high}	-2	100	
	Frequency range	57000	-	66000	2	100	
n258	Frequency range	57000	-	66000	2	100	
n260	NR Band 257	F_{DL_low}	-	F_{DL_high}	-5	100	
	NR Band 261	F_{DL_low}	-	F_{DL_high}	-5	100	
	Frequency range	57000	-	66000	2	100	
n261	NR Band 260	F_{DL_low}	-	F_{DL_high}	-2	100	
	Frequency range	57000	-	66000	2	100	
NOTE 1: F_{DL_low} and F_{DL_high} refer to each NR frequency band specified in Table 5.2-1. NOTE 2: Void.							

6.5.3.3 Additional Spurious emission

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

- Testability issue for 6GHz ~ [12.75GHz] is identified. How to treat this frequency range is TBD.
- TRP Measurement uncertainty is TBD

6.5.3.3.1 Test purpose

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.

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

The additional spurious emission limits in Table 6.5.3.3.3-1 apply for all transmitter band configurations (RB) and channel bandwidths. The requirement is verified in beam locked mode with the test metric of TRP (Link=TX beam peak direction).

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.

When "NS_201" 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. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.3-1: Additional spurious emissions (NS_201) test limits

Frequency Range	Maximum Level / Channel bandwidth				Measurement bandwidth	NOTE
	50 MHz	100 MHz	200 MHz	400 MHz		
23.6 GHz ≤ f ≤ 24 GHz	-8 dBm	-8 dBm	-8 dBm	-8 dBm	200MHz	1
NOTE 1: The protection of frequency range 23600 - 24000 MHz is meant for protection of satellite passive services.						

The normative reference for this requirement is TS 38.101-2 subclause 6.5.3.2.

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 Subscriber Station (SS) to take with the UE to reach the correct measurement state.

Table 6.5.3.3.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1		Highest	
Test SCS as specified in Table 5.3.5-1		120kHz	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration**	
		Modulation	**RB allocation (NOTE 1)**
1	N/A for Spurious Emissions testing	DFT-s-OFDM QPSK	Inner_Full
2		DFT-s-OFDM QPSK	Inner_1RB_Left
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration.			

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

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

4. The UL Reference Measurement channels are set according to Table 6.5.3.3.4.1-1

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

6. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity *NR* according to TS 38.508-1 [10] clause 4.5. Message contents are defined in clause 6.5.3.3.4.3.

6.5.3.3.4.2 Test procedure

1. Select any of the three Alignment Options (1, 2, or 3) from Tables J.2-1 through J.2-3 [3] to mount the DUT inside the QZ.

2. If the re-positioning concept is applied, position the device in DUT Orientation 1 if the maximum beam peak direction is within zenith angular range 0º≤θ≤90º for the alignment option selected in step 1; position the device in DUT Orientation 2 (either Options 1 or 2) if the maximum beam peak direction is within zenith angular range 90º<θ≤180º for DUT Orientation 1 for the alignment option selected in step 1. If the re-positioning concept is not applied, position the device in DUT Orientation 1.

3. SS sends uplink scheduling information for each UL HARQ process via PDSCH DCI format [0_1] for C_RNTI to schedule the UL RMC according to Table 6.5.3.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

4. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200msec for the UE to reach P_{UMAX}.

5. Set the UE in the Inband Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 3) for the UE Tx beam selection to complete.

6. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

7. Measure the spurious emissions as per steps outlined below with an exception to the procedure in Annex K if the re-positioning concept is applied (NOTE 4):

   (a) Perform coarse TRP measurements to identify spurious emission frequencies and corresponding power level according to the procedures in Annex K, using coarse TRP measurement grid selection criteria as per Table M.4.5-3 in Annex M.. The measurement is completed in both polarizations θ and ϕ over frequency range and measurement bandwidth according to Table 6.5.3.1.3-2. Optionally, a larger and non-constant measurement bandwidth than that of Table 6.5.3.1.3-2 may be applied as long as the SNR (ratio of test limit to floor noise of test equipment) ≥ 10dB is guaranteed. The measurement period shall capture the [active time slots]. For each spurious emission frequency with coarse TRP identified to be less than an offset dB (NOTE 2) from the TRP limit according to Table 6.5.3.1.3-2, continue with fine TRP procedures according to step (b).

   The offset value shall be the TRP measurement uncertainty at 95% confidence level including the effect of coarse grid measurement uncertainty element. Different coarse TRP grids and corresponding offset values may be used for different frequencies. The coarse TRP grid and offset values used shall be recorded in the test report.

   (b) Measure fine TRP measurements according to procedures in Annex K, using fine TRP measurement grid selection criteria as per Table M.4.5-3 in Annex M, for each of the spurious emission frequency identified in step (a). Apply a measurement bandwidth according to Table 6.5.3.1.3-2.

8. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The frequency range defined in Table 6.5.3.1.3-2 may be split into ranges. For each range a different test system, e.g. antenna and/or chamber, may be used. To pass the test case all verdicts of the frequency ranges must pass.

NOTE 2: The coarse TRP measurement grid and corresponding offset dB value referred in step 5(a) above, for some valid grids can be found in TR 38.903 section B.18.

NOTE 3: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

NOTE 4: If the (in-band) beam peak is within 0º≤θ≤90º: perform first hemispherical TRP scan (0º≤θ≤90º) in DUT Orientation 1 and second hemispherical TRP scan (90º>θ≥0º) in DUT Orientation 2. If the (in-band) beam peak is within 90º<θ≤180º: perform first hemispherical TRP scan (0º≤θ≤90º) in DUT Orientation 2 and second hemispherical TRP scan (90º>θ≥0º) in DUT Orientation 1. The DUT with UBF activated needs to be re-positioned during the test

6.5.3.3.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5.3.3.5 Test requirement

This clause specifies the requirements for the specified *NR* band for Transmitter Spurious emissions for UE co-existence requirement with frequency range as indicated in Table 6.5.3.3.5-1.

The maximum EIRP or TRP power of spurious emission for UE co-existence, measured using RMS detector, shall not exceed the described value in Table 6.5.3.3.5-1.

The spurious emission UE co-existence limits in Table 6.5.3.3.5-1 apply for all transmitter band configurations (NRB) 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 6.5.3.3.5-1: Additional spurious emissions (NS_201) test requirements

Frequency Range	Maximum Level / Channel bandwidth				Measurement bandwidth	NOTE
	50 MHz	100 MHz	200 MHz	400 MHz		
23.6 GHz ≤ f ≤ 24 GHz	-8 dBm	-8 dBm	-8 dBm	-8 dBm	200MHz	1
NOTE 1: The protection of frequency range 23600 - 24000 MHz is meant for protection of satellite passive services.						

6.5A Output RF spectrum emissions for CA

6.5A.1 Occupied bandwidth for CA

6.5A.1.0 Minimum conformance requirements

For intra-band contiguous carrier aggregation, the occupied bandwidth is a measure of the bandwidth containing 99 % of the total integrated power of the transmitted spectrum. The occupied bandwidth for CA shall be less than the aggregated channel bandwidth defined in subclause 5.5A.

The occupied bandwidth for CA is defined as a directional requirement. The requirement is verified in beam locked mode on beam peak direction.

The normative reference for this requirement is TS 38.101-2 [3] clause 6.5A.1.

6.5A.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:

- The test configuration table is FFS
- SCC configuration in the procedure is FFS

- Connection Diagram is FFS
- Applicability of UBF of single UL is FFS
- Applicability of Beam peak of single UL is FFS
- Test procedure for intra-band non-contiguous CA is TBD
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD
- How to apply Multi-band relaxation into UL CA test cases is FFS

6.5A.1.1.1 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 on each component carrier is set to a minimum value.

6.5A.1.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 2UL CA.

6.5A.1.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.1.0.

6.5A.1.1.4 Test description

6.5A.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.1-1. All of these configurations shall be tested with applicable test parameters for each CA configuration, and 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: Test Configuration Table

FFS

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure [TBD] for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] clause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex G.0, G.1 and G.3.0.
4. The UL Reference Measurement Channel is 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 [10] 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.3.0 for all downlink physical channels.
2. The SS shall configure SCC as per TS 38.508-1 [10] clause [TBD]. 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 [TBD], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], clause 9.2).
4. Set the UE in the Tx beam peak direction found with a TX beam peak direction search as performed in Annex K.
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 6.5A.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.
6. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 ms for the UE to reach maximum output power.
7. Measure the EIRP spectrum distribution over all component carriers within two times or more frequency range over the requirement for Occupied Bandwidth for CA specification centring on the current carrier frequency. The characteristics of the filter shall be approximately Gaussian (typical spectrum analyser filter). The measuring duration is one active uplink subframe. EIRP is captured from both polarizations, theta and phi.
8. Calculate the total EIRP from both polarizations, theta and phi, within the range of all frequencies measured in step 4 and save this value as “Total EIRP”. EIRP measurement procedure is defined in Annex K.
9. Identify the measurement window whose centre is aligned on the centre of the channel for which the sum of the power measured in theta and phi polarization is 99% of the “Total EIRP”.
10. The “Occupied Bandwidth” is the width of the measurement window obtained in step 9.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

6.5A.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5A.1.1.5 Test requirement

The measured Occupied Bandwidth shall not exceed the aggregated channel bandwidth defined in subclause 5.5A.

6.5A.1.2 Occupied bandwidth for CA (3UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS
- Applicability of Beam peak of single UL is FFS
- Test procedure for intra-band non-contiguous CA is TBD
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD
- How to apply Multi-band relaxation into UL CA test cases is FFS

6.5A.1.2.1 Test purpose

To verify that the UE occupied bandwidth for all transmission bandwidth configurations supported by the UE are less than their specific limits.

6.5A.1.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA.

6.5A.1.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.1.0.

6.5A.1.2.4 Test description

6.5A.1.2.4.1 Initial condition

Same as in clause 6.5A.1.1.4 with following exceptions:

- Instead of Table 6.5A.1.1.4.1-1→ use Table 6.5A.1.2.4.1-1.
- Instead of clause 6.5A.1.1.4.3→ use clause 6.5A.1.2.4.3.

Table 6.5A.1.2.4.1-1: Test Configuration Table

FFS

6.5A.1.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5A.1.2.5 Test requirement

The measured Occupied Bandwidth shall not exceed the aggregated channel bandwidth defined in subclause 5.5A.

6.5A.1.3 Occupied bandwidth for CA (4UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS
- Applicability of Beam peak of single UL is FFS
- Test procedure for intra-band non-contiguous CA is TBD
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD
- How to apply Multi-band relaxation into UL CA test cases is FFS

6.5A.1.3.1 Test purpose

To verify that the UE occupied bandwidth for all transmission bandwidth configurations supported by the UE are less than their specific limits.

6.5A.1.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA.

6.5A.1.3.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.1.0.

6.5A.1.3.4 Test description

6.5A.1.3.4.1 Initial condition

Same as in clause 6.5A.1.1.4 with following exceptions:

- Instead of Table 6.5A.1.1.4.1-1→ use Table 6.5A.1.3.4.1-1.
- Instead of clause 6.5A.1.1.4.3→ use clause 6.5A.1.3.4.3.

Table 6.5A.1.3.4.1-1: Test Configuration Table

FFS

6.5A.1.3.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5A.1.3.5 Test requirement

The measured Occupied Bandwidth shall not exceed the aggregated channel bandwidth defined in subclause 5.5A.

6.5A.1.4 Occupied bandwidth for CA (5UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS
- Applicability of Beam peak of single UL is FFS
- Test procedure for intra-band non-contiguous CA is TBD
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD
- How to apply Multi-band relaxation into UL CA test cases is FFS

6.5A.1.4.1 Test purpose

To verify that the UE occupied bandwidth for all transmission bandwidth configurations supported by the UE are less than their specific limits.

6.5A.1.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 5UL CA.

6.5A.1.4.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.1.0.

6.5A.1.4.4 Test description

6.5A.1.4.4.1 Initial condition

Same as in clause 6.5A.1.1.4 with following exceptions:

- Instead of Table 6.5A.1.1.4.1-1→ use Table 6.5A.1.4.4.1-1.
- Instead of clause 6.5A.1.1.4.3→ use clause 6.5A.1.4.4.3.

Table 6.5A.1.4.4.1-1: Test Configuration Table

FFS

6.5A.1.4.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5A.1.4.5 Test requirement

The measured Occupied Bandwidth shall not exceed the aggregated channel bandwidth defined in subclause 5.5A.

6.5A.1.5 Occupied bandwidth for CA (6UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS
- Applicability of Beam peak of single UL is FFS
- Test procedure for intra-band non-contiguous CA is TBD
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD
- How to apply Multi-band relaxation into UL CA test cases is FFS

6.5A.1.5.1 Test purpose

To verify that the UE occupied bandwidth for all transmission bandwidth configurations supported by the UE are less than their specific limits.

6.5A.1.5.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 6UL CA.

6.5A.1.5.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.1.0.

6.5A.1.5.4 Test description

6.5A.1.5.4.1 Initial condition

Same as in clause 6.5A.1.1.4 with following exceptions:

- Instead of Table 6.5A.1.1.4.1-1→ use Table 6.5A.1.5.4.1-1.
- Instead of clause 6.5A.1.1.4.3→ use clause 6.5A.1.5.4.3.

Table 6.5A.1.5.4.1-1: Test Configuration Table

FFS

6.5A.1.5.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5A.1.5.5 Test requirement

The measured Occupied Bandwidth shall not exceed the aggregated channel bandwidth defined in subclause 5.5A.

6.5A.1.6 Occupied bandwidth for CA (7UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS
- Applicability of Beam peak of single UL is FFS
- Test procedure for intra-band non-contiguous CA is TBD
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD
- How to apply Multi-band relaxation into UL CA test cases is FFS

6.5A.1.6.1 Test purpose

To verify that the UE occupied bandwidth for all transmission bandwidth configurations supported by the UE are less than their specific limits.

6.5A.1.6.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 7UL CA.

6.5A.1.6.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.1.0.

6.5A.1.6.4 Test description

6.5A.1.6.4.1 Initial condition

Same as in clause 6.5A.1.1.4 with following exceptions:

- Instead of Table 6.5A.1.1.4.1-1→ use Table 6.5A.1.6.4.1-1.
- Instead of clause 6.5A.1.1.4.3→ use clause 6.5A.1.6.4.3.

Table 6.5A.1.6.4.1-1: Test Configuration Table

FFS

6.5A.1.6.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5A.1.6.5 Test requirement

The measured Occupied Bandwidth shall not exceed the aggregated channel bandwidth defined in subclause 5.5A.

6.5A.1.7 Occupied bandwidth for CA (8UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS
- Applicability of Beam peak of single UL is FFS
- Test procedure for intra-band non-contiguous CA is TBD
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD
- How to apply Multi-band relaxation into UL CA test cases is FFS

6.5A.1.7.1 Test purpose

To verify that the UE occupied bandwidth for all transmission bandwidth configurations supported by the UE are less than their specific limits.

6.5A.1.7.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 8UL CA.

6.5A.1.7.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.1.0.

6.5A.1.7.4 Test description

6.5A.1.7.4.1 Initial condition

Same as in clause 6.5A.1.1.4 with following exceptions:

- Instead of Table 6.5A.1.1.4.1-1→ use Table 6.5A.1.7.4.1-1.
- Instead of clause 6.5A.1.1.4.3→ use clause 6.5A.1.7.4.3.

Table 6.5A.1.7.4.1-1: Test Configuration Table

FFS

6.5A.1.7.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5A.1.7.5 Test requirement

The measured Occupied Bandwidth shall not exceed the aggregated channel bandwidth defined in subclause 5.5A.

6.5A.2 Out of band emission for CA

6.5A.2.1 Spectrum Emission Mask for CA

6.5A.2.1.0 Minimum conformance requirements

The requirement specified in this section shall apply if the UE has at least one of UL or DL configured for CA or if the UE is configured for single CC operation with different channel bandwidths in UL and DL carriers.

For intra-band contiguous carrier aggregation, the spectrum emission mask of the UE applies to frequencies (Δf_{OOB}) starting from the ± edge of the aggregated channel bandwidth (Table 5.3A.5-1). For any bandwidth class defined in Table 5.3A.5-1, the UE emission shall not exceed the levels specified in Table 6.5A.2.1.0-1. The requirement is verified in beam locked mode with the test metric of TRP (Link=TX beam peak direction).

Table 6.5A.2.1.0-1: General NR spectrum emission mask for intra-band contiguous CA in frequency range 2

Δf_{OOB} (MHz)	Any carrier aggregation bandwidth class	Measurement bandwidth
± 0-0.1*$BW_{Channel\_CA}$	-5	1 MHz
± 0.1*$BW_{Channel\_CA}$ -2*$BW_{Channel\_CA}$	-13	1 MHz
NOTE 1: If carrier leakage or I/Q image lands inside the spectrum occupied by the configured UL and DL CCs, exception to the general spectrum emission mask limit applies. For carrier leakage the requirements specified in section 6.4A.2.2.0 shall apply. For I/Q image the requirements specified in section 6.4A.2.3.0 shall apply.		

6.5A.2.1.1 Spectrum Emission Mask for CA (2UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.1.1.1 Test purpose

To verify that the power of any UE emission shall not exceed specified lever for the specified channel bandwidth.

6.5A.2.1.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 2UL CA.

6.5A.2.1.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.1.0.

6.5A.2.1.1.4 Test description

6.5A.2.1.1.4.1 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, and channel bandwidths based on NR operating bands specified in table 5.5A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and subcarrier spacing, are shown in table 6.5A.2.1.1.4.1-1. 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.2.1.1.4.1-1: Test Configuration Table [TBD]

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure [TBD] for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.2 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.
4. The UL Reference Measurement channels are set according to Table 6.5A.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 [10] clause 4.5. Message contents are defined in clause 6.5A.2.1.1.4.3

6.5A.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 [10] clause [TBD]. Message contents are defined in clause 6.5A.2.1.1.4.3.
3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [x], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], clause 9.3).
4. Set the UE in the Tx beam peak direction found with a TX beam peak direction search as performed in Annex K.
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 6.5A.2.1.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
6. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 ms for the UE to reach maximum output power.

7. Measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Table 6.5A.2.1.1.5-1 for Min peak EIRP requirement. EIRP measurement procedure is defined in Annex K. The period of the measurement shall be at least 1 msec over consecutive active uplink slots. EIRP is captured from both polarizations, theta and phi.

8. Measure the TRP of the transmitted signal with a measurement filter of bandwidths according to table 6.5.2.1.1.5-1. The centre frequency of the filter shall be stepped in continuous steps according to the same table. TRP shall be recorded for each step. The measurement period shall capture the active time slots. Total radiated power is measured according to TRP measurement procedure defined in Annex K. The measurement grid used for TRP measurement defined in Annex M. TRP is calculated considering both polarizations, theta and phi.

NOTE 1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.5A.2.1.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [10] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

6.5A.2.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5A.2.1.1.5 Test Requirements

The measured EIRP derived in step 7, shall fulfil requirements in Table 6.2A.2.1.1.5-1 for Min peak EIRP requirement as appropriate, and the power (TRP) of any UE emission shall fulfil requirements in Table.6.5A.2.1.1.5-1.

Table 6.5A.2.1.1.5-1: General NR spectrum emission mask for intra-band contiguous CA in frequency range 2

Δf_{OOB} (MHz)	Any carrier aggregation bandwidth class	Measurement bandwidth
± 0-0.1*$BW_{Channel\_CA}$	-5 + TT	1 MHz
± 0.1*$BW_{Channel\_CA}$ -2*$BW_{Channel\_CA}$	-13 + TT	1 MHz
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.1.1.5-1a NOTE 2: If carrier leakage or I/Q image lands inside the spectrum occupied by the configured UL and DL CCs, exception to the general spectrum emission mask limit applies. For carrier leakage the requirements specified in section 6.4A.2.2.0 shall apply. For I/Q image the requirements specified in section 6.4A.2.3.0 shall apply.		

Table 6.5A.2.1.1.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	3.21 dB	TBD

6.5A.2.1.2 Spectrum Emission Mask for CA (3UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.1.2.1 Test purpose

To verify that the power of any UE emission shall not exceed specified lever for the specified channel bandwidth.

6.5A.2.1.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA.

6.5A.2.1.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.1.0.

6.5A.2.1.2.4 Test description

Same as in clause 6.5A.2.1.1.4 with following exceptions:

- Instead of Table 6.5A.2.1.1.4.1-1→ use Table 6.5A.2.1.2.4.1-1.
- Instead of clause 6.5A.2.1.1.4.3→ use clause 6.5A.2.1.2.4.3.
- Instead of Table 6.5A.2.1.1.5-1→ use Table 6.5A.2.1.2.5-1.

Table 6.5A.2.1.2.4.1-1: Test Configuration Table [TBD]

6.5A.2.1.2.5 Test Requirements

The measured EIRP derived in step 7, shall fulfil requirements in Table 6.2A.2.1.1.5-1 for Min peak EIRP requirement as appropriate, and the power (TRP) of any UE emission shall fulfil requirements in Table.6.5A.2.1.2.5-1.

Table 6.5A.2.1.2.5-1: General NR spectrum emission mask for intra-band contiguous CA in frequency range 2

Δf_{OOB} (MHz)	Any carrier aggregation bandwidth class	Measurement bandwidth
$\pm$ 0-0.1*$BW_{Channel\_CA}$	-5 + TT	1 MHz
$\pm$ 0.1*$BW_{Channel\_CA}$ -2*$BW_{Channel\_CA}$	-13 + TT	1 MHz
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.1.2.5-1a NOTE 2: If carrier leakage or I/Q image lands inside the spectrum occupied by the configured UL and DL CCs, exception to the general spectrum emission mask limit applies. For carrier leakage the requirements specified in section 6.4A.2.2.0 shall apply. For I/Q image the requirements specified in section 6.4A.2.3.0 shall apply.		

Table 6.5A.2.1.2.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	3.21 dB	TBD

6.5A.2.1.3 Spectrum Emission Mask for CA (4UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.

- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.1.3.1 Test purpose

To verify that the power of any UE emission shall not exceed specified lever for the specified channel bandwidth.

6.5A.2.1.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA.

6.5A.2.1.3.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.1.0.

6.5A.2.1.3.4 Test description

Same as in clause 6.5A.2.1.1.4 with following exceptions:

- Instead of Table 6.5A.2.1.1.4.1-1→ use Table 6.5A.2.1.3.4.1-1.
- Instead of clause 6.5A.2.1.1.4.3→ use clause 6.5A.2.1.3.4.3.
- Instead of Table 6.5A.2.1.1.5-1→ use Table 6.5A.2.1.3.5-1.

Table 6.5A.2.1.3.4.1-1: Test Configuration Table

FFS

6.5A.2.1.3.5 Test Requirements

The measured EIRP derived in step 7, shall fulfil requirements in Table 6.2A.2.1.1.5-1 for Min peak EIRP requirement as appropriate, and the power (TRP) of any UE emission shall fulfil requirements in Table.6.5A.2.1.3.5-1.

Table 6.5A.2.1.3.5-1: General NR spectrum emission mask for intra-band contiguous CA in frequency range 2

Δf_{OOB} (MHz)	Any carrier aggregation bandwidth class	Measurement bandwidth
± 0-0.1*$BW_{Channel\_CA}$	-5 + TT	1 MHz
± 0.1*$BW_{Channel\_CA}$ -2*$BW_{Channel\_CA}$	-13 + TT	1 MHz
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.1.3.5-1a NOTE 2: If carrier leakage or I/Q image lands inside the spectrum occupied by the configured UL and DL CCs, exception to the general spectrum emission mask limit applies. For carrier leakage the requirements specified in section 6.4A.2.2.0 shall apply. For I/Q image the requirements specified in section 6.4A.2.3.0 shall apply.		

Table 6.5A.2.1.3.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	3.21 dB	TBD

6.5A.2.1.4 Spectrum Emission Mask for CA (5UL CA)

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

- Test configuration table is TBD

- Connection diagram is TBD
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.1.4.1 Test purpose

To verify that the power of any UE emission shall not exceed specified lever for the specified channel bandwidth.

6.5A.2.1.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 5UL CA.

6.5A.2.1.4.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.1.0.

6.5A.2.1.4.4 Test description

Same as in clause 6.5A.2.1.1.4 with following exceptions:

- Instead of Table 6.5A.2.1.1.4.1-1→ use Table 6.5A.2.1.4.4.1-1.
- Instead of clause 6.5A.2.1.1.4.3→ use clause 6.5A.2.1.4.4.3.
- Instead of Table 6.5A.2.1.1.5-1→ use Table 6.5A.2.1.4.5-1.

Table 6.5A.2.1.4.4.1-1: Test Configuration Table

FFS

6.5A.2.1.4.5 Test Requirements

The measured EIRP derived in step 7, shall fulfil requirements in Table 6.2A.2.1.1.5-1 for Min peak EIRP requirement as appropriate, and the power (TRP) of any UE emission shall fulfil requirements in Table.6.5A.2.1.4.5-1.

Table 6.5A.2.1.4.5-1: General NR spectrum emission mask for intra-band contiguous CA in frequency range 2

Δf_{OOB} (MHz)	Any carrier aggregation bandwidth class	Measurement bandwidth
$\pm$ 0-0.1*$BW_{Channel\_CA}$	-5 + TT	1 MHz
$\pm$ 0.1*$BW_{Channel\_CA}$ -2*$BW_{Channel\_CA}$	-13 + TT	1 MHz
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.1.4.5-1a NOTE 2: If carrier leakage or I/Q image lands inside the spectrum occupied by the configured UL and DL CCs, exception to the general spectrum emission mask limit applies. For carrier leakage the requirements specified in section 6.4A.2.2.0 shall apply. For I/Q image the requirements specified in section 6.4A.2.3.0 shall apply.		

Table 6.5A.2.1.4.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	3.21 dB	TBD

6.5A.2.1.5 Spectrum Emission Mask for CA (6UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.1.5.1 Test purpose

To verify that the power of any UE emission shall not exceed specified lever for the specified channel bandwidth.

6.5A.2.1.5.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 6UL CA.

6.5A.2.1.5.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.1.0.

6.5A.2.1.5.4 Test description

Same as in clause 6.5A.2.1.1.4 with following exceptions:

- Instead of Table 6.5A.2.1.1.4.1-1→ use Table 6.5A.2.1.5.4.1-1.
- Instead of clause 6.5A.2.1.1.4.3→ use clause 6.5A.2.1.5.4.3.
- Instead of Table 6.5A.2.1.1.5-1→ use Table 6.5A.2.1.5.5-1.

Table 6.5A.2.1.5.4.1-1: Test Configuration Table

FFS

6.5A.2.1.5.5 Test Requirements

The measured EIRP derived in step 7, shall fulfil requirements in Table 6.2A.2.1.1.5-1 for Min peak EIRP requirement as appropriate, and the power (TRP) of any UE emission shall fulfil requirements in Table.6.5A.2.1.5.5-1.

Table 6.5A.2.1.5.5-1: General NR spectrum emission mask for intra-band contiguous CA in frequency range 2

Δf_{OOB} (MHz)	Any carrier aggregation bandwidth class	Measurement bandwidth
± 0-0.1*$BW_{Channel\_CA}$	-5 + TT	1 MHz
± 0.1*$BW_{Channel\_CA}$ -2*$BW_{Channel\_CA}$	-13 + TT	1 MHz
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.1.5.5-1a NOTE 2: If carrier leakage or I/Q image lands inside the spectrum occupied by the configured UL and DL CCs, exception to the general spectrum emission mask limit applies. For carrier leakage the requirements specified in section 6.4A.2.2.0 shall apply. For I/Q image the requirements specified in section 6.4A.2.3.0 shall apply.		

Table 6.5A.2.1.5.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	3.21 dB	TBD

6.5A.2.1.6 Spectrum Emission Mask for CA (7UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.1.6.1 Test purpose

To verify that the power of any UE emission shall not exceed specified lever for the specified channel bandwidth.

6.5A.2.1.6.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 7UL CA.

6.5A.2.1.6.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.1.0.

6.5A.2.1.6.4 Test description

Same as in clause 6.5A.2.1.1.4 with following exceptions:

- Instead of Table 6.5A.2.1.1.4.1-1→ use Table 6.5A.2.1.6.4.1-1.
- Instead of clause 6.5A.2.1.1.4.3→ use clause 6.5A.2.1.6.4.3.
- Instead of Table 6.5A.2.1.1.5-1→ use Table 6.5A.2.1.6.5-1.

Table 6.5A.2.1.6.4.1-1: Test Configuration Table

FFS

6.5A.2.1.6.5 Test Requirements

The measured EIRP derived in step 7, shall fulfil requirements in Table 6.2A.2.1.1.5-1 for Min peak EIRP requirement as appropriate, and the power (TRP) of any UE emission shall fulfil requirements in Table.6.5A.2.1.6.5-1.

Table 6.5A.2.1.6.5-1: General NR spectrum emission mask for intra-band contiguous CA in frequency range 2

Δf_{OOB} (MHz)	Any carrier aggregation bandwidth class	Measurement bandwidth
± 0-0.1*$BW_{Channel\_CA}$	-5 + TT	1 MHz
± 0.1*$BW_{Channel\_CA}$ -2*$BW_{Channel\_CA}$	-13 + TT	1 MHz
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.1.6.5-1a NOTE 2: If carrier leakage or I/Q image lands inside the spectrum occupied by the configured UL and DL CCs, exception to the general spectrum emission mask limit applies. For carrier leakage the requirements specified in section 6.4A.2.2.0 shall apply. For I/Q image the requirements specified in section 6.4A.2.3.0 shall apply.		

Table 6.5A.2.1.6.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	3.21 dB	TBD

6.5A.2.1.7 Spectrum Emission Mask for CA (8UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band contiguous CA supporting aggregated BW > 400MHz is TBD.
- Measurement Uncertainties and Test Tolerances for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.1.7.1 Test purpose

To verify that the power of any UE emission shall not exceed specified lever for the specified channel bandwidth.

6.5A.2.1.7.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 8UL CA.

6.5A.2.1.7.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.1.0.

6.5A.2.1.7.4 Test description

Same as in clause 6.5A.2.1.1.4 with following exceptions:

- Instead of Table 6.5A.2.1.1.4.1-1→ use Table 6.5A.2.1.7.4.1-1.
- Instead of clause 6.5A.2.1.1.4.3→ use clause 6.5A.2.1.7.4.3.
- Instead of Table 6.5A.2.1.1.5-1→ use Table 6.5A.2.1.7.5-1.

Table 6.5A.2.1.7.4.1-1: Test Configuration Table

FFS

6.5A.2.1.7.5 Test Requirements

The measured EIRP derived in step 7, shall fulfil requirements in Table 6.2A.2.1.1.5-1 for Min peak EIRP requirement as appropriate, and the power (TRP) of any UE emission shall fulfil requirements in Table.6.5A.2.1.7.5-1.

Table 6.5A.2.1.7.5-1: General NR spectrum emission mask for intra-band contiguous CA in frequency range 2

Δf_{OOB} (MHz)	Any carrier aggregation bandwidth class	Measurement bandwidth
± 0-0.1*$BW_{Channel\_CA}$	-5 + TT	1 MHz
± 0.1*$BW_{Channel\_CA}$ -2*$BW_{Channel\_CA}$	-13 + TT	1 MHz
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.1.7.5-1a NOTE 2: If carrier leakage or I/Q image lands inside the spectrum occupied by the configured UL and DL CCs, exception to the general spectrum emission mask limit applies. For carrier leakage the requirements specified in section 6.4A.2.2.0 shall apply. For I/Q image the requirements specified in section 6.4A.2.3.0 shall apply.		

Table 6.5A.2.1.7.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	3.21 dB	TBD

6.5A.2.2 Adjacent channel leakage ratio for CA

6.5A.2.2.0 Minimum conformance requirements

For intra-band contiguous carrier aggregation, the carrier aggregation NR adjacent channel leakage power ratio (CA NR_{ACLR}) is the ratio of the filtered mean power centred on the aggregated channel bandwidth to the filtered mean power centred on an adjacent aggregated channel bandwidth at nominal channel spacing. The assigned aggregated channel bandwidth power and adjacent aggregated channel bandwidth power are measured with rectangular filters with measurement bandwidths specified in 6.5A.2.2.0-1. If the measured adjacent channel power is greater than -35 dBm then the NR_{ACLR} shall be higher than the value specified in Table 6.5A.2.2.0-1.

Table 6.5A.2.2.0-1: General requirements for CA NR_{ACLR}

	CA bandwidth class / CA NR_{ACLR} / Measurement bandwidth
	Any CA bandwidth class
CA NR_{ACLR} for band n257, n258, n261	17 dB
CA NR_{ACLR} for band n260	16 dB
NR channel measurement bandwidth[1]	$BW_{Channel\_CA}$ – $GB_{Channel(1)}$ - $GB_{Channel(2)}$
NOTE 1: The $GB_{Channel(i)}$ is the minimum guard band of the component carriers at the lower edge $F_{edge, low}$ and the upper edge $F_{edge,high}$ of the sub-block respectively.	

6.5A.2.2.1 Adjacent channel leakage ratio for CA (2UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Measurement Uncertainties and Test Tolerances are TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.2.1.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5A.2.2.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 2UL CA.

6.5A.2.2.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.2.0.

6.5A.2.2.1.4 Test description

6.5A.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, and channel bandwidths based on NR operating bands specified in table 5.5A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and subcarrier spacing, 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: Test Configuration Table

FFS

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure [TBD] for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.2 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and 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 [10] 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 [10] 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 [x], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], clause 9.3).
4. Set the UE in the Tx beam peak direction found with a TX beam peak direction search as performed in Annex K.
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 6.5A.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.
6. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 ms for the UE to reach maximum output power.
7. Measure TRP of the transmitted signal for the assigned NR channel with a rectangular measurement filter with bandwidths according to Table 6.5A.2.2.1.5-1. Total radiated power is measured according to TRP measurement procedure defined in Annex K and measurement grid specified in Annex M. TRP is calculated considering both polarizations, theta and phi.
8. Measure TRP of the first NR adjacent channel on both lower and upper side of the assigned NR channel, respectively using a rectangular measurement filter with bandwidths according to Table 6.5A.2.2.1.5-1. Total radiated power is measured according to TRP measurement procedure defined in Annex K. The measurement grid used for TRP measurement defined in Annex M. TRP is calculated considering both polarizations, theta and phi.
9. Calculate the ratios of the power between the values measured in step 7 over step 8 for lower and upper NR ACLR, respectively.

NOTE 1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.5A.2.2.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [10] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

6.5A.2.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5A.2.2.1.5 Test Requirements

If the measured adjacent channel power, derived in step 8, is greater than -35 dBm then the measured NR ACLR, derived in step 9, shall be higher than the limits in table 6.5A.2.2.1.5-1.

Table 6.5A.2.2.1.5-1: General requirements for CA NR_{ACLR}

	CA bandwidth class / CA NR_{ACLR} / Measurement bandwidth
	Any CA bandwidth class
CA NR_{ACLR} for band n257, n258, n261	17 - TT dB
CA NR_{ACLR} for band n260	16 - TT dB
NR channel measurement bandwidth[1]	$BW_{Channel\_CA}$ – $GB_{Channel(1)}$ - $GB_{Channel(2)}$
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.2.1.5-1a. NOTE 2: The $GB_{Channel(i)}$ is the minimum guard band of the component carriers at the lower edge $F_{edge, low}$ and the upper edge $F_{edge,high}$ of the sub-block respectively.	

Table 6.5A.2.2.1.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	[4.6] dB	[5.0] dB

6.5A.2.2.2 Adjacent channel leakage ratio for CA (3UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Measurement Uncertainties and Test Tolerances are TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.2.2.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5A.2.2.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA.

6.5A.2.2.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.2.0.

6.5A.2.2.2.4 Test description

Same as in clause 6.5A.2.2.1.4 with following exceptions:

- Instead of Table 6.5A.2.2.1.4.1-1→ use Table 6.5A.2.2.2.4.1-1.
- Instead of clause 6.5A.2.2.1.4.3→ use clause 6.5A.2.2.2.4.3.
- Instead of Table 6.5A.2.2.1.5-1→ use Table 6.5A.2.2.2.5-1.

Table 6.5A.2.2.2.4.1-1: Test Configuration Table

FFS

6.5A.2.2.2.5 Test Requirements

If the measured adjacent channel power, derived in step 8, is greater than -35 dBm then the measured NR ACLR, derived in step 9, shall be higher than the limits in table 6.5A.2.2.2.5-1.

Table 6.5A.2.2.2.5-1: General requirements for CA NR_{ACLR}

	CA bandwidth class / CA NR_{ACLR} / Measurement bandwidth
	Any CA bandwidth class
CA NR_{ACLR} for band n257, n258, n261	17 - TT dB
CA NR_{ACLR} for band n260	16 - TT dB
NR channel measurement bandwidth[1]	$BW_{Channel\_CA}$ – $GB_{Channel(1)}$ - $GB_{Channel(2)}$
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.2.2.5-1a. NOTE 2: The $GB_{Channel(i)}$ is the minimum guard band of the component carriers at the lower edge $F_{edge, low}$ and the upper edge $F_{edge,high}$ of the sub-block respectively.	

Table 6.5A.2.2.2.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	[4.6] dB	[5.0] dB

6.5A.2.2.3 Adjacent channel leakage ratio for CA (4UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Measurement Uncertainties and Test Tolerances are TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.2.3.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5A.2.2.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA.

6.5A.2.2.3.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.2.0.

6.5A.2.2.3.4 Test description

Same as in clause 6.5A.2.2.1.4 with following exceptions:

- Instead of Table 6.5A.2.2.1.4.1-1→ use Table 6.5A.2.2.3.4.1-1.
- Instead of clause 6.5A.2.2.1.4.3→ use clause 6.5A.2.2.3.4.3.
- Instead of Table 6.5A.2.2.1.5-1→ use Table 6.5A.2.2.3.5-1.

Table 6.5A.2.2.3.4.1-1: Test Configuration Table

FFS

6.5A.2.2.3.5 Test Requirements

If the measured adjacent channel power, derived in step 8, is greater than -35 dBm then the measured NR ACLR, derived in step 9, shall be higher than the limits in table 6.5A.2.2.3.5-1.

Table 6.5A.2.2.3.5-1: General requirements for CA NR_{ACLR}

	CA bandwidth class / CA NR_{ACLR} / Measurement bandwidth
	Any CA bandwidth class
CA NR_{ACLR} for band n257, n258, n261	17 - TT dB
CA NR_{ACLR} for band n260	16 - TT dB
NR channel measurement bandwidth[1]	$BW_{Channel\_CA}$ – $GB_{Channel(1)}$ - $GB_{Channel(2)}$
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.2.3.5-1a. NOTE 2: The $GB_{Channel(i)}$ is the minimum guard band of the component carriers at the lower edge $F_{edge, low}$ and the upper edge $F_{edge,high}$ of the sub-block respectively.	

Table 6.5A.2.2.3.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	[4.6] dB	[5.0] dB

6.5A.2.2.4 Adjacent channel leakage ratio for CA (5UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Measurement Uncertainties and Test Tolerances are TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.2.4.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5A.2.2.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 5UL CA.

6.5A.2.2.4.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.2.0.

6.5A.2.2.4.4 Test description

Same as in clause 6.5A.2.2.1.4 with following exceptions:

- Instead of Table 6.5A.2.2.1.4.1-1→ use Table 6.5A.2.2.4.4.1-1.
- Instead of clause 6.5A.2.2.1.4.3→ use clause 6.5A.2.2.4.4.3.
- Instead of Table 6.5A.2.2.1.5-1→ use Table 6.5A.2.2.4.5-1.

Table 6.5A.2.2.4.4.1-1: Test Configuration Table

FFS

6.5A.2.2.4.5 Test Requirements

If the measured adjacent channel power, derived in step 8, is greater than -35 dBm then the measured NR ACLR, derived in step 9, shall be higher than the limits in table 6.5A.2.2.4.5-1.

Table 6.5A.2.2.4.5-1: General requirements for CA NR_{ACLR}

	CA bandwidth class / CA NR_{ACLR} / Measurement bandwidth
	Any CA bandwidth class
CA NR_{ACLR} for band n257, n258, n261	17 - TT dB
CA NR_{ACLR} for band n260	16 - TT dB
NR channel measurement bandwidth[1]	$BW_{Channel\_CA} - GB_{Channel(1)} - GB_{Channel(2)}$
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.2.4.5-1a. NOTE 2: The $GB_{Channel(i)}$ is the minimum guard band of the component carriers at the lower edge $F_{edge, low}$ and the upper edge $F_{edge,high}$ of the sub-block respectively.	

Table 6.5A.2.2.4.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	[4.6] dB	[5.0] dB

6.5A.2.2.5 Adjacent channel leakage ratio for CA (6UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Measurement Uncertainties and Test Tolerances are TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.2.5.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5A.2.2.5.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 6UL CA.

6.5A.2.2.5.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.2.0.

6.5A.2.2.5.4 Test description

Same as in clause 6.5A.2.2.1.4 with following exceptions:

- Instead of Table 6.5A.2.2.1.4.1-1→ use Table 6.5A.2.2.5.4.1-1.

- Instead of clause 6.5A.2.2.1.4.3→ use clause 6.5A.2.2.5.4.3.
- Instead of Table 6.5A.2.2.1.5-1→ use Table 6.5A.2.2.5.5-1.

Table 6.5A.2.2.5.4.1-1: Test Configuration Table

FFS

6.5A.2.2.5.5 Test Requirements

If the measured adjacent channel power, derived in step 8, is greater than -35 dBm then the measured NR ACLR, derived in step 9, shall be higher than the limits in table 6.5A.2.2.5.5-1.

Table 6.5A.2.2.5.5-1: General requirements for CA NR_{ACLR}

	CA bandwidth class / CA NR_{ACLR} / Measurement bandwidth
	Any CA bandwidth class
CA NR_{ACLR} for band n257, n258, n261	17 - TT dB
CA NR_{ACLR} for band n260	16 - TT dB
NR channel measurement bandwidth[1]	$BW_{Channel\_CA} - GB_{Channel(1)} - GB_{Channel(2)}$
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.2.5.5-1a. NOTE 2: The $GB_{Channel(i)}$ is the minimum guard band of the component carriers at the lower edge $F_{edge, low}$ and the upper edge $F_{edge,high}$ of the sub-block respectively.	

Table 6.5A.2.2.5.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	[4.6] dB	[5.0] dB

6.5A.2.2.6 Adjacent channel leakage ratio for CA (7UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Measurement Uncertainties and Test Tolerances are TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.2.6.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5A.2.2.6.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 7UL CA.

6.5A.2.2.6.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.2.0.

6.5A.2.2.6.4 Test description

Same as in clause 6.5A.2.2.1.4 with following exceptions:

- Instead of Table 6.5A.2.2.1.4.1-1→ use Table 6.5A.2.2.6.4.1-1.
- Instead of clause 6.5A.2.2.1.4.3→ use clause 6.5A.2.2.6.4.3.
- Instead of Table 6.5A.2.2.1.5-1→ use Table 6.5A.2.2.6.5-1.

Table 6.5A.2.2.6.4.1-1: Test Configuration Table

FFS

6.5A.2.2.6.5 Test Requirements

If the measured adjacent channel power, derived in step 8, is greater than -35 dBm then the measured NR ACLR, derived in step 9, shall be higher than the limits in table 6.5A.2.2.6.5-1.

Table 6.5A.2.2.6.5-1: General requirements for CA NR_{ACLR}

	CA bandwidth class / CA NR_{ACLR} / Measurement bandwidth
	Any CA bandwidth class
CA NR_{ACLR} for band n257, n258, n261	17 - TT dB
CA NR_{ACLR} for band n260	16 - TT dB
NR channel measurement bandwidth[1]	$BW_{Channel\_CA}$ – $GB_{Channel(1)}$ - $GB_{Channel(2)}$
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.2.6.5-1a. NOTE 2: The $GB_{Channel(i)}$ is the minimum guard band of the component carriers at the lower edge $F_{edge, low}$ and the upper edge $F_{edge,high}$ of the sub-block respectively.	

Table 6.5A.2.2.6.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	[4.6] dB	[5.0] dB

6.5A.2.2.7 Adjacent channel leakage ratio for CA (8UL CA)

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

- Test configuration table is TBD
- Connection diagram is TBD
- Measurement Uncertainties and Test Tolerances are TBD.
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.
- Test procedure for intra-band non-contiguous CA is TBD.
- How to apply Multi-band relaxation into UL CA test cases is FFS.

6.5A.2.2.7.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5A.2.2.7.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 8UL CA.

6.5A.2.2.7.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.2.2.0.

6.5A.2.2.7.4 Test description

Same as in clause 6.5A.2.2.1.4 with following exceptions:

- Instead of Table 6.5A.2.2.1.4.1-1→ use Table 6.5A.2.2.7.4.1-1.
- Instead of clause 6.5A.2.2.1.4.3→ use clause 6.5A.2.2.7.4.3.
- Instead of Table 6.5A.2.2.1.5-1→ use Table 6.5A.2.2.7.5-1.

Table 6.5A.2.2.7.4.1-1: Test Configuration Table

FFS

6.5A.2.2.7.5 Test Requirements

If the measured adjacent channel power, derived in step 8, is greater than -35 dBm then the measured NR ACLR, derived in step 9, shall be higher than the limits in table 6.5A.2.2.7.5-1.

Table 6.5A.2.2.7.5-1: General requirements for CA NR_{ACLR}

	CA bandwidth class / CA NR_{ACLR} / Measurement bandwidth
	Any CA bandwidth class
CA NR_{ACLR} for band n257, n258, n261	17 - TT dB
CA NR_{ACLR} for band n260	16 - TT dB
NR channel measurement bandwidth[1]	$BW_{Channel\_CA}$ – $GB_{Channel(1)}$ - $GB_{Channel(2)}$
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.5A.2.2.7.5-1a. NOTE 2: The $GB_{Channel(i)}$ is the minimum guard band of the component carriers at the lower edge $F_{edge,\ low}$ and the upper edge $F_{edge,high}$ of the sub-block respectively.	

Table 6.5A.2.2.7.5-1a: Test Tolerance (Aggregated BW ≤ 400MHz)

Test Metric	FR2a	FR2b
IFF (Quiet Zone size ≤ 30 cm)	[4.6] dB	[5.0] dB

6.5A.3 Spurious emissions for CA

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

- Testability issue for 6GHz ~ [12.75GHz] is identified. How to treat this frequency range is TBD.
- TRP Measurement Uncertainty for CA is TBD.
- TP analysis for CA is FFS (identify lowest MPR w/form, RB allocation for multiple carrier or PCC only, 1RB location if RB allocated for multiple carrier).
- Beam peak direction for CA is TBD and cannot be assumed to be the same as single carrier.
- Update all CA test config tables to RAN 5 agreed format.

6.5A.3.1 Transmitter Spurious emissions for CA

6.5A.3.1.0 Minimum conformance requirements

This clause specifies the spurious emission requirements for carrier aggregation. The requirement is verified in beam locked mode with the test metric of TRP (Link=TX beam peak direction). The TX beam peak direction used for CA testing is the [same as that found for single carrier scenario in clause 6.5.3].

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.

For intra-band contiguous carrier aggregation, the spurious emission limits apply for the frequency ranges that are more than F_{OOB} (MHz) from the edge of the aggregated channel bandwidth, where F_{OOB} is defined as the twice the aggregated channel bandwidth. For frequencies Δf_{OOB} greater than F_{OOB}, the spurious emission requirements in Table 6.5.3.1.3-2 are applicable. If carrier leakage or I/Q image lands inside the spectrum occupied by the configured UL and DL CCs, exception to the spurious emissions requirement applies. For carrier leakage the requirements specified in section 6.4A.2.2.0 shall apply. For I/Q image the requirements specified in section 6.4A.2.3.0 shall apply.

6.5A.3.1.1 Transmitter 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 FR2 2UL CA.

6.5A.3.1.1.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.3.1.0.

6.5A.3.1.1.4 Test description

6.5A.3.1.1.4.1 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, and channel bandwidths based on NR operating bands specified in table 5.5A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and subcarrier spacing, 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: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, High range (NOTE 2)	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1		Maximum aggregated BW (contiguous CA)	
Test SCS as specified in Table 5.3.5-1		120kHz	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration [per component carrier]**	
	N/A for Spurious Emissions testing	**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 Common UL configuration. NOTE 2: When testing Low range test only in Frequency Range lower than (F_{UL_low} – Δf_{OOB}) and when testing High range test only in Frequency Range higher than (F_{UL_high} + Δf_{OOB}).			

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.2 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and 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 [10] 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. Select any of the three Alignment Options (1, 2, or 3) from Tables J.2-1 through J.2-3 [3] to mount the DUT inside the QZ.
2. If the re-positioning concept is applied, position the device in DUT Orientation 1 if the maximum beam peak direction is within zenith angular range 0º≤θ≤90º for the alignment option selected in step 1; position the device in DUT Orientation 2 (either Options 1 or 2) if the maximum beam peak direction is within zenith angular range 90º<θ≤180º for DUT Orientation 1 for the alignment option selected in step 1. If the re-positioning concept is not applied, position the device in DUT Orientation 1.
3. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.
4. The SS shall configure SCC as per TS 38.508-1 [10] clause 5.5.1. Message contents are defined in clause 6.5A.3.1.1.4.3.
5. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [28], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], clause 9.3).
6. SS sends uplink scheduling information for each UL HARQ process via PDSCH DCI format [0_1] for C_RNTI to schedule the UL RMC according to Table 6.5A.3.1.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
7. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200msec for the UE to reach P_{UMAX}.

8. Set the UE in the Inband Tx beam peak direction [(same as that found for single carrier in clause 6.5.3)] found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 3) for the UE Tx beam selection to complete.

9. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

10. Measure the spurious emissions as per steps outlined below with an exception to the procedure in Annex K if the re-positioning concept is applied (NOTE 4):

    (a) Perform coarse TRP measurements to identify spurious emission frequencies and corresponding power level according to the procedures in Annex L, using coarse TRP measurement grid selection criteria as per Table M.4.5-3 in Annex M. The measurement is completed in both polarizations θ and ϕ over frequency range and measurement bandwidth according to Table 6.5.3.1.3-2. Optionally, a larger and non-constant measurement bandwidth than that of Table 6.5.3.1.3-2 may be applied as long as the SNR (ratio of test limit to floor noise of test equipment) ≥ 10dB is guaranteed. The measurement period shall capture the [active time slots]. For each spurious emission frequency with coarse TRP identified to be less than an offset dB (NOTE 2) from the TRP limit according to Table 6.5.3.1.3-2, continue with fine TRP procedures according to step (b).

    The offset value shall be the TRP measurement uncertainty at 95% confidence level including the effect of coarse grid measurement uncertainty element. Different coarse TRP grids and corresponding offset values may be used for different frequencies. The coarse TRP grid and offset values used shall be recorded in the test report.

    (b) Measure fine TRP measurements according to procedures in Annex K, using fine TRP measurement grid selection criteria as per Table M.4.5-3 in Annex M, for each of the spurious emission frequency identified in step (a). Apply a measurement bandwidth according to Table 6.5.3.1.3-2.

11. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The frequency range defined in Table 6.5.3.1.3-2 may be split into ranges. For each range a different test system, e.g. antenna and/or chamber, may be used. To pass the test case all verdicts of the frequency ranges must pass.

NOTE 2: The coarse TRP measurement grid and corresponding offset dB value referred in step 5(a) above, for some valid grids can be found in TR 38.903 section B.18.

NOTE 3: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

NOTE 4: If the (in-band) beam peak is within 0º≤θ≤90º: perform first hemispherical TRP scan (0º≤θ≤90º) in DUT Orientation 1 and second hemispherical TRP scan (90º>θ≥0º) in DUT Orientation 2. If the (in-band) beam peak is within 90º<θ≤180º: perform first hemispherical TRP scan (0º≤θ≤90º) in DUT Orientation 2 and second hemispherical TRP scan (90º>θ≥0º) in DUT Orientation 1. The DUT with UBF activated needs to be re-positioned during the test.

6.5A.3.1.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

6.5A.3.1.1.5 Test Requirements

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.

The maximum EIRP or TRP power of spurious emission, measured using RMS detector, shall not exceed the described value 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 F_{OOB} (MHz) in Table 6.5.3.1.3-1 starting from the edge of the assigned *NR* channel bandwidth. The spurious emission limits in Table 6.5A.3.1.1.5-1 apply for all transmitter band configurations (NRB) 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 6.5A.3.1.1.5-1: Spurious emissions for CA test requirements

Frequency Range	Maximum Level	Measurement bandwidth	NOTE
6 GHz ≤ f < 12.75 GHz	-30 dBm	1 MHz	
12.75 GHz ≤ f ≤ 2nd harmonic of the upper frequency edge of the UL operating band in GHz	-13 dBm	1 MHz	
NOTE 1: Applies for Band n257, n258, n260			

6.5A.3.1.2 Transmitter Spurious emissions for CA (3UL CA)

6.5A.3.1.2.1 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.3.1.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA.

6.5A.3.1.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.3.1.0.

6.5A.3.1.2.4 Test description

Same test description as in clause 6.5A.3.1.1.4.

6.5A.3.1.2.5 Test Requirements

The test requirement is the same as in clause 6.5A.3.1.1.5.

6.5A.3.1.3 Transmitter Spurious emissions for CA (4UL CA)

6.5A.3.1.3.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions.

6.5A.3.1.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA.

6.5A.3.1.3.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.3.1.0.

6.5A.3.1.3.4 Test description

Same test description as in clause 6.5A.3.1.1.4.

Table 6.5A.3.1.3.4.1-1: Test Configuration Table

[TBD]

6.5A.3.1.3.5 Test Requirements

The test requirement is the same as in clause 6.5A.3.1.1.5.

6.5A.3.1.4 Transmitter spurious emissions for CA (5UL CA)

6.5A.3.1.4.1 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.3.1.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 5UL CA.

6.5A.3.1.4.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.3.1.0.

6.5A.3.1.4.4 Test description

Same test description as in clause 6.5A.3.1.1.4.

6.5A.3.1.4.5 Test Requirements

The test requirement is the same as in clause 6.5A.3.1.1.5

6.5A.3.1.5 Transmitter spurious emissions for CA (6UL CA)

6.5A.3.1.5.1 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.3.1.5.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 6UL CA.

6.5A.3.1.5.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.3.1.0.

6.5A.3.1.5.4 Test description

Same test description as in clause 6.5A.3.1.1.4.

6.5A.3.1.5.5 Test Requirements

The test requirement is the same as in clause 6.5A.3.1.1.5

6.5A.3.1.6 Transmitter spurious emissions for CA (7UL CA)

6.5A.3.1.6.1 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.3.1.6.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 7UL CA.

6.5A.3.1.6.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.3.1.0.

6.5A.3.1.6.4 Test description

Same test description as in clause 6.5A.3.1.1.4.

6.5A.3.1.6.5 Test Requirements

The test requirement is the same as in clause 6.5A.3.1.1.5

6.5A.3.1.7 Transmitter spurious emissions for CA (8UL CA)

6.5A.3.1.7.1 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.3.1.7.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 8UL CA.

6.5A.3.1.7.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.3.1.0.

6.5A.3.1.7.4 Test description

Same test description as in clause 6.5A.3.1.1.4.

6.5A.3.1.7.5 Test Requirements

The test requirement is the same as in clause 6.5A.3.1.1.5

6.5A.3.2 Spurious emission band UE co-existence for CA

This clause specifies the requirements for the specified carrier aggregation configurations for coexistence with protected bands. The requirement is verified in beam locked mode with the test metric of TRP (Link=TX beam peak direction). The TX beam peak direction used for CA testing is the [same as that found for single carrier scenario in clause 6.5.3].

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.

6.5A.3.2.0 Minimum conformance requirements

For intra-band contiguous carrier aggregation, the requirements in Table 6.5A.3.2.0-1 apply.

Table 6.5A.3.2.0-1: Spurious emissions UE co-existence CA limits

UL CA for any CA bandwidth class	Spurious emission						
	Protected band / frequency range	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
CA_n257	NR Band n260	F_{DL_low}	-	F_{DL_high}	-2	100	
	Frequency range	23600	-	24000	TBD	200	2
	Frequency range	57000	-	66000	2	100	
CA_n258	Frequency range	23600	-	24000	TBD	200	2
	Frequency range	57000	-	66000	2	100	
CA_n260	NR Band 257	F_{DL_low}	-	F_{DL_high}	-5	100	
	NR Band 261	F_{DL_low}	-	F_{DL_high}	-5	100	
	Frequency range	23600	-	24000	TBD	200	2
	Frequency range	57000	-	66000	2	100	
CA_n261	NR Band 260	F_{DL_low}	-	F_{DL_high}	-2	100	
	Frequency range	23600	-	24000	TBD	200	2
	Frequency range	57000	-	66000	2	100	
NOTE 1: F_{DL_low} and F_{DL_high} refer to each NR frequency band specified in Table 5.2-1 NOTE 2: The protection of frequency range 23600-2400MHz is meant for protection of satellite passive services.							

6.5A.3.2.1 Spurious emission band 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 when in co-existence with protected bands in terms of transmitter spurious emissions.

6.5A.3.2.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 2UL CA.

6.5A.3.2.1.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 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 Subscriber Station (SS) to take with the UE to reach the correct measurement state.

Table 6.5A.3.2.1.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, High range (NOTE 2)	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1		Maximum aggregated BW (contiguous CA)	
Test SCS as specified in Table 5.3.5-1		120kHz	
Test Parameters			
Test ID	**Downlink Configuration**	**Uplink Configuration [per component carrier]**	
	N/A for Spurious Emissions testing	**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 Common UL configuration. NOTE 2: When testing Low range test only in Frequency Range lower than (F_{UL_low} – Δf_{OOB}) and when testing High range test only in Frequency Range higher than (F_{UL_high} + Δf_{OOB}).			

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex G.0, G.1 and 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 [10] 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. Select any of the three Alignment Options (1, 2, or 3) from Tables J.2-1 through J.2-3 [3] to mount the DUT inside the QZ.
2. If the re-positioning concept is applied, position the device in DUT Orientation 1 if the maximum beam peak direction is within zenith angular range 0º≤θ≤90º for the alignment option selected in step 1; position the device in DUT Orientation 2 (either Options 1 or 2) if the maximum beam peak direction is within zenith angular range 90º<θ≤180º for DUT Orientation 1 for the alignment option selected in step 1. If the re-positioning concept is not applied, position the device in DUT Orientation 1.
3. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.
4. The SS shall configure SCC as per TS 38.508-1 [10] clause 5.5.1. Message contents are defined in clause 6.5A.3.1.1.4.3.
5. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [28], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], clause 9.3).
6. SS sends uplink scheduling information for each UL HARQ process via PDSCH DCI format [0_1] for C_RNTI to schedule the UL RMC according to Table 6.5A.3.1.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
7. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200msec for the UE to reach P_{UMAX}.

8. Set the UE in the Inband Tx beam peak direction [(same as that found for single carrier in clause 6.5.3)] found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 3) for the UE Tx beam selection to complete.

9. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

10. Measure the spurious emissions as per steps outlined below with an exception to the procedure in Annex K if the re-positioning concept is applied (NOTE 4):

   (a) Perform coarse TRP measurements to identify spurious emission frequencies and corresponding power level according to the procedures in Annex L, using coarse TRP measurement grid selection criteria as per Table M.4.5-3 in Annex M. The measurement is completed in both polarizations θ and ϕ over frequency range and measurement bandwidth according to Table 6.5.3.1.3-2. Optionally, a larger and non-constant measurement bandwidth than that of Table 6.5.3.1.3-2 may be applied as long as the SNR (ratio of test limit to floor noise of test equipment) ≥ 10dB is guaranteed. The measurement period shall capture the [active time slots]. For each spurious emission frequency with coarse TRP identified to be less than an offset dB (NOTE 2) from the TRP limit according to Table 6.5.3.1.3-2, continue with fine TRP procedures according to step (b).

   The offset value shall be the TRP measurement uncertainty at 95% confidence level including the effect of coarse grid measurement uncertainty element. Different coarse TRP grids and corresponding offset values may be used for different frequencies. The coarse TRP grid and offset values used shall be recorded in the test report.

   (b) Measure fine TRP measurements according to procedures in Annex K, using fine TRP measurement grid selection criteria as per Table M.4.5-3 in Annex M, for each of the spurious emission frequency identified in step (a). Apply a measurement bandwidth according to Table 6.5.3.1.3-2.

11. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The frequency range defined in Table 6.5.3.1.3-2 may be split into ranges. For each range a different test system, e.g. antenna and/or chamber, may be used. To pass the test case all verdicts of the frequency ranges must pass.

NOTE 2: The coarse TRP measurement grid and corresponding offset dB value referred in step 5(a) above, for some valid grids can be found in TR 38.903 section B.18.

NOTE 3: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

NOTE 4: If the (in-band) beam peak is within 0º≤θ≤90º: perform first hemispherical TRP scan (0º≤θ≤90º) in DUT Orientation 1 and second hemispherical TRP scan (90º>θ≥0º) in DUT Orientation 2. If the (in-band) beam peak is within 90º<θ≤180º: perform first hemispherical TRP scan (0º≤θ≤90º) in DUT Orientation 2 and second hemispherical TRP scan (90º>θ≥0º) in DUT Orientation 1. The DUT with UBF activated needs to be re-positioned during the test.

6.5A.3.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] subclause 4.6.1.

6.5A.3.2.1.5 Test requirement

This clause specifies the requirements for the specified *NR* band for Transmitter Spurious emissions for UE co-existence requirement with frequency range as indicated in Table 6.5A.3.2.1.5-1.

The maximum EIRP or TRP power of spurious emission for UE co-existence, measured using RMS detector, shall not exceed the described value in Table 6.5A.3.2.1.5-1.

The spurious emission UE co-existence limits in Table 6.5A.3.2.1.5-1 apply for all transmitter band configurations (NRB) 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 6.5A.3.2.1.5-1: Spurious emissions UE co-existence CA test requirements

UL CA for any CA bandwidth class	Spurious emission						
	Protected band / frequency range	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
CA_n257	NR Band n260	F_{DL_low}	-	F_{DL_high}	-2	100	
	Frequency range	23600	-	24000	TBD	200	2
	Frequency range	57000	-	66000	2	100	
CA_n258	Frequency range	23600	-	24000	TBD	200	2
	Frequency range	57000	-	66000	2	100	
CA_n260	NR Band 257	F_{DL_low}	-	F_{DL_high}	-5	100	
	NR Band 261	F_{DL_low}	-	F_{DL_high}	-5	100	
	Frequency range	23600	-	24000	TBD	200	2
	Frequency range	57000	-	66000	2	100	
CA_n261	NR Band 260	F_{DL_low}	-	F_{DL_high}	-2	100	
	Frequency range	23600	-	24000	TBD	200	2
	Frequency range	57000	-	66000	2	100	

NOTE 1: F_{DL_low} and F_{DL_high} refer to each NR frequency band specified in Table 5.2-1
NOTE 2: The protection of frequency range 23600-2400MHz is meant for protection of satellite passive services.

6.5A.3.2.2 Spurious emission band UE co-existence for CA (3UL CA)

6.5A.3.2.2.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference when in co-existence with protected bands in terms of transmitter spurious emissions.

6.5A.3.2.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA.

6.5A.3.2.2.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.3.2.0.

6.5A.3.2.2.4 Test description

Same test description as in clause 6.5A.3.2.1.4.

6.5A.3.2.2.5 Test Requirements

The test requirement is the same as in clause 6.5A.3.2.1.5.

6.5A.3.2.3 Spurious emission band UE co-existence for CA (4UL CA)

6.5A.3.2.3.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference when in co-existence with protected bands in terms of transmitter spurious emissions.

6.5A.3.2.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA.

6.5A.3.2.3.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.3.2.0.

6.5A.3.2.3.4 Test description

Same test description as in clause 6.5A.3.2.1.4.

6.5A.3.2.3.5 Test Requirements

The test requirement is the same as in clause 6.5A.3.2.1.5.

6.5A.3.2.4 Spurious emission band UE co-existence for CA (5UL CA)

6.5A.3.2.4.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference when in co-existence with protected bands in terms of transmitter spurious emissions.

6.5A.3.2.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 5UL CA.

6.5A.3.2.4.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.3.2.0.

6.5A.3.2.4.4 Test description

Same test description as in clause 6.5A.3.2.1.4.

6.5A.3.2.4.5 Test Requirements

The test requirement is the same as in clause 6.5A.3.2.1.5.

6.5A.3.2.5 Spurious emission band UE co-existence for CA (6UL CA)

6.5A.3.2.5.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference when in co-existence with protected bands in terms of transmitter spurious emissions.

6.5A.3.2.5.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 6UL CA.

6.5A.3.2.5.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.3.2.0.

6.5A.3.2.5.4 Test description

Same test description as in clause 6.5A.3.2.1.4.

6.5A.3.2.5.5 Test Requirements

The test requirement is the same as in clause 6.5A.3.2.1.5.

6.5A.3.2.6 Spurious emission band UE co-existence for CA (7UL CA)

6.5A.3.2.6.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference when in co-existence with protected bands in terms of transmitter spurious emissions.

6.5A.3.2.6.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 7UL CA.

6.5A.3.2.6.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.3.2.0.

6.5A.3.2.6.4 Test description

Same test description as in clause 6.5A.3.2.1.4.

6.5A.3.2.6.5 Test Requirements

The test requirement is the same as in clause 6.5A.3.2.1.5.

6.5A.3.2.7 Spurious emission band UE co-existence for CA (8UL CA)

6.5A.3.2.7.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference when in co-existence with protected bands in terms of transmitter spurious emissions.

6.5A.3.2.7.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 8UL CA.

6.5A.3.2.7.3 Minimum conformance requirements

The minimum conformance requirements are defined in clause 6.5A.3.2.0.

6.5A.3.2.7.4 Test description

Same test description as in clause 6.5A.3.2.1.4.

6.5A.3.2.7.5 Test Requirements

The test requirement is the same as in clause 6.5A.3.2.1.5.

6.5A.3.3 Additional spurious emissions for CA

6.5A.3.3.0 Minimum conformance requirements

The additional spurious emission for CA limits in Table 6.5A.3.3.0-1 apply for all transmitter band configurations (RB) and channel bandwidths. The requirement is verified in beam locked mode with the test metric of TRP (Link=TX beam peak direction).

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.

When "NS_201" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5A.3.3.0-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3-1 from the edge of the channel bandwidth.

Table 6.5A.3.3.0-1: Additional spurious emissions for CA (NS_201) test limits

Frequency Range	Maximum Level / Channel bandwidth				Measurement bandwidth	NOTE
	50 MHz	100 MHz	200 MHz	400 MHz		
23.6 GHz ≤ f ≤ 24 GHz	-8 dBm	-8 dBm	-8 dBm	-8 dBm	200MHz	1
NOTE 1: The protection of frequency range 23600 - 24000 MHz is meant for protection of satellite passive services.						

The normative reference for this requirement is TS 38.101-2 subclause 6.5A.3.2.

6.5A.3.3.1 Additional spurious emission for CA (2UL CA)

6.5A.3.3.1.1 Test purpose

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.

6.5A.3.3.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 2UL CA.

6.5A.3.3.1.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.5A.3.3.0.

6.5A.3.3.1.4 Test description

6.5A.3.3.1.4.1 Initial conditions

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

Table 6.5A.3.3.1.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, High range (NOTE 2)	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1		Highest	
Test SCS as specified in Table 5.3.5-1		120kHz	
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
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration. NOTE 2: When testing Low range test only in Frequency Range lower than (F_{UL_low} – Δf_{OOB}) and when testing High range test only in Frequency Range higher than (F_{UL_high} + Δf_{OOB}).			

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.0, and uplink signals according to Annex G.0, G.1 and G.3.0.
4. The UL Reference Measurement channels are set according to Table 6.5A.3.3.1.4.1-1.
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 [10] clause 4.5. Message contents are defined in clause 6.5A.3.3.1.4.3.

6.5A.3.3.1.4.2 Test procedure

1. Select any of the three Alignment Options (1, 2, or 3) from Tables J.2-1 through J.2-3 [3] to mount the DUT inside the QZ.
2. If the re-positioning concept is applied, position the device in DUT Orientation 1 if the maximum beam peak direction is within zenith angular range 0º≤θ≤90º for the alignment option selected in step 1; position the device in DUT Orientation 2 (either Options 1 or 2) if the maximum beam peak direction is within zenith angular range 90º<θ≤180º for DUT Orientation 1 for the alignment option selected in step 1. If the re-positioning concept is not applied, position the device in DUT Orientation 1.
3. Configure SCC according to Annex C.0, C.1, C.2 for all downlink physical channels.
4. The SS shall configure SCC as per TS 38.508-1 [10] clause 5.5.1. Message contents are defined in clause 6.5A.3.1.1.4.3.
5. SS activates SCC by sending the activation MAC CE (Refer TS 38.321 [28], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], clause 9.3).
6. SS sends uplink scheduling information for each UL HARQ process via PDSCH DCI format [0_1] for C_RNTI to schedule the UL RMC according to Table 6.5A.3.1.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
7. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200msec for the UE to reach P_{UMAX}.
8. Set the UE in the Inband Tx beam peak direction [(same as that found for single carrier in clause 6.5.3)] found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 3) for the UE Tx beam selection to complete.
9. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.
10. Measure the spurious emissions as per steps outlined below with an exception to the procedure in Annex K if the re-positioning concept is applied (NOTE 4):

    (a) Perform coarse TRP measurements to identify spurious emission frequencies and corresponding power levelaccording to the procedures in Annex L, using coarse TRP measurement grid selection criteria as per Table M.4.5-3 in Annex M. The measurement is completed in both polarizations θ and ϕ over frequency range and measurement bandwidth according to Table 6.5.3.1.3-2. Optionally, a larger and non-constant measurement bandwidth than that of Table 6.5.3.1.3-2 may be applied as long as the SNR (ratio of test limit to floor noise of test equipment) ≥ 10dB is guaranteed. The measurement period shall capture the [active time slots]. For each spurious emission frequency with coarse TRP identified to be less than an offset dB (NOTE 2) from the TRP limit according to Table 6.5.3.1.3-2, continue with fine TRP procedures according to step (b).

    The offset value shall be the TRP measurement uncertainty at 95% confidence level including the effect of coarse grid measurement uncertainty element. Different coarse TRP grids and corresponding offset values may be used for different frequencies. The coarse TRP grid and offset values used shall be recorded in the test report.

(b) Measure fine TRP measurements according to procedures in Annex K, using fine TRP measurement grid selection criteria as per Table M.4.5-3 in Annex M, for each of the spurious emission frequency identified in step (a). Apply a measurement bandwidth according to Table 6.5.3.1.3-2.

11. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

NOTE 1: The frequency range defined in Table 6.5.3.1.3-2 may be split into ranges. For each range a different test system, e.g. antenna and/or chamber, may be used. To pass the test case all verdicts of the frequency ranges must pass.

NOTE 2: The coarse TRP measurement grid and corresponding offset dB value referred in step 5(a) above, for some valid grids can be found in TR 38.903 section B.18.

NOTE 3: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

NOTE 4: If the (in-band) beam peak is within 0º≤θ≤90º: perform first hemispherical TRP scan (0º≤θ≤90º) in DUT Orientation 1 and second hemispherical TRP scan (90º>θ≥0º) in DUT Orientation 2. If the (in-band) beam peak is within 90º<θ≤180º: perform first hemispherical TRP scan (0º≤θ≤90º) in DUT Orientation 2 and second hemispherical TRP scan (90º>θ≥0º) in DUT Orientation 1. The DUT with UBF activated needs to be re-positioned during the test.

6.5A.3.3.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] subclause 4.6.1.

6.5A.3.3.1.5 Test requirement

This clause specifies the requirements for the specified *NR* band for Transmitter Spurious emissions for UE co-existence requirement with frequency range as indicated in Table 6.5A.3.3.1.5-1.

The maximum EIRP or TRP power of spurious emission for UE co-existence, measured using RMS detector, shall not exceed the described value in Table 6.5A.3.3.1.5-1.

The additional spurious emission for CA limits in Table 6.5A.3.3.1.5-1 apply for all transmitter band configurations (NRB) 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 6.5A.3.3.1.5-1: Additional spurious emissions for CA (NS_201) test requirements

Frequency Range	Maximum Level / Channel bandwidth				Measurement bandwidth	NOTE
	50 MHz	100 MHz	200 MHz	400 MHz		
23.6 GHz ≤ f ≤ 24 GHz	-8 dBm	-8 dBm	-8 dBm	-8 dBm	200MHz	1
NOTE 1: The protection of frequency range 23600 - 24000 MHz is meant for protection of satellite passive services.						

6.5A.3.3.2 Additional spurious emission for CA (3UL CA)

6.5A.3.3.2.1 Test purpose

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.

6.5A.3.3.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3UL CA.

6.5A.3.3.2.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.5A.3.3.0.

6.5A.3.3.2.4 Test description

Same test description as in clause 6.5A.3.3.1.4.

6.5A.3.3.2.5 Test requirement

The test requirement is the same as in clause 6.5A.3.3.1.5

6.5A.3.3.3 Additional spurious emission for CA (4UL CA)

6.5A.3.3.3.1 Test purpose

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.

6.5A.3.3.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4UL CA.

6.5A.3.3.3.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.5A.3.3.0.

6.5A.3.3.3.4 Test description

Same test description as in clause 6.5A.3.3.1.4.

6.5A.3.3.3.5 Test requirement

The test requirement is the same as in clause 6.5A.3.3.1.5.

6.5A.3.3.4 Additional spurious emission for CA (5UL CA)

6.5A.3.3.4.1 Test purpose

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.

6.5A.3.3.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 5UL CA.

6.5A.3.3.4.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.5A.3.3.0.

6.5A.3.3.4.4 Test description

Same test description as in clause 6.5A.3.3.1.4.

6.5A.3.3.4.5 Test requirement

The test requirement is the same as in clause 6.5A.3.3.1.5.

6.5A.3.3.5 Additional spurious emission for CA (6UL CA)

6.5A.3.3.5.1 Test purpose

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.

6.5A.3.3.5.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 6UL CA.

6.5A.3.3.5.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.5A.3.3.0.

6.5A.3.3.5.4 Test description

Same test description as in clause 6.5A.3.3.1.4.

6.5A.3.3.5.5 Test requirement

The test requirement is the same as in clause 6.5A.3.3.1.5.

6.5A.3.3.6 Additional spurious emission for CA (7UL CA)

6.5A.3.3.6.1 Test purpose

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.

6.5A.3.3.6.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 7UL CA.

6.5A.3.3.6.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.5A.3.3.0.

6.5A.3.3.6.4 Test description

Same test description as in clause 6.5A.3.3.1.4.

6.5A.3.3.6.5 Test requirement

The test requirement is the same as in clause 6.5A.3.3.1.5.

6.5A.3.3.7 Additional spurious emission for CA (8UL CA)

6.5A.3.3.7.1 Test purpose

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.

6.5A.3.3.7.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 8UL CA.

6.5A.3.3.7.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.5A.3.3.0.

6.5A.3.3.7.4 Test description

Same test description as in clause 6.5A.3.3.1.4.

6.5A.3.3.7.5 Test requirement

The test requirement is the same as in clause 6.5A.3.3.1.5

6.5D Output RF spectrum emissions for UL MIMO

6.5D.1 Occupied bandwidth for UL MIMO

FFS.

6.5D.2 Out of band emission for UL MIMO

FFS.

6.5D.3 Spurious emissions for UL MIMO

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

- OTA test procedure for UL MIMO is still under investigation
- TRP Measurement Uncertainty is FFS.
- 39.905 TP analysis for UL MIMO is pending
- Applicability of UBF of single UL is FFS.
- Applicability of Beam peak of single UL is FFS.

6.5D.3.1 Transmitter 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 supporting UL MIMO.

6.5D.3.1.3 Minimum conformance requirements

For UE configured with UL MIMO, the minimum conformance requirements are defined in clause 6.5.3.1.3. The requirements shall be met with the UL MIMO configurations specified in Table 6.5D.3.1.3-1.

Table 6.5D.3.1.3-1: UL MIMO configuration

Transmission scheme	DCI format	TPMI Index
Codebook based uplink	DCI format 0_1	0

The normative reference for this requirement is TS 38.101-2 [3] clause 6.5D.3.

6.5D.3.1.4 Test description

6.5D.3.1.4.1 Initial condition

Same initial condition in clause 6.5.3.1.4.1.

6.5D.3.1.4.2 Test procedure

Same test procedure as in clause 6.5.3.1.4.2 with the following added to step 3 for UL MIMO configuration:

3.1 The PDCCH DCI format 0_1 is specified with the condition 2TX_UL_MIMO in 38.508-1 [10] subclause 4.3.6.1.1.2.

6.5D.3.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX_UL_MIMO.

6.5D.3.1.5 Test requirements

The test requirement is the same as in clause 6.5.3.1.5.

6.5D.3.2 Spurious emission band UE co-existence for UL MIMO

6.5D.3.2.1 Test purpose

To verify that UL MIMO configured UE's transmitter does not cause unacceptable interference when in co-existence with protected bands 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 supporting UL MIMO.

6.5D.3.2.3 Minimum conformance requirements

For UE configured with UL MIMO, the minimum conformance requirements are defined in clause 6.5.3.2.3. The requirements shall be met with the UL MIMO configurations specified in Table 6.5D.3.1.3-1.

The normative reference for this requirement is TS 38.101-2 [3] clause 6.5D.3.

6.5D.3.2.4 Test description

6.5D.3.2.4.1 Initial condition

Same initial condition in clause 6.5.3.2.4.1.

6.5D.3.2.4.2 Test procedure

Same test procedure as in clause 6.5.3.2.4.2 with the following added to step 3 for UL MIMO configuration:

3.1 The PDCCH DCI format 0_1 is specified with the condition 2TX_UL_MIMO in 38.508-1 [10] subclause 4.3.6.1.1.2.

6.5D.3.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX_UL_MIMO.

6.5D.3.2.5 Test requirements

The test requirement is the same as in clause 6.5.3.2.5.

6.5D.3.3 Additional Spurious emission for UL MIMO

6.5D.3.3.1 Test purpose

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.

6.5D.3.3.2 Test applicability

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

6.5D.3.3.3 Minimum conformance requirements

For UE configured with UL MIMO, the minimum conformance requirements are defined in clause 6.5.3.3.3. The requirements shall be met with the UL MIMO configurations specified in Table 6.5D.3.1.3-1.

The normative reference for this requirement is TS 38.101-2 [3] clause 6.5D.3.

6.5D.3.3.4 Test description

6.5D.3.3.4.1 Initial condition

Same initial condition in clause 6.5.3.3.4.1.

6.5D.3.3.4.2 Test procedure

Same test procedure as in clause 6.5.3.3.4.2 with the following added to step 3 for UL MIMO configuration:

3.1 The PDCCH DCI format 0_1 is specified with the condition 2TX_UL_MIMO in 38.508-1 [10] subclause 4.3.6.1.1.2.

6.5D.3.3.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX_UL_MIMO.

6.5D.3.3.5 Test requirements

The test requirement is the same as in clause 6.5.3.3.5.

6.6 Beam correspondence

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

- Measurement Uncertainties and Test Tolerances are FFS for power class 3.

6.6.0 General

Beam correspondence is the ability of the UE to select a suitable beam for UL transmission based on DL measurements with or without relying on UL beam sweeping. The beam correspondence requirement is satisfied assuming the presence of both SSB and CSI-RS signal and Type D QCL is maintained between SSB and CSI-RS.

6.6.1 Beam correspondence - EIRP

6.6.1.1 Test purpose

To verify the UE's ability to select a suitable beam for UL transmission based on DL measurements with or without relying on UL beam sweeping within the range prescribed by the specified nominal maximum output power and beam correspondence tolerance.

6.6.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that does not support beam correspondence without UL beam sweeping.

6.6.1.3 Minimum conformance requirements

6.6.1.3.1 (Void)

6.6.1.3.2 (Void)

6.6.1.3.3 Beam correspondence for PC3

6.6.1.3.3.1 General

The beam correspondence requirement for PC3 UEs consists of three components: UE minimum peak EIRP (as defined in clause 6.2.1.1.3.3), UE spherical coverage (as defined in clause 6.2.1.1.3.3), and beam correspondence tolerance (as defined in clause 6.6.1.3.3.2). The beam correspondence requirement is fulfilled if the UE satisfies one of the following conditions, depending on the UE's beam correspondence capability, as defined in TS 38.306 [26]:

- If [bit-1], the UE shall meet the minimum peak EIRP requirement according to Table 6.2.1.3-1 and spherical coverage requirement according to Table 6.2.1.3-3 with its autonomously chosen UL beams and without uplink beam sweeping. Such a UE is considered to have met the beam correspondence tolerance requirement.
- If [bit-0], the UE shall meet the minimum peak EIRP requirement according to Table 6.2.1.3-1 and spherical coverage requirement according to Table 6.2.1.3-3 with uplink beam sweeping. Such a UE shall meet the beam correspondence tolerance requirement defined in Clause 6.6.4.2 and shall support uplink beam management, as defined in TS 38.306 [26].

6.6.1.3.3.1.1 Side condition for SSB and CSI-RS

The beam correspondence requirements are only applied under the following conditions:

- The downlink reference signals including both SSB and CSI-RS are provided and Type D QCL shall be maintained between SSB and CSI-RS.
- The reference measurement channel for beam correspondence are fulfilled according to the CSI-RS configuration in Annex A.3.
- The beam correspondence conditions for L1-RSRP measurements are fulfilled according to Table 6.6.1.3.3.1.1-1 and Table 6.6.1.3.3.1.1-2.

Table 6.6.1.3.3.1.1-1: Conditions for SSB based L1-RSRP measurements for beam correspondence

Angle of arrival	NR operating bands	Minimum SSB_RP Note 2	SSB Ês/Iot
		dBm / SCS_{SSB}	dB
		SCS_{SSB} = 120 kHz	
All angles Note 1	n257	-96.4	≥6
	n258	-96.4	
	n260	-92.1	

	n261	-96.4	
Note 1: For UEs that support multiple FR2 bands, Rx Beam Peak values are increased by ΣMB_P and Spherical coverage values are increased by ΣMB_S, the UE multi-band relaxation factor in dB specified in TS 38.101-2 [3] clause 6.2.1. Note 2: Values specified at the Reference point to give minimum SSB Ês/Iot, with no applied noise.			

Table 6.6.1.3.3.1.1-2: Conditions for CSI-RS based L1-RSRP measurements for beam correspondence

Angle of arrival	NR operating bands	Minimum CSI-RS_RP [Note 2]	CSI-RS Ês/Iot
		dBm / SCS_{CSI-RS}	dB
		SCS_{CSI-RS} = 120 kHz	
All angles [Note 1]	n257	-96.4	≥6
	n258	-96.4	
	n260	-92.1	
	n261	-96.4	
Note 1: For UEs that support multiple FR2 bands, Rx Beam Peak values are increased by ΣMB_P and Spherical coverage values are increased by ΣMB_S, the UE multi-band relaxation factor in dB specified in TS 38.101-2 [3] clause 6.2.1. Note 2: Values specified at the Reference point to give minimum SSB Ês/Iot, with no applied noise.			

6.6.1.3.3.2 Beam correspondence tolerance for PC3

The beam correspondence tolerance requirement $\Delta EIRP_{BC}$ for power class 3 UEs is defined based on a percentile of the distribution of $\Delta EIRP_{BC}$, defined as $\Delta EIRP_{BC} = EIRP_2 - EIRP_1$ over the link angles spanning a subset of the spherical coverage grid points, such that

- $EIRP_1$ is the total EIRP in dBm calculated based on the beam the UE chooses autonomously (corresponding beam) to transmit in the direction of the incoming DL signal, which is based on beam correspondence without relying on UL beam sweeping.
- $EIRP_2$ is the best total EIRP (beam yielding highest EIRP in a given direction) in dBm which is based on beam correspondence with relying on UL beam sweeping.
- The link angles are the ones corresponding to the top N^{th} percentile of the $EIRP_2$ measurement over the whole sphere, where the value of N is according to the test point of EIRP spherical coverage requirement for power class 3, i.e. N = 50.

For power class 3 UEs, the requirement is fulfilled if the UE’s corresponding UL beams satisfy the maximum limit in Table 6.6.1.3.3.2-1.

Table 6.6.1.3.3.2-1: UE beam correspondence tolerance for power class 3

Operating band	Max $\Delta EIRP_{BC}$ at 85 %-tile $\Delta EIRP_{BC}$ CDF (dB)
n257	3.0
n258	3.0
n260	3.2
n261	3.0
NOTE: The requirements in this table are verified only under normal temperature conditions as defined in Annex E.2.1	

6.6.1.3.4 Normative reference

The normative reference for this requirement is TS 38.101-2 [3] clause 6.6.

6.6.1.4 Test description

6.6.1.4.1 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 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and subcarrier spacing, are shown in Table 6.6.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. The downlink reference measurement channels (RMCs) are specified in Annex A.3.1. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.6.1.4.1-1: Test Configuration Table

Default Conditions					
Test Environment as specified in TS 38.508-1 [10] subclause [4.1]			Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause [4.3.1]			Low range, High range		
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause [4.3.1]			Lowest, Highest		
Test SCS as specified in Table 5.3.5-1			120 kHz		
Test Parameters					
Test ID	**ChBw**	**SCS**	**Downlink Configuration**	**Uplink Configuration**	
		Default	N/A	**Modulation**	**RB allocation (NOTE 1)**
1	50			DFT-s-OFDM QPSK	Inner_Full
2	100				
3	200				
4	400				
NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.					

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.2 and TS 38.508-1 [10] subclause 5.2.1.1.1, and uplink signals according to Annex G.0, G.1 and G.3.0.

4. The UL Reference Measurement channels are set according to Table 6.6.1.4.1-1.

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 [10] clause 4.5. Message contents are defined in clause 6.6.1.4.3.

6.6.1.4.2 Test procedure

Test procedure without beam sweeping:

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 6.6.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Messages to configure the appropriate uplink modulation in section 6.6.1.4.3.

1.2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 msec to ensure that the UE transmits at its maximum output power.

1.3. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1 without uplink beam sweeping. Allow at least BEAM_SELECT_WAIT_TIME (Note 1) for the UE Tx beam selection to complete.

1.4. Measure UE $EIRP_1$ in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration. Repeat $EIRP_1$ measurement for all directions in the sphere according to EIRP measurement procedure defined in Annex K.1.9 without beam sweeping for all the points in the grid. After a rotation, allow at least BEAM_SELECT_WAIT_TIME (Note 1) for UE to find the best beam to use. The measuring duration is one active uplink subframe. $EIRP_1$ is calculated considering both polarizations, theta and phi.

1.5 Record all the measured $EIRP_1$values.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

Test procedure with beam sweeping:

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 6.6.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. Messages to configure the appropriate uplink modulation in section 6.6.1.4.3.

2.2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 msec to ensure that the UE transmits at its maximum output power.

2.3. Set the UE in the Tx beam peak direction found with a 3D EIRP scan as performed in Annex K.1.1. Allow at least BEAM_SELECT_WAIT_TIME (Note 1) for the UE Tx beam selection to complete.

2.4. Measure UE EIRP in the Tx beam peak direction in the channel bandwidth of the radio access mode according to the test configuration. Repeat EIRP measurements for all directions in the sphere according to EIRP measurement procedure defined in Annex K.1.9 with beam sweeping. After a rotation, allow at least BEAM_SELECT_WAIT_TIME (Note 1) for UE to find the best beam to use. The measuring duration is one active uplink subframe. EIRP is calculated considering both polarizations, theta and phi.

2.5. Record all the measured $EIRP_2$ values.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

2.6. Calculate the $\Delta EIRP_{BC} = EIRP_2 - EIRP_1$.

2.7. Calculate a cumulative distribution function for the $\Delta EIRP_{BC}$ values.

NOTE 1: The $\Delta EIRP_{target\text{-}CDF}$ is then obtained from the Cumulative Distribution Function (CDF) computed using $\Delta EIRP_{BC}$ for each of all top N^{th} percentile of the $EIRP_2$ measurement points in the grid. When using constant step size measurement grids, a theta-dependent correction shall be applied, i.e., the PDF probability contribution for each measurement point is scaled by sin(θ).

6.6.1.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 with following exceptions:

Table 6.6.1.4.3-1: SRS-Config: SpatialRelationInfo test requirement for with beam sweeping

Derivation Path: TS 38.508-1 [10], clause 4.6.3, Table 4.6.3-182			
Information Element	**Value/remark**	**Comment**	**Condition**
spatialRelationInfo	Not present	The UE can consider the UL beam sweeping.	

Table 6.6.1.4.3-2: SRS-Config: SpatialRelationInfo test requirement for without beam sweeping

Derivation Path: TS 38.508-1 [10], clause 4.6.3, Table 4.6.3-182			
Information Element	**Value/remark**	**Comment**	**Condition**
spatialRelationInfo	SRS-SpatialRelationInfo	The UE consider autonomous beam selection	

Table 6.6.1.4.3-3: SRS-Config: ssb-Index test requirement for without beam sweeping

Derivation Path: TS 38.508-1 [10], clause 4.6.3, Table 4.6.3-182			
Information Element	**Value/remark**	**Comment**	**Condition**
ssb-Index	SSB-Index		

***Table 6.6.1.4.3-4: SRS-Config: SRS resources test requir*ement**

Derivation Path: TS 38.508-1 [10], clause 4.6.3, Table 4.6.3-182			
Information Element	**Value/remark**	**Comment**	**Condition**
srs-ResourceSetToReleaseList	Not present		
srs-ResourceSetToAddModList	1		
srs-ResourceToReleaseList	Not present		
srs_ResourceToAddModList	8	The default beam correspondence SRS resource upper limit (M) = 8 in Rel-15.	

6.6.1.5 Test requirements

The defined %-tile EIRP in measurement distribution derived in step 2.6 shall exceed the values specified in Table 6.2.1.2.5-3 in clause 6.2.1.2.5. The defined %-tile $\Delta EIRP_{BC}$ in measurement distribution derived in step 2.7 shall not exceed the values specified in Table 6.6.1.5-1.

Table 6.6.1.5-1: UE beam correspondence tolerance for power class 3

Operating band	**Max $\Delta EIRP_{BC}$ at 85^{th} %-tile $\Delta EIRP_{BC}$ CDF (dB)**
n257	3.0 +TT
n258	3.0 +TT
n260	3.2 +TT
n261	[3.0] +TT
NOTE: The requirements in this table are verified only under normal temperature conditions as defined in TS 38.101-2 [3] Annex E.2.1	

6.6A Beam correspondence for CA

For intra-band CA in FR2, the same beam correspondence relationship for beam management is supported across CCs in Rel-15 and no requirement is specified. Beam correspondence performance for intra-band CA is fulfilled if the beam correspondence requirements defined in section 6.6 is met for non-CA case.6

7 Receiver characteristics

TBD

7.1 General

Editor's Note: Test configurations/environments that require new spherical scan shall be included in test procedure section and identifying such scenarios is currently FFS and owned by RAN5.

Unless otherwise stated, the receiver characteristics are specified over the air (OTA). The reference receive sensitivity (REFSENS) is defined assuming a 0 dBi reference antenna located at the centre of the quiet zone.

For Rx test cases the identified beam peak direction can be stored and reused for a device under test in various configurations/environments for the full duration of device testing as long as beam peak direction is the same.

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.

For conformance testing of all test cases in this specification, the UE under test shall disable UL Tx diversity schemes.

7.2 Diversity characteristics

FFS

7.3 Reference sensitivity

7.3.1 General

The reference sensitivity power level REFSENS is the EIS level (total component) at the centre of the quiet zone in the RX beam peak direction, at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

7.3.2 Reference sensitivity power level

Editor's note: The following aspects of the clause are for future consideration:

- Measurement Uncertainties and Test Tolerances are FFS for power class 1,2 and 4.

The following aspects of the clause are for future consideration:

- The 3D EIS scan test time optimization in RAN 4/ RAN 5 is FFS (existing EIS based test time needs to be re-evaluated for 200/266 grid points).
- Test Procedures for EIS beam peak Extreme Conditions are FFS
- Statistical model in Annex H.2 (currently based on LTE model) needs to be validated to confirm that it is also applicable for FR2

7.3.2.1 Test purpose

To verify the UE's ability 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 of an g-NodeB.

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 defined as the EIS level at the centre of the quiet zone in the RX beam peak direction, at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

7.3.2.3.1 Reference sensitivity power level for power class 1

The throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annex A3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal) with peak reference sensitivity specified in Table 7.3.2.1-1. The requirement is verified with the test metric of EIS (Link=Beam peak search grids, Meas=Link Angle).

Table 7.3.2.3.1-1: Reference sensitivity for power class 1

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-97.5	-94.5	-91.5	-88.5
n258	-97.5	-94.5	-91.5	-88.5
n260	-94.5	-91.5	-88.5	-85.5
n261	-97.5	-94.5	-91.5	-88.5
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4				

The REFSENS requirement shall be met for an uplink transmission using QPSK DFT-s-OFDM waveforms and for uplink transmission bandwidth less than or equal to that specified in Table 7.3.2.3.1-2.

Table 7.3.2.3.1-2: Uplink configuration for reference sensitivity

Operating band	NR Band / Channel bandwidth / NRB / SCS / Duplex mode					
	50 MHz	100 MHz	200 MHz	400 MHz	SCS	Duplex Mode
n257	32	64	128	256	120 kHz	TDD
n258	32	64	128	256	120 kHz	TDD
n260	32	64	128	256	120 kHz	TDD
n261	32	64	128	256	120 kHz	TDD

Unless given by Table 7.3.2.3.1-3, the minimum requirements for reference sensitivity shall be verified with the network signalling value NS_200 (Table 6.2.3-1) configured.

Table 7.3.2.3.1-3: Network signalling value for reference sensitivity

Operating band	Network Signalling value
n258	NS_201

7.3.2.3.2 Reference sensitivity power level for power class 2

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal) with peak reference sensitivity specified in Table 7.3.2.3.2-1. The requirement is verified with the test metric of EIS (Link=Beam peak search grids, Meas=Link Angle).

Table 7.3.2.3.2-1: Reference sensitivity for power class 2

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-94.5	-91.5	-88.5	-85.5
n258	-94.5	-91.5	-88.5	-85.5
n261	-94.5	-91.5	-88.5	-85.5
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4				

The REFSENS requirement shall be met for an uplink transmission using QPSK DFT-s-OFDM waveforms and for uplink transmission bandwidth less than or equal to that specified in Table 7.3.2.3.1-2.

Unless given by Table 7.3.2.3.1-3, the minimum requirements for reference sensitivity shall be verified with the network signalling value NS_200 (Table 6.2.3-1) configured.

7.3.2.3.3 Reference sensitivity power level for power class 3

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal) with peak reference sensitivity specified in Table 7.3.2.3-1. The requirement is verified with the test metric of EIS (Link=Beam peak search grids, Meas=Link Angle).

For the UEs that support multiple FR2 bands, the minimum requirement for Reference sensitivity in Table 7.3.2.3.3-1 shall be increased per band, respectively, by the reference sensitivity relaxation parameter $\Delta MB_{P,n}$ as specified in section 6.2.1.3. The requirement for the UE which supports a single FR2 band is specified in Table 7.3.2.3.3-1. The requirement for the UE which supports multiple FR2 bands is specified in both Table 7.3.2.3.3-1 and Table 6.2.1.3-4.

Table 7.3.2.3.3-1: Reference sensitivity

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-88.3	-85.3	-82.3	-79.3
n258	-88.3	-85.3	-82.3	-79.3
n260	-85.7	-82.7	-79.7	-76.7
n261	-88.3	-85.3	-82.3	-79.3
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4				

The REFSENS requirement shall be met for an uplink transmission using QPSK DFT-s-OFDM waveforms and for uplink transmission bandwidth less than or equal to that specified in Table 7.3.2.3.1-2.

Unless given by Table 7.3.2.3.1-3, the minimum requirements for reference sensitivity shall be verified with the network signalling value NS_200 (Table 6.2.3-1) configured.

7.3.2.3.4 Reference sensitivity power level for power class 4

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal) with peak reference sensitivity specified in Table 7.3.2.3.4-1. The requirement is verified with the test metric of EIS (Link=Beam peak search grids, Meas=Link Angle).

Table 7.3.2.3.4-1: Reference sensitivity for power class 4

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-97.0	-94.0	-91.0	-88.0
n258	-97.0	-94.0	-91.0	-88.0
n260	-95.0	-92.0	-89.0	-86.0
n261	-97.0	-94.0	-91.0	-88.0
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4				

The REFSENS requirement shall be met for an uplink transmission using QPSK DFT-s-OFDM waveforms and for uplink transmission bandwidth less than or equal to that specified in Table 7.3.2.3.1-2.

Unless given by Table 7.3.2.3.1-3, the minimum requirements for reference sensitivity shall be verified with the network signalling value NS_200 (Table 6.2.3-1) configured.

The normative reference for this requirement is TS 38.101-2 [3] 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 Annex A.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 [10] subclause 4.1		Normal, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, Mid range, High range		
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1		Highest supported BW, in addition to 100MHz and 200MHz		
Test SCS as specified in Table 5.3.5-1		120kHz		
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.				

Table 7.3.2.4.1-2: Downlink Configuration of each RB allocation

Channel Bandwidth	SCS kHz	LCRBmax	RB allocation (LCRB@RBstart)
50MHz	120	32	32@0
100MHz	120	64	64@0
200MHz	120	128	128@0
400MHz	120	256	256@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@RBstart format

Operating Band	SCS kHz	50 MHz	100 MHz	200 MHz	400 MHz	Duplex Mode
n257	120	32@0	64@0	128@0	256@0	TDD
n258	120	32@0	64@0	128@0	256@0	TDD
n260	120	32@0	64@0	128@0	256@0	TDD
n261	120	32@0	64@0	128@0	256@0	TDD

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.1, and uplink signals according to Annex G.0, G.1 and G.3.1.
4. The UL Reference Measurement channels are 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 [10] 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. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200msec for the UE to reach P_{UMAX}.
4. Set the UE in the Rx beam peak direction found with a 3D EIS scan as performed in Annex K.1.2. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Rx beam selection to complete.
5. Perform EIS procedure as stated in Annex K.1.4 to calculate “averaged EIS” .. At each power level, measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2. The downlink power step size shall be no more than 0.2 dB when the RF power level is near the sensitivity level.
6. Compare the dB value of the “averaged EIS” value corresponding to the Rx beam peak direction identified in step 5 to the test requirement in table 7.3.2.5-1. If the EIS value is lower or equal to the value in table 7.3.2.5-1, pass the UE. Otherwise fail the UE.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

7.3.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

7.3.2.5 Test requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.2 and A.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5) with peak reference sensitivity specified in Tables 7.3.2.5-1 to 7.3.2.5-4. The requirement is verified with the test metric of EIS (Link=Beam peak search grids, Meas=Link Angle).

Table 7.3.2.5-1: Reference sensitivity for power class 1

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-97.5+TT	-94.5+TT	-91.5+TT	-88.5+TT
n258	-97.5+TT	-94.5+TT	-91.5+TT	-88.5+TT
n260	-94.5+TT	-91.5+TT	-88.5+TT	-85.5+TT
n261	-97.5+TT	-94.5+TT	-91.5+TT	-88.5+TT

Table 7.3.2.5-2: Reference sensitivity for power class 2

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-94.5+TT	-91.5+TT	-88.5+TT	-85.5+TT
n258	-94.5+TT	-91.5+TT	-88.5+TT	-85.5+TT
n260				
n261	-94.5+TT	-91.5+TT	-88.5+TT	-85.5+TT

Table 7.3.2.5-3: Reference sensitivity for power class 3

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-88.3+TT	-85.3+TT	-82.3+TT	-79.3+TT
n258	-88.3+TT	-85.3+TT	-82.3+TT	-79.3+TT
n260	-85.7+TT	-82.7+TT	-79.7+TT	-76.7+TT
n261	-88.3+TT	-85.3+TT	-82.3+TT	-79.3+TT

Table 7.3.2.5-3a: Test Tolerance (Reference sensitivity for power class 3)

Test Metric	f ≤ 40.8 GHz
IFF (Quiet Zone size ≤ 30 cm)	2.34 dB

Table 7.3.2.5-4: Reference sensitivity for power class 4

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-97+TT	-94+TT	-91+TT	-88+TT
n258	-97+TT	-94+TT	-91+TT	-88+TT
n260	-95+TT	-92+TT	-89+TT	-86+TT
n261	-97+TT	-94+TT	-91+TT	-88+TT

7.3.4 EIS spherical coverage

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

- Measurement Uncertainties and Test Tolerances are FFS for power class 1, 2 and 4.
- Incorporating multi band relaxation testing in this clause is not complete.

The following aspects of the clause are for future consideration:

- Testing extreme conditions is FFS.

7.3.4.1 Test purpose

To verify that the EIS spherical coverage of the UE receiver is acceptable under conditions of low signal level, ideal propagation and no added noise.

7.3.4.2 Test applicability

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

7.3.4.3 Minimum conformance requirements

The reference sensitivity power level REFSENS at a single grid point of the spherical grid 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 reference measurement channels and throughput criterion shall be as specified in section 7.3.2.3.

For power class 1, the maximum EIS at the 85th percentile of the CCDF of EIS measured over the full sphere around the UE is defined as the spherical coverage requirement and is found in Table 7.3.4.3-1 below. The requirement is verified with the test metric of EIS (Link=Beam peak search grids, Meas=Link angle).

Table 7.3.4.3-1: EIS spherical coverage for power class 1

Operating band	EIS at 85th%ile CCDF (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-89.5	-86.5	-83.5	-80.5
n258	-89.5	-86.5	-83.5	-80.5
n260	-86.5	-83.5	-80.5	-77.5
n261	-89.5	-86.5	-83.5	-80.5
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4. NOTE 2: The EIS spherical coverage requirements are verified only under normal thermal conditions as defined in Annex E.2.1.				

For power class 2, the maximum EIS at the 60th percentile of the CCDF of EIS measured over the full sphere around the UE is defined as the spherical coverage requirement and is found in Table 7.3.4.3-2 below. The requirement is verified with the test metric of EIS (Link=Beam peak search grids, Meas=Link angle).

Table 7.3.4.3-2: EIS spherical coverage for power class 2

Operating band	EIS at 60th%ile CCDF (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-83.5	-80.5	-77.5	-74.5
n258	-83.5	-80.5	-77.5	-74.5
n261	-83.5	-80.5	-77.5	-74.5
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4. NOTE 2: The EIS spherical coverage requirements are verified only under normal thermal conditions as defined in Annex E.2.1.				

For power class 3, the maximum EIS at the 50th percentile of the CCDF of EIS measured over the full sphere around the UE is defined as the spherical coverage requirement and is found in Table 7.3.4.3-3 below. The requirement is verified with the test metric of EIS (Link=Beam peak search grids, Meas=Link angle).

For power class 3, the UEs that support operation in multiple FR2 bands, the minimum requirement for EIS spherical coverage in Table 7.3.4.3-3 shall be increased per band, respectively, by the reference sensitivity relaxation parameter $\Delta MB_{S,n}$ as specified in Table 7.3.4.3-4 below.

Table 7.3.4.3-3: EIS spherical coverage for power class 3

Operating band	EIS at 50th%ile CCDF (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-77.4	-74.4	-71.4	-68.4
n258	-77.4	-74.4	-71.4	-68.4
n260	-73.1	-70.1	-67.1	-64.1
n261	-77.4	-74.4	-71.4	-68.4
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4 NOTE 2: The EIS spherical coverage requirements are verified only under normal thermal conditions as defined in Annex E.2.1.				

Table 7.3.4.3-3a: UE multi-band relaxation factors for power class 3

Supported bands	$\sum MB_S$ (dB)
n257, n258	≤ 1.25
n258, n260	≤ 0.75[3]
n258, n261	≤ 1.25
n260, n261	≤ 0.75[2]
n257, n258, n261	≤ 1.75
n257, n260, n261	≤ 1.25[3]
n258, n260, n261	≤ 1.25[3]
n257, n258, n260, n261	≤ 1.75[3]
NOTE 1: The requirements in this table are applicable to UEs which support only the indicated bands. NOTE 2: For supported bands n260 + n261, $\Delta MB_{S,n}$ is not applied for band n260. NOTE 3: For n260, maximum applicable $\Delta MB_{S,n}$ is 0.4 dB.	

For power class 4, the maximum EIS at the 20th percentile of the CCDF of EIS measured over the full sphere around the UE is defined as the spherical coverage requirement and is found in Table 7.3.4.3-4 below. The requirement is verified with the test metric of EIS (Link=Beam peak search grids, Meas=Link angle).

Table 7.3.4.3-4: EIS spherical coverage for power class 4

Operating band	EIS at 20th%ile CCDF (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-88.0	-85.0	-82.0	-79.0
n258	-88.0	-85.0	-82.0	-79.0
n260	-83.0	-80.0	-77.0	-74.0
n261	-88.0	-85.0	-82.0	-79.0
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4 NOTE 2: The EIS spherical coverage requirements are verified only under normal thermal conditions as defined in Annex E.2.1.				

The REFSENS requirement shall be met for an uplink transmission using QPSK DFT-s-OFDM waveforms and for uplink transmission bandwidth less than or equal to that specified in Table 7.3.4.3-5.

Table 7.3.4.3-5: Uplink configuration for reference sensitivity

NR Band / Channel bandwidth / N_{RB} / SCS / Duplex mode						
NR Band	50 MHz	100 MHz	200 MHz	400 MHz	SCS	Duplex Mode
n257	32	64	128	256	120 kHz	TDD
n258	32	64	128	256	120 kHz	TDD
n260	32	64	128	256	120 kHz	TDD
n261	32	64	128	256	120 kHz	TDD

Unless given by Table 7.3.4.3-6, the minimum requirements specified in Table 7.3.4.3-1, Table 7.3.4.3-2, Table 7.3.4.3-3 and Tables 7.3.4.3-4 shall be verified with the network signalling value NS_200 configured.

Table 7.3.4.3-6: Network Signalling value for reference sensitivity

NR Band	Network Signalling value
n258	NS_201

For the UE which supports inter-band carrier aggregation, the minimum requirement for reference sensitivity in Table 7.3.4.3-1, Table 7.3.4.3-2, Table 7.3.4.3-3 and Table 7.3.4.3-4 shall be increased by the amount given in $\Delta R_{IB,c}$ defined in subclause [TBD] for the applicable operating bands.

The normative reference for this requirement is TS 38.101-2 [3] clause 7.3.4.

7.3.4.4 Test description

7.3.4.4.1 Initial conditions

Same initial conditions as in clause 7.3.2.4.1.

7.3.4.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to Table 7.3.2.4.1-1. 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. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200msec for the UE to reach P_{UMAX}.
4. Set the UE in the Rx beam peak direction found with a 3D EIS scan as performed in Annex K.1.2. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Rx beam selection to complete.
5. Measure UE EIS value for each grid point according to EIS spherical coverage procedure defined in Annex K.1.6, and obtain a Complimentary Cumulative Distribution Function (CCDF) of all EIS dBm values.
6. Identify the EIS dBm value corresponding to %-tile (UE power class dependent) value in the applicable test requirement table in section 7.3.4.5.
7. Compare the EIS dBm value identified in step 6, to the limit value in the applicable test requirement table in section 7.3.4.5. If the EIS dBm value is lower or equal to the limit value, pass the UE. Otherwise fail the UE.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

7.3.4.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

7.3.4.5 Test requirement

The reference measurement channels and throughput criterion shall be as specified in section 7.3.2.5.

Table 7.3.4.5-1: EIS spherical coverage for power class 1

Operating band	EIS at 85th%ile CCDF (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-89.5 +TT	-86.5 +TT	-83.5 +TT	-80.5 +TT
n258	-89.5 +TT	-86.5 +TT	-83.5 +TT	-80.5 +TT
n260	-86.5 +TT	-83.5 +TT	-80.5 +TT	-77.5 +TT
n261	-89.5 +TT	-86.5 +TT	-83.5 +TT	-80.5 +TT
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4. NOTE 2: The EIS spherical coverage requirements are verified only under normal thermal conditions as defined in Annex E.2.1.				

Table 7.3.4.5-2: EIS spherical coverage for power class 2

Operating band	EIS at 60th%ile CCDF (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-83.5 +TT	-80.5 +TT	-77.5 +TT	-74.5 +TT
n258	-83.5 +TT	-80.5 +TT	-77.5 +TT	-74.5 +TT
n261	-83.5 +TT	-80.5 +TT	-77.5 +TT	-74.5 +TT
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4. NOTE 2: The EIS spherical coverage requirements are verified only under normal thermal conditions as defined in Annex E.2.1.				

Table 7.3.4.5-3: EIS spherical coverage for power class 3

Operating band	EIS at 50th%ile CCDF (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-77.4 +TT	-74.4 +TT	-71.4 +TT	-68.4 +TT
n258	-77.4 +TT	-74.4 +TT	-71.4 +TT	-68.4 +TT
n260	-73.1 +TT	-70.1 +TT	-67.1 +TT	-64.1 +TT
n261	-77.4 +TT	-74.4 +TT	-71.4 +TT	-68.4 +TT
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4. NOTE 2: The EIS spherical coverage requirements are verified only under normal thermal conditions as defined in Annex E.2.1.				

Table 7.3.4.5-3a: UE multi-band relaxation factors for power class 3

Supported bands	$\sum MB_S$ (dB)
n257, n258	≤ 1.25
n258, n260	≤ 0.75[3]
n258, n261	≤ 1.25
n260, n261	≤ 0.75[2]
n257, n258, n261	≤ 1.75
n257, n260, n261	≤ 1.25[3]
n258, n260, n261	≤ 1.25[3]
n257, n258, n260, n261	≤ 1.75[3]
NOTE 1: The requirements in this table are applicable to UEs which support only the indicated bands. NOTE 2: For supported bands n260 + n261, $\Delta MB_{S,n}$ is not applied for band n260. NOTE 3: For n260, maximum applicable $\Delta MB_{S,n}$ is 0.4 dB.	

Table 7.3.4.5-3b: Test Tolerance (Reference sensitivity for power class 3)

Test Metric	f ≤ 40.8 GHz
IFF (Quiet Zone size ≤ 30 cm)	2.21 dB

Table 7.3.4.5-4: EIS spherical coverage for power class 4

Operating band	EIS at 20th%ile CCDF (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-88.0 +TT	-85.0 +TT	-82.0 +TT	-79.0 +TT
n258	-88.0 +TT	-85.0 +TT	-82.0 +TT	-79.0 +TT
n260	-83.0 +TT	-80.0 +TT	-77.0 +TT	-74.0 +TT
n261	-88.0 +TT	-85.0 +TT	-82.0 +TT	-79.0 +TT
NOTE 1: The transmitter shall be set to P_{UMAX} as defined in subclause 6.2.4 NOTE 2: The EIS spherical coverage requirements are verified only under normal thermal conditions as defined in Annex E.2.1.				

7.3A Reference sensitivity for CA

Editors note:

- TP analysis for Reference sensitivity CA pending.
- Beam peak direction for CA is TBD and cannot be assumed to be the same as single carrier.

7.3A.1 General

The reference sensitivity power level REFSENS for both Intra-band non-contiguous CA and Intra-band contiguous CA is defined as the EIS level at the centre of the quiet zone in the RX beam peak direction[(same as that found for single carrier scenario in clause 7.3.2)], at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

7.3A.2 Reference sensitivity power level for CA

7.3A.2.0 Minimum Conformance Requirements

7.3A.2.0.1 Intra-band contiguous CA

For each component carrier in the intra-band contiguous carrier aggregation, the throughput in QPSK R = 1/3 shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annex A (with one sided dynamic OCNG Pattern OP.1 TDD for the DL-signal) with peak reference sensitivity values determined from section 7.3.2.3, and relaxation applied to peak reference sensitivity requirement as specified in Table 7.3A.2.0.1-1.

The normative reference for this requirement is TS 38.101-2 [3] clause 7.3A.2.1.

Table 7.3A.2.0.1-1: ΔR_{IB} EIS Relaxation for CA operation by aggregated channel bandwidth

Aggregated Channel BW ‘$BW_{Channel\_CA}$’ (MHz)	ΔR_{IB} (dB)
$BW_{Channel\_CA} \leq 800$	0.0
$800 < BW_{Channel\_CA} \leq 1200$	0.5

7.3A.2.0.2 Intra-band non-contiguous CA

For each component carrier in the intra-band non-contiguous carrier aggregation, the throughput in QPSK R=1/3 shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annex A (with one sided dynamic OCNG Pattern OP.1 TDD for the DL-signal) with peak reference sensitivity values determined from section 7.3.2.3, and relaxation applied to peak reference sensitivity requirement as specified in Table 7.3A.2.0.2-1.

The cumulative aggregated channel bandwidth is defined as the frequency band from the lowest edge of the lowest CC to the upper edge of the highest CC of all UL and DL configured CCs.

The normative reference for this requirement is TS 38.101-2 [3] clause 7.3A.2.2.

Table 7.3A.2.0.2-1: ΔR_{IB} EIS Relaxation for CA operation by cumulative aggregated channel bandwidth

Cumulative Aggregated Channel BW (MHz)	ΔR_{IB} (dB)
≤ 800	0.0
[> 800 and ≤ 1400]	[0.5]

7.3A.2.1 Reference sensitivity power level for CA (2DL CA)

7.3A.2.1.1 Test purpose

Same test purpose as in clause 7.3.2.1.

7.3A.2.1.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 2DL CA.

7.3A.2.1.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 7.3A.2.0.

7.3A.2.1.4 Test description

7.3A.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, and channel bandwidths based on NR CA configurations specified in clause 5.5A. All of these configurations shall be tested with applicable test parameters for each channel bandwidth and are shown in Table 7.3A.2.1.4.1-1, Table 7.3A.2.1.4.1-2 and Table 7.3A.2.1.4.1-3. 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 7.3A.2.1.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Low range, High range		
Test CA Bandwidth combination as specified in subclause 5.5A		Maximum aggregated BW (contiguous CA) or Maximum cumulative aggregated BW (non-contiguous CA)		
Test SCS as specified in Table 5.3.5-1		120kHz		
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 3)
NOTE 1: Full RB allocation shall be used per each SCS and component carrier as specified in Table 7.3A.2.1.4.1-2. NOTE 2: REFSENS refers to Table 7.3A.2.1.4.1-3 which defines uplink RB configuration and start RB location for each SCS, channel BW. NOTE 3: Use single carrier UL when testing reference sensitivity power level for CA.				

Table 7.3A.2.1.4.1-2: Downlink Configuration of each RB allocation

Component Carrier Bandwidth	SCS kHz	LCRBmax	RB allocation (LCRB@RBstart)
50MHz	120	32	32@0
100MHz	120	64	64@0
200MHz	120	128	128@0
400MHz	120	256	256@0
NOTE 1: CA Bandwidths are checked separately for each NR band, the applicable CA bandwidths are specified in Table 5.3A.4-1.			

Table 7.3A.2.1.4.1-3: Uplink configuration for reference sensitivity, LCRB@RBstart format

Operating Band	SCS kHz	50 MHz	100 MHz	200 MHz	400 MHz	Duplex Mode
n257	120	32@0	64@0	128@0	256@0	TDD
n258	120	32@0	64@0	128@0	256@0	TDD
n260	120	32@0	64@0	128@0	256@0	TDD
n261	120	32@0	64@0	128@0	256@0	TDD

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.1, and uplink signals according to Annex G.0, G.1 and G.3.1.
4. The UL Reference Measurement channels are set according to Table 7.3A.2.1.4.1-1, Table 7.3A.2.1.4.1-2 and Table 7.3A.2.1.4.1-3.
5. Propagation conditions are set according to Annex B.0.
6. Ensure the UE is in State RRC_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On*, Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [10] clause 4.5. Message contents are defined in clause 7.3A.2.1.4.3.

7.3A.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 [10] clause 5.5.1. Message contents are defined in clause 7.3A.2.1.4.3.
3. SS activates SCC by sending the activation MAC CE (Refer TS 38.321[28], clauses 5.9, 6.1.3.10). Wait for at least 2 seconds (Refer TS 38.133[25], clause 9.2).
4. SS transmits PDSCH via PDCCH DCI format [1_1] for C_RNTI to transmit the DL RMC according to Table 7.3A.2.1.4.1-1. 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 7.3A.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.
6. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200msec for the UE to reach P_{UMAX}.
7. Set the UE in the Rx beam peak direction [(same as that found for single carrier in clause 7.3.2)]. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE Rx beam selection to complete.
8. For each component carrier, perform EIS procedure as stated in Annex K.1.4 to calculate “averaged EIS” by changing the power level of the wanted signal with a step size of 0.2dB. For each power step measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2.
9. For each component carrier, compare the dB value of the “averaged EIS” value corresponding to the Rx beam peak direction (same as that found for single carrier in clause 7.3.2) identified in step 8 to the test requirement in Tables 7.3A.2.1.5-3 to Table 7.3A.2.1.5-7. If the EIS value is lower or equal to the value in Tables 7.3A.2.1.5-3 to Table 7.3A.2.1.5-7, pass the UE. Otherwise fail the UE.

NOTE 1: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

7.3A.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [6] subclause 4.6.1.

7.3A.2.1.5 Test requirement

For each component carrier, the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A.2 and A.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5) with peak reference sensitivity specified in Tables 7.3A.2.1.5-3 to 7.3A.2.1.5-7. The requirement is verified with the test metric of EIS (Link=Beam peak search grids, Meas=Link Angle).

Table 7.3A.2.1.5-1: ΔR_{IB} EIS Relaxation per component carrier for intra-band contiguous CA

Aggregated Channel BW '$BW_{Channel\_CA}$' (MHz)	ΔR_{IB} (dB) / CC
$BW_{Channel\_CA}$ ≤ 800	0.0
800 < $BW_{Channel\_CA}$ ≤ 1200	0.5

Table 7.3A.2.1.5-2: ΔR_{IB} EIS Relaxation per component carrier for intra-band non-contiguous CA

Cumulative Aggregated Channel BW (MHz)	ΔR_{IB} (dB) / CC
≤ 800	0.0
[> 800 and ≤ 1400]	[0.5]

Table 7.3A.2.1.5-3: Reference sensitivity per component carrier for power class 1

Operating band	REFSENS (dBm) / CC			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-97.5+TT+ΔR_{IB}	-94.5+TT+ΔR_{IB}	-91.5+TT+ΔR_{IB}	-88.5+TT+ΔR_{IB}
n258	-97.5+TT+ΔR_{IB}	-94.5+TT+ΔR_{IB}	-91.5+TT+ΔR_{IB}	-88.5+TT+ΔR_{IB}
n260	-94.5+TT+ΔR_{IB}	-91.5+TT+ΔR_{IB}	-88.5+TT+ΔR_{IB}	-85.5+TT+ΔR_{IB}
n261	-97.5+TT+ΔR_{IB}	-94.5+TT+ΔR_{IB}	-91.5+TT+ΔR_{IB}	-88.5+TT+ΔR_{IB}

Table 7.3A.2.1.5-4: Reference sensitivity per component carrier for power class 2

Operating band	REFSENS (dBm) / CC			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-94.5+TT+ΔR_{IB}	-91.5+TT+ΔR_{IB}	-88.5+TT+ΔR_{IB}	-85.5+TT+ΔR_{IB}
n258	-94.5+TT+ΔR_{IB}	-91.5+TT+ΔR_{IB}	-88.5+TT+ΔR_{IB}	-85.5+TT+ΔR_{IB}
n260				
n261	-94.5+TT+ΔR_{IB}	-91.5+TT+ΔR_{IB}	-88.5+TT+ΔR_{IB}	-85.5+TT+ΔR_{IB}

Table 7.3A.2.1.5-5: Reference sensitivity per component carrier for power class 3

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-88.3+TT+ΔR_{IB}	-85.3+TT+ΔR_{IB}	-82.3+TT+ΔR_{IB}	-79.3+TT+ΔR_{IB}
n258	-88.3+TT+ΔR_{IB}	-85.3+TT+ΔR_{IB}	-82.3+TT+ΔR_{IB}	-79.3+TT+ΔR_{IB}
n260	-85.7+TT+ΔR_{IB}	-82.7+TT+ΔR_{IB}	-79.7+TT+ΔR_{IB}	-76.7+TT+ΔR_{IB}
n261	-88.3+TT+ΔR_{IB}	-85.3+TT+ΔR_{IB}	-82.3+TT+ΔR_{IB}	-79.3+TT+ΔR_{IB}

Table 7.3A.2.1.5-6a: Test Tolerance per component carrier (Reference sensitivity for power class 3)

Test Metric	f ≤ 40.8 GHz
IFF (Quiet Zone size ≤ 30 cm)	3.37 dB

Table 7.3A.2.1.5-7: Reference sensitivity per component carrier for power class 4

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	-97+TT+ΔR_{IB}	-94+TT+ΔR_{IB}	-91+TT+ΔR_{IB}	-88+TT+ΔR_{IB}
n258	-97+TT+ΔR_{IB}	-94+TT+ΔR_{IB}	-91+TT+ΔR_{IB}	-88+TT+ΔR_{IB}
n260	-95+TT+ΔR_{IB}	-92+TT+ΔR_{IB}	-89+TT+ΔR_{IB}	-86+TT+ΔR_{IB}
n261	-97+TT+ΔR_{IB}	-94+TT+ΔR_{IB}	-91+TT+ΔR_{IB}	-88+TT+ΔR_{IB}

7.3A.2.2 Reference sensitivity power level for CA (3DL CA)

7.3A.2.2.1 Test purpose

Same test purpose as in clause 7.3A.2.1.1.

7.3A.2.2.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3DL CA.

7.3A.2.2.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 7.3A.2.0.

7.3A.2.2.4 Test description

Same test description as in clause 7.3A.2.1.4.

7.3A.2.2.5 Test requirement

For each component carrier, the test requirement is the same as in clause 7.3A.2.1.5.

7.3A.2.3 Reference sensitivity power level for CA (4DL CA)

7.3A.2.3.1 Test purpose

Same test purpose as in clause 7.3A.2.1.1.

7.3A.2.3.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 4DL CA.

7.3A.2.3.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 7.3A.2.0.

7.3A.2.3.4 Test description

Same test description as in clause 7.3A.2.1.4.

7.3A.2.3.5 Test requirement

For each component carrier, the test requirement is the same as in clause 7.3A.2.1.5.

7.3A.2.4 Reference sensitivity power level for CA (5DL CA)

7.3A.2.4.1 Test purpose

Same test purpose as in clause 7.3A.2.1.1.

7.3A.2.4.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 5DL CA.

7.3A.2.4.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 7.3A.2.0.

7.3A.2.4.4 Test description

Same test description as in clause 7.3A.2.1.4.

7.3A.2.4.5 Test requirement

For each component carrier, the test requirement is the same as in clause 7.3A.2.1.5.

7.3A.2.5 Reference sensitivity power level for CA (6DL CA)

7.3A.2.5.1 Test purpose

Same test purpose as in clause 7.3A.2.1.1.

7.3A.2.5.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 6DL CA.

7.3A.2.5.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 7.3A.2.0.

7.3A.2.5.4 Test description

Same test description as in clause 7.3A.2.1.4.

7.3A.2.5.5 Test requirement

For each component carrier, the test requirement is the same as in clause 7.3A.2.1.5.

7.3A.2.6 Reference sensitivity power level for CA (7DL CA)

7.3A.2.6.1 Test purpose

Same test purpose as in clause 7.3A.2.1.1.

7.3A.2.6.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 7DL CA.

7.3A.2.6.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 7.3A.2.0.

7.3A.2.6.4 Test description

Same test description as in clause 7.3A.2.1.4.

7.3A.2.6.5 Test requirement

For each component carrier, the test requirement is the same as in clause 7.3A.2.1.5.

7.3A.2.7 Reference sensitivity power level for CA (8DL CA)

7.3A.2.7.1 Test purpose

Same test purpose as in clause 7.3A.2.1.1.

7.3A.2.7.2 Test applicability

This test case applies to all types of NR UE release 15 and forward that supports FR2 3DL CA.

7.3A.2.7.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 7.3A.2.0.

7.3A.2.7.4 Test description

Same test description as in clause 7.3A.2.1.4.

7.3A.2.7.5 Test requirement

For each component carrier, the test requirement is the same as in clause 7.3A.2.1.5.

7.3D Reference sensitivity for UL MIMO

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

- OTA test procedure for UL MIMO is still under investigation
- 39.905 TP analysis for UL MIMO is pending
- Applicability of Beam peak of single UL is FFS.

7.3D.1 General

The reference sensitivity power level REFSENS for UL MIMO is the EIS level (total component) at the centre of the quiet zone in the RX beam peak direction [TBD], at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

7.3D.2 Reference sensitivity power level

7.3D.2.1 Test purpose

To verify UL MIMO configured UE's ability 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 of an g-NodeB.

7.3D.2.2 Test applicability

This test case applies to all types of *NR* UE release 15 and forward supporting UL MIMO.

7.3D.2.3 Minimum conformance requirements

For UE configured with UL MIMO, the minimum conformance requirements are defined in clause 7.3.2.3. The requirements shall be met with the UL MIMO configurations specified in Table 7.3D.2.3-1.

Table 7.3D.2.3-1: UL MIMO configuration

Transmission scheme	DCI format	TPMI Index
Codebook based uplink	DCI format 0_1	0

The normative reference for this requirement is TS 38.101-2 [3] clause 7.3D.

7.3D.2.4 Test description

7.3D.2.4.1 Initial conditions

Same initial condition in clause 7.3.2.4.1.

7.3D.2.4.2 Test procedure

Same test procedure as in clause 7.3.2.4.2 with the following added to step 2 for UL MIMO configuration:

2.1 The PDCCH DCI format 0_1 is specified with the condition 2TX_UL_MIMO in 38.508-1 [10] subclause 4.3.6.1.1.2.

7.3D.2.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX_UL_MIMO.

7.3D.2.5 Test requirement

The test requirement is the same as in clause 7.3.2.5.

7.3D.3 Void

7.3D.4 EIS spherical coverage

7.3D.4.1 Test purpose

To verify that UL MIMO configured UE's EIS spherical coverage is acceptable under conditions of low signal level, ideal propagation and no added noise.

7.3D.4.2 Test applicability

This test case applies to all types of *NR* UE release 15 and forward supporting UL MIMO.

7.3D.4.3 Minimum conformance requirements

For UE configured with UL MIMO, the minimum conformance requirements are defined in clause 7.3.4.3. The requirements shall be met with the UL MIMO configurations specified in Table 7.3D.4.3-1.

Table 7.3D.4.3-1: UL MIMO configuration

Transmission scheme	DCI format	TPMI Index
Codebook based uplink	DCI format 0_1	0

The normative reference for this requirement is TS 38.101-2 [3] clause 7.3D.

7.3D.4.4 Test description

7.3D.4.4.1 Initial conditions

Same initial condition in clause 7.3.4.4.1.

7.3D.4.4.2 Test procedure

Same test procedure as in clause 7.3.4.4.2 with the following added to step 2 for UL MIMO configuration:

2.1 The PDCCH DCI format 0_1 is specified with the condition 2TX_UL_MIMO in 38.508-1 [10] subclause 4.3.6.1.1.2.

7.3D.4.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6 ensuring Table 4.6.3-182 with condition 2TX_UL_MIMO.

7.3D.4.5 Test requirement

The test requirement is the same as in clause 7.3.4.5.

7.4 Maximum input level

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

- Measurement uncertainty is FFS.
- UL power level configuration is TBD.

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

The minimum conformance requirements in this test case are not testable due to maximum input level unachievable in IFF OTA test setup. Other test setups have not been analysed. Thus the test case will not be tested as part of UE conformance testing.

NOTE: As a result TC 7.4 has not been included in the test case applicability table 4.1.2-1, TS 38.522. This does not preclude the test from being used for R&D or other purposes if deemed useful to all types of NR UE release 15 and forward.

7.4.3 Minimum conformance requirements

The maximum input level is defined as the maximum mean power, for which the throughput shall meet or exceed the minimum requirements for the specified reference measurement channel.

The maximum input level is defined as a directional requirement. The requirement is verified in beam locked mode in the direction where peak gain is achieved.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A (with one sided dynamic OCNG Pattern OP.1 TDD for the DL-signal as described in Annex A.5.2.1) with parameters specified in Table 7.4.3-1. The requirement is verified with the test metric of EIS (Link=RX beam peak direction, Meas=Link angle).

Table 7.4.3-1: Maximum input level

Rx Parameter	Units	Channel bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz
Power in transmission bandwidth configuration	dBm	-25 (NOTE 2)			
NOTE 1: The transmitter shall be set to 4 dB below the lower limit of the $P_{UMAX,f,c}$ inequality defined in subclause 6.2.4, with uplink configuration specified in Table 7.3.2.3-5. NOTE 2: Reference measurement channel is specified in Annex A.3.3: QPSK, R=1/3 variant with one sided dynamic OCNG Pattern as described in Annex A.					

Table 7.4.3-2: Void

The normative reference for this requirement is TS 38.101-2 [3] 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 [10] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Mid range	
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1		Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1		120kHz	
Test Parameters for Channel Bandwidths			
Downlink Configuration		**Uplink Configuration**	
Modulation	**RB allocation**	**Modulation**	**RB allocation**
CP-OFDM QPSK	NOTE1	DFT-s-OFDM QPSK	NOTE2
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. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.3.1.1 for TE diagram and Figure A.3.4.1.1 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C, and uplink signals according to AnnexG.
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 [10] clause 4.5. Message content 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 Table 7.4.4.1-1. Since the UL has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

3. Set the Downlink signal level for θ-polarization to the value as defined in Table 7.4.5-1.

4. Set the UE in the Rx beam peak direction found with a 3D EIS scan as performed in Annex K.1.2. Allow at least BEAM_SELECT_WAIT_TIME (NOTE) for the UE Rx beam selection to complete.

5. Send Uplink power control commands to the UE (less or equal to [TBD] dB step size should be used), to ensure that the UE output power is within [TBD] dB of the target power level in Table 7.4.5-1, for at least the duration of the Throughput measurement.

6. SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Rx Only.

7. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2.

8. SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

9. Repeat steps from 3 to 8, for the downlink signal from φ-polarization.

10. Compare the results for both the θ-polarization and φ-polarization against the requirement. If either result meets the requirements, pass the UE.

NOTE: The BEAM_SELECT_WAIT_TIME default value is defined in Annex K.1.1.

7.4.4.3 Message contents

Message contents are according to TS 38.508-1 [10] subclause 4.6.

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 with parameters specified in Tables 7.4.5-1.

Table 7.4.5-1: Maximum input level

Rx Parameter	Units	Channel bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz
Power in Transmission Bandwidth Configuration	dBm	-51 (NOTE 2,3) for band n257, n258 and n261 -59 (NOTE 2,3) for band n260			
NOTE 1: The transmitter shall be set to 4 dB below the lower limit of the $P_{UMAX,f,c}$ inequality defined in subclause 6.2.4, with uplink configuration specified in Table 7.3.2.3-5. NOTE 2: Reference measurement channel is specified in Annex A.3.3: QPSK, R=1/3 variant with one sided dynamic OCNG Pattern as described in Annex A. NOTE 3: The test requirements deviate from minimum requirements by 26dB relaxation for 24.25 ~ 29.5 GHz and 34 dB relaxation for 37 ~ 40 GHz.					

7.4A Maximum input level for CA

FFS

7.4D Maximum input level for UL MIMO

FFS

7.5 Adjacent channel selectivity

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

- Measurement Uncertainty is FFS.
- The minimum conformance requirements for Case 2 in this test case are not testable due to maximum input level unachievable in IFF OTA test setup. Other test setups have not been analysed.

7.5.1 Test purpose

Adjacent channel selectivity tests the UE's ability to receive data with a given average throughput for a specified reference measurement channel, in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel, under conditions of ideal propagation and no added noise.

7.5.2 Test applicability

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

7.5.3 Minimum conformance requirements

Adjacent Channel Selectivity (ACS) is a measure of a receiver's ability to receive a 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).

The requirement applies at the Radiated Interface Boundary (RIB) when the AoA of the incident wave of the wanted signal and the interfering signal are both from the direction where peak gain is achieved.

The wanted and interfering signals apply to all supported polarizations, under the assumption of polarization match.

The UE shall fulfil the minimum requirement specified in Table 7.5.3-1 for all values of an adjacent channel interferer up to –25 dBm. However, it is not possible to directly measure the ACS, instead the lower and upper range of test parameters are chosen in Table 7.5.3-2 and Table 7.5.3-3 where the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A(with QPSK, R=1/3 and one sided dynamic OCNG Pattern OP.1 TDD for the DL-signal as described in Annex A. The requirement is verified with the test metric of EIS (Link=RX beam peak direction, Meas=Link angle).

Table 7.5.3-1: Adjacent channel selectivity

Rx Parameter	Units	Channel bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz
ACS for band n257, n258, n261	dB	23	23	23	23
ACS for band n260	dB	22	22	22	22

Table 7.5.3-2: Test parameters for adjacent channel selectivity, Case 1

Rx Parameter	Units	Channel bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz

Power in Transmission Bandwidth Configuration	dBm	REFSENS + 14 dB			
$P_{Interferer}$ for band n257, n258, n261	dBm	REFSENS + 35.5 dB	REFSENS +35.5dB	REFSENS +35.5dB	REFSENS +35.5dB
$P_{Interferer}$ for band n260	dBm	REFSENS + 34.5 dB	REFSENS +34.5dB	REFSENS +34.5dB	REFSENS +34.5dB
$BW_{Interferer}$	MHz	50	100	200	400
$F_{Interferer}$ (offset)	MHz	50 / -50 NOTE 3	100 / -100 NOTE 3	200 / -200 NOTE 3	400 / -400 NOTE 3
NOTE 1: The interferer consists of the Reference measurement channel specified in Annex A with one sided dynamic OCNG Pattern as described in Annex A and set-up according to Annex C. NOTE 2: The REFSENS power level is specified in Table 7.3.2.3-1., which are applicable to different UE power classes. NOTE 3: The absolute value of the interferer offset $F_{Interferer}$ (offset) shall be further adjusted to $(\lfloor \lvert F_{Interferer} \rvert / SCS \rfloor + 0.5)SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. Wanted and interferer signal have same SCS.					

Table 7.5.3-3: Test parameters for adjacent channel selectivity, Case 2

Rx Parameter	Units	Channel bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz
Power in Transmission Bandwidth Configuration for band n257, n258, n261	dBm	-46.5	-46.5	-46.5	-46.5
Power in Transmission Bandwidth Configuration for band n260	dBm	-45.5	-45.5	-45.5	-45.5
$P_{Interferer}$	dBm	-25			
$BW_{Interferer}$	MHz	50	100	200	400
$F_{Interferer}$ (offset)	MHz	50 / -50 NOTE 2	100 / -100 NOTE 2	200 / -200 NOTE 2	400 / -400 NOTE 2
NOTE 1: The interferer consists of the Reference measurement channel specified in Annex A with one sided dynamic OCNG Pattern TDD as described in Annex A.5.2.1 and set-up according to Annex C. NOTE 2: The absolute value of the interferer offset FInterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. Wanted and interferer signal have same SCS.					

The normative reference for this requirement is TS 38.101-2 [3] 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, 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 subcarrier spacing, are shown in table 7.5.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A. The details of the OCNG patterns used are specified in Annex A. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.5.4.1-1: Test Configuration

Initial Conditions				
Test Environment as specified in TS 38.508-1 [10] subclause 4.1		Normal		
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1		Mid range		
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1		50 MHz, 100 MHz		
Test SCS as specified in Table 5.3.5-1		120 kHz		
Test Parameters				
Test ID	Downlink Configuration		Uplink Configuration	
	Modulation	RB allocation	Modulation	RB allocation
1	CP-OFDM QPSK	NOTE 1	DFT-s-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of each RB allocation is defined in Table 7.3.2.4.1-1.				

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, Figure A.3.1.4.1 for TE diagram and section A.3.4 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.1, and uplink signals according to Annex G.0, G.1 and G.3.1.
4. The 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 [10] clause 4.5. Message contents are defined in clause 7.5.4.3.

7.5.4.2 Test procedure

1. Set the UE in the Rx beam peak direction found with a Rx beam peack search direcion as performed in Annex K.
2. 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.
3. 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 data to send, the UE transmits uplink MAC padding bits on the UL RMC.
4. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200msec for the UE to reach P_{UMAX}.
5. Perform Blocking measurement procedure as stated in Annex K.1.8 using Downlink signal level and Interferer signal level as defined in Table 7.5.5-2 (Case 1). Modulated interferer signal characteristics as defined in Annex D with frequency below the wanted signal.
6. Repeat step 5 using an interfering signal frequency above the wanted signal in Case 1.
7. Perform Blocking measurement procedure as stated in Annex K.1.8 using Downlink signal level and Interferer signal level as defined in Table 7.5.5-3 (Case 2). Modulated interferer signal characteristics as defined in Annex D with frequency below the wanted signal.. Measure throughput for a duration sufficient to achieve statistical significance according to Annex H.2.
8. Repeat step 7 using an interfering signal frequency above the wanted signal in Case 2.
9. 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 [10] subclause 4.6 with TRANSFORM_PRECODER_ENABLED condition in Table 4.6.3-118 PUSCH-Config.

7.5.5 Test requirements

The throughput measurement derived in test procedure shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annex A, under the conditions specified in Table 7.5.5-2 and also under the conditions specified in Table 7.5.5-3.

Table 7.5.5-1: Adjacent channel selectivity

		Channel bandwidth			
Rx Parameter	**Units**	**50 MHz**	**100 MHz**	**200 MHz**	**400 MHz**
ACS for band n257, n258, n261	dB	23	23	23	23
ACS for band n260	dB	22	22	22	22

Table 7.5.5-2: Test parameters for adjacent channel selectivity, Case 1

Rx Parameter	Units	Channel bandwidth			
		50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
Power in Transmission Bandwidth Configuration for band n257, n258, n261	dBm	REFSENS + 14 dB			
Power in Transmission Bandwidth Configuration for band n260	dBm	REFSENS + 14 - 1.8 dB NOTE 4	REFSEN + 14 - 4.8 dB NOTE 4	REFSENS + 14 dB	REFSENS + 14 dB
$P_{Interferer}$ for band n257, n258, n261	dBm	REFSENS + 35.5 dB	REFSENS +35.5dB	REFSENS +35.5dB NOTE 5	REFSENS +35.5dB NOTE 5
$P_{Interferer}$ for band n260	dBm	REFSENS + 34.5 - 1.8 dB NOTE 4	REFSENS +34.5 - 4.8 dB NOTE 4	REFSENS +34.5dB NOTE 5	REFSENS +34.5dB NOTE 5
$BW_{Interferer}$	MHz	50	100	200	400
$F_{Interferer}$ (offset)	MHz	50 / -50 NOTE 3	100 / -100 NOTE 3	200 / -200 NOTE 3	400 / -400 NOTE 3

NOTE 1: The interferer consists of the Reference measurement channel specified in Annex A with one sided dynamic OCNG Pattern as described in Annex A.5.2.1 and set-up according to Annex C [].
NOTE 2: The REFSENS power level is specified in Table 7.3.2.3-1.
NOTE 3: The absolute value of the interferer offset $F_{Interferer}$ (offset) shall be further adjusted to $(\lceil |F_{Interferer}|/SCS \rceil + 0.5)SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. Wanted and interferer signal have same SCS.
NOTE 4: Core requirement cannot be tested due to testability issue and test requirement for wanted signal and interferer includes relaxation to achieve feasible interferer power level.
NOTE 5: Core requirement cannot be tested due to testability issue.

Table 7.5.5-3: Test parameters for adjacent channel selectivity, Case 2

Rx Parameter	Units	Channel bandwidth			
		50 MHz	**100 MHz**	**200 MHz**	**400 MHz**

Power in Transmission Bandwidth Configuration for band n257, n258, n261	dBm	-46.5	-46.5	-46.5	-46.5
Power in Transmission Bandwidth Configuration for band n260	dBm	-45.5	-45.5	-45.5	-45.5
$P_{Interferer}$	dBm	-25			
$BW_{Interferer}$	MHz	50	100	200	400
$F_{Interferer}$ (offset)	MHz	50 / -50 NOTE 2	100 / -100 NOTE 2	200 / -200 NOTE 2	400 / -400 NOTE 2
NOTE 1: The interferer consists of the Reference measurement channel specified in Annex A with one sided dynamic OCNG Pattern TDD as described in Annex A.5.2.1 and set-up according to Annex C. NOTE 2: The absolute value of the interferer offset FInterferer (offset) shall be further adjusted to $(\lceil \lvert F_{Interferer} \rvert / SCS \rceil + 0.5) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. Wanted and interferer signal have same SCS.					

7.5A Adjacent channel selectivity for CA

FFS

7.5D Adjacent channel selectivity for UL MIMO

FFS

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.

The requirement applies at the RIB when the AoA of the incident wave of the wanted signal and the interfering signal are both from the direction where peak gain is achieved.

The wanted and interfering signals apply to all supported polarizations, under the assumption of polarization match.

7.6.1 General

FFS

7.6.2 In-band blocking

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

- Measurement uncertainty is FFS.

7.6.2.1 Test purpose

In-band blocking is defined for an unwanted interfering signal falling into the UE receive band or into the spectrum equivalent to twice the channel bandwidth below or above the UE receive band at which the relative throughput shall meet or exceed the minimum requirement for the specified measurement channels.

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

In-band blocking is defined for an unwanted interfering signal falling into the UE receive band or into the spectrum equivalent to twice the channel bandwidth below or above the UE receive band at which the relative throughput shall meet or exceed the minimum requirement for the specified measurement channels.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A with one sided dynamic OCNG Pattern for the DL-signal as described in Annex A The requirement is verified with the test metric of EIS (Link=RX beam peak direction, Meas=Link angle).

Table 7.6.2.3-1: In band blocking requirements

Rx parameter	Units	Channel bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz
Power in Transmission Bandwidth Configuration	dBm	REFSENS + 14dB			
$BW_{Interferer}$	MHz	50	100	200	400
$P_{Interferer}$ for bands n257, n258, n261	dBm	REFSENS + 35.5 dB	REFSENS + 35.5 dB	REFSENS + 35.5 dB	REFSENS + 35.5 dB
$P_{Interferer}$ for band n260	dBm	REFSENS + 34.5 dB	REFSENS + 34.5 dB	REFSENS + 34.5 dB	REFSENS + 34.5 dB
$F_{Ioffset}$	MHz	≤ 100 & ≥ -100 NOTE 5	≤ 200 & ≥ -200 NOTE 5	≤ 400 & ≥ -400 NOTE 5	≤ 800 & ≥ -800 NOTE 5
$F_{Interferer}$	MHz	F_{DL_low} + 25 to F_{DL_high} - 25	F_{DL_low} + 50 to F_{DL_high} - 50	F_{DL_low} + 100 to F_{DL_high} - 100	F_{DL_low} + 200 to F_{DL_high} - 200

NOTE 1: The interferer consists of the Reference measurement channel specified in Annex A with one sided dynamic OCNG Pattern as described in Annex A and set-up according to Annex C.
NOTE2: The REFSENS power level is specified in Section 7.3.2, which are applicable according to different UE power classes.
NOTE 3: The wanted signal consists of the reference measurement channel specified in Annex A QPSK, R=1/3 with one sided dynamic OCNG pattern as described in Annex A and set-up according to Annex C.
NOTE 4: $F_{Ioffset}$ is the frequency separation between the centre of the aggregated CA bandwidth and the centre frequency of the Interferer signal.
NOTE 5: The absolute value of the interferer offset $F_{Ioffset}$ shall be further adjusted to ([| $F_{Interferer}$ | /SCS] + 0.5)SCS$(\lceil|F_{Interferer}|/SCS\rceil + 0.5)SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. Wanted and interferer signal have same SCS.
NOTE 6: $F_{Interferer}$ range values for unwanted modulated interfering signals are interferer centre frequencies.

The normative reference for this requirement is TS 38.101-2 [10] 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 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. The details of the OCNG patterns used are specified in Annex A.5.

Table 7.6.2.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 38.508-1 [10] subclause 4.1	Normal			
Test Frequencies as specified in TS 38.508-1 [10] subclause 4.3.1	Mid range			
Test Channel Bandwidths as specified in TS 38.508-1 [10] subclause 4.3.1	50 MHz, 100 MHz			
Test SCS as specified in Table 5.3.5-1	120 kHz			
Test Parameters				
Test ID	**Downlink Configuration**		**Uplink Configuration**	
	Modulation	**RB allocation**	**Modulation**	**RB allocation**
1	CP-OFDM QPSK	NOTE 1	DFT-s-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of each RB allocation is defined in Table 7.3.2.4.1-1.				

1. Connection between SS and UE is shown in TS 38.508-1 [10] Annex A, in Figure A.3.1.4.1 for TE diagram and section A.3.4 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [10] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.3.1, and uplink signals according to Annex G.0, G.1 and 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 [10] clause 4.5. Message content are defined in clause 7.6.2.4.3.

7.6.2.4.2 Test procedure

1. Set the UE in the Rx beam peak direction found with a Rx beam peack search direcion as performed in Annex K.
2. 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.
3. 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.
4. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200msec for the UE to reach P_{UMAX}.
5. Perform Blocking measurement procedure as stated in Annex K.1.8 using Downlink signal level and Interferer signal level as defined in Table 7.6.2.5-1. Modulated interferer signal characteristics as defined in Annex D. Measure throughput for a duration sufficient to achieve statistical significance according to Annex H.2.
6. Repeat steps using interfering signals specified in 7.6.2.5-1. The ranges 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 [10] subclause 4.6 with TRANSFORM_PRECODER_ENABLED condition in Table 4.6.3-118 PUSCH-Config.

7.6.2.5 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 with parameters specified in Tables 7.6.2.5-1.

Table 7.6.2.5-1: In band blocking test requirement

Rx parameter	Units	Channel bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz
Power in Transmission Bandwidth Configuration for bands n257, n258, n261	dBm	REFSENS + 14dB			
Power in Transmission Bandwidth Configuration for band n260	dBm	REFSENS + 14 - 1.8 dB NOTE 7	REFSENS + 14 - 4.8 dB NOTE 7	REFSENS + 14 dB	REFSENS + 14 dB
$BW_{Interferer}$	MHz	50	100	200	400
$P_{Interferer}$ for bands n257, n258, n261	dBm	REFSENS + 35.5 dB	REFSENS + 35.5 dB	REFSENS + 35.5 dB NOTE 8	REFSENS + 35.5 dB NOTE 8
$P_{Interferer}$ for band n260	dBm	REFSENS + 34.5 - 1.8 dB NOTE 7	REFSENS + 34.5 - 1.8 dB NOTE 7	REFSENS + 34.5 dB NOTE 8	REFSENS + 34.5 dB NOTE 8
$F_{Ioffset}$	MHz	≤ 100 & ≥ -100 NOTE 5	≤ 200 & ≥ -200 NOTE 5	≤ 400 & ≥ -400 NOTE 5	≤ 800 & ≥ -800 NOTE 5
$F_{Interferer}$	MHz	F_{DL_low} + 25 to F_{DL_high} - 25	F_{DL_low} + 50 to F_{DL_high} - 50	F_{DL_low} + 100 to F_{DL_high} - 100	F_{DL_low} + 200 to F_{DL_high} - 200

NOTE 1: The interferer consists of the Reference measurement channel specified in Annex A with one sided dynamic OCNG Pattern as described in Annex A and set-up according to Annex C.

NOTE2: The REFSENS power level is specified in Section 7.3.2, which are applicable according to different UE power classes.

NOTE 3: The wanted signal consists of the reference measurement channel specified in Annex A QPSK, R=1/3 with one sided dynamic OCNG pattern as described in Annex A and set-up according to Annex C.

NOTE 4: $F_{Ioffset}$ is the frequency separation between the centre of the aggregated CA bandwidth and the centre frequency of the Interferer signal.

NOTE 5: The absolute value of the interferer offset $F_{Ioffset}$ shall be further adjusted to ([| $F_{Interferer}$ | /SCS] + 0.5)SCS $([|F_{Interferer}|/SCS] + 0.5)SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. Wanted and interferer signal have same SCS.

NOTE 6: $F_{Interferer}$ range values for unwanted modulated interfering signals are interferer centre frequencies.

NOTE 7: Core requirement cannot be tested due to testability issue and test requirement for wanted signal and interferer includes relaxation to achieve feasible interferer power level.

NOTE 8: Core requirement cannot be tested due to testability issue.

7.6.3 Void

7.6A Blocking characteristics for CA

7.6A.1 General

FFS

7.6A.2 In-band blocking for CA

FFS

7.6D Blocking characteristics for UL MIMO

FFS

7.7 Void

7.8 Void

7.9 Spurious emissions

Editor's note: This test case is not complete. Following aspects are either missing or not yet determined:

- The testability of this test case is pending further analysis on relaxation of the requirement.

- Noise impact for Band n257 (34 to 40 GHz) is to be completed by RAN5#86 (Feb-2020). If by RAN5#86 the noise impact is not concluded, the agreement is to retain 17.2 dB relaxation.

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

FFS

7.9.3 Minimum conformance requirements

The spurious emissions power is the power of emissions generated or amplified in a receiver. The spurious emissions power level is measured as TRP.

The power of any narrow band CW spurious emission shall not exceed the maximum level specified in Table 7.9.3-1. The requirement is verified in beam locked mode with the test metric of TRP (Link=TX beam peak direction).

Table 7.9.3-1: General receiver spurious emission requirements

Frequency range	Measurement bandwidth	Maximum level	NOTE
30MHz ≤ f < 1GHz	100 kHz	-57 dBm	1
1GHz ≤ f ≤ 2nd harmonic of the upper frequency edge of the DL operating band in GHz	1 MHz	-47 dBm	
NOTE 1: Unused PDCCH resources are padded with resource element groups with power level given by PDCCH as defined in Annex C.3.1.			

The normative reference for this requirement is TS 38.101-2 [3] clause 7.9.

7.9.4 Test description

7.9.4.1 Initial conditions

FFS

7.9.4.2 Test procedure

FFS

7.9.4.3 Message contents

FFS

7.9.5 Test requirement

The measured spurious emissions derived in step [TBD], shall not exceed the maximum level specified in Table 7.9.5-1 and 7.9.5-2.

Table 7.9.5-1: General receiver spurious emission requirements (Band n257)

Frequency range	Measurement bandwidth	Maximum level	NOTE
6GHz ≤ f < 20GHz	1 MHz	-47 + 10.2 dBm	1
20GHz ≤ f < 34GHz	1 MHz	-47 + 17.2 dBm	1
34GHz ≤ f < 40GHz	1 MHz	-47 + [17.2] dBm	1
40GHz ≤ f ≤ 2nd harmonic of the upper frequency edge of the DL operating band in GHz	1 MHz	-47 + 33.1 dBm	1
NOTE 1: Unused PDCCH resources are padded with resource element groups with power level given by PDCCH as defined in Annex C.3.1.			

Table 7.9.5-2: General receiver spurious emission requirements (Band n258, n260, n261)

Frequency range	Measurement bandwidth	Maximum level	NOTE
6GHz ≤ f < 20GHz	1 MHz	-47 + [TBD] dBm	1
20GHz ≤ f < 40GHz	1 MHz	-47 + [TBD] dBm	1
40GHz ≤ f ≤ 2nd harmonic of the upper frequency edge of the DL operating band in GHz	1 MHz	-47 + [TBD] dBm	1
NOTE 1: Unused PDCCH resources are padded with resource element groups with power level given by PDCCH as defined in Annex C.3.1.			

7.10 Void

Annex A (normative): Measurement channels

A.1 General

TBD

A.2 UL reference measurement channels

A.2.1 General

TBD

A.2.2 Void

A.2.3 Reference measurement channels for TDD

For UL RMCs defined below, TDD slot pattern defined in Table A.2.3-1 will be used for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, TDD slot patterns defined for reference sensitivity tests in Table A.3.3.1-1 will be used.

Table A.2.3-1 Additional reference channels parameters for TDD

Parameter		Value	
		SCS 60 kHz (μ=2)	**SCS 120 kHz (μ=3)**
UL-DL configuration	*referenceSubcarrierSpacing*	60 kHz	120 kHz
	dl-UL-TransmissionPeriodicity	2 ms	2 ms
	nrofDownlinkSlots	3	7
	nrofDownlinkSymbols	4	12
	nrofUplinkSlot	4	8
	nrofUplinkSymbols	0	0
	UL slot numbers	mod(slot index, 32) = {28,…,31}	mod(slot index, 64) = {56,…,63}

A.2.3.1DFT-s-OFDM Pi/2-BPSK

Table A.2.3.1-1: Reference Channels for DFT-s-OFDM pi/2-BPSK for 60 kHz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 4)	Total number of bits per slot for UL slots (Note 4)	Total modulated symbols per slot for UL slots (Note 4)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-200	60	1	11	pi/2 BPSK	0	1/4	32	16	2	1	132	132
	50-200	60	16	11	pi/2 BPSK	0	1/4	480	16	2	1	2024	2024
	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
	100	60	64	11	pi/2 BPSK	0	1/4	2024	16	2	1	8448	8448
	100	60	128	11	pi/2 BPSK	0	1/4	3976	24	2	2	16896	16896
	200	60	128	11	pi/2 BPSK	0	1/4	3976	24	2	2	16896	16896
	200	60	256	11	pi/2 BPSK	0	1/4	7944	24	2	3	33792	33792

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 [23].
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).
Note 4: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

Table A.2.3.1-2: Reference Channels for DFT-s-OFDM pi/2-BPSK for 120 kHz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 4)	Total number of bits per slot for UL slots (Note 4)	Total modulated symbols per slot for UL slots (Note 4)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-400	120	1	11	pi/2 BPSK	0	1/4	32	16	2	1	132	132
	50	120	16	11	pi/2 BPSK	0	1/4	504	16	2	1	2112	2112
	50	120	32	11	pi/2 BPSK	0	1/4	1032	16	2	1	4224	4224
	100	120	32	11	pi/2 BPSK	0	1/4	1032	16	2	1	4224	4224
	100	120	64	11	pi/2 BPSK	0	1/4	2024	16	2	1	8448	8448
	200	120	64	11	pi/2 BPSK	0	1/4	2024	16	2	1	8448	8448
	200	120	128	11	pi/2 BPSK	0	1/4	3976	24	2	2	16896	16896
	400	120	128	11	pi/2 BPSK	0	1/4	3976	24	2	2	16896	16896
	400	120	256	11	pi/2 BPSK	0	1/4	7944	24	2	3	33792	33792

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 [23].
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).
Note 4: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

A.2.3.2 DFT-s-OFDM QPSK

Table A.2.3.2-1: Reference Channels for DFT-s-OFDM QPSK for 60 kHz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 4)	Total number of bits per slot for UL slots (Note 4)	Total modulated symbols per slot for UL slots (Note 4)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-200	60	1	11	QPSK	2	1/6	56	16	2	1	264	132
	50-200	60	16	11	QPSK	2	1/6	768	16	2	1	4048	2024
	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
	100	60	64	11	QPSK	2	1/6	3240	16	2	1	16896	8448
	100	60	128	11	QPSK	2	1/6	6408	24	2	2	33792	16896
	200	60	128	11	QPSK	2	1/6	6408	24	2	2	33792	16896
	200	60	256	11	QPSK	2	1/6	12808	24	2	4	67584	33792

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 [23].
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).
Note 4: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

Table A.2.3.2-2: Reference Channels for DFT-s-OFDM QPSK for 120 kHz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 4)	Total number of bits per slot for UL slots (Note 4)	Total modulated symbols per slot for UL slots (Note 4)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-400	120	1	11	QPSK	2	1/6	56	16	2	1	264	132
	50	120	16	11	QPSK	2	1/6	808	16	2	1	4224	2112
	50	120	32	11	QPSK	2	1/6	1608	16	2	1	8448	4224
	100	120	20	11	QPSK	2	1/6	984	16	2	1	5060	2530
	100	120	32	11	QPSK	2	1/6	1608	16	2	1	8448	4224
	100	120	64	11	QPSK	2	1/6	3240	16	2	1	16896	8448
	200	120	64	11	QPSK	2	1/6	3240	16	2	1	16896	8448
	200	120	128	11	QPSK	2	1/6	6408	24	2	2	33792	16896
	400	120	128	11	QPSK	2	1/6	6408	24	2	2	33792	16896
	400	120	256	11	QPSK	2	1/6	12808	24	2	4	67584	33792

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 [23].
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).
Note 4: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

A.2.3.3 DFT-s-OFDM 16QAM

Table A.2.3.3-1: Reference Channels for DFT-s-OFDM 16QAM for 60 kHz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 4)	Total number of bits per slot for UL slots (Note 4)	Total modulated symbols per slot for UL slots (Note 4)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-200	60	1	11	16QAM	10	1/3	176	16	2	1	528	132
	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
	100	60	64	11	16QAM	10	1/3	11272	24	1	2	33792	8448
	100	60	128	11	16QAM	10	1/3	22536	24	1	3	67584	16896
	200	60	128	11	16QAM	10	1/3	22536	24	1	3	67584	16896
	200	60	256	11	16QAM	10	1/3	45096	24	1	6	135168	33792

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 [23].
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.
Note 5: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

Table A.2.3.3-2: Reference Channels for DFT-s-OFDM 16QAM for 120 kHz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 4)	Total number of bits per slot for UL slots (Note 4)	Total modulated symbols per slot for UL slots (Note 4)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-400	120	1	11	16QAM	10	1/3	176	16	2	1	528	132
	50	120	16	11	16QAM	10	1/3	2792	16	2	1	8448	2112
	50	120	32	11	16QAM	10	1/3	5632	24	1	1	16896	4224
	100	120	32	11	16QAM	10	1/3	5632	24	1	1	16896	4224
	100	120	64	11	16QAM	10	1/3	11272	24	1	2	33792	8448
	200	120	64	11	16QAM	10	1/3	11272	24	1	2	33792	8448
	200	120	128	11	16QAM	10	1/3	22536	24	1	3	67584	16896
	400	120	128	11	16QAM	10	1/3	22536	24	1	3	67584	16896
	400	120	256	11	16QAM	10	1/3	45096	24	1	6	135168	33792

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 [23].

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.

Note 4: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

A.2.3.4 DFT-s-OFDM 64QAM

Table A.2.3.4-1: Reference Channels for DFT-s-OFDM 64QAM for 60 kHz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 4)	Total number of bits per slot for UL slots (Note 4)	Total modulated symbols per slot for UL slots (Note 4)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-200	60	1	11	64QAM	18	1/2	408	16	2	1	792	132
	50	60	32	11	64QAM	18	1/2	12808	24	1	2	25344	4224
	50	60	64	11	64QAM	18	1/2	25608	24	1	4	50688	8448
	100	60	64	11	64QAM	18	1/2	25608	24	1	4	50688	8448
	100	60	128	11	64QAM	18	1/2	51216	24	1	7	101376	16896
	200	60	128	11	64QAM	18	1/2	51216	24	1	7	101376	16896
	200	60	256	11	64QAM	18	1/2	102416	24	1	13	202752	33792

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 [23].
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.
Note 4: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

Table A.2.3.4-2: Reference Channels for DFT-s-OFDM 64QAM for 120 kHz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 4)	Total number of bits per slot for UL slots (Note 4)	Total modulated symbols per slot for UL slots (Note 4)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-400	120	1	11	64QAM	18	1/2	408	16	2	1	792	132
	50	120	16	11	64QAM	18	1/2	6400	24	1	1	12672	2112
	50	120	32	11	64QAM	18	1/2	12808	24	1	2	25344	4224
	100	120	32	11	64QAM	18	1/2	12808	24	1	2	25344	4224
	100	120	64	11	64QAM	18	1/2	25608	24	1	4	50688	8448
	200	120	64	11	64QAM	18	1/2	25608	24	1	4	50688	8448
	200	120	128	11	64QAM	18	1/2	51216	24	1	7	101376	16896
	400	120	128	11	64QAM	18	1/2	51216	24	1	7	101376	16896
	400	120	256	11	64QAM	18	1/2	102416	24	1	13	202752	33792

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 [23].

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.

Note 4: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

A.2.3.5 CP-OFDM QPSK

Table A.2.3.5-1: Reference Channels for CP-OFDM QPSK for 60 kHz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 4)	Total number of bits per slot for UL slots (Note 4)	Total modulated symbols per slot for UL slots (Note 4)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-200	60	1	11	QPSK	2	1/6	56	16	2	1	264	132
	50-200	60	16	11	QPSK	2	1/6	768	16	2	1	4048	2024
	50	60	33	11	QPSK	2	1/6	1672	16	2	1	8712	4356
	50	60	66	11	QPSK	2	1/6	3368	16	2	1	17424	8712
	100	60	66	11	QPSK	2	1/6	3368	16	2	1	17424	8712
	100	60	132	11	QPSK	2	1/6	6536	24	2	2	34848	17424
	200	60	132	11	QPSK	2	1/6	6536	24	2	2	34848	17424
	200	60	264	11	QPSK	2	1/6	13064	24	2	4	69696	34848

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 [23].
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)
Note 4: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

Table A.2.3.5-2: Reference Channels for CP-OFDM QPSK for 120 kHz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 4)	Total number of bits per slot for UL slots (Note 4)	Total modulated symbols per slot for UL slots (Note 4)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-400	120	1	11	QPSK	2	1/6	56	16	2	1	264	132
	50	120	16	11	QPSK	2	1/6	808	16	2	1	4224	2112
	50	120	32	11	QPSK	2	1/6	1608	16	2	1	8448	4224
	100	120	33	11	QPSK	2	1/6	1672	16	2	1	8712	4356
	100	120	66	11	QPSK	2	1/6	3368	16	2	1	17424	8712
	200	120	66	11	QPSK	2	1/6	3368	16	2	1	17424	8712
	200	120	132	11	QPSK	2	1/6	6536	24	2	2	34848	17424
	400	120	132	11	QPSK	2	1/6	6536	24	2	2	34848	17424
	400	120	264	11	QPSK	2	1/6	13064	24	2	4	69696	34848

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 [23].
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)
Note 4: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

A.2.3.6 CP-OFDM 16QAM

Table A.2.3.6-1: Reference Channels for CP-OFDM 16QAM for 60 kHz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 4)	Total number of bits per slot for UL slots (Note 4)	Total modulated symbols per slot for UL slots (Note 4)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-200	60	1	11	16QAM	10	1/3	176	16	2	1	528	132
	50	60	33	11	16QAM	10	1/3	5760	24	1	1	17424	4356
	50	60	66	11	16QAM	10	1/3	11528	24	1	2	34848	8712
	100	60	66	11	16QAM	10	1/3	11528	24	1	2	34848	8712
	100	60	132	11	16QAM	10	1/3	23040	24	1	3	69696	17424
	200	60	132	11	16QAM	10	1/3	23040	24	1	3	69696	17424
	200	60	264	11	16QAM	10	1/3	46104	24	1	6	139392	34848

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 [23].
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.
Note 4: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

Table A.2.3.6-2: Reference Channels for CP-OFDM 16QAM for 120 kHz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 4)	Total number of bits per slot for UL slots (Note 4)	Total modulated symbols per slot for UL slots (Note 4)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-400	120	1	11	16QAM	10	1/3	176	16	2	1	528	132
	50	120	16	11	16QAM	10	1/3	2792	16	2	1	8448	2112
	50	120	32	11	16QAM	10	1/3	5632	24	1	1	16896	4224
	100	120	33	11	16QAM	10	1/3	5760	24	1	1	17424	4356
	100	120	66	11	16QAM	10	1/3	11528	24	1	2	34848	8712
	200	120	66	11	16QAM	10	1/3	11528	24	1	2	34848	8712
	200	120	132	11	16QAM	10	1/3	23040	24	1	3	69696	17424
	400	120	132	11	16QAM	10	1/3	23040	24	1	3	69696	17424
	400	120	264	11	16QAM	10	1/3	46104	24	1	6	139392	34848

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 [23].

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.

Note 5: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

A.2.3.7 CP-OFDM 64QAM

Table A.2.3.7-1: Reference Channels for CP-OFDM 64QAM for 60k Hz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 5)	Total number of bits per slot for UL slots (Note 5)	Total modulated symbols per slot for UL slots (Note 5)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-200	60	1	11	64QAM	19	1/2	408	16	2	1	792	132
	50	60	33	11	64QAM	19	1/2	13064	24	1	2	26136	4356
	50	60	66	11	64QAM	19	1/2	26120	24	1	4	52272	8712
	100	60	66	11	64QAM	19	1/2	26120	24	1	4	52272	8712
	100	60	132	11	64QAM	19	1/2	53288	24	1	7	104544	17424
	200	60	132	11	64QAM	19	1/2	53288	24	1	7	104544	17424
	200	60	264	11	64QAM	19	1/2	106576	24	1	13	209088	34848

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 [23].

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.

Note 4: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

Table A.2.3.7-2: Reference Channels for CP-OFDM 64QAM for 120 kHz 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 UL slots (Note 4)	Transport block CRC	LDPC Base Graph	Number of code blocks per slot for UL slots (Note 3, Note 4)	Total number of bits per slot for UL slots (Note 4)	Total modulated symbols per slot for UL slots (Note 4)
Unit	MHz	kHz						Bits	Bits			Bits	
	50-400	120	1	11	64QAM	19	1/2	408	16	2	1	792	132
	50	120	16	11	64QAM	19	1/2	6400	24	1	1	12672	2112
	50	120	32	11	64QAM	19	1/2	12808	24	1	2	25344	4224
	100	120	33	11	64QAM	19	1/2	13064	24	1	2	26136	4356
	100	120	66	11	64QAM	19	1/2	26120	24	1	4	52272	8712
	200	120	66	11	64QAM	19	1/2	26120	24	1	4	52272	8712
	200	120	132	11	64QAM	19	1/2	53288	24	1	7	104544	17424
	400	120	132	11	64QAM	19	1/2	53288	24	1	7	104544	17424
	400	120	264	11	64QAM	19	1/2	106576	24	1	13	209088	34848

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 [23].
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.
Note 5: UL slot numbers are given by Table A.2.3-1 with TDD UL-DL configuration specified in A2.3 for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, UL slot numbers are given by the slots satisfying mod(slot index+1, 5) = 0 with TDD UL-DL configuration specified in A.3.3.1.

A.3 DL reference measurement channels

A.3.1 General

Unless otherwise stated, Tables A.3.3.2-1 and A.3.3.2-2 are applicable for measurements of the Receiver Characteristics (clause 7).

Unless otherwise stated, Tables A.3.3.2-1 and A.3.3.2-2 also apply for the modulated interferer used in Clauses 7.5 and 7.6 with test specific bandwidths.

CSI-RS configuration parameter defined in A.3.1-2 is used for verifying the beam correspondence requirement, 2 slots of CSI-RS shall be provided at each test grid point. The DL channel shall be configured for zero power on all tones except those used by CSI-RS in slots containing CSI-RS for beam refinement, and the DL and UL channel sizes shall be the same during verification.

Table A.3.1-1 Test 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
MCS table for TBS determination		64QAM
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		1 slot, periodicity 10 ms, offset 0
PTRS configuration		PTRS is not configured

Table A.3.1-2: CSI-RS parameters

Resource Type	aperiodic
Resource Set Config	
repetition	on
aperiodicTriggeringOffset	Depending on UE capability
Resource Config	
nzp-CSI-RS-ResourceId	30 for resource #0 31 for resource #1 32 for resource #2 33 for resource #3 34 for resource #4 35 for resource #5 36 for resource #6 37 for resource #7
powerControlOffset	0
powerControlOffsetSS	db0
nrofPorts	1
firstOFDMSymbolInTimeDomain	6 for resource #0 7 for resource #1 8 for resource #2 9 for resource #3 10 for resource #4 11 for resource #5 12 for resource #6 13 for resource #7
cdm-Type	noCDM
density	3
nrofRBs	48 for channel bandwdith≥100MHz 32 for channel bandwidth=50MHz
qcl-info	Type D to SSB

A.3.2 Void

A.3.3 DL reference measurement channels for TDD

A.3.3.1 General

Table A.3.3.1-1: Additional test parameters for TDD

Parameter		Value	
		SCS 60 kHz (μ=2)	**SCS 120 kHz (μ=3)**
UL-DL configuration	*referenceSubcarrierSpacing*	60 kHz	120 kHz
	dl-UL-TransmissionPeriodicity	1.25 ms	0.625 ms
	nrofDownlinkSlots	3	3
	nrofDownlinkSymbols	4	10
	nrofUplinkSlot	1	1
	nrofUplinkSymbols	4	2
Number of HARQ Processes		8	8
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,…,39}	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,…,79}

A.3.3.2 FRC for receiver requirements for QPSK

Table A.3.3.2-1: Fixed Reference Channel for Receiver Requirements (SCS 60 kHz, TDD)

Parameter	Unit	Value		
Channel bandwidth	MHz	50	100	200
Subcarrier spacing configuration μ		2	2	2
Allocated resource blocks		66	132	264
Subcarriers per resource block		12	12	12
Allocated slots per Frame		23	23	23
MCS index		4	4	4
Modulation		QPSK	QPSK	QPSK
Target Coding Rate		1/3	1/3	1/3
Maximum number of HARQ transmissions		1	1	1
Information Bit Payload per Slot				
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,39} (NOTE 5)	Bits	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,39} (NOTE 6)	Bits	4224	8456	16896
Transport block CRC	Bits	24	24	24
LDPC base graph		1	1	1
Number of Code Blocks per Slot				
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,39} (NOTE 5)	CBs	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,39} (NOTE 6)	CBs	1	2	2
Binary Channel Bits Per Slot				
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,39} (NOTE 5)	Bits	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,39} (NOTE 6)	Bits	14256	28512	57024
Max. Throughput averaged over 1 frame	Mbps	9.715	19.449	38.861

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
Note 5: When this DL RMC used together with the UL RMC for the transmitter requirements requiring at least one sub frame (1ms) for the measurement period, Slot i, if mod(i, 8) = {3,4,5,6,7} for i from {0,…,39} together with the TDD UL-DL configuration specified in A2.3.
Note 6: When this DL RMC used together with the UL RMC for the transmitter requirements requiring at least one sub frame (1ms) for the measurement period, Slot i, if mod(i, 8) = {0,1,2} for i from {0,…,39} together with the TDD UL-DL configuration specified in A2.3.

Table A.3.3.2-2: Fixed Reference Channel for Receiver Requirements (SCS 120 kHz, TDD)

Parameter	Unit	Value			
Channel bandwidth	MHz	50	100	200	400
Subcarrier spacing configuration μ		3	3	3	3
Allocated resource blocks		32	66	132	264
Subcarriers per resource block		12	12	12	12
Allocated slots per Frame		47	47	47	47
MCS index		4	4	4	4
Modulation		QPSK	QPSK	QPSK	QPSK
Target Coding Rate		1/3	1/3	1/3	1/3
Maximum number of HARQ transmissions		1	1	1	1
Information Bit Payload per Slot					
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,79} (NOTE 5)	Bits	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79} (NOTE 6)	Bits	2088	4224	8456	16896
Transport block CRC	Bits	16	24	24	24
LDPC base graph		2	1	1	1
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,79} (NOTE 5)	CBs	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79} (NOTE 6)	CBs	1	1	2	2
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,79} (NOTE 5)	Bits	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79} (NOTE 6)	Bits	6912	14256	28512	57024
Max. Throughput averaged over 1 frame	Mbps	9.814	19.853	39.743	79.411
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 Note 5: When this DL RMC used together with the UL RMC for the transmitter requirements requiring at least one sub frame (1ms) for the measurement period, Slot i, if mod(i, 16) = {7,…,15} for i from {0,…,79} together with the TDD UL-DL configuration specified in A2.3. Note 6: When this DL RMC used together with the UL RMC for the transmitter requirements requiring at least one sub frame (1ms) for the measurement period, Slot i, if mod(i, 16) = {0,…,6} for i from {0,…,79} together with the TDD UL-DL configuration specified in A2.3.					

A.3.3.3 FRC for receiver requirements for 16QAM

TBD

A.3.3.4 FRC for receiver requirements for 64QAM

Table A.3.3.4-1 Fixed Reference Channel for Receiver Requirements (SCS 60 kHz, TDD)

Parameter	Unit	Value		
Channel bandwidth	MHz	50	100	200
Subcarrier spacing configuration μ		2	2	2
Allocated resource blocks		66	132	264
Subcarriers per resource block		12	12	12
Allocated slots per Frame		23	23	23
MCS index		19	19	19
Modulation		64QAM	64QAM	64QAM
Target Coding Rate		1/2	1/2	1/2
Maximum number of HARQ transmissions		1	1	1
Information Bit Payload per Slot				
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,39}	Bits	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {0,1,2} for i from {1,…,39}	Bits	20496	40976	81976
Transport block CRC	Bits	24	24	24
LDPC base graph		1	1	1
Number of Code Blocks per Slot				
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,39}	CBs	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {0,1,2} for i from {1,…,39}	CBs	3	5	10
Binary Channel Bits Per Slot				
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,39}	Bits	N/A	N/A	N/A
For Slot i, if mod(i, 10) = {0,1,2} for i from {1,…,39}	Bits	40986	81972	163944
Max. Throughput averaged over 1 frame	Mbps	47.141	94.245	188.545
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 Note 5: PTRS is configured on symbols containing PDSCH with 1 port, per 2PRB in frequency domain, per symbol in time domain. Overhead for TBS calculation is assumed to be 6.				

Table A.3.3.4-2 Fixed Reference Channel for Receiver Requirements (SCS 120 kHz, TDD)

Parameter	Unit	Value			
Channel bandwidth	MHz	50	100	200	400
Subcarrier spacing configuration μ		3	3	3	3
Allocated resource blocks		32	66	132	264
Subcarriers per resource block		12	12	12	12
Allocated slots per Frame		47	47	47	47
MCS index		19	19	19	19
Modulation		64QAM	64QAM	64QAM	64QAM
Target Coding Rate		1/2	1/2	1/2	1/2
Maximum number of HARQ transmissions		1	1	1	1
Information Bit Payload per Slot					
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,79}	Bits	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79}	Bits	9992	20496	40976	81976
Transport block CRC	Bits	24	24	24	24
LDPC base graph		1	1	1	1
Number of Code Blocks per Slot					
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,79}	CBs	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79}	CBs	2	3	5	10
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if mod(i, 5) = {3,4} for i from {0,…,79}	Bits	N/A	N/A	N/A	N/A
For Slot i, if mod(i, 5) = {0,1,2} for i from {1,…,79}	Bits	19872	40986	81972	163944
Max. Throughput averaged over 1 frame	Mbps	46.962	96.331	192.587	385.287
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 Note 5: PTRS is configured on symbols containing PDSCH with 1 port, per 2PRB in frequency domain, per symbol in time domain. Overhead for TBS calculation is assumed to be 6.					

A.4 Void

A.5 OFDMA Channel Noise Generator (OCNG)

A.5.1 OCNG Patterns for FDD

TBD

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

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

Editor's Note : Consideration to minimize the required number of additional FR2 link is under discussion

The downlink power settings in Table C.0-1 is used unless otherwise specified in a test case.

Table C.0-1: Default Downlink power levels for NR

SCS (kHz)		Unit	Channel Bandwidth			
			50 MHz	100 MHz	200 MHz	400 MHz
60	Number of RBs		66	132	264	N/A
	Channel BW power	dBm	-70	-67	-64	N/A
120	Number of RBs		32	66	132	264
	Channel BW power	dBm	-70	-67	-64	-61
	SS/PBCH SSS EPRE	dBm/60kHz	[-99]	[-99]	[-99]	[-99]

Note 1: The channel bandwidth powers are informative, based on [-99]dBm/60kHz 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 the centre of quiet zone.
Note 3: DL level is applied for any of the Subcarrier Spacing configuration (μ) with the same power spectrum density of [–99]dBm/60kHz.

The default downlink signal level uncertainty is +/- TBD dB, 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.

For TRP measurement, DL signal may be supplied from RSRP based pathloss compensation link. Downlink signal level using RSRP based pathloss compensation link is specified in Table C.0-2 or Table C.0-3.

Table C.0-2: Downlink power levels for RSRP based pathloss compensation link for TRP measurement for n257, n258 and n260

SCS (kHz)		Unit	Channel Bandwidth			
			50 MHz	100 MHz	200 MHz	400 MHz
60	Number of RBs		66	132	264	N/A
	Channel BW power	dBm	≥ -87	≥ -84	≥ -80	N/A
120	Number of RBs		32	66	132	264
	Channel BW power	dBm	≥ -87	≥ -84	≥ -80	≥ -77
	SS/PBCH SSS EPRE	dBm/60kHz	≥ -115.5	≥ -115.5	≥ -115.5	≥ -115.5

Note 1: The channel bandwidth powers are informative, based on -115.5dBm/60kHz 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 the RSRP reference point as defined in TS 38.215 [24].
Note 3: DL level is applied for any of the Subcarrier Spacing configuration (μ) with the same power spectrum density of ≥ –115.5 dBm/60kHz.

Table C.0-3: Downlink power levels for RSRP based pathloss compensation link for TRP measurement for n261

SCS (kHz)		Unit	Channel Bandwidth			
			50 MHz	100 MHz	200 MHz	400 MHz
60	Number of RBs		66	132	264	N/A
	Channel BW power	dBm	≥ -84	≥ -81	≥ -78	N/A
120	Number of RBs		32	66	132	264
	Channel BW power	dBm	≥ -84	≥ -81	≥ -78	≥ -75
	SS/PBCH SSS EPRE	dBm/60kHz	≥ -113	≥ -113	≥ -113	≥ -113
Note 1: The channel bandwidth powers are informative, based on -113dBm/60kHz 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 the RSRP reference point as defined in TS 38.215 [24]. Note 3: DL level is applied for any of the Subcarrier Spacing configuration (μ) with the same power spectrum density of ≥ –113 dBm/60kHz.						

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
PTRS

As common PDSCH and PDCCH configuration parameters the parameters in Table A.3.1-1, C.2-2, C.2-3, and C.2-4 shall be used to bring up the connection setup for FR1 NR cell.

Table C.2-2: PDSCH and PDCCH configuration

Parameter	Unit	Value
Number of HARQ processes		8 (TDD)
Aggregation level	CCE	4

Table C.2-3: Additional test parameters for TDD for SCS 60 KHz

Parameter		Unit	UL-DL pattern
TDD Slot Configuration pattern (Note 1)			DDSU
Special Slot Configuration (Note 2)			11D+3G+0U
UL-DL configuration (*tdd-UL-DL-ConfigurationCommon*)	*referenceSubcarrierSpacing*	kHz	60
	dl-UL-TransmissionPeriodicity	ms	1
	nrofDownlinkSlots		2

	nrofDownlinkSymbols		11
	nrofUplinkSlot		1
	nrofUplinkSymbols		0
K1 value (PDSCH-to-HARQ-timing-indicator)			K1 = 3 if mod(i,4) = 0 K1 = 2 if mod(i,4) = 1 K1 = 5 if mod(i,4) = 2
Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information. Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information. Note 3: i is the slot index per frame; i = {0,…,39}			

Table C.2-4: Additional test parameters for TDD for SCS 120 KHz

Parameter		Unit	UL-DL pattern
TDD Slot Configuration pattern (Note 1)			DDDSU
Special Slot Configuration (Note 2)			10D+2G+2U
UL-DL configuration (*tdd-UL-DL-ConfigurationCommon*)	*referenceSubcarrierSpacing*	kHz	120
	dl-UL-TransmissionPeriodicity	ms	0.625
	nrofDownlinkSlots		3
	nrofDownlinkSymbols		10
	nrofUplinkSlot		1
	nrofUplinkSymbols		2
K1 value (PDSCH-to-HARQ-timing-indicator)			K1 = [4] if mod(i,5) = 0 K1 = [3] if mod(i,5) = 1 K1 = [2] if mod(i,5) = 2 K1 = [6] if mod(i,5) = 3
Note 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information. Note 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information. Note 3: i is the slot index per frame; i = {0,…,79}			

C.3 Connection

C.3.0 Measurement of Transmitter Characteristics

Unless otherwise stated, Table C.3.0-1 is applicable for measurements on the Transmitter Characteristics (clause 6).

Table C.3.0-1: Downlink Physical Channels transmitted during a connection (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.		

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 (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

Unless otherwise stated, a modulated full bandwidth NR downlink signal, which equals to channel bandwidth of the wanted signal for Single Carrier case is used as interfering signals when RF performance requirements for NR UE receiver are defined. For intra-band contiguous CA case, a modulated NR downlink signal which equals to the aggregated channel bandwidth of the wanted signal is used.

D.2 Interference signals

Table D.2-1 describes the modulated interferer for different channel bandwidth options.

Table D.2-1: Description of modulated NR interferer

	Channel bandwidth for Single Carrier				Intra band contiguous CA
	50 MHz	100 MHz	200 MHz	400 MHz	
$BW_{Interferer}$	50 MHz	100 MHz	200 MHz	400MHz	$BW_{Channel\_CA}$
RB	NOTE1				
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.					

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 TDD with normal CP length and 100 MHz bandwidth with 60 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, the *n* slots should be extracted from more than 1 continuous radio frame where

$$n = \begin{cases} 30, \text{ for 60 kHz SCS} \\ 60, \text{ for 120 kHz SCS} \end{cases}.$$

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 Mbps in the time domain.

The reference signal $i_2(v)$ 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 Mbps 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”.

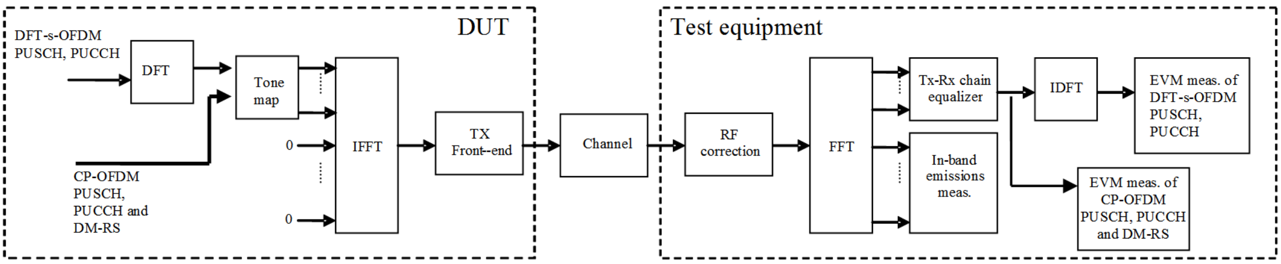


Figure E.2.5-1: EVM measurement points

E.3 Signal processing

E.3.1 Pre FFT minimization process

Before applying the pre-FFT minimization process, z(v) and i(v) are portioned into n pieces, comprising one slot each, where

$$n = \begin{cases} 80, & \text{for 60 kHz SCS} \\ 160, & \text{for 120 kHz SCS} \end{cases}.$$

Each slot is processed separately. Sample timing, Carrier frequency and carrier leakage in z(v) are jointly varied in order to minimise the difference between z(v) and i(v). Best fit (minimum difference) is achieved when the RMS difference value between z(v) and i(v) 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 2048 samples per OFDM symbol. 14 FFTs (28672 samples) cover less than the acquired number of samples (30720 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.

For all calculations, except EVM, the number of samples in $z^0(\nu)$ is reduced to 14 blocks of samples, comprising 2048 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 2048 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: (TDD, normal CP length)

$\Delta\tilde{c}$ is on T_f=72 (=CP/2) within the CP of length 144 FFT samples (in OFDM symbols except 0 and 28 (=$7 \cdot 2^{\mu}$), where symbol 0 is the first symbol of each subframe) for channel bandwidth of 100 MHz and SCS = 60 kHz.

$\Delta\tilde{c}$ is on T_f=88 (=160-72) within the CP of length 160 FFT samples (in OFDM symbol 0 and 28 (=$7 \cdot 2^{\mu}$), where symbol 0 is the first symbol of each subframe) for channel bandwidth of 100 MHz and SCS = 60 kHz.

E.3.3 Post FFT equalisation

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 2048 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 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

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

$$n = \begin{cases} 30, \text{ for 60 kHz SCS} \\ 60, \text{ for 120 kHz SCS} \end{cases}$$

for PUCCH, PUSCH.

The averaging is done separately for timing $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2 leading to $\overline{EVM}_l$ and $\overline{EVM}_h$

$EVM_{\text{final}} = \max(\overline{\text{EVM}}_l, \overline{\text{EVM}}_h)$ 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:

$$P_{RB} = \frac{1}{|T_s| \cdot L_{CRBs}} \sum_{t \in T_S} \sum_{c_1}^{c_1 + (12 \cdot L_{CRBs} - 1) \cdot \Delta f} |\mathrm{MS}(t,f)|^2 [\mathrm{dBm}/(12\Delta f)]$$

$$P_{All-RBs} = \frac{1}{|T_s|} \sum_{t \in T_S} \sum_{c_l}^{c_l + (12 \cdot L_{CRBs} - 1) * \Delta f} |\mathrm{MS}(t, f)|^2 \ [\mathrm{dBm}]$$

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:

$$Emissions_{relative} = 10 \cdot \log_{10}\left(\frac{Emissions_{absolute}(RBnextDC)}{\frac{1}{|T_s|} \sum_{t \in T_S} \sum_{c_l}^{c_l + (12 \cdot L_{CRBs} - 1) \cdot \Delta f} |\mathrm{MS}(t,f)|^2}\right) [\mathrm{dBc}]$$
$$= Emissions_{absolute}(RBnextDC) [\mathrm{dBm}/12\Delta f] - P_{All\ RBs}[\mathrm{dBm}]$$

where RBnextDC means: Resource Block next to the carrier.

This can be 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. n values or n pairs of carrier leakage inband emissions can be derived. They are compared against different limits.

The in-band emissions are averaged over the *n* samples (equivalent to 10 UL subframes):

$$\overline{Emissions}_{absolute}(\Delta_{RB}) = \frac{1}{n}\sum_{i=1}^{n} Emissions_{absolute,i}(\Delta_{RB})$$

$$\overline{Emissions}_{relative}(\Delta_{RB}) = 10*\log_{10}\left(\frac{1}{n}\sum_{i=1}^{n}10^{Emissions_{relative,i}(\Delta_{RB})/10}\right)[dB]$$

$$\overline{Emissions}_{relative} = 10*\log_{10}\left(\frac{1}{n}\sum_{i=1}^{n}10^{Emissions_{relative,i}/10}\right)[dBc]$$

E.4.4 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.

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 in Table 6.5.2.4.5-1 for normal condition and Table 6.5.2.4.5-2 for extreme condition

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.4.5 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. (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

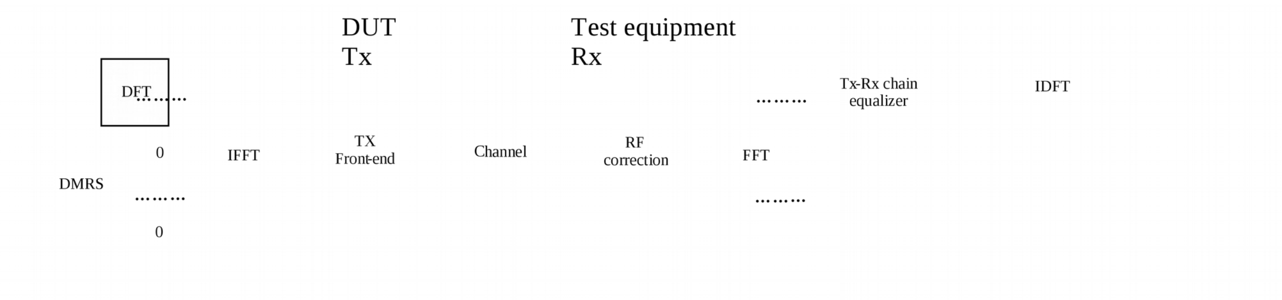


Figure E.4.6-1: EVM$_{DMRS}$ measurement points

Re-use the following formula from E.3.3:

Z'(f,t) = MS(f,t) · 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.

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

$$1stEVM_{DMRS} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(EVM_{DMRS,i}\right)^2}$$

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 (6,15,25,50,75,100 RBs).

The EVM for PUCCH (EVM_{PUCCH}) is averaged over *n* slots, where

$$n = \begin{cases} 30, \text{ for 60 kHz SCS} \\ 60, \text{ for 120 kHz SCS} \end{cases}.$$

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 7 (depending on the format, configuration and cyclic prefix length), the text below uses 7 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 the 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 2048 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 <u>M</u>easured data-<u>S</u>ymbols and reference-<u>S</u>ymbols (MS(f,t))

versus an array of <u>N</u>ominal data-<u>S</u>ymbols and reference <u>S</u>ymbols (NS(f,t))

The arrays comprise in sum 7 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)

$$EC(f) = \frac{\sum_{t=0}^{6} NS(f,t)^{*} NS(f,t)}{\sum_{t=0}^{6} MS(f,t)^{*} NS(f,t)}$$

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 7 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|= 5)

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

E.5.9.2 Averaged EVM_{PUCCH}

EVM_{PUCCH} is averaged over all basic EVM_{PUCCH} measurements

The averaging comprises *n* UL slots

$$\overline{EVM}_{PUCCH} = \sqrt{\frac{1}{n} \sum_{i=1}^{n} \left(EVM_{PUCCH,i} \right)^2}$$

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 system BW,

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

$$Emissions_{relative}(\Delta_{RB}) = 10*\log_{10}\frac{Emissions_{absolute}(\Delta_{RB})}{\frac{1}{|T_s|\cdot L_{CRBs}}\sum_{t\in T_s}\sum_{c_l}^{c_l+(12\cdot L_{CRBs}-1)*\Delta f}|MS(t,f)|^2}[dB]$$

where

L_{CRBs} is the number of allocated RBs,

and $MS(t,f)$ 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.

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:

$$\overline{Emissions}_{absolute}(\Delta_{RB}) = \frac{1}{n}\sum_{i=1}^{n} Emissions_{absolute,i}(\Delta_{RB})$$

$$\overline{Emissions}_{relative}(\Delta_{RB}) = 10*\log_{10}\left(\frac{1}{n}\sum_{i=1}^{n} 10^{Emissions_{relative,i}(\Delta_{RB})/10}\right)[dB]$$

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 B4 without excluding the other formats. The sampling rate for the PUSCH, 122.88 Mbps in the time domain, is re-used for the PRACH. The carrier spacing of the PUSCH is up to 48 times higher than that of PRACH depending on the PRACH format and SCS. This results in an oversampling factor *ovf* of up to 48, when acquiring the time samples for the PRACH. The pre-FFT algorithms (clauses E.6.6 and E.6.7) use all time samples, although oversampled. For the FFT the time samples are decimated by the *ovf*, resulting in the same FFT size as for the other transmit modulation tests. Decimation requires a decision, which samples are used and which ones are rejected. The algorithm in E.6.6, Timing of the FFT window, can also be used to decide about the used samples.

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 [9] and 10 preambles are recorded for short preamble formats as defined in Table 6.3.3.1-2 in [9].

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 Mbps 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:

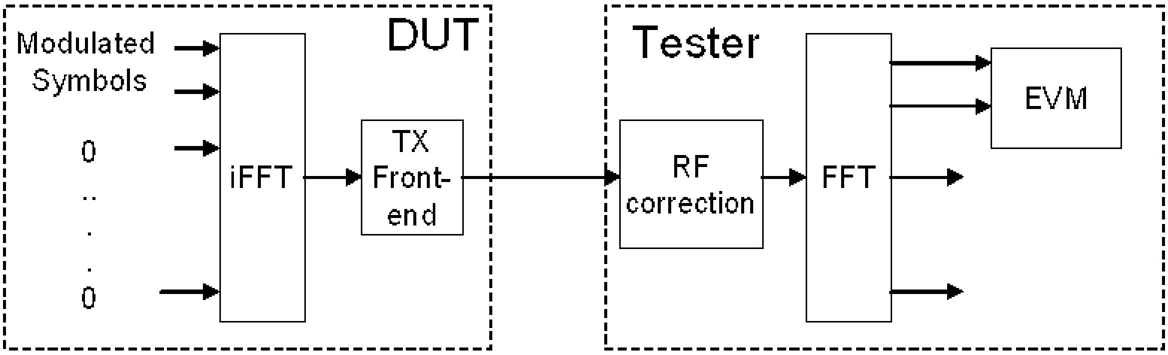


Figure E.6.5-1: Measurement points

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(v) are jointly varied in order to minimise the difference between z(v) and i(v). Best fit (minimum difference) is achieved when the RMS difference value between z(v) and i(v) is an absolute minimum.

After this process the samples z(v) are called $z^0(v)$.

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 $8192 \cdot 2^{-\mu}$ samples for preamble format B4, however in the measurement period at least $11936 \cdot 2^{-\mu}$ samples are taken where $\mu \in \{2,3\}$. 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 $z^0(v)$ with respect to the ideal signal i(v) is determined in the pre FFT domain as follows:

Correlation between $z^0(v)$ and i(v) 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 $L_{RA} = 139$ and $\Delta f^{RA} = 15 \cdot 2^{\mu}$ kHz where $\mu \in \{2,3\}$.

Table E.6.7-1 EVM window length for PRACH formats for L_{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	$1152 \cdot 2^{-\mu}$	$8192 \cdot 2^{-\mu}$	$576 \cdot 2^{-\mu}$	50.0%
A2	$2304 \cdot 2^{-\mu}$	$8192 \cdot 2^{-\mu}$	$1728 \cdot 2^{-\mu}$	75.0%
A3	$3456 \cdot 2^{-\mu}$	$8192 \cdot 2^{-\mu}$	$2880 \cdot 2^{-\mu}$	83.3%
B1	$864 \cdot 2^{-\mu}$	$8192 \cdot 2^{-\mu}$	$288 \cdot 2^{-\mu}$	33.3%
B2	$1440 \cdot 2^{-\mu}$	$8192 \cdot 2^{-\mu}$	$864 \cdot 2^{-\mu}$	60.0%
B3	$2016 \cdot 2^{-\mu}$	$8192 \cdot 2^{-\mu}$	$1440 \cdot 2^{-\mu}$	71.4%
B4	$3744 \cdot 2^{-\mu}$	$8192 \cdot 2^{-\mu}$	$3168 \cdot 2^{-\mu}$	84.6%
C0	$4960 \cdot 2^{-\mu}$	$8192 \cdot 2^{-\mu}$	$4384 \cdot 2^{-\mu}$	88.4%
C2	$8192 \cdot 2^{-\mu}$	$8192 \cdot 2^{-\mu}$	$7616 \cdot 2^{-\mu}$	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 $z^0(v)$. This subset of samples is called z''(v).

The sample frequency 122.88 MHz is oversampled with respect to the PRACH-subcarrier spacing of $\Delta f^{RA} = 15 \cdot 2^{\mu}$ kHz . EVM is based on $8192 \cdot 2^{-\mu}$ samples per PRACH preamble and requires decimation of the time samples by the factor of $12 \cdot 2^{\mu}$. The final number of samples per PRACH preamble, used for FFT is reduced compared to z''(v) by the same factor. This subset of samples is called z'(v).

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$_{PRACH}$

Perform FFT on z'(v) and i(v) using the FFT timing $\Delta\tilde{c}$ –W/2 and $\Delta\tilde{c}$ +W/2.

For format B4 the first and the repeated preamble sequence are FFT-converted separately using the standard FFT length of 8192.

The EVM$_{PRACH}$ 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$_{PRACH}$

$I(f,t)$ 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.

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. Care should be taken to ensure that each conformance test implementation including the OTA chamber aspects meets the specified measurement uncertainty for each test case by requiring the test laboratory to maintain a detailed measurement uncertainty test report showing compliance to all the measurement uncertainty requirements. The detailed measurement uncertainty report would contain the justification for each measurement uncertainty component and its value and distribution. The derivation of these values is based on the minimum conformance requirements plus relaxation, i.e., test tolerance is not to be considered. 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.

The downlink signal uncertainties apply at the defined quiet zone with the UE properly positioned in the quiet zone. The uplink signal uncertainties apply at the measurement equipment with the UE positioned properly in the quiet zone.

F.1.1 Measurement of test environments

TBD

F.1.2 Measurement of transmitter

Editor's note: The measurement uncertainties for 6.5.2.1 Spectrum Emission Mask and 6.5.2.3 Adjacent Channel Leakage Ratio are based on a preliminary MU assessment and require an approval of the uncertainty contributors to be included in the uncertainty assessment as well as the contributors need further technical analysis.

Table F.1.2-1: Maximum Test System Uncertainty (MTSU) for transmitter tests

Sub clause	Maximum Test System Uncertainty	Derivation of MTSU
6.2.1.1 UE maximum output power (EIRP)	PC3 Minimum peak EIRP, Max EIRP Quiet Zone size ≤ 30 cm ±4.89 dB (FR2a) ±5.09 dB (FR2b)	MTSU = 1.00 x MU (from Table B.3-2-2 in TR 38.903)
6.2.1.1 UE maximum output power (TRP)	PC3 Max TRP Quiet Zone size ≤ 30 cm ±4.42 dB (FR2a) ±4.62 dB (FR2b)	MTSU = 1.00 x MU (from Table B.3-2-2 in TR 38.903)
6.2.1.2 UE maximum output power (Spherical coverage)	PC3 Quiet Zone size ≤ 30 cm ±4.60 dB (FR2a) ±5.20 dB (FR2b)	MTSU = 1.00 x MU (from Table B.3-2-4 in TR 38.903)
6.2.2 UE maximum output power for modulation / channel bandwidth	TBD	
6.2.3 UE maximum output power with additional requirements	TBD	
6.2.4 Configured transmitted power	TBD	
6.2A.1.1.1 UE maximum output power - EIRP and TRP for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.2.1.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.2A.1.2.1 Spherical coverage for CA (2UL CA)	Intra-band contiguous CA TBD	
6.2A.1.2.2 Spherical coverage for CA (3UL CA)	Intra-band contiguous CA TBD	
6.2A.1.2.3 Spherical coverage for CA (4UL CA)	Intra-band contiguous CA TBD	
6.2A.1.2.4 Spherical coverage for CA (5UL CA)	Intra-band contiguous CA TBD	
6.2A.1.2.5 Spherical coverage for CA (6UL CA)	Intra-band contiguous CA TBD	
6.2A.1.2.6 Spherical coverage for CA (7UL CA)	Intra-band contiguous CA TBD	
6.2A.1.2.7 Spherical coverage for CA (8UL CA)	Intra-band contiguous CA TBD	
6.2A.1.1.2 UE maximum output power - EIRP and TRP for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.2.1.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.2A.1.1.3 UE maximum output power - EIRP and TRP for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.2.1.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.3.1 Minimum output power	TBD	
6.3.2 Transmit OFF power	TBD	

6.3.3.2 General ON/OFF time mask	TBD	
6.3.3.4 PRACH time mask	TBD	
6.3.3.6 SRS time mask	TBD	
6.3.4.2 Absolute power tolerance	TBD	
6.3.4.3 Relative power tolerance	TBD	
6.3.4.4 Aggregate power tolerance	TBD	
6.3A.2.1 Transmit OFF power for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.3.2 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.3A.2.2 Transmit OFF power for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.3.2 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.3A.2.3 Transmit OFF power for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.3.2 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.4.1 Frequency error	± 0.01 ppm	MTSU = 1.00 x MU (from B.10.1 and B.10.2 in TR 38.903)
6.4.2.1 Error vector magnitude	TBD	
6.4.2.2 Carrier leakage	TBD	
6.4.2.3 In-band emissions	TBD	
6.4.2.4 EVM equalizer spectrum flatness	TBD	
6.4.2.5 EVM equalizer spectrum flatness for BPSK modulation	TBD	
6.4A.1.1 Frequency error for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.4.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.4A.2.2.1 Carrier leakage for CA (2UL CA)	TBD	
6.4A.1.2 Frequency error for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.4.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.4A.2.2.2 Carrier leakage for CA (3UL CA)	TBD	

6.4A.2.2.3 Carrier leakage for CA (4UL CA)	TBD	
6.4A.1.3 Frequency error for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.4.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5.1 Occupied bandwidth	TBD	
6.5.2.1 Spectrum Emission Mask	Quiet Zone size ≤ 30 cm ±4.94 dB (FR2a) ±5.32 dB (FR2b)	MTSU = 1.00 x MU (from Table B.16.2-2, B.16.2-3 in TR 38.903)
6.5.2.3 Adjacent Channel Leakage Ratio	Quiet Zone size ≤ 30cm TBD	
6.5.3.1 Transmitter Spurious emissions	Quiet Zone size ≤ 30 cm Maximum in-band BW ≤ 400MHz ±TBD dB (6GHz ≤ f ≤ 12.75GHz) ±TBD dB (12.75GHz < f ≤ 23.45GHz) ±TBD dB (23.45GHz < f < 40.8GHz) ±TBD dB (40.8GHz ≤ f ≤ 66GHz) ±TBD dB (66GHz ≤ f ≤ 80GHz)	MTSU = 1.00 x MU (from Table B.18-1 in TR 38.903)
6.5.3.2 Spurious emission band UE co-existence	TBD	
6.5.3.3 Additional Spurious emission	TBD	
6.5A.1.1 Occupied bandwidth for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.1.2 Occupied bandwidth for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.1.3 Occupied bandwidth for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.1.4 Occupied bandwidth for CA (5UL CA)	TBD	
6.5A.1.5 Occupied bandwidth for CA (6UL CA)	TBD	
6.5A.1.6 Occupied bandwidth for CA (7UL CA)	TBD	
6.5A.1.7 Occupied bandwidth for CA (8UL CA)	TBD	

6.5A.2.1.1 Spectrum Emission Mask for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.2.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.2.1.2 Spectrum Emission Mask for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.2.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.2.1.3 Spectrum Emission Mask for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.2.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.2.1.4 Spectrum Emission Mask for CA (5UL CA)	TBD	
6.5A.2.1.5 Spectrum Emission Mask for CA (6UL CA)	TBD	
6.5A.2.1.6 Spectrum Emission Mask for CA (7UL CA)	TBD	
6.5A.2.1.7 Spectrum Emission Mask for CA (8UL CA)	TBD	
6.5A.2.2.1 Adjacent channel leakage ratio for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.2.3 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.2.2.2 Adjacent channel leakage ratio for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.2.3 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.2.2.3 Adjacent channel leakage ratio for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.2.3 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.2.2.4 Adjacent channel leakage ratio for CA (5UL CA)	TBD	
6.5A.2.2.5 Adjacent channel leakage ratio for CA (6UL CA)	TBD	
6.5A.2.2.6 Adjacent channel leakage ratio for CA (7UL CA)	TBD	

6.5A.2.2.7 Adjacent channel leakage ratio for CA (8UL CA)	TBD	
6.5A.3.1.1 Transmitter Spurious emissions for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.3.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.3.1.2 Transmitter Spurious emissions for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.3.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.3.1.3 Transmitter Spurious emissions for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.3.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.3.1.4 Transmitter Spurious emissions for CA (5UL CA)	TBD	
6.5A.3.1.5 Transmitter Spurious emissions for CA (6UL CA)	TBD	
6.5A.3.1.6 Transmitter Spurious emissions for CA (7UL CA)	TBD	
6.5A.3.1.7 Transmitter Spurious emissions for CA (8UL CA)	TBD	
6.5A.3.2.1 Spurious emission band UE co-existence for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.3.2 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.3.2.2 Spurious emission band UE co-existence for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.3.2 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.3.2.3 Spurious emission band UE co-existence for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.3.2 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.3.2.4 Spurious emission band UE co-existence for CA (5UL CA)	TBD	

6.5A.3.2.5 Spurious emission band UE co-existence for CA (6UL CA)	TBD	
6.5A.3.2.6 Spurious emission band UE co-existence for CA (7UL CA)	TBD	
6.5A.3.2.7 Spurious emission band UE co-existence for CA (8UL CA)	TBD	
6.5A.3.3.1 Additional spurious emissions for CA (2UL CA)	TBD	
6.5A.3.3.2 Additional spurious emissions for CA (3UL CA)	TBD	
6.5A.3.3.3 Additional spurious emissions for CA (4UL CA)	TBD	
6.5A.3.3.4 Additional spurious emissions for CA (5UL CA)	TBD	
6.5A.3.3.5 Additional spurious emissions for CA (6UL CA)	TBD	
6.5A.3.3.6 Additional spurious emissions for CA (7UL CA)	TBD	
6.5A.3.3.7 Additional spurious emissions for CA (8UL CA)	TBD	
NOTE 1: FR2a: 23.45GHz ≤ f ≤ 32.125GHz FR2b: 32.125GHz ≤ f ≤ 40.8GHz		

F.1.3 Measurement of receiver

Table F.1.3-1: Maximum Test System Uncertainty (MTSU) for receiver tests

Sub clause	Maximum Test System Uncertainty	Derivation of MTSU
7.3.2 Reference sensitivity power level	±5.19 dB (Quiet Zone size ≤ 30 cm, FR2a, FR2b)	MTSU = 1.00 x MU (from Table B.19-2-2 in TR 38.903)
7.3.4 EIS spherical coverage	[±4.90] dB (Quiet Zone size ≤ 30 cm, FR2a, FR2b)	MTSU = 1.00 x MU (from Table B.19-2-2 in TR 38.903)
7.4 Maximum input level	TBD	
7.5 Adjacent channel selectivity	TBD	
7.6.2 In-band blocking	TBD	
7.9 Spurious emissions	TBD	
NOTE 1: FR2a and FR2b are specified in Table F.1.2-1.		

F.2 Interpretation of measurement results (normative)

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 using one of the permitted test methods defined in TR38.903 [20] 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)

TBD

F.3.1 Measurement of test environments

TBD

F.3.2 Measurement of transmitter

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

- Influence of noise is subtracted from MTSU before calculating the TT for lower limit Tx test cases.

Table F.3.2-1: Derivation of Test Requirements (Transmitter tests)

Sub clause	Test Tolerance (TT)	Formula for test requirement
6.2.1.1 UE maximum output power (EIRP)	PC3 Minimum peak EIRP IFF (Quiet Zone size ≤ 30 cm) 2.87 dB (FR2a) 2.87 dB (FR2b) Max EIRP 0 dB	Minimum peak EIRP TT = 0.60 x ($MTSU_{IFF}$ - 0.1) (FR2a) TT = 0.60 x ($MTSU_{IFF}$ - 0.3) (FR2b)
6.2.1.1 UE maximum output power (TRP)	PC3 Max TRP IFF (Quiet Zone size ≤ 30 cm) 2.87 dB (FR2a) 3.00 dB (FR2b)	Max TRP TT = 0.60 x $MTSU_{IFF}$
6.2.1.2 UE maximum output power (Spherical coverage)	PC1 TBD PC2 TBD PC3 IFF (Quiet Zone size ≤ 30 cm) 2.58 dB (FR2a) 2.58 dB (FR2b) PC4 TBD	PC3 TT = 0.60 x ($MTSU_{IFF}$ - 0.3) (FR2a) TT = 0.60 x ($MTSU_{IFF}$ - 0.9) (FR2b)
6.2.2 UE maximum output power for modulation / channel bandwidth	TBD	
6.2.3 UE maximum output power with additional requirements	TBD	
6.2.4 Configured transmitted power	TBD	
6.2A.1.1.1 UE maximum output power - EIRP and TRP for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.2.1.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.2A.1.2.1 Spherical coverage for CA (2UL CA)	Intra-band contiguous CA TBD	
6.2A.1.2.3 Spherical coverage for CA (4UL CA)	Intra-band contiguous CA TBD	
6.2A.1.2.4 Spherical coverage for CA (5UL CA)	Intra-band contiguous CA TBD	
6.2A.1.2.5 Spherical coverage for CA (6UL CA)	Intra-band contiguous CA TBD	
6.2A.1.2.6 Spherical coverage for CA (7UL CA)	Intra-band contiguous CA TBD	
6.2A.1.2.7 Spherical coverage for CA (8UL CA)	Intra-band contiguous CA TBD	
6.2A.1.1.2 UE maximum output power - EIRP and TRP for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.2.1.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	

6.2A.1.1.3 UE maximum output power - EIRP and TRP for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.2.1.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.3.1 Minimum output power	TBD	
6.3.2 Transmit OFF power	0 dB	
6.3.3.2 General ON/OFF time mask	TBD	
6.3.3.4 PRACH time mask	TBD	
6.3.4.2 Absolute power tolerance	TBD	
6.3.4.3 Relative power tolerance	TBD	
6.3.4.4 Aggregate power tolerance	TBD	
6.3A.2.1 Transmit OFF power for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.3.2 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.3A.2.2 Transmit OFF power for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.3.2 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.3A.2.3 Transmit OFF power for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.3.2 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.4.1 Frequency error	0.005 ppm	TT = 0.5 x MTSU
6.4.2.1 Error vector magnitude	0%, up to 64QAM	Minimum requirement + TT
6.4.2.2 Carrier leakage	TBD	
6.4.2.3 In-band emissions	TBD	
6.4.2.4 EVM equalizer spectrum flatness	TBD	
6.4.2.5 EVM equalizer spectrum flatness for BPSK modulation	TBD	
6.4A.1.1 Frequency error for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.4.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.4A.2.2.1 Carrier leakage for CA (2UL CA)	TBD	

6.4A.1.2 Frequency error for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.4.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.4A.2.2.2 Carrier leakage for CA (3UL CA)	TBD	
6.4A.2.2.3 Carrier leakage for CA (4UL CA)	TBD	
6.4A.1.3 Frequency error for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.4.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5.1 Occupied bandwidth	0 kHz	Minimum requirement + TT
6.5.2.1 Spectrum Emission Mask	IFF (Quiet Zone size ≤ 30 cm) 3.21 dB (FR2a) 3.46 (FR2b)	TT = 0.65 x $MTSU_{IFF}$
6.5.2.3 Adjacent Channel Leakage Ratio	Absolute requirement 0 dB Relative requirement IFF (Quiet Zone size ≤ 30 cm) BW = 50MHz [2.97] dB (23.45GHz ≤ f ≤ 30.3GHz) [3.20] dB (30.3GHz < f ≤ 40.8GHz)	TT = 0.65 x $MTSU_{IFF}$
6.5.3.1 Transmitter Spurious emissions	0 dB	Minimum requirement + TT
6.5.3.2 Spurious emission band UE co-existence	0 dB	Minimum requirement + TT
6.5A.1.1 Occupied bandwidth for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.1.2 Occupied bandwidth for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.1.3 Occupied bandwidth for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.1.4 Occupied bandwidth for CA (5UL CA)	TBD	

6.5A.1.5 Occupied bandwidth for CA (6UL CA)	TBD	
6.5A.1.6 Occupied bandwidth for CA (7UL CA)	TBD	
6.5A.1.7 Occupied bandwidth for CA (8UL CA)	TBD	
6.5A.2.1.1 Spectrum Emission Mask for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.2.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.2.1.2 Spectrum Emission Mask for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.2.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.2.1.3 Spectrum Emission Mask for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.2.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.2.1.4 Spectrum Emission Mask for CA (5UL CA)	TBD	
6.5A.2.1.5 Spectrum Emission Mask for CA (6UL CA)	TBD	
6.5A.2.1.6 Spectrum Emission Mask for CA (7UL CA)	TBD	
6.5A.2.1.7 Spectrum Emission Mask for CA (8UL CA)	TBD	
6.5A.2.2.1 Adjacent channel leakage ratio for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.2.3 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.2.2.2 Adjacent channel leakage ratio for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.2.3 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.2.2.3 Adjacent channel leakage ratio for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.2.3 Maximum aggregated BW > 400MHz	

	TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.2.2.4 Adjacent channel leakage ratio for CA (5UL CA)	TBD	
6.5A.2.2.5 Adjacent channel leakage ratio for CA (6UL CA)	TBD	
6.5A.2.2.6 Adjacent channel leakage ratio for CA (7UL CA)	TBD	
6.5A.2.2.7 Adjacent channel leakage ratio for CA (8UL CA)	TBD	
6.5A.3.1.1 Transmitter Spurious emissions for CA (2UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.3.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.3.1.2 Transmitter Spurious emissions for CA (3UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.3.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
6.5A.3.1.3 Transmitter Spurious emissions for CA (4UL CA)	Intra-band contiguous CA Maximum aggregated BW ≤ 400MHz Same as 6.5.3.1 Maximum aggregated BW > 400MHz TBD Intra-band non-contiguous, Inter-band CA TBD	
NOTE 1: FR2a: 23.45GHz ≤ f ≤ 32.125GHz FR2b: 32.125GHz ≤ f ≤ 40.8GHz		

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	IFF (Quiet Zone size ≤ 30 cm, FR2a, FR2b) 2.34 dB	TT = 0.45 x $MTSU_{IFF}$
7.3.4 EIS spherical coverage	IFF (Quiet Zone size ≤ 30 cm, FR2a, FR2b) 2.21 dB	PC3 TT = 0.45 x $MTSU_{IFF}$
7.4 Maximum input level	TBD	
7.5 Adjacent channel selectivity	0 dB	Wanted signal power + TT T-put limit unchanged
7.6.2 In-band blocking	0 dB	Wanted signal power + TT T-put limit unchanged
7.9 Spurious emissions	0 dB	Minimum requirement + TT T-put limit unchanged
NOTE 1: FR2a and FR2b are specified in Table F.3.2-1.		

Annex G (normative): Uplink Physical Channels

G.0 Uplink Signal Levels

Please refer to Annex G.0 in TS 38.521-1 [13].

G.1 General

Please refer to Annex G.1 in TS 38.521-1 [13].

G.2 Set-up

Please refer to Annex G.2 in TS 38.521-1 [13].

G.3 Connection

Please refer to Annex G.3 in TS 38.521-1 [13].

G.3.0 Measurement of Transmitter Characteristics

Please refer to Annex G.3.0 in TS 38.521-1 [13].

G.3.1 Measurement of Receiver Characteristics

Please refer to Annex G.3.1 in TS 38.521-1 [13].

Annex H (normative): Statistical Testing

Editor's Note: Further investigate the technical details behind this statistical method to ensure that this is applicable for FR2 radiated test cases.

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, fail the test at 2- 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:Void

Annex J (normative): Test applicability per permitted test method

This annex describes, per test requirement, the permitted test methodologies as a function of DUT antenna configuration.

Table J-1: Test case applicability per permitted test method

Clause	No DUT antenna configuration declaration	DUT antenna configuration declaration		
		Configuration 1 (one antenna panel with D ≤ 5 cm active at any one time)	**Configuration 2** (More than one antenna panel D ≤ 5 cm without phase coherency between panels active at any one time)	**Configuration 3** (Any phase coherent antenna panel of any size)
6.5.1 Occupied bandwidth	IFF	DFF, DFF simplification, IFF, NFTF	DFF, DFF simplification, IFF, NFTF	IFF
6.5.2.1 Spectrum Emission Mask	IFF	DFF, DFF simplification, IFF, NFTF	DFF, DFF simplification, IFF, NFTF	IFF
6.5.2.3 Adjacent leakage ratio	IFF	DFF, DFF simplification, IFF, NFTF	DFF, DFF simplification, IFF, NFTF	IFF
7.5 Adjacent Channel Selectivity	IFF	DFF, DFF simplification, IFF, NFTF	DFF, DFF simplification, IFF, NFTF	IFF
7.6.2 In-band Blocking	IFF	DFF, DFF simplification, IFF, NFTF	DFF, DFF simplification, IFF, NFTF	IFF
NOTE: D = DUT radiating aperture declared by UE vendor.				

Annex K (normative): EIRP, TRP, and EIS measurement procedures

Editor's Note: The measurement procedures are applicable only for single-carrier test cases

Annex K defines the EIRP, TRP, and EIS measurement procedures which includes Tx and Rx beam peak direction search, spherical coverage procedures and TRP procedures for the permitted testing methodologies defined in [5].

K.1 Direct far field (DFF)

K.1.1 TX beam peak direction search

This Tx beam peak search procedure applies to DUTs with and without beam correspondence. The TX beam peak direction is found with a 3D EIRP scan (separately for each orthogonal downlink polarization). The TX beam peak direction search grid points for this single grid approach are defined in Annex M.2.1. Alternatively, a coarse and fine grid approach could be used according to the definition in Annex M.2.2.

The measurement procedure includes the following steps:

1) Select any of the three Alignment Options (1, 2, or 3) from Tables J.2-1 through J.2-3 [3] to mount the DUT inside the QZ.

2) Position the DUT in DUT Orientation 1 from Tables J.2-1 through J.2-3 [3].

3) Connect the SS (System Simulator) with the DUT through the measurement antenna with $Pol_{Link}=\theta$ polarization to form the TX beam towards the measurement antenna. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE TX beam selection to complete.

4) For beam correspondence, DUT refines its TX beam toward that direction depending on DUT's beam correspondence capability which shall match OEM declaration: if DUT's beam correspondence capability is [bit-1], then DUT autonomously chooses the corresponding TX beam for PUSCH transmission using downlink reference signals to transmit in the direction of the incoming DL signal, which is based on beam correspondence without relying on UL beam sweeping; if DUT's beam correspondence capability is [bit-0], then DUT chooses the TX beam for PUSCH transmission which is based on beam correspondence with relying on both DL measurements on downlink reference signals and network-assisted uplink beam sweeping (NOTE 2).

5) SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

6) Measure the mean power P_{meas} ($Pol_{Meas}=\theta$, $Pol_{Link}=\theta$) of the modulated signal arriving at the power measurement equipment (such as a spectrum analyser, power meter, or gNB emulator).

7) Calculate EIRP ($Pol_{Meas}=\theta$, $Pol_{Link}=\theta$) by adding the composite loss of the entire transmission path for utilized signal path, $L_{EIRP,\theta}$, and frequency to the measured power P_{meas}($Pol_{Meas}=\theta$, $Pol_{Link}=\theta$).

8) Measure the mean power P_{meas} ($Pol_{Meas}=\phi$, $Pol_{Link}=\theta$) of the modulated signal arriving at the power measurement equipment.

9) Calculate EIRP ($Pol_{Meas}=\phi$, $Pol_{Link}=\theta$) by adding the composite losses of the entire transmission path for utilized signal path, $L_{EIRP,\varphi}$, and frequency to the measured power P_{meas} ($Pol_{Meas}=\phi$, $Pol_{Link}=\theta$).

10) Calculate total EIRP($Pol_{Link}=\theta$) = EIRP($Pol_{Meas}=\theta$, $Pol_{Link}=\theta$) + EIRP($Pol_{Meas}=\phi$, $Pol_{Link}=\theta$).

11) SS deactivates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.3.

12) Connect the SS (System Simulator) with the DUT through the measurement antenna with Pol_{Link}=ϕ polarization to form the TX beam towards the measurement antenna. Allow at least BEAM_SELECT_WAIT_TIME for the UE TX beam selection to complete.

13) Advance to the next grid point and repeat steps 3 through 12 until measurements within zenith range $0º \leq \theta \leq 90º$ have been completed

14) After the measurements within zenith range $0º \leq \theta \leq 90º$ have been completed and

a) if the re-positioning concept is applied to the TX test cases, position the device in DUT Orientation 2 (either Options 1 or 2) from Tables J.2-1 through J.2-3 [3] for the Alignment Option selected in Step 1. For the TX beam peak search in the second hemisphere, perform steps 3 through 13 for the range of zenith angles $90º < \theta \leq 0º$.

b) if the re-positioning concept is not applied to the TX test cases, continue steps 3 through 13 for the range of zenith angles $90º < \theta \leq 180º$

For beam correspondence capability [bit-0] DUT, the above step 3) can be further clarified as following sub-steps:

3.1) DUT uses downlink reference signals to select proper RX beam and uses autonomous beam correspondence to select the TX beam.

3.2) SS configures M=8 SRS resources to DUT, with the field *spatialRelationInfo* omitted. In case DUT supports less than 8 SRS resources, SS configures the number of SRS resources according to the maximum number of SRS resources indicated by UE capability signalling.

3.3) Based on the TX beam autonomously selected by DUT, DUT chooses TX beams to transmit SRS-resources configured by SS.

3.4) Based on measurement of the received SRS, SS chooses the best SRS beam which is indicated in the field of SRS Resource Indicator (SRI) in the scheduling grant for PUSCH.

3.5) DUT transmits PUSCH corresponding to the SRS resource indicated by the SRI.

The TX beam peak direction is where the maximum total component of EIRP(Pol_{Link}=θ) or EIRP(Pol_{Link}=ϕ) is found.

NOTE 1: The default value for BEAM_SELECT_WAIT_TIME = 3 sec for all applicable Tx and Rx test cases. The BEAM_SELECT_WAIT_TIME represents a default minimum wait time period required to complete beam selection process at a single position before start of measurement. For a particular EUT, if it is known/determined that a lower wait time than default value is enough to complete beam selection process, then such a lower value may be used by the Test system to achieve test time optimization.

NOTE 2: This is used for beam correspondence.

K.1.2 RX beam peak direction search

The RX beam peak direction is found with a 3D EIS scan (separately for each orthogonal downlink polarization). The RX beam peak direction search grid points for this single grid approach are defined in Annex M.2.1. Alternatively, a coarse and fine grid approach could be used according to the definition in Annex M.2.4. The measurement procedure includes the following steps:

1) Select any of the three Alignment Options (1, 2, or 3) from Tables J.2-1 through J.2-3 [3] to mount the DUT inside the QZ.

2) Position the DUT in DUT Orientation 1 from Tables J.2-1 through J.2-3 [3].

3) Connect the SS (System Simulator) with the DUT through the measurement antenna with Pol_{Link}=θ polarization to form the RX beam towards the measurement antenna. Allow at least BEAM_SELECT_WAIT_TIME NOTE 1) for the UE RX beam selection to complete.

4) Determine EIS(Pol_{Meas}=θ, Pol_{Link}=θ) for θ-polarization, i.e., by sweeping the power level for the θ-polarization, at which the throughput exceeds the requirements for the specified reference measurement channel. The downlink power step size shall be no more than 0.2 dB when the RF power level is near the sensitivity level.

5) Connect the SS (System Simulator) with the DUT through the measurement antenna with Pol_{Link}=ϕ polarization to form the RX beam towards the measurement antenna. Allow at least BEAM_SELECT_WAIT_TIME for the UE RX beam selection to complete.

6) Determine EIS(Pol_{Meas}=ϕ, Pol_{Link}=ϕ) for φ-polarization, i.e., by sweeping the power level for the φ-polarization, at which the throughput exceeds the requirements for the specified reference measurement channel. The downlink power step size shall be no more than 0.2 dB when the RF power level is near the sensitivity level.

7) Advance to the next grid point and repeat steps 3 through 6 until measurements within zenith range 0º≤θ≤90º have been completed

8) After the measurements within zenith range 0º≤θ≤90º have been completed and

   a) if the re-positioning concept is applied to the RX test cases, position the device in DUT Orientation 2 (either Options 1 or 2) from Tables J.2-1 through J.2-3 [3] for the Alignment Option selected in Step 1. For the RX beam peak search in the second hemisphere, perform steps 3 through 6 for the range of zenith angles 90º<θ≤0º.

   b) If the re-positioning concept is not applied to the RX test cases, continue steps 3 through 6 for the range of zenith angles 90º<θ≤180º

9) Calculate the resulting "averaged EIS" as:

$$\text{averaged EIS} = 2*[1/EIS(Pol_{Meas}=\theta, Pol_{Link}=\theta) + 1/EIS(Pol_{Meas}=\phi, Pol_{Link}=\phi)]^{-1}$$

The RX beam peak direction is where the minimum "averaged EIS" is found.

K.1.3 Peak EIRP measurement procedure

This section describes EIRP measurement procedure for a chosen Pol_{Link} of θ or ϕ

The TX beam peak direction is where the maximum total component of EIRP is found, including the respective polarization of the measurement antenna used to form the TX beam, according to K.1.1.

The measurement procedure includes the following steps:

1) Select any of the three Alignment Options (1, 2, or 3) from Tables J.2-1 through J.2-3 [3] to mount the DUT inside the QZ.

2) If the re-positioning concept is not applied to the TX test cases, position the device in DUT Orientation 1. If the re-positioning concept is applied to the TX test cases,

   a) position the device in DUT Orientation 1 from Tables J.2-1 through J.2-3 [3] if the maximum beam peak direction is within zenith angular range 0º≤θ≤90º for the alignment option selected in step 1

   b) position the device in DUT Orientation 2 (either Options 1 or 2) from Tables J.2-1 through J.2-3 [3] if the maximum beam peak direction is within zenith angular range 90º<θ≤180º for DUT Orientation 1 for the alignment option selected in step 1.

3) Connect the SS (System Simulator) with the DUT through the measurement antenna with polarization reference Pol_{Link} to form the TX beam towards the TX beam peak direction and respective polarization. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE TX beam selection to complete.

4) SS activates the UE Beamlock Function (UBF) by performing the procedure as specified in TS 38.508-1 [10] clause 4.9.2 using condition Tx only.

5) Measure the mean power P_{meas} (Pol_{Meas}=θ, Pol_{Link}) of the modulated signal arriving at the power measurement equipment (such as a spectrum analyser, power meter, or gNB emulator).

6) Calculate EIRP(Pol_{Meas}=θ, Pol_{Link}) by adding the composite loss of the entire transmission path for utilized signal path, $L_{EIRP,θ}$, and frequency to the measured power P_{meas} (Pol_{Meas}=θ, Pol_{Link}).

7) Measure the mean power P_{meas} (Pol_{Meas}=ϕ, Pol_{Link}) of the modulated signal arriving at the power measurement equipment.

8) Calculate EIRP(Pol_{Meas}=ϕ, Pol_{Link}) by adding the composite losses of the entire transmission path for utilized signal path, $L_{EIRP,φ}$ and frequency to the measured power P_{meas} (Pol_{Meas}=ϕ, Pol_{Link})

9) Calculate the resulting "total EIRP(Pol_{Link})", for the chosen Pol_{Link} of θ or ϕ as follows:

$$\text{total EIRP } (Pol_{Link}) = EIRP(Pol_{Meas}=\theta, Pol_{Link}) + EIRP(Pol_{Meas}=\phi, Pol_{Link})$$

K.1.4 Peak EIS measurement procedure

This section describes EIS measurement procedure. The RX beam peak direction is where the minimum EIS is found according to K.1.2.

The measurement procedure includes the following steps:

1) Select any of the three Alignment Options (1, 2, or 3) from Tables J.2-1 through J.2-3 [3] to mount the DUT inside the QZ.

2) If the re-positioning concept is not applied to the RX test cases, position the device in DUT Orientation 1. If the re-positioning concept is applied to the RX test cases

   a) position the device in DUT Orientation 1 from Tables J.2-1 through J.2-3 [3] if the maximum beam peak direction is within zenith angular range 0º≤θ≤90º for the alignment option selected in step 1

   b) position the device in DUT Orientation 2 (either Options 1 or 2) from Tables J.2-1 through J.2-3 [3] if the maximum beam peak direction is within zenith angular range 90º<θ≤180º for DUT Orientation 1 for the alignment option selected in step 1.

3) Connect the SS (System Simulator) with the DUT through the measurement antenna with Pol_{Link}=θ polarization to form the RX beam towards the RX beam peak direction. Allow at least BEAM_SELECT_WAIT_TIME (NOTE 1) for the UE RX beam selection to complete.

4) Determine EIS(Pol_{Meas}=θ, Pol_{Link}=θ) for θ-polarization, i.e., the power level for the θ-polarization at which the throughput exceeds the requirements for the specified reference measurement channel

5) Connect the SS (System Simulator) with the DUT through the measurement antenna with Pol_{Link}=ϕ polarization to form the RX beam towards the RX beam peak direction. Allow at least BEAM_SELECT_WAIT_TIME for the UE RX beam selection to complete.

6) Determine EIS(Pol_{Meas}=ϕ, Pol_{Link}=ϕ) for φ-polarization, i.e., the power level for the φ-polarization at which the throughput exceeds the requirements for the specified reference measurement channel

7) Calculate the resulting averaged EIS as:

$$EIS = 2*[1/EIS(Pol_{Mes}=\theta, Pol_{Link}=\theta) +1/EIS(Pol_{Meas}=\phi, Pol_{Link}=\phi)]^{-1}$$

K.1.5 EIRP spherical coverage

The EIRP results from the TX beam peak search procedures of K.1.1, using the minimum number of grid points as described in Annex M.2.1 can be re-used for EIRP spherical coverage.

In case a coarse beam peak grid is used for TX beam peak search, using the minimum number of grid points defined in Annex M.3.1.1, the EIRP results can be re-used for EIRP spherical coverage.

In case a separate test is performed for EIRP spherical coverage, the procedure as per K.1.3 should be followed using the minimum number of grid points defined in Annex M.3.1.1 for spherical coverage.

The $EIRP_{target-CDF}$ is then obtained from the Cumulative Distribution Function (CDF) computed using maximum(EIRP(Pol_{Link}=θ), EIRP(Pol_{Link}=ϕ)) for all grid points. When using constant step size measurement grids, a theta-dependent correction shall be applied, i.e., the PDF probability contribution for each measurement point is scaled by sin(θ).

K.1.6 EIS spherical coverage

The EIS results from the RX beam peak search procedures of K.1.2, using the minimum number of grid points as described in Annex M.2.2 can be re-used for EIS spherical coverage.

In case a coarse beam peak grid is used for RX beam peak search with an EIS metric, using the minimum number of grid points defined in Annex M.3.2.1, the EIS results can be re-used for EIS spherical coverage.

In case a separate test is performed for spherical coverage, the procedure K.1.4 should be followed using the minimum number of grid points defined in Annex M.3.2.1 for spherical coverage.

The $EIS_{target-CDF}$ is then obtained from the Cumulative Distribution Function (CDF) computed using averaged EIS for all grid points. When using constant step size measurement grids, a theta-dependent correction shall be applied, i.e., the PDF probability contribution for each measurement point is scaled by sin(θ).

K.1.7 TRP measurement procedure

The minimum number of measurement points for TRP measurement grid is outlined in Annex M.4.

The measurement procedure includes the following steps:

1) Select any of the three Alignment Options (1, 2, or 3) from Tables J.2-1 through J.2-3 [3] to mount the DUT inside the QZ.

2) If the re-positioning concept is not applied to the TX test cases, position the device in DUT Orientation 1. If the re-positioning concept is applied to the TX test cases

   a) position the device in DUT Orientation 1 from Tables J.2-1 through J.2-3 [3] if the maximum beam peak direction is within zenith angular range 0º≤θ≤90º for the alignment option selected in step 1

   b) Position de device in DUT Orientation 2 (either Options 1 or 2) from Tables J.2-1 through J.2-3 [3] if the maximum beam peak direction is within zenith angular range 90º<θ≤180º for DUT Orientation 1 for the alignment option selected in step 1.

3) Connect the SS with the DUT through the downlink antenna with desired polarization reference Pol_{Link} to form the TX beam towards the desired TX beam direction and respective polarization.

4) Lock the beam toward that direction and polarization for the entire duration of the test. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE.

5) For each measurement point, measure P_{meas}(Pol_{Meas}=θ, Pol_{Link}) and P_{meas}(Pol_{Meas}=ϕ, Pol_{Link}). The angle between the measurement antenna and the DUT (θ_{Meas}, φ_{Meas}) is achieved by rotating the measurement antenna and the DUT (based on system architecture).

6) Calculate EIRP(Pol_{Meas}=θ, Pol_{Link}) and EIRP(Pol_{Meas}=ϕ, Pol_{Link}) by adding the composite loss of the entire transmission path for utilized signal paths, $L_{EIRP,\theta}$, $L_{EIRP,\varphi}$ and frequency to the respective measured powers P_{meas}.

7) The TRP value for the uniform measurement grid is calculated using the TRP integration approaches outlined in Annex M.4.2. The TRP value for the constant density grid is calculated using the TRP integration formula in Annex M.4.3.

K.1.8 Blocking measurement procedure

The RX beam peak direction is where the minimum EIS is found according to K.1.2.

The measurement procedure includes the following steps:

1) Select any of the three Alignment Options (1, 2, or 3) from Tables C.2-1 through C.2-3 to mount the DUT inside the QZ.

2) If the re-positioning concept is not applied to the RX test cases, position the device in DUT Orientation 1. If the re-positioning concept is applied to the RX test cases

   a) position the device in DUT Orientation 1 from Tables J.2-1 through J.2-3 [3] if the maximum beam peak direction is within zenith angular range $0^o \leq \theta \leq 90^o$ for the alignment option selected in step 1

   b) position the device in DUT Orientation 2 (either Options 1 or 2) from Tables J.2-1 through J.2-3 [3] if the maximum beam peak direction is within zenith angular range $90^o < \theta \leq 180^o$ for DUT Orientation 1 for the alignment option selected in step 1.

3) Establish a connection between the DUT and the SS with the downlink signal applied to the θ-polarization of the measurement antenna

4) Position the UE so that the beam is formed towards the measurement antenna in the RX beam peak direction.

5) Apply a signal with the specified reference measurement channel on the θ-polarization, setting the power level of the signal 3dB below the EIS level stated in the requirement.

6) Apply the blocking signal with the same polarization and coming from the same direction as the downlink signal. Set the power level of the blocking signal 3dB below the level stated in the requirement.

7) Measure the throughput of the downlink signal on the θ-polarization.

8) Switch the downlink and blocking signal to the φ-polarization of the measurement antenna.

9) Repeat steps 3 to 7 on the φ-polarization.

10) Compare the results for both the θ-polarization and φ-polarization against the requirement. If both results meet the requirements, pass the UE.

K.1.9 Beam Correspondence tolerance procedure

Editor's Note: The side conditions for downlink reference signals SSB and CSI-RS in beam correspondence tolerance test are FFS.

This beam correspondence tolerance procedure applies to the DUT that has beam correspondence capability as [bit-0] (which shall match OEM declaration), such that DUT relies on uplink beam sweeping to fulfil the minimum peak EIRP and spherical coverage requirements.

The measurement procedure includes the following steps for each of the points in the grid:

1) Follow the test procedures specified in subclause K.1.5 with uplink beam sweeping disabled, obtain total $EIRP_1(Pol_{Link}=\theta)$ and total $EIRP_1(Pol_{Link}=\phi)$. $EIRP_1$ is calculated by $EIRP_1 = maximum(EIRP_1(Pol_{Link}=\theta), EIRP_1(Pol_{Link}=\phi))$.

2) Follow the test procedures specified in subclause K.1.5, with uplink beam sweeping enabled (SS does not configure the *spatialRelationInfo* to DUT) during DUT TX beam refinement, obtain total $EIRP_2(Pol_{Link}=\theta)$ and total $EIRP_2(Pol_{Link}=\phi)$. $EIRP_2$ is calculated by $EIRP_2 = maximum(EIRP_2(Pol_{Link}=\theta), EIRP_2(Pol_{Link}=\phi))$.

3) Calculate the $\Delta EIRP_{BC} = EIRP_2 - EIRP_1$.

The $\Delta EIRP_{target\text{-}CDF}$ is then obtained from the Cumulative Distribution Function (CDF) computed using $\Delta EIRP_{BC}$ for each of all top N^{th} percentile of the $EIRP_2$ measurement points in the grid. When using constant step size measurement grids, a theta-dependent correction shall be applied, i.e., the PDF probability contribution for each measurement point is scaled by sin(θ).

NOTE: $\Delta EIRP_{BC}$ is introduced for beam correspondence tolerance based on two EIRP measurements ($EIRP_1$ and $EIRP_2$). $EIRP_1$ is the measured total EIRP based on the beam which DUT chooses autonomously (corresponding beam) to transmit in the direction of the incoming DL signal, which is based on beam correspondence without relying on UL beam sweeping. $EIRP_2$ is the measured total EIRP based on the beam yielding highest EIRP in a given direction, which is based on beam correspondence with relying on UL beam sweeping. $\Delta EIRP_{BC}$ shall be calculated over the link angles spanning a subset of the spherical coverage grid points which are corresponding to the top N^{th} percentile of the $EIRP_2$ measurement points in the grid, where the value of N is according to EIRP spherical coverage requirement of DUT's power class defined in TS 38.101-2 [3] clause 6.2.1, e.g., N=50 for power class 3 DUT.

K.2 Direct far field (DFF) simplification

K.2.1 TX beam peak direction search

Same measurement procedure as in clause K.1.1.

K.2.2 RX beam peak direction search

Same measurement procedure as in clause K.1.2.

K.2.3 Peak EIRP measurement procedure

Same measurement procedure as in clause K.1.3.

K.2.4 Peak EIS measurement procedure

Same measurement procedure as in clause K.1.4.

K.2.5 EIRP spherical coverage

Same measurement procedure as in clause K.1.5.

K.2.6 EIS spherical coverage

Same measurement procedure as in clause K.1.6.

K.2.7 TRP measurement procedure

Same measurement procedure as in clause K.1.7.

K.2.8 Blocking measurement procedure

Same measurement procedure as in clause K.1.8.

K.3 Indirect far field (IFF)

K.3.1 TX beam peak direction search

Same measurement procedure as in clause K.1.1.

K.3.2 RX beam peak direction search

Same measurement procedure as in clause K.1.2.

K.3.3 Peak EIRP measurement procedure

Same measurement procedure as in clause K.1.3.

K.3.4 Peak EIS measurement procedure

Same measurement procedure as in clause K.1.4.

K.3.5 EIRP spherical coverage

Same measurement procedure as in clause K.1.5.

K.3.6 EIS spherical coverage

Same measurement procedure as in clause K.1.6.

K.3.7 TRP measurement procedure

Same measurement procedure as in clause K.1.7.

K.3.8 Blocking measurement procedure

Same measurement procedure as in clause K.1.8.

K.4 Near field to far field transform (NFTF)

K.4.1 TX beam peak direction search

The TX beam peak direction is found with a 3D EIRP scan (separately for each orthogonal polarization) with a grid that is TBD. The TX beam peak direction is where the maximum total component of EIRP is found.

FFS

K.4.2 RX beam peak direction search

Not applicable for NFTF method.

K.4.3 Peak EIRP measurement procedure

1) Connect the SS (System Simulator) to the DUT through the measurement antenna with polarization reference Pol_{Meas} to form the TX beam towards the previously determined TX beam peak direction and respective polarization.

2) Lock the beam toward that direction for the entire duration of the test.

3) Perform a 3D pattern measurement (amplitude and phase) with the DUT sending a modulated signal.

4) Determine the EIRP for both polarization towards the TX beam peak direction by using a Near Field to Far Field transform.

5) Calculate total EIRP = $EIRP_{\theta}$ + $EIRP_{\phi}$

K.4.4 Peak EIS measurement procedure

Not applicable for NFTF method.

K.4.5 EIRP spherical coverage

Same measurement procedure as in clause K.1.5.

K.4.6 EIS spherical coverage

Not applicable for NFTF method.

K.4.7 TRP measurement procedure

The minimum number of measurement points for TRP measurement grid is outlined in Annex M.4.

The measurement procedure includes the following steps:

1) Connect the SS to the DUT through the measurement antenna with polarization reference Pol_{Meas} to form the TX beam towards the previously determined TX beam peak direction and respective polarization.

2) Lock the beam toward that direction for the entire duration of the test.

3) Perform a 3D pattern measurement (amplitude and phase) with the DUT sending a modulated signal.

4) For each measurement point on the grid, determine the EIRP for both polarization by using a Near Field to Far Field transform.

5) The TRP value for the constant step size measurement grids are calculated using the TRP integration approaches outlined in Annex M.4.2. The TRP value for the constant density grid is calculated using the TRP integration formula in Annex M.4.3.

K.4.8 Blocking measurement procedure

Not applicable for NFTF method.

Annex L (normative): Void

Annex M:(normative) Measurement grids

This appendix describes the assumptions and definition of the minimum number of measurement grid points for various grid types. Further details can be found in [5].

A total of three measurement grids are considered:

- Beam Peak Search Grid: using this grid, the TX and RX beam peak direction will be determined. 3D EIRP scans are used to determine the TX beam peak direction and 3D Throughput/RSRP/EIS scans for RX beam peak directions.

- Spherical Coverage Grid: using this grid, the CDF of the EIRP/EIS distribution in 3D is calculated to determine the spherical coverage performance.

- TRP Measurement Grid: using this grid, the total power radiated by the DUT in the TX beam peak direction is determined by integrating the EIRP measurements taken on the sampling grid.

M.1 Grid Types

Two different measurement grid types are considered:

- The constant step size grid type has the azimuth and elevation angles uniformly distributed as in the examples illustrated in Figures M.1-1 in 2D and M.1-2 in 3D.

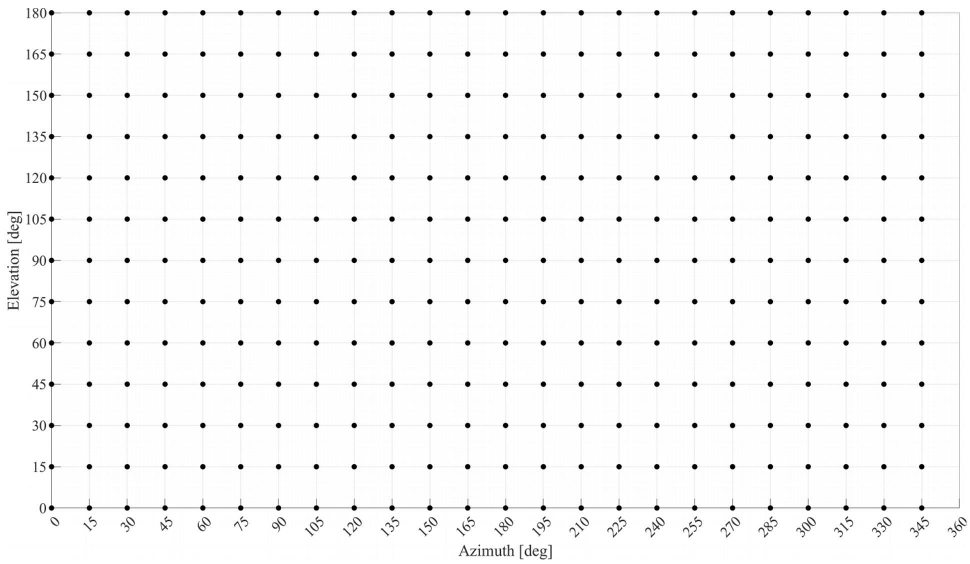


Figure M.1-1: Distribution of measurement grid points in 2D for a constant step size grid with Δθ=Δϕ=15° (266 unique measurement points)

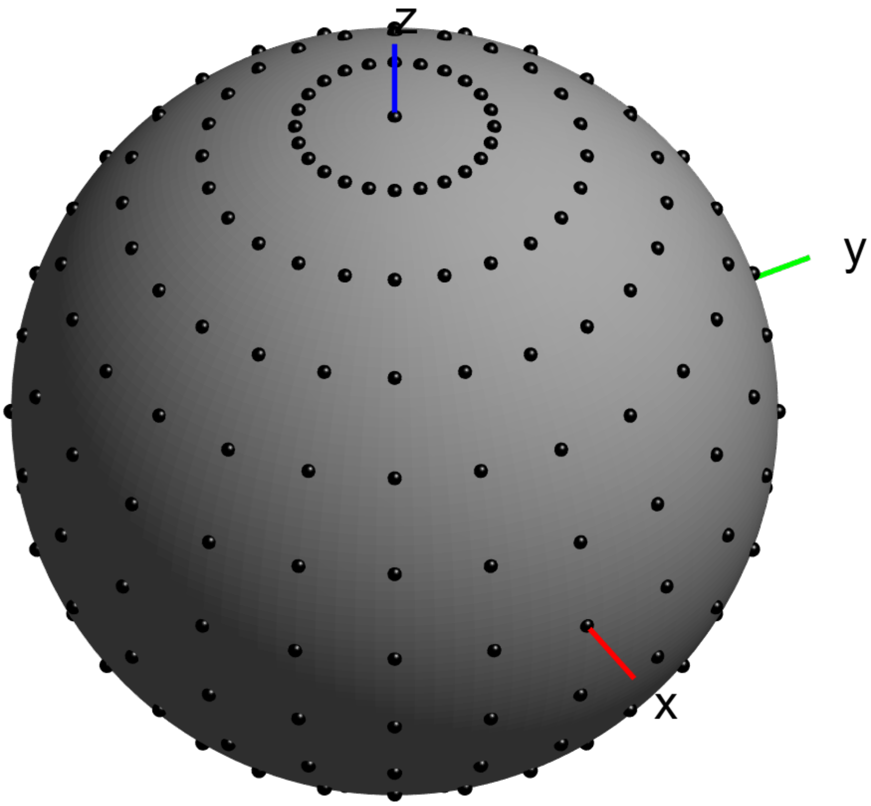


Figure M.1-2: Distribution of measurement grid points in 3D for a constant step size grid with Δθ=Δϕ=15º (266 unique measurement points)

- Constant density grid types have measurement points that are evenly distributed on the surface of the sphere with a constant density as in the example illustrated in Figures M.1-3 in 2D and M.1-4 in 3D.

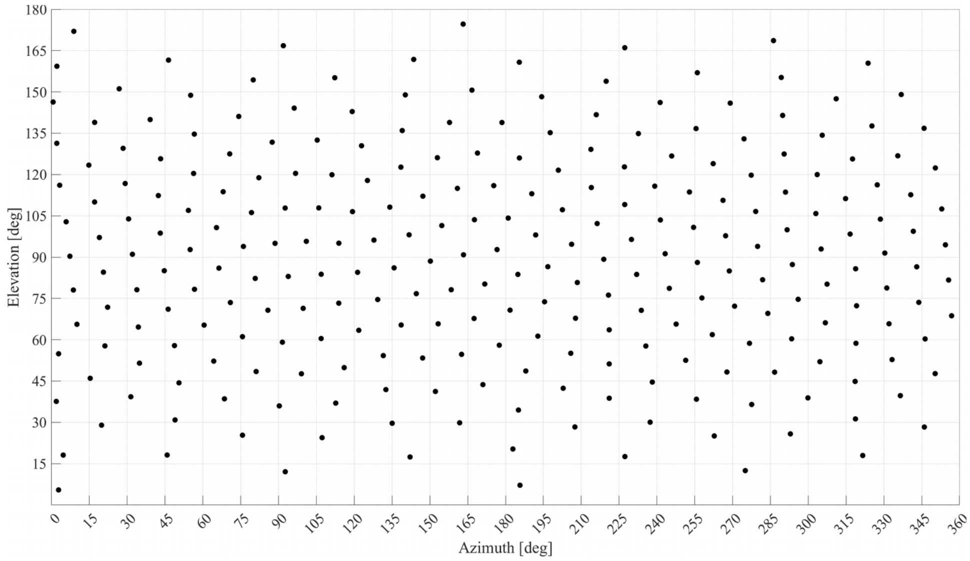


Figure M.1-3: Distribution of measurement grid points in 2D for a constant density grid with 266 unique measurement points

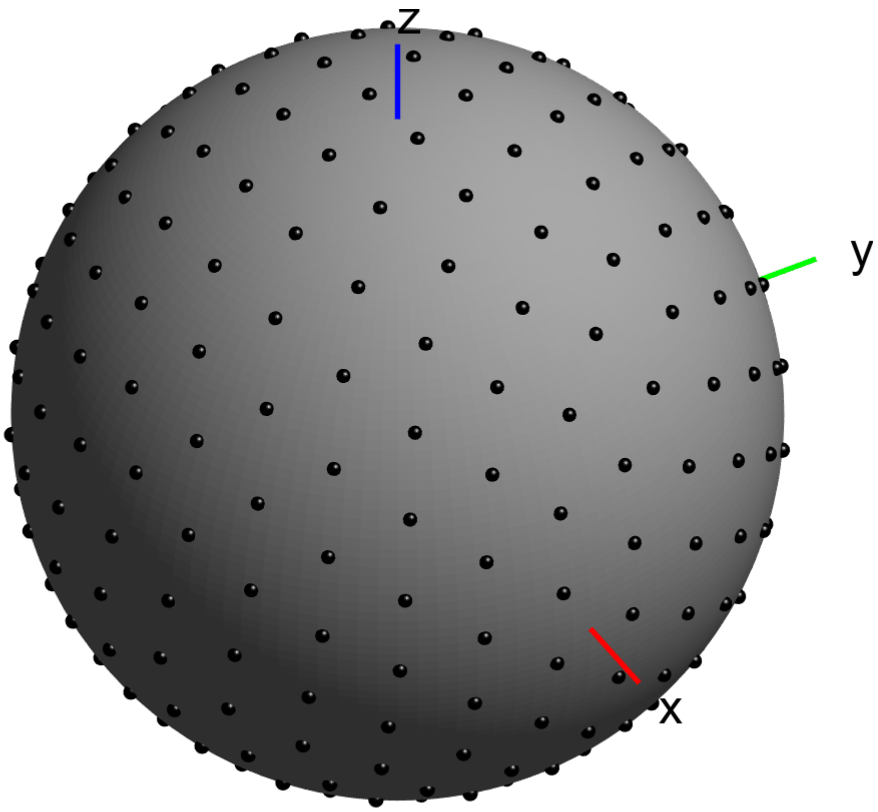


Figure M.1-4: Distribution of measurement grid points in 3D for a constant density grid type with 266 unique measurement points

M.2 Beam Peak Search Grid

Editor's note:

- Other implementations are not precluded as far as the respective analysis are presented and included in this TS

M.2.1 UE Power classes

M.2.1.1 Power class 1 devices

In order to make a reasonable trade-off with measurement uncertainties, it is recommended to use for beam peak search the following measurement grids leading to a systematic error of "Beam Peak Search" of 0.7 dB:

- Constant density grid (using the charged particle implementation) with at least 3000 grid points.
- Constant step size grid with at least 4902 grid points, corresponding to an angular step size of 3.6º.

For better measurement uncertainties, finer measurement grids as shown in Table M.2.1.1-1 may be used. Choice of grids among these 2 types of grids is up to test system implementation.

Table M.2.1.1-1: Minimum number of unique grid points for sample systematic errors

Systematic Error of 'Beam Peak Search': Offset from Beam Peak at which CDF is 5%	Minimum Number of Unique Grid Points for Constant Step Size Grid	Minimum Number of Unique Grid Points for Constant Density Grid
0.3dB	10226 (2.5º step size)	7000
0.4dB	N/A	5000
0.5dB	7082 (3ºstep size)	4500
0.6dB	N/A	3500
0.7dB	4902 (3.6º step size)	3000

M.2.1.2 Power class 2 devices

TBD

M.2.1.3 Power class 3 devices

In order to make a reasonable trade-off between measurement uncertainties, at least 800(constant density grid with charged particle implementation) or 1106 (constant step size grid) measurement grid points shall be used for beam peak search procedures. For better measurement uncertainties, finer measurement grids as shown below may be used. Choice of grids among these 2 types of grids is up to test system implementation.

Table M.2.1.3-1: Minimum number of unique grid points for sample systematic errors (non-sparse antenna arrays)

Systematic Error of 'Beam Peak Search': Offset from Beam Peak at which CDF is 5%	Minimum Number of Unique Grid Points for Constant Step Size Grid	Minimum Number of Unique Grid Points for Constant Density Grid (charged particle implementation)
0.2dB	2522 (5º step size)	2000
0.3dB	1742 (6º step size)	1500
0.4dB	N/A	1000
0.5dB	1106 (7.5ºstep size)	800

M.2.1.4 Power class 4 devices

TBD

M.2.2 Coarse and fine measurement grids

The baseline beam peak search is based on a single and fine beam peak search grid to determine the TX/RX beam peak of the DUT in any given direction. This means that even in sectors where poor EIRP/EIS performance is observed, a very fine grid is used to search for the TX/RX beam peak.

An optimized approach, based on an initial coarse search followed by a subsequent fine search could reduce the number of beam peak search grid points significantly. The basis for this approach is to use a coarse grid with fewer number of points than the ones described in section M.2.1 in the first stage to identify candidate regions that contain the global beam peak and search for the global beam peak with the fine grid in the second stage with a minimum number of points described in section M.2.1.

As an example, Figure M.2.2-1 illustrates the coarse and fine measurement grid approach applied to TX beam search; while this illustration is for EIRP, it can easily be extended to RX beam peak search using EIS or throughput metrics For simplification purposes, 2D coarse and fine searches are illustrated but the concept can be extended to 3D easily. The UE is assumed to form a total of six beams in the 2D plane as illustrated on the left of Figure M.2.2-1. In the centre of Figure M.2.2-1, the 36 coarse beam peak search grid points in the 2D plane are illustrated. On the right, the grey circles on the respective antenna patterns illustrate the measured EIRP values towards each coarse grid point direction based on the respective beam steering directions. This illustration shows that the EIRP beam peak of the coarse search,

$EIRP_{CSBP}$, is found to be the peak of the orange beam while the global TX beam peak (red beam) was not identified due to the coarse sampling of the grid points.

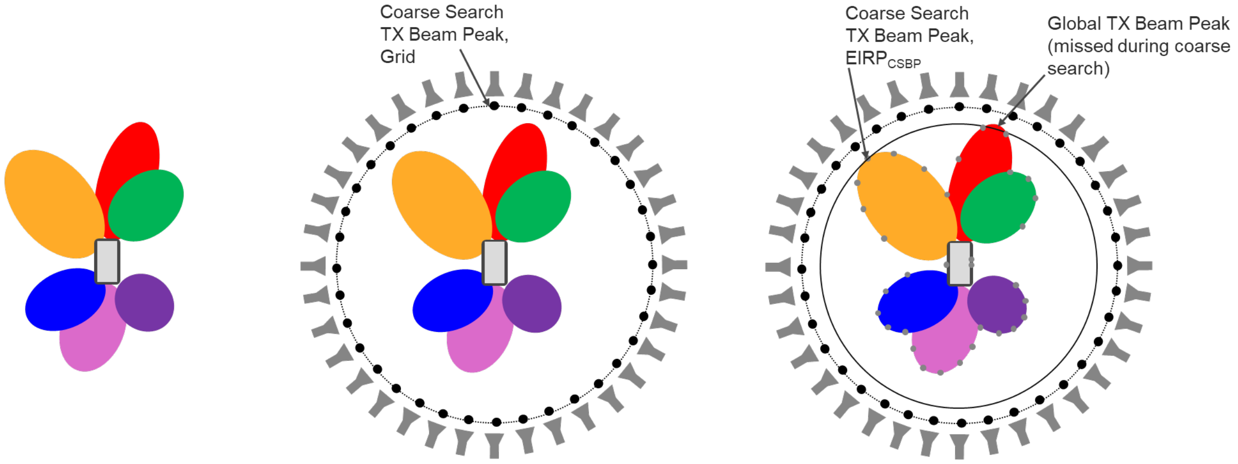


Figure M.2.2-1: Illustration of the Coarse Search Approach for TX Beam Peak Search. Left: Antenna Pattern assumptions in 2D, Centre: Coarse beam peak search grid points/discrete antenna measurement positions, Right: TX beam EIRP measurements per grid point

The proposed fine search approach is illustrated further in Figure M.2.2-2. A fine search region starting from the beam peak identified in the coarse search, $EIRP_{CSBP}$, over a range of Δ_{FS} is used to identify the regions that need to be investigated more closely with the fine search algorithm. The fine search range Δ_{FS} is a function of the angular spacing of the coarse beam peak search grid as well as the beam width of the reference antenna pattern considered for smartphone UEs.

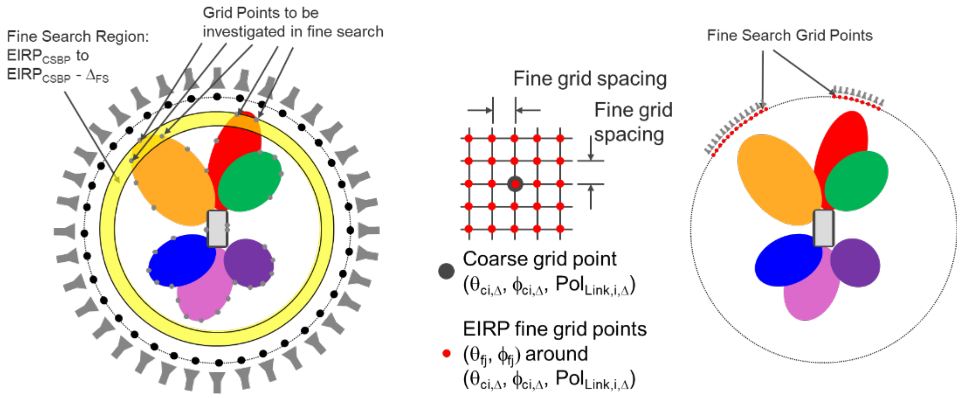


Figure M.2.2-2: Illustration of the fine beam peak search grid. Left: identify the measurement grid points that yielded EIRP values within the fine search region, right: placement of fine beam peak search grid points

Figure M.2.2-3 illustrates coarse and fine grids for constant step size measurement grids while Figure M.2.2-4 illustrates the same for constant density grid.

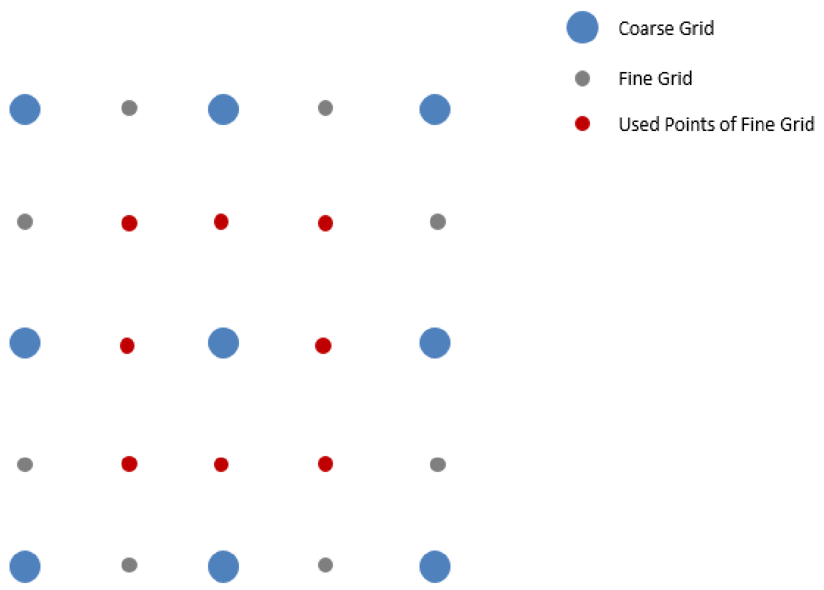


Figure M.2.2-3: Illustration: Coarse & Fine Constant Step Size Grids

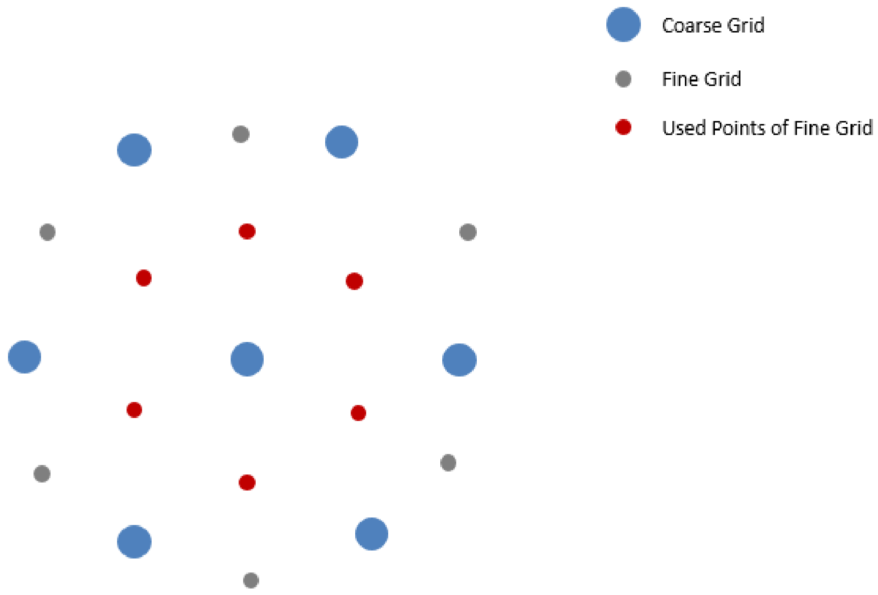


Figure M.2.2-4: Illustration: Coarse & Fine Constant Density Grids

The metric using a coarse & fine grid approach for the TX beam peak search is EIRP for both grids. For RX beam peak search either EIS or Throughput could be used for coarse grids while only EIS for fine grid,

M.3 Spherical Coverage Grid

Editor's note: Other implementations are not precluded as far as the respective analysis are presented and included in this TS

M.3.1 EIRP spherical coverage

M.3.1.1 UE Power classes

M.3.1.1.1 Power class 1 devices

In order to make a reasonable trade-off with measurement uncertainties, it is recommended to use the following recommendation in terms of min. number of grid points, standard deviation, and mean error for spherical coverage grids:

- constant density grid (using the charged particle implementation) with at least 200 grid points: standard deviation (MU element ‘Influence of spherical coverage grid’) of 0.05dB and 0.01dB Mean Error

- constant step size grid with at least 266 grid points: standard deviation (MU element ‘Influence of spherical coverage grid’) of 0.05dB and 0.01dB Mean Error

For better measurement uncertainties, finer measurement grids as shown in Tables M.3.1.1.1-1 and M.3.1.1.1-2 may be used. Choice of grids among these 2 types of grids is up to test system implementation.

There is no need to have the Tx beam peak placed on a measurement grid point.

For constant step size measurement grids, the CDF analyses require the PDFs to be scaled by sin(theta).

Table M.3.1.1.1-1: Statistical results of $EIRP_{85\%CDF}$ for the 12x12 antenna array for constant step size measurement grids and the beam peak oriented in completely random orientations.

Step Size [°]	Number of unique grid points	Std. Dev [dB]	|Mean Error| [dB]
4.5	3122	0.02	0.00
10	614	0.03	0.00
12	422	0.04	0.01
15	266	0.05	0.01
20	146	0.07	0.02
22.5	114	0.09	0.04
30	62	0.11	0.06
36	42	0.15	0.12
45	26	0.19	0.19

Table M.3.1.1.1-2: Statistical results of $EIRP_{50\%CDF}$ for the 12x12 antenna array for constant density measurement grids and the beam peak oriented in completely random orientations.

Number of unique grid points	Std. Dev [dB]	|Mean Error| [dB]
200	0.05	0.01
175	0.06	0.01
150	0.06	0.02
125	0.07	0.02
100	0.08	0.02
50	0.11	0.05
25	0.17	0.12
15	0.27	0.27

M.3.1.1.2 Power class 2 devices

TBD

M.3.1.1.3 Power class 3 devices

In order to make a reasonable trade-off between measurement uncertainties, at least 200 (constant density grid with charged particle implementation) or 266 (constant step size grid) measurement grid points shall be used for EIRP spherical coverage procedure. For better measurement uncertainties, finer measurement grids as shown below may be used. Choice of grids among these 2 types of grids is up to test system implementation.

There is no need to have the Tx beam peak placed on a measurement grid point.

For constant step size measurement grids, the CDF analyses require the PDFs to be scaled by sin(theta).

Table M.3.1.1.3-1: Statistical results of EIRP50%CDF for the 8x2 antenna array for constant density measurement grids (with charged particle implementation) and the beam peak oriented in completely random orientations errors (non-sparse antenna arrays)

Number of unique grid points	STD [dB]	|Mean Error| [dB]
200	0.11	0.02
300	0.08	0.01
400	0.07	0.01
500	0.06	0.01

Table M.3.1.1.3-2: Statistical results of EIRP50%CDF for the 8x2 antenna array for constant step size measurement grids and the beam peak oriented in completely random orientations errors (non-sparse antenna arrays)

Step Size [º]	Number of unique grid points	STD [dB]	|Mean Error| [dB]
9	762	0.05	0.00
10	614	0.06	0.00
12	422	0.07	0.01
15	266	0.12	0.01

M.3.1.1.4 Power class 4 devices

TBD

M.3.2 EIS spherical coverage

M.3.2.1 UE Power classes

M.3.2.1.1 Power class 1 devices

In order to make a reasonable trade-off with measurement uncertainties, it is recommended to use the following recommendation in terms of min. number of grid points, standard deviation, and mean error for spherical coverage grids:

- constant density grid (using the charged particle implementation) with at least 200 grid points: standard deviation (MU element ‘Influence of spherical coverage grid’) of 0.05dB and 0.01dB Mean Error

- constant step size grid with at least 266 grid points: standard deviation (MU element ‘Influence of spherical coverage grid’) of 0.05dB and 0.01dB Mean Error

- the MU element ‘Systematic error related to EIS spherical coverage’ is the DL step size, i.e., 0.2dB.

Choice of grids among these 2 types of grids is up to test system implementation.

There is no need to have the Rx beam peak placed on a measurement grid point.

For constant step size measurement grids, the CCDF analyses require the PDFs to be scaled by sin(theta).

M.3.2.1.2 Power class 2 devices

TBD

M.3.2.1.3 Power class 3 devices

In order to make a reasonable trade-off between measurement uncertainties, at least 200 (constant density grid with charged particle implementation) or 266 (constant step size grid) measurement grid points shall be used for EIS spherical coverage procedure. For better measurement uncertainties, finer measurement grids as shown below may be used. Choice of grid(s) among these 2 types of grids is up to test system implementation.

There is no need to have the Rx beam peak placed on a measurement grid point.

For constant step size measurement grids, the CCDF analyses require the PDFs to be scaled by sin(theta).

Table M.3.2.1.3-1: Statistical results of EIS50%CDF for the 8x2 antenna array for constant step size measurement grids and the beam peak oriented in completely random orientations errors (non-sparse antenna arrays)

		DL Power Step Size: infinitesimal		DL Power Step Size: 0.1dB		DL Power Step Size: 0.5dB		DL Power Step Size: 1dB	
Step Size [º]	Number of unique grid points	STD [dB]	|Mean Error| [dB]	STD [dB]	|Mean Error| [dB]	STD [dB]	|Mean Error| [dB]	STD [dB]	|Mean Error| [dB]
6.0	1742	0.03	0.00	0.03	0.10	0.03	0.50	0.02	1.02
9.0	762	0.05	0.00	0.05	0.10	0.05	0.50	0.04	1.02
10.0	614	0.06	0.00	0.06	0.10	0.06	0.50	0.05	1.02
12.0	422	0.08	0.01	0.07	0.10	0.07	0.50	0.07	1.02
15.0	266	0.12	0.02	0.12	0.10	0.11	0.50	0.10	1.02

Table M.3.2.1.3-2: Statistical results of EIS50%CDF for the 8x2 antenna array for constant density measurement grids (with charged particle implementation) and the beam peak oriented in completely random orientations errors (non-sparse antenna arrays)

	DL Power Step Size: infinitesimal		DL Power Step Size: 0.1dB		DL Power Step Size: 0.5dB		DL Power Step Size: 1dB	
Number of unique grid points	STD [dB]	|Mean Error| [dB]	STD [dB]	|Mean Error| [dB]	STD [dB]	|Mean Error| [dB]	STD [dB]	|Mean Error| [dB]
200	0.10	0.02	0.10	0.10	0.10	0.50	0.09	1.01
300	0.08	0.01	0.08	0.10	0.08	0.50	0.07	1.01
400	0.06	0.01	0.06	0.10	0.06	0.50	0.05	1.01
500	0.06	0.01	0.06	0.10	0.06	0.50	0.05	1.01

M.3.2.1.4 Power class 4 devices

TBD

M.4 TRP Measurement Grid

Editor's note: Other implementations are not precluded as far as the respective analysis are presented and included in this TS

M.4.1 UE Power Classes

M.4.1.1 Power class 1 devices

In order to make a reasonable trade-off between measurement uncertainties, at least the following number of points shall be included in the measurement grid for TRP measurements PC1 UEs based on the assumption that the standard deviation does not exceed 0.25dB. If the re-positioning concept is not applied to TRP test cases:

- 480 measurement grid points for constant density grid – Charged Particle implementation, with standard deviation of 0.23 dB
- 25 latitudes and 48 longitudes (1106 unique grid points) for constant step size grid – sin (theta) weights integration approach, with standard deviation of 0.07dB with the allowance to skip and interpolate measurements at the pole at θ=180°, see Annex M.4.4
- 21 latitudes and 40 longitudes (762 unique grid points) for constant step size grid – Clenshaw Curtis weights integration approach, with standard deviation of 0.24 dB with the allowance to skip and interpolate measurements at the pole at θ=180°, see Annex M.4.4

If the re-positioning concept is applied to TRP test cases:

- 500 measurement grid points for constant density grid – Charged Particle implementation, with standard deviation of 0.24 dB with the allowance to skip and interpolate measurements beyond 165° in θ, see Annex M.4.4
- 25 latitudes and 48 longitudes (1106 unique grid points) for constant step size grid – sin (theta) weights integration approach, with standard deviation of 0.14dB with the allowance to skip and interpolate measurements beyond 165° in θ, see Annex M.4.4
- 21 latitudes and 40 longitudes (762 unique grid points) for constant step size grid – Clenshaw Curtis weights integration approach, with standard deviation of 0.25 dB with the allowance to skip and interpolate measurements beyond 162° in θ, see Annex M.4.4
- 25 latitudes and 48 longitudes (1106 unique grid points) for constant step size grid – Clenshaw Curtis weights integration approach, with standard deviation of 0.15 dB with the allowance to skip and interpolate measurements beyond 150° in θ, see Annex M.4.4

M.4.1.2 Power class 2 devices

TBD

M.4.1.3 Power class 3 devices

In order to make a reasonable trade-off between measurement uncertainties, at least the following number of points should be included in the measurement grid for TRP measurements for non-sparse antenna arrays case. If the re-positioning concept is not applied to TRP test cases:

- 135 measurement grid points for constant density grid – Charged Particle implementation, with standard deviation of 0.23 dB with the allowance to skip and interpolate measurements at the pole at θ=180°
- 12 latitudes and 19 longitudes for constant step size grid – sin (theta) weights integration approach, with standard deviation of 0.25dB with the allowance to skip and interpolate measurements at the pole at θ=180°.

- 12 latitudes and 19 longitudes for constant step size grid – Clenshaw Curtis weights integration approach, with standard deviation of 0.20 dB with the allowance to skip and interpolate measurements at the pole at θ=180º.

If the re-positioning concept is applied to TRP test cases:

- 135 measurement grid points for constant density grid – Charged Particle implementation, with standard deviation of 0.23 dB with the allowance to skip and interpolate measurements beyond 165º in θ, see Annex M.4.4
- 150 measurement grid points for constant density grid – Charged Particle implementation, with standard deviation of 0.25 dB with the allowance to skip and interpolate measurements beyond 150º in θ, see Annex M.4.4
- 12 latitudes and 19 longitudes for constant step size grid – sin (theta) weights integration approach, with standard deviation of 0.25dB with the allowance to skip and interpolate measurements the at pole at θ=180º, see Annex M.4.4
- 12 latitudes and 19 longitudes for constant step size grid – Clenshaw Curtis weights integration approach, with standard deviation of 0.20 dB with the allowance to skip and interpolate measurements the at pole at θ=180º, see Annex M.4.4
- 13 latitudes and 24 longitudes for constant step size grid – sin (theta) weights integration approach, with standard deviation of 0.21dB with the allowance to skip and interpolate measurements beyond 150º in θ, see Annex M.4.4
- 13 latitudes and 24 longitudes for constant step size grid – Clenshaw Curtis weights integration approach, with standard deviation of 0.15 dB with the allowance to skip and interpolate measurements beyond 150º in θ, see Annex M.4.4.

Choice of grid(s) among above 3 types of grids is up to test system implementation.

M.4.1.4 Power class 1 devices

TBD

M.4.2 TRP Integration for Constant Step Size Grid Type

Different approaches to perform the TRP integration from the respective EIRP measurements are outlined in the next sub clauses for the constant step size grid type.

M.4.2.1 TRP Integration using Weights

In many engineering disciplines, the integral of a function needs to be solved using numerical integration techniques, commonly referred to as “quadrature”. Here, the approximation of the integral of a function is usually stated as a weighted sum of function values at specified points within the domain of integration. The derivation from the closed surface TRP integral

$$TRP = \oint_S \frac{EIRP(\theta,\phi)}{4\pi} \cdot \sin\theta \cdot d\theta\, d\phi$$

to the classical discretized summation equation used for OTA

$$TRP \approx \frac{\pi}{2NM} \sum_{i=1}^{N-1} \sum_{j=0}^{M-1} \left[EIRP_\theta(\theta_i,\phi_j) + EIRP_\phi(\theta_i,\phi_j) \right] \sin(\theta_i)$$

The weights for this integral are based on the sinθ·Δθ weights. More accurate implementations are based on the Clenshaw-Curtis quadrature integral approximation based on an expansion of the integrand in terms of Chebyshev polynomials. This implementation does not ignore the measurement points at the poles (θ=0º and 180º) where sinθ = 0. The discretized TRP can be expressed as

$$TRP \approx \frac{1}{2M} \sum_{i=0}^{N} \sum_{j=0}^{M-1} \left[EIRP_\theta(\theta_i,\phi_j) + EIRP_\phi(\theta_i,\phi_j) \right] W(\theta_i)$$

which the sinθ·Δθ weights replaced by a weight function W(θ) and extends the sum over I to include the poles. There is no simple closed-form expression for the Clenshaw-Curtis weights; however, a numerical straightforward approach is available, i.e.,

$$W(\theta_i) = \frac{c_i}{N} \left[1 - \sum_{j=1}^{\mathrm{int}(\frac{N}{2})} \frac{b_j}{4j^2 - 1} \cos(2j\theta_i) \right]$$

with

$$b_j = \begin{cases} 1, & j = n/2 \\ 2, & j < n/2 \end{cases}$$

and

$$c_i = \begin{cases} 1, & i = 0 \bmod N \\ 2, & otherwise \end{cases}$$

The Clenshaw-Curtis weights are compared to the classical sin θ·Δθ weights in Tables M.4.2.1-1 and M.4.2.1-2 for two different numbers of latitudes. The TRP measurement grid consists of N+1 latitudes and M longitudes with

$$\theta_i = i\Delta\theta \text{ where } \Delta\theta = \frac{\pi}{N}$$

and

$$\phi_j = j\Delta\phi \text{ where } \Delta\phi = \frac{2\pi}{M}$$

Table M.4.2.1-1: Samples and weights for the classical sin θ·Δθ weighting and Clenshaw-Curtis quadratures with 12 latitudes (Δθ=16.4°)

Classical sinθ·Δθ		Clenshaw-Curtis	
θ [deg]	Weights	θ [deg]	Weights
0	0	0	0.008
16.4	0.08	16.4	0.079
32.7	0.154	32.7	0.155
49.1	0.216	49.1	0.216
65.5	0.26	65.5	0.26
81.8	0.283	81.8	0.283
98.2	0.283	98.2	0.283
114.6	0.26	114.6	0.26
130.9	0.216	130.9	0.216
147.3	0.154	147.3	0.155
163.6	0.08	163.6	0.079
180	0	180	0.008

Table M.4.2.1-2: Samples and weights for the classical sin θ·Δθ weighting and Clenshaw-Curtis quadratures with 13 latitudes (Δθ=15º)

Classical sinθ·Δθ		Clenshaw-Curtis	
θ [deg]	Weights	θ [deg]	Weights
0	0	0	0.007
15	0.0678	15	0.0661
30	0.1309	30	0.1315
45	0.1851	45	0.1848
60	0.2267	60	0.227
75	0.2529	75	0.2527
90	0.2618	90	0.262
105	0.2529	105	0.2527
120	0.2267	120	0.227
135	0.1851	135	0.1848
150	0.1309	150	0.1315
165	0.0678	165	0.0661
180	0	180	0.007

M.4.3 TRP Integration for Constant Density Grid Types

For constant density grid types, the TRP integration should ideally take into account the area of the Voronoi region surrounding each grid point. Assuming an ideal constant density configuration of the grid points, the TRP can be approximated using

$$TRP \approx \frac{1}{N}\sum_{i=0}^{N-1}\left(EIRP_{\theta}(\theta_i,\phi_i)+EIRP_{\phi}(\theta_i,\phi_i)\right)$$

where N is the number of grid points of the constant density grid type.

M.4.4 Interpolation at or near the Pole

As illustrated in Figure M.4.4-1, for systems that either do not allow measurements at the pole (θ=180º), e.g., using distributed-axes positioners, or systems that have the positioners/support structures block the radiation towards the pole (θ=180º), e.g., combined-axes positioners, measurements beyond 150º in θ can be skipped and interpolated instead for measurement grids defined in Annex M.4.1.

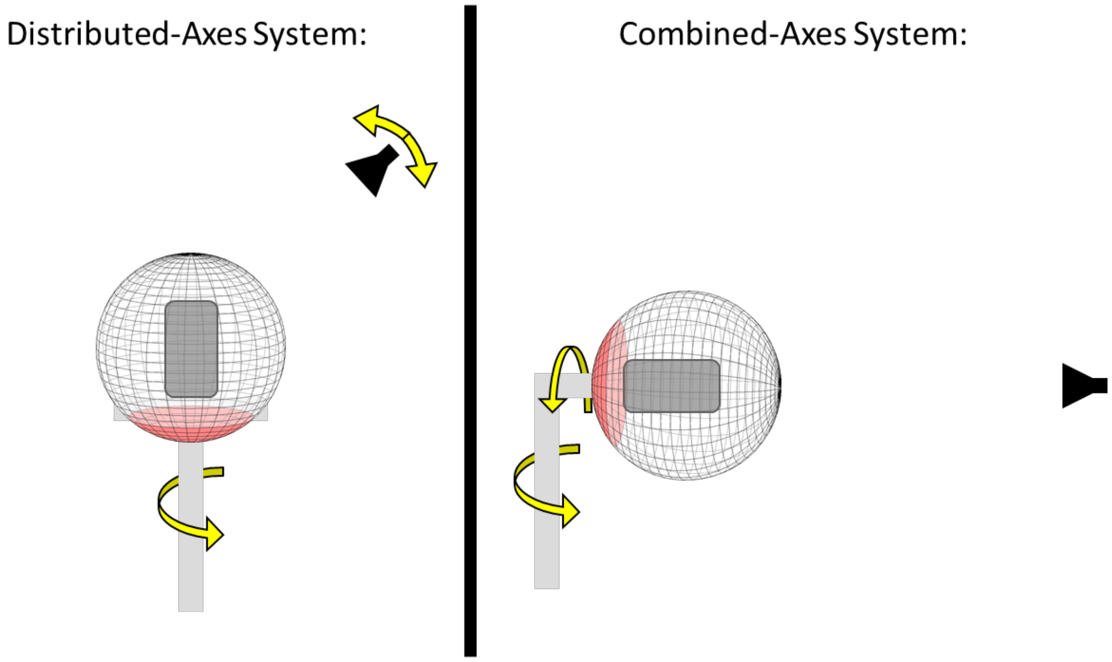


Figure M.4.4-1: Illustration of areas around the pole that either cannot be reached by the measurement antenna or are blocked by the positioner

M.4.5 TRP Grids for Spurious Emissions

The worst antenna array assumptions for the MU simulations are outlined in Tables M.4.5-1 and M.4.5-2.

Table M.4.5-1: Single Antenna Element Radiation Pattern for spurious emission measurements

Antenna element horizontal radiation pattern	$A_{E,H}(\varphi) = -\min\left[12\left(\frac{\varphi}{\varphi_{3dB}}\right)^2, A_m\right] dB$, A_m =30 dB
Horizontal half-power beam width of single element	260°
Antenna element vertical radiation pattern	$A_{E,V}(\theta) = -\min\left[12\left(\frac{\theta - 90}{\theta_{3dB}}\right)^2, SLA_v\right]$, SLA_v =30 dB
Vertical half-power beam width of single array element	130°
Array element radiation pattern	$A_E(\varphi,\theta) = G_{E,\max} - \min\{-(A_{E,H}(\varphi) + A_{E,V}(\theta)), A_m\}$
Element gain without antenna losses	$G_{E,max}$ = 1.5 dBi

Table M.4.5-2: Composite Antenna Array Radiation Pattern for spurious emission measurements

Composite array radiation pattern in dB $A_A(\theta,\varphi)$	$A_{A,Beami}(\theta,\varphi) = A_E(\theta,\varphi) + 10\log_{10}\left(\left\lvert\sum_{m=1}^{N_H}\sum_{n=1}^{N_V} w_{i,n,m} \cdot v_{n,m}\right\rvert^2\right)$ the super position vector is given by: $v_{n,m} = \exp\left(i \cdot 2\pi\left((n-1)\cdot\frac{d_V}{\lambda}\cdot\cos(\theta) + (m-1)\cdot\frac{d_H}{\lambda}\cdot\sin(\theta)\cdot\sin(\varphi)\right)\right),$ $n = 1,2,\ldots N_V; m = 1,2,\ldots N_H;$ the weighting is given by: $w_{i,n,m} = \frac{1}{\sqrt{N_H N_V}}\exp\left(i \cdot 2\pi\left((n-1)\cdot\frac{d_V}{\lambda}\cdot\sin(\theta_{i,etilt}) - (m-1)\cdot\frac{d_H}{\lambda}\cdot\cos(\theta_{i,etilt})\right)\right)$
Antenna array configuration (Row×Column)	8 x 2
Horizontal radiating element spacing, d_h/λ	1
Vertical radiating element spacing, d_v/λ	1

The TRP measurement grid selection for spurious emissions is up to test system implementation but shall meet the criteria shown in Table M.4.5-3.

Table M.4.5-3: TRP measurement grid requirement for spurious emission measurements

Level of Grid	Grid Type	Standard Deviation of MU Element 'Influence of TRP Measurement'	Systematic error due to TRP calculation/quadrature	Number of unique grid points
Coarse	Constant Density	N/A	N/A	35
	Constant-Step Size	N/A	N/A	62 (Δθ=Δϕ=30º)
Fine	Constant Density	0.32dB	0dB	135
	Constant-Step Size	0.31dB	0dB	266 Δθ=Δϕ=15º)

For spurious emissions, TRP measurements with measurement antennas displaced up to 10º from the focal point (based on electrical switching) in an IFF (based on CATR) test system, alternate TRP approaches for constant-step size grids are allowed for the coarse and fine grids:

interpolation to the non-offset system coordinate system that allows the use of Clenshaw-Curtis or classical sin(θ) quadratures

use of the advanced Jacobian matrix quadrature approach that uses triangulations of the sphere

Annex N (normative): UE coordinate system

N.1 Reference coordinate system

This annex defines the measurement coordinate system for the NR UE. The reference coordinate system as defined in IEEE Std 149 [27] is provided in Figure N.1-1 below while Figure N.1.-2 shows the DUT in the default alignment, i.e., the DUT and the reference coordinate systems are aligned with α = 0º and β = 0º and γ = 0º where α, β, and γ describe the relative angles between the two coordinate systems.

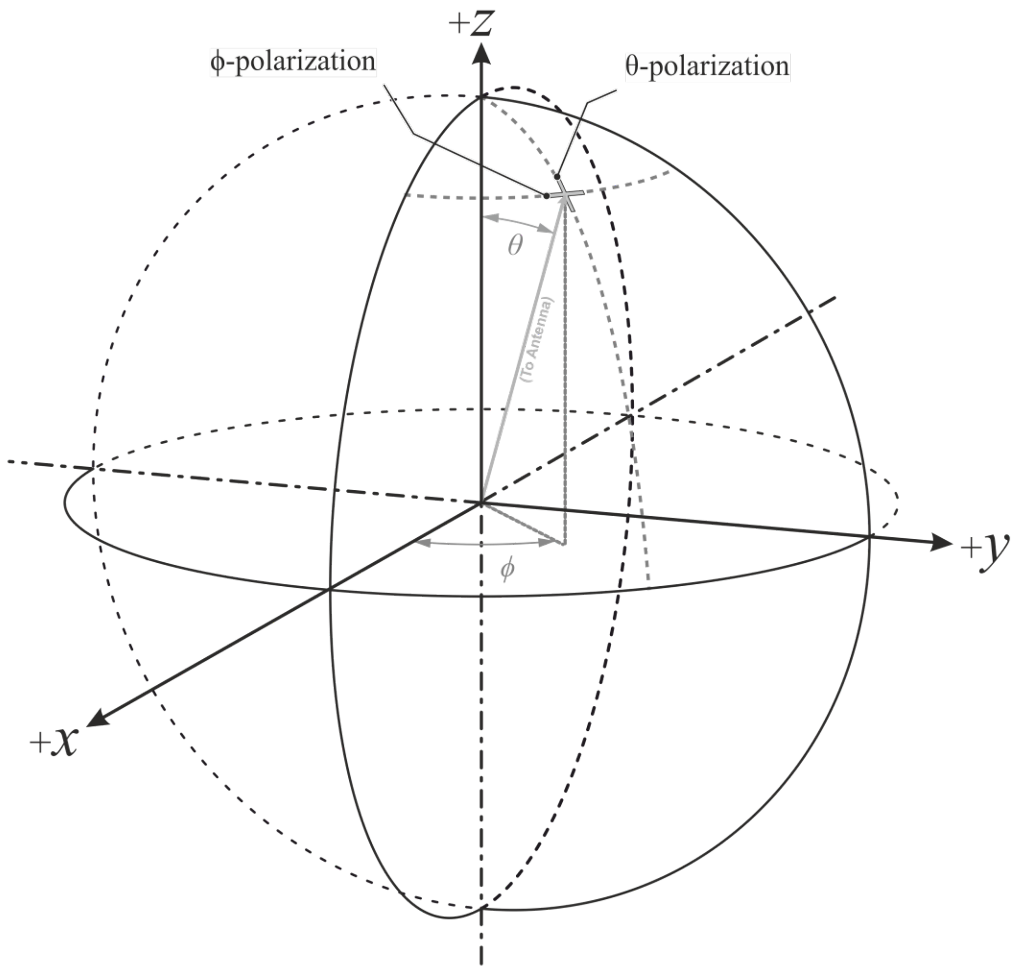


Figure N.1-1: Reference coordinate system

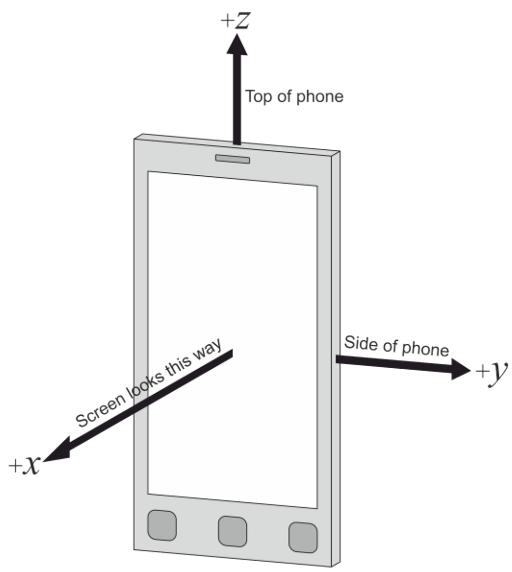


Figure N.1-2: DUT default alignment to coordinate system

The following aspects are necessary:

- A basic understanding of the top and bottom of the device is needed in order to define unambiguous DUT positioning requirements for the test, e.g., in the drawings used in this annex, the three buttons are on the bottom of the device (front) and the camera is on the top of the device (back).
- An understanding of the origin and alignment the coordinate system inside the test system i.e. the directions in which the x, y, z -axes points inside the test chamber is needed in order to define unambiguous DUT orientation, DUT beam, signal, interference, and measurement angles

N.2 Test conditions and angle definitions

Tables N.2-1 through N.2-3 below provides the test conditions and angle definitions for three permitted device alignment for the default test condition, DUT orientation 1, and two different options for each permitted device alignment to re-position the device for DUT Orientation 2 as outlined in Figures N.2-1 and N.2-3.

Table N.2-1: Test conditions and angle definitions for Alignment Option 1

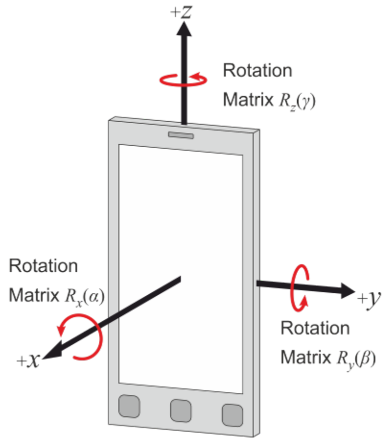
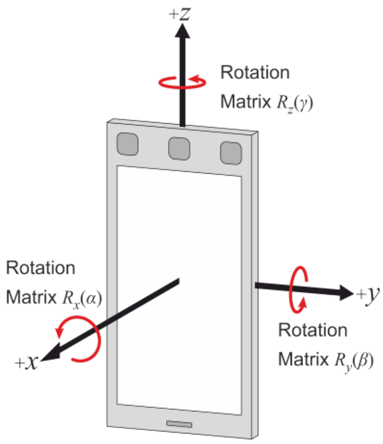
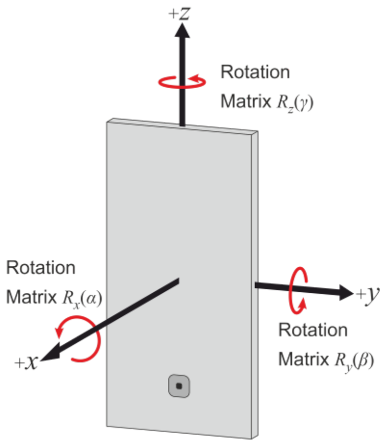
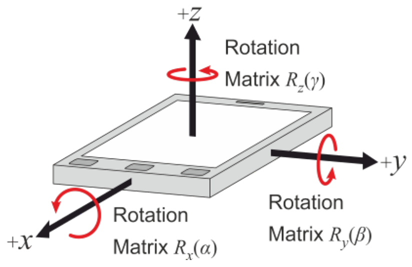
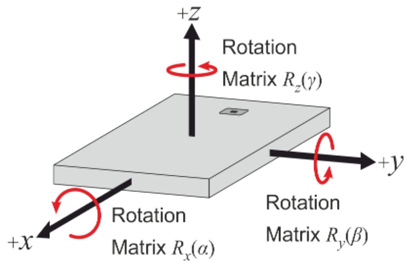
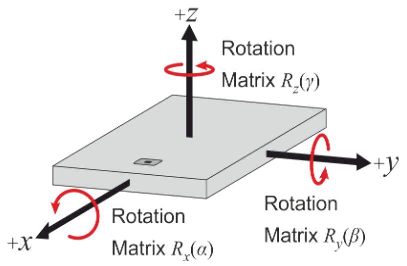
Test condition	DUT orientation	Link angle	Measurement angle	Diagram
Free space DUT Orientation 1 (default)	α = 0º; β = 0º; γ = 0º	θ_{Link}; ϕ_{Link} with polarization reference $Pol_{Link} = \theta$ or ϕ	θ_{Meas}; ϕ_{Meas} with polarization reference $Pol_{Meas} = \theta$ or ϕ	
Free space DUT Orientation 2 – Option 1 (based on re-positioning approach)	α = 180º; β = 0º; γ = 0º	θ_{Link}; ϕ_{Link} with polarization reference $Pol_{Link} = \theta$ or ϕ	θ_{Meas}; ϕ_{Meas} with polarization reference $Pol_{Meas} = \theta$ or ϕ	
Free space DUT Orientation 2 – Option 2 (based on re-positioning approach)	α = 0º; β = 180º; γ = 0º	θ_{Link}; ϕ_{Link} with polarization reference $Pol_{Link} = \theta$ or ϕ	θ_{Meas}; ϕ_{Meas} with polarization reference $Pol_{Meas} = \theta$ or ϕ	
NOTE 1: A polarization reference, as defined in relation to the reference coordinate system in N.1-1, is maintained for each signal angle, link or interferer angle, and measurement angle. NOTE 2: The combination of rotations is captured by matrix $M=R_z(\gamma) \cdot R_y(\beta) \cdot R_x(\alpha)$				

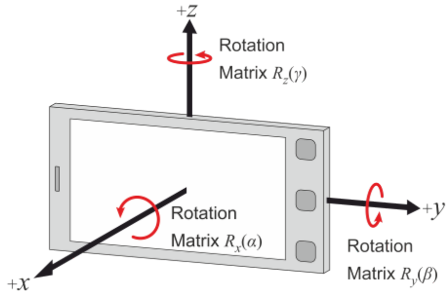
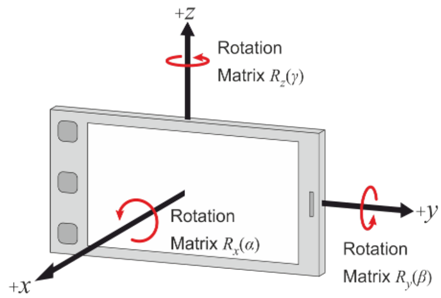
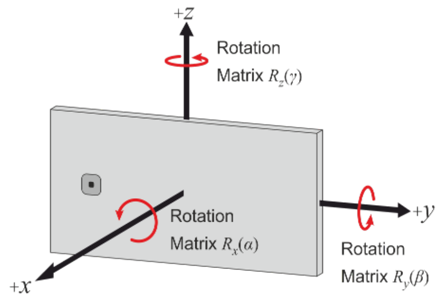
Table N.2-2: Test conditions and angle definitions for Alignment Option 2

Test condition	DUT orientation	Link angle	Measurement angle	Diagram
Free space DUT Orientation 1 (default)	α = 0º; β = -90º; γ = 0º	$\theta_{Link;}$ ϕ_{Link} with polarization reference Pol_{Link} = θ or ϕ	$\theta_{Meas;}$ ϕ_{Meas} with polarization reference Pol_{Meas} = θ or ϕ	
Free space DUT Orientation 2 – Option 1 (based on re-positioning approach)	α = 180º; β = 90º; γ = 0º	$\theta_{Link;}$ ϕ_{Link} with polarization reference Pol_{Link} = θ or ϕ	$\theta_{Meas;}$ ϕ_{Meas} with polarization reference Pol_{Meas} = θ or ϕ	
Free space DUT Orientation 2 – Option 2 (based on re-positioning approach)	α = 0º; β = 90º; γ = 0º	$\theta_{Link;}$ ϕ_{Link} with polarization reference Pol_{Link} = θ or ϕ	$\theta_{Meas;}$ ϕ_{Meas} with polarization reference Pol_{Meas} = θ or ϕ	

NOTE 1: A polarization reference, as defined in relation to the reference coordinate system in N.1-1, is maintained for each signal angle, link or interferer angle, and measurement angle.

NOTE 2: The combination of rotations is captured by matrix $M=R_z(\gamma)\bullet R_y(\beta)\bullet R_x(\alpha)$

Table N.2-3: Test conditions and angle definitions for Alignment Option 3

Test condition	DUT orientation	Link angle	Measurement angle	Diagram
Free space DUT Orientation 1 (default)	α = 90º; β = 0º; γ = 0º	θ_{Link}; ϕ_{Link} with polarization reference Pol_{Link} = θ or ϕ	θ_{Meas}; ϕ_{Meas} with polarization reference Pol_{Meas} = θ or ϕ	
Free space DUT Orientation 2 – Option 1 (based on re-positioning approach)	α = -90º; β = 0º; γ = 0º	θ_{Link}; ϕ_{Link} with polarization reference Pol_{Link} = θ or ϕ	θ_{Meas}; ϕ_{Meas} with polarization reference Pol_{Meas} = θ or ϕ	
Free space DUT Orientation 2 – Option 2 (based on re-positioning approach)	α = 90º; β = 180º; γ = 0º	θ_{Link}; ϕ_{Link} with polarization reference Pol_{Link} = θ or ϕ	θ_{Meas}; ϕ_{Meas} with polarization reference Pol_{Meas} = θ or ϕ	
NOTE 1: A polarization reference, as defined in relation to the reference coordinate system in N.1-1, is maintained for each signal angle, link or interferer angle, and measurement angle. NOTE 2: The combination of rotations is captured by matrix $M=R_z(\gamma)\bullet R_y(\beta)\bullet R_x(\alpha)$				

For each UE requirement and test case, each of the parameters in Table N.2-1 through N.2-3 need to be recorded, such that DUT positioning, DUT beam direction, and angles of the signal, link/interferer, and measurement are specified in terms of the fixed coordinate system.

Due to the non-commutative nature of rotations, the order of rotations is important and needs to be defined when multiple DUT orientations are tested.

The rotations around the x, y, and z axes can be defined with the following rotation matrices

$$R_x(\alpha) = \begin{pmatrix} & 0 & 0 & 0 \\ & \cos\alpha & -\sin\alpha & 0 \\ & \sin\alpha & \cos\alpha & 0 \\ & 0 & 0 & 1 \end{pmatrix}$$

$$R_y(\beta) = \begin{bmatrix} \cos\beta & 0 & \sin\beta & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\beta & 0 & \cos\beta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

and

$$R_z(\gamma) = \begin{bmatrix} \cos\gamma & -\sin\gamma & 0 & 0 \\ \sin\gamma & \cos\gamma & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}.$$

with the respective angles of rotation, α, β, γ, and

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = R \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Additionally, any translation of the DUT can be defined with the translation matrix

$$T(t_x, t_y, t_z) = \begin{bmatrix} 1 & 0 & 0 & t_x \\ 0 & 1 & 0 & t_y \\ 0 & 0 & 1 & t_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

with offsets t_x, t_y, t_z in x, y, and z, respectively and with

$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = T \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

The combination of rotations and translation is captured by the multiplication of rotation and translation matrices.

For instance, the matrix M

$$M = T(t_x, t_y, t_z) \cdot R_z(\gamma) \cdot R_y(\beta) \cdot R_x(\alpha)$$

describes an initial rotation of the DUT around the x axis with angle α, a subsequent rotation around the y axis with angle β, and a final rotation around the z axis with angle γ. After those rotations, the DUT is translated by t_x, t_y, t_z in x, y, and z, respectively.

N.3 DUT positioning guidelines

The centre of the reference coordinate system shall be aligned with the geometric centre of the DUT in order to minimize the offset between antenna arrays integrated at any position of the UE and the centre of the quiet zone.

Near-field coupling effects between the antenna and the pedestals/positioners/fixtures generally cause increased signal ripples. Re-positioning the DUT by directing the beam peak away from those areas can reduce the effect of signal ripple on EIRP/EIS measurements. Figure N.3-1 and N.3-2 illustrate how to reposition the DUT in distributed axes and combined axes system, when the beam peak is directed to the DUTs upper hemisphere (DUT orientation 1) or the DUTs lower hemisphere (DUT orientation 2). While these figures are examples of different positioning systems and other implementations are not precluded, the relative orientation of the coordinate system with respect to the antennas/reflectors and the axes of rotation shall apply to any measurement setup.

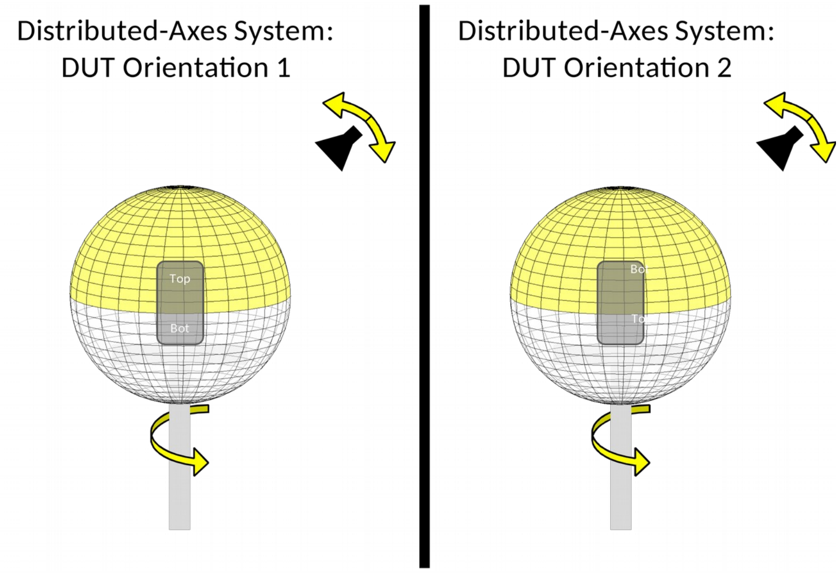


Figure N.3-1: DUT re-positioning for an example of distributed-axes system

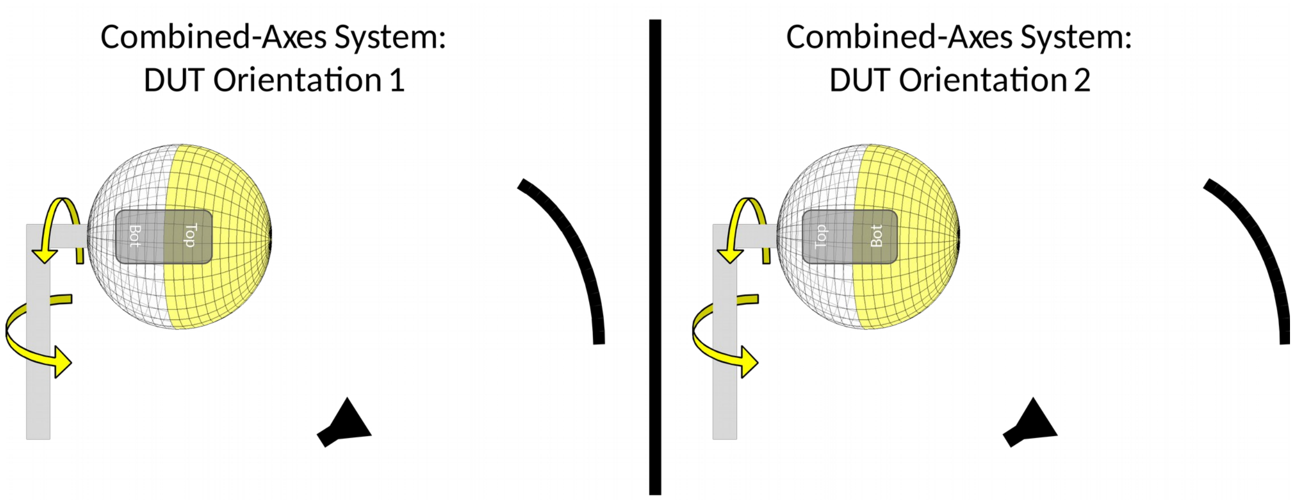


Figure N.3-2: DUT re-positioning for an example of combined-axes system

For EIRP/EIS measurements, re-positioning the DUT makes sure the pedestal is not obstructing the beam path and that the pedestal is not in closer proximity to the measurement antenna/reflector than the DUT. For TRP measurements, re-positioning the DUT makes sure that the beam peak direction is not obstructed by the pedestal and the pedestal is in the measurement path only when measuring the back-hemisphere. No re-positioning during the TRP measurement is required.

Annex O: Quality of the quiet zone validation

O.1 General

This annex describes the procedures for validating the quality of the quiet zone for the permitted far-field methods outlined in Annex B.2.2 (DFF), B.2.3 (simplified DFF), and in B.2.4 (IFF based on CATR) in [10]. Annex O.2 focuses on the procedure for in-band and OOB test cases while Annex O.3 focuses on the procedure for spurious emissions test cases.

O.2 Procedure to characterize the quality of the quiet zone for in-band/OOB for the permitted far field methods

This procedure is mandatory before the test system is commissioned for certification tests and characterizes the quiet zone performance of the anechoic chamber, specifically the effect of reflections within the anechoic chamber including any positioners and support structures. Additionally, it includes the effect of offsetting the directive antenna array inside a DUT from the centre of the quiet zone, i.e., the centre of rotation of the DUT and measurement antenna positioning systems as well as the directivity MU, i.e., the variation of antenna gains in the different direct line-of-sight links.

The quiet zone is illustrated in Figure O.2-1 which includes the definitions of centre of quiet zone range, i.e., the geometric centre of the positioning systems, and the range length, i.e., the distance between the centre of the quiet zone and the aperture of the measurement antenna.

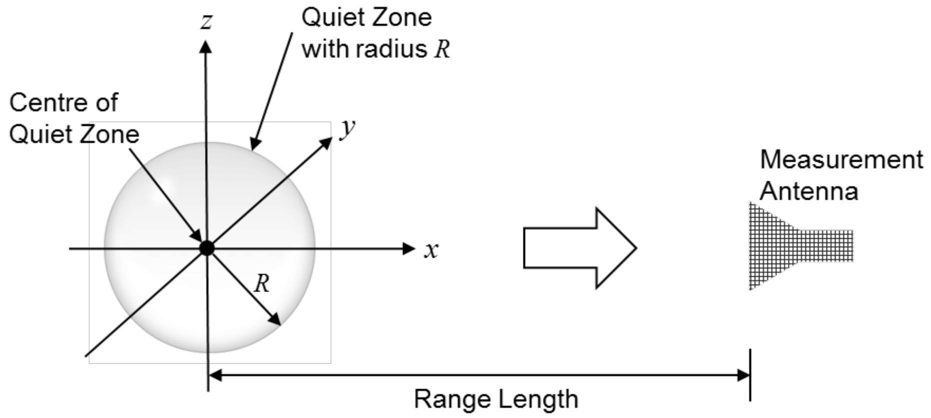


Figure O.2-1: Quiet Zone Illustration

The outcome of the procedures can be used to predict the

- variation of the TRP measurements, spherical surface integrals of EIRP/EIS, when the DUT is placed anywhere within the quiet zone and with the beam formed in any arbitrary direction inside the chamber

- variation of the EIRP/EIS measurements when the DUT is placed anywhere within the quiet zone and with the beam formed in any arbitrary direction inside the chamber

The reference coordinate system defined in Annex N applies to this procedure.

O.2.1 Equipment used

The reference antenna under test (AUT) that is placed at various locations within the quiet zone shall be a directive antenna with similar properties of typical antenna arrays integrated in DUTs. The characteristics in terms of Directivity and Half Power Beamwidth (HPBW) of the reference AUT are shown in Figure O.2.1-1, O.2.1-2, and O.2.1-3.

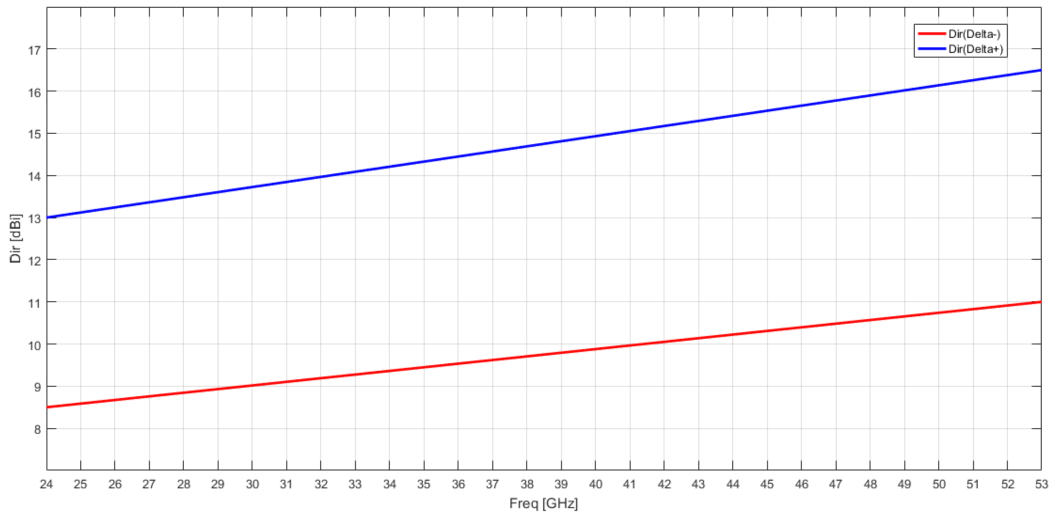


Figure O.2.1-1: Directivity mask

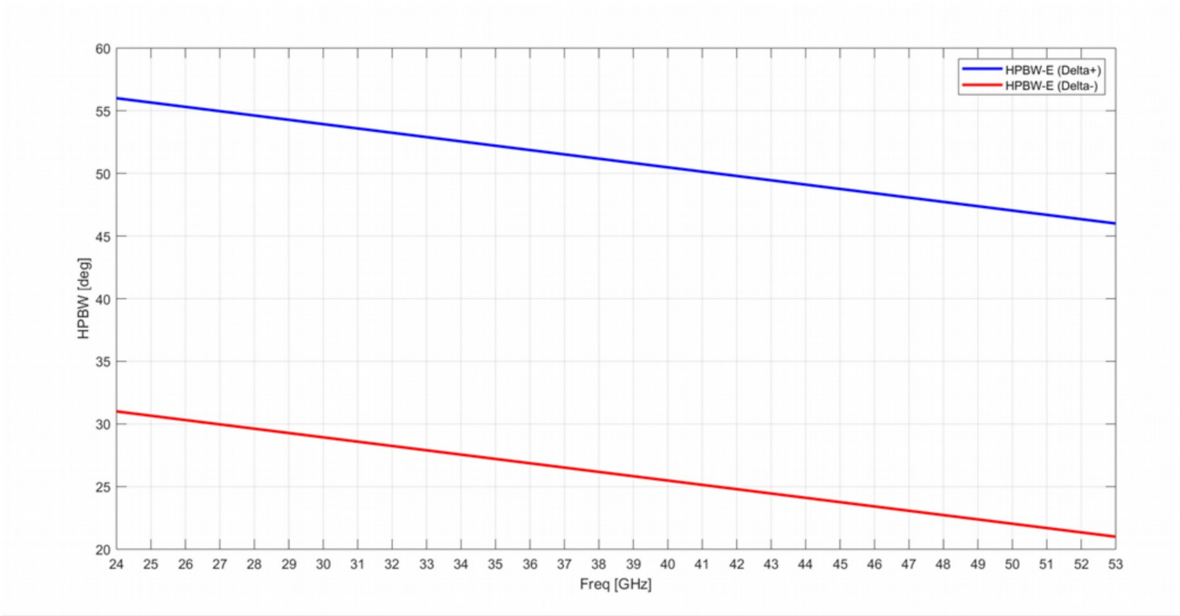


Figure O.2.1-2: 2xHPBW-E mask

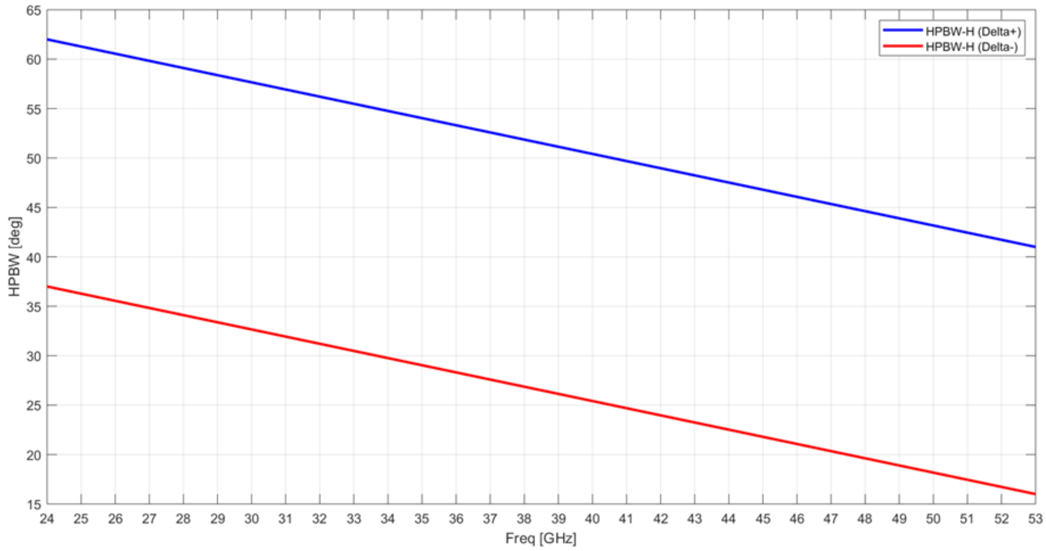


Figure O.2.1-3: 2xHPBW-H mask

AUT shall be symmetric on E and H planes.

The above masks for the reference antenna are met based on antenna vendors' calibration report.

For the measurement, a combination of signal generator and spectrum analyser or a network analyser can be used. The multi-port (with three ports) network analyser is most suitable to reduce test time as both polarizations of the measurement antenna can be measured simultaneously, and multiple frequencies can be measured in a sweep.

O.2.2 Test frequencies

The frequencies to be used to characterize the quality of the quiet zone are 23.45 GHz, 32.125 GHz, and 40.8 GHz. The quiet zone validation analysis is performed for each frequency individually.

O.2.3 Reference measurements

The quality of the quiet measurements for integrated RF parameters such as TRP shall use 3D pattern measurements of the reference antenna patterns as they most closely resemble the 3D/spherical surface measurements/integrals of EIRP or EIS. Therefore, the quality of the quiet zone measurements for TRP metrics shall be based on efficiency measurements. On the other hand, the quality of the quiet zone measurements for single-directional EIRP and EIS metrics shall be based on gain measurements of the direct line-of-sight link between the reference AUT and the measurement antenna.

The grid types for the TRP measurements shall match those outlined in M.1 and the minimum number of grid points (including quadratures for constant step size grids and implementation of constant density grids) shall meet the 0.25 dB maximum standard uncertainty summarized in M.4.

O.2.4 Size of the quiet zone

The size of the quiet zone within which the variations of measurements are evaluated depends on the size of the DUT. For smartphones, the quiet zone shall be considered a sphere with radius of R=10cm. For larger smartphones and tablet type devices, the quiet zone shall be considered a sphere with radius of R=15cm. Alternate quiet zone sizes can be defined for even larger DUTs.

The quality of quiet zone procedure for systems supporting larger quiet zone sizes can be performed for the largest quiet zone radius only and the results can be applied to the smaller quiet zone radius. Performing separate sets of quality of quiet zone measurements for different radii is not precluded.

O.2.5 Reference AUT positions

The reference AUT shall be positioned in a total of 7 different reference positions, shown in Figure O.2.5.1-1 and O.2.5.2-1

While position 1, P1, is the centre of the quiet zone, the remaining positions, 2 through 7, are off-centre positions each displaced by the radius of the quiet zone, R. The coordinates of the respective test points are shown in Table O.2.5-1.

Table O.2.5-1: Reference AUT Measurement Coordinates

Position	*x*	*y*	*z*
P1	0	0	0
P2	*R*	0	0
P3	*-R*	0	0
P4	0	*R*	0
P5	0	*-R*	0
P6	0	0	*R*
P7	0	0	*-R*

O.2.5.1 Distributed-axes system

The reference AUT shall be positioned in a total of 7 different reference positions, shown in Figure O.2.5.1-1.

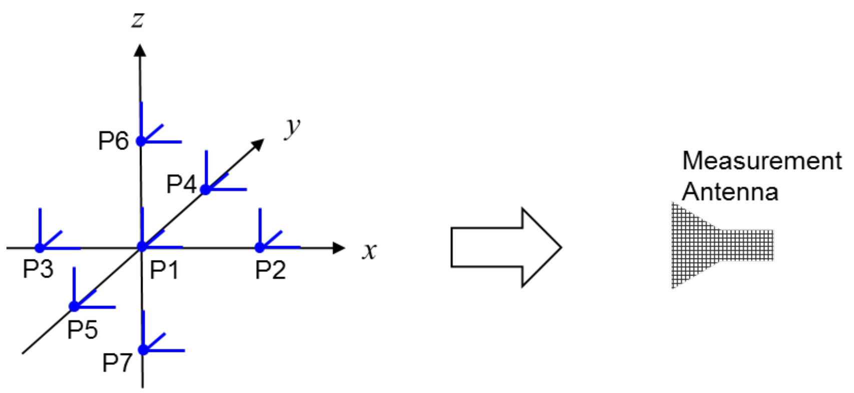


Figure O.2.5.1-1: Reference AUT Measurement Positions for distributed-axes system

The reference AUT positions inside a typical distributed-axes system are shown in Figure O.2.5.1-2.

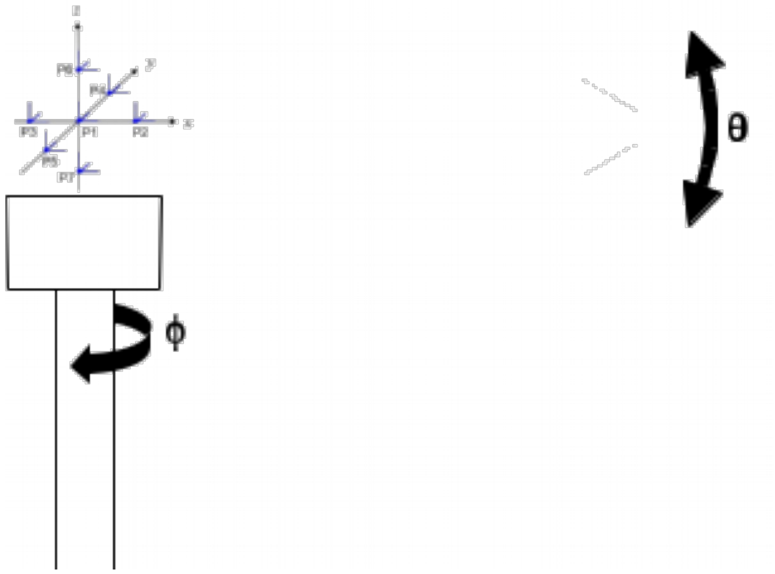


Figure O.2.5.1-2: Reference AUT Measurement Positions for distributed-axes system

O.2.5.2 Combined-axes system

The reference AUT shall be positioned in a total of 7 different reference positions, shown in Figure O.2.5.2-1.

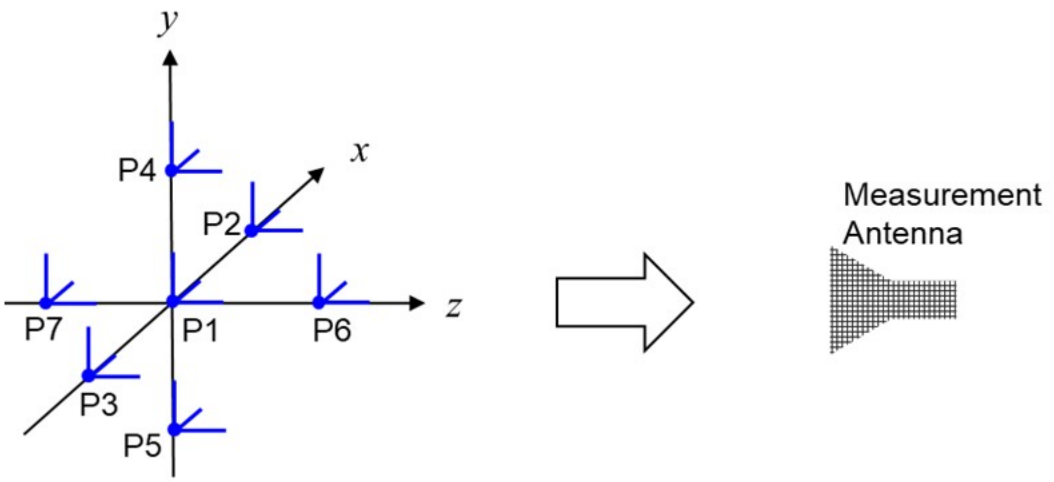


Figure O.2.5.2-1: Reference AUT Measurement Positions for combined-axes system

The reference AUT positions inside a typical combined-axes system are shown in Figure O.2.5.2-2.

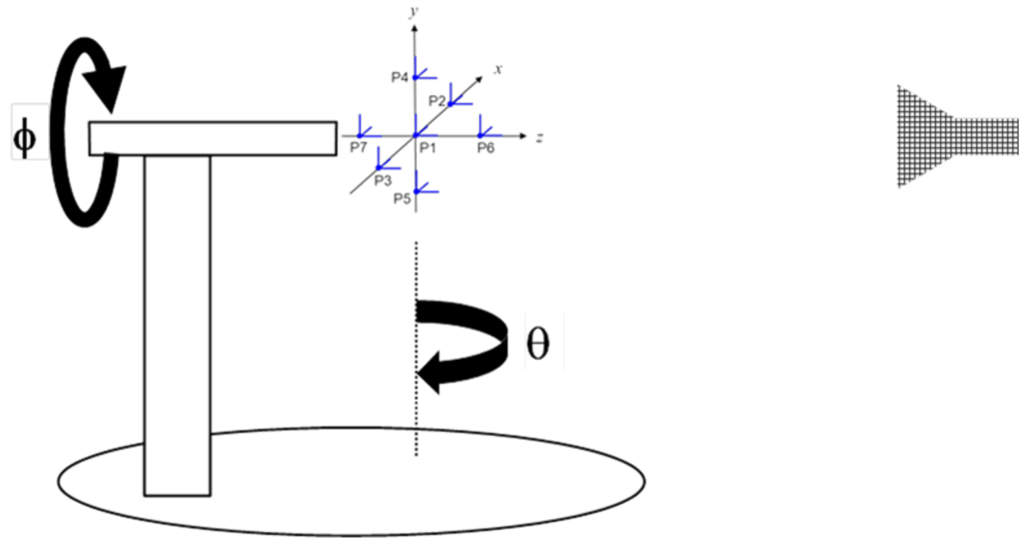


Figure O.2.5.2-2: Reference AUT Measurement Positions for combined-axes system

O.2.6 Reference AUT orientations

As different areas within the chamber could yield variations in the field uniformity inside the quiet zone caused by reflections, it is important to characterize the electromagnetic fields with the reference antennas uniformly illuminating the anechoic chamber.

O.2.6.1 Distributed-axes system

In order to keep the quality of the quiet zone characterization manageable in terms of test times, it is suggested to perform the reference measurements for the reference AUT placed at the 7 antenna positions with the antenna rotated around the y axis with 5 different angles β, i.e., β = 0º, 45º, 90º, 135º, and 180º, and rotated around the z axis with 8 different γ = 0º, 45º, 90º, 135º, 180º, 225º, 270º, and 315º. A graphical illustration of the some sample reference AUT orientations is shown in Figure O.2.6.1-1 with a reference AUT placed at position 6, P6, for reference antenna polarization γ_{pol} = 0º; Figure O.2.6.1-2 illustrates the reference AUT orientations for the reference polarization γ_{pol} = 90º.

The matrix operation for the rotations and translation is defined as

$$M = T(t_x, t_y, t_z) \cdot R_z(\gamma) \cdot R_y(\beta) \cdot R_{z,pol}(\gamma_{pol})$$

for the distributed-axes system.

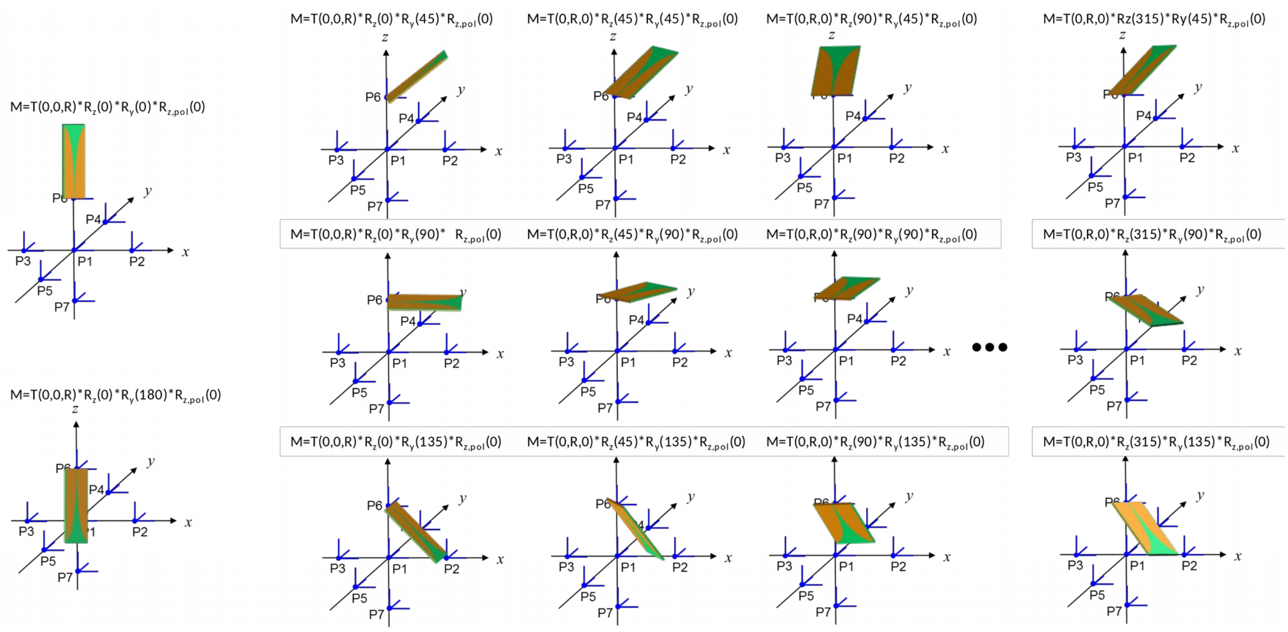


Figure O.2.6.1-1: Sample reference AUT orientations for position 6, P6 for reference antenna polarization $\gamma_{pol} = 0^o$

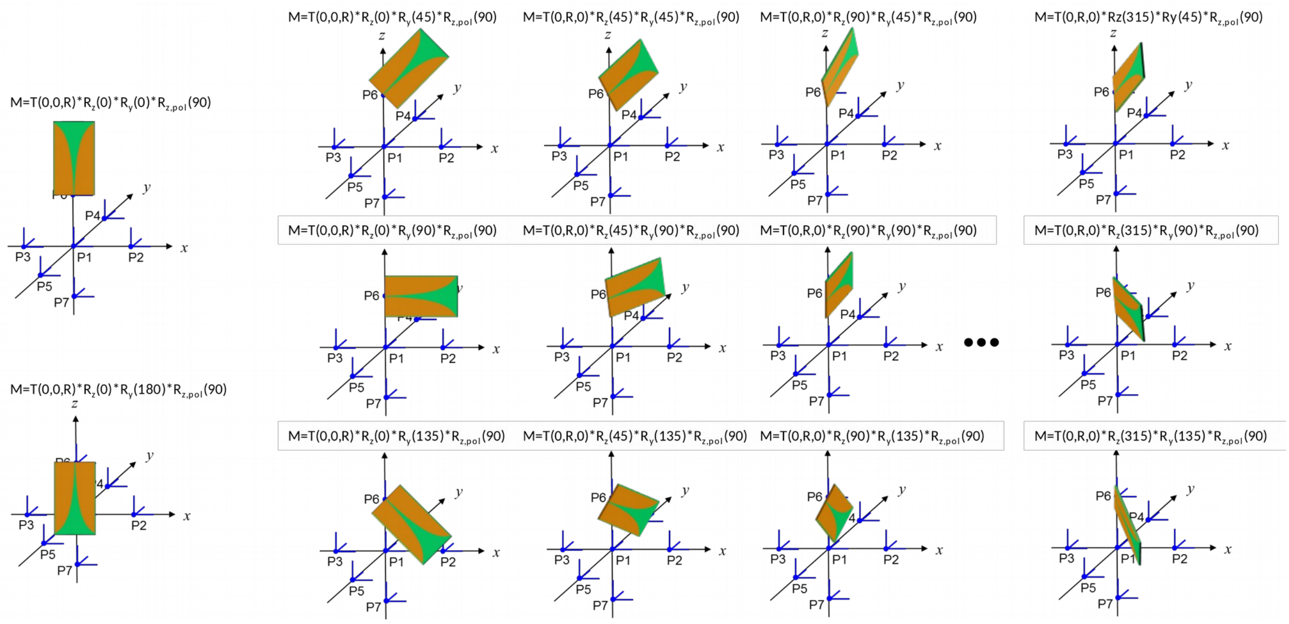


Figure O.2.6.1-2: Sample reference AUT orientations for position 6, P6, for reference antenna polarization $\gamma_{pol} = 90^o$

When facing the z-axis, $\beta = 0^o$ and $\beta = 180^o$, the antenna does not need to be evaluated for the 8 different rotations around the z axis. A single orientation is sufficient since those orientations are unique. Due to the pedestal, distributed-axes systems are not able to measure towards the β =180º direction; for those systems, the reference measurements at this reference AUT orientation can be skipped.

If the device re-positioning approach outlined in Annex N is adopted for the EIRP/EIS/TRP based conformance test cases, the quality of quiet zone analysis is sufficient only for β = 0º, 45º, 90º.

O.2.6.2 Combined-axes system

In order to keep the quality of the quiet zone characterization manageable in terms of test times, it is suggested to perform the reference measurements for the reference AUT placed at the 7 antenna positions with the antenna rotated around the x axis with 5 different angles α, i.e., α = -90º, -45º, 0º, 45º, and 90º and rotated around the y axis with 8 different angles β = 0º, 45º, 90º, 135º, 180º, 225º, 270º, and 315º. A graphical illustration of some sample reference AUT orientations is shown in Figure O.2.6.2-1 with a reference AUT placed at position 4, P4, for reference antenna polarization γ_{pol} = 0º; Figure O.2.6.2-2 illustrates the reference AUT orientations for the reference polarization γ_{pol} = 90º.

The matrix operation for the rotations and translation is defined as

$$M = T(t_x, t_y, t_z) \cdot R_y(\beta) \cdot R_x(\alpha) \cdot R_{z,pol}(\gamma_{pol})$$

for the combined-axes system.

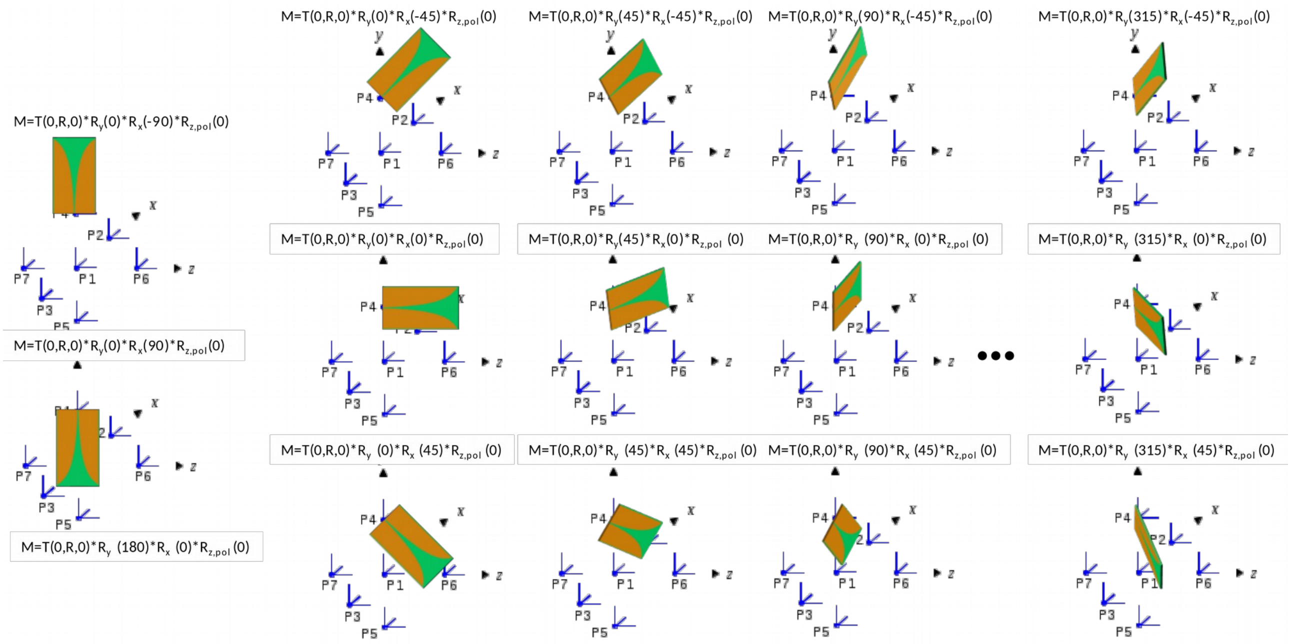


Figure O.2.6.2-1: Sample reference AUT orientations for position 4, P4, for reference antenna polarization γ_{pol} = 0º

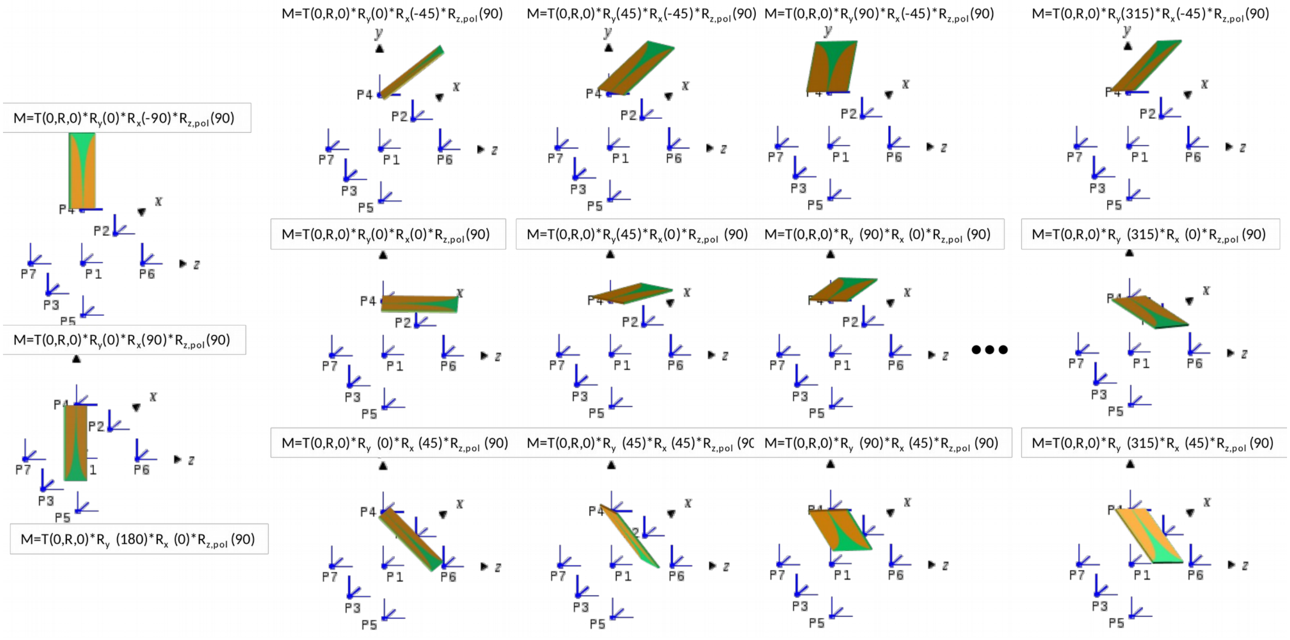


Figure O.2.6.2-2: Sample reference AUT orientations for position 4, P4, for reference antenna polarization γ_{pol} = 90º

When facing the y axis, α = 90º and α = -90º, the antenna does not need to be evaluated for the 8 different rotations around the y axis. A single rotation is sufficient since those orientations are unique. Due to the pedestal of the 2-axis positioner, combined-axes systems are not able to measure towards the β = 180º direction; for those systems, the reference measurements at this reference AUT orientation can be skipped.

If the device re-positioning approach outlined in Annex N is adopted for all EIRP/EIS/TRP based conformance test cases, the quality of quiet zone analysis is sufficient only for β = 0º, 45º, 90º, 270º, and 315º.

O.2.7 Quality of quiet zone measurement uncertainty calculations for TRP

The combined MU element related to the quality of the quiet zone for TRP and offset between UE antenna array and centre of quiet zone is the standard deviation of the various efficiency measurement results that are based on the 7 different reference AUT positions, the respective reference AUT orientations, and the two reference AUT polarization orientations.

O.2.8 Quality of quiet zone measurement uncertainty for EIRP/EIS

The MU for the quality of the quiet zone for EIRP/EIS includes the additional MU element of the directivity of the DUT and measurement antennas as shown in Figure O.2.9-1. The EIRP/EIS measurements are taking the peak gains of the respective antennas into account with the reference AUT placed in the centre of the quiet zone. Once the antenna is displaced in directions other than the measurement antenna, the direct line-of-sight link is taking reduced antenna gains into account. The type of reference AUT should therefore have similar pattern properties as typical UE antennas. For systems with very large range lengths, the directivity MU will be insignificant.

The combined MU element related to the quality of the quiet zone for EIRP/EIS, offset between UE antenna array and centre of quiet zone, and directivity is the standard deviation of the single-point gain measurement results that are based on the 7 different reference AUT positions, the respective reference AUT orientations, and the two reference AUT polarization orientations.

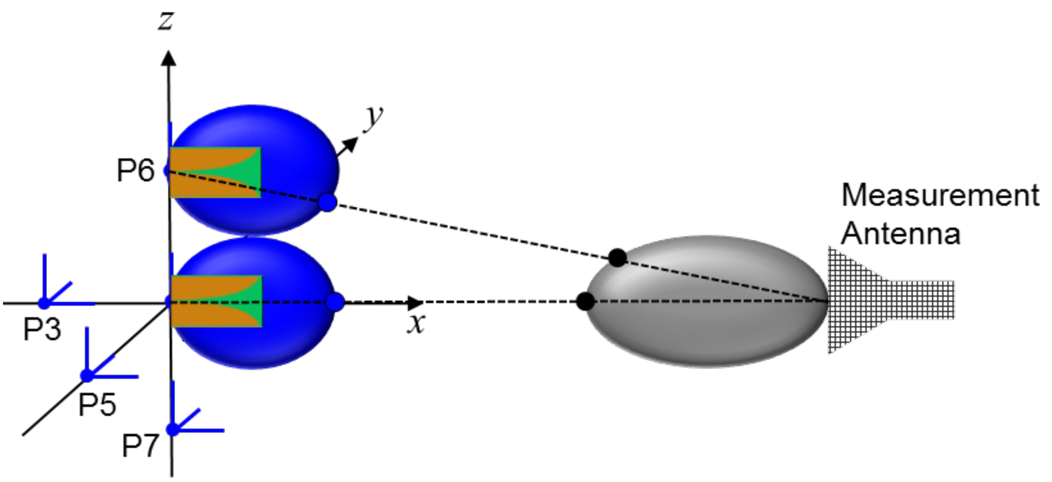


Figure O.2.9-1: Illustration of the Directivity MU Element

O.3 Procedure to characterize the spurious emissions quality of the quiet zone for the permitted far field methods

This procedure is mandatory before the spurious emissions test system is commissioned for certification tests and characterizes the quiet zone performance of the anechoic chamber, specifically the effect of reflections within the anechoic chamber including any positioners and support structures. Additionally, it includes the effect of offsetting the directive antenna array inside a DUT from the centre of the quiet zone, i.e., the centre of rotation of the DUT and measurement antenna positioning systems.

The quiet zone is illustrated in Figure O.2-1 which includes the definitions of centre of quiet zone range, i.e., the geometric centre of the positioning systems, and the range length, i.e., the distance between the centre of the quiet zone and the aperture of the measurement antenna.

The outcome of the procedures can be used to predict the variation of the TRP measurements, spherical surface integrals of EIRP, when the DUT is placed anywhere within the quiet zone and with the beam formed in any arbitrary direction inside the chamber

The reference coordinate system defined in Annex N applies to this procedure.

O.3.1 Equipment used

The reference antenna under test (AUT) that is placed at various locations within the quiet zone shall be a directive antenna with a half-power beam width (HPBW) of ≥ 20° in E-Plane and H-Plane. The HPBWs met based on antenna vendors' calibration report or datasheet.

For the measurement, a combination of signal generator and spectrum analyser or a network analyser can be used. The multi-port (with three ports) network analyser is most suitable to reduce test time as both polarizations of the measurement antenna can be measured simultaneously, and multiple frequencies can be measured in a sweep.

O.3.2 Test frequencies

Editor Note: Another test frequency of [TBD] GHz will be added as soon as FR2 bands >40GHz are introduced.

The frequencies to characterize the quality of the quiet zone shall be [6], [12.75], 23.45, 40.8, 66, and 80GHz. The quiet zone validation analysis is performed for each frequency individually.

The measurements from the 23.45 and 40.8GHz in-band QoQZ validation can be re-used provided that the reference antenna position and orientation as well as the measurement frequency and measurement antenna are identical in both cases.

O.3.3 Reference measurements

The spurious emissions quality of the quiet zone measurements shall use 3D pattern measurements of the reference antenna patterns as they most closely resemble the 3D/spherical surface measurements/integrals of EIRP. Therefore, the quality of the quiet zone measurements for TRP metrics shall be based on efficiency measurements.

The grid types for the TRP measurements shall meet the 0.25 dB maximum standard uncertainty. The min number of grid points for the two grid types are:

- 192 grid points for the constant step-size measurement grids
- 100 grid points for the constant density measurement grids (charged particle implementation)

O.3.4 Size of the quiet zone

The size of the quiet zone within which the variations of measurements are evaluated depends on the size of the DUT. For smartphones, the quiet zone shall be considered a sphere with radius of R=10cm. For larger smartphones and tablet type devices, the quiet zone shall be considered a sphere with radius of R=15cm. Alternate quiet zone sizes can be defined for even larger DUTs.

The quality of quiet zone procedure for systems supporting larger quiet zone sizes can be performed for the largest quiet zone radius only and the results can be applied to the smaller quiet zone radius. Performing separate sets of quality of quiet zone measurements for different radii is not precluded.

O.3.5 Reference AUT positions

The reference AUT shall be positioned in a total of 7 different reference positions, shown in Figure O.2.5.1-1 and O.2.5.2-1

While position 1, P1, is the centre of the quiet zone, the remaining positions, 2 through 7, are off-centre positions each displaced by the radius of the quiet zone, *R*. The coordinates of the respective test points are shown in Table O.2.5-1.

O.3.5.1 Distributed-axes system

The reference AUT shall be positioned in a total of 7 different reference positions, shown in Figure O.2.5.1-1 for distributed-axes systems.

The reference AUT positions inside a typical distributed-axes system are shown in Figure O.2.5.1-2.

O.3.5.2 Combined-axes system

The reference AUT shall be positioned in a total of 7 different reference positions, shown in Figure O.2.5.2-1 for combined-axes systems.

The reference AUT positions inside a typical combined-axes system are shown in Figure O.2.5.2-2.

O.3.6 Reference AUT orientations

As different areas within the chamber could yield variations in the field uniformity inside the quiet zone caused by reflections, it is important to characterize the electromagnetic fields with the reference antennas uniformly illuminating the anechoic chamber. However, in order to keep the spurious emissions quality of the quiet zone characterization manageable in terms of test time, the number of orientations for the spurious emissions quality of quiet zone validation is limited when compared to the number of orientations for the in-band quality of quiet zone validation.

O.3.6.1 Distributed-axes system

The reference measurements for the reference AUT placed at the 7 antenna positions shall be rotated around the *y* axis with 2 different angles β, i.e., $\beta = 0^o$ and 180^o and fixed $\gamma = 0^o$. A graphical illustration of the reference AUT orientations is shown in Figure O.3.6.1-1 with a reference AUT placed at position 6, P6, for reference antenna polarization $\gamma_{pol} = 0^o$; Figure O.3.6.1-2 illustrates the reference AUT orientations for the reference polarization $\gamma_{pol} = 90^o$.

The matrix operation for the rotations and translation is defined as

$$M = T(t_x, t_y, t_z) \cdot R_z(\gamma) \cdot R_y(\beta) \cdot R_{z,pol}(\gamma_{pol})$$

for the distributed-axes system. The matrices are defined in Annex J.2 of TS 38.101-2.

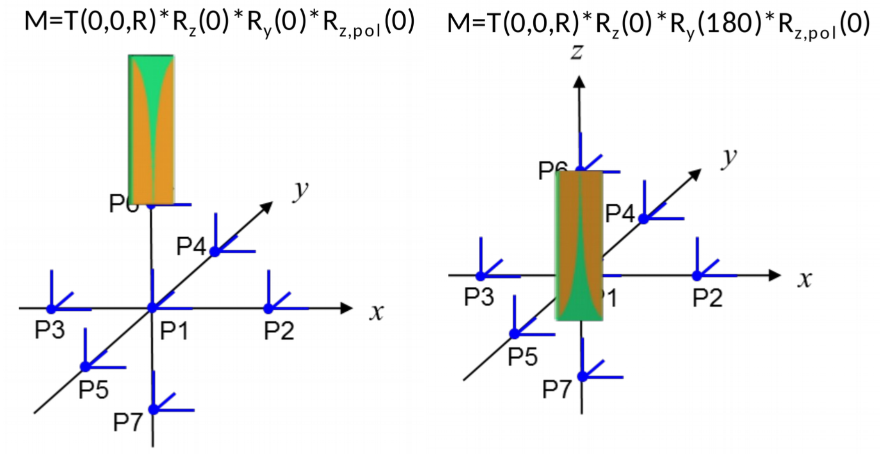


Figure O.3.6.1-1: Reference AUT orientations for position 6, P6 for reference antenna polarization γ_{pol} = 0°

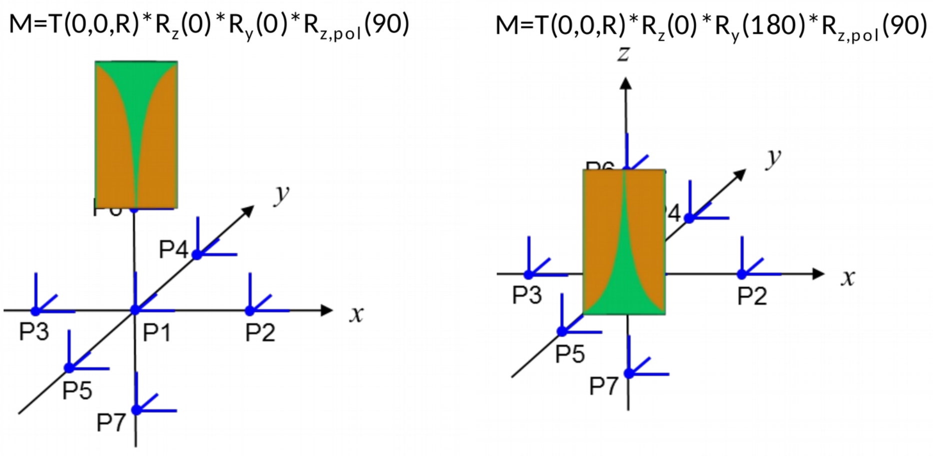


Figure O.3.6.1-2: Reference AUT orientations for position 6, P6, for reference antenna polarization γ_{pol} = 90°

If the device re-positioning approach is adopted for the spurious emissions test cases, i.e., two hemispheres are measured separately which involves the DUT, while connected to the gNB emulator, to be rotated by 180° around its axis halfway through the test, the quality of quiet zone analysis is sufficient only for β = 0°.

O.3.6.2 Combined-axes system

The reference measurements for the reference AUT placed at the 7 antenna positions shall be rotated around the *x* axis with 2 different angles β, i.e., β = 0° and 180° and fixed α = 0°. A graphical illustration of the sample reference AUT orientations is shown in Figure O.3.6.2-1 with a reference AUT placed at position 4, P4, for reference antenna polarization γ_{pol} = 0°; Figure O.3.6.2-2 illustrates the reference AUT orientations for the reference polarization γ_{pol} = 90°.

The matrix operation for the rotations and translation is defined as

$$M = T(t_x, t_y, t_z) \cdot R_y(\beta) \cdot R_x(\alpha) \cdot R_{z,pol}(\gamma_{pol})$$

for the combined-axes system. The matrices are defined in Annex J.2 of TS 38.101-2.

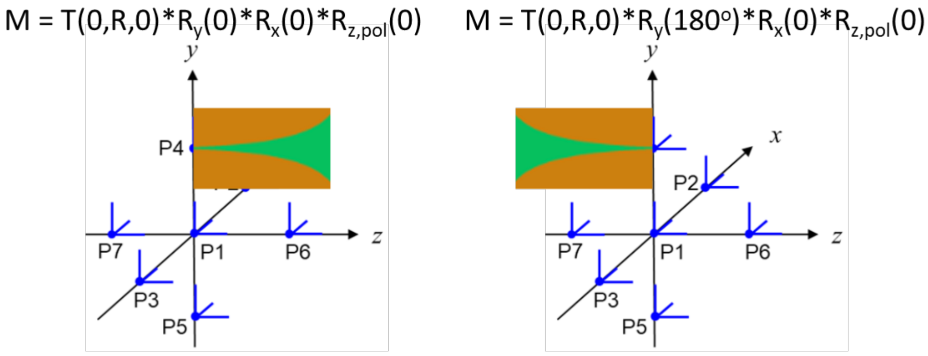


Figure O.3.6.2-1: Reference AUT orientations for position 4, P4, for reference antenna polarization γ_{pol} = 0°.

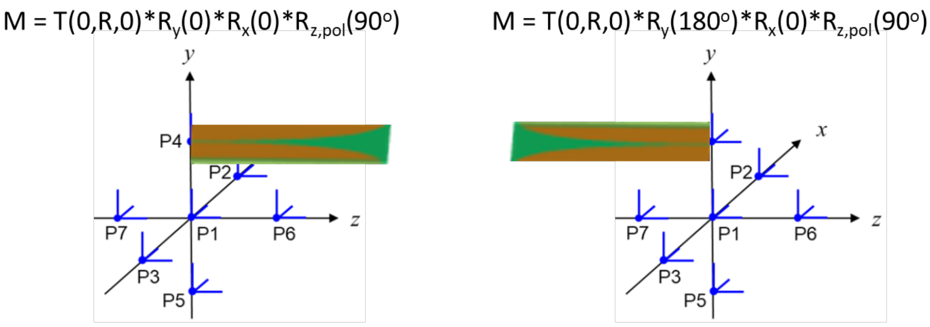


Figure O.3.6.2-2: Reference AUT orientations for position 4, P4, for reference antenna polarization γ_{pol} = 90°

If the device re-positioning approach is adopted for the spurious emissions test cases, i.e., two hemispheres are measured separately which involves the DUT, while connected to the gNB emulator, to be rotated by 180° around its axis halfway through the test, the quality of quiet zone analysis is sufficient only for β = 0°.

O.3.7 Quality of quiet zone measurement uncertainty calculations for TRP

The combined MU element related to the spurious emissions quality of the quiet zone for TRP and offset between UE antenna array and centre of quiet zone is the standard deviation of the various efficiency measurement results that are based on the 7 different reference AUT positions, the respective reference AUT orientations, and the two reference AUT polarization orientations.

Annex P (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2017-08	RAN5 #76	R5-174709	-	-	-	Draft skeleton	0.0.1
2018-01	RAN5#1-5G-NR Adhoc	R5-180002	-	-	-	Add references	0.1.0
2018-01	RAN5#1-5G-NR Adhoc	R5-180103	-	-	-	Add definitions, symbols and abbreviations	0.1.0
2018-01	RAN5#1-5G-NR Adhoc	R5-180104	-	-	-	Introduction of Operating bands and Channel arrangement	0.1.0
2018-01	RAN5#1-5G-NR Adhoc	R5-180094	-	-	-	Introduction of new test case 6.3.2 Transmit OFF power	0.1.0
2018-01	RAN5#1-5G-NR Adhoc	R5-180095	-	-	-	TP to add skeleton of 6.5.1 Occupied bandwidth to 38.521-2	0.1.0
2018-01	RAN5#1-5G-NR Adhoc	R5-180096	-	-	-	TP to add skeleton of 6.5.2.1 SEM to 38.521-2	0.1.0
2018-01	RAN5#1-5G-NR Adhoc	R5-180097	-	-	-	TP to add skeleton of 6.5.2.3 ACLR to 38.521-2	0.1.0
2018-03	RAN5 #78	R5-181508	-	-	-	Updated 38.521-2 to extend Annex with additional testing information	0.2.0
2018-03	RAN5 #78	R5-181680	-	-	-	TP to skeleton of 7.6.1 Inband blocking to 38.521-2	0.2.0
2018-03	RAN5 #78	R5-181681	-	-	-	5G-NR: Text Proposal to add spurious emissions test case to 38.521-2	0.2.0
2018-04	RAN5#2-5G-NR Adhoc	R5-181978	-	-	-	Update TS 38.521-2 further to align with the latest TS 38.101-2 spec structure.	0.3.1
2018-04	RAN5#2-5G-NR Adhoc	R5-182027	-	-	-	5G-NR Text Proposal to update spurious emissions test case to 38.521-2	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-182041	-	-	-	5G-NR Text Proposal to add REFSENS test case to 38.521-2	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-182009	-	-	-	General section updated to 38.521-2	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-182048	-	-	-	Addition of FR2 test case 6.3.1 Minimum Output Power	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-182049	-	-	-	Addition of FR2 test case 6.3.3.2 General ON/OFF time mask	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-181839	-	-	-	Definitions and abbreviations updated to 38.521-2	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-181840	-	-	-	Operating bands and Channel arrangement updated to 38.521-2	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-182008	-	-	-	Introduction of new test case 7.4 Maximum input level	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-182010	-	-	-	Common uplink configuration table for Tx test cases for TS 38.521-2 non-CA	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-182011	-	-	-	TP for 6.5.1 Occupied Bandwidth in TS 38.521-2	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-182029	-	-	-	TP for 6.5.2.1 Spectrum Emission Mask in TS 38.521-2	0.4.0

2018-04	RAN5#2-5G-NR Adhoc	R5-182031	-	-	-	TP for 6.5.2.3 Adjacent Channel Leakage Ratio in TS 38.521-2	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-182043	-	-	-	TP for 7.6.2 InBand Blocking in TS 38.521-2	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-182046	-	-	-	TP for 7.5 Adjacent channel selectivity in TS 38.521-2	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-181844	-	-	-	Add Annex G (normative): Measurement uncertainties and Test Tolerances	0.4.0
2018-04	RAN5#2-5G-NR Adhoc	R5-181844	-	-	-	Add clause 4.4 Test point analysis	0.4.0
2018-05	RAN5 #79	R5-183908	-	-	-	Introduction of New FR2 test case 6.3.3.4 PRACH time mask	0.5.0
2018-05	RAN5 #79	R5-182769	-	-	-	General section updated to 38.521-2	0.5.0
2018-05	RAN5 #79	R5-183914	-	-	-	TP for FR2 spurious test procedure (38.521-2)	0.5.0
2018-05	RAN5 #79	R5-183925	-	-	-	Update of Refsens test procedure for FR2	0.5.0
2018-05	RAN5 #79	R5-182883	-	-	-	Definitions, symbols and abbreviations updated to 38.521-2	0.5.0
2018-05	RAN5 #79	R5-182884	-	-	-	Operating bands and Channel arrangement updated to 38.521-2	0.5.0
2018-05	RAN5 #79	R5-182890	-	-	-	Update minimum conformance requirements and test requirement for 6.3.2 Transmit OFF power	0.5.0
2018-05	RAN5 #79	R5-183926	-	-	-	Annex for test case applicability per permitted test method	0.5.0
2018-05	RAN5 #79	R5-183712	-	-	-	Corrections annexes for EIRP and TRP metric definition	0.5.0
2018-05	RAN5 #79	R5-183927	-	-	-	Clean up TBD from Occupied Bandwidth, SEM and ACLR test cases	0.5.0
2018-05	RAN5 #79	R5-183928	-	-	-	Clean up TBD from ACS and Inband Blocking test cases	0.5.0
2018-05	RAN5 #79	R5-183948	-	-	-	Statistical Testing Annex for 38.521-2	0.5.0
2018-08	RAN5 #80	R5-185348	-	-	-	Correction to FR2 Spurious TC and introduction of TRP measurement grid requirement	1.0.0
2018-08	RAN5 #80	R5-185350	-	-	-	Addition of Frequency Error test case to TS 38.521-2	1.0.0
2018-08	RAN5 #80	R5-185490	-	-	-	FR2_TxSpurious_TestConfig_38.521-2	1.0.0
2018-08	RAN5 #80	R5-185562	-	-	-	FR2_StoreTxRxBeamPeakCoordinates_38.521-2	1.0.0
2018-08	RAN5 #80	R5-184742	-	-	-	Update of FR2 test case 6.3.1	1.0.0
2018-08	RAN5 #80	R5-184743	-	-	-	Update of FR2 test case 6.3.3.2	1.0.0
2018-08	RAN5 #80	R5-184856	-	-	-	General sections updated to 38.521-2	1.0.0
2018-08	RAN5 #80	R5-185519	-	-	-	Updates of FR2 TRx MU and TT in Annex	1.0.0
2018-08	RAN5 #80	R5-185555	-	-	-	FR2_UE_BeamlockInvoke_38.521-2	1.0.0
2018-08	RAN5 #80	R5-185191	-	-	-	Update to Occupied Bandwidth, SEM and ACLR test cases in TS 38.521-2	1.0.0
2018-08	RAN5 #80	R5-185192	-	-	-	Update to ACS and inband blocking test cases in TS 38.521-2	1.0.0
2018-08	RAN5 #80	R5-185187	-	-	-	FR2_RefSens_TestConfig_38.521-2	1.0.0
2018-08	RAN5 #80	R5-185188	-	-	-	DL and UL RMC updated for FR2 tests	1.0.0
2018-08	RAN5 #80	R5-185189	-	-	-	Downlink physical channel updated for FR2 tests	1.0.0
2018-08	RAN5 #80	R5-185190	-	-	-	OCNG Patterns updated for FR2 tests	1.0.0
2018-08	RAN5 #80	R5-185194	-	-	-	Update to Test frequencies for SEM in TS 38.521-2	1.0.0
2018-08	RAN5 #80	R5-185196	-	-	-	Addition of Carrier Leakage test case to TS 38.521-2	1.0.0
2018-08	RAN5 #80	R5-185193	-	-	-	Addition of Annex Global In-Channel TX-Test to 38.521-2	1.0.0
2018-08	RAN5 #80	R5-185197	-	-	-	Introduction of maximum output power test cases	1.0.0
2018-08	RAN5 #80	R5-185195	-	-	-	Addition of EVM test case to TS 38.521-2	1.0.0
2018-09	RAN #81	-	-	-	-	raised to v15.0.0 with editorial changes only	15.0.0
2018-12	RAN #82	R5-186504	0021	-	F	FR2 RefSens test case updates	15.1.0
2018-12	RAN #82	R5-186505	0022	-	F	Update Text on Store Beam Peak Coordinate	15.1.0
2018-12	RAN #82	R5-186510	0023	-	F	Structure updates to Annex C and G	15.1.0
2018-12	RAN #82	R5-186675	0026	-	F	Updating test case 6.2.3 maximum output power with additional requirements	15.1.0
2018-12	RAN #82	R5-187151	0034	-	F	Updated to Annexes for FR2 tests	15.1.0
2018-12	RAN #82	R5-187152	0035	-	F	General Information updated for TS38.521-2	15.1.0
2018-12	RAN #82	R5-187561	0042	-	F	Update to Table 5.3.5-1 in TS 38.521-2	15.1.0
2018-12	RAN #82	R5-187619	0050	-	F	Update of Section 6.3.3.1 General	15.1.0
2018-12	RAN #82	R5-187838	0045	1	F	Update of transmit signal quality test cases in 38.521-2	15.1.0
2018-12	RAN #82	R5-187839	0046	1	F	Addition of In-band Emissions test case to TS 38.521-2	15.1.0
2018-12	RAN #82	R5-187840	0047	1	F	Addition of EVM equalizer spectral flatness test cases 6.4.2.4 and 6.4.2.5 to TS 38.521-2	15.1.0
2018-12	RAN #82	R5-187841	0048	1	F	Update of Common Uplink Configuration for FR2	15.1.0
2018-12	RAN #82	R5-187842	0029	1	F	General sections updated to 38.521-2	15.1.0
2018-12	RAN #82	R5-187843	0044	1	F	Update of Global In-channel Tx Test Annex in 38.521-2	15.1.0
2018-12	RAN #82	R5-187886	0020	1	F	FR2 Spurious Emission test case updates	15.1.0
2018-12	RAN #82	R5-187912	0038	1	F	Addition of notes to clarify test point selection into general section of TS 38.521-2	15.1.0
2018-12	RAN #82	R5-188037	0032	1	F	Removing the Editor's notes of SA messages and procedures for all FR2 test cases	15.1.0
2018-12	RAN #82	R5-188038	0036	1	F	FR2 downlink signal level(38.521-2)	15.1.0

2018-12	RAN #82	R5-188063	0027	1	F	Update of FR2 6.3.2 Transmit OFF power	15.1.0
2018-12	RAN #82	R5-188212	0040	2	F	Updates to maximum output power test cases	15.1.0
2018-12	RAN #82	R5-188213	0028	1	F	Update of FR2 test case 7.4	15.1.0
2018-12	RAN #82	R5-188214	0025	1	F	Updates of TT in TS 38.521-2 Annex F during RAN5#81	15.1.0
2018-12	RAN #82	R5-188215	0031	1	F	TDD configuration for UE Tx test in FR2	15.1.0
2018-12	RAN #82	R5-188216	0039	1	F	Core alignment CR to capture TS 38.101-2 updates during RAN4#89	15.1.0
2018-12	RAN #82	R5-188217	0041	2	F	On measurement grids	15.1.0
2018-12	RAN #82	R5-188218	0043	1	F	Update to Annex K	15.1.0
2018-12	RAN #82	RP-182736	0024	2	F	Updates of MU Annex F	15.1.0
2019-03	RAN #83	R5-191091	0083	-	F	Updates of TT in TS38.521-2 Annex F during RAN5#NR4	15.2.0
2019-03	RAN #83	R5-191092	0084	-	F	Editorial correction of core alignment in TS 38.521-2	15.2.0
2019-03	RAN #83	R5-191093	0085	-	F	Editorial cleaning up of test configuration tables in TS 38.521-2	15.2.0
2019-03	RAN #83	R5-191246	0086	-	F	Update TRP measurement procedure Annex in TS38.521-2	15.2.0
2019-03	RAN #83	R5-191247	0087	-	F	Update Annex K and Annex M in TS38.521-2	15.2.0
2019-03	RAN #83	R5-191259	0088	-	F	Update to FR2 test case 6.3.3.4 PRACH time mask	15.2.0
2019-03	RAN #83	R5-191507	0090	-	F	Shared Risk clarification in TS 38.521-2	15.2.0
2019-03	RAN #83	R5-191609	0093	-	F	CR to TS 38.521-2 to add text proposal for Annex F.1	15.2.0
2019-03	RAN #83	R5-191676	0094	-	F	Addition of FR2 6.2.4 Configured transmitted power	15.2.0
2019-03	RAN #83	R5-191677	0095	-	F	Update of FR2 6.3.1 Minimum Output Power	15.2.0
2019-03	RAN #83	R5-191679	0096	-	F	Addition of FR2 6.3.4.2 Absolute power tolerance	15.2.0
2019-03	RAN #83	R5-191680	0097	-	F	Update of FR2 6.3.3.2 General ON/OFF time mask	15.2.0
2019-03	RAN #83	R5-191793	0098	-	F	Introduction of Minimum output power for 2UL CA	15.2.0
2019-03	RAN #83	R5-191809	0099	-	F	OBW test procedure update for 38.521-2	15.2.0
2019-03	RAN #83	R5-191812	0100	-	F	FR2 Spurious Emission test case updates	15.2.0
2019-03	RAN #83	R5-191824	0102	-	F	Update to Annex K and Annex L	15.2.0
2019-03	RAN #83	R5-191986	0107	-	F	Introduction of Annex on Characteristics of the Interfering Signal FR2	15.2.0
2019-03	RAN #83	R5-192092	0110	-	F	Test mode and test loop function activation in SA Tx RF test cases in TS 38.521-2	15.2.0
2019-03	RAN #83	R5-192095	0111	-	F	Test mode and test loop function activation in SA Rx RF test cases in TS 38.521-2	15.2.0
2019-03	RAN #83	R5-192122	0112	-	F	Update of Global In-channel Tx Test Annex for FR2	15.2.0
2019-03	RAN #83	R5-192450	0089	1	F	Update of test case 6.3.4.3, Relative power tolerance in 38.521-2	15.2.0
2019-03	RAN #83	R5-192451	0082	1	F	Updates of test environment for frequency error	15.2.0
2019-03	RAN #83	R5-192452	0105	1	F	FR2 SA Spurious Emission Coexistence test case	15.2.0
2019-03	RAN #83	R5-192648	0106	1	F	Introduction of Aggregate power tolerance in NR SA FR2	15.2.0
2019-03	RAN #83	R5-192649	0117	1	F	CR to add UL RMC for 60kHz SCS in Annex A.2.3	15.2.0
2019-03	RAN #83	R5-192650	0113	1	F	Update of transmit signal quality test cases for FR2	15.2.0
2019-03	RAN #83	R5-192651	0114	1	F	Update OBW test case in TS 38.521-2	15.2.0
2019-03	RAN #83	R5-192652	0115	1	F	Update SEM test case in TS 38.521-2	15.2.0
2019-03	RAN #83	R5-192653	0116	1	F	Update ACLR test case in TS 38.521-2	15.2.0
2019-03	RAN #83	R5-192654	0101	1	F	FR2 Reference Sensitivity test case updates	15.2.0
2019-03	RAN #83	R5-192655	0104	1	F	FR2 Reference Sensitivity EIS spherical coverage	15.2.0
2019-03	RAN #83	R5-192667	0108	1	F	Update of Annex F.2	15.2.0
2019-03	RAN #83	R5-192849	0080	2	F	Updates of MU in TS38.521-2 Annex F during RAN5#82	15.2.0
2019-03	RAN #83	R5-192843	0081	2	F	Updates of TT in TS38.521-2 Annex F during RAN5#82	15.2.0
2019-03	RAN #83	R5-192680	0103	1	F	38.521-2 Editor's Note Updates	15.2.0
2019-03	RAN #83	RP-190746	0118	4	F	Updates to maximum output power test cases	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	R5-193541	0137	-	F	Alignment of scheduling of DL RMC with scheduling of UL RMC	15.3.0
2019-06	RAN#84	R5-193552	0138	-	F	Core alignment of RAN4 pending issues in TS 38.521-2	15.3.0
2019-06	RAN#84	R5-193575	0143	-	F	Correction of 38.521-2 7.4	15.3.0
2019-06	RAN#84	R5-193749	0151	-	F	Updates of ACLR test procedure	15.3.0
2019-06	RAN#84	R5-193820	0152	-	F	Correction of 38.521-2 clause 2 to 5	15.3.0
2019-06	RAN#84	R5-194009	0153	-	F	FR2 Reference Sensitivity test case updates	15.3.0
2019-06	RAN#84	R5-194243	0161	-	F	Addition FR2 blocking measurement procedure in Annex K	15.3.0
2019-06	RAN#84	R5-194264	0163	-	F	Correction to FR2 EIRP test configurations	15.3.0
2019-06	RAN#84	R5-194265	0164	-	F	Correction to FR2 EIS test configurations	15.3.0
2019-06	RAN#84	R5-194269	0165	-	F	Update FR2 ACS and Inband blocking test cases	15.3.0
2019-06	RAN#84	R5-194461	0170	-	F	Update to 6.2.3 A-MPR FR2	15.3.0
2019-06	RAN#84	R5-194618	0171	-	F	Update of Global In-channel Tx Test Annex for FR2	15.3.0
2019-06	RAN#84	R5-194958	0139	1	F	Updates of MU and TT in TS 38.521-2 Annex F during RAN5#NR5	15.3.0
2019-06	RAN#84	R5-194968	0167	1	F	Update of TC 6.3A.1.1 Minimum output power for 2UL CA	15.3.0
2019-06	RAN#84	R5-194969	0166	1	F	Clean up FR2 SA test cases	15.3.0
2019-06	RAN#84	R5-194970	0160	1	F	Introduction of beam correspondence	15.3.0
2019-06	RAN#84	R5-194971	0162	1	F	Introduction of beam correspondence for CA	15.3.0
2019-06	RAN#84	R5-194976	0173	1	F	Update of Frequency Error Test Case for FR2	15.3.0
2019-06	RAN#84	R5-194977	0175	1	F	Editorial corrections for 6.2.1 UE maximum output power	15.3.0
2019-06	RAN#84	R5-195080	0176	-	F	Update of FR2 ON_ON time mask test cases	15.3.0
2019-06	RAN#84	R5-195147	0141	1	F	Addition of new SA FR2 RF test case 6.2.2	15.3.0
2019-06	RAN#84	R5-195149	0142	1	F	Correction of 38.521-2 6.3.2	15.3.0
2019-06	RAN#84	R5-195151	0144	1	F	Introduction of MOP (SA UL CA)	15.3.0

2019-06	RAN#84	R5-195152	0145	1	F	Introduction of OFF power (SA UL CA)	15.3.0
2019-06	RAN#84	R5-195153	0146	1	F	Introduction of Frequency error (SA UL CA)	15.3.0
2019-06	RAN#84	R5-195154	0148	1	F	Introduction of SEM (SA UL CA)	15.3.0
2019-06	RAN#84	R5-195155	0149	1	F	Introduction of ACLR (SA UL CA)	15.3.0
2019-06	RAN#84	R5-195156	0150	1	F	Introduction of General Spurious (SA UL CA)	15.3.0
2019-06	RAN#84	R5-195157	0157	1	F	Introduction of New test case 6.5A.1.1 Occupied bandwidth for CA (2UL CA)	15.3.0
2019-06	RAN#84	R5-195158	0156	1	F	Update Out of band emission test cases in TS 38.521-2	15.3.0
2019-06	RAN#84	R5-195160	0159	1	F	Introduction of SRS time mask for UL-MIMO	15.3.0
2019-06	RAN#84	R5-195404	0172	1	F	Update of transmit signal quality test cases for FR2	15.3.0
2019-06	RAN#84	R5-195417	0154	1	F	38.521-2 implementation of FR2 UL demod OTA tests using single pol Rx TE	15.3.0
2019-06	RAN#84	R5-195432	0168	2	F	Update to 6.2.1.1 UE maximum output power - EIRP and TRP	15.3.0
2019-06	RAN#84	R5-195433	0169	2	F	Update to 6.2.1.2 UE maximum output power - Spherical coverage	15.3.0
2019-06	RAN#84	R5-195434	0140	1	F	Updates of MU and TT in TS 38.521-2	15.3.0
2019-06	RAN#84	R5-195435	0155	1	F	Core alignment with TS 38.101-2	15.3.0
2019-06	RAN#84	-	-	-	-	Administrative release upgrade to match the release of 3GPP TS 38.508-1 and TS 38.521-1 which were upgraded at RAN#84 to Rel-16 due to Rel-16 relevant CR(s)	16.0.0
2019-09	RAN#85	R5-195695	0178	-	F	Change of TS 38.521-2 UL CA MOP Minimum conformance requirements	16.1.0
2019-09	RAN#85	R5-196069	0194	-	F	Introduction of absolute power tolerance for CA test cases	16.1.0
2019-09	RAN#85	R5-196165	0198	-	F	Correction of wrong spec reference numbers for TS 38.508-1	16.1.0
2019-09	RAN#85	R5-196236	0202	-	F	Correction to test procedure of TC 6.4.2.2 Carrier Leakage	16.1.0
2019-09	RAN#85	R5-196240	0206	-	F	Clarification on EVM test requirement for PUCCH and PRACH	16.1.0
2019-09	RAN#85	R5-196427	0208	-	F	Update of FR2 6.2.4 Configured transmitted power	16.1.0
2019-09	RAN#85	R5-196428	0209	-	F	Update of FR2 6.3.3.2 General ON_OFF time mask	16.1.0
2019-09	RAN#85	R5-196431	0211	-	F	Addition of FR2 6.2A.4 Configured transmitted power for 2UL CA	16.1.0
2019-09	RAN#85	R5-196433	0213	-	F	Addition of FR2 6.2D.4 Configured transmitted power for UL MIMO	16.1.0
2019-09	RAN#85	R5-196434	0214	-	F	Addition of FR2 6.3D.1 Minimum output power for UL MIMO	16.1.0
2019-09	RAN#85	R5-196594	0220	-	F	Addition of new test case 6.4A.2.1.2 Error vector magnitude for 3UL CA in FR2	16.1.0
2019-09	RAN#85	R5-196595	0221	-	F	Addition of new test case 6.4A.2.1.3 Error vector magnitude for 4UL CA in FR2	16.1.0
2019-09	RAN#85	R5-196650	0225	-	F	Update of Minimum conformance requirements and test configurations in TC 6.2.2	16.1.0
2019-09	RAN#85	R5-196810	0229	-	F	Update to TRP measurement grid section in TS 38.521-2	16.1.0
2019-09	RAN#85	R5-196950	0239	-	F	Corrections on clause 2 and 3 in 38.521-2	16.1.0
2019-09	RAN#85	R5-197384	0197	1	F	Update UL-MIMO to UL MIMO to align with RAN4 terminology in FR2	16.1.0
2019-09	RAN#85	R5-197385	0238	1	F	Update OBW FR2 test case	16.1.0
2019-09	RAN#85	R5-197386	0200	1	F	Alignment of clause 2 to 5 with the core spec	16.1.0
2019-09	RAN#85	R5-197387	0242	-	F	Integrating the QoQZ Procedures into 38.521-2	16.1.0
2019-09	RAN#85	R5-197388	0219	1	F	Addition of new test case 6.4A.2.1.1 Error vector magnitude for 2UL CA in FR2	16.1.0
2019-09	RAN#85	R5-197389	0222	1	F	Update of TC 6.3A.1.1 Minimum output power for 2UL CA	16.1.0
2019-09	RAN#85	R5-197390	0223	1	F	Addition of new test case 6.3A.1.2 Minimum output power for 3UL CA in FR2	16.1.0
2019-09	RAN#85	R5-197391	0224	1	F	Addition of new test case 6.3A.1.3 Minimum output power for 4UL CA in FR2	16.1.0
2019-09	RAN#85	R5-197392	0227	1	F	Update of Common Uplink Configuration table for PC3	16.1.0
2019-09	RAN#85	R5-197393	0212	1	F	Addition of FR2 6.3A.3 ON_OFF time mask for 2 UL CA	16.1.0
2019-09	RAN#85	R5-197394	0215	1	F	Addition of FR2 6.3D.3 General ON_OFF power for UL MIMO	16.1.0
2019-09	RAN#85	R5-197395	0199	1	F	Addition of new Annex N (normative): UE coordinate system	16.1.0
2019-09	RAN#85	R5-197500	0231	1	F	Update of Spurious Emissions TRP test procedure	16.1.0
2019-09	RAN#85	R5-197501	0233	1	F	Update of FR2 MUs in TS 38.521-2	16.1.0
2019-09	RAN#85	R5-197503	0230	1	F	Update of TRP measurement grids for spurious emissions	16.1.0
2019-09	RAN#85	R5-197529	0180	1	F	New Introduction of TC 6.2A.1.2.1 UE Maximum output power Spherical coverage 2UL CA	16.1.0
2019-09	RAN#85	R5-197530	0181	1	F	New Introduction of TC 6.2A.1.2.2 UE Maximum output power Spherical coverage 3UL CA	16.1.0
2019-09	RAN#85	R5-197531	0182	1	F	New Introduction of TC 6.2A.1.2.3 UE Maximum output power Spherical coverage 4UL CA	16.1.0
2019-09	RAN#85	R5-197532	0183	1	F	New Introduction of TC 6.4A.2.2.1 Carrier leakage 2UL CA	16.1.0
2019-09	RAN#85	R5-197533	0184	1	F	New Introduction of TC 6.4A.2.2.2 Carrier leakage 3UL CA	16.1.0
2019-09	RAN#85	R5-197534	0185	1	F	New Introduction of TC 6.4A.2.2.3 Carrier leakage 4UL CA	16.1.0
2019-09	RAN#85	R5-197535	0189	1	F	Rel-16_NR_38.521-2_Addition of new TC 6.2A.1.1.1	16.1.0
2019-09	RAN#85	R5-197536	0193	1	F	Additions to the SRS time mask for UL-MIMO test case	16.1.0
2019-09	RAN#85	R5-197537	0195	1	F	Additions to the beam correspondence test case	16.1.0
2019-09	RAN#85	R5-197538	0203	1	F	Correction to RB allocation in 6.2.2 UE maximum output power reduction	16.1.0
2019-09	RAN#85	R5-197539	0204	1	F	Correction to number of measurements of 6.4.2.3 In-band emissions	16.1.0

2019-09	RAN#85	R5-197540	0205	1	F	Correction to UBF in transmit modulation quality test cases	16.1.0
2019-09	RAN#85	R5-197541	0226	1	F	Update of FR2 A-MPR test case	16.1.0
2019-09	RAN#85	R5-197543	0190	1	F	Refsens test case updates	16.1.0
2019-09	RAN#85	R5-197544	0196	1	F	Introduction of beam correspondence to direct far field (DFF)	16.1.0
2019-09	RAN#85	R5-197545	0216	1	F	Updated to Annex A for RF FR2 tests	16.1.0
2019-09	RAN#85	R5-197546	0232	1	F	Integrating the Re-Positioning Concept into Annex K	16.1.0
2019-09	RAN#85	R5-197614	0191	1	F	Spurious test case updates	16.1.0
2019-09	RAN#85	R5-197642	0201	1	F	Correction to 6.5.2.1 SEM and 6.5.2.3 ACLR to consider MPR values	16.1.0
2019-09	RAN#85	R5-197643	0210	2	F	Addition of FR2 6.2A.2 MPR for 2 UL CA	16.1.0
2019-09	RAN#85	R5-197644	0177	2	F	Updates of MU and TT in TS 38.521-2	16.1.0
2019-09	RAN#85	R5-197645	0234	2	F	Addition of the connection setup in TS 38.521-2	16.1.0
2019-12	RAN#86	R5-198072	0247	-	F	Introduction of 4 New test cases 6.5A.1 Occupied bandwidth for CA	16.2.0
2019-12	RAN#86	R5-198073	0248	-	F	Introduction of 4 New test cases 6.5A.2.1 Spectrum Emission Mask for CA	16.2.0
2019-12	RAN#86	R5-198075	0249	-	F	Introduction of 4 New test cases 6.5A.2.2 Adjacent channel leakage ratio for CA	16.2.0
2019-12	RAN#86	R5-198078	0250	-	F	New Introduction of TC 6.2A.1.2.4 UE maximum output power - Spherical coverage 5UL CA	16.2.0
2019-12	RAN#86	R5-198079	0251	-	F	New Introduction of TC 6.2A.1.2.5 UE maximum output power - Spherical coverage 6UL CA	16.2.0
2019-12	RAN#86	R5-198080	0252	-	F	New Introduction of TC 6.2A.1.2.6 UE maximum output power - Spherical coverage 7UL CA	16.2.0
2019-12	RAN#86	R5-198081	0253	-	F	New Introduction of TC 6.2A.1.2.7 UE maximum output power - Spherical coverage 8UL CA	16.2.0
2019-12	RAN#86	R5-198210	0260	-	F	Addition of Common Uplink Configuration for PC1 in SA FR2 6.1	16.2.0
2019-12	RAN#86	R5-198381	0267	-	F	Introduction of beam correspondence side conditions	16.2.0
2019-12	RAN#86	R5-198385	0269	-	F	Update of minimum conformance requirements for SA FR2 7.4	16.2.0
2019-12	RAN#86	R5-198636	0276	-	F	General clause updated for FR2 spec	16.2.0
2019-12	RAN#86	R5-198730	0278	-	F	Correction of test requirements	16.2.0
2019-12	RAN#86	R5-199086	0262	1	F	CR to 38.521-2 on Measurement Grids for PC1 UEs	16.2.0
2019-12	RAN#86	R5-199087	0243	2	F	Updates of MU and TT in TS 38.521-2	16.2.0
2019-12	RAN#86	R5-199356	0245	1	F	Update of FR2 6.3.3.2 ON-OFF time mask	16.2.0
2019-12	RAN#86	R5-199357	0244	1	F	Update of FR2 6.3.1 minimum output power	16.2.0
2019-12	RAN#86	R5-199358	0263	1	F	CR to 38.521-2 on optimized search procedure for REFSENS	16.2.0
2019-12	RAN#86	R5-199359	0264	1	F	CR to 38.521-2 on optimized search procedure for RX Beam Peak Search	16.2.0
2019-12	RAN#86	R5-199360	0254	1	F	Updating incorrect note in test procedure	16.2.0
2019-12	RAN#86	R5-199361	0256	1	F	Spurious UL MIMO test case updates	16.2.0
2019-12	RAN#86	R5-199373	0265	1	F	Introduction of New TC 6.4A.2.3.1 In-band emissions for 2UL CA	16.2.0
2019-12	RAN#86	R5-199374	0266	1	F	Update to test case 6.3.3.4 PRACH time mask in FR2	16.2.0
2019-12	RAN#86	R5-199375	0257	1	F	Ref Sens UL MIMO test case updates	16.2.0
2019-12	RAN#86	R5-199376	0258	1	F	Alignment of clause 3 to 5 with the core spec	16.2.0
2019-12	RAN#86	R5-199461	0271	2	F	Further updates to the SRS time mask for UL-MIMO test case	16.2.0
2019-12	RAN#86	R5-199473	0282	-	F	Update to UE maximum output power - Spherical coverage	16.2.0
2019-12	RAN#86	R5-199483	0277	1	F	Update of applicability for Spherical coverage and Beam Correspondence test cases	16.2.0
2019-12	RAN#86	R5-199494	0281	1	F	Add section 4.5 Applicability and test coverage rules	16.2.0
2019-12	RAN#86	R5-199495	0246	1	F	Update of FR2 6.3.4.2 absolute power tolerance	16.2.0
2019-12	RAN#86	R5-199496	0270	1	F	Further updates to the absolute power tolerance for CA test cases	16.2.0
2019-12	RAN#86	R5-199504	0259	1	F	Addition of test requirements and update of minimum conformance requirements and test configurations for SA FR2 6.2.2	16.2.0
2019-12	RAN#86	R5-199548	0268	1	F	Updates to the beam correspondence TC	16.2.0
2019-12	RAN#86	R5-199579	0279	1	F	Update of quality of quiet zone validation procedure	16.2.0
2019-12	RAN#86	R5-199586	0275	1	F	Update on FR2 Spurious Test in 38.521-2	16.2.0