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Foreword

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 - 1 presented to TSG for information;
 - 2 presented to TSG for approval;
 - 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.

In the present document, modal verbs have the following meanings:

- shall** indicates a mandatory requirement to do something
- shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

- should** indicates a recommendation to do something
- should not** indicates a recommendation not to do something
- may** indicates permission to do something
- need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

- can** indicates that something is possible
- cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

- will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

1 Scope

The present document specifies the measurement procedures for the conformance test of the NR User Equipment (UE) supporting satellite access operation that contains RF and Performance requirements.

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 38.521-1: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Range 1 Standalone".
- [3] Recommendation ITU-R M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".
- [4] 3GPP TS 38.108: "NR; Satellite Node radio transmission and reception".
- [5] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".
- [6] 3GPP TS 38.101-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements".
- [7] 3GPP TS 38.213: "NR; Physical layer procedures for control".
- [8] 3GPP TS 38.331: "Radio Resource Control (RRC) protocol specification".
- [9] 3GPP TS 38.300: "NR; NR and NG-RAN Overall description; Stage-2".
- [10] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".
- [11] 3GPP TS 38.101-5: "NR; User Equipment (UE) radio transmission and reception; Part 5: Satellite access Radio Frequency (RF) and performance requirements".
- [12] 3GPP TS 38.508-1: "5GS; User Equipment (UE) conformance specification; Part 1: Common test environment".
- [13] 3GPP TS 38.306: "User Equipment (UE) radio access capabilities".
- [14] 3GPP TS 38.521-4: "NR; User Equipment (UE) conformance specification; Radio transmission and reception; Part 4: Performance requirements".
- [15] ITU-R Recommendation SM.329, "Unwanted emissions in the spurious domain".
- [16] 3GPP TS 38.214: "NR; Physical layer procedures for data".
- [17] 3GPP TS 38.211: "NR; Physical channels and modulation".
- [18] 3GPP TR 38.811: "Study on New Radio (NR) to support non-terrestrial networks".

- [19] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".
- [20] EN 303 978, Satellite Earth Stations and Systems (SES); Harmonised Standard for Earth Stations on Mobile Platforms (ESOMP) transmitting towards satellites in geostationary orbit, operating in the 27,5 GHz to 30,0 GHz frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU, v2.1.2, 2016-10.
- [21] EN 301 459, Satellite Earth Stations and Systems (SES); Harmonised Standard for Satellite Interactive Terminals (SIT) and Satellite User Terminals (SUT) transmitting towards satellites in geostationary orbit, operating in the 29,5 GHz to 30,0 GHz frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU, v2.1.1, 2016-05.
- [22] IEEE Std 149: "IEEE Standard Test Procedures for Antennas", IEEE.

3 Definitions of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms 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].

"Carrier-off" state: radio state in which the NTN VSAT may transmit but does not transmit any carrier.

NOTE: "NTN VSAT may transmit" means that all the conditions for transmission are satisfied (e.g. in a state where transmissions are permitted, no failure detected, and the NTN VSAT is correctly pointed towards the satellite).

NOTE: The existence of a "Carrier-off" radio state depends on the system of transmission used. For NTN VSATs designed for continuous transmission mode there may be no "Carrier-off" state.

"Carrier-on" state: Radio state in which the NTN VSAT may transmit and transmits a carrier.

Co-polarized transmission: when the DUT transmission antenna polarization is aligned with test antenna polarization.

Cross-polarized transmission: when the DUT transmission antenna polarization is aligned with the tangent of the test antenna polarization.

Emissions disables state: Radio state in which the ESOMP is not emitting (e.g. before system monitoring pass, before the control channel is received, when a failure is detected, when an ESOMP is commanded to disable, and when the ESOMP is in a location requiring cessation of emissions).

Enhanced channel raster: channel raster with a 10 kHz granularity in bands with a 100 kHz channel raster.

Feeder link: A radio link from an earth station at a given location to a space station, or vice versa, conveying information for a space radiocommunication service other than for the fixed-satellite service. The given location may be at a specified fixed point, or at any fixed point within specified areas.

Fixed Satellite Service: A radiocommunication service between earth stations at given positions, when one or more satellites are used; the given position may be a specified fixed point or any fixed point within specified areas; in some cases this service includes satellite-to-satellite links, which may also be operated in the inter-satellite service; the fixed-satellite service may also include feeder links for other space radiocommunication services.

Fixed VSAT: VSAT used in FSS system at given position; the given position may be a specified fixed point or any fixed point within specified areas.

NOTE: Mobile VSAT is excluded from this definition.

Geostationary-Satellite Orbit: The orbit of a geosynchronous satellite whose circular and direct orbit lies in the plane of the Earth's equator.

Geostationary satellite: A geosynchronous satellite whose circular and direct orbit lies in the plane of the Earth's equator and which thus remains fixed relative to the Earth; by extension, a geosynchronous satellite which remains approximately fixed relative to the Earth.

Geosynchronous Earth Orbit: Earth-centred orbit at approximately 35786 kilometres above Earth's surface and synchronised with Earth's rotation. A geostationary orbit is a non-inclined geosynchronous orbit, i.e. in the Earth's equator plane.

Geosynchronous satellite: An earth satellite whose period of revolution is equal to the period of rotation of the Earth about its axis.

Low Earth Orbit: Orbit around the Earth with an altitude between 300 km, and 1500 km.

Mobile VSAT: VSAT on moving platform, and which can be further declined in three types: airborne, maritime or land based.

NOTE: Mobile VSAT can be also referred to as ESIM or ESOMP.

Non-terrestrial networks: Networks, or segments of networks, using an airborne or space-borne vehicle to embark a transmission equipment relay node or SAN.

NTN VSAT: a UE operating in FR2-NTN which could be a Fixed VSAT or a Mobile VSAT.

Plane perpendicular to the GSO arc: The plane that is perpendicular to the “plane tangent to the GSO arc,” as defined below, and includes a line between the [earth station](#) in question and the GSO [space station](#) that it is communicating with (FCC 47 CFR 25.103).

Plane tangent to the GSO arc: The plane defined by the location of an [earth station](#)'s transmitting antenna and a line in the equatorial plane that is tangent to the GSO arc at the location of the GSO [space station](#) that the [earth station](#) is communicating with (FCC 47 CFR 25.103).

Satellite: A space-borne vehicle embarking a transparent payload, or a regenerative payload telecommunication transmitter, placed into Low-Earth Orbit (LEO), Medium-Earth Orbit (MEO), or Geostationary Earth Orbit (GEO).

Satellite Access Node: node providing NR user plane and control plane protocol terminations towards NTN satellite capable UE, and connected via the NG interface to the 5GC. It encompasses a transparent payload on board a NTN platform, with satellite-gateway and gNB functions.

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.

3.2 Symbols

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

ΔF_{Global}	Granularity of the global frequency raster
ΔF_{Raster}	Band dependent channel raster granularity
BW_{Channel}	Channel bandwidth
$BW_{\text{interferer}}$	Bandwidth of the interferer
$F_{\text{DL_low}}$	The lowest frequency of the downlink <i>operating band</i>
$F_{\text{DL_high}}$	The highest frequency of the downlink <i>operating band</i>
$F_{\text{UL_low}}$	The lowest frequency of the uplink <i>operating band</i>
$F_{\text{UL_high}}$	The highest frequency of the uplink <i>operating band</i>
$F_{\text{Interferer}}$	Frequency of the interferer
$F_{\text{Interferer}}(\text{offset})$	Frequency offset of the interferer (between the center frequency of the interferer and the carrier frequency of the carrier measured)
F_{offset}	Frequency offset of the interferer (between the center frequency of the interferer and the closest edge of the carrier measured)
F_{OOB}	The boundary between the NR out of band emission and spurious emission domains
F_{REF}	RF reference frequency
$F_{\text{REF-Offs}}$	Offset used for calculating F_{REF}
$F_{\text{uw}}(\text{offset})$	The frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer
N_{RB}	Transmission bandwidth configuration, expressed in units of resource blocks

N_{REF}	NR Absolute Radio Frequency Channel Number (NR-ARFCN)
$N_{\text{REF-Offs}}$	Offset used for calculating N_{REF}
$P_{\text{Interferer}}$	Modulated mean power of the interferer
PUType	Minimum UE type peak EIPR (i.e. no tolerance) as specified in sub-clause 9.2.1
P_{uw}	Power of an unwanted DL signal
θ	Angle in degrees from a line from the earth station antenna to the assigned orbital location of the target satellite
TRPmax	The maximum TRP for the NTN VSAT as specified in sub-clause 9.2.1

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
A-MPR	Additional Maximum Power Reduction
BW	Bandwidth
BWP	Bandwidth Part
CP-OFDM	Cyclic Prefix-OFDM
CW	Continuous Wave
DFT-s-OFDM	Discrete Fourier Transform-spread-OFDM
DM-RS	Demodulation Reference Signal
DTX	Discontinuous Transmission
EIRP	Equivalent Isotropically Radiated Power
EVM	Error Vector Magnitude
FR	Frequency Range
FRC	Fixed Reference Channel
GEO	Geosynchronous Earth Orbit
GSCN	Global Synchronization Channel Number
IBB	In-band Blocking
ITU-R	Radiocommunication Sector of the International Telecommunication Union
LEO	Low Earth Orbiting
MBW	Measurement bandwidth defined for the protected band
MOP	Maximum Output Power
MPR	Allowed maximum power reduction
MSD	Maximum Sensitivity Degradation
NGEO	Non-Geostationary Earth Orbiting
NGSO	Non-Geostationary-Satellite Orbit
NR	New Radio
NR-ARFCN	NR Absolute Radio Frequency Channel Number
NS	Network Signalling
NTN	Non-Terrestrial Network
OCNG	OFDMA Channel Noise Generator
OOB	Out-of-band
PRB	Physical Resource Block
QAM	Quadrature Amplitude Modulation
RAN	Radio Access Network
RE	Resource Element
REFSENS	REFerence SENSitivity
RF	Radio Frequency
RMS	Root Mean Square (value)
RSRP	Reference Signal Receive Power
RSRQ	Reference Signal Receive Quality
RX	Receiver
SAN	Satellite Access Node
SC	Single Carrier
SCS	Subcarrier spacing
SEM	Spectrum Emission Mask
SNR	Signal-to-Noise Ratio
SRS	Sounding Reference Symbol

SS	Synchronization Symbol
TN	Terrestrial Network
TX	Transmitter
TxD	Tx Diversity
UE	User Equipment

4 General

4.1 Relationship between minimum requirements and test requirements

TS 38.101-5 [11] is a Single-RAT specification for satellite NR UE, covering RF characteristics and minimum performance requirements. Conformance to the TS 38.101-5 [11] is demonstrated by fulfilling the test requirements specified in the present document.

The Minimum Requirements given in TS 38.101-5 [11] makes no allowance for measurement uncertainty (MU). 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 TS 38.101-5 [11] 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 the various levels of "shared risk" principle as described below.

- a) Core specification value is not relaxed by any relaxation value ($TT=0$). For each single measurement, the probability of a borderline good UE being judged as FAIL equals the probability of a borderline bad UE being judged as PASS.
 - Test tolerances equal to 0 ($TT=0$) are considered in this specification.
- b) Core specification value is relaxed by a relaxation value ($TT>0$). For each single measurement, the probability of a borderline bad UE being judged as PASS is greater than the probability of a borderline good UE being judged as FAIL.
 - Test tolerances lower than measurement uncertainty and greater than 0 ($0 < TT < MU$) are considered in this specification.
 - Test tolerances high up to measurement uncertainty ($TT = MU$) are considered in this specification which is also known as "Never fail a good DUT" principle.
- c) Core specification value is tightened by a stringent value ($TT<0$). For each single measurement, the probability of a borderline good UE being judged as FAIL is greater than the probability of a borderline bad UE being judged as PASS.

Test tolerances lower than 0 ($TT<0$) are not considered in this specification. The "Never fail a good DUT" and the "Shared Risk" principles are defined in Recommendation ITU-R M.1545 [3].

4.2 Applicability of minimum requirements

The Minimum Requirements are specified as general requirements and additional requirements. The applicability of each requirement is described under clauses 6.1, 7.1, 8.1 of TS 38.101-5 [11].

The conducted minimum requirements specified in TS 38.101-5 [11] as a general requirement, the requirement shall be met in all applicable scenarios for FR1. 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.

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.

4.3 Specification suffix information

Specification suffix information is not defined for the time being in Release 17.

4.4 Relationship with core specifications

TS 38.101-5 [11] specifies the minimum RF and performance requirements for NR User Equipment (UE) operating in a Non-Terrestrial Network. TS 38.108 [4] specifies the minimum RF and performance requirements of Satellite Access Node (SAN).

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 NTN satellite can operate according to this version of the specification are identified as described in Table 5.1-1.

Table 5.1-1: Definition of NTN frequency ranges

Frequency range designation	Corresponding frequency range
FR1-NTN (Note 1)	410 MHz – 7125 MHz
FR2-NTN (Note 2)	17300 MHz – 30000 MHz
NOTE 1: NTN bands within this frequency range are regarded as a FR1 band when references from other specifications.	
NOTE 2: NTN bands within this frequency range are regarded as a FR2-1 band when references from other specifications unless otherwise stated.	

5.2 Operating bands

5.2.1 General

NTN satellite covers FR1-NTN operating bands in the present specification.

5.2.2 Operating bands with conducted requirements

NTN satellite is designed to operate in the operating bands defined in Table 5.2.2-1.

Table 5.2.2-1: NTN satellite bands in FR1-NTN

NTN satellite operating band	Uplink (UL) operating band Satellite Access Node receive / UE transmit $F_{UL,low} - F_{UL,high}$	Downlink (DL) operating band Satellite Access Node transmit / UE receive $F_{DL,low} - F_{DL,high}$	Duplex mode
n256	1,980MHz – 2,010 MHz	2,170 MHz – 2,200 MHz	FDD
n255	1,626.5 MHz – 1,660.5 MHz	1,525 MHz – 1,559 MHz	FDD
n254	1610 – 1626.5 MHz	2483.5 – 2500 MHz	FDD

NOTE: NTN satellite bands are numbered in descending order from n256.

5.2.3 Operating bands with radiated requirements

NTN satellite is designed to operate in the operating bands defined in Table 5.2.3-1.

Table 5.2.3-1: Satellite operating bands in FR2-NTN

Satellite operating band	Uplink (UL) operating band SAN receive / UE transmit $F_{UL,low} - F_{UL,high}$	Downlink (DL) operating band SAN transmit / UE receive $F_{DL,low} - F_{DL,high}$	Duplex mode
n512(Note 1)	27500 MHz - 30000 MHz	17300 MHz - 20200 MHz	FDD
n511(Note 2)	28350 MHz - 30000 MHz	17300 MHz - 20200 MHz	FDD
n510(Note 3)	27500 MHz - 28350 MHz	17300 MHz - 20200 MHz	FDD
NOTE 1: This band is applicable in the countries subject to CEPT ECC Decision(05)01 and ECC Decision (13)01. NOTE 2: This band is applicable in the USA subject to FCC 47 CFR part 25. NOTE 3: This band is applicable for Earth Station operations in the USA subject to FCC 47 CFR part 25. FCC rules currently do not include ESIM operations in this band (47 CFR 25.202).			

5.3 UE channel bandwidth

5.3.1 General

The UE channel bandwidth supports a single RF carrier in the uplink or downlink at the UE. From a SAN perspective, different UE channel bandwidths may be supported within the same spectrum for transmitting to and receiving from UEs connected to the SAN.

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 SAN channel bandwidth or how the SAN 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 SAN channel bandwidth.

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

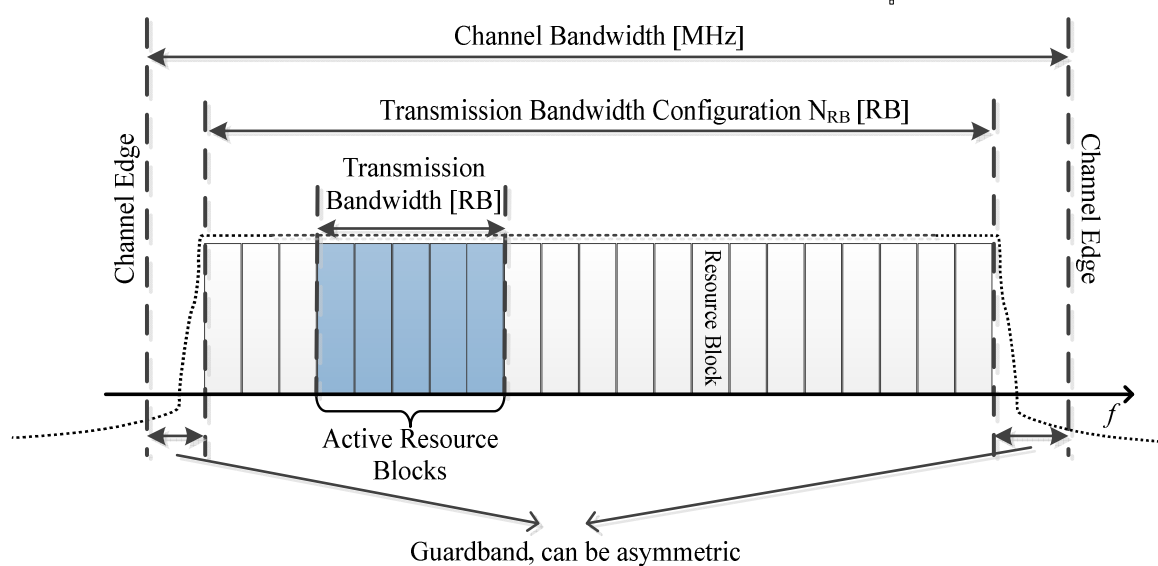


Figure 5.3.1-1: Definition of the channel bandwidth and the maximum transmission bandwidth configuration for one channel

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 for FR1-NTN and table 5.3.2-2 for FR2-NTN.

Table 5.3.2-1: Maximum transmission bandwidth configuration N_{RB} for FR1-NTN

SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz
	N_{RB}	N_{RB}	N_{RB}	N_{RB}
15	25	52	79	106
30	11	24	38	51
60	N/A	11	18	24

Table 5.3.2-2: Maximum transmission bandwidth configuration N_{RB} for FR2-NTN

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 for FR1-NTN and in table 5.3.3-2 for FR2-NTN.

Table 5.3.3-1: Minimum guardband for each UE channel bandwidth and SCS (kHz) for FR1-NTN

SCS (kHz)	5 MHz	10 MHz	15 MHz	20 MHz
15	242.5	312.5	382.5	452.5
30	505	665	645	805
60	N/A	1,010	990	1,330

Table 5.3.3-2: Minimum guardband for each UE channel bandwidth and SCS (kHz) for FR2-NTN

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: $(BW_{\text{Channel}} \times 1,000 \text{ (kHz)} - N_{RB} \times SCS \times 12) / 2 - SCS/2$, where N_{RB} are from Table 5.3.2-1 and Table 5.3.2-2.

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.

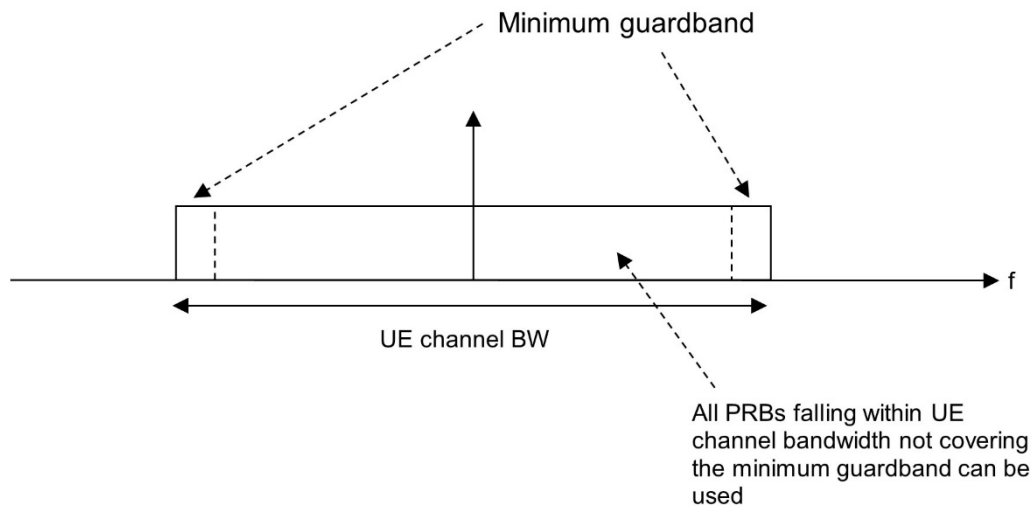


Figure 5.3.3-2: UE PRB utilization

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

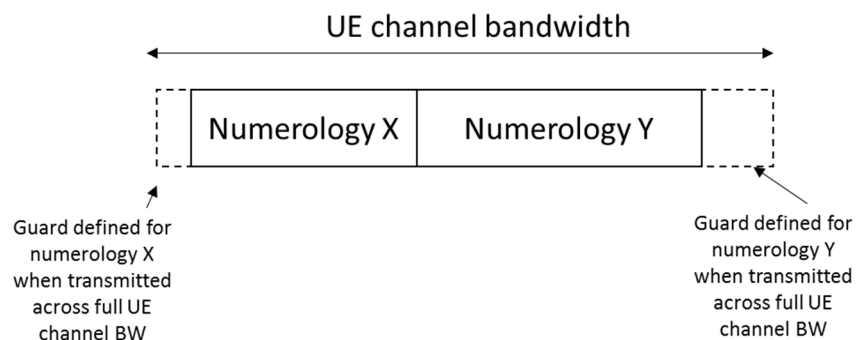


Figure 5.3.3-3: Guard band definition when transmitting multiple numerologies

NOTE: Figure 5.3.3-2 is not intended to imply the size of any guard between the two numerologies. Inter-numerology guard band within the carrier is implementation dependent.

5.3.4 RB alignment

The RB alignment for FR1-NTN refers to NR RB alignments as specified in 3GPP TS 38.101-1 [5] clause 5.3.4.

The RB alignment for FR2-NTN refers to NR RB alignments as specified in 3GPP TS 38.101-2 [15] clause 5.3.4.

5.3.5 UE channel bandwidth per operating band

The requirements in this specification apply to the combination of channel bandwidths, SCS and operating bands shown in Table 5.3.5-1 for FR1-NTN and table 5.3.5-2 for FR2-NTN. The transmission bandwidth configuration in Table 5.3.2-1 and Table 5.3.2-2 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 NTN satellite band in FR1-NTN

NTN satellite band	SCS kHz	UE Channel bandwidth (MHz)			
		5	10	15	20
n256	15	5	10	15	20
	30		10	15	20
	60		10	15	20
n255	15	5	10	15	20
	30		10	15	20
	60		10	15	20
n254	15	5	10	15	
	30		10	15	
	60		10	15	

Table 5.3.5-2: Channel bandwidths for each NTN satellite band in FR2-NTN

SAN Operating Band	SCS (kHz)	SAN channel bandwidth (MHz)			
		50	100	200	400
n512	60	50	100	200	
	120	50	100	200	400
n511	60	50	100	200	
	120	50	100	200	400
n510	60	50	100	200	
	120	50	100	200	400

5.3.6 Asymmetric channel bandwidths

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

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

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

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

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

NR Band	Channel bandwidths for UL (MHz)	Channel bandwidths for DL (MHz)	Asymmetric channel bandwidth combination set
n254	5	10,15	0
	10	15	0
NOTE 1: The assignment of the paired UL and DL channels are subject to a TX-RX separation as specified in clause 5.4.4.			
NOTE 2: As indicated in TS38.306 [11], it is mandatory for UEs to support asymmetric channel BCS0 if there is an asymmetric BCS0 defined for the band.			

5.4 Channel arrangement

5.4.1 Channel spacing

5.4.1.1 Channel spacing for adjacent NTN satellite carriers

The channel spacing for adjacent NTN satellite carriers in FR1-NTN refers to the NR channel spacing as specified in TS 38.101-1 [5] clause 5.4.1.1.

The channel spacing for adjacent NTN satellite carriers in FR2-NTN refers to the NR channel spacing as specified in 3GPP TS 38.101-2 [19] clause 5.4.1.1.

5.4.2 Channel raster

5.4.2.1 NR-ARFCN and channel raster

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

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

For the uplink of FDD FR1 NTN bands n256, n255 defined in Table 5.2-1

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

where Δ_{shift} is signalled by the network in higher layer parameter *frequencyShift7p5khz* [7].

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

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

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

Frequency range (MHz)	ΔF_{Global} (kHz)	$F_{\text{REF-Offs}}$ (MHz)	$N_{\text{REF-Offs}}$	Range of N_{REF}
0 – 3,000	5	0	0	0 – 599,999
3000 – 24250	15	3000	600000	600000 – 2016666
24250 – 30000	60	24250.08	2016667	2016667 – 2112499

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 clause 5.4.2.2. The applicable entries for each operating band are defined in clause 5.4.2.3.

5.4.2.2 Channel raster to resource element mapping

The mapping between the RF reference frequency on the channel raster and the corresponding resource element in FR1-NTN refers to the NR requirements specified in 3GPP TS 38.101-1 [5] clause 5.4.2.2.

The mapping between the RF reference frequency on the channel raster and the corresponding resource element for FR2-NTN refers to the NR requirements specified in 3GPP TS 38.101-2 [19] clause 5.4.2.2.

5.4.2.3 Channel raster entries for each operating band

The RF channel positions on the channel raster in each NTN satellite 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 clause 5.4.2.2.

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

Table 5.4.2.3-1: Applicable NR-ARFCN per operating band in FR1-NTN

NTN satellite operating band	ΔF_{Raster} (kHz)	Uplink Range of N_{REF} (First – <Step size> – Last)	Downlink Range of N_{REF} (First – <Step size> – Last)
n256	100	396,000 – <20> – 402,000	434,000 – <20> – 440,000
n255	100	325,300 – <20> – 332,100	305,000 – <20> – 311,800
n254	100	322000 – <20> – 325300	496700 – <20> – 500000
NOTE: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used.			

For NTN operating bands with 100 kHz channel raster, Enhanced channel raster is defined with $\Delta F_{\text{Raster}} = 2 \times \Delta F_{\text{Global}}$. In this case every 2th 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 5.4.2.3-2 is given as <2>.

Table 5.4.2.3-2: Applicable NR-ARFCN per operating band in FR1-NTN

NTN satellite operating band	ΔF_{Raster} (kHz)	Uplink Range of N_{REF} (First – <Step size> – Last)	Downlink Range of N_{REF} (First – <Step size> – Last)	Mandatory support
n256	10	396000 – <2> – 402000	434000 – <2> – 440000	Yes
n255	10	325300 – <2> – 332100	305000 – <2> – 311800	Yes
n254	10	322000 – <2> – 325300	496700 – <2> – 500000	Yes
NOTE: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. These channel numbers shall also be such that the minimum guard band for each channel bandwidth and SCS specified in Table 5.3.3-1 are met for carriers located at the upper or lower edge of an operating band.				

For FR2-NTN satellite operating bands, $\Delta F_{\text{Raster}} = I_1 \times \Delta F_{\text{Global}}$ for UL channel and $\Delta F_{\text{Raster}} = I_2 \times \Delta F_{\text{Global}}$ for DL channel, where $(I_1, I_2) \in \{(1,4) \text{ or } (2, 8)\}$. But $(I_1, I_2) = (2, 8)$ only applies under the condition that 120kHz SCS is configured in the channel and SSB SCS is equal to or larger than 120kHz. In this case, every I_1^{th} NR-ARFCN for UL channel and I_2^{th} NR-ARFCN for DL channel are applicable for the UL and DL channel raster correspondingly within the operating band and the <(UL_step size, DL_step size)> for the UL and DL channel raster in Table 5.4.2.3-3 is given as <(I₁, I₂)> for FR2-NTN.

Table 5.4.2.3-3: Applicable NR-ARFCN per operating band in FR2-NTN

SAN operating band	ΔF_{Raster} (kHz)	Uplink range of N_{REF} (First – <Step size> – Last)	Downlink range of N_{REF} (First – <Step size> – Last)
n512	60	2070833 – <1> – 2112499	1553336 – <4> – 1746664
	120	2070833 – <2> – 2112499	1553336 – <8> – 1746664
n511	60	2084999 – <1> – 2112499	1553336 – <4> – 1746664
	120	2084999 – <2> – 2112499	1553336 – <8> – 1746664
n510	60	2070833 – <1> – 2084999	1553336 – <4> – 1746664
	120	2070833 – <2> – 2084999	1553336 – <8> – 1746664

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 clause 5.4.3.2. The synchronization raster and the subcarrier spacing of the synchronization block is defined separately for each band.

The synchronization raster and the corresponding SS block do not cover all possible RF channel bandwidth and locations on Enhanced channel raster.

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

Frequency range	SS Block frequency position SS_{REF}	GSCN	Range of GSCN
0 – 3,000 MHz	$N * 1,200 \text{ kHz} + M * 50 \text{ kHz}$, $N=1:2,499$, $M \in \{1,3,5\}^1$	$3N + (M-3)/2$	2 – 7,498
3000 – 24250	$3000 \text{ MHz} + N * 1.44 \text{ MHz}$, $N = 0:14756$	$7499 + N$	7499 – 22255

NOTE: The default value for operating bands with which only support SCS spaced channel raster(s) is $M=3$.

5.4.3.2 Synchronization raster to synchronization block resource element mapping

The mapping between the synchronization raster and the corresponding resource element of the SS block in FR1-NTN refers to 3GPP TS 38.101-1 [5] clause 5.4.3.2.

The mapping between the synchronization raster and the corresponding resource element of the SS block in FR2-NTN refers to 3GPP TS 38.101-2 [19] clause 5.4.3.2.

5.4.3.3 Synchronization raster entries for each operating band

The synchronization raster for each band is give in Table 5.4.3.3-1 and table 5.4.3.3-2. The distance between applicable GSCN entries is given by the <Step size> indicated in Table 5.4.3.3-1 for FR1-NTN and table 5.4.3.3-2 for FR2-NTN.

Table 5.4.3.3-1: Applicable SS raster entries per operating band (FR1-NTN)

NTN satellite operating band	SS Block SCS	SS Block pattern ¹	Range of GSCN (First – <Step size> – Last)
n256	15 kHz	Case A	5,429 – <1> – 5,494
n255	15 kHz	Case A	3,818 – <1> – 3,892
	30 kHz	Case B	3,824 – <1> – 3,886
n254	15 kHz	Case A	6215 – <1> – 6244
	30 kHz	Case C	6218 – <1> – 6241

NOTE : SS Block pattern is defined in clause 4.1 in 3GPP TS 38.213 [7].

Table 5.4.3.3-2: Applicable SS raster entries per operating band (FR2-NTN)

SAN operating band	SS Block SCS	SS Block pattern (NOTE)	Range of GSCN (First – <Step size> – Last)
n512	120 kHz	Case D	17448 – <12> – 19428
	240 kHz	Case E	17472 – <24> – 19416
n511	120 kHz	Case D	17448 – <12> – 19428
	240 kHz	Case E	17472 – <24> – 19416
n510	120 kHz	Case D	17448 – <12> – 19428
	240 kHz	Case E	17472 – <24> – 19416

NOTE: SS Block pattern is defined in section 4.1 in TS 38.213 [7].

5.4.4 TX–RX frequency separation

The default TX channel (carrier centre frequency) to RX channel (carrier centre frequency) separation for operating bands is specified in Table 5.4.4-1 for FR1-NTN.

Table 5.4.4-1: UE TX-RX frequency separation (FR1-NTN)

NTN Satellite Operating Band	TX – RX carrier centre frequency separation
n256	190 MHz ¹ 165 to 215 MHz ²
n255	-101.5 MHz ¹ -72.5 to -130.5 MHz ²
n254	862 – 885 MHz
NOTE 1: Default Tx-Rx separation	
NOTE 2: The verification of flexible Tx-Rx frequency separation within this range is limited to reference sensitivity. Further details are specified in clause 7.3.2	

6 Transmitter characteristics

6.1 General

Unless otherwise stated, the transmitter characteristics are specified at the antenna connector of the UE with a single or multiple transmit antenna(s). For UE with integral antenna only, a reference antenna with a gain of 0 dBi is assumed. Handheld power class 3 UE is assumed in Release 17 for satellite access.

All requirements in this clause are applicable to devices supporting GSO and/or NGSO satellites.

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 clause, unless otherwise stated by the test case.

Table 6.1-1: Common uplink configuration

Channel Bandwidth	SCS(kHz)	OFDM	RB allocation							
			Edge_Full_Left	Edge_Full_Right	Edge_1RB_Left	Edge_1RB_Right	Outer_Full	Inner_Full	Inner_1RB_Left	Inner_1RB_Right
5MHz	15	DFT-s	2@0	2@23	1@0	1@24	25@0	12@6	1@1	1@23
		CP	2@0	2@23	1@0	1@24	25@0	13@6	1@1	1@23
	30	DFT-s	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		CP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	60	DFT-s	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		CP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10MHz	15	DFT-s	2@0	2@50	1@0	1@51	50@0	25@12	1@1	1@50
		CP	2@0	2@50	1@0	1@51	52@0	26@13	1@1	1@50
	30	DFT-s	2@0	2@22	1@0	1@23	24@0	12@6	1@1	1@22
		CP	2@0	2@22	1@0	1@23	24@0	12@6	1@1	1@22
	60	DFT-s	2@0	2@9	1@0	1@10	10@0	5@2 ¹	1@1	1@9
		CP	2@0	2@9	1@0	1@10	11@0	5@2 ¹	1@1	1@9
15MHz	15	DFT-s	2@0	2@77	1@0	1@78	75@0	36@18	1@1	1@77
		CP	2@0	2@77	1@0	1@78	79@0	39@19 ¹	1@1	1@77
	30	DFT-s	2@0	2@36	1@0	1@37	36@0	18@9	1@1	1@36
		CP	2@0	2@36	1@0	1@37	38@0	19@9	1@1	1@36
	60	DFT-s	2@0	2@16	1@0	1@17	18@0	9@4	1@1	1@16
		CP	2@0	2@16	1@0	1@17	18@0	9@4	1@1	1@16
20MHz	15	DFT-s	2@0	2@104	1@0	1@105	100@0	50@25	1@1	1@104
		CP	2@0	2@104	1@0	1@105	106@0	53@26	1@1	1@104
	30	DFT-s	2@0	2@49	1@0	1@50	50@0	25@12	1@1	1@49
		CP	2@0	2@49	1@0	1@50	51@0	25@12 ¹	1@1	1@49
	60	DFT-s	2@0	2@22	1@0	1@23	24@0	12@6	1@1	1@22
		CP	2@0	2@22	1@0	1@23	24@0	12@6	1@1	1@22

NOTE 1: The allocated RB number L_{CRB} is $\text{ceil}(N_{RB}/2) - 1$ in order to meet Inner RB allocation definition ($RB_{Start,Low} \leq RB_{Start} \leq RB_{Start,High}$) described in subclause 6.2.2 of TS 38.101-1 [5].

6.2 Transmitter power

6.2.1 UE maximum output power

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

- Test procedure and test point analysis need to be updated to incorporate new metric related to power density
- MU Analysis and any associated Annex F updates for new power density metric is pending.

6.2.1.1 Test purpose

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

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

6.2.1.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.2.1.3 Minimum conformance requirements

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

Table 6.2.1.3-1: UE Power Class

NR satellite band	Class 3 (dBm)	Tolerance (dB)
n256	23	± 2
n255	23	± 2
n254	23	± 2
NOTE 1: $P_{\text{PowerClass}}$ is the maximum UE power specified without taking into account the tolerance		
NOTE 2: Power class 3 is default power class unless otherwise stated		

The UE shall meet the following additional requirements for maximum mean transmission power density specified in Table 6.2.1-2 when NS is signaled and when the configured channel overlaps with any portion of the specified frequency range.

Table 6.2.1-2: Additional requirements for transmit power density

NR Band	NS value	Channel bandwidth (MHz)	Frequency range (MHz)	Maximum power density
n254	NS_04N	5	1610 - 1618.25	-27dBm/4kHz (mean)
	NS_05N	5	1618.25 - 1626.5	-15dBm/4kHz (peak limit)
		10, 15	1610 – 1626.5	

The normative reference for this requirement is TS 38.101-5 [11] clause 6.2.1.

6.2.1.4 Test description

6.2.1.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.2.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.2.1.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [12] subclause 4.1		Normal, TL/VL, TL/VH, TH/VL, TH/VH	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1		Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1		Lowest, Highest	
Test Parameters			
Test ID	Downlink Configuration	Uplink Configuration	
	N/A for maximum output power test case	Modulation (NOTE 2)	RB allocation (NOTE 1)
1		DFT-s-OFDM Pi/2 BPSK	Inner Full
2		DFT-s-OFDM Pi/2 BPSK	Inner 1RB Left
3		DFT-s-OFDM Pi/2 BPSK	Inner 1RB Right
4		DFT-s-OFDM QPSK	Inner Full
5		DFT-s-OFDM QPSK	Inner 1RB Left
6		DFT-s-OFDM QPSK	Inner 1RB Right
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.			
NOTE 2: DFT-s-OFDM Pi/2 BPSK test applies only for UEs which supports Pi/2 BPSK in FR1.			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.1.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to TS 38.521-1 [2] Annex G.0, G.1, G.2, and G.3.1.
4. The UL Reference Measurement Channel is set according to Table 6.2.1.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.2.1.4.3.

6.2.1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.2.1.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.
3. Measure the mean power of the UE in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration of one active sub-frame (1 ms) and in the uplink symbols. For TDD symbols with transient periods are not under test.

6.2.1.4.3 Message contents

6.2.1.4.3.0 General

Message contents are according to TS 38.508-1 [12] subclause 4.6 and 5.4 with the following exceptions.

Table 6.2.1.4.3.0-1: *PUSCH-Config*

Derivation Path: TS 38.508-1 [12], Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED

6.2.1.4.3.1 Message contents exceptions for network signalling value "NS_04N"

Information element additionalSpectrumEmission is set to NS_04N. This can be set in the SIB1 as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.1.4.3.1-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_04N"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	Value/remark	Comment	Condition
additionalSpectrumEmission	2 (NS_04N)		

6.2.1.4.3.2 Message contents exceptions for network signalling value "NS_05N"

Information element additionalSpectrumEmission is set to NS_05N. This can be set in the SIB1 as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.1.4.3.2-1: *AdditionalSpectrumEmission*: Additional spurious emissions test requirement for "NS_05N"

Derivation Path: TS 38.508-1 [5], Table 4.6.3-1			
Information Element	Value/remark	Comment	Condition
additionalSpectrumEmission	3 (NS_05N)		

6.2.1.5 Test requirement

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

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

NR satellite band	Class 3 (dBm)	Tolerance (dB)
n256	23	$\pm(2+TT)$
n255	23	$\pm(2+TT)$
n254	23	$\pm(2+TT)$
NOTE 1: $P_{PowerClass}$ is the maximum UE power specified without taking into account the tolerance		
NOTE 2: Power class 3 is default power class unless otherwise stated		
NOTE 3: TT for each frequency and channel bandwidth is specified in Table 6.2.1.5-2		

Table 6.2.1.5-2: Test Tolerance (UE maximum output power)

	$f \leq 3.0\text{GHz}$
$BW \leq 30\text{MHz}$	0.7 dB

Table 6.2.1.5-3: Transmit power density test requirement

NR Band	NS value	Channel bandwidth (MHz)	Frequency range (MHz)	Maximum power density
n254	NS_04N	5	1610 - 1618.25	-27dBm/4kHz (mean)
	NS_05N	5	1618.25 - 1626.5	-15dBm/4kHz (peak limit)
		10, 15	1610 – 1626.5	

6.2.2 UE maximum output power reduction

6.2.2.1 Test purpose

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

6.2.2.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

NOTE: Test execution is not necessary if TS 38.521-5 clause 6.5.2.4.1 is executed.

6.2.2.3 Minimum conformance requirements

UE is allowed to reduce the maximum output power due to higher order modulations and transmit bandwidth configurations. For UE power class 3, the allowed maximum power reduction (MPR) is defined in Table 6.2.2.3-1 for channel bandwidths ≤ 100 MHz. The Δ MPR is set to zero.

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.

Table 6.2.2.3-1: Maximum power reduction (MPR) for power class 3

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

RB allocation ranges for Outer and Inner RB allocations are specified in TS 38.521-1 [2] 6.2.2.3.

The normative reference for this requirement is TS 38.101-5 [11] clause 6.2.2.

6.2.2.4 Test description

6.2.2.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in Table 6.2.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in TS 38.521-1 [2] Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in TS 38.521-1 [2] Annex C.2.

Table 6.2.2.4.1-1: Test Configuration Table for power class 3 (contiguous allocation)

Initial Conditions				
Test Environment as specified in TS 38.508-1 [12] subclause 4.1		Normal, TL/VL, TL/VH, TH/VL, TH/VH		
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Low range, High range		
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1		Lowest, Highest		
Test SCS as specified in Table 5.3.5-1		Lowest, Highest		
Test Parameters for Channel Bandwidths				
Test ID	Freq	Downlink Configuration	Uplink Configuration	
		N/A for Maximum Power Reduction (MPR) test case	Modulation (NOTE 2)	RB allocation (NOTE 1)
1	Default		DFT-s-OFDM Pi/2 BPSK	Inner Full
2	Low		DFT-s-OFDM Pi/2 BPSK	Edge_1RB_Left
3	High		DFT-s-OFDM Pi/2 BPSK	Edge_1RB_Right
4	Default		DFT-s-OFDM Pi/2 BPSK	Outer Full
5	Default		DFT-s-OFDM QPSK	Inner Full
6	Low		DFT-s-OFDM QPSK	Edge_1RB_Left
7	High		DFT-s-OFDM QPSK	Edge_1RB_Right
8	Default		DFT-s-OFDM QPSK	Outer Full
9	Default		DFT-s-OFDM 16 QAM	Inner Full
10	Low		DFT-s-OFDM 16 QAM	Edge_1RB_Left
11	High		DFT-s-OFDM 16 QAM	Edge_1RB_Right
12	Default		DFT-s-OFDM 16 QAM	Outer Full
13	Low		DFT-s-OFDM 64 QAM	Edge_1RB_Left
14	High		DFT-s-OFDM 64 QAM	Edge_1RB_Right
15	Default		DFT-s-OFDM 64 QAM	Outer Full
16	Default		CP-OFDM QPSK	Inner Full
17	Low		CP-OFDM QPSK	Edge_1RB_Left
18	High		CP-OFDM QPSK	Edge_1RB_Right
19	Default		CP-OFDM QPSK	Outer Full
20	Default		CP-OFDM 16 QAM	Inner Full
21	Low		CP-OFDM 16 QAM	Edge_1RB_Left
22	High		CP-OFDM 16 QAM	Edge_1RB_Right
23	Default		CP-OFDM 16 QAM	Outer Full
24	Low		CP-OFDM 64 QAM	Edge_1RB_Left
25	High		CP-OFDM 64 QAM	Edge_1RB_Right
26	Default		CP-OFDM 64 QAM	Outer Full
27 ³	Low		DFT-s-OFDM Pi/2 BPSK w Pi/2 BPSK DMRS	Edge_1RB_Left
28 ³	High		DFT-s-OFDM Pi/2 BPSK w Pi/2 BPSK DMRS	Edge_1RB_Right
29 ³	Default		DFT-s-OFDM Pi/2 BPSK w Pi/2 BPSK DMRS	Outer Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.				
NOTE 2: DFT-s-OFDM Pi/2 BPSK test applies only for UEs which supports Pi/2 BPSK in FR1.				
NOTE 3: Applicable to UEs indicating support for UE capability <i>lowPAPR-DMRS-PUSCHwithPrecoding-r16</i> .				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.2.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to TS 38.521-1 [2] Annex G.0, G.1, G.2, and G.3.1.
4. The UL Reference Measurement Channel is set according to Table 6.2.2.4.1-1.

5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.2.2.4.3.

6.2.2.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.2.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 ms for the UE to reach P_{UMAX} level.
3. Measure the mean power of the UE in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration of 1 ms over consecutive active uplink slots.

NOTE 1: When switching to DFT-s-OFDM waveform, as specified in the test configuration Table 6.2.2.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [12] 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 [12] subclause 4.6 and 5.4 with the following exceptions:

Table 6.2.2.4.3-1: PUSCH-Config

Derivation Path: TS 38.508-1 [12] subclause 4.6.3 Table 4.6.3-118 PUSCH-Config			
Information Element	Value/remark	Comment	Condition
PUSCH-Config ::= SEQUENCE {			
resourceAllocation	resourceAllocationType0		Almost contiguous allocation
	resourceAllocationType1		Contiguous allocation
}			

Table 6.2.2.4.3-2: DMRS-UplinkConfig Test ID 33 - 35 in Table 6.2.2.4.1-1

Derivation Path: TS 38.508-1 [12], Table 4.6.3-51			
Information Element	Value/remark	Comment	Condition
DMRS-UplinkConfig ::= SEQUENCE {			
transformPrecodingEnabled SEQUENCE {			
dmrs-UplinkTransformPrecoding-r16 SEQUENCE {			
pi2BPSK-ScramblingID0	Not present		
pi2BPSK-ScramblingID1	Not present		
}			
}			
}			

Table 6.2.2.4.3-3: ServingCellConfig

Derivation Path: TS 38.508-1 [12] Table 4.6.3-167			
Information Element	Value/remark	Comment	Condition
ServingCellConfig ::= SEQUENCE {			
uplinkConfig SEQUENCE {			
powerBoostPi2BPSK	0		
}			
}			

6.2.2.5 Test requirement

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

Table 6.2.2.5-1: UE MPR test requirements for power class 3 (contiguous allocation)

Test ID	P _{PowerClass} (dBm)	ΔP _{PowerClass} (dB)	MPR (dB)	ΔT _{C,c} (dB)	P _{CMAX_L,f,c} (dBm)	T(P _{CMAX_L,f,c}) (dB)	T _{L,c} (dB)	Upper limit (dBm)	Lower limit (dBm)
1	23	0	0	0	23.0	2.0	2	25.0 + TT	21.0 - TT
2	23	0	0.5	0	22.5	2.0	2	25.0 + TT	20.5 - TT
3	23	0	0.5	0	22.5	2.0	2	25.0 + TT	20.5 - TT
4	23	0	0.5	0	22.5	2.0	2	25.0 + TT	20.5 - TT
5	23	0	0	0	23.0	2.0	2	25.0 + TT	21.0 - TT
6	23	0	1	0	22.0	2.0	2	25.0 + TT	20.0 - TT
7	23	0	1	0	22.0	2.0	2	25.0 + TT	20.0 - TT
8	23	0	1	0	22.0	2.0	2	25.0 + TT	20.0 - TT
9	23	0	1	0	22.0	2.0	2	25.0 + TT	20.0 - TT
10	23	0	2	0	21.0	2.0	2	25.0 + TT	19.0 - TT
11	23	0	2	0	21.0	2.0	2	25.0 + TT	19.0 - TT
12	23	0	2	0	21.0	2.0	2	25.0 + TT	19.0 - TT
13	23	0	2.5	0	20.5	2.5	2	25.0 + TT	18.0 - TT
14	23	0	2.5	0	20.5	2.5	2	25.0 + TT	18.0 - TT
15	23	0	2.5	0	20.5	2.5	2	25.0 + TT	18.0 - TT
16	23	0	1.5	0	21.5	2.0	2	25.0 + TT	19.5 - TT
17	23	0	3	0	20.0	2.5	2	25.0 + TT	17.5 - TT
18	23	0	3	0	20.0	2.5	2	25.0 + TT	17.5 - TT
19	23	0	3	0	20.0	2.5	2	25.0 + TT	17.5 - TT
20	23	0	2	0	21.0	2.0	2	25.0 + TT	19.0 - TT
21	23	0	3	0	20.0	2.5	2	25.0 + TT	17.5 - TT
22	23	0	3	0	20.0	2.5	2	25.0 + TT	17.5 - TT
23	23	0	3	0	20.0	2.5	2	25.0 + TT	17.5 - TT
24	23	0	3.5	0	19.5	3.5	2	25.0 + TT	16.0 - TT
25	23	0	3.5	0	19.5	3.5	2	25.0 + TT	16.0 - TT
26	23	0	3.5	0	19.5	3.5	2	25.0 + TT	16.0 - TT
27	23	0	0.5	0	22.5	2.0	2	25.0 + TT	20.5 - TT
28	23	0	0.5	0	22.5	2.0	2	25.0 + TT	20.5 - TT
29	23	0	0	0	23	2.0	2	25.0 + TT	21.0 - TT

NOTE 1: P_{PowerClass} is the maximum UE power specified without taking into account the tolerance.

NOTE 2: TT for each frequency and channel bandwidth is specified in Table 6.2.2.5-2.

Table 6.2.2.5-2: Test Tolerance (Maximum Power Reduction (MPR))

	f ≤ 3.0GHz
BW ≤ 30MHz	0.7 dB

6.2.3 UE additional maximum output power reduction

6.2.3.1 Test purpose

Additional emission requirements can be signalled by the network. Each additional emission requirement is associated with a unique network signalling (NS) value indicated in RRC signalling by an NR frequency band number of the applicable operating band and an associated value in the field *additionalSpectrumEmission*. Throughout this specification, the notion of indication or signalling of an NS value refers to the corresponding indication of an NR satellite band number of the applicable operating band, the IE field *freqBandIndicatorNR* and an associated value of *additionalSpectrumEmission* in the relevant RRC information elements [8].

To meet the additional requirements, additional maximum power reduction (A-MPR) is allowed for the maximum output power as specified in Table 6.2.1.3-1 except for 256QAM. Unless stated otherwise, the total reduction to UE maximum output power is max(MPR, A-MPR) where MPD is defined in clause 6.2.2 except for 256QAM. Outer and inner allocation notation used in clause 6.2.3 is defined in clause 6.2.2. In absence of modulation and waveform types the A-MPR applies to all modulation and waveform types.

6.2.3.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.2.3.3 Minimum conformance requirements

6.2.3.3.1 General

Table 6.2.3.3.1-1 specifies the additional requirements with their associated network signalling values and the allowed A-MPR and applicable operating band(s) for each NS value. The mapping of NR satellite band numbers and values of the *additionalSpectrumEmission* to network signalling labels is specified in Table 6.2.3.3.1-2.

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

Network signalling label	Requirements (clause)	NR satellite Band	Channel bandwidth (MHz)	Resources blocks (N_{RB})	A-MPR (dB)
NS_01		Table 5.2.2-1 (NOTE 3)	5, 10, 15, 20	Table 5.3.2-1	N/A
NS_24	6.5.3.3.13 in 3GPP TS 38.101-1 [5]	n256	5, 10, 15, 20	Table 6.2.3.15-1 in 3GPP TS 38.101-1 [5]	Clause 6.2.3.15 in 3GPP TS 38.101-1 [5] ²
NS_02N	6.5.3.3.3.1	n255	5, 10, 15, 20		N/A
NS_100	6.5.2.4.2 in 3GPP TS 38.101-1 [5]	n256 ¹			Table 6.2.3.3.1-3, and Table 6.2.3.1-2 in 3GPP TS 38.101-1 [5]
NS_03N	6.5.3.3.3.2	n254	5, 10, 15		Clause 6.2.3.3.2
NS_04N	6.5.3.3.3.3	n254	5		Clause 6.2.3.3.3
NS_05N	6.5.3.3.3.3	n254	5, 10, 15		Clause 6.2.3.3.4
NOTE 1: This NS can be signalled for NR satellite bands that have UTRA services deployed.					
NOTE 2: A-MPR for the upper 5 MHz of the band is not specified, and therefore shall be used as a guard band.					
NOTE 3: The NS_01 label with the field <i>additionalPmax</i> [8] absent is default for all NR satellite bands.					

Table 6.2.3.3.1-2: Mapping of network signalling label

NR satellite band	Value of <i>additionalSpectrumEmission</i>							
	0	1	2	3	4	5	6	7
n256	NS_01	NS_24	NS_100					
n255	NS_01	NS_02N						
n254	NS_01	NS_03N	NS_04N	NS_05N				

NOTE: *additionalSpectrumEmission* corresponds to an information element of the same name defined in clause 6.3.2 of 3GPP TS 38.331 [8].

Table 6.2.3.3.1-3: A-MPR for NS_100 (UTRA protection)

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

6.2.3.3.2 A-MPR for NS_03N

Table 6.2.3.3.2-1: A-MPR regions for NS_03N

Channel BW	Carrier Center Frequency	RB_start*12*SCS (MHz)	LCRB*12*SCS (MHz)	A-MPR
5MHz	1612.5 \leq fc < 1613.9	≤ 0.36	≤ 0.36	A1
			≥ 2.88	A2
	1613.9 \leq fc < 1615.7		≥ 3.24	A3
10MHz	1615 \leq fc < 1620.1	≤ 1.8	≤ 5.04	A4
		≤ 1.8	> 5.04	A5
		> 7.2	> 0	A6
		> 1.8	≥ 2.88	A2
	1620.1 \leq fc < 1621.5		≤ 6.48	A6
		≤ 0.36	≤ 0.36	A1
	fc = 1621.5		≥ 7.2	A1
15MHz	all	≤ 3.6	≤ 5.04	A4
		≤ 3.6	> 5.04	A5
		> 10.44		A6
		> 3.6	≥ 4.32	A2

Table 6.2.3.3.2-2: A-MPR for NS_03N

	Modulation	A1	A2	A3	A4	A5	A6
DFT-s-OFDM	Pi/2 BPSK	2.5	3.0	1.0	4.0	6.5	1.5
	QPSK	2.5	4.0	2.5	6.0	7.0	2.0
	16QAM	3.0	4.5	3.0	6.5	7.5	2.5
	64QAM	3.5	5	3.5	7	8	3
CP-OFDM	QPSK	3.5	6.0	4.0	8.0	10.0	4.0
	16QAM	3.5	6.0	4.0	8.0	10.0	4.0
	64QAM	3.5	6.0	4.0	8.0	10.0	4.0

6.2.3.3.3 A-MPR for NS_04N

Table 6.2.3.3.3-1: A-MPR regions for NS_04N

Channel BW	Carrier Center Frequency	RB_start*12*SCS (MHz)	LCRB*12*SCS (MHz)	A-MPR
5MHz	1612.5 ≤ fc < 1613.9	≤ 0.36	≤ 0.36	A1
			≥ 2.88	A2
	1613.9 ≤ fc < 1615.7		≥ 3.24	A3

Table 6.2.3.3.3-2: A-MPR for NS_04N

	Modulation	A1	A2	A3
DFT-s-OFDM	Pi/2 BPSK	2.5	3.0	1.0
	QPSK	2.5	4.0	2.5
	16QAM	3.0	4.5	3.0
	64QAM	3.5	5	3.5
CP-OFDM	QPSK	3.5	6.0	4.0
	16QAM	3.5	6.0	4.0
	64QAM	3.5	6.0	4.0

6.2.3.3.4 A-MPR for NS_05N

Table 6.2.3.3.4-1: A-MPR regions for NS_05N

Channel BW	Carrier Center Frequency	RB_start*12*SCS (MHz)	LCRB*12*SCS (MHz)	A-MPR
5MHz	1622.4 < fc ≤ 1624	≤ 3.6	> 0.36	A3
			≥ 2.88	A1
10MHz	1615 ≤ fc < 1620.1	≤ 1.8	≤ 5.04	A4
		≤ 1.8	> 5.04	A5
		> 7.2	> 0	A6
		> 1.8	≥ 2.88	A2
	1620.1 ≤ fc ≤ 1621.5		≤ 7.2	A6
		≤ 0.36	≤ 0.36	A1
		> 7.2	> 0	A6
15MHz	all	≤ 3.6	≤ 5.04	A4
		≤ 3.6	> 5.04	A5
		> 10.44		A6
		> 3.6	≥ 4.32	A2

Table 6.2.3.3.4-2: A-MPR for NS_05N

	Modulation	A1	A2	A3	A4	A5	A6
DFT-s-OFDM	Pi/2 BPSK	1.5	5.0	1.5	6.5	6.5	2.0
	QPSK	1.5	5.0	1.5	6.5	7.0	2.5
	16QAM	2.0	5.5	2.0	7.0	7.5	3.0
	64QAM	2.5	6	2.5	7.5	8	3.5
CP-OFDM	QPSK	3.0	6.5		8.0	10.0	4.5
	16QAM	3.0	6.5		8.0	10.0	4.5
	64QAM	3.0	6.5		8.0	10.0	4.5

6.2.3.3.5 A-MPR for NS_24

Table 6.2.3.3.5-1: A-MPR regions for NS_24

Channel Bandwidth, MHz	Carrier Centre Frequency, Fc, MHz	Region A		Region B		Region C	
		RB _{end} *12* SCS MHz	L _{CRB} *12* SCS MHz	RB _{end} *12*S CS MHz	L _{CRB} *12* SCS MHz	RB _{end} *12*S CS MHz	L _{CRB} *12* SCS MHz
5MHz	Fc=1,992.5		>3.24				
5MHz	Fc=1,997.5		>3.24				
5MHz	Fc=2,002.5		>2.16	>3.78	≤1.98	≤3.6	≤1.98
10MHz	Fc=1,985	>5.4					
10MHz	Fc=1,995		>4.5	>7.56	≤4.32	≤7.38	≤4.32
10MHz	Fc=2,000	>6.84		<2.88		≥3.06 ≤6.66	>1.44
15MHz	Fc=1,987.5		>7.02	>11.52	≤6.84	≤11.34	≤6.84
15MHz	Fc=1,997.5	>9.36		<3.6		≥3.78 ≤9.18	>1.44
20MHz	Fc=1,990	>13.5		<4.5		≥4.68 ≤13.32	>2.16
20MHz	Fc=1,995	>12.6		<5.4		≥5.58 ≤12.42	>1.44
NOTE 1: The A-MPR values are listed in Table 6.2.3.3.2-2.							
NOTE 2: For any undefined region, MPR applies							

Table 6.2.3.3.5-2: A-MPR for NS_24

Modulation/Waveform		Outer (dB)	Inner (dB)
DFT-s-OFDM	PI/2 BPSK	≤ 1.5	N/A
	QPSK	≤ 2	
	16 QAM	≤ 3	
	64 QAM	≤ 3.5	
	QPSK	≤ 4	
CP-OFDM	16 QAM	≤ 4	
	64 QAM	≤ 4.5	
	QPSK	≤ 4	

The normative reference for this requirement is TS 38.101-5 [11] clause 6.2.3.1.

6.2.3.4 Test description

6.2.3.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in Tables 6.2.3.4.1-1 to 6.2.3.4.1-30. The details of the uplink reference measurement channels (RMCs) are specified in clause A.2. Configurations of PDSCH and PDCCH before measurement are specified in clause C.2.

Table 6.2.3.4.1-1: Test Configuration table for NS_100

Initial Conditions							
Test Environment as specified in TS 38.508-1 [12] subclause 4.1						Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1						Low range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1						Lowest, Highest	
Test SCS as specified in Table 5.3.5-1						Lowest, Highest	
A-MPR test parameters for NS_100							
Test ID	Freq	ChBw	SCS	Downlink Configuration	Uplink Configuration		
					Modulation (Note 2)	RB allocation (Note 1)	
1	Low	Default	Default	N/A for A-MPR test cases	DFT-s OFDM	Pi/2 BPSK	Edge_1RB_Left
2	High	Default	Default			Pi/2 BPSK	Edge_1RB_Right
3	Default	Default	Default			Pi/2 BPSK	Outer_Full
4	Low	Default	Default			QPSK	Edge_1RB_Left
5	High	Default	Default			QPSK	Edge_1RB_Right
6	Default	Default	Default			QPSK	Outer_Full
7	Low	Default	Default			16 QAM	Edge_1RB_Left
8	High	Default	Default			16 QAM	Edge_1RB_Right
9	Default	Default	Default			16 QAM	Outer_Full
10	Low	Default	Default			64 QAM	Edge_1RB_Left
11	High	Default	Default			64 QAM	Edge_1RB_Right
12	Default	Default	Default			64 QAM	Outer_Full
13	Low	Default	Default		CP-s OFDM	QPSK	Edge_1RB_Left
14	High	Default	Default			QPSK	Edge_1RB_Right
15	Default	Default	Default			QPSK	Outer_Full
16	Low	Default	Default			16 QAM	Edge_1RB_Left
17	High	Default	Default			16 QAM	Edge_1RB_Right
18	Default	Default	Default			16 QAM	Outer_Full
19	Low	Default	Default			64 QAM	Edge_1RB_Left
20	High	Default	Default			64 QAM	Edge_1RB_Right
21	Default	Default	Default			64 QAM	Outer_Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 unless otherwise stated in this table.							
NOTE 2: DFT-s-OFDM Pi/2 BPSK test applies only for UEs which supports Pi/2 BPSK in FR1.							

Table 6.2.3.4.1-2: Test Configuration table for NS_24

Initial Conditions									
Test Environment as specified in TS 38.508-1 [12] subclause 4.1					Normal				
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1					Refer to uplink carrier centre frequency (F _c) in test parameters				
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1					Refer to test parameters (5, 10, 15, 20 MHz)				
Test SCS as specified in Table 5.3.5-1					Lowest				
A-MPR test parameters for NS_24									
Test ID	F _c (MHz)	ChBw (MHz)	SCS	Downlink Configuration	Uplink Configuration				
					Modulation (NOTE 2, 3)	RB allocation (Note 1)			
						Region A	Region B	Region C	
1-4	1,992.5	5	Default	N/A for A-MPR testing	DFT-s OFDM	Pi/2 BPSK QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A
5-8	1,997.5	5	Default			Pi/2 BPSK QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A
9-20	2,002.5	5	Default			Pi/2 BPSK QPSK 16 QAM 64 QAM	Outer_Full	Edge_1RB_Right	Edge_1RB_Left

e	1,985	10	Default		Pi/2 BPSK QPSK 16 QAM 64 QAM	Edge_1RB_Right	N/A	N/A
25-28	1,985	10	Default		Pi/2 BPSK QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A
29-40	1,995	10	Default		Pi/2 BPSK QPSK 16 QAM 64 QAM	Outer_Full	Edge_1RB_Right	Edge_1RB_Left
41-52	2,000	10	Default		Pi/2 BPSK QPSK 16 QAM 64 QAM	Edge_1RB_Right	Edge_1RB_Left	36@0
53-56	2,000	10	Default		Pi/2 BPSK QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A
57-68	1,987.5	15	Default		Pi/2 BPSK QPSK 16 QAM 64 QAM	Outer_Full	Edge_1RB_Right	Edge_1RB_Left
69-80	1,997.5	15	Default		Pi/2 BPSK QPSK 16 QAM 64 QAM	Edge_1RB_Right	Edge_1RB_Left	50@0
81-84	1,997.5	15	Default		Pi/2 BPSK QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A
85-96	1,990	20	Default		Pi/2 BPSK QPSK 16 QAM 64 QAM	Edge_1RB_Right	Edge_1RB_Left	74@0
97-100	1,990	20	Default		Pi/2 BPSK QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A
101-112	1,995	20	Default		Pi/2 BPSK QPSK 16 QAM 64 QAM	Edge_1RB_Right	Edge_1RB_Left	69@0
113-116	1,995	20	Default		Pi/2 BPSK QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A

117-119	1,992.5	5	Default	CP-OFDM	QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A
120-122	1,997.5	5	Default		QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A
123-131	2,002.5	5	Default		QPSK 16 QAM 64 QAM	Outer_Full	Edge_1RB_Right	Edge_1RB_Left
132-134	1,985	10	Default		QPSK 16 QAM 64 QAM	Edge_1RB_Right	N/A	N/A
135-137	1,985	10	Default		QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A
138-146	1,995	10	Default		QPSK 16 QAM 64 QAM	Outer_Full	Edge_1RB_Right	Edge_1RB_Left
147-155	2,000	10	Default		QPSK 16 QAM 64 QAM	Edge_1RB_Right	Edge_1RB_Left	37@0
156-158	2,000	10	Default		QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A
159-167	1,987.5	15	Default		QPSK 16 QAM 64 QAM	Outer_Full	Edge_1RB_Right	Edge_1RB_Left
168-176	1,997.5	15	Default		QPSK 16 QAM 64 QAM	Edge_1RB_Right	Edge_1RB_Left	51@0
177-179	1,997.5	15	Default		QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A
180-188	1,990	20	Default		QPSK 16 QAM 64 QAM	Edge_1RB_Right	Edge_1RB_Left	74@0
189-191	1,990	20	Default		QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A
192-200	1,995	20	Default		QPSK 16 QAM 64 QAM	Edge_1RB_Right	Edge_1RB_Left	69@0
201-203	1,995	20	Default		QPSK 16 QAM 64 QAM	Outer_Full	N/A	N/A
204	1,992.5	5	Default		QPSK	Edge_1RB_Right	N/A	N/A
205	1,997.5	5	Default		16 QAM	Edge_1RB_Right	N/A	N/A
206	1,985	10	Default		QPSK	Edge_1RB_Left	N/A	N/A

NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 unless otherwise stated in this table.

NOTE 2: DFT-s-OFDM Pi/2 BPSK test applies only for UEs which supports Pi/2 BPSK in FR1.

NOTE 3: In test IDs with multiple modulations, each UL Modulation shall be tested separately against Range A, B, and C.

Table 6.2.3.4.1-3: FFS

Table 6.2.3.4.1-4: Test Configuration table for NS_03N

Initial Conditions								
Test Environment as specified in TS 38.508-1 [5] subclause 4.1								Normal
Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1								(See Freq column)
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1								(See Ch BW column)
Test SCS as specified in Table 5.3.5-1								Lowest, Highest
A-MPR test parameters for NS_50 (Power Class 3)								
Test ID	F _c (MHz)	Ch BW (MHz)	SCS (kHz)	Downlink Configurati on	Uplink Config			
					Modulation (Note 2)	SCS 15 kHz		
1	Low	5	Default	N/A	DFT-s-OFDM	QPSK	Edge_1RB_left (A1)	
2	Low	5	Default			QPSK	Outer_Full (A2)	
3	Low	5	Default			QPSK	Outer_Full (A3)	
4	Low	10	Default			QPSK		
5	Low	10	Default			QPSK		
6	Low	10	Default			QPSK	10@41 (A6)	
7	Low	10	Default			QPSK	40@11 (A2)	
8	Low	10	Default			QPSK	36@0 (A6)	
9	Low	10	Default			QPSK		
10	1621.5	10	Default			QPSK		
11	Low	15	Default			QPSK		
12	Low	15	Default			QPSK		
13	Low	15	Default			QPSK	20@59 (A6)	
14	Low	15	Default			QPSK	24@55 (A2)	
15	Low	5	Default	N/A	CP-OFDM	QPSK	Edge_1RB_left (A1)	
16	Low	5	Default			QPSK	Outer_Full (A2)	
17	Low	5	Default			QPSK	Outer_Full (A3)	
18	Low	10	Default			QPSK		
19	Low	10	Default			QPSK		
20	Low	10	Default			QPSK	11@41 (A6)	
21	Low	10	Default			QPSK	41@11 (A2)	
22	Low	10	Default			QPSK	36@0 (A6)	
23	Low	10	Default			QPSK		
24	1621.5	10	Default			QPSK		
25	Low	15	Default			QPSK		
26	Low	15	Default			QPSK		
27	Low	15	Default			QPSK	20@59 (A6)	
28	Low	15	Default			QPSK	24@55 (A2)	

NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 unless otherwise stated in this table.

Table 6.2.3.4.1-5: Test Configuration table for NS_04N

Initial Conditions								
Test Environment as specified in TS 38.508-1 [5] subclause 4.1								Normal
Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1								Low range, High range
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1								5 MHz
Test SCS as specified in Table 5.3.5-1								Lowest, Highest
A-MPR test parameters for NS_50 (Power Class 3)								
Test ID	F _c (MHz)	Ch BW (MHz)	SCS (kHz)	Downlink Configurati on	Uplink Configurati on			
					Modulation (Note 2)		SCS 15 kHz	
1	Default	5	Default	N/A	DFT-s-OFDM	QPSK	Edge_1RB_left (A1)	
2	Default	5	Default			QPSK	Outer_Full (A2)	
3	Default	5	Default			QPSK	Outer_Full (A3)	
4	Default	5	Default	N/A	CP-OFDM	QPSK	Edge_1RB_left (A1)	
5	Default	5	Default			QPSK	Outer_Full (A2)	
6	Default	5	Default			QPSK	Outer_Full (A3)	

NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 unless otherwise stated in this table.

Table 6.2.3.4.1-6: Test Configuration table for NS_05N

Initial Conditions								
Test Environment as specified in TS 38.508-1 [5] subclause 4.1								Normal
Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1								Low range, High range
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1								5 MHz, 10MHz, 15MHz
Test SCS as specified in Table 5.3.5-1								Lowest, Highest
A-MPR test parameters for NS_50 (Power Class 3)								
Test ID	F _c (MHz)	Ch BW (MHz)	SCS (kHz)	Downlink Configurati on	Uplink Configurati on			
					Modulation (Note 2)		SCS 15 kHz	
1	Default	5	Default	N/A	DFT-s-OFDM	QPSK	5@20 (A3)	
2	Default	5	Default			QPSK	Outer_Full (A1)	
3	Default	10	Default			QPSK		
4	Default	10	Default			QPSK		
5	Default	10	Default			QPSK	10@41 (A6)	
6	Default	10	Default			QPSK	40@11 (A2)	
7	Default	10	Default			QPSK	40@0 (A6)	
8	Default	10	Default			QPSK		
9	Default	10	Default			QPSK		
10	Default	15	Default			QPSK		
11	Default	15	Default			QPSK		
12	Default	15	Default			QPSK	20@59 (A6)	
13	Default	15	Default			QPSK	24@55 (A2)	
14	Default	5	Default	N/A	CP-OFDM	QPSK	5@20 (A3)	
15	Default	5	Default			QPSK	Outer_Full (A1)	
16	Default	10	Default			QPSK		
17	Default	10	Default			QPSK		
18	Default	10	Default			QPSK	11@41 (A6)	
19	Default	10	Default			QPSK	41@11 (A2)	
20	Default	10	Default			QPSK	40@0 (A6)	
21	Default	10	Default			QPSK		
22	Default	10	Default			QPSK		
23	Default	15	Default			QPSK		
24	Default	15	Default			QPSK		
25	Default	15	Default			QPSK	20@59 (A6)	
26	Default	15	Default			QPSK	24@55 (A2)	

NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 unless otherwise stated in this table.

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.1.1 for TE diagram and clause A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2 and uplink signals according Annex G.0, G.1, G.2 and G.3.1.
4. The UL Reference Measurement channels are set according to the applicable table from Table 6.2.3.4.1-1 to Table 6.2.3.4.1-2.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.2.3.4.3.

6.2.3.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to the applicable table from Table 6.2.3.4.1-1 to Table 6.2.3.4.1-2. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE Allow at least 200 ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.
3. Measure the mean power of the UE in the channel bandwidth of the radio access mode. The period of measurement shall be at least the continuous duration one sub-frame (1 ms).

NOTE: When switching to DFT-s-OFDM waveform, as specified in the test configuration Table 6.2.3.4.1-1 to Table 6.2.3.4.1-2, send an NR RRCReconfiguration message according to TS 38.508-1 [12] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

6.2.3.4.3 Message contents

6.2.3.4.3.1 Message contents exceptions for network signalling value "NS_100"

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

Table 6.2.3.4.3.1-1: AdditionalSpectrumEmission: Additional spurious emissions test requirement for "NS_100"

Derivation Path: TS 38.508-1 [12], Table 4.6.3-1			
Information Element	Value/remark	Comment	Condition
additionalSpectrumEmission	2 (NS_100)		

6.2.3.4.3.2 Message contents exceptions for network signalling value "NS_24"

1. Information element additionalSpectrumEmission is set to NS_24. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.2-1: AdditionalSpectrumEmission: Additional spurious emissions test requirement for "NS_24"

Derivation Path: TS 38.508-1 [12], Table 4.6.3-1			
Information Element	Value/remark	Comment	Condition
additionalSpectrumEmission	1 (NS_24)		

6.2.3.4.3.3 Message contents exceptions for network signalling value "NS_03N"

1. Information element additionalSpectrumEmission is set to NS_03N. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.3-1: AdditionalSpectrumEmission: Additional spurious emissions test requirement for "NS_03N "

Derivation Path: TS 38.508-1 [12], Table 4.6.3-1			
Information Element	Value/remark	Comment	Condition
additionalSpectrumEmission	1 (NS_03N)		

6.2.3.4.3.4 Message contents exceptions for network signalling value "NS_04N"

1. Information element additionalSpectrumEmission is set to NS_04N. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.3-1: AdditionalSpectrumEmission: Additional spurious emissions test requirement for "NS_04N "

Derivation Path: TS 38.508-1 [12], Table 4.6.3-1			
Information Element	Value/remark	Comment	Condition
additionalSpectrumEmission	2 (NS_04N)		

6.2.3.4.3.5 Message contents exceptions for network signalling value "NS_05N"

1. Information element additionalSpectrumEmission is set to NS_05N. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.3-1: AdditionalSpectrumEmission: Additional spurious emissions test requirement for "NS_05N "

Derivation Path: TS 38.508-1 [12], Table 4.6.3-1			
Information Element	Value/remark	Comment	Condition
additionalSpectrumEmission	3 (NS_05N)		

6.2.3.5 Test requirement

The maximum output power, derived in step 3 shall be within the range prescribed by the nominal maximum output power and tolerance in the applicable Table from table 6.2.3.5-1 to Table 6.2.3.5-3. The allowed A-MPR values specified in Table 6.2.3.3.1-1 are in addition to the allowed MPR requirements specified in clause 6.2.2. For the UE maximum output power modified by MPR and/or A-MPR, the power limits specified in Table 6.2.1.3-1 apply.

Table 6.2.3.5-1: Test Tolerance (UE additional maximum output power reduction)

	f ≤ 3.0GHz
BW ≤ 30MHz	0.7 dB

Table 6.2.3.5-2: UE Power Class 3 test requirements (NS_100) for n256

Test ID	P _{PowerClass} (dBm)	MPR (dB)	A-MPR (dB)	$\Delta T_{C,c}$ (dB)	P _{CMAX_L,c} (dBm)	T(P _{CMAX_L,c}) (dB)	T _{L,c} (dB)	Upper limit (dBm)	Lower limit (dBm)
1, 2	23	0.5	2	0	21	2	2	25+TT	19-TT
3	23	0.5	2	0	21	2	2	25+TT	19-TT
4, 5	23	1	2	0	21	2	2	25+TT	19-TT
6	23	1	2	0	21	2	2	25+TT	19-TT
7, 8	23	2	2.5	0	20.5	2.5	2	25+TT	18-TT
9	23	2	2.5	0	20.5	2.5	2	25+TT	18-TT
10, 11	23	2.5	3	0	20	2.5	2	25+TT	17.5-TT
12	23	2.5	3	0	20	2.5	2	25+TT	17.5-TT
13, 14	23	3	4	0	19	3.5	2	25+TT	15.5-TT
15	23	3	4	0	19	3.5	2	25+TT	15.5-TT
16, 17	23	3	4	0	19	3.5	2	25+TT	15.5-TT
18	23	3	4	0	19	3.5	2	25+TT	15.5-TT
19, 20	23	3.5	4	0	19	3.5	2	25+TT	15.5-TT
21	23	3.5	4	0	19	3.5	2	25+TT	15.5-TT

NOTE 1: P_{PowerClass} is the maximum UE power specified without taking into account the tolerance.

NOTE 2: TT for each frequency and channel bandwidth is specified in Table 6.2.3.5-1.

Table 6.2.3.5-3: UE Power Class 3 test requirements (NS_24) for n256

Test ID	P _{PowerClass} (dBm)	MPR (dB)	A-MPR (dB)	$\Delta T_{C,c}$ (dB)	P _{CMAX_L,c} (dBm)	T(P _{CMAX_L,c}) (dB)	T _{L,c} (dB)	Upper limit (dBm)	Lower limit (dBm)
1, 5, 9-11, 21, 25, 29-31, 41-43, 53, 57-59, 69-71, 81, 85-87, 97, 101-103, 113	23	N/A	1.5	0	21.5	2	2	25+TT	19.5-TT
2, 6, 12-13, 22, 26, 32-33, 44-45, 54, 60-61, 72-73, 82, 88-89, 98, 104-105, 114	23	N/A	2.0	0	21	2	2	25+TT	19-TT
3, 7, 14-16, 23, 27, 34-36, 46-48, 55, 62-64, 74-76, 83, 90-92, 99, 106-108, 115	23	N/A	3.0	0	20	2.5	2	25+TT	17.5-TT

Test ID	P _{PowerClass} (dBm)	MPR (dB)	A-MPR (dB)	$\Delta T_{C,c}$ (dB)	P _{CMAX_L,c} (dBm)	T(P _{CMAX_L,c}) (dB)	T _{L,c} (dB)	Upper limit (dBm)	Lower limit (dBm)
4, 8, 17-18, 24, 28, 37-38, 49-50, 56, 65-66, 77-78, 84, 93-94, 100, 109-110, 116	23	N/A	3.5	0	19.5	3.5	2	25+TT	16-TT
19-20, 39-40, 51-52, 67-68, 79-80, 95-96, 111-112	23	N/A	5.5	0	17.5	5	2	25+TT	12.5-TT
117-118, 120-121, 123-127, 132-133, 135-136, 138-142, 147-151, 156-157, 159-163, 168-172, 177-178, 180-184, 189-190, 192-196, 201-202, 204-206	23	N/A	4	0	19	3.5	2	25+TT	15.5-TT
119, 122, 128-129, 134, 137, 143-144, 152-153, 158, 164-165, 173-174, 179, 185-186, 191, 197-198, 203	23	N/A	4.5	0	18.5	4	2	25+TT	14.5-TT
130-131, 145-146, 154-155, 166-167, 175-176, 187-188, 199-200	23	N/A	7.5	0	15.5	5	2	25+TT	10.5-TT
NOTE 1: P _{PowerClass} is the maximum UE power specified without taking into account the tolerance.									
NOTE 2: TT for each frequency and channel bandwidth is specified in Table 6.2.3.5-1.									

Table 6.2.3.5-4: UE Power Class 3 test requirements (NS_03N) for n254

Test ID	P _{PowerClass} (dBm)	MPR (dB)	A-MPR (dB)	$\Delta T_{C,c}$ (dB)	P _{CMAX_L,f,c} (dBm)	T(P _{CMAX_L,f,c}) (dB)	T _{L,c} (dB)	Upper limit (dBm)	Lower limit (dBm)
1	23	1	2.5	0	20.5	2.5	2	25.0 + TT	18.0 - TT
2	23	1	4.0	0	19	3.5	2	25.0 + TT	15.5 - TT
3	23	1	2.5	0	20.5	2.5	2	25.0 + TT	18.0 - TT
4	23	1	6.0	0	17	5.0	2	25.0 + TT	12.0 - TT
5	23	1	7.0	0	16	5.0	2	25.0 + TT	11.0 - TT
6	23	1	2.0	0	21	2.0	2	25.0 + TT	19.0 - TT
7	23	1	4.0	0	19	3.5	2	25.0 + TT	15.5 - TT
8	23	1	2.0	0	21	2.0	2	25.0 + TT	19.0 - TT
9	23	1	2.5	0	20.5	2.5	2	25.0 + TT	18.0 - TT
10	23	1	2.5	0	20.5	2.5	2	25.0 + TT	18.0 - TT
11	23	1	6.0	0	17	5.0	2	25.0 + TT	12.0 - TT
12	23	1	7.0	0	16	5.0	2	25.0 + TT	11.0 - TT
13	23	1	2.0	0	21	2.0	2	25.0 + TT	19.0 - TT
14	23	1	4.0	0	19	3.5	2	25.0 + TT	15.5 - TT
15	23	3	3.5	0	19.5	3.5	2	25.0 + TT	16.0 - TT
16	23	3	6.0	0	17	5.0	2	25.0 + TT	12.0 - TT
17	23	3	4.0	0	19	3.5	2	25.0 + TT	15.5 - TT
18	23	3	8.0	0	15	5.0	2	25.0 + TT	10.0 - TT
19	23	3	10.0	0	13	5.0	2	25.0 + TT	8.0 - TT
20	23	3	4.0	0	19	3.5	2	25.0 + TT	15.5 - TT
21	23	3	6.0	0	17	5.0	2	25.0 + TT	12.0 - TT
22	23	3	4.0	0	19	3.5	2	25.0 + TT	15.5 - TT
23	23	3	3.5	0	19.5	3.5	2	25.0 + TT	16.0 - TT
24	23	3	3.5	0	19.5	3.5	2	25.0 + TT	16.0 - TT
25	23	3	8.0	0	15	5.0	2	25.0 + TT	10.0 - TT
26	23	3	10.0	0	13	5.0	2	25.0 + TT	8.0 - TT
27	23	3	4.0	0	19	3.5	2	25.0 + TT	15.5 - TT
28	23	3	6.0	0	17	5.0	2	25.0 + TT	12.0 - TT

NOTE 1: P_{PowerClass} is the maximum UE power specified without taking into account the tolerance.

NOTE 2: TT for each frequency and channel bandwidth is specified in Table 6.2.2.5-2.

Table 6.2.3.5-5: UE Power Class 3 test requirements (NS_04N) for n254

Test ID	P _{PowerClass} (dBm)	MPR (dB)	A-MPR (dB)	$\Delta T_{C,c}$ (dB)	P _{CMAX_L,c} (dBm)	T(P _{CMAX_L,c}) (dB)	T _{L,c} (dB)	Upper limit (dBm)	Lower limit (dBm)
1	23	1	2.5	0	20.5	2.5	2	25 + TT	18.0 - TT
2	23	1	4.0	0	19	3.5	2	25 + TT	15.5 - TT
3	23	1	2.5	0	20.5	2.5	2	25 + TT	18.0 - TT
4	23	3	3.5	0	19.5	3.5	2	25 + TT	16.0 - TT
5	23	3	6.0	0	17	5.0	2	25 + TT	12.0 - TT
6	23	3	4.0	0	19	3.5	2	25 + TT	15.5 - TT

NOTE 1: P_{PowerClass} is the maximum UE power specified without taking into account the tolerance.

NOTE 2: TT for each frequency and channel bandwidth is specified in Table 6.2.3.5-1.

Table 6.2.3.5-6: UE Power Class 3 test requirements (NS_05N) for n254

Test ID	P _{PowerClass} (dBm)	MPR (dB)	A-MPR (dB)	$\Delta T_{C,c}$ (dB)	P _{C_{MAX}_L,f,c} (dBm)	T(P _{C_{MAX}_L,f,c}) (dB)	T _{L,c} (dB)	Upper limit (dBm)	Lower limit (dBm)
1	23	1	1.5	0	21.5	2.0	2	25.0 + TT	19.5 - TT
2	23	1	1.5	0	21.5	2.0	2	25.0 + TT	19.5 - TT
3	23	1	6.5	0	16.5	5.0	2	25.0 + TT	11.5 - TT
4	23	1	7.0	0	16	5.0	2	25.0 + TT	11 - TT
5	23	1	2.5	0	20.5	2.5	2	25.0 + TT	18 - TT
6	23	1	5.0	0	18	4.0	2	25.0 + TT	14 - TT
7	23	1	2.5	0	20.5	2.5	2	25.0 + TT	18 - TT
8	23	1	1.5	0	21.5	2.0	2	25.0 + TT	19.5 - TT
9	23	1	2.5	0	20.5	2.5	2	25.0 + TT	18 - TT
10	23	1	6.5	0	16.5	5.0	2	25.0 + TT	11.5 - TT
11	23	1	7.0	0	16	5.0	2	25.0 + TT	11 - TT
12	23	1	2.5	0	20.5	2.5	2	25.0 + TT	18 - TT
13	23	1	5.0	0	18	4.0	2	25.0 + TT	14 - TT
14	23	3	0.0	0	20	2.5	2	25.0 + TT	17.5 - TT
15	23	3	3.0	0	20	2.5	2	25.0 + TT	17.5 - TT
16	23	3	8.0	0	15	5.0	2	25.0 + TT	10 - TT
17	23	3	10.0	0	13	5.0	2	25.0 + TT	8 - TT
18	23	3	4.5	0	18.5	4.0	2	25.0 + TT	14.5 - TT
19	23	3	6.5	0	16.5	4.0	2	25.0 + TT	12.5 - TT
20	23	3	4.5	0	18.5	4.0	2	25.0 + TT	14.5 - TT
21	23	3	3.0	0	20	2.5	2	25.0 + TT	17.5 - TT
22	23	3	4.5	0	18.5	4.0	2	25.0 + TT	14.5 - TT
23	23	3	8.0	0	15	5.0	2	25.0 + TT	10 - TT
24	23	3	10.0	0	13	5.0	2	25.0 + TT	8 - TT
25	23	3	4.5	0	18.5	4.0	2	25.0 + TT	14.5 - TT
26	23	3	6.5	0	16.5	5.0	2	25.0 + TT	11.5 - TT

NOTE 1: P_{PowerClass} is the maximum UE power specified without taking into account the tolerance.

NOTE 2: TT for each frequency and channel bandwidth is specified in Table 6.2.2.5-2.

6.2.4 Configured transmitted power

6.2.4.1 Test purpose

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

6.2.4.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.2.4.3 Minimum conformance requirements

The requirements for configured transmitted power defined in subclause 6.2.4 of 3GPP TS 38.521-1 [2] clause 6.2.4 shall apply to NTN satellite UE.

The normative reference for this requirement is TS 38.101-1 [5] clause 6.2.4.

6.2.4.4 Test description

6.2.4.4.1 Initial condition

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with

applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.2.4.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in clause A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.2.4.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [12] subclause 4.1		Normal, TL/VL, TL/VH, TH/VL, TH/VH	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Mid range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1		Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1		Lowest	
Test Parameters for Channel Bandwidths			
Test ID	Downlink Configuration	Uplink Configuration	
	N/A	Modulation (NOTE 2)	RB allocation (NOTE 1)
1		DFT-s-OFDM Pi/2 BPSK	Inner Full
2		DFT-s-OFDM QPSK	Inner Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.			
NOTE 2: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK.			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.1.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.
4. The UL Reference Measurement Channel is set according to Table 6.2.4.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause [to be updated] is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.2.4.4.3.

6.2.4.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.2.4.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 ms starting from the first TPC command in this step to ensure that the UE reaches the P_{max} level of the test point.
3. Measure the mean power of the UE in the channel bandwidth for each test point in table 6.2.4.5-1 according to the test configuration from table 6.2.4.4.1-1. The period of measurement shall be at least the continuous duration of one active slot and in the uplink symbols. For TDD slots with transient periods are not under test.

6.2.4.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exceptions:

Table 6.2.4.4.3-0: PUSCH-Config

Derivation Path: TS 38.508-1 [12], Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED

Table 6.2.4.4.3-1: FrequencyInfoUL-SIB: Test point 1

Derivation Path: TS 38.508-1 [12] Table 4.6.3-62 FrequencyInfoUL-SIB			
Information Element	Value/remark	Comment	Condition
p-Max	-10		

Table 6.2.4.4.3-2: FrequencyInfoUL-SIB: Test point 2

Derivation Path: TS 38.508-1 [12] Table 4.6.3-62 FrequencyInfoUL-SIB			
Information Element	Value/remark	Comment	Condition
p-Max	10		

Table 6.2.4.4.3-3: FrequencyInfoUL-SIB: Test point 3

Derivation Path: TS 38.508-1 [12] Table 4.6.3-62 FrequencyInfoUL-SIB			
Information Element	Value/remark	Comment	Condition
p-Max	15		

Table 6.2.4.4.3-4: FrequencyInfoUL-SIB: Test point 4

Derivation Path: TS 38.508-1 [12] Table 4.6.3-62 FrequencyInfoUL-SIB			
Information Element	Value/remark	Comment	Condition
p-Max	20		

Table 6.2.4.4.3-5: ServingCellConfig

Derivation Path: TS 38.508-1 [12] Table 4.6.3-167			
Information Element	Value/remark	Comment	Condition
ServingCellConfig ::= SEQUENCE {			
uplinkConfig SEQUENCE {			
powerBoostPi2BPSK	0		Test ID 1, 2
}			
}			

6.2.4.5 Test requirement

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

Table 6.2.4.5-1: P_CMAX configured UE output power for Test ID 1,2

	Maximum output power
Measured UE output power test point 1	-10 dBm ± (7+TT)
Measured UE output power test point 2	10 dBm ± (6+TT)
Measured UE output power test point 3	15 dBm ± (5+TT)
Measured UE output power test point 4	Note 3
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.2.4.5-2.	
NOTE 2: Power class 3 is default power class unless otherwise stated.	
NOTE 3: The maximum output power shall be within the range in Table 6.2.4.5-1a.	

Table 6.2.4.5-1a: Measured UE output power test point 4 for Test ID 1,2

NR band	Tolerance (dB)
n256	20 dBm ±(2.5+TT)
n255	20 dBm ±(2.5+TT)
n254	20 dBm ±(2.5+TT)
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.2.4.5-2.	

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

	f ≤ 3.0GHz
BW ≤ 30MHz	0.7 dB

6.3 Output power dynamics

6.3.1 Minimum output power

6.3.1.1 Test purpose

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

6.3.1.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.3.1.3 Minimum conformance requirements

The minimum controlled output power of the UE is defined as the power in the channel bandwidth for all transmit bandwidth configurations (resource blocks), when the power is set to a minimum value.

The minimum output power is defined as the mean power in at least one sub-frame 1 ms. The minimum output power shall not exceed the values specified in Table 6.3.1.3-1.

Table 6.3.1.3-1: Minimum output power

Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
5	-40	4.515
10	-40	9.375
15	-40	14.235
20	-40	19.095

The normative reference for this requirement is TS 38.101-5 [11] clause 6.3.1.

6.3.1.4 Test description

6.3.1.4.1 Initial condition

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in table 6.3.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.3.1.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [12] subclause 4.1		Normal, TL/VL, TL/VH, TH/VL, TH/VH	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1		Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1		Highest	
Test Parameters for Channel Bandwidths			
Test ID	Downlink Configuration	Uplink Configuration	
	N/A for minimum output power	Modulation	RB allocation (NOTE 1)
1	test case	DFT-s-OFDM QPSK	Outer Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.1.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to clauses C.0, C.1, C.2, and uplink signals according to clauses G.0, G.1, G.2, G.3.0.
4. The UL Reference Measurement Channel is set according to Table 6.3.1.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508[12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. 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 [12] 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 200 ms starting from the first TPC command in this step to ensure that the UE transmits at its minimum output power.
3. Measure the mean power of the UE in the associated measurement channel bandwidth specified in Table 6.3.1.5-1 for the specific channel bandwidth under test. The period of measurement shall be at least the continuous duration of one active sub-frame (1 ms) and in the uplink symbols. For TDD symbols with transient periods are not under test.

6.3.1.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 with following exception.

Table 6.3.1.4.3-1: PUSCH-Config

Derivation Path: TS 38.508-1 [12], Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED
--

6.3.1.5 Test requirement

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

Table 6.3.1.5-1: Minimum output power

Channel bandwidth (MHz)	Minimum output power (dBm)	Measurement bandwidth (MHz)
5	-40+TT	4.515
10	-40+TT	9.375
15	-40+TT	14.235
20	-40+TT	19.095
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3.1.5-2		

Table 6.3.1.5-2: Test Tolerance (Minimum output power)

	f ≤ 3.0GHz
BW ≤ 40MHz	1 dB

6.3.2 Transmit OFF power

6.3.2.1 Test purpose

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

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

6.3.2.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.3.2.3 Minimum conformance requirements

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

The Transmit OFF power is defined as the mean power in a duration of at least one sub-frame (1 ms) excluding any transient periods. The Transmit OFF power shall not exceed the values specified in Table 6.3.2.3-1.

Table 6.3.2.3-1: Transmit OFF power

Channel bandwidth	(MHz)	5, 10, 15, 20
REF_SCS	(kHz)	15
Transmit OFF power	(dBm)	-50
Measurement bandwidth	(MHz)	$MBW = REF_SCS * (12 * N_{RB} + 1) / 1000$

The normative reference for this requirement is TS 38.101-5 [11] clause 6.3.2.

6.3.2.4 Test description

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

6.3.2.5 Test requirement

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

Table 6.3.2.5-1: Transmit OFF power

Channel bandwidth (MHz)	Transmit OFF power (dBm)	Measurement bandwidth (MHz)
5	-50+TT	4.515
10	-50+TT	9.375
15	-50+TT	14.235
20	-50+TT	19.095
NOTE 1: TT for each frequency and channel bandwidth is specified in Table 6.3.2.5-2		

Table 6.3.2.5-2: Test Tolerance (Transmit OFF power)

	f ≤ 3.0GHz
BW ≤ 40MHz	1.5 dB

6.3.3 Transmit on/off time mask

6.3.3.1 Test purpose

To verify that the general ON/OFF time mask meets the requirements given in 6.3.3.5.

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

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

6.3.3.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.3.3.3 Minimum conformance requirements

The requirements for transmit ON/OFF time mask defined in 3GPP TS 38.101-1 [5] clause 6.3.3 shall apply for NTN satellite UE.

The normative reference for this requirement is TS 38.101-5 [11] clause 6.2.2.

6.3.3.4 Test description

6.3.3.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, 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 6.3.3.4.1-1. 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 6.3.3.4.1-1: Test Configuration Table for power class 3

Initial Conditions			
Test Environment as specified in TS 38.508-1 [12] subclause 4.1		Normal, TL/VL, TL/VH, TH/VL, TH/VH	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1		Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1		Lowest, Highest	
Test Parameters for Channel Bandwidths			
Test ID	Downlink Configuration	Uplink Configuration	
	N/A	Modulation	RB allocation (NOTE 1)
1		DFT-s-OFDM QPSK	Inner Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.NOTE 2: Void.			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.1.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to TS 38.521-1 [2] clauses G.0, G.1, G.2, and G.3.1.
4. The UL Reference Measurement Channel is set according to Table 6.3.3.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. Ensure the UE is in State [to be updated] with generic procedure parameters Connectivity *NR*, Connected without release *On*, Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [12] clause 4.5. Message contents are defined in clause 6.3.3.4.3.

6.3.3.4.2 Test procedure

1. SS sends uplink scheduling information via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.3.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC. The UL assignment is such that the UE transmits on slots 8 for 15 kHz SCS, on slots 8 and 18 for 30 kHz SCS and on slots 17 and 37 for 60 kHz SCS.
2. Send continuously uplink power control "up" commands in every uplink scheduling information to the UE; allow at least 200 ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.
3. ON power sub test:
 - 3.1. Measure the output power of the UE PUSCH transmission during one slot.
4. OFF power sub test:
 - 4.1. Measure the UE transmission OFF power during the slot prior to the PUSCH transmission, excluding a transient period of 10 μ s in the end of the slot.
 - 4.2. Measure the UE transmission OFF power during the slot following the PUSCH transmission, excluding a transient period of 10 μ s at the beginning of the slot.

6.3.3.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exceptions: SIB19 message contents according to TS 38.508-1 [12] clause 5.6.2.1. In addition the below message contents needs to be configured.

Table 6.3.3.4.3-1: PUSCH-TimeDomainResourceAllocationList

Derivation Path: TS 38.508-1 [12], Table 4.6.3-122			
Information Element	Value/remark	Comment	Condition
PUSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF { PUSCH-TimeDomainResourceAllocation[1] SEQUENCE {	2 entries		
k2	4		FR1_15kHz, FR1_30kHz
	6		FR1_60kHz
mappingType	typeA		
startSymbolAndLength	27	Start symbol(S)=0, Length(L)=14	
}			
PUSCH-TimeDomainResourceAllocation[2] SEQUENCE {		Addressed by Msg3 PUSCH time resource allocation field of the Random Access Response acc. to TS 38.213 [7] Table 8.2-1.	
k2	2	$K_2 + \Delta = 4$ acc. to TS 38.214 [16] Table 6.1.2.1.1-5 (NOTE 1)	FR1_15kHz
	6	$K_2 + \Delta = 9$ acc. to TS 38.214 [16] Table 6.1.2.1.1-5 (NOTE 1)	FR1_30kHz

mappingType	typeA		
startSymbolAndLength	27	Start symbol(S)=0, Length(L)=14	
}			
}			

NOTE 1: Values are chosen so that first slot of a TDD-UL-DL slot configuration period can be used for the Random Access Response and the last slot (of the same or another period) for the corresponding Msg3.

Condition	Explanation
FR1_15kHz	FR1 is used under the test. SCS is set to 15kHz.
FR1_30kHz	FR1 is used under the test. SCS is set to 30kHz.
FR1_60kHz	FR1 is used under the test. SCS is set to 60kHz.

Table 6.3.3.4.3-2: PUSCH-Config

Derivation Path: TS 38.508-1 [12], Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED

Table 6.3.3.4.3-3: P-Max

Derivation Path: TS 38.508-1 [12], Table 4.6.3-89			
Information Element	Value/remark	Comment	Condition
P-Max	23		

6.3.3.5 Test requirement

The requirement for the power measured in steps 2, 3 and 4 of the test procedure shall not exceed the values specified in Table 6.3.3.5-1.

Table 6.3.3.5-1: General ON/OFF time mask

	Channel bandwidth / minimum output power / measurement bandwidth			
	5MHz	10MHz	15MHz	20MHz
Transmit OFF power	$\leq -50 + TT$ dBm			
Transmission OFF Measurement bandwidth	4.515	9.375	14.235	19.095
Transmit ON power	Same as Table 6.2.1.5-1			

NOTE 1: TT for each frequency and channel bandwidth of OFF power is specified in Table 6.3.3.5-2
NOTE 2: TT for each frequency and channel bandwidth of ON power is specified in Table 6.2.1.5-2

Table 6.3.3.5-2: Test Tolerance for OFF power

	$f \leq 3.0\text{GHz}$
$BW \leq 40\text{MHz}$	1.5 dB

6.3.4 Power Control

6.3.4.1 Test purpose

Same as in 3GPP TS 38.101-1 [5] clause 6.3.4 for NTN satellite UE.

6.3.4.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.3.4.3 Minimum conformance requirements

The requirements for power control defined in 3GPP TS 38.101-1 [5] clause 6.3.4 shall apply for NTN satellite UE.

The normative reference for this requirement is TS 38.101-5 [11] clause 6.3.4.

6.3.4.4 Test description

6.3.4.4.1 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, 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 6.3.4.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCCH before measurement are specified in Annex C.2.

Table 6.3.4.4.1-1: Test Configuration Table

Test configuration table is the same as in 3GPP TS 38.521-1 [2] clause 6.3.4 for NTN satellite UE.

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.1.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to TS 38.521-1 [2] clauses G.0, G.1, G.2, and G.3.1.
4. The UL Reference Measurement Channel is set according to Table 6.3.4.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.3.4.4.3.

6.3.4.4.2 Test procedure

Same as in 3GPP TS 38.521-1 [2] clause 6.3.4 for NTN satellite UE.

6.3.4.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exceptions: SIB19 message contents according to TS 38.508-1 [12] clause 5.6.2.1.

6.3.4.5 Test requirement

Same as in 3GPP TS 38.521-1 [2] clause 6.3.4 for NTN satellite UE.

6.4 Transmit signal quality

6.4.1 Frequency error

6.4.1_1 Frequency error with GSO ephemeris

6.4.1_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.

6.4.1_1.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation and GSO.

6.4.1_1.3 Minimum conformance requirements

The NTN satellite UE basic measurement interval of modulated carrier frequency is 1 UL slot. The NTN satellite UE pre-compensates the uplink modulated carrier frequency by the estimated Doppler shift according to 3GPP TS 38.300 [9] clause 16.14.2. The mean value of basic measurements of NTN UE modulated carrier frequency shall be accurate to within ± 0.1 PPM observed over a period of 1 ms of cumulated measurement intervals compared to ideally pre-compensated reference uplink carrier frequency.

[NOTE: The ideally pre-compensated reference uplink carrier frequency consists of the UL carrier frequency signalled to the UE by SAN and UL pre-compensated Doppler frequency shift. For the test case, the location of the UE is explicitly provided to the UE from the test equipment.]

The normative reference for this requirement is TS 38.101-5 [11] clause 6.4.1.

6.4.1_1.4 Test description

6.4.1_1.4.1 Initial condition

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR 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_1.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in TS 38.521-1 [2] Annex A.2. Configurations of PDSCH and PDCCH before measurement are specified in TS 38.521-1 Annex C.2.

Table 6.4.1_1.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 38.508-1 [12] subclause 4.1			Normal, TL/VL, TL/VH, TH/VL, TH/VH	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1			Mid range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1			Highest	
Test SCS as specified in Table 5.3.5-1			Lowest	
Test Parameters				
	Downlink Configuration		Uplink Configuration	
Test ID	Modulation	RB allocation	Modulation	RB allocation
1	CP-OFDM QPSK	Full RB (NOTE 1)	DFT-s-OFDM QPSK	REFSENS (NOTE 2)
NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2				
NOTE 2: REFSENS refers to Table 7.3.2.4.1-3 which defines uplink RB configuration and start RB location for each SCS, channel BW and NR band.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, in Figure A.3.1.1.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, and G.3.1.0.
4. The DL and UL Reference Measurement channels are set according to Table 6.4.1_1.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location for GSO according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Deactivate UE prediction of satellite trajectory by any preconfigured means.

6.4.1_1.4.2 Test procedure

1. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508 [12] table 5.6.2.1-1. Test system shall send same SIB19 information during the duration of this frequency error measurement as defined in TS 38.508-1 [12] clause 5.6.3.1.
2. 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 [12] clause 4.5. Message contents are defined in clause 6.4.1_1.4.3.
3. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 6.4.1_1.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.
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 6.4.1_1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
5. Set the Downlink signal level to the appropriate REFSENS value defined in Table 7.3.2.5-1. Send continuously uplink power control "up" commands to the UE in every uplink scheduling information to the UE so that the UE transmits at P_{UMAX} level for the duration of the test. Allow at least 200 ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.
6. Measure the Frequency Error using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.
7. Repeat from test procedure steps 1-6 with ephemeris values for maximum positive Doppler replacing ephemeris in step 1 by Table 6.4.1_1.4.3-1a. Test system shall send same SIB19 information during the duration of this frequency error measurement.

8. Repeat from test procedure steps 1-6 with ephemeris values for maximum negative Doppler replacing ephemeris in step 1 by Table 6.4.1_1.4.3-2a. Test system shall send same SIB19 information during the duration of each frequency error measurement.
9. Repeat from test procedure steps 1-6 with ephemeris values for half of maximum positive Doppler replacing ephemeris in step1 by Table 6.4.1_1.4.3-3a. Test system shall send same SIB19 information during the duration of this frequency error measurement.

6.4.1_1.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 and subclause 5.6.2.1 with the following exceptions:

Table 6.4.1_1.4.3-1a: SIB19 for RF tests with NR NTN Ephemeris Information for GSO satellites (maximum positive Doppler)

Derivation Path: TS 38.508-1, Table 5.6.3.1-1			
Information Element	Value/remark	Comment	Condition
SIB19-r17 ::= SEQUENCE {			
ntn-Config-r17 SEQUENCE {			
cellSpecificOffset-r17	264		
EphemerisInfo-r17 CHOICE {			
positionVelocity-r17 SEQUENCE {			
positionX-r17	-17104941		
positionY-r17	27550229		
positionZ-r17	-607219		
velocityVX-r17	258		
velocityVY-r17	299		
velocityVZ-r17	6277		
}			
}			
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 26.15 degrees, one-way delay equal to 129.93 ms and Doppler equal to 0.17 ppm			

Table 6.4.1_1.4.3-1b: Void

Table 6.4.1_1.4.3-2a: SIB19 for RF tests with NNR NTN Ephemeris Information for GSO satellites (maximum negative Doppler)

Derivation Path: TS 38.508-1, Table 5.6.3.1-1			
Information Element	Value/remark	Comment	Condition
SIB19-r17 ::= SEQUENCE {			
ntn-Config-r17 SEQUENCE {			
cellSpecificOffset-r17	264		
EphemerisInfo-r17 CHOICE {			
positionVelocity-r17 SEQUENCE {			
positionX-r17	-17061001		
positionY-r17	27582763		
positionZ-r17	-276165		
velocityVX-r17	361		
velocityVY-r17	160		
velocityVZ-r17	-6335		
}			
}			
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 26.78 degrees, one-way delay equal to 129.74 ms and Doppler equal to -0.17 ppm.			

Table 6.4.1_1.4.3-2b: Void

Table 6.4.1_1.4.3-3a: SIB19 for RF tests with NR NTN Ephemeris Information for GSO satellites (maximum positive Doppler/2)

Derivation Path: TS 38.508-1, Table 5.6.3.1-1			
Information Element	Value/remark	Comment	Condition
SIB19-r17 ::= SEQUENCE {			
ntn-Config-r17 SEQUENCE {			
cellSpecificOffset-r17	264		
EphemerisInfo-r17 CHOICE {			
positionVelocity-r17 SEQUENCE {			
positionX-r17	-17062164		
positionY-r17	27354696		
positionZ-r17	-3544856		
velocityVX-r17	-360		
velocityVY-r17	164		
velocityVZ-r17	2993		
}			
}			
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 20.61 degrees, one-way delay equal to 131.70 ms and Doppler equal to -0.085 ppm.			

Table 6.4.1.4.3-3b: Void

6.4.1_1.5 Test requirement

The frequency error Δf shall fulfil the test requirement:

$$|\Delta f| \leq (0.1 \text{ PPM} + [15 \text{ Hz}])$$

The above requirement shall be verified for at least two cases of which one has zero Doppler conditions.

6.4.1_2 Frequency error with NGSO ephemeris

6.4.1_2.1 Test purpose

Same test purpose as in clause 6.4.1_1.1.

6.4.1_2.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation and NGSO.

6.4.1_2.3 Minimum conformance requirements

Same minimum conformance requirements as in clause 6.4.1_1.3.

6.4.1_2.4 Test description

6.4.1_2.4.1 Initial condition

Same initial conditions as in clause 6.4.1_1.4.1 with the following exception:

- In step 6, instead of UE location for GSO satellite → use UE location for NGSO satellite

6.4.1_2.4.2 Test procedure

Same test procedure as in clause 6.4.1_1.4.2 with the following exceptions:

- In step 1, instead of TS 38.508-1 [12] Table 5.6.2.1-1 → use TS 38.508-1 [12] Table 5.6.2.1-3 (ephemeris for NGSO LEO 1200).
- Instead of Tables 6.4.1_1.4.3-1a, 6.4.1_1.4.3-2a, and 6.4.1_1.4.3-3a → use Tables 6.4.1_2.4.3-1, 6.4.1_2.4.3-2, and 6.4.1_2.4.3-3, respectively.
- If the UE supports GSO and NGSO, skip steps 1 to 6 of the test procedure and start with step 7.

6.4.1_2.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 and subclause 5.6.2.1 with the following exceptions

Table 6.4.1_2.4.3-1: SIB19 for RF tests with NR NTN Ephemeris Information for NGSO (LEO-600) satellites (maximum positive Doppler)

Derivation Path: TS 38.508-1, Table 5.6.3.1-1			
Information Element	Value/remark	Comment	Condition
EphemerisInfo-r17 ::= CHOICE {			
positionVelocity-r17 SEQUENCE {			
positionX-r17	-2717617		
positionY-r17	4550419		
positionZ-r17	852799		
velocityVX-r17	6164		
velocityVY-r17	-19424		
velocityVZ-r17	124281		
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 10 degrees, one-way delay equal to 6.44 ms and Doppler equal to 22.65 ppm.			

Table 6.4.1_2.4.3-2: SIB19 for RF tests with NR NTN Ephemeris Information for NGSO (LEO-600) satellites (maximum negative Doppler)

Derivation Path: TS 38.508-1, Table 5.6.3.1-1			
Information Element	Value/remark	Comment	Condition
EphemerisInfo-r17 ::= CHOICE {			
positionVelocity-r17 SEQUENCE {			
positionX-r17	-2199272		
positionY-r17	3404229		
positionZ-r17	3535794		
velocityVX-r17	35394		
velocityVY-r17	-74414		
velocityVZ-r17	94682		
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 169.97 degrees, one-way delay equal to 6.60 ms and Doppler equal to -22.62 ppm.			

Table 6.4.1_2.4.3-3: SIB19 for RF tests with NR NTN Ephemeris Information for NGSO (LEO-600) satellites (maximum positive Doppler/2)

Derivation Path: TS 38.508-1, Table 5.6.3.1-1			
Information Element	Value/remark	Comment	Condition
EphemerisInfo-r17 ::= CHOICE {			
positionVelocity-r17 SEQUENCE {			
positionX-r17	-2592823		
positionY-r17	4245650		
positionZ-r17	2024520		
velocityVX-r17	19359		
velocityVY-r17	-43278		
velocityVZ-r17	116553		
}			
}			
NOTE 1: Satellite-UE elevation angle equal to 60.25 degrees, one-way delay equal to 2.30 ms and Doppler equal to 11.29 ppm.			

6.4.1_2.5 Test requirement

The frequency error Δf shall fulfil the test requirement:

$$|\Delta f| \leq (0.1 \text{ PPM} + [15 \text{ Hz}])$$

The above requirement shall be verified for at least two cases of which one has zero Doppler conditions.

6.4.2 Transmit modulation quality

Transmit modulation quality defines the modulation quality for expected in-channel RF transmissions from the UE. The transmit modulation quality is specified in terms of:

- Error Vector Magnitude (EVM) for the allocated resource blocks (RBs),
- EVM equalizer spectrum flatness derived from the equalizer coefficients generated by the EVM measurement process
- Carrier leakage
- In-band emissions for the non-allocated RB

All the parameters defined in subclause 6.4.2 are defined using the measurement methodology specified in Annex E in TS 38.521-1 [2].

In case the parameter 3300 or 3301 is reported from UE via *txDirectCurrentLocation* IE (as defined in TS 38.331 [8]), carrier leakage measurement requirement in subclause 6.4.2.2 and 6.4.2.3 shall be waived, and the RF correction with regard to the carrier leakage and IQ image shall be omitted during the calculation of transmit modulation quality.

6.4.2.1 Error Vector Magnitude

6.4.2.1.1 Test Purpose

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM.

The measured waveform is further equalised using the channel estimates subjected to the EVM equaliser spectrum flatness requirement specified in sub-clause 6.4.2.4.3. For DFT-s-OFDM waveforms, the EVM result is defined after the front-end FFT and IDFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %. For CP-OFDM waveforms, the EVM result is defined after the front-end FFT as the square root of the ratio of the mean error vector power to the mean reference power expressed as a %.

The basic EVM measurement interval in the time domain is one preamble sequence for the PRACH and the duration of PUCCH/PUSCH channel, or one hop, if frequency hopping is enabled for PUCCH and PUSCH in the time domain. The EVM measurement interval is reduced by any symbols that contains an allowable power transient as defined in subclause 6.3.3.3.

6.4.2.1.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.4.2.1.3 Minimum conformance requirements

The RMS average of the basic EVM measurements for 10 sub-frames excluding any transient period for the average EVM case, and 60 sub-frames excluding any transient period for the reference signal EVM case, for the different modulation schemes shall not exceed the values specified in Table 6.4.2.1.3-1 for the parameters defined in Table 6.4.2.1.3-2. For EVM evaluation purposes, all PRACH preamble formats 0-4 and all 5 PUCCH formats are considered to have the same EVM requirement as QPSK modulated.

Table 6.4.2.1.3-1: Requirements for Error Vector Magnitude

Parameter	Unit	Average EVM Level
Pi/2-BPSK	%	30
QPSK	%	17.5
16 QAM	%	12.5
64 QAM	%	8

Table 6.4.2.1.3-2: Parameters for Error Vector Magnitude

Parameter	Unit	Level
UE Output Power	dBm	≥ Table 6.3.1.3-1
Operating conditions		Normal conditions

The normative reference for this requirement is TS 38.101-1 [5] clause 6.4.2.1, as indicated in TS 38.101-5 [11] clause 6.4.2.

6.4.2.1.4 Test description

6.4.2.1.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4.2.1.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.2.1.4.1-1: Test Configuration Table for PUSCH

Initial Conditions			
Test Environment as specified in TS 38.508-1 [12] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1		Lowest, Highest	
Test SCS as specified in Table 5.3.5-1		All	
Test Parameters			
Test ID	Downlink Configuration	Uplink Configuration	
	N/A	Modulation (NOTE 3)	RB allocation (NOTE 1)
1 ³		DFT-s-OFDM PI/2 BPSK	Inner Full
2 ³		DFT-s-OFDM PI/2 BPSK	Outer Full
3		DFT-s-OFDM QPSK	Inner Full
4		DFT-s-OFDM QPSK	Outer Full
5		DFT-s-OFDM 16 QAM	Inner Full
6		DFT-s-OFDM 16 QAM	Outer Full
7		DFT-s-OFDM 64 QAM	Outer Full
8		CP-OFDM QPSK	Inner Full
9		CP-OFDM QPSK	Outer Full
10		CP-OFDM 16 QAM	Inner Full
11		CP-OFDM 16 QAM	Outer Full
12		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.			
NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.			

Table 6.4.2.1.4.1-2: Test Configuration Table for PUCCH

Initial Conditions					
Test Environment as specified in TS 38.508-1 [12] subclause 4.1			Normal		
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1			See Table 6.4.2.1.4.1-1		
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1			See Table 6.4.2.1.4.1-1		
Test SCS as specified in Table 5.3.5-1			See Table 6.4.2.1.4.1-1		
Test Parameters					
ID	Downlink Configuration		Uplink Configuration		
	Modulation	RB allocation	Waveform	PUCCH format	RB index
1	CP-OFDM QPSK	Full RB (Note 1)	CP-OFDM	PUCCH format = Format 1 Length in OFDM symbols = 14	0
2	CP-OFDM QPSK	Full RB (Note 1)	CP-OFDM	PUCCH format = Format 1 Length in OFDM symbols = 14	$N_{RB}-1$
3	CP-OFDM QPSK	Full RB (Note 1)	DFT-s-OFDM	PUCCH format = Format 3 (Note 3) Length in OFDM symbols = 14	0
4	CP-OFDM QPSK	Full RB (Note 1)	DFT-s-OFDM	PUCCH format = Format 3 (Note 3) Length in OFDM symbols = 14	$N_{RB}-1$
NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2.					
NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.					
NOTE 3: For FDD, set K1 value (PDSCH-to-HARQ-timing-indicator) as follows: K1 = 2 if mod(i,5) = 0 K1 = 2 if mod(i,5) = 1 K1 = 4 if mod(i,5) = 2 K1 = 3 if mod(i,5) = 3 K1 = 2 if mod(i,5) = 4 where i is slot index per frame					

Table 6.4.2.1.4.1-3: Test Configuration for PRACH

Initial Conditions	
Test Environment as specified in TS 38.508-1 [12] subclause 4.1	Normal
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1	See Table 6.4.2.1.4.1-1
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1	See Table 6.4.2.1.4.1-1
Test SCS as specified in Table 5.3.5-1	SCS defined in TS 38.211 [17] subclause 6.3.3.2 determined by PRACH Configuration Index
PRACH preamble format	
	FDD
PRACH Configuration Index	17
RS EPRE setting for test point 1 (dBm/15kHz)	-71
RS EPRE setting for test point 2 (dBm/15kHz)	-86

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.
4. The UL Reference Measurement channels are set according to Table 6.4.2.1.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.

7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.4.2.1.4.3.

6.4.2.1.4.2 Test procedure

Test procedure for PUSCH:

- 1.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.4.2.1.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
- 1.2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at P_{UMAX} level, allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.
- 1.3. Measure the EVM and \overline{EVM}_{DMRS} using Global In-Channel Tx-Test (Annex E).
- 1.4. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level P_{min} , where:
 - P_{min} is the minimum output power according to Table 6.3.1.3-1.
 - MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.
 - Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [5], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.
- 1.5. Measure the EVM and \overline{EVM}_{DMRS} using Global In-Channel Tx-Test (Annex E).

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4.2.1.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [12] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

Table 6.4.2.1.4.2-1: Void

Test procedure for PUCCH:

- 2.1. PUCCH is set according to Table 6.4.2.1.4.1-2.
- 2.2. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 6.4.2.1.4.1-2. The SS sends downlink MAC padding bits on the DL RMC. The transmission of PDSCH will make the UE send uplink ACK/NACK using PUCCH. There is no PUSCH transmission.
- 2.3. SS send appropriate TPC commands for PUCCH to the UE until the UE transmit PUCCH at P_{UMAX} level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.

2.4. Measure PUCCH EVM using Global In-Channel Tx-Test (Annex E).

2.5. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE PUCCH output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level P_{min} , where:

- P_{min} is the minimum output power according to Table 6.3.1.3-1.
- MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.
- Uplink power control window size = 1dB (UE power step size) + 2.0dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where the UE power step tolerance is specified in TS 38.101-1 [5], Table 6.3.4.3-1 and is 2.0dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.

2.6. Measure PUCCH EVM using Global In-Channel Tx-Test (Annex E).

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4.2.1.4.1-2, send an NR RRCReconfiguration message according to TS 38.508-1 [12] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

Test procedure for PRACH:

- 3.1. The SS shall set RS EPRE according to Table 6.4.2.1.4.1-3.
- 3.2. PRACH is set according to Table 6.4.2.1.4.1-3.
- 3.3. The SS shall signal a Random Access Preamble ID via a PDCCH order to the UE and initiate a Non-contention based Random Access procedure.
- 3.4. The UE shall send the signalled preamble to the SS.
- 3.5. In response to the preamble, the SS shall transmit a random access response not corresponding to the transmitted random access preamble, or send no response.
- 3.6. The UE shall consider the random access response reception not successful then re-transmit the preamble with the calculated PRACH transmission power.
- 3.7. Repeat step 5 and 6 until the SS collect enough PRACH preambles. Measure the EVM in PRACH channel using Global In-Channel Tx-Test (Annex E).

6.4.2.1.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exceptions:

Table 6.4.2.1.4.3-1: RACH-ConfigCommon: PRACH measurement

Derivation Path: TS 38.508-1 [12], Table 4.6.3-128			
Information Element	Value/remark	Comment	Condition
RACH-ConfigCommon ::= SEQUENCE {			
rach-ConfigGeneric	RACH-ConfigGeneric		
totalNumberOfRA-Preambles	Not present		
ssb-perRACH-OccasionAndCB-PreamblesPerSSB CHOICE {			
one	n8		FR1
}			
groupBconfigured	Not present		
ra-ContentionResolutionTimer	sf64		
rsrp-ThresholdSSB	RSRP-Range		
rsrp-ThresholdSSB-SUL	Not present		
	RSRP-Range		SUL
prach-RootSequenceIndex CHOICE {			
l139	Set according to table 4.4.2-2 for the NR Cell.		PRACH Format A3
l839	0	NR Cell 1	PRACH Format 0
	TBD	Other than NR Cell 1	PRACH Format 0
}			
msg1-SubcarrierSpacing	SubcarrierSpacing		
restrictedSetConfig	unrestrictedSet		
msg3-transformPrecoder	Not present	transform precoding is disabled for Msg3 PUSCH transmission and any PUSCH transmission scheduled with DCI format 0_0	
}			

Table 6.4.2.1.4.3-2: RACH-ConfigGeneric: PRACH measurement

Derivation Path: TS 38.508-1 [12], Table 4.6.3-130			
Information Element	Value/remark	Comment	Condition
RACH-ConfigGeneric ::= SEQUENCE {			
prach-ConfigurationIndex	17	Paired Spectrum	PRACH Format 0
	7	Unpaired Spectrum	PRACH Format 0
msg1-FDM	four		FR1
msg1-FrequencyStart	0		
zeroCorrelationZoneConfig	15		
preambleReceivedTargetPower	-92		Test point 1
	-74		Test point 2
preambleTransMax	n7		
powerRampingStep	dB0		
ra-ResponseWindow	sl20		
}			

Table 6.4.2.1.4.3-3: PUSCH-TimeDomainResourceAllocationList: PRACH measurement

Derivation Path: TS 38.508-1 [12], Table 4.6.3-122			
Information Element	Value/remark	Comment	Condition
PUSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF PUSCH-TimeDomainResourceAllocation {	2 entries		
PUSCH-TimeDomainResourceAllocation[2] SEQUENCE {		entry 2 addressed by Msg3 PUSCH time resource allocation field of the Random Access Response acc. to TS 38.213 [7] Table 8.2-1.	
k2	6	K2+ $\Delta=8$ acc. to TS 38.214 [16] Table 6.1.2.1.1-5	Unpaired Spectrum for SCS15kHz and PRACH Format 0
}			
}			

Table 6.4.2.1.4.3-4: PDSCH-ServingCellConfig: PUCCH format3 measurement

Derivation Path: TS 38.508-1 [12], Table 4.6.3-102			
Information Element	Value/remark	Comment	Condition
PDSCH-ServingCellConfig ::= SEQUENCE {			
codeBlockGroupTransmission	Not present		
xOverhead	Not present		
nrofHARQ-ProcessesForPDSCH	n6		FDD
pucch-Cell	Not present		
maxMIMO-Layers	Not present		
processingType2Enabled	Not present		
pdsch-CodeBlockGroupTransmissionList-r16	Not present		
}			

6.4.2.1.5 Test requirement

The PUSCH EVM, derived in Annex E.4.2, shall not exceed the values in Table 6.4.2.1.5-1.

The PUSCH \overline{EVM}_{DMRS} , derived in Annex E.4.6.2, shall not exceed the values in Table 6.4.2.1.5-1 when embedded with data symbols of the respective modulation scheme.

Table 6.4.2.1.5-1: Test requirements for Error Vector Magnitude

Parameter	Unit	Average EVM Level
Pi/2-BPSK	%	30 + TT
QPSK	%	17.5 + TT
16 QAM	%	12.5 + TT
64 QAM	%	8 + TT
Note 1: TT is defined in Table 6.4.2.1.5-2.		

Table 6.4.2.1.5-2: Test Tolerance

Parameter	Unit	Average EVM Level
Pi/2-BPSK	%	0
QPSK	%	0
16 QAM	%	0
64 QAM	%	0

The PUCCH EVM derived in Annex E.5.9.2 shall not exceed 17.5%.

The PRACH EVM derived in Annex E.6.9.2 shall not exceed 17.5%.

6.4.2.1a Error Vector Magnitude including symbols with transient period

6.4.2.1a.1 Test Purpose

The Error Vector Magnitude is a measure of the difference between the reference waveform and the measured waveform. This difference is called the error vector. Before calculating the EVM the measured waveform is corrected by the sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM.

6.4.2.1a.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation and support short transient period capability.

6.4.2.1a.3 Minimum conformance requirements

In 6.4.2.1, EVM has been defined by excluding the symbols which have a transient period. In this section, measurement interval is defined for the symbols with a transient period to include these symbols in the RMS average EVM computation when the UE reports a transient period capability other than the default. Before calculating the EVM, the measured waveform is corrected for sample timing offset and RF frequency offset. Then the carrier leakage shall be removed from the measured waveform before calculating the EVM. The symbols with transient period should not be used for equalization. Only CP-OFDM waveform is used for conformance testing.

In the case of PUSCH or PUCCH transmissions when the mean power, modulation or RB allocation across slot or subslot boundaries is expected to change the EVM result over the symbols where the transient occurs is calculated according to Table 6.4.2.1a.3-1.

Table 6.4.2.1a.3-1: EVM definition for reported transient period

Reported transient capability (us)	EVM definition	tp_{start} (μs)	SCS ⁴
2	$EVM_{after} = \max(\overline{EVM_{l,tp}}, \overline{EVM_h})$ $EVM_{before} = \max(\overline{EVM_l}, \overline{EVM_{h,tp}})$	-0.5	15kHz or 30kHz ⁵
4	$EVM_{after} = \max(\overline{EVM_{l,tp}}, \overline{EVM_h})$ $EVM_{before} = \max(\overline{EVM_l}, \overline{EVM_{h,tp}})$	-1	15kHz
7	$EVM_{after} = \min(\overline{EVM_{l,tp}}, \overline{EVM_h})$ $EVM_{before} = \max(\overline{EVM_l}, \overline{EVM_{h,tp}})$	-2.7	15kHz
NOTE 1: $\overline{EVM_l}$, $\overline{EVM_h}$, $\overline{EVM_{l,tp}}$, and $\overline{EVM_{h,tp}}$ are defined in Annex E.4.7 NOTE 2: EVM_{after} is the EVM for a symbol right after a transition; EVM_{before} is the EVM for a symbol right before a transition NOTE 3: tp_{start} denotes the start position of the EVM exclusion window as shown in Annex E.4.7 NOTE 4: SCS denotes the SCS that can be used in the conformance test NOTE 5: 30kHz shall be used in the conformance test unless the UE signals in <i>supportedSubCarrierSpacingUL</i> in <i>FeatureSetPerCC</i> that it only supports 15kHz in the corresponding band			

The RMS average of the basic EVM measurements over 108 subframes calculated only on the symbols where the transient occurs for the different modulation schemes shall not exceed the values specified in Table 6.4.2.1a.3-2 for the parameters defined in Table 6.4.2.1a.3-3. This requirement can be verified with 64 QAM modulation.

Table 6.4.2.1a.3-2: Requirements for Error Vector Magnitude

Parameter	Unit	Average EVM Level
64 QAM	%	10

Table 6.4.2.1a.3-3: Parameters for Error Vector Magnitude

Parameter	Unit	Level
UE Output Power	dBm	≥ Table 6.3.1-1
Operating conditions		Normal conditions

The normative reference for this requirement is TS 38.101-1 [5] clause 6.4.2.1a, as indicated in TS 38.101-5 [11] clause 6.4.2.

6.4.2.1a.4 Test description

6.4.2.1a.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4.2.1a.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.2.1a.4.1-1: Test Configuration Table for PUSCH

Initial Conditions			
Test Environment as specified in TS 38.508-1 [12] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1		Lowest, Highest	
Test SCS as specified in Table 5.3.5-1		15 kHz (Note 3)	
Test Parameters			
Test ID	Downlink Configuration	Uplink Configuration	
	N/A	Modulation	RB allocation (NOTE 1)
1		CP-OFDM 64 QAM	24@0 ⁴ and 1@0 ⁵
NOTE 1: This RB allocation is used for all UL slots when UL power is fixed within the UL power control window. Refer to Table 6.4.2.1a.4.2-1 for the UL RB allocation to be used during the EVM measurement.			
NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.			
NOTE 3: For UE supporting 2 us transient period, 30kHz shall be used in the conformance test unless the UE signals in <i>supportedSubCarrierSpacingUL</i> in <i>FeatureSetPerCC</i> that it only supports 15kHz in the corresponding band.			
NOTE 4: Applicable to slots 3 and 9 for SCS 15 kHz, and slots 8 and 19 for SCS 30 kHz.			
NOTE 5: Applicable to slots 4 and 8 for SCS 15 kHz, and slots 9 and 18 for SCS 30 kHz.			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.
4. The UL Reference Measurement channels are set according to Table 6.4.2.1a.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.4.2.1a.4.3.

6.4.2.1a.4.2

Test procedure

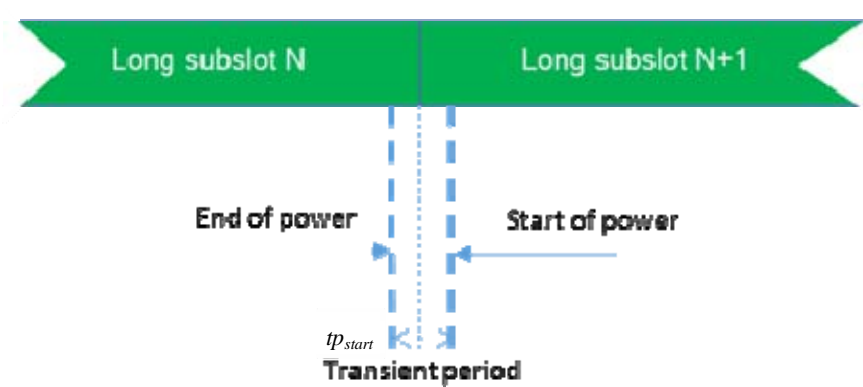


Figure 6.4.2.1a.4.2-1: Error Vector Magnitude including symbols with transient period

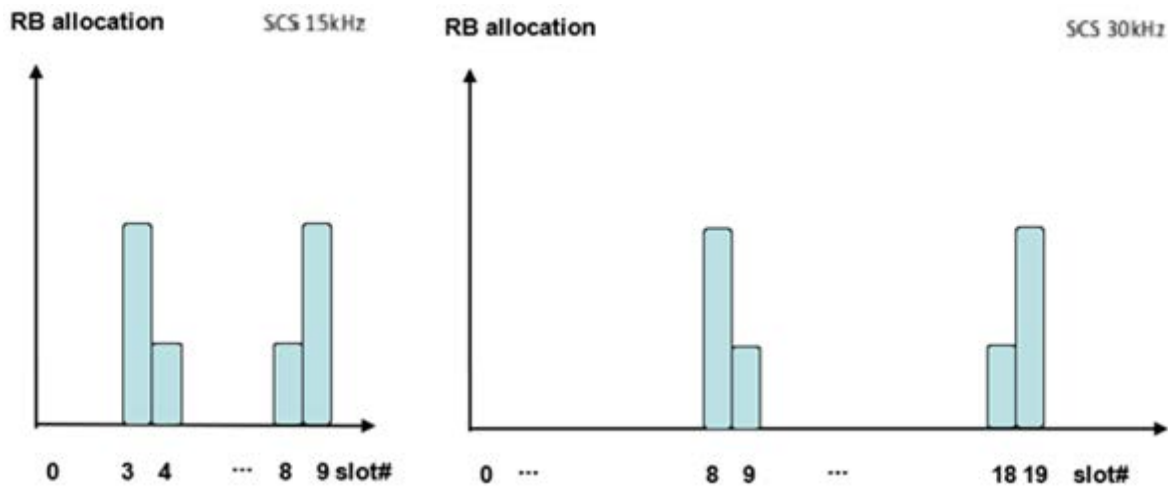


Figure 6.4.2.1a.4.2-2: Test power patterns for Error Vector Magnitude including symbols with transient period

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.4.2.1a.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC. The UL assignment is such that the UE transmits on slots 3, 4, and 8, 9 for 15 kHz SCS, on slots 8, 9, and 18, 19 for 30 kHz SCS.
2. Set Uplink RB allocation as 24@0 as defined in Table 6.4.2.1a.4.1-1. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as $-\text{MU}$ to $-(\text{MU} + \text{Uplink power control window size})$ dB of the target power level +11.5 dBm, where:
 - MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.
 - Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.
3. Schedule the UE's PUSCH data transmission as described in Figure 6.4.2.1a.4.2-2 and Uplink RB allocation pattern as defined in Table 6.4.2.1a.4.1-1 while transmitting 0 dB TPC command for PUSCH via the PDCCH.
4. Measure the EVM_{before} and EVM_{after} using Global In-Channel Tx-Test (Annex E) applying tp_{start} of Table 6.4.2.1a.3-1 according to the declared enhanced transient capability.
5. Repeat test steps 3~4 with UL RMC according to Table 6.4.2.1a.4.1-1 until the SS collect enough EVM_{before} and EVM_{after} .

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no greater than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.3.

6.4.2.1a.4.3 Message contents

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

6.4.2.1a.5 Test requirement

The EVM_{before} and EVM_{after} derived in Table 6.4.2.1a.3-1 shall not exceed the values in Table 6.4.2.1a.5-1. Both rising and falling edges of transient occurring at the respective slot boundaries are considered to have the same EVM requirements.

Table 6.4.2.1a.5-1: Test requirements for Error Vector Magnitude

Parameter	Unit	Average EVM Level
64 QAM	%	10 + TT
Note 1: TT is defined in Table 6.4.2.1a.5-2.		

Table 6.4.2.1a.5-2: Test Tolerance

Parameter	Unit	Average EVM Level
64 QAM	%	0

6.4.2.2 Carrier leakage

6.4.2.2.1 Test purpose

Carrier leakage expresses itself as unmodulated sine wave with the carrier frequency or centre frequency of aggregated transmission bandwidth configuration. It is an interference of approximately constant amplitude and independent of the amplitude of the wanted signal.

The purpose of this test is to exercise the UE transmitter to verify its modulation quality in terms of carrier leakage.

6.4.2.2.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.4.2.2.3 Minimum conformance requirements

Carrier leakage is an additive sinusoid waveform whose frequency is the same as the modulated waveform carrier frequency. The measurement interval is one slot in the time domain.

In the case that uplink sharing, the carrier leakage may have 7.5 kHz shift with the carrier frequency.

The relative carrier leakage power is a power ratio of the additive sinusoid waveform and the modulated waveform. The relative carrier leakage power shall not exceed the values specified in Table 6.4.2.2.3-1.

Table 6.4.2.2.3-1: Requirements for Carrier Leakage

Parameter	Relative Limit (dBc)
Output power > 10 dBm	-28
0 dBm ≤ Output power ≤ 10 dBm	-25
-30 dBm ≤ Output power < 0 dBm	-20
-40 dBm ≤ Output power < -30 dBm	-10

The normative reference for this requirement is TS 38.101-1 [5] clause 6.4.2.2, as indicated in TS 38.101-5 [11] clause 6.4.2.

6.4.2.2.4 Test description

6.4.2.2.4.1 Initial condition

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4.2.2.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.2.2.4.1-1: Test Configuration

Initial Conditions			
Test Environment as specified in TS 38.508-1 [12] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1		Mid	
Test SCS as specified in Table 5.3.5-1		Lowest	
Test Parameters			
Test ID	Downlink Configuration	Uplink Configuration	
	N/A	Modulation	RB allocation (NOTE 1, 3)
1		DFT-s-OFDM QPSK	Inner_1RB_Left
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.			
NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.			
NOTE 3: When the reported DC carrier position is at Inner_1RB_Left, use Inner_1RB_Right for UL RB allocation.			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2 and uplink signals according to Annex G.0, G.1, G.2, G.3.0.
4. The UL Reference Measurement channels are set according to Table 6.4.2.2.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.4.2.2.4.3.
10. In case the parameter 3300 or 3301 is reported from the UE via *txDirectCurrentLocation* IE, do not proceed to test procedure and mark the test not applicable with reasoning in the test report.

6.4.2.2.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for `C_RNTI` to schedule the UL RMC according to Table 6.4.2.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 10 dBm, where:
 - MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.
 - Uplink power control window size = 1dB (UE power step size) + 0.7 dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [5], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.
3. Measure carrier leakage using Global In-Channel Tx-Test (Annex E).
4. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 0 dBm, where MU and Uplink power control window size are defined above.
5. Measure carrier leakage using Global In-Channel Tx-Test (Annex E).
6. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level -30 dBm, where MU and Uplink power control window size are defined above.
7. Measure carrier leakage using Global In-Channel Tx-Test (Annex E).
8. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink

power control window size) dB of the target power level P_{min} , where MU and Uplink power control window size are defined above, P_{min} is the minimum output power according to Table 6.3.1.3-1.

9. Measure carrier leakage using Global In-Channel Tx-Test (Annex E).

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

6.4.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exception:

Table 6.4.2.2.4.3-1: *PUSCH-Config*

Derivation Path: TS 38.508-1 [12], Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED
--

Table 6.4.2.2.4.3-2: *CellGroupConfig*

Derivation Path: TS 38.508-1 [12], Table 4.6.3-19			
Information Element	Value/remark	Comment	Condition
CellGroupConfig ::= SEQUENCE {			
reportUplinkTxDirectCurrent	true		
}			

6.4.2.2.5 Test requirement

In case the parameter 3300 or 3301 is reported from UE via *txDirectCurrentLocation* IE, carrier leakage measurement requirement shall be waived. Otherwise, each of the n carrier leakage results, derived in Annex E.3.1, shall not exceed the values in table 6.4.2.2.5-1. Allocated RBs are not under test.

Table 6.4.2.2.5-1: Test requirements for Relative Carrier Leakage Power

Parameters UE output power	Relative limit (dBc)
10 + MU to 10 + (MU + Uplink power control window size) dBm	-28 + TT
0 + MU to 0 + (MU + Uplink power control window size) dBm	-25 + TT
-30 + MU to -30 + (MU + Uplink power control window size) dBm	-20 + TT
Pmin + MU to Pmin + (MU + Uplink power control window size) dBm	-10 + TT
<p>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.</p> <p>NOTE 2: The applicable frequencies for this limit depend on the parameter <i>txDirectCurrentLocation</i> in <i>UplinkTxDirectCurrent</i> IE, and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.</p> <p>NOTE 3: N_{RB} is the Transmission Bandwidth Configuration (see Section 5.3).</p> <p>NOTE 4: MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.</p> <p>NOTE 5: Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [5], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.</p> <p>NOTE 6: Test tolerance TT = 0.8 dB.</p> <p>NOTE 7: Pmin is the minimum output power according to Table 6.3.1.3-1.</p>	

6.4.2.3 In-band emissions

6.4.2.3.1 Test purpose

The in-band emissions are a measure of the interference falling into the non-allocated resources blocks.

The in-band emission is defined as the average emission across 12 sub-carriers and as a function of the RB offset from the edge of the allocated UL transmission bandwidth. The in-band emission is measured as the ratio of the UE output power in a non-allocated RB to the UE output power in an allocated RB.

The basic in-band emissions measurement interval is defined over one slot in the time domain; however, the minimum requirement applies when the in-band emission measurement is averaged over 10 sub-frames. When the PUSCH or PUCCH transmission slot is shortened due to multiplexing with SRS, the in-band emissions measurement interval is reduced by one or more symbols, accordingly.

The purpose of this test is to exercise the UE transmitter to verify its modulation quality in terms of in-band emissions.

6.4.2.3.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.4.2.3.3 Minimum conformance requirements

The average of the basic in-band emission measurement over 10 sub-frames shall not exceed the values specified in Table 6.4.2.3.3-1.

Table 6.4.2.3.3-1: Requirements for in-band emissions

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General	dB	$\max \left\{ -25 - 10 \cdot \log_{10} (N_{RB} / L_{CRB}), \right.$ $20 \cdot \log_{10} EVM - 3 - 5 \cdot (\Delta_{RB} - 1) / L_{CRB},$ $\left. -57 \text{ dBm} + 10 \log_{10} (SCS / 15 \text{ kHz}) - \overline{P_{RB}} \right\}$		Any non-allocated (NOTE 2)
IQ Image	dB	-28	Image frequencies when output power > 10 dBm	Image frequencies (NOTES 2, 3)
		-25	Image frequencies when output power ≤ 10 dBm	
Carrier leakage	dBc	-28	Output power > 10 dBm	Carrier leakage frequency (NOTES 4, 5)
		-25	0 dBm ≤ Output power ≤ 10 dBm	
		-20	-30 dBm ≤ Output power < 0 dBm	
		-10	-40 dBm ≤ Output power < -30 dBm	
NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of $P_{RB} - 30$ dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} is defined in NOTE 10.				
NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs.				
NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.				
NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.				
NOTE 5: The applicable frequencies for this limit depend on the parameter <i>txDirectCurrentLocation</i> in <i>UplinkTxDirectCurrent</i> IE, and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency but excluding any allocated RB.				
NOTE 6: L_{CRB} is the Transmission Bandwidth (see Section 5.3).				
NOTE 7: N_{RB} is the Transmission Bandwidth Configuration (see Section 5.3).				
NOTE 8: EVM is the limit specified in Table 6.4.2.1.3-1 for the modulation format used in the allocated RBs.				
NOTE 9: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB} = 1$ or $\Delta_{RB} = -1$ for the first adjacent RB outside of the allocated bandwidth).				
NOTE 10: $\overline{P_{RB}}$ is an average of the transmitted power over 10 sub-frames normalized by the number of allocated RBs, measured in dBm.				

The normative reference for this requirement is TS 38.101-1 [5] clause 6.4.2.3, as indicated in TS 38.101-5 [11] clause 6.4.2.

6.4.2.3.4 Test description

6.4.2.3.4.1 Initial condition

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4.2.3.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.2.3.4.1-1: Test Configuration Table for PUSCH

Initial Conditions			
Test Environment as specified in TS 38.508-1 [12] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Low range, Mid range, High range (NOTE 3)	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1		Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1		Lowest	
Test Parameters			
Test ID	Downlink Configuration	Uplink Configuration	
	N/A	Modulation	RB allocation (NOTE 1)
1		DFT-s-OFDM QPSK	Inner_1RB_Left
2		DFT-s-OFDM QPSK	Inner_1RB_Right
3		CP-OFDM QPSK	Inner_1RB_Left
4		CP-OFDM QPSK	Inner_1RB_Right
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.			
NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.			
NOTE 3: For NR band n28, 30MHz test channel bandwidth is tested with Low range and High range test frequencies.			

Table 6.4.2.3.4.1-2: Test Configuration Table for PUCCH

Initial Conditions					
Test Environment as specified in TS 38.508-1 [12] subclause 4.1			See Table 6.4.2.3.4.1-1		
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1			See Table 6.4.2.3.4.1-1		
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1			See Table 6.4.2.3.4.1-1		
Test SCS as specified in Table 5.3.5-1			See Table 6.4.2.3.4.1-1		
Test Parameters					
ID	Downlink Configuration		Uplink Configuration		
	Modulation	RB allocation	Waveform	PUCCH format	RB index
1	CP-OFDM QPSK	Full RB (Note 1)	DFT-s-OFDM	PUCCH format = Format 3 (Note 4) Length in OFDM symbols = 14	0
2	CP-OFDM QPSK	Full RB (Note 1)	DFT-s-OFDM	PUCCH format = Format 3 (Note 4) Length in OFDM symbols = 14	$N_{RB}-1$
3	CP-OFDM QPSK	Full RB (Note 1)	CP-OFDM	PUCCH format = Format 1 Length in OFDM symbols = 14	0
4	CP-OFDM QPSK	Full RB (Note 1)	CP-OFDM	PUCCH format = Format 1 Length in OFDM symbols = 14	$N_{RB}-1$
NOTE 1: Full RB allocation shall be used per each SCS and channel BW as specified in Table 7.3.2.4.1-2.					
NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.					
NOTE 3: DFT-s-OFDM PI/2 BPSK test applies only for UEs which supports half Pi BPSK in FR1.					
NOTE 4: For FDD, set K1 value (PDSCH-to-HARQ-timing-indicator) as follows: K1 = 2 if mod(i,5) = 0 K1 = 2 if mod(i,5) = 1 K1 = 4 if mod(i,5) = 2 K1 = 3 if mod(i,5) = 3 K1 = 2 if mod(i,5) = 4 where i is slot index per frame					

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.

3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.
4. The UL Reference Measurement channels are set according to Table 6.4.2.3.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity *NR*, Connected UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.4.2.3.4.3

6.4.2.3.4.2 Test procedure

Test procedure for PUSCH:

- 1.1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.4.2.3.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
- 1.2. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 10 dBm, where:
 - MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency *f* and the channel bandwidth BW.
 - Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [5], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.
- 1.3. Measure In-band emission using Global In-Channel Tx-Test (Annex E).
- 1.4. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 0 dBm, where MU and Uplink power control window size are defined above.
- 1.5. Measure In-band emission using Global In-Channel Tx-Test (Annex E).
- 1.6. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level -30 dBm, where MU and Uplink power control window size are defined above.
- 1.7. Measure In-band emission using Global In-Channel Tx-Test (Annex E).
- 1.8. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level *P_{min}*, where MU and Uplink power control window size are defined above and *P_{min}* is the minimum output power according to Table 6.3.1.3-1.
- 1.9. Measure In-band emission using Global In-Channel Tx-Test (Annex E).

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4.2.3.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [12] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

Test procedure for PUCCH:

- 2.1. PUCCH is set according to Table 6.4.2.3.4.1-2. SS transmits PDSCH via PDCCH DCI format 1-1 for C_RNTI to transmit the DL RMC according to Table 6.4.2.3.4.1-2. The SS sends downlink MAC padding bits on the DL RMC. The transmission of PDSCH will make the UE send uplink ACK/NACK using PUCCH.
- 2.2. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 10 dBm, where:
 - MU is the test system uplink power measurement uncertainty and is specified in Table F.1.2-1 for the carrier frequency f and the channel bandwidth BW.
 - Uplink power control window size = 1dB (UE power step size) + 2.0 dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [5], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.
- 2.3. Measure In-band emission using Global In-Channel Tx-Test (Annex E)
- 2.4. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level 0 dBm, where MU and Uplink power control window size are defined above.
- 2.5. Measure In-band emission using Global In-Channel Tx-Test (Annex E)
- 2.6. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level -30 dBm, where MU and Uplink power control window size are defined above.
- 2.7. Measure In-band emission using Global In-Channel Tx-Test (Annex E)
- 2.8. Send uplink power control commands for PUCCH to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as +MU to +(MU + Uplink power control window size) dB of the target power level P_{min} , where MU and Uplink power control window size are defined above and P_{min} is the minimum output power according to Table 6.3.1.3-1.
- 2.9. Measure In-band emission using Global In-Channel Tx-Test (Annex E)

NOTE1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.4.2.3.4.1-2, send an NR RRCReconfiguration message according to TS 38.508-1 [12] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

NOTE2: The purpose of the Uplink power control window is to ensure that the actual UE output power is no less than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.2.

6.4.2.3.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exceptions:

Table 6.4.2.3.4.3-1: PDSCH-ServingCellConfig: PUCCH format3 measurement

Derivation Path: TS 38.508-1 [12], Table 4.6.3-102			
Information Element	Value/remark	Comment	Condition
PDSCH-ServingCellConfig ::= SEQUENCE {			
codeBlockGroupTransmission	Not present		
xOverhead	Not present		
nrofHARQ-ProcessesForPDSCH	n6		FDD
pucch-Cell	Not present		
maxMIMO-Layers	Not present		
processingType2Enabled	Not present		
pdsch-CodeBlockGroupTransmissionList-r16	Not present		
}			

6.4.2.3.5 Test requirement

The averaged In-band emission result, derived in Annex E.4.3 shall not exceed the corresponding values in Tables 6.4.2.3.5-1.

Table 6.4.2.3.5-1: Test requirements for in-band emissions

Parameter description	Unit	Limit (NOTE 1)		Applicable Frequencies
General (NOTE 12)	dB	$\max \left\{ -25 - 10 \cdot \log_{10} (N_{RB} / L_{CRB}), \right.$ $20 \cdot \log_{10} EVM - 3 - 5 \cdot (\Delta_{RB} - 1) / L_{CRB},$ $\left. -57 \text{ dBm} + 10 \log_{10} (SCS / 15 \text{ kHz}) - \overline{P_{RB}} \right\} + TT$		Any non-allocated (NOTE 2)
IQ Image (NOTE 12)	dB	-28 + TT	Image frequencies when output power > 10 dBm	Image frequencies (NOTES 2, 3)
		-25 + TT	Image frequencies when output power ≤ 10 dBm	
Carrier leakage (NOTE 12)	dBc	-28 + TT	Output power > 10 dBm	Carrier leakage frequency (NOTES 4, 5)
		-25 + TT	0 dBm ≤ Output power ≤ 10 dBm	
		-20 + TT	-30 dBm ≤ Output power < 0 dBm	
		-10 + TT	-40 dBm ≤ Output power < -30 dBm	
NOTE 1: An in-band emissions combined limit is evaluated in each non-allocated RB. For each such RB, the minimum requirement is calculated as the higher of $P_{RB} - 30$ dB and the power sum of all limit values (General, IQ Image or Carrier leakage) that apply. P_{RB} is defined in NOTE 10.				
NOTE 2: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured average power per allocated RB, where the averaging is done across all allocated RBs.				
NOTE 3: The applicable frequencies for this limit are those that are enclosed in the reflection of the allocated bandwidth, based on symmetry with respect to the carrier leakage frequency, but excluding any allocated RBs.				
NOTE 4: The measurement bandwidth is 1 RB and the limit is expressed as a ratio of measured power in one non-allocated RB to the measured total power in all allocated RBs.				
NOTE 5: The applicable frequencies for this limit depend on the parameter <i>txDirectCurrentLocation</i> in <i>UplinkTxDirectCurrent</i> IE, and are those that are enclosed either in the RBs containing the carrier leakage frequency, or in the two RBs immediately adjacent to the carrier leakage frequency, but excluding any allocated RB.				
NOTE 6: L_{CRB} is the Transmission Bandwidth (see Section 5.3).				
NOTE 7: N_{RB} is the Transmission Bandwidth Configuration (see Section 5.3).				
NOTE 8: EVM is the limit specified in Table 6.4.2.1.3-1 for the modulation format used in the allocated RBs.				
NOTE 9: Δ_{RB} is the starting frequency offset between the allocated RB and the measured non-allocated RB (e.g. $\Delta_{RB} = 1$ or $\Delta_{RB} = -1$ for the first adjacent RB outside of the allocated bandwidth).				
NOTE 10: $\overline{P_{RB}}$ is an average of the transmitted power over 10 sub-frames normalized by the number of allocated RBs, measured in dBm.				
NOTE 11: Test tolerance TT = 0.8 dB.				
NOTE 12: In case the parameter 3300 or 3301 is reported from UE via <i>txDirectCurrentLocation</i> IE, IQ Image and Carrier leakage limit do not apply and General limit applies for all non-allocated frequencies.				

6.4.2.4 EVM equalizer spectrum flatness

6.4.2.4.1 Test purpose

The zero-forcing equalizer correction applied in the EVM measurement process (as described in Annex E) must meet a spectral flatness requirement for the EVM measurement to be valid. The EVM equalizer spectrum flatness is defined in terms of the maximum peak-to-peak ripple of the equalizer coefficients (dB) across the allocated uplink block, at which the equalizer coefficients are generated by the EVM measurement process. The basic measurement interval is the same as for EVM.

The EVM equalizer spectrum flatness requirement does not limit the correction applied to the signal in the EVM measurement process but for the EVM result to be valid, the equalizer correction that was applied must meet the EVM equalizer spectrum flatness minimum requirements.

6.4.2.4.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.4.2.4.3 Minimum conformance requirements

The peak-to-peak variation of the EVM equalizer coefficients contained within the frequency range of the uplink allocation shall not exceed the maximum ripple specified in Table 6.4.2.4.3-1 for normal conditions. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 5 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 7 dB (see Figure 6.4.2.4.3-1).

The EVM equalizer spectral flatness shall not exceed the values specified in Table 6.4.2.4.3-2 for extreme conditions. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 10 dB (see Figure 6.4.2.4.3-1).

Table 6.4.2.4.3-1: Requirements for EVM equalizer spectrum flatness (normal conditions)

Frequency range	Maximum ripple (dB)
$F_{UL_Meas} - F_{UL_Low} \geq 3 \text{ MHz}$ and $F_{UL_High} - F_{UL_Meas} \geq 3 \text{ MHz}$ (Range 1)	4 (p-p)
$F_{UL_Meas} - F_{UL_Low} < 3 \text{ MHz}$ or $F_{UL_High} - F_{UL_Meas} < 3 \text{ MHz}$ (Range 2)	8 (p-p)
NOTE 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated	
NOTE 2: F_{UL_Low} and F_{UL_High} refer to each E-UTRA frequency band specified in Table 5.5-1	

Table 6.4.2.4.3-2: Minimum requirements for EVM equalizer spectrum flatness (extreme conditions)

Frequency range	Maximum Ripple (dB)
$F_{UL_Meas} - F_{UL_Low} \geq 5 \text{ MHz}$ and $F_{UL_High} - F_{UL_Meas} \geq 5 \text{ MHz}$ (Range 1)	4 (p-p)
$F_{UL_Meas} - F_{UL_Low} < 5 \text{ MHz}$ or $F_{UL_High} - F_{UL_Meas} < 5 \text{ MHz}$ (Range 2)	12 (p-p)
NOTE 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated	
NOTE 2: F_{UL_Low} and F_{UL_High} refer to each E-UTRA frequency band specified in Table 5.5-1	

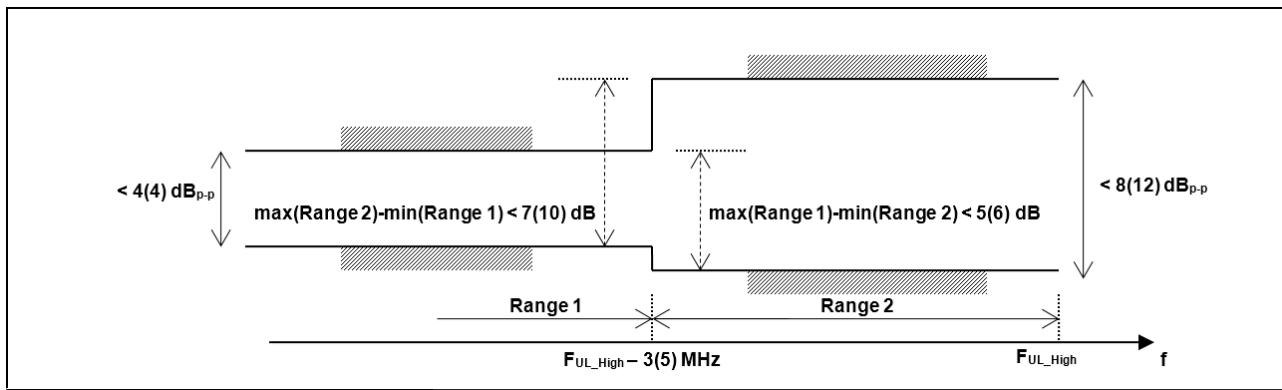


Figure 6.4.2.4.3-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated (the ETC minimum requirement are within brackets)

The normative reference for this requirement is TS 38.101-1 [5] clause 6.4.2.4, as indicated in TS 38.101-5 [11] clause 6.4.2.

6.4.2.4.4 Test description

6.4.2.4.4.1 Initial condition

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.4.2.4.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.4.2.4.4.1-1: Test Configuration

Initial Conditions			
Test Environment as specified in TS 38.508-1 [12] subclause 4.1		Normal, TL/VL, TL/VH, TH/VL, TH/VH	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Low range, Mid range, High range (NOTE 3)	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1		Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1		Lowest	
Test Parameters			
Test ID	Downlink Configuration	Uplink Configuration	
	N/A	Modulation	RB allocation (NOTE 1)
1		DFT-s-OFDM QPSK	Outer Full
2		CP-OFDM QPSK	Outer Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.			
NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, in Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.
4. The UL Reference Measurement channels are set according to Table 6.4.2.4.4.1-1.

5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.4.2.4.4.3.

6.4.2.4.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.4.2.4.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at P_{UMAX} level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.
3. Measure spectrum flatness using Global In-Channel Tx-Test (Annex E).

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 [12] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

6.4.2.4.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6.

6.4.2.4.5 Test requirement

Each of the n spectrum flatness functions, shall derive four ripple results in Annex E.4.4.1. The derived results shall not exceed the values in Figure 6.4.2.4.5-1:

For normal conditions, the maximum ripple in Range 1 and Range 2 shall not exceed the values specified in Table 6.4.2.4.5-1 and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 8.4 dB (see Figure 6.4.2.4.5-1).

For normal conditions, the peak-to-peak variation of the EVM equalizer coefficients contained within the frequency range of the uplink allocation shall not exceed the maximum ripple specified in Table 6.4.2.4.5-1. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 6.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 8.4 dB (see Figure 6.4.2.4.5-1).

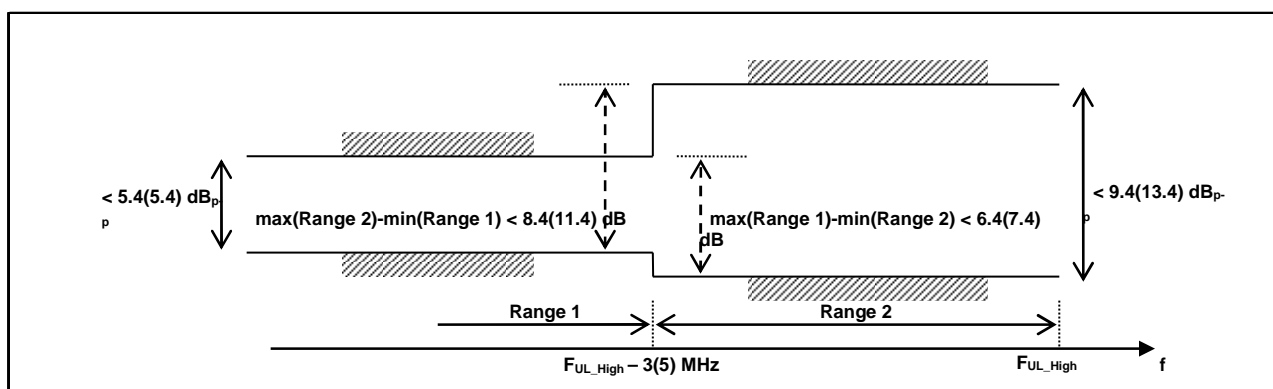
For extreme conditions, the EVM equalizer spectral flatness shall not exceed the values specified in Table 6.4.2.4.5-2. For uplink allocations contained within both Range 1 and Range 2, the coefficients evaluated within each of these frequency ranges shall meet the corresponding ripple requirement and the following additional requirement: the relative difference between the maximum coefficient in Range 1 and the minimum coefficient in Range 2 must not be larger than 7.4 dB, and the relative difference between the maximum coefficient in Range 2 and the minimum coefficient in Range 1 must not be larger than 11.4 dB (see Figure 6.4.2.4.5-1).

Table 6.4.2.4.5-1: Requirements for EVM equalizer spectrum flatness (normal conditions)

Frequency range	Maximum ripple [dB]
$F_{UL_Meas} - F_{UL_Low} \geq 3 \text{ MHz}$ and $F_{UL_High} - F_{UL_Meas} \geq 3 \text{ MHz}$ (Range 1)	$4 + TT$ (p-p)
$F_{UL_Meas} - F_{UL_Low} < 3 \text{ MHz}$ or $F_{UL_High} - F_{UL_Meas} < 3 \text{ MHz}$ (Range 2)	$8 + TT$ (p-p)
NOTE 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated	
NOTE 2: F_{UL_Low} and F_{UL_High} refer to each E-UTRA frequency band specified in Table 5.5-1	
NOTE 3: Test tolerance $TT = 1.4 \text{ dB}$.	

Table 6.4.2.4.5-2: Minimum requirements for EVM equalizer spectrum flatness (extreme conditions)

Frequency range	Maximum Ripple [dB]
$F_{UL_Meas} - F_{UL_Low} \geq 5 \text{ MHz}$ and $F_{UL_High} - F_{UL_Meas} \geq 5 \text{ MHz}$ (Range 1)	$4 + TT$ (p-p)
$F_{UL_Meas} - F_{UL_Low} < 5 \text{ MHz}$ or $F_{UL_High} - F_{UL_Meas} < 5 \text{ MHz}$ (Range 2)	$12 + TT$ (p-p)
NOTE 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated	
NOTE 2: F_{UL_Low} and F_{UL_High} refer to each E-UTRA frequency band specified in Table 5.5-1	
NOTE 3: Test tolerance $TT = 1.4 \text{ dB}$.	

**Figure 6.4.2.4.5-1: The test requirements for EVM equalizer spectral flatness with the maximum allowed variation of the coefficients indicated for unshaped modulations (the ETC test requirements are within brackets)**

6.4.2.5 EVM equalizer spectrum flatness for Pi/2 BPSK

6.4.2.5.1 Test purpose

The zero-forcing equalizer correction applied in the EVM measurement process (as described in Annex E) must meet a spectral flatness requirement for the EVM measurement to be valid. The EVM equalizer spectrum flatness is defined in terms of the maximum peak-to-peak ripple of the equalizer coefficients (dB) across the allocated uplink block, at which the equalizer coefficients are generated by the EVM measurement process. The basic measurement interval is the same as for EVM.

6.4.2.5.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation and UE capability *lowPAPR-DMRS-PUSCHwithPrecoding-r16*.

6.4.2.5.3 Minimum conformance requirements

These requirements apply if the IE *dmrs-UplinkTransformPrecoding-r16* is configured and UE indicates support for UE capability *lowPAPR-DMRS-PUSCHwithPrecoding-r16*. Otherwise the requirements for EVM equalizer spectrum flatness defined in clause 6.4.2.4.3 apply.

The EVM equalizer coefficients across the allocated uplink block shall be modified to fit inside the mask specified in Table 6.4.2.5.3-1 for normal conditions, prior to the calculation of EVM. The limiting mask shall be placed to minimize the change in equalizer coefficients in a sum of squares sense.

Table 6.4.2.5.3-1: Mask for EVM equalizer coefficients for Pi/2 BPSK, normal conditions

Frequency range	Parameter	Maximum ripple (dB)
$ F_{UL_Meas} - F_{center} \leq X$ MHz (Range 1)	X1	6 (p-p)
$ F_{UL_Meas} - F_{center} > X$ MHz (Range 2)	X2	14 (p-p)
NOTE 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated		
NOTE 2: F_{center} refers to the center frequency of an allocated block of PRBs		
NOTE 3: X, in MHz, is equal to 25% of the bandwidth of the PRB allocation		
NOTE 4: See Figure 6.4.2.5.3-1 for description of X1, X2		

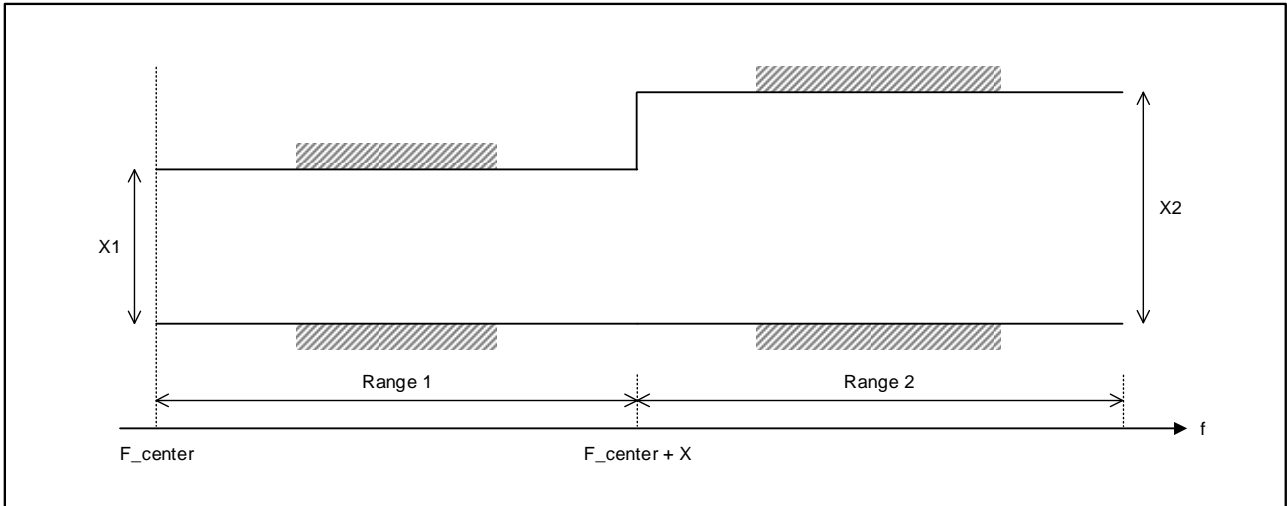


Figure 6.4.2.5.3-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation. F_{center} denotes the center frequency of the allocated block of PRBs. X, in MHz, is equal to 25 % of the bandwidth of the PRB allocation.

For pi/2 BPSK modulation the UE shall be allowed to employ spectral shaping and the shaping filter shall be restricted so that the impulse response of the shaping filter itself shall meet

$$|\tilde{a}_t(t,0)| \geq |\tilde{a}_t(t,\tau)| \quad \forall \tau \neq 0$$

$$20\log_{10} |\tilde{a}_t(t,\tau)| < -15 \text{ dB} \quad 1 < \tau < M - 1,$$

where, $|\tilde{a}_t(t,\tau)| = \text{IDFT}\{|\tilde{a}_t(t,f)| e^{j\varphi(t,f)}\}$, f is the frequency of the M allocated subcarriers, $\tilde{a}_t(t,f)$ and $\varphi(t,f)$ are the amplitude and phase response.

0dB reference is defined as $20\log_{10} |\tilde{a}_t(t,0)|$.

The normative reference for this requirement is TS 38.101-1 [5] clause 6.4.2.4.1, as indicated in TS 38.101-5 [11] clause 6.4.2.

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 [12] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] 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 w Pi/2 BPSK DMRS	Outer Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.			
NOTE 2: Test Channel Bandwidths are checked separately for each NR band, which applicable channel bandwidths are specified in Table 5.3.5-1.			

6.4.2.5.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.4.2.5.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at P_{UMAX} level. Allow at least 200ms starting from the first TPC command in this step for the UE to reach P_{UMAX} level.
3. Measure spectrum flatness using Global In-Channel Tx-Test (Annex E). For TDD, only slots consisting of only UL symbols are under test.

6.4.2.5.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exception:

Table 6.4.2.5.4.3-1: DMRS-UplinkConfig

Derivation Path: TS 38.508-1 [12], Table 4.6.3-51			
Information Element	Value/remark	Comment	Condition
DMRS-UplinkConfig ::= SEQUENCE {			
transformPrecodingEnabled SEQUENCE {			
nPUSCH-Identity	Not present		
sequenceGroupHopping	Not present		
sequenceHopping	Not present		
dmrs-UplinkTransformPrecoding-r16 SEQUENCE {			
pi2BPSK-ScramblingID0	Not present		
pi2BPSK-ScramblingID1	Not present		
}			
}			
}			

6.4.2.5.5 Test requirement

Each of the n spectrum flatness functions, shall derive four ripple results in Annex E.4.4.1 The derived results shall not exceed the values in Figure 6.4.2.5.5-1:

Table 6.4.2.5.5-1: Mask for EVM equalizer coefficients for Pi/2 BPSK, normal conditions

Frequency range	Parameter	Maximum ripple (dB)
$ F_{UL_Meas} - F_{center} \leq X$ MHz (Range 1)	X1	$6 + TT$ (p-p)
$ F_{UL_Meas} - F_{center} > X$ MHz (Range 2)	X2	$14 + TT$ (p-p)
NOTE 1: F_{UL_Meas} refers to the sub-carrier frequency for which the equalizer coefficient is evaluated NOTE 2: F_{center} refers to the center frequency of an allocated block of PRBs NOTE 3: X , in MHz, is equal to 25% of the bandwidth of the PRB allocation NOTE 4: See Figure 6.4.2.5.5-1 for description of X1, X2 NOTE 5: Test tolerance $TT = 1.4$ dB.		

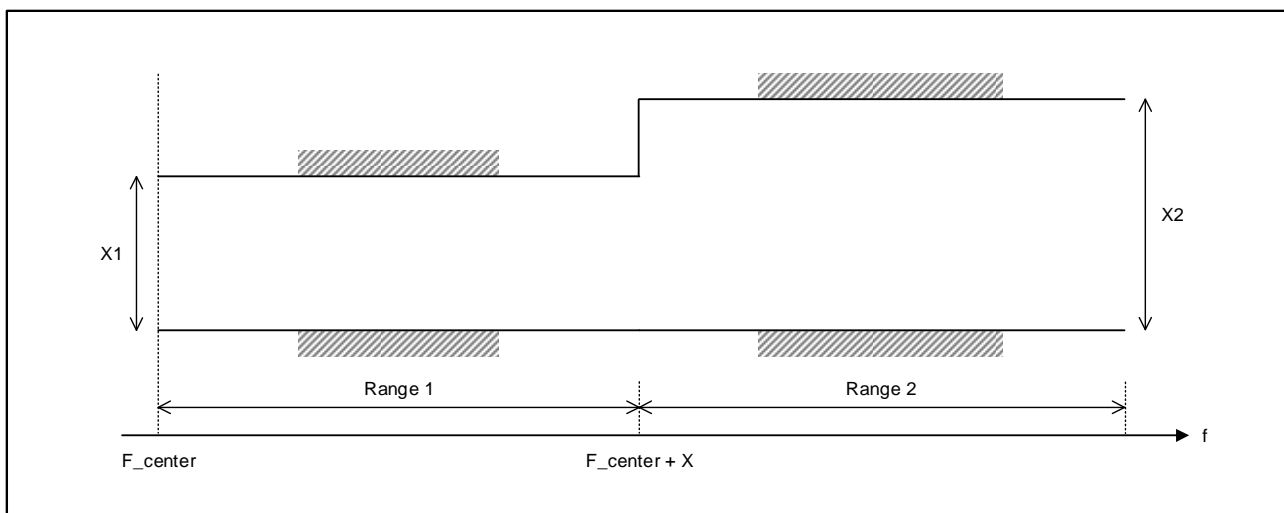


Figure 6.4.2.5.5-1: The limits for EVM equalizer spectral flatness with the maximum allowed variation. F_{center} denotes the center frequency of the allocated block of PRBs. X , in MHz, is equal to 25 % of the bandwidth of the PRB allocation.

Each of the n spectrum flatness functions shall derive an impulse response of the spectral shaping filter in Annex E.4.4.2. The derived results shall fulfill:

$$|\tilde{a}(0)| \geq |\tilde{a}(\tau)| \quad \forall \tau \neq 0$$

$$20 \log_{10} |\tilde{a}(\tau)| < -15 \text{ dB} + TT \quad 1 < \tau < M - 1,$$

where $TT = 1.4$ dB.

6.5 Output RF spectrum emissions

6.5.0 General

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.329-10 and the Radio Regulations [15].

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.

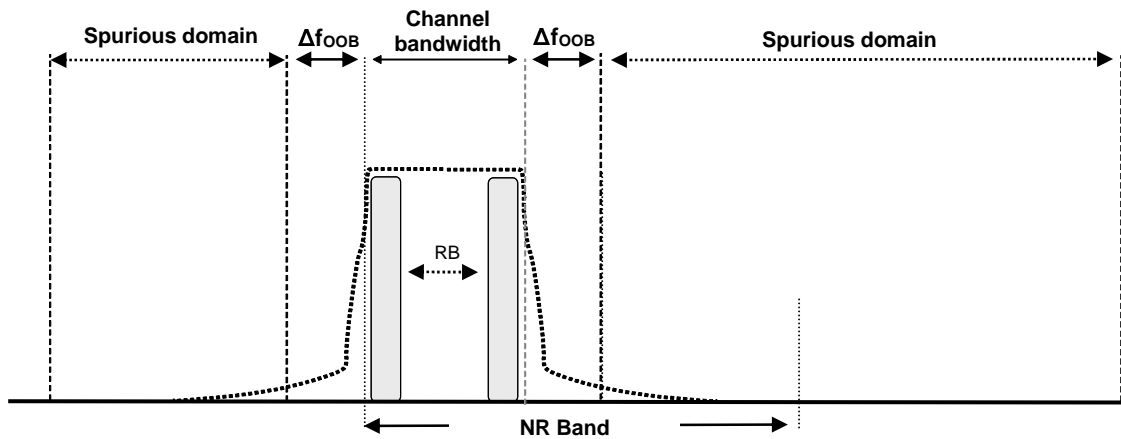


Figure 6.5.0-1: Transmitter RF spectrum

6.5.1 Occupied bandwidth

6.5.1.1 Test purpose

To verify that the UE occupied bandwidth for all transmission bandwidth configurations supported by the UE are less than their specific limits.

6.5.1.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.5.1.3 Minimum conformance requirements

Occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel. The occupied bandwidth for all transmission bandwidth configurations (Resources Blocks) shall be less than the channel bandwidth specified in Table 6.5.1.3-1.

Table 6.5.1.3-1: Occupied channel bandwidth

	NR NTN satellite channel bandwidth (MHz)
	5, 10, 15, 20
Occupied channel bandwidth (MHz)	Same as NR NTN satellite channel bandwidth

The normative reference for this requirement is TS 38.101-5 [11] clause 6.5.1.

6.5.1.4 Test description

6.5.1.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 6.5.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.5.1.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [12] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Mid range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] 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. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.1.1 for TE diagram and section A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, G.3.0.
4. The UL Reference Measurement channels are set according to Table 6.5.1.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.5.1.4.3.

6.5.1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.5.1.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send continuously power control “up” commands to the UE until the UE transmits at PUMAX level. Allow at least 200ms for the UE to reach PUMAX level.

3. Measure the power spectrum distribution within two times or more range over the requirement for Occupied Bandwidth specification centring on the current carrier frequency. The characteristics of the filter shall be approximately Gaussian (typical spectrum analyser filter). Other methods to measure the power spectrum distribution are allowed. The measuring duration is at least 1ms over consecutive active uplink slots.
4. Calculate the total power within the range of all frequencies measured in step 3 and save this value as “Total power”.
5. Identify the measurement window whose centre is aligned on the centre of the channel for which the sum of the power measured is 99% of the “Total power”.
6. The “Occupied Bandwidth” is the width of the measurement window obtained in step 5.

6.5.1.4.3 Message contents

Message contents are according to TS 38.508-1 [12] 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

	NR NTN satellite channel bandwidth			
	5 MHz	10 MHz	15 MHz	20 MHz
Occupied channel bandwidth (MHz)	5	10	15	20

6.5.2 Out of band emission

6.5.2.1 [to be updated]

6.5.2.2 Spectrum emission mask

6.5.2.2.1 Test purpose

To verify that the power of any UE emission shall not exceed specified level for the specified channel bandwidth

6.5.2.2.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.5.2.2.3 Minimum conformance requirements

The spectrum emission mask of the UE applies to frequencies (Δf_{OoB}) starting from the \pm edge of the assigned NR channel bandwidth. For frequencies offset greater than Δf_{OoB} , the spurious requirements in clause 6.5.3 are applicable.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

The power of any UE emission shall not exceed the levels specified in Table 6.5.2.2.3-1 for the specified channel bandwidth.

Table 6.5.2.2.3-1: General NR spectrum emission mask

Δf_{OoB} (MHz)	Channel bandwidth (MHz) / Spectrum emission limit (dBm)		Measurement bandwidth
	5	10, 15, 20	
± 0 -1	-13	-13	1 % of channel BW
± 1 -5	-10	-10	
± 5 -6	-13		1 MHz
± 6 -10	-25		
± 5 -BW _{Channel}		-13	
$\pm \text{BW}_{\text{Channel}}-(\text{BW}_{\text{Channel}}+5)$		-25	

The normative reference for this requirement is TS 38.101-5 [11] clause 6.5.2.2.

6.5.2.2.4 Test description

6.5.2.2.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, 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 6.5.2.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in TS 38.521-1 [2] Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in TS 38.521-1 [2] Annex C.2.

Table 6.5.2.2.4.1-1: Test Configuration Table for power class 3 (contiguous allocation)

Default Conditions						
Test Environment as specified in TS 38.508-1 [12] subclause 4.1				Normal		
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1				Low range, High range		
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1				Lowest, Highest		
Test SCS as specified in Table 5.3.5-1				Lowest, Highest		
Test Parameters for Channel Bandwidths						
Test ID	Freq	ChBw	SCS	Downlink Configuration	Uplink Configuration	
		Default	Default	N/A for Spectrum Emission Mask test case	Modulation (NOTE 2)	RB allocation (NOTE 1)
1 ⁴	Low				DFT-s-OFDM Pi/2 BPSK	Edge_1RB_Left
2 ⁴	High				DFT-s-OFDM Pi/2 BPSK	Edge_1RB_Right
3 ⁴	Default				DFT-s-OFDM Pi/2 BPSK	Outer_Full
4	Low				DFT-s-OFDM QPSK	Edger_1RB_Left
5	High				DFT-s-OFDM QPSK	Edge_1RB_Right
6	Default				DFT-s-OFDM QPSK	Outer_Full
7	Low				DFT-s-OFDM 16 QAM	Edge_1RB_Left
8	High				DFT-s-OFDM 16 QAM	Edge_1RB_Right
9	Default				DFT-s-OFDM 16 QAM	Outer_Full

10	Low			DFT-s-OFDM 64 QAM	Edge_1RB_Left
11	High			DFT-s-OFDM 64 QAM	Edge_1RB_Right
12	Default			DFT-s-OFDM 64 QAM	Outer_Full
13	Low			CP-OFDM QPSK	Edge_1RB_Left
14	High			CP-OFDM QPSK	Edge_1RB_Right
15	Default			CP-OFDM QPSK	Outer_Full
16	Low			CP-OFDM 16 QAM	Edge_1RB_Left
17	High			CP-OFDM 16 QAM	Edge_1RB_Right
18	Default			CP-OFDM 16 QAM	Outer_Full
19	Low			CP-OFDM 64 QAM	Edge_1RB_Left
20	High			CP-OFDM 64 QAM	Edge_1RB_Right
21	Default			CP-OFDM 64 QAM	Outer_Full
22 ^{5,6}	Low			DFT-s-OFDM Pi/2 BPSK w Pi/2 BPSK DMRS	Edge_1RB_Left
23 ^{5,6}	High			DFT-s-OFDM Pi/2 BPSK w Pi/2 BPSK DMRS	Edge_1RB_Right
24 ^{5,6}	Default			DFT-s-OFDM Pi/2 BPSK w Pi/2 BPSK DMRS	Outer Full
<p>NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.</p> <p>NOTE 2: DFT-s-OFDM Pi/2 BPSK test applies only for UEs which supports Pi/2 BPSK in FR1.</p> <p>NOTE 3: VOID</p> <p>NOTE 4: UE operating in FDD mode, or in TDD mode in bands other than n40, n41, n77, n78 and n79, or in TDD mode the IE <i>powerBoostPi2BPSK</i> is set to 0 for bands n40, n41, n77, n78 and n79.</p> <p>NOTE 5: For Power Class 3 testing, UE operating in FDD mode, or in TDD mode in bands other than n40, n41, n77, n78 and n79, or in TDD mode the IE <i>powerBoostPi2BPSK</i> is set to 0 for bands n40, n77, n78 and n79.</p> <p>NOTE 6: Applicable to UEs indicating support for UE capability <i>lowPAPR-DMRS-PUSCHwithPrecoding-r16</i>.</p>					

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.1.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to TS 38.521-1 [2] Annex G.0, G.1, G.2, and G.3.1.
4. The UL Reference Measurement Channel is set according to Table 6.2.2.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.

9. Ensure the UE is in State [to be updated] with generic procedure parameters [to be updated], Connected without release *On*, Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [12] clause 4.5. Message contents are defined in clause 6.2.2.4.3.

6.5.2.2.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.5.2.2.4.1-1, Table 6.5.2.2.4.1-2, Table 6.5.2.2.4.1-2a and Table 6.5.2.2.4.1-3. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send continuously power control "up" commands to the UE until the UE transmits at PUMAX level. Allow at least 200 ms for the UE to reach PUMAX level.
3. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, which shall meet the requirements described in Tables 6.2.2.5-1 to 6.2.2.5-9. The period of the measurement shall be at least the continuous duration of 1 ms over consecutive active uplink slots. For TDD, only slots consisting of only UL symbols are under test.
4. Measure the power of the transmitted signal with a measurement filter of bandwidths according to table 6.5.2.2.5-1. The centre frequency of the filter shall be stepped in continuous steps according to the same table. The measured power shall be recorded for each step. The measurement period shall capture the active TSs.

NOTE 1: When switching to DFT-s-OFDM waveform, as specified in the test configuration table 6.5.2.2.4.1-1, send an NR RRCReconfiguration message according to TS 38.508-1 [12] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

6.5.2.2.4.3 Message contents

Message contents are according to TS 38.508-1 [12] clause 4.6 ensuring Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED for NR band.

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exceptions: SIB19 message contents according to TS 38.508-1 [12] clause 5.6.2.1. In addition the below *PUSCH-Config* IE needs to be configured.

Table 6.5.2.2.4.3-1: *PUSCH-Config*

Derivation Path: TS 38.508-1 [12] subclause 4.6.3 Table 4.6.3-118 PUSCH-Config			
Information Element	Value/remark	Comment	Condition
PUSCH-Config ::= SEQUENCE {			
resourceAllocation	resourceAllocationType0		Almost contiguous allocation
	resourceAllocationType1		Contiguous allocation
}			

Table 6.5.2.2.4.3-2: DMRS-UplinkConfig (Test ID 28 – 30 in Table 6.5.2.2.4.1-1)

Derivation Path: TS 38.508-1 [12], Table 4.6.3-51			
Information Element	Value/remark	Comment	Condition
DMRS-UplinkConfig ::= SEQUENCE {			
transformPrecodingEnabled SEQUENCE {			
dmrs-UplinkTransformPrecoding-r16			
SEQUENCE {			
pi2BPSK-ScramblingID0	Not present		
pi2BPSK-ScramblingID1	Not present		
}			
}			
}			

6.5.2.2.5 Test requirement

The measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in Tables 6.2.2.5-1, and the power of any UE emission shall fulfil requirements in Table 6.5.2.2.5-1.

Table 6.5.2.2.5-1: General NR spectrum emission mask

Δf_{OoB} (MHz)	Channel bandwidth (MHz) / Spectrum emission limit (dBm)		Measurement bandwidth
	5	10, 15, 20	
± 0 -1	-13+TT	-13+TT	1 % of channel BW
± 1 -5	-10+TT	-10+TT	1 MHz
± 5 -6	-13+TT		
± 6 -10	-25+TT		
± 5 -BW _{Channel}		-13+TT	
$\pm \text{BW}_{\text{Channel}}-(\text{BW}_{\text{Channel}}+5)$		-25+TT	

Table 6.5.2.2.5-2: Test Tolerance (Spectrum Emission Mask)

	$f \leq 3.0\text{GHz}$
BW $\leq 100\text{MHz}$	1.5 dB

NOTE: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

6.5.2.3 [to be updated]

6.5.2.4 Adjacent channel leakage ratio

6.5.2.4.0 General

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.

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.

6.5.2.4.1 NR Adjacent channel leakage ratio

6.5.2.4.1.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5.2.4.1.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.5.2.4.1.3 Minimum conformance requirements

NR Adjacent Channel Leakage power Ratio (NR_{ACLR}) is the ratio of the filtered mean power centred on the assigned NR channel frequency to the filtered mean power centred on an adjacent NR channel frequency at nominal channel spacing.

The assigned NR channel power and adjacent NR channel power are measured with rectangular filters with measurement bandwidths specified in Table 6.5.2.4.1.3-1.

If the measured adjacent channel power is greater than -50 dBm then the NR_{ACLR} shall be higher than the value specified in Table 6.5.2.4.1.3-2.

Table 6.5.2.4.1.3-1: NR ACLR measurement bandwidth

Channel bandwidth	(MHz)	5,10,15,20
REF_SCS	(kHz)	15
NR ACLR measurement bandwidth	(MHz)	$MBW = REF_SCS * (12 * N_{RB} + 1) / 1000$

Table 6.5.2.4.1.3-2: NR ACLR requirement

	Power class 3
NR ACLR	30 dB

The normative reference for this requirement is TS 38.101-5 [11] clause 6.5.2.4.1.

6.5.2.4.1.4 Test description

6.5.2.4.1.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in Table 6.2.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.5.2.4.1.4.1-1: Void

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.2.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to clauses C.0, C.1, C.2, and uplink signals according to TS 38.521-1 [2] clauses G.0, G.1, G.2, and G.3.1.
4. The UL Reference Measurement Channel is set according to Table 6.5.2.2.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State [to be updated] with generic procedure parameters according to TS 38.508-1 [12] clause [to be updated], Connected without release *On*, Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [12] clause 4.5. Message contents are defined in clause 6.5.2.4.1.4.3.

6.5.2.4.1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to the test configuration tables in clause 6.2.2.4.1T. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send continuously power control "up" commands to the UE until the UE transmits at P_{UMAX} level. Allow at least 200 ms for the UE to reach P_{UMAX} level.
3. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration, as measured in step 3 of 6.2.2.4.2, which shall meet the requirements described in clause 6.2.2.5 as appropriate.
4. Measure the rectangular filtered mean power for the assigned NR channel.
5. Measure the rectangular filtered mean power of the first NR adjacent channel on both lower and upper side of the assigned NR channel, respectively.
6. Calculate the ratios of the power between the values measured in step 4 over step 5 for lower and upper NR ACLR, respectively.

NOTE: When switching to DFT-s-OFDM waveform, as specified in the test configuration tables in clause 6.2.2.4.1, send an NR RRCReconfiguration message according to TS 38.508-1 [12] clause 4.6.3 Table 4.6.3-118 PUSCH-Config with TRANSFORM_PRECODER_ENABLED condition.

6.5.2.4.1.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 and 5.4 with the following exceptions:

SIB19 message contents according to TS 38.508-1 [12] clause 5.6.2.1. In addition the below message contents needs to be configured.

Table 6.5.2.4.1.4.3-1: *P-Max* (Step 7)

Derivation Path: TS 38.508-1 [12], Table 4.6.3-89			
Information Element	Value/remark	Comment	Condition
P-Max	23		PC2 UE or PC1 UE

Table 6.5.2.4.1.4.3-1a: Void

Table 6.5.2.4.1.4.3-2: *PUSCH-Config*

Derivation Path: TS 38.508-1 [12] subclause 4.6.3 Table 4.6.3-118 PUSCH-Config			
Information Element	Value/remark	Comment	Condition
PUSCH-Config ::= SEQUENCE {			
resourceAllocation	resourceAllocationType0		Almost contiguous allocation
	resourceAllocationType1		Contiguous allocation
}			

Table 6.5.2.4.1.4.3-3: DMRS-UplinkConfig (Test ID 28-30 in Table 6.5.2.2.4.1-1)

Derivation Path: TS 38.508-1 [12], Table 4.6.3-51			
Information Element	Value/remark	Comment	Condition
DMRS-UplinkConfig ::= SEQUENCE {			
transformPrecodingEnabled SEQUENCE {			
dmrs-UplinkTransformPrecoding-r16 {			
Setup SEQUENCE {			
pi2BPSK-ScramblingID0	Not present		
pi2BPSK-ScramblingID1	Not present		
}			
}			
}			
}			

Table 6.5.2.4.1.4.3-4: ServingCellConfig

Derivation Path: TS 38.508-1 [12] Table 4.6.3-167			
Information Element	Value/remark	Comment	Condition
ServingCellConfig ::= SEQUENCE {			
uplinkConfig SEQUENCE {			
powerBoostPi2BPSK	0		
}			
}			

6.5.2.4.1.5 Test requirement

The measured UE mean power in the channel bandwidth, derived in step 3, shall fulfil requirements in clause 6.2.2.5 as appropriate, and if the measured adjacent channel power is greater than –50 dBm then the measured NR ACLR, derived in step 6, shall be higher than the limits in Table 6.5.2.4.1.5-2.

Table 6.5.2.4.1.5-1: NR ACLR measurement bandwidth

Channel bandwidth	(MHz)	5,10,15,20
REF_SCS	(kHz)	15
NR ACLR measurement bandwidth	(MHz)	$MBW = REF_SCS * (12 * N_{RB} + 1) / 1000$

Table 6.5.2.4.1.5-2: NR ACLR requirement

	Power class 3
NR ACLR	30 - TT dB

Table 6.5.2.4.1.5-3: Test Tolerance (NR ACLR)

	f ≤ 3.0GHz	3.0GHz < f ≤ 4.2GHz	4.2GHz < f ≤ 6.0GHz
BW ≤ 100MHz	0.8 dB	0.8 dB	0.8 dB

6.5.2.4.2 UTRA Adjacent channel leakage ratio

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

- Addition to applicability spec is pending
- Initial condition and call setup procedure to support NR satellite access is to be updated
- Message exceptions specific to satellite access is to be updated

- Test Points analysis is to be updated
- Test configuration is to be updated
- Annex F MU/TT is to be updated

6.5.2.4.2.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to adjacent channels in terms of Adjacent Channel Leakage power Ratio (ACLR).

6.5.2.4.2.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.5.2.4.2.3 Minimum conformance requirements

UTRA adjacent channel leakage power ratio ($UTRA_{ACLR}$) is the ratio of the filtered mean power centred on the assigned NR channel frequency to the filtered mean power centred on an adjacent(s) UTRA channel frequency.

$UTRA_{ACLR}$ is specified for the first adjacent UTRA channel ($UTRA_{ACLR1}$) which center frequency is ± 2.5 MHz from NR channel edge and for the 2nd adjacent UTRA channel ($UTRA_{ACLR2}$) which center frequency is ± 7.5 MHz from NR channel edge.

The UTRA channel power is measured with a RRC filter with roll-off factor $\alpha = 0.22$ and bandwidth of 3.84 MHz. The assigned NR channel power is measured with a rectangular filter with measurement bandwidth specified in Table 6.5.2.4.1.3-1.

If the measured adjacent channel power is greater than -50 dBm then the $UTRA_{ACLR1}$ and $UTRA_{ACLR2}$ shall be higher than the value specified in Table 6.5.2.4.2.3-1.

Table 6.5.2.4.2.3-1: UTRA ACLR requirement

	Power class 3
$UTRA_{ACLR1}$	33 dB
$UTRA_{ACLR2}$	36 dB

UTRA ACLR requirement is applicable when signalled by the network with network signalling value indicated by the field *additionalSpectrumEmission*.

The normative reference for this requirement is TS 38.101-5 [11] clause 6.5.2.4.2.

6.5.2.4.2.4 Test description

6.5.2.4.2.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of test channel bandwidth and sub-carrier spacing, and are shown in Table 6.2.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.5.2.4.2.4.1-1: Test Configuration Table for power class 3

[to be updated]

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.2.1 for TE diagram and clause A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to TS 38.521-1 [2] clauses G.0, G.1, G.2, and G.3.1.
4. The UL Reference Measurement Channel is set according to Table 6.5.2.2.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity *NR*, Connected without release *On*, Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [12] clause 4.5. Message contents are defined in clause 6.5.2.4.2.4.3.

6.5.2.4.2.4.2 Test procedure

[to be updated]

6.5.2.4.2.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 and 5.4 with the following exceptions:

[to be updated]

6.5.2.4.2.5 Test requirement

[to be updated]

6.5.3 Spurious emission

6.5.3.0 General

Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emissions, intermodulation products and frequency conversion products, but exclude out of band emissions unless otherwise stated. The spurious emission limits are specified in terms of general requirements in line with SM.329 [15] and NTN operating band requirement to address UE co-existence.

To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

6.5.3.1 General spurious emissions

6.5.3.1.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions.

6.5.3.1.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.5.3.1.3 Minimum conformance requirements

This clause specifies the requirements for the specified NR NTN satellite bands for Transmitter Spurious emissions requirement with frequency range as indicated in Table 6.5.3.1.3-2.

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth. The spurious emission limits in Table 6.5.3.1.3-2 apply for all transmitter band configurations (N_{RB}) and channel bandwidths.

Table 6.5.3.1.3-1: Boundary between NR out of band and general spurious emission domain

Channel bandwidth	OOB boundary F_{OOB} (MHz)
BW_{Channel}	$BW_{\text{Channel}} + 5$

Table 6.5.3.1.3-2: Requirement for general spurious emissions limits

Frequency Range	Maximum Level	Measurement bandwidth	NOTE
$9 \text{ kHz} \leq f < 150 \text{ kHz}$	-36 dBm	1 kHz	
$150 \text{ kHz} \leq f < 30 \text{ MHz}$	-36 dBm	10 kHz	
$30 \text{ MHz} \leq f < 1,000 \text{ MHz}$	-36 dBm	100 kHz	
$1 \text{ GHz} \leq f < 5^{\text{th}}$ harmonic of the upper frequency edge of the UL operating band in GHz	-30 dBm	1 MHz	

The normative reference for this requirement is TS 38.101-5 [11] subclause 6.5.3.1

6.5.3.1.4 Test description

6.5.3.1.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in Table 6.5.3.1.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.5.3.1.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [12] subclause 4.1.		Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1.		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] 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 for Spurious Emissions testing	Modulation	RB allocation (NOTE 1)
1		CP-OFDM QPSK	OuterFull
2		CP-OFDM QPSK	Edge_1RB_Left
3		CP-OFDM QPSK	Edge_1RB_Right
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration.			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.1.1 for TE diagram and clause A.3.2 for UE diagram.

2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.2, and uplink signals according to Annex G.0, G.1, G.2, and G.3.1.
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. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.5.3.1.4.3.

6.5.3.1.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.5.3.1.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at P_{UMAX} level.
3. Measure the power of the transmitted signal with a measurement filter of bandwidths according to Table 6.5.3.1.5-1. The centre frequency of the filter shall be stepped in contiguous steps according to Table 6.5.3.1.5-1. The measured power shall be verified for each step. The measurement period shall capture the active time slots.

6.5.3.1.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6.

6.5.3.1.5 Test requirement

This clause specifies the requirements for the specified NR band for Transmitter Spurious emissions requirement with frequency range as indicated in Table 6.5.3.1.5-1.

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth. The spurious emission limits in Table 6.5.3.1.5-1 apply for all transmitter band configurations (N_{RB}) and channel bandwidths.

The measured average power of spurious emission, derived in step 3, shall not exceed the described value in Table 6.5.3.1.5-1.

Table 6.5.3.1.5-1: General spurious emissions test requirements

frequency Range	Maximum Level	Measurement bandwidth	NOTE
$9 \text{ kHz} \leq f < 150 \text{ kHz}$	-36 dBm	1 kHz	
$150 \text{ kHz} \leq f < 30 \text{ MHz}$	-36 dBm	10 kHz	
$30 \text{ MHz} \leq f < 1,000 \text{ MHz}$	-36 dBm	100 kHz	
$1 \text{ GHz} \leq f < 5^{\text{th}}$ harmonic of the upper frequency edge of the UL operating band in GHz	-30 dBm	1 MHz	

6.5.3.2 Spurious emissions for UE co-existence

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

- Addition to applicability spec is pending
- Initial condition and call setup procedure to support NR satellite access are to be updated
- Message exceptions specific to satellite access is to be updated
- Annex F MU/TT is to be updated

6.5.3.2.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to co-existing systems for the specified bands which has specific requirements in terms of transmitter spurious emissions.

6.5.3.2.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.5.3.2.3 Minimum conformance requirements

This clause specifies the requirements for NR NTN satellite bands for UE coexistence with protected bands.

Table 6.5.3.2.3-1: Requirements for spurious emissions for UE co-existence

NR NTN satellite Band	Spurious emission for UE co-existence						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
n255	NR Band n1, n2, n3, n5, n7, n8, n12, n13, n14, n18, n20, n24, n25, n26, n28, n29, n30, n34, n38, n39, n40, n41, n48, n50, n51, n53, n65, n66, n67, n70, n71, n74, n75, n76, n85, n90, n91, n92, n93, n94, n100, n101	F _{DL_low}	-	F _{DL_high}	-50	1	
	NR Band n77, n78, n79	F _{DL_low}	-	F _{DL_high}	-50	1	2
n256	NR Band n1, n3, n5, n7, n8, n12, n13, n14, n18, n20, n24, n26, n28, n29, n30, n38, n39, n40, n41, n48, n50, n51, n53, n54, n65, n66, n67, n71, n74, n75, n76, n78, n79, n85, n90, n91, n92, n93, n94, n100, n101	F _{DL_low}	-	F _{DL_high}	-50	1	
	E-UTRA Band 33, 35	F _{DL_low}	-	F _{DL_high}	-50	1	
	NR Band n77	F _{DL_low}	-	F _{DL_high}	-50	1	2
	NR Band n2, n25, n70	F _{DL_low}	-	F _{DL_high}	NA	NA	3
NOTE 1: The protected NR or E-UTRA bands are specified in clause 5.2 from 3GPP TS 38.101-1 [5] or 3GPP TS 36.101 [10]. F _{DL_low} and F _{DL_high} refer to each frequency band specified in Table 5.2.-1 in 3GPP TS 38.101-1 [5] or 3GPP TS 36.101 [10].							
NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1.3-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x L _{CRB} x R _{Bsize} kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.							
NOTE 3: The co-existence between n256 and band n2, n25 and n70 is subject to regional/national regulation.							

NOTE: To simplify Table 6.5.3.2.3-1, NR band numbers are listed for bands which are specified only for NR operation or both E-UTRA and NR operation. E-UTRA band numbers are listed for bands which are specified only for E-UTRA operation.

The normative reference for this requirement is TS 38.101-5 [11] subclause 6.5.3.2.

6.5.3.2.4 Test description

6.5.3.2.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in Table 6.5.3.2.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in clause A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.5.3.2.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [12] subclause 4.1.		Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1.		Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] 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)
		CP-OFDM QPSK	Outer_Full
		CP-OFDM QPSK	Edge_1RB_Left
		CP-OFDM QPSK	Edge_1RB_Right
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration.			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.1.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to clauses C.0, C.1 and C.2, and uplink signals according to TS 38.521-1 [2] Annex G.0, G.1, G.2, and G.3.1.
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. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.5.3.2.4.3.

6.5.3.2.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.5.3.2.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at P_{UMAX} level.
3. Measure the power of the transmitted signal with a measurement filter of bandwidths according to Table 6.5.3.2.3-1. The centre frequency of the filter shall be stepped in contiguous steps according to Table 6.5.3.2.3-1. The measured power shall be verified for each step. The measurement period shall capture the active time slots.

6.5.3.2.4.3 Message contents

Message contents are according to TS 38.508-1[12] subclause 4.6.

6.5.3.2.5 Test requirement

This clause specifies the requirements for the specified NR band for Transmitter Spurious emissions requirement with frequency range as indicated in Table 6.5.3.2.5-1.

Unless otherwise stated, the spurious emission limits apply for the frequency ranges that are more than F_{OOB} (MHz) in Tables 6.5.3.1.3-1 from the edge of the channel bandwidth. The spurious emission limits in Tables 6.5.3.2.3-1 apply for all transmitter band configurations (N_{RB}) and channel bandwidths.

The measured average power of spurious emission, derived in step 3, shall not exceed the described value in Table 6.5.3.2.5-1.

Table 6.5.3.2.5-1: Requirements for spurious emissions for UE co-existence

NR NTN satellite Band	Spurious emission for UE co-existence						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
n255	NR Band n1, n2, n3, n5, n7, n8, n12, n13, n14, n18, n20, n24, n25, n26, n28, n29, n30, n34, n38, n39, n40, n41, n48, n50, n51, n53, n65, n66, n67, n70, n71, n74, n75, n76, n85, n90, n91, n92, n93, n94, n100, n101	F _{DL_low}	-	F _{DL_high}	-50	1	
	NR Band n77, n78, n79	F _{DL_low}	-	F _{DL_high}	-50	1	2
n256	NR Band n1, n3, n5, n7, n8, n12, n13, n14, n18, n20, n24, n26, n28, n29, n30, n38, n39, n40, n41, n48, n50, n51, n53, n65, n66, n67, n71, n74, n75, n76, n78, n79, n85, n90, n91, n92, n93, n94, n101, n100, n101	F _{DL_low}	-	F _{DL_high}	-50	1	
	E-UTRA Band 33, 35, 54	F _{DL_low}	-	F _{DL_high}	-50	1	
	NR Band n77	F _{DL_low}	-	F _{DL_high}	-50	1	2
	NR Band n2, n25, n70	F _{DL_low}	-	F _{DL_high}	NA	NA	3
NOTE 1: The protected NR or E-UTRA bands are specified in clause 5.2 from 3GPP TS 38.101-1 [5] or 3GPP TS 36.101 [10]. F _{DL_low} and F _{DL_high} refer to each frequency band specified in Table 5.2.2-1 in 3GPP TS 38.101-1 [5] or 3GPP TS 36.101 [10].							
NOTE 2: As exceptions, measurements with a level up to the applicable requirements defined in Table 6.5.3.1.3-2 are permitted for each assigned NR carrier used in the measurement due to 2nd, 3rd, 4th or 5th harmonic spurious emissions. Due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2 MHz + N x L _{CRB} x R _{Bsize} kHz), where N is 2, 3, 4, 5 for the 2nd, 3rd, 4th or 5th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.							
NOTE 3: The co-existence between n256 and band n2, n25 and n70 is subject to regional/national regulation.							

6.5.3.3 Additional Spurious emissions

6.5.3.3.1 Test purpose

To verify that UE transmitter does not cause unacceptable interference to other channels or other systems in terms of transmitter spurious emissions under the deployment scenarios where additional requirements are specified.

6.5.3.3.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.5.3.3.3 Minimum conformance requirements

These requirements are specified in terms of an additional spectrum emission requirement. Additional spurious emission requirements are signalled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message.

The normative reference for this requirement is TS 38.101-5 [11] subclause 6.5.3.3.

6.5.3.3.3.1 Minimum conformance requirements (network signalling value "NS_02N")

When "NS_02N" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.3.1-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.3.1-1: Additional requirements for "NS_02N"

Frequency range (MHz)	Channel bandwidth / Spectrum emission limit ¹ (dBm)	Measurement bandwidth	NOTE
	5 MHz, 10 MHz, 15 MHz, 20 MHz		
1,559≤ f < 1,605	-50	700 Hz	Averaged over any 2 millisecond active transmission interval
1,605≤ f ≤ 1,610	-50 + 24/5 (f-1605)	700Hz	
1,559 ≤ f < 1,605	-40	1MHz	Averaged over any 2 millisecond active transmission interval
1,605≤ f ≤ 1,610	-40 + 24/5 (f-1605)	1MHz	
NOTE: The EIRP requirement in regulation is converted to conducted requirement using a 0 dBi antenna.			

6.5.3.3.3.2 Minimum conformance requirements (network signalling value "NS_03N")

When "NS_03N" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.3.2-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.2-1: Additional out-of-band requirements for "NS_03N"

Frequency range (MHz)	Channel bandwidth / Spectrum emission limit ¹ (dBm)	Measurement bandwidth	NOTE
	5 MHz, 10 MHz, 15 MHz		
1559 ≤ f < 1605	-50	700 Hz	Discreet emissions averaged over any 2 millisecond active transmission interval
1605 ≤ f ≤ 1610	-50 + 60/5 (f-1605)	700 Hz	
1559 ≤ f < 1605	-40	1MHz	Averaged over any 2 millisecond active transmission interval
1605 ≤ f ≤ 1610	-40 + 60/5 (f-1605)	1MHz	
NOTE: The EIRP requirement in regulation is converted to conducted requirement using a 0dBi antenna.			

6.5.3.3.3.3 Minimum conformance requirements (network signalling value "NS_04N" and "NS_05N")

When "NS_04N" or "NS_05N" 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 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.3-1: Additional out-of-band requirements for "NS_04N" and "NS_05N"

Frequency range (MHz)	Channel bandwidth / Spectrum emission limit ¹ (dBm)	Measurement bandwidth	NOTE
	5 MHz, 10 MHz, 15 MHz		
1559 ≤ f < 1605	-40	1MHz	Averaged over any 2 millisecond active transmission interval
1605 ≤ f ≤ 1610	-40 + 60/5 (f-1605)	1MHz	
1628.5 ≤ f < 1631.5	-30	30kHz	
1631.5 ≤ f < 1636.5	-30	100kHz	
1636.5 ≤ f < 1646.5	-30	300kHz	
1646.5 ≤ f < 1666.5	-30	1MHz	
1666.5 ≤ f ≤ 2200	-30	3MHz	
NOTE: The EIRP requirement in regulation is converted to conducted requirement using a 0dBi antenna.			

6.5.3.3.4 Test description

6.5.3.3.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All these configurations shall be tested with applicable test parameters for each channel bandwidth and sub-carrier spacing, are shown in Tables 6.5.3.3.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annex A.2.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.5.3.3.4.1-1: Test Configuration Table (network signalling value "NS_02N")

Same test configuration as listed in Table 6.2.2.4.1-1 shall be used with the following exceptions:

- Test SCS shall be: No exception for UE mean power testing (step 3) and only Lowest for additional spurious emission testing (step 4)

Table 6.5.3.3.4.1-2: Test Configuration Table (network signalling value “NS_03N”)

Same test configuration as listed in Table 6.2.3.4.1-4 shall be used.

Table 6.5.3.3.4.1-3: Test Configuration Table (network signalling value “NS_04N”)

Same test configuration as listed in Table 6.2.3.4.1-5 shall be used.

Table 6.5.3.3.4.1-4: Test Configuration Table (network signalling value “NS_05N”)

Same test configuration as listed in Table 6.2.3.4.1-6 shall be used.

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.1.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1 and C.2, and uplink signals according to TS 38.521-1 [2] Annex G.0, G.1, G.2, and G.3.1.
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. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.5.3.3.4.3.

6.5.3.3.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.5.3.3.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE until the UE transmits at P_{UMAX} level.
3. Measure the mean power of the UE in the channel bandwidth of the radio access mode according to the test configuration in Tables 6.5.3.3.4.1-1, which shall meet the requirements in clause 6.5.3.3.5 with allowed A-MPR values specified in 6.2.3.5. The measured power shall be verified for each step. The measurement period shall capture the active time slots.
4. Measure the power of the transmitted signal with a measurement filter of bandwidths according to clauses 6.5.3.3.3.1. The centre frequency of the filter shall be stepped in contiguous steps according to the same table. During measurement the spectrum analyser shall be set to 'Detector' = RMS. For NS_02N, NS_03N, NS_04N and NS_05N, the additional spurious emissions requirement shall be verified with UE transmission power obtained by sending uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as $-\text{MU}$ to $-(\text{MU} + \text{Uplink power control window size})$ dB of the target power level 15 dBm for at least the duration of the additional spurious emissions measurement, where:
 - MU is the test system uplink power measurement uncertainty and is specified in Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW.
 - Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in 3GPP

TS 38.521-1 [2] Table 6.3.4.3.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty for 3GPP TS 38.521-1 [2] test case 6.3.4.3 is specified in 3GPP TS 38.521-1 [2] Table F.1.2-1.

6.5.3.3.4.3 Message contents

Message contents for SIB19 are according to TS 38.508-1 [12] clause 5.6.2.1 with following exceptions:

6.5.3.3.4.3.1 Message contents exceptions (network signalling value "NS_02N")

Message contents are according to TS 38.508-1 [12] subclause 4.6, with the following exceptions:

1. Information element additionalSpectrumEmission is set to NS_02N. This can be set in *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.5.3.3.4.3.1-1: AdditionalSpectrumEmission: Additional spurious emissions test requirement for "NS_02N"

Derivation Path: TS 38.508-1 [12] clause 4.6.3, Table 4.6.3-1			
Information Element	Value/remark	Comment	Condition
additionalSpectrumEmission	1 (NS_02N)		

6.5.3.3.4.3.2 Message contents exceptions (network signalling value "NS_03N")

Message contents are according to TS 38.508-1 [12] subclause 4.6, with the following exceptions:

1. Information element additionalSpectrumEmission is set to NS_03N. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.3-1: AdditionalSpectrumEmission: Additional spurious emissions test requirement for "NS_03N"

Derivation Path: TS 38.508-1 [12], Table 4.6.3-1			
Information Element	Value/remark	Comment	Condition
additionalSpectrumEmission	1 (NS_03N)		

6.5.3.3.4.3.3 Message contents exceptions (network signalling value "NS_04N")

Message contents are according to TS 38.508-1 [12] subclause 4.6, with the following exceptions:

1. Information element additionalSpectrumEmission is set to NS_04N. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.3-1: AdditionalSpectrumEmission: Additional spurious emissions test requirement for "NS_04N"

Derivation Path: TS 38.508-1 [12], Table 4.6.3-1			
Information Element	Value/remark	Comment	Condition
additionalSpectrumEmission	2 (NS_04N)		

6.5.3.3.4.3.3 Message contents exceptions (network signalling value "NS_05N")

Message contents are according to TS 38.508-1 [12] subclause 4.6, with the following exceptions:

1. Information element additionalSpectrumEmission is set to NS_05N. This can be set in the *SIB1* as part of the cell broadcast message. This exception indicates that the UE shall meet the additional spurious emission requirement for a specific deployment scenario.

Table 6.2.3.4.3.3-1: AdditionalSpectrumEmission: Additional spurious emissions test requirement for "NS_05N"

Derivation Path: TS 38.508-1 [12], Table 4.6.3-1			
Information Element	Value/remark	Comment	Condition
additionalSpectrumEmission	3 (NS_05N)		

6.5.3.3.5 Test requirement

This clause specifies the requirements for the specified NR band for an additional spectrum emission requirement with protected bands as indicated from Table 6.5.3.3.5.1-1.

NOTE: For measurement conditions at the edge of each frequency range, the lowest frequency of the measurement position in each frequency range should be set at the lowest boundary of the frequency range plus MBW/2. The highest frequency of the measurement position in each frequency range should be set at the highest boundary of the frequency range minus MBW/2. MBW denotes the measurement bandwidth defined for the protected band.

6.5.3.3.5.1 Test requirement (network signalling value "NS_02N")

When "NS_02N" is indicated in the cell,

The power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.5.1-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.5.1-1: Additional requirements for "NS_02N"

Frequency range (MHz)	Channel bandwidth / Spectrum emission limit ¹ (dBm)	Measurement bandwidth	NOTE
	5 MHz, 10 MHz, 15 MHz, 20 MHz		
1,559≤ f < 1,605	-50	700 Hz	Averaged over any 2- millisecond active transmission interval
1,605≤ f ≤ 1,610	-50 + 24/5 (f-1605)	700Hz	
1,559 ≤ f < 1,605	-40	1MHz	Averaged over any 2- millisecond active transmission interval
1,605≤ f ≤ 1,610	-40 + 24/5 (f-1605)	1MHz	
NOTE: The EIRP requirement in regulation is converted to conducted requirement using a 0 dBi antenna.			

6.5.3.3.5.2 Test requirement (network signalling value "NS_03N")

When "NS_03N" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.5.2-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.5.2-1: Additional requirements for "NS_03N"

Frequency range (MHz)	Channel bandwidth / Spectrum emission limit ¹ (dBm)	Measurement bandwidth	NOTE
	5 MHz, 10 MHz, 15 MHz		
1559 ≤ f < 1605	-50	700 Hz	Discreet emissions averaged over any 2 millisecond active transmission interval
1605 ≤ f ≤ 1610	-50 + 60/5 (f-1605)	700 Hz	
1559 ≤ f < 1605	-40	1MHz	Averaged over any 2 millisecond active transmission interval
1605 ≤ f ≤ 1610	-40 + 60/5 (f-1605)	1MHz	
NOTE: The EIRP requirement in regulation is converted to conducted requirement using a 0dBi antenna.			

6.5.3.3.5.3 Test requirement (network signalling value "NS_03N" and "NS_05N")

When "NS_04N" or "NS_05N" is indicated in the cell, the power of any UE emission shall not exceed the levels specified in Table 6.5.3.3.5.3-1. This requirement also applies for the frequency ranges that are less than F_{OOB} (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth.

Table 6.5.3.3.5.3-1: Additional out-of-band requirements for "NS_04N" and "NS_05N"

Frequency range (MHz)	Channel bandwidth / Spectrum emission limit ¹ (dBm)	Measurement bandwidth	NOTE
	5 MHz, 10 MHz, 15 MHz		
$1559 \leq f < 1605$	-40	1MHz	Averaged over any 2 millisecond active transmission interval
$1605 \leq f \leq 1610$	$-40 + 60/5 (f-1605)$	1MHz	
$1628.5 \leq f < 1631.5$	-30	30kHz	
$1631.5 \leq f < 1636.5$	-30	100kHz	
$1636.5 \leq f < 1646.5$	-30	300kHz	
$1646.5 \leq f < 1666.5$	-30	1MHz	
$1666.5 \leq f \leq 2200$	-30	3MHz	

6.5.4 Transmit intermodulation

6.5.4.1 Test purpose

To verify that the UE transmit intermodulation does not exceed the described value in the test requirement.

The transmit intermodulation performance is a measure of the capability of the transmitter to inhibit the generation of signals in its non-linear elements caused by presence of the wanted signal and an interfering signal reaching the transmitter via the antenna.

6.5.4.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

6.5.4.3 Minimum conformance requirements

UE transmit intermodulation is defined by the ratio of the mean power of the wanted signal to the mean power of the intermodulation product when an interfering CW signal is added at a level below the wanted signal at each transmitter antenna port with the other antenna port(s) if any terminated. Both the wanted signal power and the intermodulation product power are measured through NR rectangular filter with measurement bandwidth shown in Table 6.5.4.3-1.

The requirement of transmit intermodulation is specified in Table 6.5.4.3-1.

Table 6.5.4.3-1: Transmit Intermodulation

Wanted signal channel bandwidth	BW_{Channel}	
Interference signal frequency offset from channel center	BW_{Channel}	$2 \cdot BW_{\text{Channel}}$
Interference CW signal level	-40 dBc	
Intermodulation product	< -29 dBc	< -35 dBc
Measurement bandwidth	The maximum transmission bandwidth configuration among the different SCS's for the channel BW as defined in Table 6.5.2.4.3-1	
Measurement offset from channel center	BW_{Channel} and $2 \cdot BW_{\text{Channel}}$	$2 \cdot BW_{\text{Channel}}$ and $4 \cdot BW_{\text{Channel}}$

The normative reference for this requirement is TS 38.101-5 [11] clause 6.5.4.

6.5.4.4 Test description

6.5.4.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, and are shown in table 6.5.4.4.1-1. The details of the uplink reference measurement channels (RMCs) are specified in Annexes A.2. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 6.5.4.4.1-1: Test Configuration Table

Initial Conditions			
Test Environment as specified in TS 38.508-1 [12] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Mid range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1		Mid, Highest	
Test SCS as specified in Table 5.3.5-1		Lowest, Highest	
Test Parameters			
Test ID	Downlink Configuration	Uplink Configuration	
	N/A for transmit intermodulation test case	Modulation	RB allocation (NOTE 1)
1		DFT-s-OFDM Pi/2 BPSK	Inner Full
2		DFT-s-OFDM QPSK	Inner Full
NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1.			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, in Figure A.3.1.3.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and uplink signals according to Annex G.0, G.1, G.2, and G.3.1 in TS 38.521-1 [2].
4. The UL Reference Measurement channels are set according to Table 6.5.4.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for

NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.

8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 6.5.4.4.3.

6.5.4.4.2 Test procedure

1. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 6.5.4.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
2. Send continuously uplink power control "up" commands to the UE until the UE transmits at its P_{UMAX} level.
3. Measure the rectangular filtered mean power of the UE. For TDD, only slots consisting of only UL symbols are under test for the wanted signal and for the intermodulation product.
4. Set the interference signal frequency below the UL carrier frequency using the first offset in table 6.5.4.5-1.
5. Set the interference CW signal level according to table 6.5.4.5-1.
6. Search the intermodulation product signals below and above the UL carrier frequency, then measure the rectangular filtered mean power of transmitting intermodulation for both signals, and calculate the ratios with the power measured in step 3.
7. Set the interference signal frequency above the UL carrier frequency using the first offset in table 6.5.4.5-1.
8. Search the intermodulation product signals below and above the UL carrier frequency, then measure the rectangular filtered mean power of transmitting intermodulation for both signals, and calculate the ratios with the power measured in step 3.
9. Repeat the measurement using the second offset in table 6.5.4.5-1.

6.5.4.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exception:

Table 6.5.4.4.3-1: PUSCH-Config

Derivation Path: TS 38.508-1 [12], Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED
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6.5.4.5 Test requirement

The ratio derived in step 6 and 8, shall not exceed the described value in table 6.5.4.5-1.

Table 6.5.4.5-1: Transmit Intermodulation

Wanted signal channel bandwidth	BW_{Channel}	
Interference signal frequency offset from channel center	BW_{Channel}	$2 \cdot BW_{\text{Channel}}$
Interference CW signal level	-40 dBc	
Intermodulation product	< -29 dBc	< -35 dBc
Measurement bandwidth	The maximum transmission bandwidth configuration among the different SCS's for the channel BW as defined in Table 6.5.2.4.5-1	
Measurement offset from channel center	BW_{Channel} and $2 \cdot BW_{\text{Channel}}$	$2 \cdot BW_{\text{Channel}}$ and $4 \cdot BW_{\text{Channel}}$
NOTE:	The test requirements do not apply when the interfering signal overlaps with the channel bandwidth of the downlink signal.	

7 Receiver characteristics

7.1 General

Unless otherwise stated the receiver characteristics are specified at the antenna connector(s) of the UE. For UE(s) with an integral antenna only, a reference antenna(s) with a gain of 0 dBi is assumed for each antenna port(s). UE with an integral antenna(s) may be taken into account by converting these power levels into field strength requirements, assuming a 0 dBi gain antenna. For UEs with more than one receiver antenna connector, identical interfering signals shall be applied to each receiver antenna port if more than one of these is used (diversity).

The levels of the test signal applied to each of the antenna connectors shall be as defined in the respective clauses below.

With the exception of clause 7.3, the requirements shall be verified with the network signalling value NS_01 configured in Table 6.2.3.3.1-1.

All requirements in this clause are applicable to devices supporting GSO and/or NGSO satellites.

All the parameters in clause 7 are defined using the UL reference measurement channels specified in Annex A.2.2, the DL reference measurement channels specified in Annex A.3.2 and using the set-up specified in Annex C.3.1.

All Rx requirements are verified with default Tx-Rx separation specified in Table 5.4.4-1. Additional Tx-Rx frequency separations specified in clause 7.3.2 do not apply to other requirements.

7.2 Diversity characteristics

The UE is required to be equipped with a minimum of two RX antenna ports in all operating bands.

The UE shall be verified with two RX antenna ports in all supported frequency bands.

The above rules apply for all clauses with the exception of clause 7.9.

7.3 Reference sensitivity

7.3.1 General

The reference sensitivity power level REFSSENS is the minimum mean power applied to each one of the UE antenna ports for all UE categories, at which the throughput shall meet or exceed the requirements for the specified reference measurement channel.

In later clauses of Clause 7 where the value of REFSSENS is used as a reference to set the corresponding requirement. In all bands, the UE shall be verified against those requirements by applying the REFSSENS value in Table 7.3.2.3-1.

7.3.2 Reference sensitivity power level

7.3.2.1 Test purpose

The test purpose is to verify the ability of the UE to receive data with a given average throughput for a specified reference measurement channel, under conditions of low signal level, ideal propagation and no added noise for default Tx-Rx frequency separation.

7.3.2.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

7.3.2.3 Minimum conformance requirements

The throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annex A3.2, with parameters specified in Table 7.3.2.3-1.

Table 7.3.2.3-1: Two antenna port reference sensitivity QPSK PREFSENS for FDD bands

Operating band / SCS / Channel bandwidth					
Operating Band	SCS (kHz)	5 MHz (dBm)	10 MHz (dBm)	15 MHz (dBm)	20 MHz (dBm)
n256	15	-99.5	-96.3	-94.5	-93.3
	30		-96.6	-94.6	-93.5
	60		-97.0	-94.9	-93.7
n255	15	-100.0	-96.8	-95.0	-93.8
	30		-97.1	-95.1	-94.0
	60		-97.5	-95.4	-94.2
n254	15	-99.5	-96.3	-94.5	
	30		-96.6	-94.6	
	60		-97.0	-94.9	

NOTE: The transmitter shall be set to P_{UMAX} as defined in clause 6.2.4.

The reference receiver sensitivity (REFSENS) requirement specified in Table 7.3.2.3-1 shall be met with uplink transmission bandwidth less than or equal to that specified in Table 7.3.2.3-2 and with default Tx-Rx carrier center frequency separation except for cases specified in Table 7.3.2.3-3.

Table 7.3.2.3-2: Uplink configuration for reference sensitivity

Operating band / SCS (kHz) / Channel bandwidth (MHz) / Duplex mode						
Operating Band	SCS	5	10	15	20	Duplex Mode
n256	15	25	50	75	100	FDD
	30		24	36	50	
	60		10	18	24	
n255	15	25	50	75	[75]	FDD
	30		24	36	[36]	
	60		10	18	[18]	
n254	15	25	50	75		FDD
	30		24	36		
	60		10	18		

NOTE: UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth in Table 5.3.2-1.

Table 7.3.2.3-3: TX – RX carrier centre frequency separation for REFSENS verification

Operating Band	Channel bandwidth	TX – RX carrier centre frequency separation for REFSENS verification
n256	5 MHz	165 MHz, 215 MHz
	20 MHz	180 MHz, 200 MHz
n255	5 MHz	-72.5 MHz, -130.5 MHz
	20 MHz	-87.5 MHz, -115.5 MHz

The minimum requirements specified in Table 7.3.2.3-1 shall be verified with the network signalling value NS_01 configured in Table 6.2.3.1-1.

The normative reference for this requirement is TS 38.101-5 [11] 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.2.2 of TS 38.521-1 [2]. Configurations of PDSCH and PDCCH before measurement are specified in TS 38.521-1 [2] Annex C.2.

Table 7.3.2.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 38.508-1 [12] subclause 4.1			Normal, TL/VL, TL/VH, TH/VL, TH/VH	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1			Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1			Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1			Lowest	
Test Parameters				
Test ID	Downlink Configuration		Uplink Configuration	
	Modulation	RB allocation	Modulation	RB allocation
1	CP-OFDM QPSK	Full RB (NOTE 1)	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)	L_{CRBmax}	Outer RB allocation / Normal RB allocation
5MHz	15	25	25@0
	30	11	11@0
	60	N/A	N/A
10MHz	15	52	52@0
	30	24	24@0
	60	11	11@0
15MHz	15	79	79@0
	30	38	38@0
	60	18	18@0
20MHz	15	106	106@0
	30	51	51@0
	60	24	24@0
NOTE: 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, L_{CRB} @ RB_{start} format

Operating Band	SCS kHz	5 MHz	10 MHz	15 MHz	20 MHz
n256	15	25@0	50@0	75@0	100@0
	30		24@0	36@0	50@0
	60		10@0	18@0	24@0
n255	15	25@0	50@0	75@0	[75@0]
	30		24@0	36@0	[36@0]
	60		10@0	18@0	[18@0]
n254	15	25@0	50@0	75@0	
	30		24@0	36@0	
	60		10@0	18@0	

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to clauses C.0, C.1 and C.2, and uplink signals according to TS 38.521-1 [2] Annex G.0, G.1, G.2, and G.3.1.
4. The UL and Reference Measurement Channel is set according to Table 7.3.2.4.1-1, Table 7.3.2.4.1-2, and Table 7.3.2.4.1-3.
5. Propagation conditions are set according to Annex B.0.
6. Ensure the UE is in State RRC_CONNECTED with generic procedure parameters Connectivity NR, Connected without release *On*, Test Mode *On* and Test Loop Function *On* according to TS 38.508-1 [12] clause 4.5. Message contents are defined in clause 7.3.2.4.3.

7.3.2.4.2 Test procedure.

1. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
2. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
3. Deactivate UE prediction of satellite trajectory by any preconfigured means.

4. 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.
5. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Tables 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.
6. Set the Downlink signal level to the appropriate REFSENS value defined in Table 7.3.2.5-1 if 2Rx antennas connected. Send continuously uplink power control "up" commands in the uplink scheduling information to the UE to ensure the UE transmits PUMAX level for at least the duration of the Throughput measurement.
7. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2.

7.3.2.4.3 Message contents

Message contents are according to TS 38.508-1 [12] clause 4.6 ensuring Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED for NR band.

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exceptions for each network signalling value.

SIB19 message contents according to TS 38.508-1 [12] clause 5.6.2.1

7.3.2.4.3.1 Message contents exceptions (network signalled value "NS_01")

Message contents according to TS 38.508-1 [12] subclause 4.6 can be used without exceptions.

7.3.2.5 Test requirement

The throughput shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with reference receive power level specified in Tables 7.3.2.5-1 and parameters specified Tables 7.3.2.4.1-1, Tables 7.3.2.4.1-2 and Tables 7.3.2.4.1-3.

: Two antenna port Reference sensitivity QPSK P_{REFSENS} for FDD bands for PC3

Operating band / SCS / Channel bandwidth / Duplex-mode					Duplex Mode
	5 MHz (dBm)	10 MHz (dBm)	15 MHz (dBm)	20 MHz (dBm)	
	-99.5 +TT	-96.3 +TT	-94.5 +TT	-93.3 +TT	FDD
		-96.6 +TT	-94.6 +TT	-93.5 +TT	
		-97.0 +TT	-94.9 +TT	-93.7 +TT	
	-100.0 +TT	-96.8 +TT	-95.0 +TT	-93.8 +TT	FDD
		-97.1 +TT / -96.63 +TT	-95.1 +TT / -94.63 +TT	-94.0 +TT / -93.53 +TT	
		-97.5 +TT / -97.03 +TT	-95.4 +TT / -94.93 +TT	-94.2 +TT / -93.73 +TT	
	-99.5 +TT	-96.3 +TT	-94.5 +TT		FDD
		-96.6 +TT	-94.6 +TT		
		-97.0 +TT	-94.9 +TT		
t to PUMAX as defined in subclause 6.2.4					
d by -0.5 dB when the assigned NR channel bandwidth is confined within 1475.9-1510.9 MHz.					
channel bandwidth is specified in Table 7.3.2.5-2.					

Table 7.3.2.5-2: Test Tolerance (TT) for RX sensitivity level

f ≤ 3.0GHz
0.7 dB

7.3.2_1 Reference sensitivity power level for flexible Tx-Rx frequency separation

Editor's Note: This test is incomplete. The following aspects are not yet determined:

- TP analysis needs to be captured in TR 38.905
- Test frequencies have to be specified for this test case
- Clause reference for the test frequencies is FFS
- Annex F needs to be updated and is FFS

7.3.2_1.1 Test purpose

The test purpose is to verify the ability of the UE to receive data with a given average throughput for a specified reference measurement channel, under conditions of low signal level, ideal propagation and no added noise for Tx-Rx frequency separation other than the default value.

7.3.2_1.2 Test applicability

Same as in clause 7.3.2.2.

7.3.2_1.3 Minimum conformance requirements

Same as in clause 7.3.2.3.

7.3.2_1.4 Test description

7.3.2_1.4.1 Initial conditions

Same as in Clause 7.3.2.4.1 with test configuration as listed in Tables 7.3.2_1.4.1-1, 7.3.2.4.2-1 and 7.3.2.4.3-1.

Table 7.3.2_1.4.1-1: Test Configuration Table

Initial Conditions				
Test Environment as specified in TS 38.508-1 [12] subclause 4.1			Normal, TL/VL, TL/VH, TH/VL, TH/VH	
Test Frequencies as specified in TS 38.508-1 [12] subclause FFS			Low range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1			Lowest, Highest	
Test SCS as specified in Table 5.3.5-1			Lowest	
Test Parameters				
Test ID	Downlink Configuration		Uplink Configuration	
	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.				

7.3.2_1.4.2 Test procedure.

Same as in 7.3.2.4.2.

7.3.2_1.4.3 Message contents

Same as in 7.3.2.4.3.

7.3.2_1.5 Test requirement

The throughput shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with reference receive power level specified in Tables 7.3.2.5-1 and parameters specified Tables 7.3.2_1.4.1-1, Tables 7.3.2.4.1-2 and Tables 7.3.2.4.1-3.

The Test Tolerances in Table 7.3.2.5-2 shall be applied.

7.4 Maximum input level

7.4.1 Test purpose

Maximum input level tests the UE's ability to receive data with a given average throughput for a specified reference measurement channel, under conditions of high signal level, ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the coverage area near to a g-NodeB.

7.4.2 Test applicability

This test case applies to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

7.4.3 Minimum conformance requirements

Maximum input level is defined as the maximum mean power received at the UE antenna port, at which the specified relative throughput shall meet or exceed the minimum requirements for the specified reference measurement channel. The throughput shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in 3GPP TS 38.101-1 [5] Annexes A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD as described in 3GPP TS 38.101-1 [5] Annex A.5.1.1) with parameters specified in Table 7.4.3-1.

Table 7.4.3-1: Maximum input level

Rx Parameter	Units	Channel bandwidth (MHz)
		5, 10, 15, 20
Power in Transmission Bandwidth Configuration ³	dBm	-40 ²
NOTE 1: The transmitter shall be set to 4 dB below P _{CMAX_L,f,c} at the minimum uplink configuration specified in Table 7.3.2.3-2 with P _{CMAX_L,f,c} as defined in clause 6.2.4.		
NOTE 2: Reference measurement channel is specified in 3GPP TS 38.101-1 [5] Annex A.3.2.3 for 64 QAM.		
NOTE 3: Power in transmission bandwidth configuration value is rounded to the nearest 0.5dB value.		

The normative reference for this requirement is TS 38.101-5 [11] 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 [12] subclause 4.1		Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1		Mid range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1		Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1		Lowest	
Test Parameters for Channel Bandwidths			
Downlink Configuration		Uplink Configuration	
Modulation	RB allocation	Modulation	RB allocation
CP-OFDM 64 QAM	NOTE 1	DFT-s-OFDM QPSK	NOTE 2
NOTE 1: The specific configuration of downlink RB allocation is defined in Table 7.3.2.4.1-2.			
NOTE 2: The specific configuration of uplink RB allocation is defined in Table 7.3.2.4.1-3.			

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.1.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.0, C.1, C.2, and C.3.1, and uplink signals according to TS 38.521-1 [2] Annex G.0, G.1, G.2, and G.3.1.
4. The DL and UL Reference Measurement Channels are set according to Table 7.4.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508[12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.9. 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 [12] clause 4.5. Message contents are defined in clause 7.4.4.3.

7.4.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 7.4.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.

2. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Tables 7.4.4.1-1. Since the UE has no payload data and no loopback data to send, the UE sends uplink MAC padding bits on the UL RMC.
3. Set the Downlink signal level to the value as defined in Table 7.4.5-1. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as $-\text{MU}$ to $-(\text{MU} + \text{Uplink power control window size})$ dB of the target power level in Table 7.4.5-1 for at least the duration of the Throughput measurement, where:
 - MU is the test system uplink power measurement uncertainty and is specified in Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW
 - Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [5], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified for test case 6.3.4.3 in Table F.1.2-1.
 - For UEs supporting Tx diversity, the transmit power is measured as the sum of the output power from both UE antenna connectors.
4. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no greater than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.3.

7.4.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED.

7.4.5 Test requirement

The throughput measurement derived in test procedure shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Tables 7.4.5-1.

Table 7.4.5-1: Maximum input level

Rx Parameter	Units	Channel bandwidth (MHz)
		5, 10, 15, 20
Power in Transmission Bandwidth Configuration ³	dBm	$-40^2 - TT$
NOTE 1: The transmitter shall be set to 4 dB below $P_{\text{CMAX_L,f,c}}$ at the minimum uplink configuration specified in Table 7.3.2.3-2 with $P_{\text{CMAX_L,f,c}}$ as defined in clause 6.2.4.		
NOTE 2: Reference measurement channel is specified in 3GPP TS 38.101-1 [5] Annex A.3.2.3 for 64 QAM.		
NOTE 3: Power in transmission bandwidth configuration value is rounded to the nearest 0.5dB value.		

Table 7.4.5-2: Test Tolerance (Maximum input level)

$f \leq 3.0\text{GHz}$
0.7 dB

7.5 Adjacent channel selectivity

7.5.1 Test purpose

Adjacent channel selectivity (ACS) is a measure of a receiver's ability to receive an NR signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel. ACS is the ratio of the receive filter attenuation on the assigned channel frequency to the receive filter attenuation on the adjacent channel(s).

7.5.2 Test applicability

This test case applies to all types of NR UE release 17 and forward that support satellite access operation.

7.5.3 Minimum conformance requirements

In Release 17, only frequency bands below 2.7GHz are considered. The NR satellite UE shall fulfil the minimum requirements specified in Table 7.5.3-1 for NR satellite bands with $F_{DL_high} < 2700$ MHz and $F_{UL_high} < 2,700$ MHz. These requirements apply for all values of an adjacent channel interferer in case 1 and for any SCS specified for the channel bandwidth of the wanted signal. The lower and upper range of test parameters are chosen as in Table 7.5.3-2 and Table 7.5.3-3 for verification of the requirements specified in Table 7.5.3-1. For these test parameters, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in 3GPP TS 38.101-1 [5] Annexes A.2.2 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in 3GPP TS 38.101-1 [5] Annex A.5.1.1).

Table 7.5.3-1: ACS for NR satellite bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz

RX parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
ACS	dB	33	30	27

Table 7.5.3-2: Test parameters for NR bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz, case 1

RX parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
Power in transmission bandwidth configuration	dBm	REFSENS + 14 dB		
$P_{\text{interferer}}^4$	dBm	REFSENS + 45.5 dB	REFSENS + 42.5 dB	REFSENS + 39.5
$BW_{\text{interferer}}$	MHz	5		
$F_{\text{interferer}} \text{ (offset)}^2$	MHz	$BW_{\text{Channel}}/2 + 2.5$ / $-(BW_{\text{Channel}}/2 + 2.5)$		
NOTE 1: The transmitter shall be set to 4 dB below $P_{\text{CMAX_L,f,c}}$ at the minimum UL configuration specified in clause 7.3.2 with $P_{\text{CMAX_L,f,c}}$ defined in clause 6.2.4.				
NOTE 2: The absolute value of the interferer offset $F_{\text{interferer}} \text{ (offset)}$ shall be further adjusted to $(\lceil F_{\text{interferer}} / SCS \rceil + 0.5) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS.				
NOTE 3: The interferer consists of the NR interferer RMC specified in 3GPP TS 38.101-1 [5] Annexes A.3.2.2 with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in 3GPP TS 38.101-1 [5] Annex A.5.1.1.				
NOTE 4: $P_{\text{interferer}}$ shall be rounded to the next higher 0.5dB value.				

**Table 7.5.3-3: Test parameters for NR bands with
 $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz, case 2**

RX parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
Power in transmission bandwidth configuration	dBm	-71.5	-68.5	-65.5
P _{interferer}	dBm	-40		
BW _{interferer}	MHz	5		
F _{interferer} (offset)	MHz	BW _{Channel} /2 + 2.5 / -(BW _{Channel} /2 + 2.5)		
NOTE 1: The transmitter shall be set to 24 dB below P _{CMAX_L,f,c} at the minimum UL configuration specified in clause 7.3.2 with P _{CMAX_L,f,c} defined in clause 6.2.4.				
NOTE 2: The absolute value of the interferer offset F _{interferer} (offset) shall be further adjusted to $\lceil (F_{interferer} / SCS) \rceil + 0.5 \cdot SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS.				
NOTE 3: The interferer consists of the NR interferer RMC specified in 3GPP TS 38.101-1 [5] Annexes A.3.2.2 with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in 3GPP TS 38.101-1 [5] Annex A.5.1.1.				
NOTE 4: P _{interferer} shall be rounded to the next higher 0.5dB value.				

The normative reference for this requirement is TS 38.101-5 [11] clause 7.5.

7.5.4 Test description

7.5.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in Table 7.5.4.1-1. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. Configuration of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.5.4.1-1: Test Configuration Table

Default Conditions				
Test Environment as specified in TS 38.508-1 [12] subclause 4.1			Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1			Mid range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1			Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1			Lowest	
Test Parameters				
	Downlink Configuration		Uplink Configuration	
Test ID	Modulation	RB allocation	Modulation	RB allocation
1	CP-OFDM QPSK	NOTE 1	DFT-s-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3.2.4.1-1.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, in Figure A.3.1.4.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.1, C.2, C.3.1, and uplink signals according to TS 38.521-1 [2] Annex G.0, G.1, G.2 and G.3.1.
4. The DL and UL Reference Measurement channels are set according to Table 7.5.4.1-1.

5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 7.5.4.3.

7.5.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 7.5.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.
2. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 7.5.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
3. Set the Downlink signal level to the value as defined in Table 7.5.5-2 as appropriate (Case 1). Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as $-(\text{MU})$ to $-(\text{MU} + \text{Uplink power control window size})$ dB of the target power level in Table 7.5.5-2 for at least the duration of the Throughput measurement, where:
 - MU is the test system uplink power measurement uncertainty and is specified in Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW.
 - Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [5], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified in Table F.1.2-1.
 - For UEs supporting Tx diversity, the transmit power is measured as the sum of the output power from both UE antenna connectors.
4. Set the Interferer signal level to the value as defined in Table 7.5.5-2 as appropriate (Case 1) and frequency below the wanted signal, using a modulated interferer bandwidth as defined in Annex D.
5. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.
6. Repeat steps from 3 to 5, using an interfering signal above the wanted signal in Case 1 at step 4.
7. Set the Downlink signal level to the value as defined in Table 7.5.5-3 as appropriate (Case 2). Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as $-(\text{MU})$ to $-(\text{MU} + \text{Uplink power control window size})$ dB of the target power level in Table 7.5.5-3 for at least the duration of the Throughput measurement, where MU and Uplink power control window size are defined above.
8. Set the Interferer signal level to the value as defined in Table 7.5.5-3 as appropriate (Case 2) and frequency below the wanted signal, using a modulated interferer bandwidth as defined in Annex D.
9. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.
10. Repeat steps from 7 to 9, using an interfering signal above the wanted signal in Case 2 at step 8.
11. Repeat for applicable channel bandwidths and operating band combinations in both Case 1 and Case 2.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no greater than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.3.

7.5.4.3 Message contents

Message contents are according to TS 38.508-1 [12] clause 4.6 ensuring Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED.

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exceptions for each network signalling value.

SIB19 message contents according to TS 38.508-1 [12] clause 5.6.2.1.

7.5.5 Test requirement

For NR bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz, the throughput measurement derived in test procedure shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in 3GPP TS 38.101-1 [5] Annexes A.2.2 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in 3GPP TS 38.101-1 [5] Annex A.5.1.1 with parameters specified in Tables 7.5.5-2 and 7.5.5-3.

Table 7.5.5-1: ACS for NR satellite bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz

RX parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
ACS	dB	33	30	27

Table 7.5.5-2: Test parameters for NR bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz, case 1

RX parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
Power in transmission bandwidth configuration	dBm	REFSENS + 14 dB		
$P_{interferer}^4$	dBm	REFSENS + 45.5 dB	REFSENS + 42.5 dB	REFSENS + 39.5
$BW_{interferer}$	MHz	5		
$F_{interferer} \text{ (offset)}^2$	MHz	$\frac{BW_{Channel}/2 + 2.5}{-(BW_{Channel}/2 + 2.5)}$		
NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX_L,f,c}$ at the minimum UL configuration specified in clause 7.3.2 with $P_{CMAX_L,f,c}$ defined in clause 6.2.4.				
NOTE 2: The absolute value of the interferer offset $F_{interferer} \text{ (offset)}$ 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. The interferer is an NR signal with 15 kHz SCS.				
NOTE 3: The interferer consists of the NR interferer RMC specified in 3GPP TS 38.101-1 [5] clause A.3.2.2 with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in 3GPP TS 38.101-1 [5] Annex A.5.1.1.				
NOTE 4: $P_{interferer}$ shall be rounded to the next higher 0.5dB value.				

Table 7.5.5-3: Test parameters for NR bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz, case 2

RX parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
Power in transmission bandwidth configuration	dBm	-71.5	-68.5	-65.5
P _{interferer}	dBm	-40		
BW _{interferer}	MHz	5		
F _{interferer} (offset)	MHz	BW _{Channel} /2 + 2.5 / -(BW _{Channel} /2 + 2.5)		
NOTE 1: The transmitter shall be set to 24 dB below P _{CMAX_L,f,c} at the minimum UL configuration specified in clause 7.3.2 with P _{CMAX_L,f,c} defined in clause 6.2.4.				
NOTE 2: The absolute value of the interferer offset F _{interferer} (offset) shall be further adjusted to $\lceil (F_{interferer} / SCS) \rceil + 0.5 \cdot SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS.				
NOTE 3: The interferer consists of the NR interferer RMC specified in 3GPP TS 38.101-1 [5] clause A.3.2.2 with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in 3GPP TS 38.101-1 [5] clause A.5.1.1.				
NOTE 4: P _{interferer} shall be rounded to the next higher 0.5 dB value.				

7.6 Blocking characteristics

7.6.1 General

The blocking characteristic is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer on frequencies other than those of the spurious response or the adjacent channels, without this unwanted input signal causing a degradation of the performance of the receiver beyond a specified limit. The blocking performance shall apply at all frequencies except those at which a spurious response occurs.

7.6.2 In-band blocking

7.6.2.1 Test purpose

In-band blocking is defined for an unwanted interfering signal falling into the range from 15 MHz below to 15 MHz above the UE receive band, with $F_{DL_high} < 2700$ MHz and $F_{UL_high} < 2700$ MHz, or into an immediately adjacent frequency range up $3 \cdot BW_{Channel}$ below or above the UE receive band, with $F_{DL_low} \geq 3300$ MHz and $F_{UL_low} \geq 3300$ MHz, at which the relative throughput shall meet or exceed the requirement for the specified measurement channel.

7.6.2.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

7.6.2.3 Minimum conformance requirements

For NR satellite bands with $F_{DL_high} < 2700$ MHz and $F_{UL_high} < 2700$ MHz in-band blocking (IBB) is defined for an unwanted interfering signal falling into the UE receive band or into the first 15 MHz below or above the UE receive band.

The throughput of the wanted signal shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in 3GPP TS 38.101-1 [5] Annexes A.2.2 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1) with parameters specified in Table 7.6.2-1 and Table 7.6.2-2. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

Table 7.6.2-1: In-band blocking parameters for NR satellite bands with $F_{DL_high} < 2700$ MHz and $F_{UL_high} < 2700$ MHz

RX parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
Power in transmission bandwidth configuration ³	dBm	REFSENS + 6 dB	REFSENS + 7 dB	REFSENS + 9 dB
BW _{interferer}	MHz	5		
F _{offset, case 1}	MHz	7.5		
F _{offset, case 2}	MHz	12.5		
NOTE 1: The transmitter shall be set to 4 dB below P _{CMAX_L,f,c} at the minimum UL configuration specified in clause 7.3.2 with P _{CMAX_L,f,c} defined in clause 6.2.4.				
NOTE 2: The interferer consists of the RMC specified in Annex A.3.2.2 with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1 and 15 kHz SCS.				
NOTE 3: Power in transmission bandwidth configuration shall be rounded to the next higher 0.5dB value.				

Table 7.6.2-2: In-band blocking for NR satellite bands with $F_{DL_high} < 2700$ MHz and $F_{UL_high} < 2700$ MHz

Operating Band	Parameter	Unit	Case 1	Case 2
	$P_{interferer}$	dBm	-56	-44
n254, n255, n256	$F_{interferer}$ (offset)	MHz	$-BW_{Channel}/2 - F_{offset, case 1}$ and $BW_{Channel}/2 + F_{offset, case 1}$	$\leq -BW_{Channel}/2 - F_{offset, case 2}$ and $\geq BW_{Channel}/2 + F_{offset, case 2}$
	$F_{interferer}$	MHz	NOTE 2	$F_{DL_low} - 15$ to $F_{DL_high} + 15$
NOTE 1: 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. The interferer is an NR signal with 15 kHz SCS.				
NOTE 2: For each carrier frequency, the requirement applies for two interferer carrier frequencies: a: $-BW_{Channel}/2 - F_{offset, case 1}$; b: $BW_{Channel}/2 + F_{offset, case 1}$				

The normative reference for this requirement is TS 38.101-5 [11] 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 NTN operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in table 7.6.2.4.1-1. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. Configuration of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.6.2.4.1-1: Test Configuration Table

Default Conditions				
Test Environment as specified in TS 38.508-1 [12] subclause 4.1			Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1			Mid range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1			Lowest, Mid, Highest	
Test SCS as specified in Table 5.3.5-1			Lowest	
Test Parameters				
	Downlink Configuration		Uplink Configuration	
Test ID	Mod'n	RB allocation	Mod'n	RB allocation
1	CP-OFDM QPSK	NOTE 1	DFT-s-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of downlink and uplink are defined in Table 7.3.2.4.1-2 and Table 7.3.2.4.1-3.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, in Figure A.3.1.4.1 for TE diagram and section A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.1, C.2, C.3.1, and uplink signals according to TS 38-521-1 [2] Annex G.0, G.1, G.2, G.3.1.
4. The DL and UL Reference Measurement channels are set according to Table 7.6.2.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send the same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 7.6.2.4.3.

7.6.2.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 7.6.2.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.
2. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 7.6.2.4.1-1. Since the UL has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.
3. Set the parameters of the signal generator for an interfering signal below the wanted signal in Case 1 according to Tables 7.6.2.5-1 and 7.6.2.5-2.
4. Set the downlink signal level according to the table 7.6.2.5-1. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as -MU to -(MU + Uplink power control window size) dB of the target power level in Table 7.6.2.5-1 for at least the duration of the Throughput measurement, where:
 - MU is the test system uplink power measurement uncertainty and is specified in Table F.1.3-1 for the carrier frequency *f* and the channel bandwidth *BW*.
 - Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS

38.101-1 [5], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified for test case 6.3.4.3 in Table F.1.2-1.

- For UEs supporting Tx diversity, the transmit power is measured as the sum of the output power from both UE antenna connectors.
5. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2.
 6. Repeat steps from 3 to 5, using an interfering signal above the wanted signal in Case 1 at step 3.
 7. Repeat steps from 3 to 6, using interfering signals in Case 2 at step 3 and 6. The ranges of case 2 are covered in steps equal to the interferer bandwidth. Interferer frequencies should be chosen starting with an offset nearest to the centre frequency and sweep outwards towards the band edges. In order to ensure that full range is tested for interferer frequency, run last test steps at frequency equal to $F_{\text{Interferer}}$ range limit defined at the corresponding band edge.
 8. If applicable based on NR band, repeat steps from 3 to 5, using interfering signals in Case 3 at step 3.
 9. If applicable based on NR band, repeat steps from 3 to 5, using interfering signals in Case 4 at step 3.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no greater than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.3.

7.6.2.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 with TRANSFORM_PRECODER_ENABLED condition in Table 4.6.3-118 PUSCH-Config.

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exceptions for each network signalling value.

SIB19 message contents according to TS 38.508-1 [12] clause 5.6.2.1

7.6.2.5 Test requirement

For NR bands with $F_{\text{DL_high}} < 2700$ MHz and $F_{\text{UL_high}} < 2700$ MHz, the throughput measurement derived in test procedure shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in Annex in Annexes A.3.2 with parameters specified in Tables 7.6.2.5-1 and 7.6.2.5-2.

Table 7.6.2.5-1: In-band blocking parameters for NR satellite bands with $F_{\text{DL_high}} < 2700$ MHz and $F_{\text{UL_high}} < 2700$ MHz

RX parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
Power in transmission bandwidth configuration ³	dBm	REFSENS + 6 dB	REFSENS + 7 dB	REFSENS + 9 dB
BW _{interferer}	MHz	5		
F _{offset, case 1}	MHz	7.5		
F _{offset, case 2}	MHz	12.5		
NOTE 1: The transmitter shall be set to 4 dB below P _{CMAX_L,f,c} at the minimum UL configuration specified in clause 7.3.2 with P _{CMAX_L,f,c} defined in clause 6.2.4.				
NOTE 2: The interferer consists of the RMC specified in 3GPP Annex A.3.2.2 with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1 and 15 kHz SCS.				
NOTE 3: Power in transmission bandwidth configuration shall be rounded to the next higher 0.5dB value.				

Table 7.6.2.5-2: In-band blocking for NR satellite bands with $F_{DL_high} < 2700$ MHz and $F_{UL_high} < 2700$ MHz

Operating Band	Parameter	Unit	Case 1	Case 2
	$P_{interferer}$	dBm	-56	-44
n254, n255, n256	$F_{interferer}$ (offset)	MHz	$-BW_{Channel}/2 - F_{offset, case 1}$ and $BW_{Channel}/2 + F_{offset, case 1}$	$\leq -BW_{Channel}/2 - F_{offset, case 2}$ and $\geq BW_{Channel}/2 + F_{offset, case 2}$
	$F_{interferer}$	MHz	NOTE 2	$F_{DL_low} - 15$ to $F_{DL_high} + 15$
NOTE 1: 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. The interferer is an NR signal with 15 kHz SCS.				
NOTE 2: For each carrier frequency, the requirement applies for two interferer carrier frequencies: a: $-BW_{Channel}/2 - F_{offset, case 1}$; b: $BW_{Channel}/2 + F_{offset, case 1}$				

7.6.3 Out of Band Blocking

7.6.3.1 Test purpose

Out-of-band band blocking is defined for an unwanted CW interfering signal falling outside a frequency range 15 MHz below or above the UE receive band, with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz.

7.6.3.2 Test applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

7.6.3.3 Minimum conformance requirements

For NR satellite bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz out-of-band band blocking is defined for an unwanted CW interfering signal falling outside a frequency range 15 MHz below or above the UE receive band.

The throughput of the wanted signal shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in 3GPP TS 38.101-1 [5] clauses A.2.2 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in clauses A.5.1.1) with parameters specified in Table 7.6.3-1 and Table 7.6.3-2. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

Table 7.6.3-1: Out-of-band blocking parameters for NR satellite bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz

RX parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
Power in transmission bandwidth configuration ²	dBm	REFSENS + 6 dB	REFSENS + 7 dB	REFSENS + 9 dB
NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX_L,f,c}$ at the minimum UL configuration specified in clause 7.3.2 with $P_{CMAX_L,f,c}$ defined in clause 6.2.4.				
NOTE 2: Power in transmission bandwidth configuration shall be rounded to the next higher 0.5dB value.				

**Table 7.6.3-2: Out of-band blocking for NR satellite bands with
F_{DL_high} < 2,700 MHz and F_{UL_high} < 2,700 MHz**

Operating Band	Parameter	Unit	Range 1	Range 2	Range 3
	P _{interferer}	dBm	-44	-30	-15
n254 ²	F _{interferer} (CW)	MHz	-60 < f – F _{DL_low} < -15 or 15 < f – F _{DL_high} < 60	-85 < f – F _{DL_low} ≤ -60 or 60 ≤ f – F _{DL_high} < 85	1 ≤ f ≤ F _{DL_low} – 85 or F _{DL_high} + 85 ≤ f ≤ 12750
n255	F _{interferer} (CW)	MHz	-60 < f – F _{DL_low} < -15 or 15 < f – F _{DL_high} < 60	-85 < f – F _{DL_low} ≤ -60 or 60 ≤ f – F _{DL_high} < 85	1 ≤ f ≤ F _{DL_low} – 85 or F _{DL_high} + 85 ≤ f ≤ 12750
n256 ¹	F _{interferer} (CW)	MHz	-100 < f – F _{DL_low} < -15 or 15 < f – F _{DL_high} < 60	-145 < f – F _{DL_low} ≤ -100 or 60 ≤ f – F _{DL_high} < 85	1 ≤ f ≤ F _{DL_low} – 145 or F _{DL_high} + 85 ≤ f ≤ 12750
NOTE 1: Band n256 lower frequency ranges are modified to enable specific implementations NOTE 2: Band n254 power level of the interferer (P _{interferer}) for Range 3 shall be modified to -20 dBm for F _{interferer} > 2585 MHz and F _{interferer} < 2775 MHz. NOTE 3: void NOTE 4: void					

For interferer frequencies across ranges 1, 2 and 3 in Table 7.6.3-1, a maximum of

$$\lfloor \max \{24, 6 \cdot \lceil n \cdot N_{RB} / 6 \rceil \} / \min \{ \lfloor n \cdot N_{RB} / 10 \rfloor, 5 \} \rfloor$$

exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a step size of $\min(\lfloor BW_{channel}/2 \rfloor, 5)$ MHz with N_{RB} the number of resource blocks in the downlink transmission bandwidth configuration, $BW_{channel}$ the bandwidth of the frequency channel in MHz and $n = 1, 2, 3$ for SCS = 15, 30, 60 kHz, respectively. For these exceptions, the requirements in clause 7.7 apply.

The normative reference for this requirement is TS 38.101-5 [11] clause 7.6.3.

7.6.3.4 Test description

7.6.3.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, 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 7.6.3.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in TS 38.521-1 [2] clause A.2 and A.3. Configurations of PDSCH and PDCCH before measurement are specified in TS 38.521-1 [2] Annex C.2.

Table 7.6.3.4.1-1: Test Configuration Table for power class 3

Default Conditions				
Test Environment as specified in TS 38.508-1 [5] subclause 4.1			Normal	
Test Frequencies as specified in TS 38.508-1 [5] subclause 4.3.1			Low range	
Test Channel Bandwidths as specified in TS 38.508-1 [5] subclause 4.3.1			Lowest, Mid, Highest Lowest UL / Lowest DL, Lowest UL / Highest DL (NOTE 3)	
Test SCS as specified in TS 38.508-1 [5] subclause 4.3.1			Lowest	
Test Parameters				
	Downlink Configuration		Uplink Configuration	
Test ID	Mod'n	RB allocation	Mod'n	RB allocation
1	CP-OFDM QPSK	NOTE 1	DFT-s-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3.2.4.1-1.				
NOTE 2: Void.				
NOTE 3: Additional test points selected according to asymmetric channel bandwidths specified in clause 5.3.6. DL channel bandwidth shall be selected first.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, Figure A.3.1.2.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.1, C.2, C.3 and uplink signals according to TS 38.521-1 [2] Annex G.0, G.1, G.2, G.3.1.
4. The DL and UL Reference Measurement Channel is set according to Table 7.6.3.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through AT commands or any other preconfigured means.
7. Optionally, for GSO only device to reduce the test time, preconfigure the UE by any means to deactivate ephemeris consistency check so that the UE accepts NGSO (LEO-600) ephemeris.
- 8a. In case the ephemeris consistency check on the UE can be deactivated as described in step 7, the test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508 [12] Table 5.6.2.1-2 for NGSO (LEO-600).
- 8b. In case the ephemeris consistency check on the UE cannot be deactivated as described in step 7, the test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO satellites and Table 5.6.2.1-2 for NGSO (LEO-600) if UE supports only NGSO satellites or both GSO and NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1
9. Deactivate UE prediction of satellite trajectory by any preconfigured means.
10. 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 [12] clause 4.5. Message contents are defined in clause 7.6.3.4.3.

7.6.3.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 7.6.3.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.
2. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 7.6.3.4.1-1. Since the UE has no payload data to send, the UE transmits uplink MAC padding bits on the UL RMC.

3. Set the parameters of the CW signal generator for an interfering signal below the wanted signal according to Table 7.6.3.5-2 or 7.6.3.5-4. The frequency step size is $\min\left(\frac{BW_{channel}}{2}, 5\right)$ MHz.
4. Set the downlink signal level according to the table 7.6.3.5-1 or 7.6.3.5-3. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as -MU to -(MU + Uplink power control window size) dB of the target power level in Table 7.6.3.5-1 or Table 7.6.3.5-3 for at least the duration of the Throughput measurement, where:
 - MU is the test system uplink power measurement uncertainty and is specified in Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW
 - Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [2], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified for test case 6.3.4.3 in Table F.1.2-1.
 - For UEs supporting Tx diversity, the transmit power is measured as the sum of the output power from both UE antenna connectors.
5. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.
6. Record the frequencies for which the throughput doesn't meet the requirements.
7. Repeat steps from 3 to 6, using an interfering signal above the wanted signal at step 3.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no greater than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.3.

7.6.3.4.3 Message contents

Message contents are according to TS 38.508-1 [5] subclause 4.6 ensuring Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED.

7.6.3.5 Test requirement

For NR satellite bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz out-of-band band blocking is defined for an unwanted CW interfering signal falling outside a frequency range 15 MHz below or above the UE receive band.

The throughput of the wanted signal shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in 3GPP TS 38.101-1 [5] clauses A.2.2 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in clauses A.5.1.1) with parameters specified in Table 7.6.3-1 and Table 7.6.3-2. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

Table 7.6.3-1: Out-of-band blocking parameters for NR satellite bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz

RX parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
Power in transmission bandwidth configuration ²	dBm	REFSENS + 6 dB	REFSENS + 7 dB	REFSENS + 9 dB
NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX_L,f,c}$ at the minimum UL configuration specified in clause 7.3.2 with $P_{CMAX_L,f,c}$ defined in clause 6.2.4.				
NOTE 2: Power in transmission bandwidth configuration shall be rounded to the next higher 0.5dB value.				

**Table 7.6.3-2: Out of-band blocking for NR satellite bands with
F_{DL_high} < 2,700 MHz and F_{UL_high} < 2,700 MHz**

Operating Band	Parameter	Unit	Range 1	Range 2	Range 3
	P _{interferer}	dBm	-44	-30	-15
n254 ²	F _{interferer} (CW)	MHz	-60 < f – F _{DL_low} < -15 or 15 < f – F _{DL_high} < 60	-85 < f – F _{DL_low} ≤ -60 or 60 ≤ f – F _{DL_high} < 85	1 ≤ f ≤ F _{DL_low} – 85 or F _{DL_high} + 85 ≤ f ≤ 12750
n255	F _{interferer} (CW)	MHz	-60 < f – F _{DL_low} < -15 or 15 < f – F _{DL_high} < 60	-85 < f – F _{DL_low} ≤ -60 or 60 ≤ f – F _{DL_high} < 85	1 ≤ f ≤ F _{DL_low} – 85 or F _{DL_high} + 85 ≤ f ≤ 12750
n256 ¹	F _{interferer} (CW)	MHz	-100 < f – F _{DL_low} < -15 or 15 < f – F _{DL_high} < 60	-145 < f – F _{DL_low} ≤ - 100 or 60 ≤ f – F _{DL_high} < 85	1 ≤ f ≤ F _{DL_low} – 145 or F _{DL_high} + 85 ≤ f ≤ 12750
NOTE 1: Band n256 lower frequency ranges are modified to enable specific implementations NOTE 2: Band n254 power level of the interferer (P _{interferer}) for Range 3 shall be modified to -20 dBm for F _{interferer} > 2585 MHz and F _{interferer} < 2775 MHz. NOTE 3: Void NOTE 4: Void					

For interferer frequencies across ranges 1, 2 and 3 in Table 7.6.3-1, a maximum of

$$\lfloor \max \{24, 6 \cdot \lceil n \cdot N_{RB} / 6 \rceil \} / \min \{ \lfloor n \cdot N_{RB} / 10 \rfloor, 5 \} \rfloor$$

exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a step size of $\min(\lfloor BW_{channel}/2 \rfloor, 5)$ MHz with N_{RB} the number of resource blocks in the downlink transmission

bandwidth configuration, $BW_{channel}$ the bandwidth of the frequency channel in MHz and $n = 1, 2, 3$ for SCS = 15, 30, 60 kHz, respectively. For these exceptions, the requirements in clause 7.7 apply.

7.6.4 Narrow band blocking

7.6.4.1 Test Purpose

Verifies a receiver's ability to receive a NR signal at its assigned channel frequency in the presence of an unwanted narrow band CW interferer at a frequency, which is less than the nominal channel spacing.

The lack of narrow-band blocking ability will decrease the coverage area when other NR Node B transmitters exist (except in the adjacent channels and spurious response).

7.6.4.2 Test Applicability

The requirements of this test apply to all types of NR Power Class 3 UE release 17 and forward that support satellite access operation.

7.6.4.3 Minimum Conformance Requirements

The relative throughput shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3, A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.6.4.3-1.

Table 7.6.4.3-1: Narrow Band Blocking

Operating Band	Parameter	Unit	Channel Bandwidth (MHz)			
			5	10	15	20
n254, n255, n256	P _w	dBm	P _{REFSENS} + channel-bandwidth specific value below			
			16	13	14	16
	P _{uw} (CW)	dBm	-55			
	F _{uw} (offset SCS= 15 kHz) 3	MHz	$\left(\left\lceil\frac{\frac{BW_{channel}}{2} + 0.2}{SCS} + 0.5\right\rceil + 0.5\right)SCS$			
	F _{uw} (offset SCS= 30 kHz) ³	MHz	NA			
NOTE 1: The transmitter shall be set a 4 dB below P _{CMAX_L,f,c} at the minimum UL configuration specified in clause 7.3.2 with P _{CMAX_L,f,c} defined in clause 6.2.4.						
NOTE 2: The P _{REFSENS} power level is specified in clause 7.3.2.						
NOTE 3: F _{uw} shall be rounded to half of SCS.						

The normative reference for this requirement is TS 38.101-5 [11] clause 7.6.4.

7.6.4.4 Test Description

7.6.4.4.1 Initial Conditions

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

The initial test configurations consist of environmental conditions, test frequencies, and channel bandwidths based on NR NTN 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 7.6.4.4.1-1. The details of the uplink and downlink reference measurement channels (RMCs) are specified in Annexes A.2 and A.3 respectively. The details of the OCNG patterns used are specified in Annex A.5. Configurations of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.6.4.4.1-1: Test Configuration Table

Default Conditions				
Test Environment as specified in TS 38.508-1 [12] subclause 4.1			Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1			Mid range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1			Lowest, Mid and Highest	
Test SCS as specified in TS 38.508-1 [12] subclause 4.3.1			According to CH BW SCS in table 7.6.4.3-1	
Test Parameters				
	Downlink Configuration		Uplink Configuration	
Test ID	Mod'n	RB allocation	Mod'n	RB allocation
1	CP-OFDM QPSK	NOTE 1	DFT-s-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of downlink and uplink are defined in Table 7.3.2.4.1-2 and Table 7.3.2.4.1-3.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, in Figure A.3.1.4.2 for TE diagram and section A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.1, C.2, and C.3.1, and uplink signals according to TS 38-521-1 [2] Annex G.0, G.1, G.2, and G.3.1.

4. The UL and DL Reference Measurement channels are set according to Table 7.6.4.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508-1 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send the same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. Ensure the UE is in State RRC_CONNECTED with generic procedure parameters Connectivity *NR* according to TS 38.508-1 [12] clause 4.5. Message contents are defined in clause 7.6.4.4.3.

7.6.4.4.2 Test Procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 7.6.4.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.
2. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 7.6.4.4.1-1. Since the UE has no payload and no loopback data to send, the UE transmits uplink MAC padding bits on the UL RMC.
3. Set the parameters of the CW signal generator for an interfering signal below the wanted signal according to Table 7.6.4.5-1.
4. Set the downlink signal level according to the table 7.6.4.5-1. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as $-(MU)$ to $-(MU + \text{Uplink power control window size})$ dB of the target power level in Table 7.6.4.5-1 for at least the duration of the Throughput measurement, where:
 - MU is the test system uplink power measurement uncertainty and is specified in Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW
 - Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [5], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified for test case 6.3.4.3 in Table F.1.2-1.
 - For UEs supporting Tx diversity, the transmit power is measured as the sum of the output power from both UE antenna connectors.
5. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2.
6. Repeat steps from 3 to 5, using an interfering signal above the wanted signal at step 3.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no greater than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.3.

7.6.4.4.3 Message Contents

Message contents are according to TS 38.508-1 [12] subclause 4.6 ensuring Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED.

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exceptions for each network signalling value.

SIB19 message contents according to TS 38.508-1 [12] clause 5.6.2.1

7.6.4.5 Test Requirement

The throughput measurement derived in test procedure shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Table 7.6.4.5-1.

Table 7.6.4.5-1: Narrow Band Blocking

Operating Band	Parameter	Unit	Channel Bandwidth (MHz)			
			5	10	15	20
n254, n255, n256	P _w	dBm	P _{REFSENS} + channel-bandwidth specific value below			
			16	13	14	16
	P _{uw} (CW)	dBm	-55			
	F _{uw} (offset SCS= 15 kHz) 3	MHz	$\left(\left\lceil\frac{\frac{BW_{channel}}{2} + 0.2}{SCS} + 0.5\right\rceil + 0.5\right) SCS$			
	F _{uw} (offset SCS= 30 kHz) 3	MHz	NA			
NOTE 1: The transmitter shall be set a 4 dB below P _{CMAX_L,f,c} at the minimum UL configuration specified in clause 7.3.2 with P _{CMAX_L,f,c} defined in clause 6.2.4 in TS 38.101-5 [11].						
NOTE 2: The P _{REFSENS} power level is specified in clause 7.3.2 in TS 38.101-5 [11].						
NOTE 3: F _{uw} shall be rounded to half of SCS.						

7.7 Spurious response

7.7.1 Test Purpose

Spurious response is a measure of the ability of the receiver to receive a wanted signal on its assigned channel frequency without exceeding a given degradation due to the presence of an unwanted CW interfering signal at any other frequency for which a response is obtained, i.e. for which the out-of-band blocking limit as specified in subclause 7.6.3 is not met.

The lack of the spurious response ability decreases the coverage area when other unwanted interfering signal exists at any other frequency.

7.7.2 Test Applicability

This test case applies to all types of NR UE release 17 and forward that support satellite access operation.

7.7.3 Minimum Conformance Requirements

The throughput shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in 3GPP TS 38.101-1 [5] Annexes A.2.2 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1) with parameters for the wanted signal as specified in Table 7.7.3-1 for NR bands with $F_{\text{DL_high}} < 2700$ MHz and $F_{\text{UL_high}} < 2700$ MHz and for the interferer as specified in Table 7.7.3-2. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

Table 7.7.3-1: Spurious response parameters for NR bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz

RX parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
Power in transmission bandwidth configuration ²	dBm	REFSENS + 6 dB	REFSENS + 7 dB	REFSENS + 9 dB
NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX_L,f,c}$ defined in clause 6.2.4.				
NOTE 2: Power in transmission bandwidth configuration value is rounded to the next higher 0.5dB value.				

Table 7.7.3-2: Spurious response

Parameter	Unit	Level
$P_{Interferer}$ (CW)	dBm	-44
$F_{Interferer}$	MHz	Spurious response frequencies

The normative reference for this requirement is TS 38.101-5 [11] clause 7.7.

7.7.4 Test Description

7.7.4.1 Initial Conditions

The initial conditions shall be the same as in clause 7.6.3.4.1 in order to test spurious responses obtained in clause 7.6.3 under the same conditions.

7.7.4.2 Test Procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 7.6.3.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.
2. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 7.6.3.4.1-1. Since the UE has no payload and no loopback data to send, the UE transmits uplink MAC padding bits on the UL RMC.
3. Set the parameters of the CW signal generator for an interfering signal according to Table 7.7.5-2. The spurious frequencies are taken from records in the final step of test procedures in clause 7.6.3.4.2.
4. Set the downlink signal level according to the Table 7.7.5-1. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as $-MU$ to $-(MU + \text{Uplink power control window size})$ dB of the target power level in Table 7.7.5-1 for at least the duration of the Throughput measurement, where:
 - MU is the test system uplink power measurement uncertainty and is specified in Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW
 - Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [5], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified for test case 6.3.4.3 in Table F.1.2-1.
 - For UEs supporting Tx diversity, the transmit power is measured as the sum of the output power from both UE antenna connectors.
5. For the spurious frequency, measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no greater than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.3.

7.7.4.3 Message Contents

Message contents are according to TS 38.508-1 [12] clause 4.6 ensuring Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED for NR band.

Message contents are according to TS 38.508-1[12] subclause 4.6 with the following exceptions for each network signalling value.

SIB19 message contents according to TS 38.508-1 [12] clause 5.6.2.1. Message contents are according to TS 38.508-1 [12] clause 4.6 ensuring Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED for NR band.

Message contents are according to TS 38.508-1[12] subclause 4.6 with the following exceptions for each network signalling value.

SIB19 message contents according to TS 38.508-1 [12] clause 5.6.2.1.

7.7.5 Test Requirement

The throughput measurement derived in test procedure shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters for the wanted signal as specified in Table 7.7.5-1 for NR bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz and for the interferer as specified in Table 7.7.5-2.

Table 7.7.5-1: Spurious response parameters for NR bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz

RX parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
Power in transmission bandwidth configuration ²	dBm	REFSENS + 6 dB	REFSENS + 7 dB	REFSENS + 9 dB
NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX_L,f,c}$ defined in clause 6.2.4.				
NOTE 2: Power in transmission bandwidth configuration value is rounded to the next higher 0.5dB value.				

Table 7.7.5-2: Spurious response

Parameter	Unit	Level
$P_{Interferer}$ (CW)	dBm	-44
$F_{Interferer}$	MHz	Spurious response frequencies

7.8 Intermodulation characteristics

7.8.1 General

Intermodulation response rejection is a measure of the capability of the receiver to receive a wanted signal on its assigned channel frequency in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal.

7.8.2 Wide band Intermodulation

7.8.2.1 Test purpose

Intermodulation response tests the UE's ability to receive data with a given average throughput for a specified reference measurement channel, in the presence of two or more interfering signals which have a specific frequency relationship to the wanted signal, under conditions of ideal propagation and no added noise.

A UE unable to meet the throughput requirement under these conditions will decrease the coverage area when two or more interfering signals exist which have a specific frequency relationship to the wanted signal.

7.8.2.2 Test applicability

This test case applies to all types of NR UE release 17 and forward that support satellite access operation.

7.8.2.3 Minimum conformance requirements

The wide band intermodulation requirement is defined using a CW carrier and modulated NR signal as interferer 1 and interferer 2 respectively.

The throughput shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in 3GPP TS 38.101-1 [5] Annexes A.2.2 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1) with parameters specified in Table 7.8.2.3-1 for NR bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz. The relative throughput requirement shall be met for any SCS specified for the channel bandwidth of the wanted signal.

Table 7.8.2.3-1: Wide band intermodulation parameters for NR bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz

Rx parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
P_w in Transmission Bandwidth Configuration, per CC ⁵	dBm	REFSENS + 6 dB	REFSENS + 7 dB	REFSENS + (9 + 10log ₁₀ (BW _{Channel} /20)) dB
$P_{Interferer\ 1}$ (CW)	dBm	-46		
$P_{Interferer\ 2}$ (Modulated)	dBm	-46		
BW _{Interferer 2}	MHz	5		
$F_{Interferer\ 1}$ (Offset)	MHz	$\frac{-BW_{channel}/2 - 7.5}{+BW_{channel}/2 + 7.5}$		
$F_{Interferer\ 2}$ (Offset)	MHz	$2 \cdot F_{Interferer\ 1}$		
NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX_L,f,c}$ defined in clause 6.2.4.				
NOTE 2: Reference measurement channel is specified in 3GPP TS 38.101-1 [5] Annexes A.2.2 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1).				
NOTE 3: The modulated interferer consists of the Reference measurement channel specified in 3GPP TS 38.101-1 [5] Annex A.3.2.2 with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1 and 15 kHz SCS.				
NOTE 4: The $F_{interferer\ 1}$ (offset) is the frequency separation of the centre frequency of the carrier closest to the interferer and the centre frequency of the CW interferer and $F_{interferer\ 2}$ (offset) is the frequency separation of the centre frequency of the carrier closest to the interferer and the centre frequency of the modulated interferer.				
NOTE 5: 10log ₁₀ (x) is rounded to the next higher 0.5dB value.				

The normative reference for this requirement is TS 38.101-5 [11] clause 7.8.

7.8.2.4 Test description

7.8.2.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in Table 7.8.2.4.1-1. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. Configuration of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.8.2.4.1-1: Test Configuration Table

Default Conditions				
Test Environment as specified in TS 38.508-1 [12] subclause 4.1			Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1			Mid range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] 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	Modulation	RB allocation	Modulation	RB allocation
1	CP-OFDM QPSK	NOTE 1	DFT-s-OFDM QPSK	NOTE 1
NOTE 1: The specific configuration of uplink and downlink are defined in Table 7.3.2.4.1-1.				

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, in Figure A.3.1.4.3 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to clauses C.0, C.1, C.2, C.3.1, and uplink signals according to TS 38.521-1 [2] clauses G.0, G.1, G.2, G.3.1.
4. The DL and UL Reference Measurement channels are set according to Table 7.8.2.4.1-1.
5. Propagation conditions are set according to Annex B.0.
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 7.8.2.4.3.

7.8.2.4.2 Test procedure

1. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Table 7.8.2.4.1-1. The SS sends downlink MAC padding bits on the DL RMC.
2. SS sends uplink scheduling information for each UL HARQ process via PDCCH DCI format 0_1 for C_RNTI to schedule the UL RMC according to Table 7.8.2.4.1-1. Since the UE has no payload and no loopback data to send the UE sends uplink MAC padding bits on the UL RMC.

3. Set the Downlink signal level to the value as defined in Table 7.8.2.5-1. Send uplink power control commands to the UE using 1dB power step size to ensure that the UE output power measured by the test system is within the Uplink power control window, defined as $-(\text{MU})$ to $-(\text{MU} + \text{Uplink power control window size})$ dB of the target power level in Table 7.8.2.5-1 for at least the duration of the Throughput measurement, where:
 - MU is the test system uplink power measurement uncertainty and is specified in Table F.1.3-1 for the carrier frequency f and the channel bandwidth BW
 - Uplink power control window size = 1dB (UE power step size) + 0.7dB (UE power step tolerance) + (Test system relative power measurement uncertainty), where, the UE power step tolerance is specified in TS 38.101-1 [5], Table 6.3.4.3-1 and is 0.7dB for 1dB power step size, and the Test system relative power measurement uncertainty is specified for test case 6.3.4.3 in Table F.1.2-1.
 - For UEs supporting Tx diversity, the transmit power is measured as the sum of the output power from both UE antenna connectors.
4. Set the Interfering signal levels to the values as defined in Table 7.8.2.5-1 and frequency below the wanted signal.
5. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex H.2.
6. Repeat steps from 3 to 5, using an interfering signal above the wanted signal at step 4.

NOTE: The purpose of the Uplink power control window is to ensure that the actual UE output power is no greater than the target power level, and as close as possible to the target power level. The relationship between the Uplink power control window, the target power level and the corresponding possible actual UE Uplink power window is illustrated in Annex F.4.3.

7.8.2.4.3 Message contents

Message contents are according to TS 38.508-1 [12] clause 4.6 ensuring Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED for NR band.

Message contents are according to TS 38.508-1[12] subclause 4.6 with the following exceptions for each network signalling value.

SIB19 message contents according to TS 38.508-1 [12] clause 5.6.2.1.

7.8.2.5 Test requirement

The throughput shall be $\geq 95\%$ of the maximum throughput of the reference measurement channels as specified in Annex A.3.2 with parameters specified in Table 7.8.2.5-1 for the specified wanted signal mean power in the presence of two interfering signals.

Table 7.8.2.5-1: Wide band intermodulation parameters for NR bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz

Rx parameter	Units	Channel bandwidth (MHz)		
		5, 10	15	20
P_w in Transmission Bandwidth Configuration, per CC ⁵	dBm	REFSENS + 6 dB	REFSENS + 7 dB	REFSENS + (9 + 10log ₁₀ (BW _{Channel} /20)) dB
$P_{Interferer\ 1}$ (CW)	dBm	-46		
$P_{Interferer\ 2}$ (Modulated)	dBm	-46		
BW _{Interferer 2}	MHz	5		
$F_{Interferer\ 1}$ (Offset)	MHz	$\frac{-BW_{channel}/2 - 7.5}{+BW_{channel}/2 + 7.5}$		
$F_{Interferer\ 2}$ (Offset)	MHz	$2 \cdot F_{Interferer\ 1}$		
NOTE 1: The transmitter shall be set to 4 dB below $P_{CMAX_L,f,c}$ at the minimum UL configuration specified in Table 7.3.2.3-3 with $P_{CMAX_L,f,c}$ defined in clause 6.2.4.				
NOTE 2: Reference measurement channel is specified in 3GPP TS 38.101-1 [5] Annexes A.2.2 and A.3.2 (with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1).				
NOTE 3: The modulated interferer consists of the Reference measurement channel specified in 3GPP TS 38.101-1 [5] Annexes A.3.2.2 with one sided dynamic OCNG Pattern OP.1 FDD for the DL-signal as described in Annex A.5.1.1 and 15 kHz SCS.				
NOTE 4: The $F_{Interferer\ 1}$ (offset) is the frequency separation of the centre frequency of the carrier closest to the interferer and the centre frequency of the CW interferer and $F_{Interferer\ 2}$ (offset) is the frequency separation of the centre frequency of the carrier closest to the interferer and the centre frequency of the modulated interferer.				
NOTE 5: 10log ₁₀ (x) is rounded to the next higher 0.5dB value.				

7.9 Spurious emissions

7.9.1 Test purpose

The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the UE antenna connector.

Test verifies the UE's spurious emissions meet the requirements described in clause 7.9.3.

Excess spurious emissions increase the interference to other systems.

7.9.2 Test applicability

This test case applies to all types of NR UE release 17 and forward that support satellite access operation.

7.9.3 Minimum conformance requirements

The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the UE antenna connector.

The power of any narrow band CW spurious emission shall not exceed the maximum level specified in Table 7.9.3-1

Table 7.9.3-1: General receiver spurious emission requirements

Frequency range	Measurement bandwidth	Maximum level	NOTE
$30 \text{ MHz} \leq f < 1 \text{ GHz}$	100 kHz	-57 dBm	
$1 \text{ GHz} \leq f \leq 12.75 \text{ GHz}$	1 MHz	-47 dBm	
NOTE: 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 38.101-5 [11] clause 7.9.

7.9.4 Test description

7.9.4.1 Initial conditions

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

The initial test configurations consist of environmental conditions, test frequencies, test channel bandwidths and sub-carrier spacing based on NR operating bands specified in Table 5.3.5-1. All of these configurations shall be tested with applicable test parameters for each combination of channel bandwidth and sub-carrier spacing, are shown in Table 7.9.4.1-1. The details of the uplink and downlink reference measurement channels (RMC) are specified in Annexes A.2 and A.3. Configuration of PDSCH and PDCCH before measurement are specified in Annex C.2.

Table 7.9.4.1-1: Test Configuration Table

Default Conditions				
Test Environment as specified in TS 38.508-1 [12] subclause 4.1			Normal	
Test Frequencies as specified in TS 38.508-1 [12] subclause 4.3.1			Low range, Mid range, High range	
Test Channel Bandwidths as specified in TS 38.508-1 [12] subclause 4.3.1			Highest	
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. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, in Figure A.3.1.5.1 for TE diagram and clause A.3.2 for UE diagram.
2. The parameter settings for the cell are set up according to TS 38.508-1 [12] subclause 4.4.3.
3. Downlink signals are initially set up according to Annex C.1, C.2, C.3.1, and uplink signals according to TS 38.521-1 [2] Annex G.0, G.1, G.2, G.3.1.
4. The DL and UL Reference Measurement channels are set according to Table 7.9.4.1-1.
5. Propagation conditions are set according to [Annex B.0].
6. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
7. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508 [12] Table 5.6.2.1-1 for GSO if UE supports only GSO or both GSO and NGSO satellites and Table 5.6.2.1-3 for NGSO (LEO-1200) if UE supports only NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in TS 38.508-1 [12] clause 5.6.3.1.
8. Deactivate UE prediction of satellite trajectory by any preconfigured means.
9. 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 [12] clause 4.5. Message contents are defined in clause 7.9.4.3.

7.9.4.2 Test procedure

1. Sweep the spectrum analyser (or equivalent equipment) over a frequency range and measure the average power of spurious emission.
2. Repeat step 1 for all NR Rx antennas of the UE.

7.9.4.3 Message contents

Message contents are according to TS 38.508-1 [12] clause 4.6 ensuring Table 4.6.3-118 with condition TRANSFORM_PRECODER_ENABLED for NR band.

Message contents are according to TS 38.508-1 [12] subclause 4.6 with the following exceptions for each network signalling value.

SIB19 message contents according to TS 38.508-1 [12] clause 5.6.2.1.

7.9.5 Test requirement

The measured spurious emissions derived in step 1), shall not exceed the maximum level specified in Table 7.9.5-1.

Table 7.9.5-1: General receiver spurious emission requirements

Frequency range	Measurement bandwidth	Maximum level	NOTE
$30 \text{ MHz} \leq f < 1 \text{ GHz}$	100 kHz	-57 dBm	
$1 \text{ GHz} \leq f \leq 12.75 \text{ GHz}$	1 MHz	-47 dBm	
NOTE: Unused PDCCH resources are padded with resource element groups with power level given by PDCCH as defined in Annex C.3.1.			

8 Conducted performance requirements

8.0 General

[to be updated]

8.1.1 Relationship between minimum requirements and test requirements

TS 38.101-5 is a Single-RAT and interwork specification for NR UE, covering minimum performance requirements of both conducted and radiated requirements. Conformance to 38.101-5 is demonstrated by fulfilling the test requirements specified in the present document.

The Minimum Requirements given in TS 38.101-5 make no allowances for measurement uncertainty (MU). 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 38.101-4 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 various level of "Shared Risk" principle as described below.

- a) Core specification value is not relaxed by any relaxation value ($TT=0$). For each single measurement, the probability of a borderline good UE being judged as FAIL equals the probability of a borderline bad UE being judged as PASS.
 - Test tolerances equal to 0 ($TT=0$) are considered in this specification.
- b) Core specification value is relaxed by a relaxation value ($TT>0$). For each single measurement, the probability of a borderline bad UE being judged as PASS is greater than the probability of a borderline good UE being judged as FAIL.

- Test tolerances lower than measurement uncertainty and greater than 0 ($0 < TT < MU$) are considered in this specification.
 - Test tolerances high up to measurement uncertainty ($TT = MU$) are considered in this specification which is also known as "Never fail a good DUT" principle.
- c) Core specification value is tightened by a stringent value ($TT < 0$). For each single measurement, the probability of a borderline good UE being judged as FAIL is greater than the probability of a borderline bad UE being judged as PASS.

Test tolerances lower than 0 ($TT < 0$) are not considered in this specification.

The "Never fail a good DUT" and the "Shared Risk" principles are defined in Recommendation ITU-R M.1545.

8.1.2 Applicability of minimum requirements

The conducted minimum requirements specified in the present document shall be met in all applicable scenarios for FR1. The interwork minimum requirement specified in the present document shall be met in all applicable scenarios for NR interworking operation.

All minimum performance requirements defined in Clause 8 are applicable to NR/5GC, EN-DC and NE-DC unless otherwise explicitly stated.

Unless otherwise stated, all minimum performance requirements defined in Clause 8 are applicable to UE power class 3 only.

8.1.3 Conducted requirements

8.1.3.1 Introduction

The requirements are defined for the following modes:

- Mode 1: Conditions with external noise source
 - Wanted signal with power level E_s is transmitted.
 - External white noise source with power spectral density N_{oc} is used.
 - E_s and N_{oc} levels are selected to achieve target SNR as described in Clause 8.1.3.3.

8.1.3.2 Reference point

The reference point for SNR, E_s and N_{oc} of DL signal is the UE antenna connector or connectors.

8.1.3.3 SNR definition

For Mode 1 conditions conducted UE demodulation and CSI requirements the SNR is defined as:

$$SNR = \frac{\sum_{j=1}^{N_{RX}} E_s^{(j)}}{\sum_{j=1}^{N_{RX}} N_{oc}^{(j)}}$$

Where

- N_{RX} denotes the number of receiver antenna connectors and the superscript receiver antenna connector j .
- The above SNR definition assumes that the REs are not precoded, and does not account for any gain which can be associated to the precoding operation.
- Unless otherwise stated, the SNR refers to the SSS wanted signal.
- The downlink SSS transmit power is defined as the linear average over the power contributions in [W] of all resource elements that carry the SSS within the operating system bandwidth.

- The power ratio of other wanted signals to the SSS is defined in clause C.3.1.

8.1.3.4 Noc

8.1.3.4.1 Introduction

This clause describes the Noc power level for Mode 1 conditions conducted testing of demodulation and CSI requirements.

8.1.3.4.2 Noc for NR operating bands in FR1

The Noc power spectrum density shall be larger or equal to the minimum Noc power level for each operating band supported by the UE as defined in clause 8.1.3.4.2.1.

Unless otherwise stated, a fixed Noc power level of -145 dBm/Hz shall be used for all operating bands.

8.1.3.4.2.1 Derivation of Noc values for NR operating bands in FR1

The minimum Noc power level for an operating band, subcarrier spacing and channel bandwidth is derived based on the following equation:

$$\text{NOC}_{\text{Band}_X, \text{SCS}_Y, \text{CBW}_Z} = \text{REFSENS}_{\text{Band}_X, \text{SCS}_Y, \text{CBW}_Z} - 10 \cdot \log_{10}(12 \cdot \text{SCS}_Y \cdot n_{\text{PRB}}) + D - \text{SNR}_{\text{REFSENS}} + \Delta_{\text{thermal}}$$

where

- $\text{REFSENS}_{\text{Band}_X, \text{SCS}_Y, \text{CBW}_Z}$ is the REFSENS value in dBm for Band X, SCS Y and CBW Z specified in Table 7.3.2-1 of TS 38.101-5 [11]
- 12 is the number of subcarriers in a PRB
- SCS Y is the subcarrier spacing associated with the REFSENS value
- n_{PRB} is the maximum number of PRB for SCS Y and CBW Z associated with the REFSENS value, and is specified in Table 5.3.2-1 of TS 38.101-5 [11]
- D is diversity gain equal to 3 dB
- $\text{SNR}_{\text{REFSENS}} = -1$ dB is the SNR used for simulation of REFSENS
- Δ_{thermal} is the amount of dB that the wanted noise is set above UE thermal noise, giving a defined rise in total noise. $\Delta_{\text{thermal}} = 16$ dB, giving a rise in total noise of 0.1dB, regarded as insignificant.

The calculated Noc value for the baseline of Band n256, 15 kHz SCS, 10 MHz CBW is -146.5 dBm/Hz. An allowance of 1.5 dB is made for future bands, giving an Noc power level of -145 dBm/Hz.

8.2 Demodulation performance requirements

8.2.1 General

8.2.1.1 Applicability of requirements

8.2.1.1.1 General

The minimum performance requirements are applicable to all FR1 operating bands defined in clause 5.2.

If same test is listed for different UE features/capabilities in Clause 8.2.1.1.2, then this test shall apply for UEs which support all corresponding UE features/capabilities.

8.2.1.1.2 Applicability of requirements for optional UE features

The performance requirements in Table 8.2.1.1.2-1 shall apply for UEs which support optional UE features only.

Table 8.2.1.1.2-1: Requirements applicability for optional UE features

UE feature/capability 13]	Test type		Test list	Applicability notes
NR NTN access (nonTerrestrialNetwork-r17)	FR1 FDD	PDSCH	Clause 8.2.1.2.2.1 (Test 1-1, Test 1-2, Test 1-3, Test 1-4)	
NR NTN scenario support (ntn- ScenarioSupport-r17)	FR1 FDD	PDSCH	Clause 8.2.1.2.2.1 (Test 1-1, Test 1-2, Test 1-3, Test 1-4)	The requirements apply only when <i>ntn- ScenarioSupport-r17</i> is "ngso" or is not included.
Increasing the number of HARQ processes (max-HARQ- ProcessNumber-r17)	FR1 FDD	PDSCH	Clause 8.2.1.2.2.1 (Test 1-3)	
Disabled HARQ feedback for downlink transmission (harq- FeedbackDisabled-r17)	FR1 FDD	PDSCH	Clause 8.2.1.2.2.1 (Test 1-4)	
NOTE: For UE supporting NR NTN access (nonTerrestrialNetwork-r17), the requirements in TS 38.101-4 [6] also applies to UE according to applicability rules in TS 38.101-4 [6] Clause 5.1, 6.1, 7.1 and 8.1				

8.2.1.2.0 PDSCH demodulation requirements

The parameters specified in Table 8.2.1.2.0-1 are valid for all PDSCH tests unless otherwise stated.

Table 8.2.1.2.0-1: Common test parameters

Parameter		Unit	Value
PDSCH transmission scheme			Transmission scheme 1
Carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 2)	RBs	0
	Subcarrier spacing	kHz	15
DL BWP configuration #1	Cyclic prefix		Normal
	RB offset	RBs	0
	Number of contiguous PRB	PRBs	Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-1 [5] for tested channel bandwidth and subcarrier spacing
Common serving cell parameters	Physical Cell ID		0
	SSB position in burst		First SSB in Slot #0
	SSB periodicity	ms	20
PDCCH configuration	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH	Symbols	0, 1
	Number of PRBs in CORESET		Table 5.2-2 of 38.101-4 for tested channel bandwidth and subcarrier spacing
	Number of PDCCH candidates and aggregation levels		1/AL8
	CCE-to-REG mapping type		Non-interleaved
	DCI format		1_1
	TCI state		TCI state #1
	PDCCH & PDCCH DMRS Precoding configuration		Single Panel Type I, Random per slot with equal probability of each applicable i_1, i_2 combination, and with REG bundling granularity for number of Tx larger than 1
Cross carrier scheduling			Not configured
CSI-RS for tracking	First subcarrier index in the PRB used for CSI-RS		$k_0=0$ for CSI-RS resource 1,2,3,4
	First OFDM symbol in the PRB used for CSI-RS		$l_0 = 6$ for CSI-RS resource 1 and 3 $l_0 = 10$ for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)		1 for CSI-RS resource 1,2,3,4
	CDM Type		'No CDM' for CSI-RS resource 1,2,3,4
	Density (ρ)		3 for CSI-RS resource 1,2,3,4
	CSI-RS periodicity	Slots	15 kHz SCS: 20 for CSI-RS resource 1,2,3,4
	CSI-RS offset	Slots	15 kHz SCS: 10 for CSI-RS resource 1 and 2 11 for CSI-RS resource 3 and 4
	Frequency Occupation		Start PRB 0 Number of PRB = $\text{ceil}(\text{BWP size}/4)*4$
	QCL info		TCI state #0
NZP CSI-RS for CSI acquisition	Row index (Note 3)		3 for 2 CSI-RS ports and 5 for 4 CSI-RS ports
	First subcarrier index in the PRB used for CSI-RS		$k_0 = 0$
	First OFDM symbol in the PRB used for CSI-RS		$l_0 = 12$
	Number of CSI-RS ports (X)		Same as number of transmit antenna
	CDM Type		'No CDM' for 1 transmit antenna 'FD-CDM2' for 2 and 4 transmit antenna
	Density (ρ)		1
	CSI-RS periodicity	Slots	15 kHz SCS: 20
	CSI-RS offset	Slots	0
	Frequency Occupation		Start PRB 0 Number of PRB = $\text{ceil}(\text{BWP size}/4)*4$
	QCL info		TCI state #1
ZP CSI-RS for CSI acquisition	Row index (Note 3)		5
	First subcarrier index in the PRB used for CSI-RS		$k_0 = 4$

	First OFDM symbol in the PRB used for CSI-RS			$l_0 = 12$
	Number of CSI-RS ports (X)			4
	CDM Type			'FD-CDM2'
	Density (ρ)			1
	CSI-RS periodicity		Slots	15 kHz SCS: 20
	CSI-RS offset		Slots	0
	Frequency Occupation			Start PRB 0 Number of PRB = $\text{ceil}(\text{BWP size}/4) \cdot 4$
PDSCH DMRS configuration	Antenna ports indexes			{1000} for Rank 1 tests
	Position of the first DMRS for PDSCH mapping type A			2
	Number of PDSCH DMRS CDM group(s) without data			1 for Rank 1
TCI state #0	Type 1 QCL information	SSB index		SSB #0
		QCL Type		Type C
	Type 2 QCL information	SSB index		N/A
		QCL Type		N/A
TCI state #1	Type 1 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type A
	Type 2 QCL information	CSI-RS resource		N/A
		QCL Type		N/A
PT-RS configuration				PT-RS is not configured
Maximum number of code block groups for ACK/NACK feedback				1
Maximum number of HARQ transmission				4
HARQ ACK/NACK bundling				Multiplexed
Redundancy version coding sequence				{0,2,3,1}
PDSCH & PDSCH DMRS Precoding configuration				Single Panel Type I, Random precoder selection updated per slot, with equal probability of each applicable i_1, i_2 combination, and with PRB bundling granularity
Symbols for all unused REs				OP.1 FDD as defined in Annex A.5.1.1 of 38.101-4
Physical signals, channels mapping and precoding				As specified in Annex B.4.1 of 38.101-4
NOTE 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.				
NOTE 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 [5] for tested channel bandwidth and subcarrier spacing.				
NOTE 3: Refer to Table 7.4.1.5.3-1 in [9]				

8.2.1.2.1 1RX requirements

FFS

8.2.1.2.2 2RX requirements

8.2.1.2.2.1 FDD

8.2.1.2.2.1.1 Minimum requirements for PDSCH Mapping Type A

The performance requirements are specified in Table 8.2.1.2.2.1.1-3 with the addition of test parameters in Table 8.2.1.2.2.1.1-2 and the downlink physical channel setup according to Annex A.3.

The test purposes are specified in Table 8.2.1.2.2.1.1-1.

Table 8.2.1.2.2.1.1-1: Tests purpose

Purpose	Test index
Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models and MCS	1-1, 1-2, 1-3, 1-4

Table 8.2.1.2.2.1.1-2: Test parameters

Parameter		Unit	Value
Duplex mode			FDD
Active DL BWP index			1
PDSCH configuration	Mapping type		Type A
	k0		0
	Starting symbol (S)		2
	Length (L)		12
	PDSCH aggregation factor		1
	PRB bundling type		Static
	PRB bundling size		2
	Resource allocation type		Type 0
	RBG size		Config2
	VRB-to-PRB mapping type		Non-interleaved
	VRB-to-PRB mapping interleaver bundle size		N/A
PDSCH DMRS configuration	DMRS Type		Type 1
	Number of additional DMRS		1
	Maximum number of OFDM symbols for DL front loaded DMRS		1
CSI-RS for tracking	CSI-RS periodicity	Slots	20 for CSI-RS resource 1,2,3,4.
	CSI-RS offset	Slots	10 for CSI-RS resource 1 and 2 11 for CSI-RS resource 3 and 4.
Number of HARQ Processes			16 for Test 1-1, Test 1-2 32 for Test 1-3 4 with feedback disabled, 12 with feedback enabled in 16 HARQ processes with re-Tx disable for all HARQ for Test 1-4 in which 4 disabled processes are randomly select at test configuration
The number of slots between PDSCH and corresponding HARQ-ACK information			10 for Test 1-1, Test 1-2, Test 1-3 N/A for Test 1-4
Maximum number of HARQ transmission			4 for Test 1-1, Test 1-2, Test 1-3 Disabled for all HARQ processes for Test 1-4

Table 8.2.1.2.2.1.1-3: Minimum performance for Rank 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.1 FDD	10 / 15	QPSK, 0.30	NTN-TDLA100-200	1x2, ULA Low	70	0.3
1-2	R.PDSCH.1-2.1 FDD	10 / 15	16QAM, 0.48	NTN-TDLC5-200	1x2, ULA Low	70	7.6
1-3	R.PDSCH.1-1.1 FDD	10 / 15	QPSK, 0.30	NTN-TDLC5-200	1x2, ULA Low	70	-0.4
1-4	R.PDSCH.1-1.1 FDD	10 / 15	QPSK, 0.30	NTN-TDLA100-200	1x2, ULA Low	70	1.1

The normative reference for this requirement is TS 38.101-5 [11] clause 8.2.1.2.2.

8.2.1.2.2.1.1_1 2Rx FDD FR1 PDSCH Mapping Type A for Satellite Access

8.2.1.2.2.1.1_1.1 Test Purpose

Verify the PDSCH mapping Type A normal performance under 2 receive antenna conditions and with different channel models and MCS for NTN capable UE receiving signal from earth based gNB via a satellite access node.

8.2.1.2.2.1.1_1.2 Test Applicability

Test 1-1 and Test 1-2 applies to all types of NTN UE release 17 and forward supporting satellite access.

Test 1-3 applies to all types of NTN UE release 17 and forward supporting satellite access and supporting max-HARQ-ProcessNumber-r17 with 32 DL HARQ process.

Test 1-4 applies to all types of NTN UE release 17 and forward supporting satellite access and supporting harq-FeedbackDisabled-r17.

8.2.1.2.2.1.1_1.3 Test Description

8.2.1.2.2.1.1_1.3.1 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 and Table 5.3.6-1 of 38.521-1 [2].

Configurations of PDSCH and PDCCH before measurement are specified in Annex C.

Test Environment: Normal, as defined in TS 38.508-1 [12] clause 4.1.

Frequencies to be tested: Mid Range, as defined in TS 38.508-1 [12] clause 5.2.2.

1. Connect the SS, the faders and AWGN noise source to the UE antenna connectors as shown in TS 38.508-1 [12] Annex A, in Figure A.3.1.7.1 for TE diagram and clause A.3.2.2 for UE diagram.
2. The parameter settings for the cell are set up according to Table 5.2-1 and Table 5.2.2.1.1.0-2 as appropriate.
3. Downlink signals for NR cell are initially set up according to clauses C.0, C.1, C.2 and uplink signals according to clauses G.0, G.1, G.2, G.3.1 of TS 38.521-1 [2].
4. Propagation conditions are set according to Annex B.0.

5. Ensure the UE is in state RRC_CONNECTED with generic procedure parameters Connectivity NR for NR/5GC with *Connected without Release On, Test Mode On* according to TS 38.508-1 [12] clause 4.5. Message contents are defined in clause 8.2.1.2.2.1.1_1.3.3.

8.2.1.2.2.1.1_1.3.2 Test procedure

1. UE location according to TS 38.508-1 [12] clause 5.6.1 is provided to the UE through any preconfigured means.
2. Test equipment shall emulate the signal with doppler and delay according to ephemeris defined in TS 38.508[12] table 5.6.2.1-2 for NGSO (LEO-600) if UE supports only NGSO satellites or both GSO and NGSO satellites. Test system shall send same SIB19 information during the duration of the test as defined in clause 8.2.1.2.2.1.1_1.3.3.
3. Deactivate UE prediction of satellite trajectory by any preconfigured means.
4. SS transmits PDSCH via PDCCH DCI format 1_1 for C_RNTI to transmit the DL RMC according to Tables Table 8.2.1.2.2.1.1-3. The SS sends downlink MAC padding bits on the DL RMC.
5. Set the parameters of the bandwidth, MCS, reference channel, the propagation condition, the correlation matrix and the SNR according to Table 8.2.1.2.2.1.1-2 and Table 8.2.1.2.2.1.1-3 as appropriate.
6. Measure the average throughput for a duration sufficient to achieve statistical significance according to Annex G clause G.1.5. Count the number of NACKs, ACKs and statDTXs on the UL during each subtest and decide pass or fail according to [Annex G].
4. Repeat steps from 1 to 3 for each subtest in Table 8.2.1.2.2.1.1-3 as appropriate.

8.2.1.2.2.1.1_1.3.3 Message contents

Message contents are according to TS 38.508-1 [12] clauses 4.6.1 and 5.4.2 with following exceptions:

SIB19 contents as TS 38.508-1 [12] clause 5.6.2.1 with exceptions in Table 8.2.1.2.2.1.1_1.3.3-4:

Table 8.2.1.2.2.1.1_1.3.3-1: DMRS-DownlinkConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-24			
Information Element	Value/remark	Comment	Condition
DMRS-DownlinkConfig ::= SEQUENCE {			
dmrs-AdditionalPosition	Pos1		
}			

Table 8.2.1.2.2.1.1_1.3.3-2: PDSCH-ServingCellConfig

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-25			
Information Element	Value/remark	Comment	Condition
PDSCH-ServingCellConfig ::= SEQUENCE {			
nrofHARQ-ProcessesForPDSCH	n16	Test 1-1, Test 1-2	
	n32	Test 1-3	
		Test 1-4 4 with feedback disabled, 12 with feedback enabled in 16 HARQ processes with re-Tx disable for all HARQ for Test 1-4 in which 4 disabled processes are randomly select at test configuration	
}			

Table 8.2.1.2.2.1.1_1.3.3-3: CSI-ResourcePeriodicityAndOffset for CSI Tracking

Derivation Path: TS 38.508-1 [6], Table 5.4.2.0-9			
Information Element	Value/remark	Comment	Condition
CSI-ResourcePeriodicityAndOffset ::= CHOICE { slots20	10 (for CSI-RS resources 1 and 2) 11 (for CSI-RS resources 3 and 4)		
}			

Table 8.2.1.2.2.1.1_1.3.3-4: SIB19

Derivation Path: TS 38.508-1 [6], Table 5.6.3.1-1			
Information Element	Value/remark	Comment	Condition
SIB19-r17 ::= SEQUENCE {			
ntn-Config-r17 ::= SEQUENCE {			
cellSpecificKoffset-r17	8		
}			
}			

8.2.1.2.2.1.1_1.3.4 Test requirement

Table 8.2.1.2.2.1.1-2 and Table 8.2.1.2.2.1.1-3 define the primary level settings.

The fraction of maximum throughput percentage for the downlink reference measurement channels specified in Annex A 3.2.1.1 for each throughput test shall meet or exceed the specified value in Table 8.2.1.2.2.1.1_1.3.4-1 for the specified SNR including test tolerances for all throughput tests.

Table 8.2.1.2.2.1.1_1.3.4-1: Minimum performance for Rank 1

Test num.	Reference channel	Bandwidth (MHz) / Subcarrier spacing (kHz)	Modulation format and code rate	Propagation condition	Correlation matrix and antenna configuration	Reference value	
						Fraction of maximum throughput (%)	SNR (dB)
1-1	R.PDSCH.1-1.1 FDD	10 / 15	QPSK, 0.30	NTN-TDLA100-200	1x2, ULA Low	70	1.2
1-2	R.PDSCH.1-2.1 FDD	10 / 15	16QAM, 0.48	NTN-TDLC5-200	1x2, ULA Low	70	8.5
1-3	R.PDSCH.1-1.1 FDD	10 / 15	QPSK, 0.30	NTN-TDLC5-200	1x2, ULA Low	70	0.5
1-4	R.PDSCH.1-1.1 FDD	10 / 15	QPSK, 0.30	NTN-TDLA100-200	1x2, ULA Low	70*	2

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11 Demodulation performance requirements (Radiated requirements)

11.1 General

11.1.2 Applicability of minimum requirements

The conducted minimum requirements specified in this specification shall be met in all applicable scenarios for FR2-NTN.

11.1.3 Radiated requirements

11.1.3.1 Introduction

The requirements are defined for the following modes:

- Mode 1: Conditions with external noise source
 - Wanted signal with power level E_s is transmitted.
 - External white noise source with power spectral density N_{oc} is used.
 - E_s and N_{oc} levels are selected to achieve target SNR as described in Clause 11.1.3.3.

11.1.3.2 Reference point

The reference point for SNR, E_s and N_{oc} of DL signal is the UE antenna connector or connectors.

11.1.3.3 SNR definition

For Mode 1 conditions UE demodulation and CSI requirements, the Minimum performance requirement in clause 11 are defined relative to the baseband SNR level SNR_{BB} . The SNR at the reference point is defined as

$$SNR = SNR_{BB} + \Delta_{BB}$$

where Δ_{BB} is specified in clause 4.5.3.

The reference point SNR is defined as:

$$SNR = \frac{\sum_{j=1}^{N_{RX}} E_s^{(j)}}{\sum_{j=1}^{N_{RX}} N_{oc}^{(j)}}$$

- N_{RX} denotes the number of receiver reference points, and the super script receiver reference point j .
- The above SNR definition assumes that the REs are not precoded, and does not account for any gain which can be associated to the precoding operation.
- Unless otherwise stated, the SNR refers to the SSS wanted signal.

- The downlink SSS transmit power is defined as the linear average over the power contributions in [W] of all resource elements that carry the SSS within the operating system bandwidth.
- The power ratio of other wanted signals to the SSS is defined in Clause C.3.1.

11.1.3.4 Noc

11.1.3.4.1 Introduction

This clause describes the Noc power level for Mode 1 conditions conducted testing of demodulation and CSI requirements.

11.1.3.4.2 Noc for operating bands in FR2-NTN

Unless otherwise stated, a fixed Noc power level of -145 dBm/Hz shall be used for all operating bands.

11.2 Demodulation performance requirements

11.2.1 General

11.2.1.1 Applicability of requirements

11.2.1.1.1 General

The minimum performance requirements are applicable to all FR2-NTN operating bands defined in clause 5.2.

If same test is listed for different UE features/capabilities in Clauses 11.2.1.1.2, then this test shall apply for UEs which support all corresponding UE features/capabilities.

11.2.1.1.2 Applicability of requirements for optional UE features

The performance requirements in Table 11.2.1.1.2-1 shall apply for UEs which support optional UE features only.

Table 11.2.1.1.2-1: Requirements applicability for optional UE features

UE feature/capability [11]	Test type		Test list	Applicability notes
NR NTN access (nonTerrestrialNetwork-r17)	FR2-NTN	PDCCH	Clause 11.2.3.1.1.1 (Test 1-1, Test 1-2)	
NR NTN scenario support (ntn-ScenarioSupport-r17)	FR2-NTN	PDSCH	Clause 11.2.2.1.1.1 (Test 2-1, Test 2-2, Test 2-3, Test 2-4)	The requirements apply only when <i>ntn-ScenarioSupport-r17</i> is "gso"
	FR2-NTN	PDSCH	Clause 11.2.2.1.1.1 (Test 1-1, Test 1-2, Test 1-3, Test 1-4)	The requirements apply only when <i>ntn-ScenarioSupport-r17</i> is "ngso" or is not configured.
Increasing the number of HARQ processes (max-HARQ-ProcessNumber-r17)	FR2-NTN	PDSCH	Clause 11.2.1.2.2.1 (Test 1-3, 2-3)	
Disabled HARQ feedback for downlink transmission (harq-FeedbackDisabled-r17)	FR2-NTN	PDSCH	Clause 11.2.1.2.2.1 (Test 1-4, 2-4)	

11.2.2 PDSCH demodulation requirements

The parameters specified in Table 11.2.2-1 are valid for all PDSCH tests unless otherwise stated.

Table 11.2.2-1: Common test parameters

Parameter		Unit	Value
PDSCH transmission scheme			Transmission scheme 1
Carrier configuration	Offset between Point A and the lowest usable subcarrier on this carrier (Note 2)	RBs	0
	Subcarrier spacing	kHz	120
DL BWP configuration #1	Cyclic prefix		Normal
	RB offset	RBs	0
	Number of contiguous PRB	PRBs	Maximum transmission bandwidth configuration as specified in clause 5.3.2 of TS 38.101-2 [15] for tested channel bandwidth and subcarrier spacing
Common serving cell parameters	Physical Cell ID		0
	SSB position in burst		First SSB in Slot #0
	SSB periodicity	ms	20
PDCCH configuration	Slots for PDCCH monitoring		Each slot
	Symbols with PDCCH	Symbols	0
	Number of PRBs in CORESET		Table 7.2-2 of 38.101-4 for tested channel bandwidth and subcarrier spacing
	Number of PDCCH candidates and aggregation levels		1/AL8
	CCE-to-REG mapping type		Non-interleaved
	DCI format		1_1
	TCI state		TCI state #1
	PDCCH & PDCCH DMRS Precoding configuration		No precoding
Cross carrier scheduling			Not configured
CSI-RS for tracking	First subcarrier index in the PRB used for CSI-RS		$k_0=0$ for CSI-RS resource 1,2,3,4
	First OFDM symbol in the PRB used for CSI-RS		$l_0 = 6$ for CSI-RS resource 1 and 3 $l_0 = 10$ for CSI-RS resource 2 and 4
	Number of CSI-RS ports (X)		1 for CSI-RS resource 1,2,3,4
	CDM Type		'No CDM' for CSI-RS resource 1,2,3,4
	Density (ρ)		3 for CSI-RS resource 1,2,3,4
	CSI-RS periodicity	Slots	160 for CSI-RS resource 1,2,3,4
	CSI-RS offset	Slots	80 for CSI-RS resource 1 and 2 81 for CSI-RS resource 3 and 4
	Frequency Occupation		Start PRB 0 Number of PRB = $\text{ceil}(\text{BWP size}/4)*4$
	QCL info		TCI state #0
NZP CSI-RS for CSI acquisition	Row index (Note 3)		3 for 2 CSI-RS ports and 5 for 4 CSI-RS ports
	First subcarrier index in the PRB used for CSI-RS		$k_0 = 0$
	First OFDM symbol in the PRB used for CSI-RS		$l_0 = 12$
	Number of CSI-RS ports (X)		1
	CDM Type		No CDM
	Density (ρ)		1
	CSI-RS periodicity	Slots	160
	CSI-RS offset	Slots	0
	Frequency Occupation		Start PRB 0 Number of PRB = $\text{ceil}(\text{BWP size}/4)*4$
ZP CSI-RS for CSI acquisition	Row index (Note 3)		5
	First subcarrier index in the PRB used for CSI-RS		$k_0 = 4$
	First OFDM symbol in the PRB used for CSI-RS		$l_0 = 12$
	Number of CSI-RS ports (X)		4
	CDM Type		'FD-CDM2'
	Density (ρ)		1
	CSI-RS periodicity	Slots	160
	CSI-RS offset	Slots	0

	Frequency Occupation			Start PRB 0 Number of PRB = ceil(BWP size/4)*4
ZP CSI-RS for CSI acquisition	First subcarrier index in the PRB used for CSI-RS			k ₀ = 0 for CSI-RS resource 1,2
	First OFDM symbol in the PRB used for CSI-RS			l ₀ = 8 for CSI-RS resource 1 l ₀ = 9 for CSI-RS resource 2
	Number of CSI-RS ports (X)			1 for CSI-RS resource 1,2
	CDM Type			'No CDM' for CSI-RS resource 1,2
	Density (p)			3 for CSI-RS resource 1,2
	CSI-RS periodicity		Slots	160 for CSI-RS resource 1,2
	CSI-RS offset		Slots	0 for CSI-RS resource 1,2
	Frequency Occupation			Start PRB 0 Number of PRB = ceil(BWP size/4)*4
	Repetition			ON
QCL info			TCI state #1	
PDSCH DMRS configuration	Antenna ports indexes			{1000} for Rank 1 tests
	Position of the first DMRS for PDSCH mapping type A			2
	Number of PDSCH DMRS CDM group(s) without data			1 for Rank 1
TCI state #0	Type 1 QCL information	SSB index		SSB #0
		QCL Type		Type C
	Type 2 QCL information	SSB index		SSB #0
		QCL Type		Type D
TCI state #1	Type 1 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type A
	Type 2 QCL information	CSI-RS resource		CSI-RS resource 1 from 'CSI-RS for tracking' configuration
		QCL Type		Type D
PT-RS configuration				Not configured
Maximum number of code block groups for ACK/NACK feedback				1
Maximum number of HARQ transmission				4
HARQ ACK/NACK bundling				Not configured
Redundancy version coding sequence				{0,2,3,1}
PDSCH & PDSCH DMRS Precoding configuration				No precoding
Symbols for all unused REs				OP.1 FDD as defined in Annex A.5.1.1 of 38.101-4
Physical signals, channels mapping and precoding				As specified in Annex B.4.1 of 38.101-4
Note 1:	UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.			
Note 2:	Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-2 [15] for tested channel bandwidth and subcarrier spacing.			
Note 3:	Refer to Table 7.4.1.5.3-1 in [9]			

Annex A: (normative): Measurement channels

A.1 General

A.1.1 Throughput definition

The throughput values defined in the measurement channels specified in Annex A, are calculated and are valid per codeword. For multi-codeword transmissions, the throughput referenced in the minimum requirements is the sum of throughputs of all codewords.

A.2 UL reference measurement channels

A.2.1 General

The measurement channels in the following subclauses are defined to derive the requirements in clause 6 (Transmitter Characteristics) and clause 7 (Receiver Characteristics). The measurement channels represent example configurations of physical channels for different data rates.

The measurement channels in the following clauses are applicable only to FDD.

The active uplink slots for FR1-NTN FDD configurations for NGSO are specified in Table A.2.1-1. FR1-NTN FDD slot patterns defined for reference sensitivity tests will be used for FR1-NTN FDD UL RMCs, unless otherwise stated.

Table A.2.1-1: FR1-NTN FDD active uplink slots for NGSO

SCS	Active Uplink slots
15 kHz	0,1,2,3,4,5,8,9 in every radio frame
30 kHz	FFS
60 kHz	FFS
NOTE 1: Due to lack of HARQ processes for PUSCH and considering CellSpecificKoffset, all Uplink slots cannot be activated for NTN.	
NOTE 2: Assuming K2 is 2, CellSpecificKoffset is 14	

The active uplink slots for FR1-NTN FDD configurations for GSO are specified in Table A.2.1-2. FR1-NTN FDD slot patterns defined for reference sensitivity tests will be used for FR1-NTN FDD UL RMCs, unless otherwise stated.

Table A.2.1-2: FR1-NTN FDD active uplink slots for GSO

SCS	Active Uplink slots
15 kHz	262,263,264,265,266,267,268,269, 272,273,274, 275, 276, 277, 278, 279 in every 32 radio frame
30 kHz	FFS
60 kHz	FFS
NOTE 1: The active slots are counted from the 0 th slot in the 1 st radio frame of the periodicity.	
NOTE 2: Due to lack of HARQ processes for PUSCH and considering CellSpecificKoffset, all Uplink slots cannot be activated for NTN.	
NOTE 3: Assuming K2 is 2, CellSpecificKoffset is 258	

A.2.2 Reference measurement channels for FDD

A.2.2.1 DFT-s-OFDM Pi/2-BPSK

Table A.2.2.1-1: Reference Channels for DFT-s-OFDM Pi/2-BPSK

Parameter	Allocated resource blocks (L _{CRB})	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit					Bits	Bits			Bits	
	1	11	pi/2 BPSK	0	24	16	2	1	132	132
	5	11	pi/2 BPSK	0	160	16	2	1	660	660
	9	11	pi/2 BPSK	0	288	16	2	1	1188	1188
	10	11	pi/2 BPSK	0	320	16	2	1	1320	1320
	12	11	pi/2 BPSK	0	384	16	2	1	1584	1584
	15	11	pi/2 BPSK	0	480	16	2	1	1980	1980
	18	11	pi/2 BPSK	0	576	16	2	1	2376	2376
	24	11	pi/2 BPSK	0	768	16	2	1	3168	3168
	25	11	pi/2 BPSK	0	808	16	2	1	3300	3300
	30	11	pi/2 BPSK	0	984	16	2	1	3960	3960
	32	11	pi/2 BPSK	0	1032	16	2	1	4224	4224
	36	11	pi/2 BPSK	0	1128	16	2	1	4752	4752
	45	11	pi/2 BPSK	0	1416	16	2	1	5940	5940
	50	11	pi/2 BPSK	0	1544	16	2	1	6600	6600
	60	11	pi/2 BPSK	0	1864	16	2	1	7920	7920
	64	11	pi/2 BPSK	0	2024	16	2	1	8448	8448
	75	11	pi/2 BPSK	0	2408	16	2	1	9900	9900
	80	11	pi/2 BPSK	0	2472	16	2	1	10560	10560
	81	11	pi/2 BPSK	0	2536	16	2	1	10692	10692
	90	11	pi/2 BPSK	0	2792	16	2	1	11880	11880
	100	11	pi/2 BPSK	0	3104	16	2	1	13200	13200
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. DM-RS symbols are not counted.										
NOTE 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [16].										
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: The RMCs apply to all channel bandwidth where L _{CRB} ≤ N _{RB} .										

A.2.2.2 DFT-s-OFDM QPSK

Table A.2.2.2-1: Reference Channels for DFT-s-OFDM QPSK

Parameter	Allocated resource blocks (L_{CRB})	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit					Bits	Bits			Bits	
	1	11	QPSK	2	48	16	2	1	264	132
	5	11	QPSK	2	256	16	2	1	1320	660
	9	11	QPSK	2	456	16	2	1	2376	1188
	10	11	QPSK	2	504	16	2	1	2640	1320
	12	11	QPSK	2	608	16	2	1	3168	1584
	15	11	QPSK	2	768	16	2	1	3960	1980
	18	11	QPSK	2	928	16	2	1	4752	2376
	20	11	QPSK	2	1032	16	2	1	5280	2640
	24	11	QPSK	2	1192	16	2	1	6336	3168
	25	11	QPSK	2	1256	16	2	1	6600	3300
	30	11	QPSK	2	1544	16	2	1	7920	3960
	32	11	QPSK	2	1608	16	2	1	8448	4224
	36	11	QPSK	2	1800	16	2	1	9504	4752
	45	11	QPKS	2	2208	16	2	1	11880	5940
	50	11	QPSK	2	2472	16	2	1	13200	6600
	60	11	QPSK	2	3104	16	2	1	15840	7920
	64	11	QPSK	2	3240	16	2	1	16896	8448
	75	11	QPSK	2	3752	16	2	1	19800	9900
	80	11	QPSK	2	3976	24	2	2	21120	10560
	81	11	QPSK	2	4040	24	2	2	21384	10692
	90	11	QPSK	2	4488	24	2	2	23760	11880
	100	11	QPSK	2	5000	24	2	2	26400	13200
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. DM-RS symbols are not counted.										
NOTE 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [16].										
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: The RMCs apply to all channel bandwidth where $L_{CRB} \leq N_{RB}$.										

A.2.2.3 DFT-s-OFDM 16QAM

Table A.2.2.3-1: Reference Channels for DFT-s-OFDM 16QAM

Parameter	Allocated resource blocks (L _{CRB})	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit					Bits	Bits			Bits	
	1	11	16QAM	10	176	16	2	1	528	132
	5	11	16QAM	10	888	16	2	1	2640	660
	9	11	16QAM	10	1608	16	2	1	4752	1188
	10	11	16QAM	10	1800	16	2	1	5280	1320
	12	11	16QAM	10	2088	16	2	1	6336	1584
	15	11	16QAM	10	2664	16	2	1	7920	1980
	18	11	16QAM	10	3240	16	2	1	9504	2376
	24	11	16QAM	10	4224	24	1	1	12672	3168
	25	11	16QAM	10	4352	24	1	1	13200	3300
	30	11	16QAM	10	5248	24	1	1	15840	3960
	32	11	16QAM	10	5632	24	1	1	16896	4224
	36	11	16QAM	10	6272	24	1	1	19008	4752
	45	11	16QAM	10	7808	24	1	1	23760	5940
	50	11	16QAM	10	8712	24	1	2	26400	6600
	60	11	16QAM	10	10504	24	1	2	31680	7920
	64	11	16QAM	10	11272	24	1	2	33792	8448
	75	11	16QAM	10	13064	24	1	2	39600	9900
	80	11	16QAM	10	14088	24	1	2	42240	10560
	81	11	16QAM	10	14088	24	1	2	42768	10692
	90	11	16QAM	10	15880	24	1	2	47520	11880
	100	11	16QAM	10	17424	24	1	3	52800	13200
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. DM-RS symbols are not counted.										
NOTE 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [16].										
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: The RMCs apply to all channel bandwidth where L _{CRB} ≤ N _{RB} .										

A.2.2.4 DFT-s-OFDM 64QAM

Table A.2.2.4-1: Reference Channels for DFT-s-OFDM 64QAM

Parameter	Allocated resource blocks (L_{CRB})	DFT-s-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit					Bits	Bits			Bits	
	1	11	64QAM	18	408	16	2	1	792	132
	5	11	64QAM	18	2024	16	2	1	3960	660
	9	11	64QAM	18	3624	16	2	1	7128	1188
	10	11	64QAM	18	3968	24	1	1	7920	1320
	12	11	64QAM	18	4736	24	1	1	9504	1584
	15	11	64QAM	18	6016	24	1	1	11880	1980
	18	11	64QAM	18	7168	24	1	1	14256	2376
	24	11	64QAM	18	9480	24	1	2	19008	3168
	25	11	64QAM	18	9992	24	1	2	19800	3300
	30	11	64QAM	18	12040	24	1	2	23760	3960
	32	11	64QAM	18	12808	24	1	2	25344	4224
	36	11	64QAM	18	14344	24	1	2	28512	4752
	45	11	64QAM	18	17928	24	1	3	35640	5940
	50	11	64QAM	18	19968	24	1	3	39600	6600
	60	11	64QAM	18	24072	24	1	3	47520	7920
	64	11	64QAM	18	25608	24	1	4	50688	8448
	75	11	64QAM	18	30216	24	1	4	59400	9900
	80	11	64QAM	18	31752	24	1	4	63360	10560
	81	11	64QAM	18	32264	24	1	4	64152	10692
	90	11	64QAM	18	35856	24	1	5	71280	11880
	100	11	16QAM	10	17424	24	1	3	52800	13200
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. DM-RS symbols are not counted.										
NOTE 2: MCS Index is based on MCS table 6.1.4.1-1 defined in TS 38.214 [16].										
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: The RMCs apply to all channel bandwidth where $L_{CRB} \leq N_{RB}$.										

A.2.2.5 Void

A.2.2.6 CP-OFDM QPSK

Table A.2.2.6-1: Reference Channels for CP-OFDM QPSK

Parameter	Allocated resource blocks (L _{CRB})	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit					Bits	Bits			Bits	
	1	11	QPSK	2	48	16	2	1	264	132
	5	11	QPSK	2	256	16	2	1	1320	660
	6	11	QPSK	2	304	16	2	1	1584	792
	9	11	QPSK	2	456	16	2	1	2376	1188
	10	11	QPSK	2	504	16	2	1	2640	1320
	11	11	QPSK	2	552	16	2	1	2904	1452
	12	11	QPSK	2	608	16	2	1	3168	1584
	13	11	QPSK	2	672	16	2	1	3432	1716
	15	11	QPSK	2	768	16	2	1	3960	1980
	16	11	QPSK	2	808	16	2	1	4224	2112
	18	11	QPSK	2	928	16	2	1	4752	2376
	19	11	QPSK	2	984	16	2	1	5016	2508
	24	11	QPSK	2	1192	16	2	1	6336	3168
	25	11	QPSK	2	1256	16	2	1	6600	3300
	26	11	QPSK	2	1288	16	2	1	6864	3432
	31	11	QPSK	2	1544	16	2	1	8184	4092
	33	11	QPSK	2	1672	16	2	1	8712	4356
	38	11	QPSK	2	1928	16	2	1	10032	5016
	39	11	QPSK	2	2024	16	2	1	10296	5148
	40	11	QPSK	2	2024	16	2	1	10560	5280
	47	11	QPSK	2	2408	16	2	1	12408	6204
	51	11	QPSK	2	2536	16	2	1	13464	6732
	52	11	QPSK	2	2600	16	2	1	13728	6864
	53	11	QPSK	2	2664	16	2	1	13992	6996
	54	11	QPSK	2	2664	16	2	1	14256	7128
	61	11	QPSK	2	3104	16	2	1	16104	8052
	65	11	QPSK	2	3240	16	2	1	17160	8580
	67	11	QPSK	2	3368	16	2	1	17688	8844
	68	11	QPSK	2	3368	16	2	1	17952	8976
	78	11	QPSK	2	3848	24	2	2	20592	10296
	79	11	QPSK	2	3912	24	2	2	20856	10428
	80	11	QPSK	2	3976	24	2	2	21120	10560
	81	11	QPSK	2	4040	24	2	2	21384	10692
	93	11	QPSK	2	4616	24	2	2	24552	12276
	95	11	QPSK	2	4744	24	2	2	25080	12540

Parameter	Allocated resource blocks (L_{CRB})	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
	106	11	QPSK	2	5256	24	2	2	27984	13992
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. DM-RS symbols are not counted.										
NOTE 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [16].										
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: The RMCs apply to all channel bandwidth where $L_{CRB} \leq N_{RB}$.										

A.2.2.7 CP-OFDM 16QAM

Table A.2.2.7-1: Reference Channels for CP-OFDM 16QAM

Parameter	Allocated resource blocks (L_{CRB})	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit					Bits	Bits			Bits	
	1	11	16QAM	10	176	16	2	1	528	132
	5	11	16QAM	10	888	16	2	1	2640	660
	6	11	16QAM	10	1064	16	2	1	3168	792
	9	11	16QAM	10	1608	16	2	1	4752	1188
	10	11	16QAM	10	1800	16	2	1	5280	1320
	11	11	16QAM	10	1928	16	2	1	5808	1452
	12	11	16QAM	10	2088	16	2	1	6336	1584
	13	11	16QAM	10	2280	16	2	1	6864	1716
	15	11	16QAM	10	2664	16	2	1	7920	1980
	16	11	16QAM	10	2792	16	2	1	8448	2112
	18	11	16QAM	10	3240	16	2	1	9504	2376
	19	11	16QAM	10	3368	16	2	1	10032	2508
	24	11	16QAM	10	4224	24	1	1	12672	3168
	25	11	16QAM	10	4352	24	1	1	13200	3300
	26	11	16QAM	10	4480	24	1	1	13728	3432
	31	11	16QAM	10	5376	24	1	1	16368	4092
	33	11	16QAM	10	5760	24	1	1	17424	4356
	38	11	16QAM	10	6656	24	1	1	20064	5016
	39	11	16QAM	10	6784	24	1	1	20592	5148
	40	11	16QAM	10	7040	24	1	1	21120	5280
	47	11	16QAM	10	8192	24	1	1	24816	6204

Parameter	Allocated resource blocks (L_{CRB})	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
	51	11	16QAM	10	8968	24	1	2	26928	6732
	52	11	16QAM	10	9224	24	1	2	27456	6864
	53	11	16QAM	10	9224	24	1	2	27984	6996
	54	11	16QAM	10	9480	24	1	2	28512	7128
	61	11	16QAM	10	10760	24	1	2	32208	8052
	65	11	16QAM	10	11272	24	1	2	34320	8580
	67	11	16QAM	10	11784	24	1	2	35376	8844
	68	11	16QAM	10	11784	24	1	2	35904	8976
	78	11	16QAM	10	13576	24	1	2	41184	10296
	79	11	16QAM	10	13832	24	1	2	41712	10428
	80	11	16QAM	10	14088	24	1	2	42240	10560
	81	11	16QAM	10	14088	24	1	2	42768	10692
	93	11	16QAM	10	16392	24	1	2	49404	12276
	95	11	16QMA	10	16392	24	1	2	50160	12540
	106	11	16QAM	10	18432	24	1	3	55968	13992
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. DM-RS symbols are not counted.										
NOTE 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [16].										
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: The RMCs apply to all channel bandwidth where $L_{CRB} \leq N_{RB}$.										

A.2.2.8 CP-OFDM 64QAM

Table A.2.2.8-1: Reference Channels for CP-OFDM 64QAM

Parameter	Allocated resource blocks (L_{CRB})	CP-OFDM Symbols per slot (Note 1)	Modulation	MCS Index (Note 2)	Payload size	Transport block CRC	LDPC Base Graph	Number of code blocks per slot (Note 3)	Total number of bits per slot	Total modulated symbols per slot
Unit					Bits	Bits			Bits	
	1	11	64QAM	19	408	16	2	1	792	132
	5	11	64QAM	19	2024	16	2	1	3960	660
	9	11	64QAM	19	3624	16	2	1	7128	1188
	10	11	64QAM	19	3968	24	1	1	7920	1320
	11	11	64QAM	19	4352	24	1	1	8712	1452
	12	11	64QAM	19	4736	24	1	1	9504	1584
	13	11	64QAM	19	5120	24	1	1	10296	1716

	15	11	64QAM	19	6016	24	1	1	11880	1980
	18	11	64QAM	19	7168	24	1	1	14256	2376
	19	11	64QAM	19	7552	24	1		15048	2508
	24	11	64QAM	19	9480	24	1	2	19008	3168
	25	11	64QAM	19	9992	24	1	2	19800	3300
	26	11	64QAM	19	10504	24	1	2	20592	3432
	31	11	64QAM	19	12296	24	1	2	24552	4092
	33	11	64QAM	19	13064	24	1	2	26136	4356
	38	11	64QAM	19	15112	24	1	2	30096	5016
	39	11	64QAM	19	15624	24	1	2	30888	5148
	47	11	64QAM	19	18960	24	1	3	37224	6204
	51	11	64QAM	19	20496	24	1	3	40392	6732
	52	11	64QAM	19	21000	24	1	3	41184	6864
	53	11	64QAM	19	21000	24	1	3	41976	6996
	61	11	64QAM	19	24567	24	1	3	48312	8052
	65	11	64QAM	19	26120	24	1	4	51480	8580
	67	11	64QAM	19	26632	24	1	4	53064	8844
	78	11	64QAM	19	31240	24	1	4	61776	10296
	79	11	64QAM	19	31752	24	1	4	62568	10428
	80	11	64QAM	19	31752	24	1	4	63360	10560
	81	11	64QAM	19	32264	24	1	4	64152	10692
	93	11	64QAM	19	36896	24	1	5	73656	12276
	95	11	64QAM	19	37896	24	1	5	75240	12540
	106	11	64QAM	19	42016	24	1	5	83952	13992
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. DM-RS symbols are not counted.										
NOTE 2: MCS Index is based on MCS table 5.1.3.1-1 defined in TS 38.214 [16].										
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: The RMCs apply to all channel bandwidth where $L_{CRB} \leq N_{RB}$.										

A.2.2.9 eVoid

A.3 DL reference measurement channels

A.3.1 General

The transport block size (TBS) determination procedure is described in clause 5.1.3.2 of TS 38.214 [16].

Unless otherwise stated, no user data is scheduled on slot #0 within 20 ms in order to avoid SSB and PDSCH transmissions in one slot and simplify test configuration.

A.3.2 Reference measurement channels for PDSCH performance requirements

A.3.2.0 General

For PDSCH reference channels if more than one Code Block is present, an additional CRC sequence of $L = 24$ Bits is attached to each Code Block (otherwise $L = 0$ Bit).

A.3.2.1 FDD

A.3.2.1.1 Reference measurement channels for SCS 15 kHz FR1

Table A.3.2.1.1-1: PDSCH Reference Channel for FDD (QPSK)

Parameter	Unit	Value				
Reference channel		R.PDSCH.1-1.1 FDD				
Channel bandwidth	MHz	10				
Subcarrier spacing	kHz	15				
Number of allocated resource blocks	PRBs	52				
Number of consecutive PDSCH symbols		12				
Allocated slots per 2 frames	Slots	19				
MCS table		64QAM				
MCS index		4				
Modulation		QPSK				
Target Coding Rate		0.30				
Number of MIMO layers		1				
Number of DMRS REs		12				
Overhead for TBS determination		0				
Information Bit Payload per Slot						
For Slot $i = 0$	Bits	N/A				
For Slots $i = 1, \dots, 19$	Bits	4,096				
Transport block CRC per Slot						
For Slot $i = 0$	Bits	N/A				
For Slots $i = 1, \dots, 19$	Bits	24				
Number of Code Blocks per Slot						
For Slot $i = 0$	CBs	N/A				
For Slots $i = 1, \dots, 19$	CBs	1				
Binary Channel Bits Per Slot						
For Slot $i = 0$	Bits	N/A				
For Slots $i = 10, 11$	Bits	13,104				
For Slots $i = 1, \dots, 9, 12, \dots, 19$	Bits	13,728				
Max. Throughput averaged over 2 frames	Mbps	3.891				
NOTE 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms						
NOTE 2: Slot i is slot index per 2 frames						

Table A.3.2.1.1-2: PDSCH Reference Channel for FDD (16QAM)

Parameter	Unit	Value					
Reference channel		R.PDSCH.1-2.1 FDD					
Channel bandwidth	MHz	10					
Subcarrier spacing	kHz	15					
Number of allocated resource blocks	PRBs	52					
Number of consecutive PDSCH symbols		12					
Allocated slots per 2 frames	Slots	19					
MCS table		64QAM					
MCS index		13					
Modulation		16QAM					
Target Coding Rate		0.48					
Number of MIMO layers		1					
Number of DMRS REs		12					
Overhead for TBS determination		0					
Information Bit Payload per Slot							
For Slot $i = 0$	Bits	N/A					
For Slots $i = 1, \dots, 19$	Bits	13,064					
Transport block CRC per Slot							
For Slot $i = 0$	Bits	N/A					
For Slots $i = 1, \dots, 19$	Bits	24					
Number of Code Blocks per Slot							
For Slot $i = 0$	CBs	N/A					
For Slots $i = 1, \dots, 19$	CBs	2					
Binary Channel Bits Per Slot							
For Slot $i = 0$	Bits	N/A					
For Slots $i = 10, 11$	Bits	26,208					
For Slots $i = 1, \dots, 9, 12, \dots, 19$	Bits	27,456					
Max. Throughput averaged over 2 frames	Mbps	12.411					
NOTE 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms							
NOTE 2: Slot i is slot index per 2 frames							

A.3.2.1.2 Reference measurement channels for SCS 60 kHz FR2-NTN

Editor's note: RMC for performance requirements is FFS.

Table A.3.2.1.2-1: Void

Table A.3.2.1.2-2: Void

Table A.3.2.1.2-3: Void

A.3.2.1.3 Reference measurement channels for SCS 120 kHz FR2-NTN

Table A.3.2.1.3-1: Void

Table A.3.2.1.3-2: Void

Table A.3.2.1.3-3: PDSCH Reference Channel for FDD (QPSK)

Parameter	Unit	Value				
Reference channel		R.PDSCH.3-3.1 FDD				
Channel bandwidth	MHz	200				
Subcarrier spacing	kHz	120				
Number of allocated resource blocks	PRBs	132				
Number of consecutive PDSCH symbols		13				
Allocated slots per 2 frames	Slots	159				
MCS table		64QAM				
MCS index		4				
Modulation		QPSK				
Target Coding Rate		0.30				
Number of MIMO layers		1				
Number of DMRS REs		12				
Overhead for TBS determination		0				
Information Bit Payload per Slot						
For Slot $i = 0$	Bits	N/A				
For Slots $i = 1, \dots, 159$	Bits	11528				
Transport block CRC per Slot						
For Slot $i = 0$	Bits	N/A				
For Slots $i = 1, \dots, 159$	Bits	24				
Number of Code Blocks per Slot						
For Slot $i = 0$	CBs	N/A				
For Slots $i = 1, \dots, 159$	CBs	2				
Binary Channel Bits Per Slot						
For Slot $i = 0$	Bits	N/A				
For Slots $i = 80, 81$	Bits	36432				
For Slots $i = 1, \dots, 79, 82, \dots, 159$	Bits	38016				
Max. Throughput averaged over 2 frames	Mbps	91.648				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms						
Note 2: Slot i is slot index per 2 frames						

Table A.3.2.1.3-4: PDSCH Reference Channel for FDD (16QAM)

Parameter	Unit	Value				
Reference channel		R.PDSCH.3-4.1 FDD				
Channel bandwidth	MHz	200				
Subcarrier spacing	kHz	120				
Number of allocated resource blocks	PRBs	132				
Number of consecutive PDSCH symbols		13				
Allocated slots per 2 frames	Slots	159				
MCS table		64QAM				
MCS index		13				
Modulation		16QAM				
Target Coding Rate		0.48				
Number of MIMO layers		1				
Number of DMRS REs		12				
Overhead for TBS determination		0				
Information Bit Payload per Slot						
For Slot $i = 0$	Bits	N/A				
For Slots $i = 1, \dots, 159$	Bits	36896				
Transport block CRC per Slot						
For Slot $i = 0$	Bits	N/A				
For Slots $i = 1, \dots, 159$	Bits	24				
Number of Code Blocks per Slot						
For Slot $i = 0$	CBs	N/A				
For Slots $i = 1, \dots, 159$	CBs	5				
Binary Channel Bits Per Slot						
For Slot $i = 0$	Bits	N/A				
For Slots $i = 80, 81$	Bits	72864				
For Slots $i = 1, \dots, 79, 82, \dots, 159$	Bits	76032				
Max. Throughput averaged over 2 frames	Mbps	293.323				
Note 1: SS/PBCH block is transmitted in slot #0 with periodicity 20 ms						
Note 2: Slot i is slot index per 2 frames						

Table A.3.2.1.3-5: Void

A.3.3

A.3.4 Reference measurement channels for receiver requirements

A.3.4.1 FDD

A.3.4.1.1 Fixed reference channels for SCS 15kHz FR1-NTN

In addition to general description, no user data is scheduled on slot #1 within 20 ms in order to avoid SIB and PDSCH transmissions in one slot and simplify test configuration.

Table A.3.4.1.1-1: Fixed reference channel for receiver requirements (SCS 15kHz, FDD, QPSK 1/3, NGSO)

Parameter	Unit	Value							
Channel bandwidth	MHz	5	10	15	20				
Subcarrier spacing	kHz	15	15	15	15				
Subcarrier spacing configuration μ		0	0	0	0				
Allocated resource blocks		25	52	79	106				
Subcarriers per resource block		12	12	12	12				
Allocated slots per 2 Radio Frame		16	16	16	16				
MCS Index		4	4	4	4				
MCS Table for TBS determination		64QAM							
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, 1, 10, 11	Bits	N/A	N/A	N/A	N/A				
For Slots 2, ..., 9, 12, ..., 19	Bits	1672	3368	5120	6912				
Transport block CRC	Bits	16	16	24	24				
LDPC base graph		2	2	1	1				
Number of Code Blocks per Slot									
For Slots 0, 1, 10, 11	CBs	N/A	N/A	N/A	N/A				
For Slots 2, ..., 9, 12, ..., 19	CBs	1	1	1	1				
Binary Channel Bits per Slot									
For Slots 0, 1, 10, 11	Bits	N/A	N/A	N/A	N/A				
For Slots 2, ..., 9, 12, ..., 19	Bits	5400	11232	17064	22896				
Max. Throughput averaged over 2 frame	Mbps	TBD	TBD	TBD	TBD				
Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1 from TS 38.101-1 [5]. 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 with periodicity 20 ms. Note 4: Slot i is slot index per 2 frames. Note 5: PDSCHs are scheduled from 1 st frame of the periodicity.									

Table A.3.4.1.1-2: Fixed reference channel for receiver requirements (SCS 15kHz, FDD, 64QAM, NGSO)

Parameter	Unit	Value							
Channel bandwidth	MHz	5	10	15	20				
Subcarrier spacing	kHz	15	15	15	15				
Subcarrier spacing configuration μ		0	0	0	0				
Allocated resource blocks		25	52	79	106				
Subcarriers per resource block		12	12	12	12				
Allocated slots per 2 Radio Frame		16	16	16	16				
MCS Index		24	24	24	24				
MCS Table for TBS determination		64QAM							
Modulation		64 QAM	64 QAM	64 QAM	64 QAM				
Target Coding Rate		3/4	3/4	3/4	3/4				
Maximum number of HARQ transmissions		1	1	1	1				
Information Bit Payload per Slot									
For Slots 0, 1, 10, 11	Bits	N/A	N/A	N/A	N/A				
For Slots 2, ..., 9, 12, ..., 19	Bits	12296	25608	38936	52224				
Transport block CRC	Bits	24	24	24	24				
LDPC base graph		1	1	1	1				
Number of Code Blocks per Slot									
For Slots 0, 1, 10, 11	CBs	N/A	N/A	N/A	N/A				
For Slots 2, ..., 9, 12, ..., 19	CBs	2	4	5	7				
Binary Channel Bits per Slot									
For Slots 0, 1, 10, 11	Bits	N/A	N/A	N/A	N/A				
For Slots 2, ..., 9, 12, ..., 19	Bits	16200	33696	51192	68688				
Max. Throughput averaged over 2 frame	Mbps	TBD	TBD	TBD	TBD				
NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1 from TS 38.101-1 [5].									
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 with periodicity 20 ms.									
NOTE 4: Slot i is slot index per 2 frames.									
NOTE 5: PDSCHs are scheduled from 1 st frame of the periodicity.									

Table A.3.4.1.1-3: Fixed reference channel for receiver requirements (SCS 15kHz, FDD, QPSK 1/3, GSO)

Parameter	Unit	Value							
Channel bandwidth	MHz	5	10	15	20				
Subcarrier spacing	kHz	15	15	15	15				
Subcarrier spacing configuration μ		0	0	0	0				
Allocated resource blocks		25	52	79	106				
Subcarriers per resource block		12	12	12	12				
Allocated slots per 32 Radio Frame		16	16	16	16				
MCS Index		4	4	4	4				
MCS Table for TBS determination		64QAM							
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, 1, 10, 11, 20, ..., 319	Bits	N/A	N/A	N/A	N/A				
For Slots 2, ..., 9, 12, ..., 19	Bits	1672	3368	5120	6912				
Transport block CRC	Bits	16	16	24	24				
LDPC base graph		2	2	1	1				
Number of Code Blocks per Slot									
For Slots 0, 1, 10, 11, 20, ..., 319	CBs	N/A	N/A	N/A	N/A				
For Slots 2, ..., 9, 12, ..., 19	CBs	1	1	1	1				
Binary Channel Bits per Slot									
For Slots 0, 1, 10, 11, 20, ..., 319	Bits	N/A	N/A	N/A	N/A				
For Slots 2, ..., 9, 12, ..., 19	Bits	5400	11232	17064	22896				
Max. Throughput averaged over 2 frame	Mbps	TBD	TBD	TBD	TBD				
Note 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1 from TS 38.101-1 [5]. 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 with periodicity 20 ms. Note 4: Slot i is slot index per 32 frames. Note 5: PDSCHs are scheduled from 1 st frame of the periodicity.									

Table A.3.4.1.1-4: Fixed reference channel for receiver requirements (SCS 15kHz, FDD, 64QAM, GSO)

Parameter	Unit	Value							
Channel bandwidth	MHz	5	10	15	20				
Subcarrier spacing	kHz	15	15	15	15				
Subcarrier spacing configuration μ		0	0	0	0				
Allocated resource blocks		25	52	79	106				
Subcarriers per resource block		12	12	12	12				
Allocated slots per 32 Radio Frame		16	16	16	16				
MCS Index		24	24	24	24				
MCS Table for TBS determination		64QAM							
Modulation		64 QAM	64 QAM	64 QAM	64 QAM				
Target Coding Rate		3/4	3/4	3/4	3/4				
Maximum number of HARQ transmissions		1	1	1	1				
Information Bit Payload per Slot									
For Slots 0, 1, 10, 11, 20, ..., 319	Bits	N/A	N/A	N/A	N/A				
For Slots 2, ..., 9, 12, ..., 19	Bits	12296	25608	38936	52224				
Transport block CRC	Bits	24	24	24	24				
LDPC base graph		1	1	1	1				
Number of Code Blocks per Slot									
For Slots 0, 1, 10, 11, 20, ..., 319	CBs	N/A	N/A	N/A	N/A				
For Slots 2, ..., 9, 12, ..., 19	CBs	2	4	5	7				
Binary Channel Bits per Slot									
For Slots 0, 1, 10, 11, 20, ..., 319	Bits	N/A	N/A	N/A	N/A				
For Slots 2, ..., 9, 12, ..., 19	Bits	16200	33696	51192	68688				
Max. Throughput averaged over 2 frame	Mbps	TBD	TBD	TBD	TBD				
NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.2.1-1 from TS 38.101-1 [5].									
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 with 20ms periodicity.									
NOTE 4: Slot i is slot index per 32 frames.									
NOTE 5: PDSCHs are scheduled from 1 st frame of the periodicity.									

A.3.4.1.2 Fixed reference channels for SCS 60 kHz FR2-NTN

Table A.3.4.1.2-1: PDSCH Reference Channel for FDD (QPSK)

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 (NOTE 7)		23/24	23/24	23/24
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 $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 79\}$ (NOTE 5)	Bits	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 79\}$ (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 $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 79\}$ (NOTE 5)	CBs	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 79\}$ (NOTE 6)	CBs	1	2	3
Binary Channel Bits Per Slot				
For Slots 0 and Slot i, if $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 79\}$ (NOTE 5)	Bits	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 79\}$ (NOTE 6)	Bits	14256	28512	57024
Max. Throughput averaged over 1 frame (NOTE 8)	Mbps	10.138	20.294	40.550
<p>NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.</p> <p>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).</p> <p>NOTE 3: SS/PBCH block is transmitted in slot 0 with periodicity 20 ms.</p> <p>NOTE 4: Slot i is slot index per 2 frames.</p> <p>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 $\text{mod}(i, 8) = \{3,4,5,6,7\}$ for i from $\{0, \dots, 79\}$.</p> <p>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 $\text{mod}(i, 8) = \{0,1,2\}$ for i from $\{0, \dots, 79\}$.</p> <p>NOTE 7: First number corresponds to the number slots allocated in the first frame of the RMC; second number corresponds to the number slots allocated in the second frame of the RMC.</p> <p>NOTE 8: Throughput is averaged over 2nd frame of RMC.</p>				

Table A.3.4.1.2-2: PDSCH Reference Channel for FDD (16QAM)

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 (NOTE 6)		23/24	23/24	23/24
MCS index		13	13	13
Modulation		16QAM	16QAM	16QAM
Target Coding Rate		0.48	0.48	0.48
Maximum number of HARQ transmissions		1	1	1
Information Bit Payload per Slot				
For Slots 0 and Slot i, if $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 79\}$	Bits	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 79\}$	Bits	12808	25608	51216
Transport block CRC	Bits	24	24	24
LDPC base graph		1	1	1
Number of Code Blocks per Slot				
For Slot i, if $\text{mod}(i, 10) = \{0,1,2\}$ for i from $\{1, \dots, 79\}$	CBs	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 79\}$	CBs	2	4	7
Binary Channel Bits Per Slot				
For Slots 0 and Slot i, if $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 79\}$	Bits	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 79\}$	Bits	27324	54648	109296
Max. Throughput averaged over 1 frame (NOTE 7)	Mbps	30.739	61.459	122.918
<p>NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.</p> <p>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).</p> <p>NOTE 3: SS/PBCH block is transmitted in slot 0 with periodicity 20 ms.</p> <p>NOTE 4: Slot i is slot index per 2 frames.</p> <p>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.</p> <p>NOTE 6: First number corresponds to the number slots allocated in the first frame of the RMC; second number corresponds to the number slots allocated in the second frame of the RMC.</p> <p>NOTE 7: Throughput is averaged over 2nd frame of RMC.</p>				

Table A.3.4.1.2-3: PDSCH Reference Channel for FDD (64QAM)

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 (NOTE 6)		23/24	23/24	23/24
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 $\text{mod}(i, 5) = \{3, 4\}$ for i from $\{0, \dots, 79\}$	Bits	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0, 1, 2\}$ for i from $\{1, \dots, 79\}$	Bits	20496	40976	81976
Transport block CRC	Bits	24	24	24
LDPC base graph		1	1	1
Number of Code Blocks per Slot				
For Slot i, if $\text{mod}(i, 10) = \{0, 1, 2\}$ for i from $\{1, \dots, 79\}$	CBs	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0, 1, 2\}$ for i from $\{1, \dots, 79\}$	CBs	3	5	10
Binary Channel Bits Per Slot				
For Slots 0 and Slot i, if $\text{mod}(i, 5) = \{3, 4\}$ for i from $\{0, \dots, 79\}$	Bits	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0, 1, 2\}$ for i from $\{1, \dots, 79\}$	Bits	40986	81972	163944
Max. Throughput averaged over 1 frame (NOTE 7)	Mbps	49.190	98.342	196.742
<p>NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.</p> <p>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).</p> <p>NOTE 3: SS/PBCH block is transmitted in slot 0 with periodicity 20 ms.</p> <p>NOTE 4: Slot i is slot index per 2 frames.</p> <p>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.</p> <p>NOTE 6: First number corresponds to the number slots allocated in the first frame of the RMC; second number corresponds to the number slots allocated in the second frame of the RMC.</p> <p>NOTE 7: Throughput is averaged over 2nd frame of RMC.</p>				

A.3.4.1.3 Fixed reference channels for SCS 120 kHz FR2-NTN**Table A.3.4.1.3-1: PDSCH Reference Channel for FDD (QPSK)**

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 (NOTE 7)		47/48	47/48	47/48	47/48
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 $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 159\}$ (NOTE 5)	Bits	N/A	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 159\}$ (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 $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 159\}$ (NOTE 5)	CBs	N/A	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 159\}$ (NOTE 6)	CBs	1	1	2	3
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 159\}$ (NOTE 5)	Bits	N/A	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 159\}$ (NOTE 6)	Bits	6912	14256	28512	57024
Max. Throughput averaged over 1 frame (NOTE 8)	Mbps	10.022	20.275	40.589	81.101
<p>NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.</p> <p>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).</p> <p>NOTE 3: SS/PBCH block is transmitted in slot 0 with periodicity 20 ms.</p> <p>NOTE 4: Slot i is slot index per 2 frames.</p> <p>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 $\text{mod}(i, 16) = \{7, \dots, 15\}$ for i from $\{0, \dots, 159\}$.</p> <p>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 $\text{mod}(i, 16) = \{0, \dots, 6\}$ for i from $\{0, \dots, 159\}$.</p> <p>NOTE 7: First number corresponds to the number slots allocated in the first frame of the RMC; second number corresponds to the number slots allocated in the second frame of the RMC.</p> <p>NOTE 8: Throughput is averaged over 2nd frame of RMC.</p>					

Table A.3.4.1.3-2: PDSCH Reference Channel for FDD (16QAM)

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 (NOTE 6)		47/48	47/48	47/48	47/48
MCS index		13	13	13	13
Modulation		16QAM	16QAM	16QAM	16QAM
Target Coding Rate		0.48	0.48	0.48	0.48
Maximum number of HARQ transmissions		1	1	1	1
Information Bit Payload per Slot					
For Slots 0 and Slot i, if $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 159\}$	Bits	N/A	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 159\}$	Bits	6272	12808	25608	51216
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 $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 159\}$	CBs	N/A	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 159\}$	CBs	1	2	4	7
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 159\}$	Bits	N/A	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 159\}$	Bits	13248	27324	54648	109296
Max. Throughput averaged over 1 frame (NOTE 7)	Mbps	30.106	61.478	122.918	245.837
<p>NOTE 1: Additional parameters are specified in Table A.3.1-1 and Table A.3.3.1-1.</p> <p>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).</p> <p>NOTE 3: SS/PBCH block is transmitted in slot 0 of each frame.</p> <p>NOTE 4: Slot i is slot index per frame.</p> <p>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.</p> <p>NOTE 6: First number corresponds to the number slots allocated in the first frame of the RMC; second number corresponds to the number slots allocated in the second frame of the RMC.</p> <p>NOTE 7: Throughput is averaged over 2nd frame of RMC.</p>					

Table A.3.4.1.3-3: PDSCH Reference Channel for FDD (64QAM)

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 (NOTE 6)		47/48	47/48	47/48	47/48
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 $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 159\}$	Bits	N/A	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 159\}$	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 $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 159\}$	CBs	N/A	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 159\}$	CBs	2	3	5	10
Binary Channel Bits Per Slot					
For Slots 0 and Slot i, if $\text{mod}(i, 5) = \{3,4\}$ for i from $\{0, \dots, 159\}$	Bits	N/A	N/A	N/A	N/A
For Slot i, if $\text{mod}(i, 5) = \{0,1,2\}$ for i from $\{1, \dots, 159\}$	Bits	19872	40986	81972	163944
Max. Throughput averaged over 1 frame (NOTE 7)	Mbps	47.962	98.381	196.685	393.485
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. NOTE 6: First number corresponds to the number slots allocated in the first frame of the RMC; second number corresponds to the number slots allocated in the second frame of the RMC. NOTE 7: Throughput is averaged over 2nd frame of RMC.					

A.4 Testing related to Satellite Access

A.4.1 General

The following test conditions should be maintained for Satellite Access when test equipment emulates the snapshot of the satellite link channel.

- The same ephemeris info will be maintained during each test.
- A set of ephemeris information are pre-defined for each satellite corresponding to respective epoch times in TS 38.508-1 [12].
- The range of the selected constant delay shift is as follows:
 - For NGSO an altitude of 600 km and 1200 km on a circular orbit are considered. The range of the one-way delay between UE and satellite is from 2ms (lowest value for LEO orbit 600km) to 6.67 ms (highest value for LEO orbit 1200 km).
 - For GSO the range of the one-way delay from UE to satellite is within 119.375 ms to 128.79 ms.

- Constant delay value is derived from ephemeris info (SIB19) and UE location associated to zero Doppler or non-zero Doppler value under test.

A.4.2 Test condition for transmitter characteristics

All requirements in clause 6 for transmitter characteristics, other than frequency error in clause 6.4.1 shall be verified when Doppler conditions are set to zero and delay conditions are set to constant for all types of satellites.

Frequency error requirement in clause 6.4.1 shall be verified for at least two cases: one with zero Doppler condition and the other one with a constant Doppler shift where the range of the absolute value of Doppler is greater than zero and up to 0.93 ppm if the IE field *ntn-ScenarioSupport-r17* is present and indicated as GSO and up to 24 ppm if the IE field *ntn-ScenarioSupport-r17* is present and indicated as NGSO or only the IE field *nonTerrestrialNetwork-r17* is present. The delay condition is a constant.

A.4.3 Test condition for receiver characteristics

All requirements in clause 7 for receiver characteristics shall be verified when Doppler conditions are set to zero and delay conditions are set to constant for all types of satellites.

A.4.4 Test condition for performance requirements

All requirements in clause 8 for performance requirements shall be verified when Doppler conditions related to satellite motion for DL in service link are set to zero and delay conditions are set to constant for all types of NGSO satellites.

The one-way delay between UE and satellite for NGSO at an altitude of 600 km is 2 ms.

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.

B.1 Static propagation condition

B.1.1 UE Receiver with 1Rx

For 2 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = [1 \ 1].$$

B.1.2 UE Receiver with 2Rx

For 1 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{pmatrix} 1 \\ 1 \end{pmatrix}.$$

For 2 port transmission the channel matrix is defined in the frequency domain by

$$\mathbf{H} = \begin{pmatrix} 1 & j \\ 1 & -j \end{pmatrix}.$$

B.2 Multi-path fading propagation conditions

B.2.0 General

The multipath propagation conditions consist of several parts:

- A delay profile in the form of a "tapped delay-line", characterized by a number of taps at fixed positions on a sampling grid. The profile can be further characterized by the r.m.s. delay spread and the maximum delay spanned by the taps.
- A combination of channel model parameters that include the Delay profile and the Doppler spectrum that is characterized by a classical spectrum shape and a maximum Doppler frequency.

Initial channel matrix for LOS component of NTN-TDL-C channel model is equal to channel matrix of Static propagation conditions in Clause B.1.

B.2.1 Delay profiles

The delay profiles are derived from the TR 38.811 [18] NTN-TDL models for the desired delay spread and tap resolution. After scaling the normalized delay spread values for each tap by the desired RMS delay spread, the tap delays are quantized to a delay resolution of 5ns by rounding to the nearest multiple of the delay resolution.

Table B.2.1-1: Delay profiles for NR NTN channel models

Type	Model	Delay spread (r.m.s.)	Delay resolution
NLOS	NTN-TDLA100	100 ns	5 ns
LOS	NTN-TDLC5	5 ns	5 ns

Table B.2.1-2: NTN-TDLA100 (DS = 100 ns)

Tap #	Delay [ns]	Power [dB]	Fading distribution
1	0	0	Rayleigh
2	110	-4.7	Rayleigh
3	285	-6.5	Rayleigh

Table B.2.1-3: NTN-TDLC5 (DS = 5 ns)

Tap #	Delay [ns]	Power [dB]	Fading distribution
1	0	-0.6	LOS path
	0	-8.9	Rayleigh
2	60	-21.5	Rayleigh

NOTE 1: Tap #1 follows a Rician distribution.

B.2.2 Combinations of channel model parameters

The propagation conditions used for the performance measurements in multi-path fading environment are indicated as a combination of a channel model name and a maximum Doppler frequency, i.e., NTN-TDLA<DS>-<Doppler>, or NTN-TDLC<DS>-<Doppler> where '<DS>' indicates the desired delay spread and '<Doppler>' indicates the maximum Doppler frequency (Hz).

Table B.2.2-1 show the propagation conditions that are used for the performance measurements in multi-path fading environment for NLOS and LOS propagation conditions.

Table B.2.2-1: Channel model parameters for NTN

Combination name	Model	Maximum Doppler frequency
NTN-TDLA100-200	NTN-TDLA100	200 Hz
NTN-TDLC5-200	NTN-TDLC5	200 Hz
NTN-TDLC5-1200	NTN-TDLC5	1200Hz

B.2.3 MIMO Channel Correlation Matrices

B.2.3.0 General

The MIMO channel correlation matrices defined in clause B.2.3 apply for the antenna configuration using uniform linear arrays at both gNB and UE.

B.2.3.1 MIMO Correlation Matrices using Uniform Linear Array (ULA)

B.2.3.1.0 General

The MIMO channel correlation matrices defined in clause B.2.3.1.1 apply for the antenna configuration using uniform linear array (ULA) at both gNB and UE.

B.2.3.1.1 Definition of MIMO Correlation Matrices

Table B.2.3.1.1-1 defines the correlation matrix for the gNB.

Table B.2.3.1.1-1: gNB correlation matrix

	One antenna	Two antennas
gNB Correlation	$R_{gNB}=1$	$R_{gNB} = \begin{pmatrix} 1 & \alpha \\ \alpha^* & 1 \end{pmatrix}$

Table B.2.3.1.1-2 defines the correlation matrix for the UE:

Table B.2.3.1.1-2: UE correlation matrix

	One antenna	Two antennas
UE Correlation	$R_{UE}=1$	$R_{UE} = \begin{pmatrix} 1 & \beta \\ \beta^* & 1 \end{pmatrix}$

Table B.2.3.1.1-3 defines the channel spatial correlation matrix R_{spat} . The parameters, α and β in Table B.2.3.1.1-3 defines the spatial correlation between the antennas at the gNB and UE.

Table B.2.3.1.1-3: R_{spat} correlation matrices

1x2 case	$R_{spat} = R_{UE} = \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix}$
2x1 case	$R_{spat} = R_{gNB} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix}$
2x2 case	$R_{spat} = R_{gNB} \otimes R_{UE} = \begin{bmatrix} 1 & \alpha \\ \alpha^* & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 & \beta \\ \beta^* & 1 \end{bmatrix} = \begin{bmatrix} 1 & \beta & \alpha & \alpha\beta \\ \beta^* & 1 & \alpha\beta^* & \alpha \\ \alpha^* & \alpha^*\beta & 1 & \beta \\ \alpha^*\beta^* & \alpha^* & \beta^* & 1 \end{bmatrix}$

B.2.3.1.2 MIMO Correlation Matrices at High, Medium and Low Level

The α and β for different correlation types are given in Table B.2.3.1.2-1.

Table B.2.3.1.2-1: The α and β parameters for ULA MIMO correlation matrices

Correlation Model	α	β
Low correlation	0	0

The correlation matrices low correlation are defined in Table B.2.3.1.2-2 below.

Table B.2.3.1.2-2: MIMO correlation matrices for low correlation

1x2 case	$R_{low}=\mathbf{I}_2$
2x1 case	$R_{low}=\mathbf{I}_2$
2x2 case	$R_{low}=\mathbf{I}_4$
NOTE: \mathbf{I}_d is the $d \times d$ identity matrix.	

Annex C (normative): Downlink physical channels

C.1 General

This annex specifies the downlink physical channels that are needed for setting a connection and channels that are needed during a connection.

C.2 Setup (Conducted)

Table C.2-1 describes the downlink Physical Channels that are required for connection set up.

Table C.2-1: Downlink Physical Channels required for connection set-up

Physical Channel
PBCH
SSS
PSS
PDCCH
PDSCH
PBCH DMRS
PDCCH DMRS
PDSCH DMRS
CSI-RS

C.3 Connection (Conducted)

C.3.0 General

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

C.3.1 Measurement of Performance requirements

Table C.3.1-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels, unless otherwise stated.

Table C.3.1-1: Downlink Physical Channels transmitted during a connection (FDD and TDD)

Parameter	Unit	Value (Note 2)
SSS transmit power	W	Test specific
EPRE ratio of PSS to SSS	dB	0
EPRE ratio of PBCH to SSS	dB	0
EPRE ratio of PBCH to PBCH DMRS	dB	0
EPRE ratio of PDCCH to SSS	dB	0
EPRE ratio of PDCCH to PDCCH DMRS	dB	0
EPRE ratio of PDSCH to SSS	dB	0
EPRE ratio of PDSCH to PDSCH DMRS	dB	Test specific (Note 1)
EPRE ratio of CSI-RS to SSS	dB	$-10 \cdot \log_{10}(L)$ (Note 3)
EPRE ratio of OCNG to SSS	dB	0
EPRE ratio of PDCCH OCNG to SSS	dB	0
EPRE ratio of LTE CRS to NR SSS	dB	0 (Note 4)

NOTE 1: Value is derived from Table 4.1-1 in TS 38.214 [16] based on "Number of DM-RS CDM groups without data" and "DMRS Type" parameters specified for each test.
NOTE 2: The value is the energy of per RE for a single antenna port before pre-coding.
NOTE 3: $L \in \{1, 2, 4, 8\}$ is the CDM group size of NZP CSI-RS specified for each test.
NOTE 4: It is only applicable to LTE-NR coexistence tests.

C.4 Setup (Radiated)

Table C.4-1 describes the downlink Physical Channels that are required for connection set up.

Table C.4-1: Downlink Physical Channels required for connection set-up

Physical Channel
PBCH
SSS
PSS
PDCCH
PDSCH
PBCH DMRS
PDCCH DMRS
PDSCH DMRS
CSI-RS
PTRS

C.5 Connection (Radiated)

The following clauses, describes the downlink Physical Channels that are transmitted during a connection i.e., when measurements are done.

C.5.1 Measurement of Receiver Characteristics

Table C.5.1-1 is applicable for measurements in which uniform RS-to-EPRE boosting for all downlink physical channels, unless otherwise stated.

Table C.5.1-1: Downlink Physical Channels transmitted during a connection (TDD)

Parameter	Unit	Value (Note 2)
SSS transmit power	W	Test specific
EPRE ratio of PSS to SSS	dB	0
EPRE ratio of PBCH to SSS	dB	0
EPRE ratio of PBCH to PBCH DMRS	dB	0
EPRE ratio of PDCCH to SSS	dB	0
EPRE ratio of PDCCH to PDCCH DMRS	dB	0
EPRE ratio of PDSCH to SSS	dB	0
EPRE ratio of PDSCH to PDSCH DMRS	dB	Test specific (Note 1)
EPRE ratio of CSI-RS to SSS	dB	$-10 \cdot \log_{10}(L)$ (Note 3)
EPRE ratio of PTRS to PDSCH	dB	Test specific
EPRE ratio of OCNG to SSS	dB	0
EPRE ratio of PDCCH OCNG to SSS	dB	0
Note 1: Value is derived from Table 4.1-1 in TS 38.214 [12] based on "Number of DM-RS CDM groups without data" and "DMRS Type" parameters specified for each test.		
Note 2: The value is the energy of per RE for a single antenna port before pre-coding.		
Note 3: $L \in \{1,2,4,8\}$ is the CDM group size of NZP CSI-RS specified for each test.		
Note 4: Value is derived from Table 4.1-2 in TS 38.214 [12] based on "The number of PDSCH layers" and "epre-Ratio" parameters specified for each test.		

Annex D (normative): Characteristics of the interfering signal

D.1 General

Some RF performance requirements for the NR UE receiver are defined with interfering signals present in addition to the wanted signal.

For NR bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz, a modulated 5 MHz full bandwidth NR down link signal, and in some cases an additional CW signal, are used as interfering signal. And for some cases an additional CW signal is used.

D.2 Interference signals

Table D.2-1 describes the modulated interferer for different channel bandwidth options for NR band lower than 2700 MHz.

**Table D.2-1: Description of modulated NR interferer
for NR bands with $F_{DL_high} < 2,700$ MHz and $F_{UL_high} < 2,700$ MHz**

	Channel bandwidth			
	5 MHz	10MHz	15 MHz	20 MHz
RB	NOTE 1			
BW _{Interferer}	5 MHz			
NOTE 1: The RB configured for interfering signal is the same as maximum RB number defined in Table 5.3.2-1 for each sub-carrier spacing.				

Annex E (normative): Global In-Channel TX-Test

Same content as defined in Annex E in TS 38.521-1 [2] with the following exceptions:

TDD does not apply to satellite access operation for NR UEs in this release of specification.

Annex F (normative): Measurement uncertainties and Test Tolerances

F.1 Acceptable uncertainty of Test System (normative)

F.1.0 General

The maximum acceptable uncertainty of the Test System is specified below for each test, where appropriate. The Test System shall enable the stimulus signals in the test case to be adjusted to within the specified range, and the equipment under test to be measured with an uncertainty not exceeding the specified values. All ranges and uncertainties are absolute values, and are valid for a confidence level of 95 %, unless otherwise stated.

A confidence level of 95 % is the measurement uncertainty tolerance interval for a specific measurement that contains 95 % of the performance of a population of test equipment.

For RF tests it should be noted that the uncertainties in clause F.1 apply to the Test System operating into a nominal 50 ohm load and do not include system effects due to mismatch between the DUT and the Test System.

The downlink signal uncertainties apply at each receiver antenna connector.

F.1.1 Measurement of test environments

The measurement accuracy of the UE test environments defined in TS 38.508-1 [12] subclause 4.1, Test environments shall be

- Pressure ± 5 kPa.
- Temperature ± 2 degrees.
- Relative Humidity ± 5 %.
- DC Voltage ± 1.0 %.
- AC Voltage ± 1.5 %.
- Vibration 10 %.
- Vibration frequency 0.1 Hz.

The above values shall apply unless the test environment is otherwise controlled and the specification for the control of the test environment specifies the uncertainty for the parameter.

F.1.2 Measurement of transmitter

Table F.1.2-1: Maximum Test System Uncertainty for transmitter tests

Subclause	Maximum Test System Uncertainty	Derivation of Test System Uncertainty
6.2.1 UE maximum output power	Same as clause 6.2.1 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	
6.2.2 Maximum Power Reduction (MPR)	Same as clause 6.2.2 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	
6.2.3 UE additional maximum output power reduction	Same as clause 6.2.3 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	
6.2.4 Configured transmitted power	Same as clause 6.2.4 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	
6.3.1 Minimum output power	Same as clause 6.3.1 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	
6.3.2 Transmit OFF power	Same as clause 6.3.2 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	
6.3.3 Transmit on/off time mask	Same as clause 6.3.3 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	
6.3.4 Power Control	Same as clause 6.3.4 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	
6.4.1_1 Frequency error with GSO ephemeris	Same as clause 6.4.1 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	
6.4.1_2 Frequency error with NGSO ephemeris	Same as clause 6.4.1 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	
6.4.2.1 Error Vector Magnitude	Same as clause 6.4.2.1 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	
6.4.2.1a Error Vector Magnitude including symbols with transient period	Same as clause 6.4.2.1a in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	
6.4.2.2 Carrier Leakage	Same as clause 6.4.2.2 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	
6.4.2.3 In-band emissions	Same as clause 6.4.2.3 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	
6.4.2.4 EVM equalizer spectrum flatness	Same as clause 6.4.2.4 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	
6.4.2.5 EVM equalizer spectrum flatness for $\text{Pi}/2$ BPSK	Same as clause 6.4.2.5 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	
6.5.1 Occupied bandwidth	Same as clause 6.5.1 in TS 38.521-1 [2].	
6.5.2.4.1 NR Adjacent Channel Leakage Ratio	Same as clause 6.5.2.4.1 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	
6.5.2.2 Spectrum Emission Mask	Same as clause 6.5.2.2 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	
6.5.3.1 General spurious emissions	Same as clause 6.5.3.1 in TS 38.521-1 [2].	
6.5.3.2 Spurious emission for UE co-existence	Same as clause 6.5.3.2 in TS 38.521-1 [2].	
6.5.3.3 Additional spurious emissions	Same as clause 6.5.3.3 in TS 38.521-1 [2].	
6.5.4 Transmit intermodulation	Same as clause 6.5.4 in TS 38.521-1 [2].	

F.1.3 Measurement of receiver

Table F.1.3-1: Maximum Test System Uncertainty for receiver tests

Subclause	Maximum Test System Uncertainty	Derivation of Test System Uncertainty
7.3.2 Reference sensitivity power level	Same as clause 7.3.2 in TS 38.521-1 [2].	
7.4 Maximum input level	Same as clause 7.4 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	
7.5 Adjacent channel selectivity 7.5 Adjacent channel selectivity	Same as clause 7.5 in TS 38.521-1 [2] for FDD band with " $f \leq 3.0$ GHz".	Same as clause 7.5 in TS 38.521-1 [2].
7.6.2 In-band blocking	Same as clause 7.6.2 in TS 38.521-1 [2] for FDD band with " $f \leq 3.0$ GHz".	Same as clause 7.6.2 in TS 38.521-1 [2].
7.6.3 Out of Band Blocking	Same as clause 7.6.3 in TS 38.521-1 [2] for FDD band with " $f \leq 3.0$ GHz".	Same as clause 7.6.3 in TS 38.521-1 [2].
7.6.4 Narrow band blocking	Same as clause 7.6.4 in TS 38.521-1 [2] for FDD band with " $f \leq 3.0$ GHz".	Same as clause 7.6.4 in TS 38.521-1 [2].
7.7 Spurious response	Same as clause 7.6.3 in TS 38.521-1 [2].	Same as clause 7.6.3.
7.8.2 Wide band Intermodulation	Same as clause 7.8.2 in TS 38.521-1 [2] for FDD band with " $f \leq 3.0$ GHz".	Same as clause 7.8.2 in TS 38.521-1 [2].
7.9 Spurious emissions	Same as clause 7.8.2 in TS 38.521-1 [2] with " $f \leq 12.75$ GHz"	

F.1.4 Measurement of Demod Performance requirements

Table F.1.4-1: Maximum Test System Uncertainty for demodulation performance tests

Subclause	Maximum Test System Uncertainty	Derivation of Test System Uncertainty
8.2.1.2.2.1.1_1 2Rx FDD FR1 PDSCH Mapping Type A for Satellite Access	Same as clause 5.2.2.1.1_1 in TS 38.521-4 [14]	Same as clause 5.2.2.1.1_1 in TS 38.521-4 [14]

F.2 Interpretation of measurement results (normative)

The measurement results returned by the Test System are compared – without any modification – against the Test Requirements. The Test Requirement is defined as a threshold considered in a test to assess compliance of the device; it might be either equal ("Shared Risk" principle) or relaxed ("Never fail a good DUT" principle) compared to the corresponding core specification value by an amount defined in Annex F.3 as Test Tolerance.

The "Shared Risk" and the "Never fail a good DUT" principles are defined in Recommendation ITU-R M.1545.

The actual measurement uncertainty of the Test System for the measurement of each parameter shall be included in the test report.

The recorded value for the Test System uncertainty shall be, for each measurement, equal to or lower than the appropriate figure in clause F.1 of the present document.

If the Test System for a test is known to have a measurement uncertainty greater than that specified in clause F.1, it is still permitted to use this apparatus provided that an adjustment is made value as follows:

Any additional uncertainty in the Test System over and above that specified in clause F.1 shall be used to tighten the Test Requirement, making the test harder to pass. For some tests, for example receiver tests, this may require modification of stimulus signals. This procedure will ensure that a Test System not compliant with clause F.1 does 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)

F.3.0 General

The Test Requirements in the present document have been calculated by relaxing the Minimum Requirements of the core specification using the Test Tolerances defined in this clause. When the Test Tolerance is zero, the Test Requirement will be the same as the Minimum Requirement. When the Test Tolerance is non-zero, the Test Requirements will differ from the Minimum Requirements, and the formula used for the relaxation is given in this clause.

The Test Tolerances are derived from Test System uncertainties, regulatory requirements and criticality to system performance. As a result, the Test Tolerances may sometimes be set to zero.

The test tolerances should not be modified for any reason e.g. to take account of commonly known test system errors (such as mismatch, cable loss, etc.).

The downlink Test Tolerances apply at each receiver antenna connector.

F.3.1 Measurement of test environments

The UE test environments are set to the values defined in TS 38.508-1 subclause 4.1, without any relaxation. The applied Test Tolerance is therefore zero.

F.3.2 Measurement of transmitter

Table F.3.2-1: Derivation of Test Requirements (Transmitter tests)

Sub clause	Test Tolerance (TT)	Formula for test requirement
6.2.1 UE maximum output power	Same as clause 6.2.1 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	Upper limit + TT, Lower limit - TT
6.2.2 Maximum Power Reduction (MPR)	Same as clause 6.2.2 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	Upper limit + TT, Lower limit - TT
6.2.3 UE additional maximum output power reduction	Same as clause 6.2.3 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	Upper limit + TT, Lower limit - TT
6.2.4 Configured transmitted power	Same as clause 6.2.4 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	Upper limit + TT, Lower limit - TT
6.3.1 Minimum output power	Same as clause 6.3.1 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	Minimum requirement + TT
6.3.2 Transmit OFF power	Same as clause 6.3.2 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	Minimum requirement + TT
6.3.3 Transmit on/off time mask	Same as clause 6.3.3 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz	Minimum requirement + TT
6.3.4 Power Control	Same as clause 6.3.4 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz	Upper limit + TT, Lower limit – TT
6.4.1_1 Frequency error with GSO ephemeris	Same as clause 6.4.1 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	Modulated carrier frequency: Upper limit + TT, Lower limit – TT DL power: REFSENS + TT
6.4.1_2 Frequency error with NGSO ephemeris	Same as clause 6.4.1 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	Modulated carrier frequency: Upper limit + TT, Lower limit – TT DL power: REFSENS + TT
6.4.2.1 Error Vector Magnitude	Same as clause 6.4.2.1 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	Minimum requirement + TT
6.4.2.1a Error Vector Magnitude including symbols with transient period	Same as clause 6.4.2.1a in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	Minimum requirement + TT
6.4.2.2 Carrier Leakage	Same as clause 6.4.2.2 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	Minimum requirement + TT
6.4.2.3 In-band emissions	Same as clause 6.4.2.3 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	Minimum requirement + TT
6.4.2.4 EVM equalizer spectrum flatness	Same as clause 6.4.2.4 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	Minimum requirement + TT
6.4.2.5 EVM equalizer spectrum flatness for Pi/2 BPSK	Same as clause 6.4.2.5 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz and $BW \leq 30$ MHz.	Minimum requirement + TT
6.5.1 Occupied bandwidth	Same as clause 6.5.1 in TS 38.521-1 [2].	Minimum requirement + TT
6.5.2.2 Spectrum Emission Mask	Same as clause 6.5.2.2 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	Minimum requirement + TT
6.5.2.4.1 NR Adjacent Channel Leakage Ratio	Same as clause 6.5.2.4.1 in TS 38.521-1 [2] for FDD band with $f \leq 3$ GHz.	Minimum requirement - TT
6.5.3.1 General spurious emissions	Same as clause 6.5.3.1 in TS 38.521-1 [2].	Minimum requirement + TT
6.5.3.2 Spurious emission for UE co-existence	Same as clause 6.5.3.2 in TS 38.521-1 [2].	Minimum requirement + TT
6.5.3.3 Additional spurious emissions	Same as clause 6.5.3.3 in TS 38.521-1 [2].	Minimum requirement + TT
6.5.4 Transmit intermodulation	Same as clause 6.5.4 in TS 38.521-1 [2].	Minimum requirement + TT

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	Same as clause 7.3.2 in TS 38.521-1 [2].	Minimum requirement + TT
7.4 Maximum input level	Same as clause 7.4 in TS 38.521-1 [2] for FDD band with $f \leq 3\text{GHz}$.	Maximum input level - TT
7.5 Adjacent channel selectivity	Same as clause 7.5 in TS 38.521-1 [2].	Same as clause 7.5 in TS 38.521-1 [2].
7.6.2 In-band blocking	Same as clause 7.6.2 in TS 38.521-1 [2].	Same as clause 7.6.2 in TS 38.521-1 [2].
7.6.3 Out of Band Blocking	Same as clause 7.6.3 in TS 38.521-1 [2].	Same as clause 7.6.3 in TS 38.521-1 [2].
7.6.4 Narrow band blocking	Same as clause 7.6.4 in TS 38.521-1 [2].	Same as clause 7.6.4 in TS 38.521-1 [2].
7.7 Spurious response	Same as clause 7.6.3 in TS 38.521-1 [2].	Same as clause 7.6.3.
7.8.2 Wide band Intermodulation	Same as clause 7.8.2 in TS 38.521-1 [2].	Same as clause 7.8.2 in TS 38.521-1 [2].
7.9 Spurious emissions	Same as clause 7.9 in TS 38.521-1 [2].	Same as clause 7.9 in TS 38.521-1 [2].

F.3.4 Measurement of Demod Performance requirements

Table F.3.4-1: Derivation of Test Requirements for demodulation performance tests

Sub clause	Test Tolerance (TT)	Formula for test requirement
8.2.1.2.2.1.1_1 2Rx FDD FR1 PDSCH Mapping Type A for Satellite Access	Same as clause 5.2.2.1.1_1 in TS 38.521-4 [14]	Same as clause 5.2.2.1.1_1 in TS 38.521-4 [14]

F.4 Uplink power window

F.4.1 Introduction

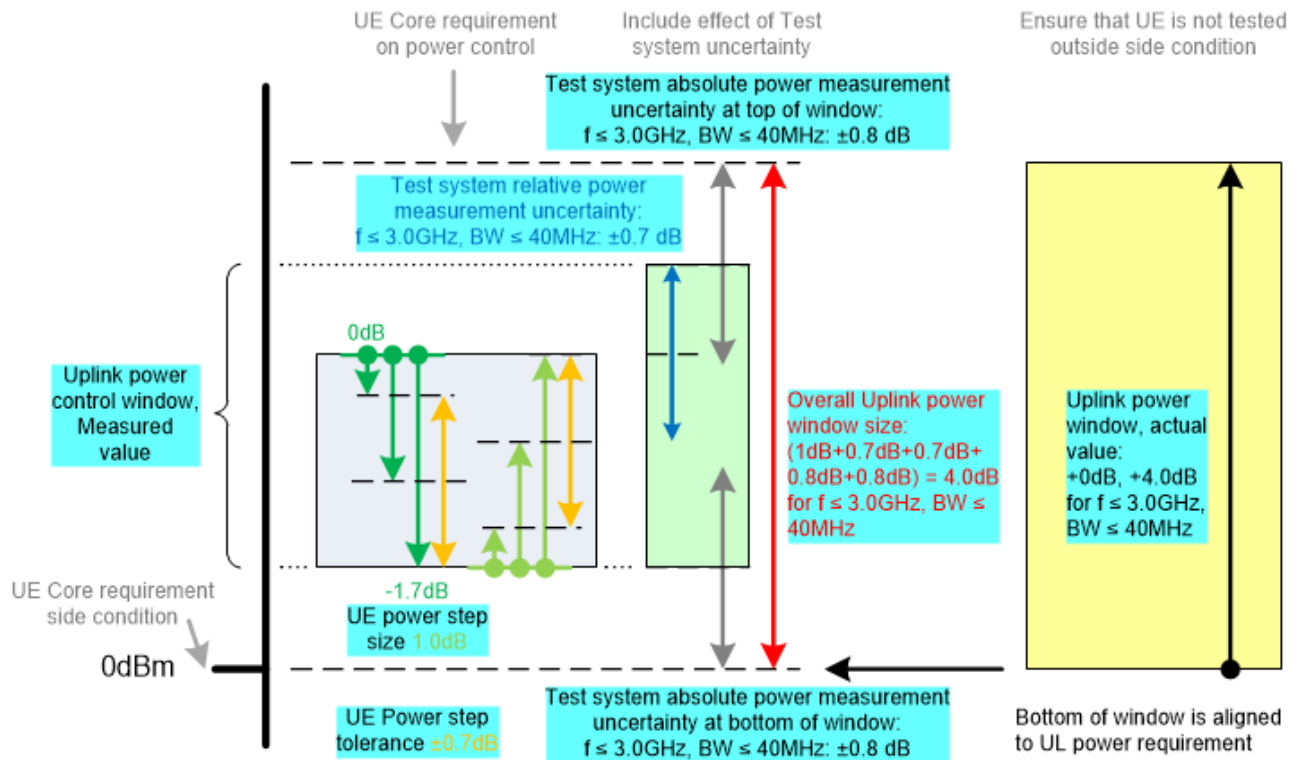
A number of Tx and Rx Test cases set the UE uplink power to be within a defined window to ensure the test is carried out in the intended conditions. This clause gives the method for calculating the uplink power window used in Tx test cases and Rx Test cases.

F.4.2 Setting the power window above a requirement

Information from the core requirements in TS 38.101-1 [5], TS 38.213 [7] and the uncertainties in Annex F applicable to the Test case are used to derive the uplink power window. There are 4 stages:

- Find the uplink power target value.
- Determine how closely the uplink power can be set to the target value.
- Include the effect of test system uncertainty.
- Position the Uplink power window to ensure UE is not tested outside Core requirements.

This process is shown in the diagram below, using values for $f \leq 3\text{ GHz}$ and $\text{BW} \leq 40\text{ MHz}$ and taking an example where the target value is 0dBm (lower end of a UE Core requirement side condition range of $0\text{ dBm} \leq \text{Output power} \leq 10\text{ dBm}$):



UE Uplink power

Figure F.4.2-1: Example uplink power setting to be above a requirement

The smallest UE Power step size is defined in TS 38.213 [7] Table 7.1.1-1, for absolute $\delta_{\text{PUSCH},f,c}$.

The UE Power step size tolerance is defined in TS 38.101-1 [5] Table 6.3.4.3-1, for PUSCH to PUSCH transitions with the allocated resource blocks fixed in frequency and no transmission gaps other than those generated by downlink subframes, DwPTS fields or Guard Periods, and for a power step $\Delta P \leq 1\text{ dB}$.

The Test system uncertainties are defined in Annex F of the present document.

To ensure that the actual UE uplink power is within the Uplink power window, UE uplink power measured by the test system should remain within the smaller Uplink power control window shown in Figure F.4.2-1.

F.4.3 Setting the power window below a requirement

Information from the core requirements in TS 38.101-1 [5], TS 38.213 [7] and the uncertainties in Annex F applicable to the Test case are used to derive the uplink power window. There are 4 stages:

- Find the uplink power target value.
- Determine how closely the uplink power can be set to the target value.
- Include the effect of test system uncertainty.
- Position the Uplink power window to ensure UE is not tested outside Core requirements.

This process is shown in the diagram below, using values for $f \leq 3\text{ GHz}$ and $\text{BW} \leq 40\text{ MHz}$ and taking an example where the target value is 4 dB below PCMAX_L (UE Core requirement side condition):

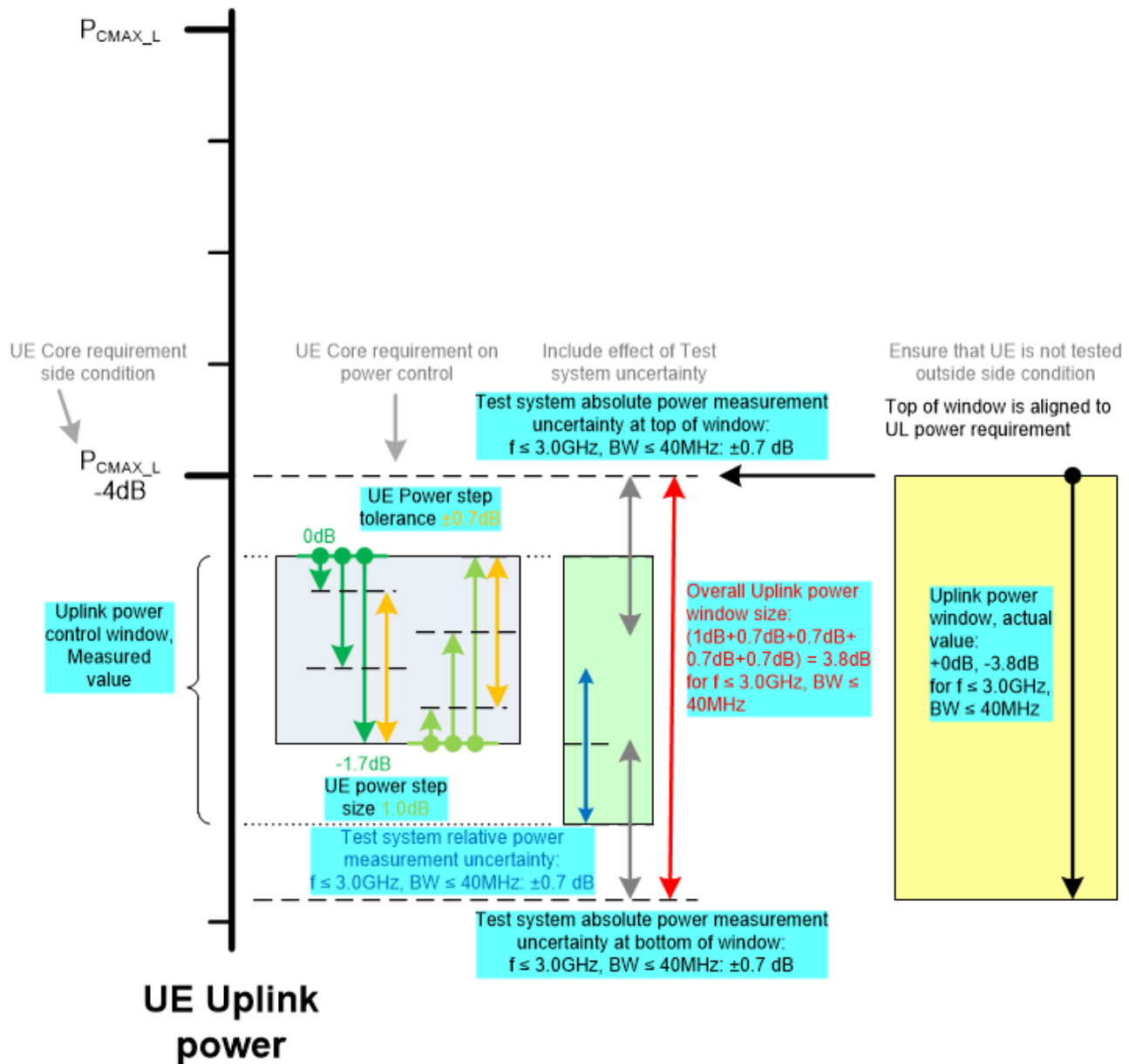


Figure F.4.3-1: Example uplink power setting to be below a requirement

The smallest UE Power step size is defined in TS 38.213 [7] Table 7.1.1-1, for absolute $\delta_{PUSCH,f,c}$.

The UE Power step size tolerance is defined in TS 38.101-1 [5] Table 6.3.4.3-1, for PUSCH to PUSCH transitions with the allocated resource blocks fixed in frequency and no transmission gaps other than those generated by downlink subframes, DwPTS fields or Guard Periods, and for a power step $\Delta P \leq 1\text{ dB}$.

The Test system uncertainties are defined in Annex F of the present document.

To ensure that the actual UE uplink power is within the Uplink power window, UE uplink power measured by the test system should remain within the smaller Uplink power control window shown in Figure F.4.3-1.

F.4.4 Setting the power window centred on a target value

Information from the core requirements in TS 38.101-1 [5], TS 38.213 [7] and the uncertainties in Annex F applicable to the Test case are used to derive the uplink power window. There are 4 stages:

- Find the uplink power target value.

- Determine how closely the uplink power can be set to the target value.
- Include the effect of test system uncertainty.
- Position the Uplink power window centred on the target value.

This process is shown in the diagram below, using values for $f \leq 3$ GHz and $BW \leq 40$ MHz and taking an example where the target value is +10 dBm:

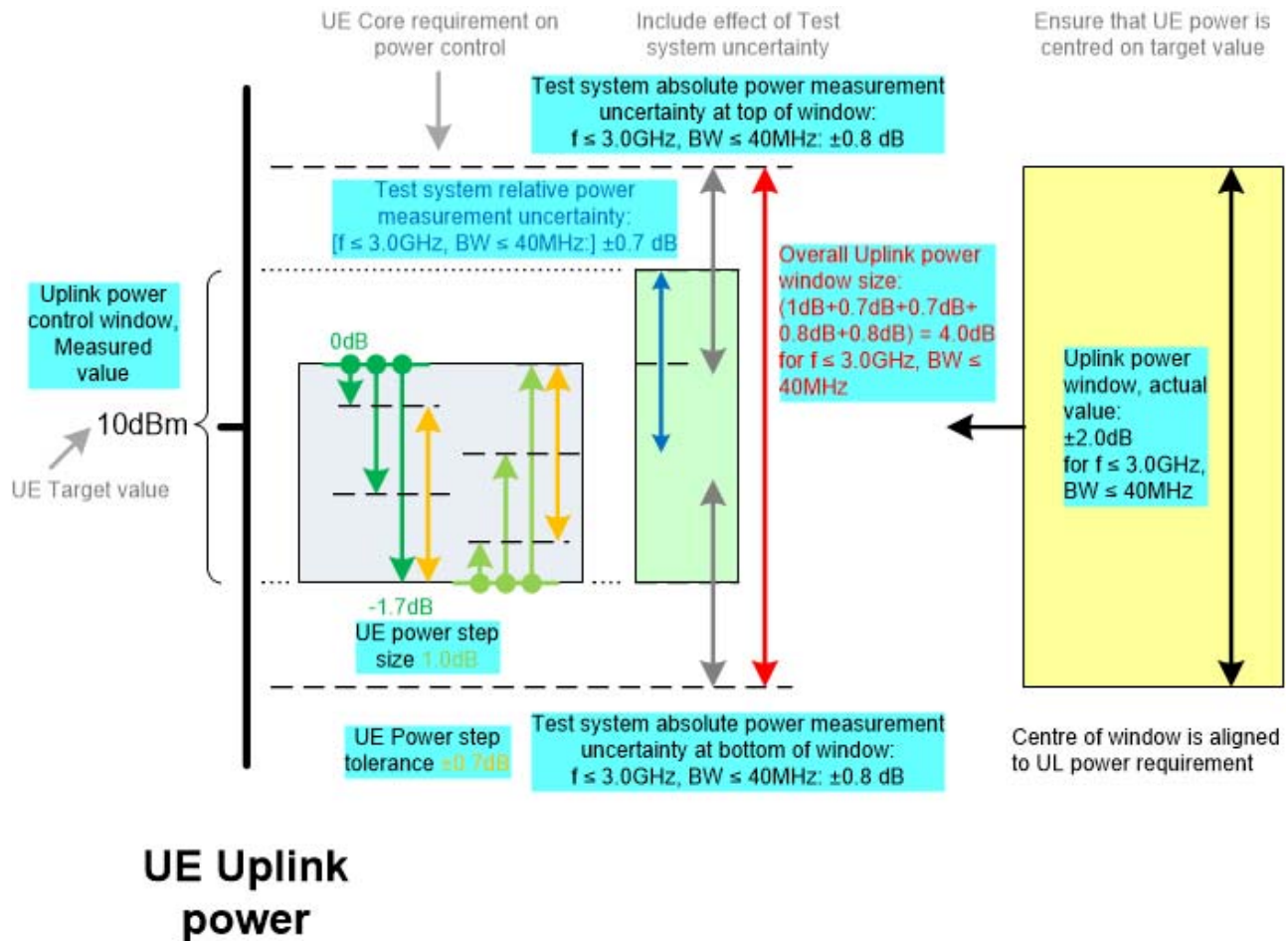


Figure F.4.4-1: Example NR FR1 uplink power setting centred on a target value

The smallest UE Power step size is defined in TS 38.213 [7] Table 7.1.1-1, for absolute $\delta_{\text{PUSCH},f,c}$.

The UE Power step size tolerance is defined in TS 38.101-1 [5] Table 6.3.4.3-1, for PUSCH to PUSCH transitions with the allocated resource blocks fixed in frequency and no transmission gaps other than those generated by downlink subframes, DwPTS fields or Guard Periods, and for a power step $\Delta P \leq 1$ dB.

The Test system uncertainties are defined in Annex F of the present document.

To ensure that the actual UE uplink power is centred on the target value, UE uplink power measured by the test system should remain within the smaller Uplink power control window shown in Figure F.4.4-1.

Annex G (normative): Statistical Testing

G.1 Statistical testing of Performance Requirements with throughput

G.1.1 General

The test of receiver performance 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 most receiver performance tests is either 70 % or 30 % of the maximum throughput.

All receiver performance tests are performed in fading conditions. In addition to the statistical considerations, this requires the definition of a minimum test time.

G.1.2 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 slots, however in a radio frame it is fixed during one test.
- e) The time in the measurement interval is composed of successfully received slots (ACK), unsuccessfully received slots (NACK) and no reception at all (DTX-slots).
- f) DTX-slots 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 slots. regDTX vary from test to test but are fixed within the test.
- g) Additional DTX-slots 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 $(\text{NACK} + \text{statDTX}) / (\text{NACK} + \text{statDTX} + \text{ACK})$ 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.

G.1.3 Design of the test

The test is defined by the following design principles (see clause G.2, Theory):

1. The standard concept is applied. (not the early decision concept)
2. A second limit is introduced: The second limit is different, whether 30 % or 70 % throughput is tested.
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:

- 1a) Limit Error Ratio = 0.3 (in case 70 % Throughput is tested) or
- 1b) Limit Throughput = 0.3 (in case 30 % Throughput is tested) or
- 1c) Limit Error Ratio = 0.01 (in case 1% BLER is tested)
- 2a) Bad DUT factor $M=1.378$ (selectivity)
- 2b) Bad DUT factor $m=0.692$ (selectivity)
- 2c) Bad DUT factor $M=1.5$ (selectivity)
 - justification see: TS 34.121 Clause F.6.3.3
- 3) Confidence level $CL = 95 \%$ (for specified DUT and Bad DUT-quality)

G.1.4 Pass Fail limit

Testing Throughput = 30 %, then the test limit is

Number of successes (ACK) / number of samples $\geq 59 / 233$

Testing Throughput = 70 % then the test limit is

Number of fails (NACK and statDTX) / number of samples $\leq 66 / 184$

Testing BLER = 1% then the test limit is

Number of fails (NACK and statDTX) / number of samples $\leq 163 / 13135$

There are 3 distinct cases:

- a) The duration for the number of samples (233, 184 or 13135) is greater than the minimum test time:
 - Then the number of samples (233, 184 or 13135) is predefined and the decision is done according to the number of events (59 successes, 66 fails or 163 fails)
- b) Since subframe 0 and 5 contain less bits than the remaining subframes, it is allowed to predefine a number of samples contained in an integer number of frames. In this case test-limit-ratio applies.
- c) The minimum test time is greater than the duration for the number of samples:

The minimum test time is predefined and the decision is done comparing the measured ratio at that instant against the test-limit-ratio.

NOTE: The test time for most of the tests is governed by the Minimum Test Time.

G.1.5 Minimum Test time

If a pass fail decision in clause G.1.4 can be achieved earlier than the minimum test time, then the test shall not be decided, but continued until the minimum test time is elapsed.

The tables below contain the minimum number of slots for FDD and TDD.

By simulations the minimum number of active subframes (carrying DL payload) was derived (MNAS), then adding inactive subframes to the active ones. (for TDD additional subframes contain no DL payload), then rounding up to full thousand.

Simulation method to derive minimum test time:

With a level, corresponding a throughput at the test limit (here 30 % or 70 % of the max. throughput) the preliminary throughput versus time converges towards the final throughput. The allowance of $\pm 2\%$ throughput variation around the above mentioned level is predefined by RAN5 to find the minimum test time. The allowance of $\pm 2\%$ maps through the function "final throughput versus level" into a throughput corridor. The minimum test time is achieved when the preliminary throughput escapes the corridor the last time. The two functions "final throughput versus level" and "preliminary throughput versus time" are simulation results, which are done individual for each demodulation scenario.

In the case where the throughput does not converge across all the seeds used in the simulation within a reasonable time duration, then the throughput corridor is expanded to $\pm 3.5\%$ of the target throughput to see if the all the seeds converge. In order to account for the additional throughput variation, a SNR uncertainty due to finite test time term is added to the overall MU calculation.

The entire procedure is summarized as below.

G.1.5.0_1 Minimum Test Time procedure for PDSCH scenarios with 30% or 70% Throughput requirement

1. Run the PDSCH simulations for an extended period of time at the SNR of interest for multiple seeds.
2. The minimum test time is determined by the time it took the throughput curve to settle within $\pm 2\%$ of the target throughput value across all seeds.
3. If the throughput does not settle within the $\pm 2\%$ throughput limit within a reasonable amount of time for any seed, expand the threshold to $\pm 3.5\%$ of the target throughput value.
4. To account for the additional 1.5% throughput variation, determine from the Throughput vs SNR curve, what is the SNR delta corresponding to this 1.5 % throughput increase.
5. That SNR value is the added SNR uncertainty due to finite test time.

G.1.5.0_2 Minimum Test Time procedure for PDSCH and PDCCH scenarios with 1% BLER requirement

1. Run the PDSCH simulations for an extended period of time at the SNR of interest for multiple seeds.
2. The minimum test time is determined by the time it took the residual BLER curve to converge within $\pm 10\%$ of the target 1% residual BLER (i.e. within 0.9% and 1.1% BLER) across all seeds.
3. If the residual BLER does not converge within the $\pm 10\%$ of the 1% target limit within a reasonable amount of time for any seed, increase SNR in steps of 0.1 dB and rerun the simulations within the same target BLER limit.
4. The additional delta SNR required to meet the residual BLER convergence limit is the added SNR uncertainty due to finite test time.
5. This SNR uncertainty due to finite test time would be one of the MU term in the overall MU calculation

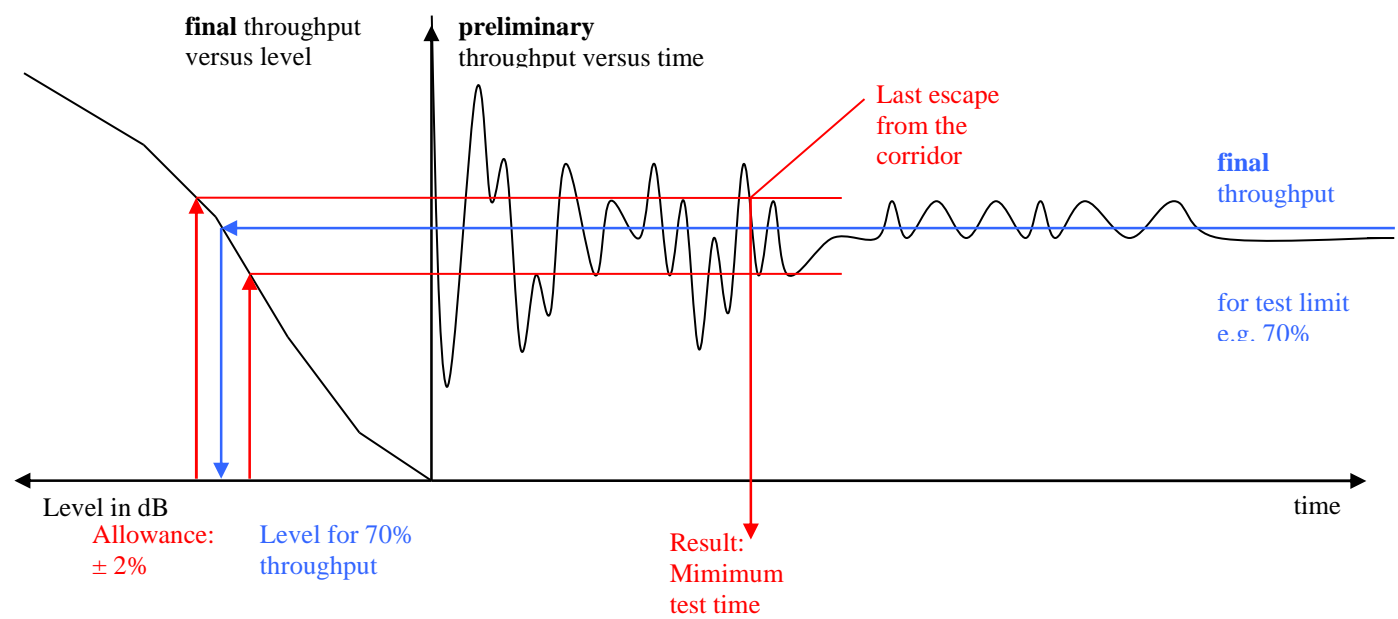


Figure G.1.5-1: Simulation method to derive minimum test time

Table G.1.5-1: Minimum Test time for PDSCH demodulation

Test number	Reference Channel	Propagation condition	Minimum number of active subframes (MNAS)	MNAS to MNS Scaling factor (Note 3)	Minimum Number of Subframes (MNS) after rounding up to nearest thousand $MNS = 1000 * \lceil \frac{MNAS}{1000} \rceil$
1-1	R.PDSCH.1-1.1 FDD	NTN-TDLA100-200	30000 (Note 1)	1.0526	32000
1-2	R.PDSCH.1-2.1 FDD	NTN-TDLC5-200	72000 (Note 1)	1.0526	76000
1-3	R.PDSCH.1-1.1 FDD	NTN-TDLC5-200	80000 (Note 1)	1.0526	85000
1-4	R.PDSCH.1-1.1 FDD	NTN-TDLA100-200	30000 (Note 1)	1.0526	32000
Note 1: MNAS determined by simulations. Note 2: For cases where MNAS is not determined by simulations, use same MNAS as the similar case simulated (same doppler speed) Note 3: MNS/MNAS ratio decided by scheduling pattern and is ratio of all slots to DL slots.					

G.2 Theory to derive the numbers for statistical testing (informative)

Editor's note: This clause of the Annex G is for information only and it described the background theory and information for statistical testing.

G.2.1 Error Ratio (ER)

The Error Ratio (ER) is defined as the ratio of number of errors (ne) to all results, number of samples (ns).

(1-ER is the success ratio).

G.2.2 Test Design

A statistical test is characterized by:

Test-time, Selectivity and Confidence level.

G.2.3 Confidence level

The outcome of a statistical test is a decision. This decision may be correct or in-correct. The Confidence Level CL describes the probability that the decision is a correct one. The complement is the wrong decision probability (risk) $D = 1 - CL$.

G.2.4 Introduction: Supplier Risk versus Customer Risk

There are two targets of decision:

- (a) A measurement on the pass-limit shows, that the DUT has the specified quality or is better with probability CL (CL e.g.95 %). This shall lead to a "pass decision".

The pass-limit is on the good side of the specified DUT-quality. A more stringent CL (CL e.g.99 %) shifts the pass-limit farer into the good direction. Given the quality of the DUTs is distributed, a greater CL passes less and better DUTs.

A measurement on the bad side of the pass-limit is simply "not pass" (undecided or artificial fail).

- (aa) Complementary:

A measurement on the fail-limit shows, that the DUT is worse than the specified quality with probability CL.

The fail-limit is on the bad side of the specified DUT-quality. A more stringent CL shifts the fail-limit farer into the bad direction. Given the quality of the DUTs is distributed, a greater CL fails less and worse DUTs.

A measurement on the good side of the fail-limit is simply "not fail".

- (b) A DUT, known to have the specified quality, shall be measured and decided pass with probability CL. This leads to the test limit.

For CL e.g. 95 %, the test limit is on the bad side of the specified DUT-quality. CL e.g.99 % shifts the pass-limit farer into the bad direction. Given the DUT-quality is distributed, a greater CL passes more and worse DUTs.

- (bb) A DUT, known to be an ($\epsilon \rightarrow 0$) beyond the specified quality, shall be measured and decided fail with probability CL.

For CL e.g.95 %, the test limit is on the good side of the specified DUT-quality.

NOTE 1: The different sense for CL in (a), (aa) versus (b), (bb).

NOTE 2: For constant CL in all 4 bullets (a) is equivalent to (bb) and (aa) is equivalent to (b).

G.2.5 Supplier Risk versus Customer Risk

The table below summarizes the different targets of decision.

Table G.2.5-1: Equivalent statements

	Equivalent statements, using different cause-to-effect-directions, and assuming CL = constant >1/2	
cause-to-effect-directions	Known measurement result → estimation of the DUT's quality	Known DUT's quality → estimation of the measurement's outcome
Supplier Risk	A measurement on the pass-limit shows, that the DUT has the specified quality or is better (a)	A DUT, known to have an ($\varepsilon \rightarrow 0$) beyond the specified DUT-quality, shall be measured and decided fail (bb)
Customer Risk	A measurement on the fail-limit shall shows, that the DUT is worse than the specified quality (aa)	A DUT, known to have the specified quality, shall be measured and decided pass (b)

The shaded area shown the direct interpretation of Supplier Risk and Customer Risk.

The same statements can be based on other DUT-quality-definitions.

G.2.6 Introduction: Standard test versus early decision concept

In standard statistical tests, a certain number of results (n_s) is predefined in advance to the test. After n_s results the number of bad results (n_e) is counted and the error ratio (ER) is calculated by n_e/n_s .

Applying statistical theory, a decision limit can be designed, against which the calculated ER is compared to derive the decision. Such a limit is one decision point and is characterized by:

- D: the wrong decision probability (a predefined parameter)
- n_s : the number of results (a fixed predefined parameter)
- n_e : the number of bad results (the limit based on just n_s)

In the formula for the limit, D and n_s can be understood as variable parameter and variable. However the standard test execution requires fixed n_s and D. The property of such a test is: It discriminates between two states only, depending on the test design:

- pass (with CL) / undecided (undecided in the sense: finally undecided)
- fail (with CL) / undecided (undecided in the sense: finally undecided)
- pass(with CL) / fail (with CL) (however against two limits).

In contrast to the standard statistical tests, the early decision concept predefines a set of (n_e, n_s) co-ordinates, representing the limit-curve for decision. After each result a preliminary ER is calculated and compared against the limit-curve. After each result one may make the decision or not (undecided for later decision). The parameters and variables in the limit-curve for the early decision concept have a similar but not equal meaning:

- D: the wrong decision probability (a predefined parameter)
- n_s : the number of results (a variable parameter)
- n_e : the number of bad results (the limit. It varies together with n_s)

To avoid a "final undecided" in the standard test, a second limit shall be introduced and the single decision co-ordinate (n_e, n_s) needs a high n_e , leading to a fixed (high) test time. In the early decision concept, having the same selectivity and the same confidence level an "undecided" need not to be avoided, as it can be decided later. A perfect DUT will hit the decision coordinate (n_e, n_s) with $n_e=0$. This test time is short.

G.2.7 Standard test versus early decision concept

For Supplier Risk:

The wrong decision probability D in the standard test is the probability, to decide a DUT in-correct in the single decision point. In the early decision concept there is a probability of in-correct decisions d at each point of the limit-curve. The sum of all those wrong decision probabilities accumulate to D . Hence $d < D$.

For Customer Risk:

The correct decision probability CL in the standard test is the probability, to decide a DUT correct in the single decision point. In the early decision concept there is a probability of correct decisions cl at each point of the limit-curve. The sum of all those correct decision probabilities accumulate to CL . Hence $cl < CL$ or $d > D$.

G.2.8 Selectivity

There is no statistical test which can discriminate between a limit DUT and a DUT which is an $(\varepsilon \rightarrow 0)$ apart from the limit in finite time and high confidence level CL . Either the test discriminates against one limit with the results pass (with CL)/undecided or fail (with CL)/undecided, or the test ends in a result pass (with CL)/fail (with CL) but this requires a second limit.

For $CL > 1/2$, a (measurement-result = specified-DUT-quality), generates undecided in test "supplier risk against pass limit" (a, from above) and also in the test "customer risk against the fail limit" (aa)

For $CL > 1/2$, a DUT, known to be on the limit, will be decided pass for the test "customer risk against pass limit" (b) and also "supplier risk against fail limit" (bb).

This overlap or undecided area is not a fault or a contradiction, however it can be avoided by introducing a Bad or a Good DUT quality according to:

- Bad DUT quality: specified DUT-quality * M ($M > 1$)
- Good DUT quality: specified DUT-quality * m ($m < 1$)

Using e.g. $M > 1$ and $CL = 95\%$ % the test for different DUT qualities yield different pass probabilities:

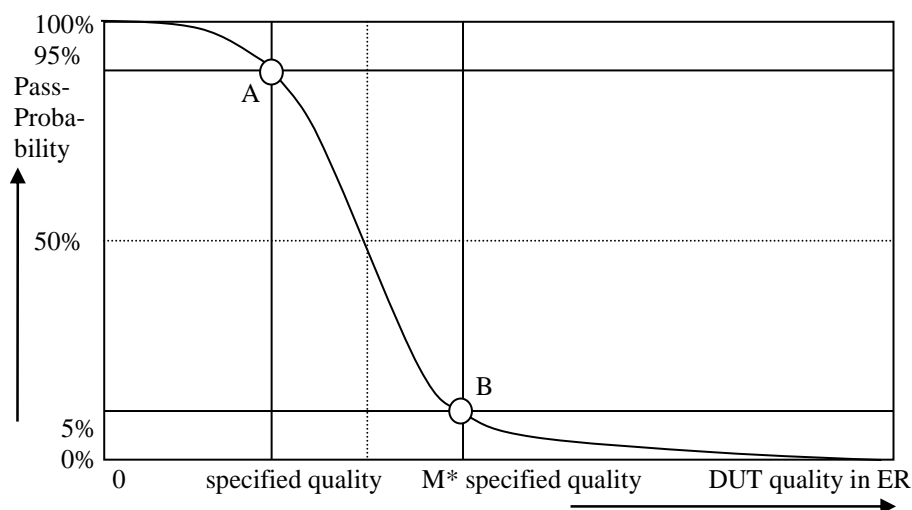


Figure G.2.8-1: Pass probability versus DUT quality

G.2.9 Design of the test

The receiver characteristic test are defined by the following design principles:

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 receiver characteristic test are defined by the following parameters:

1. Limit $ER = 0.05$
2. Bad DUT factor $M = 1.5$ (selectivity)
3. Confidence level $CL = 95\%$ (for specified DUT and Bad DUT-quality)

This has the following consequences:

1. A measurement on the fail limit is connected with 2 equivalent statements:

A measurement on the fail-limit shows, that the DUT is worse than the specified DUT-quality	A DUT, known have the specified quality, shall be measured and decided pass
---	---

2. A measurement on the pass limit is connected with the complementary statements:

A measurement on the pass limit shows, that the DUT is better than the Bad DUT-quality.	A DUT, known to have the Bad DUT quality, shall be measured and decided fail
---	--

The left column is used to decide the measurement.

The right column is used to verify the design of the test by simulation.

The simulation is based on the two fulcrums A and B only in Figure G.2.8-1

3. Test time

The minimum and maximum test time is fixed.

The average test time is a function of the DUT's quality.

The individual test time is not predictable.

4. The number of decision co-ordinates (n_e, n_s) in the early decision concept is responsible for the selectivity of the test and the maximum test time. Having fixed the number of decision co-ordinates there is still freedom to select the individual decision co-ordinates in many combinations, all leading to the same confidence level.

G.2.10 Simulation to derive the pass fail limits

There is freedom to design the decision co-ordinates (n_e, n_s).

The binomial distribution and its inverse is used to design the pass and fail limits. Note that this method is not unique and that other methods exist.

$$\text{fail}(ne, d_f) := \frac{ne}{(ne + \text{qnbinom}(d_f, ne, ER))}$$

$$\text{pass}(ne, cl_p, M) := \frac{ne}{(ne + \text{qnbinom}(cl_p, ne, ER \cdot M))}$$

Where

- fail(..) is the error ratio for the fail limit
- pass(..) is the error ratio for the pass limit
- ER is the specified error ratio 0.05
- ne is the number of bad results. This is the variable in both equations
- M is the Bad DUT factor M=1.5
- d_f is the wrong decision probability of a single (ne,ns) co-ordinate for the fail limit.
It is found by simulation to be $d_f = 0.004$
- cl_p is the confidence level of a single (ne,ns) co-ordinate for the pass limit.
It is found by simulation to be $cl_p = 0.9975$
- $\text{qnbinom}(\cdot)$: The inverse cumulative function of the negative binomial distribution

The simulation works as follows:

- A large population of limit DUTs with true $ER = 0.05$ is decided against the pass and fail limits.
- cl_p and d_f are tuned such that CL (95 %) of the population passes and D (5 %) of the population fails.
- A population of Bad DUTs with true $ER = M \cdot 0.05$ is decided against the same pass and fail limits.
- cl_p and d_f are tuned such that CL (95 %) of the population fails and D (5 %) of the population passes.
- This procedure and the relationship to the measurement is justified in clause G.2.9. The number of DUTs decrease during the simulation, as the decided DUTs leave the population. That number decreases with an approximately exponential characteristics. After 169 bad results all DUTs of the population are decided.

NOTE: The exponential decrease of the population is an optimal design goal for the decision co-ordinates (ne,ns), which can be achieved with other formulas or methods as well.

Annex H (normative): Statistical Testing

H.1 General

This annex specifies mapping throughput to error ratio, pass fail limits and pass fail decision rules that are needed for measuring average throughput for a duration sufficient to achieve statistical significance for testing receiver characteristics.

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 slots, however in a radio frame it is fixed during one test.
- e) The time in the measurement interval is composed of successfully received slots (ACK), unsuccessfully received slots (NACK) and no reception at all (DTX-slots).
- f) DTX-slots 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 slots. regDTX vary from test to test but are fixed within the test.
- g) Additional DTX-slots 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 $(\text{NACK} + \text{statDTX})/(\text{NACK} + \text{statDTX} + \text{ACK})$ 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.2.6, 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	37	715	477	74	1290	1093	111	1847	1739
1	67	NA	38	731	493	75	1306	1110	112	1862	1756
2	95	NA	39	747	509	76	1321	1128	113	1877	1774
3	119	NA	40	763	525	77	1336	1145	114	1891	1792
4	141	NA	41	779	541	78	1351	1162	115	1906	1809
5	162	NA	42	795	557	79	1366	1179	116	1921	1827
6	183	NA	43	810	573	80	1382	1197	117	1936	1845
7	203	NA	44	826	590	81	1397	1214	118	1951	1863
8	222	NA	45	842	606	82	1412	1231	119	1966	1880
9	241	67	46	858	622	83	1427	1248	120	1981	1898
10	259	80	47	873	639	84	1442	1266	121	1995	1916
11	278	92	48	889	655	85	1457	1283	122	2010	1934
12	296	105	49	905	672	86	1472	1300	123	2025	1951
13	314	118	50	920	688	87	1487	1318	124	2040	1969
14	332	131	51	936	705	88	1503	1335	125	2055	1987
15	349	145	52	952	721	89	1518	1353	126	2069	2005
16	367	159	53	967	738	90	1533	1370	127	2084	2023
17	384	173	54	983	755	91	1548	1387	128	2099	2041
18	401	187	55	998	771	92	1563	1405	129	2114	2058
19	419	201	56	1014	788	93	1578	1422	130	2128	2076
20	436	216	57	1029	805	94	1593	1440	131	2143	2094
21	453	230	58	1045	822	95	1608	1457	132	2158	2112
22	469	245	59	1060	838	96	1623	1475	133	2173	2130
23	486	260	60	1076	855	97	1638	1492	134	2187	2148
24	503	275	61	1091	872	98	1653	1510	135	2202	2166
25	520	290	62	1107	889	99	1668	1527	136	2217	2183
26	536	305	63	1122	906	100	1683	1545	137	2232	2201
27	553	320	64	1137	923	101	1698	1562	138	2246	2219
28	569	335	65	1153	940	102	1713	1580	139	2261	2237
29	585	351	66	1168	957	103	1728	1598	140	2276	2255
30	602	366	67	1184	974	104	1742	1615	141	2291	2273
31	618	382	68	1199	991	105	1757	1633	142	2305	2291
32	634	398	69	1214	1008	106	1772	1650	143	2320	2309
33	651	413	70	1229	1025	107	1787	1668	144	2335	2327
34	667	429	71	1245	1042	108	1802	1686	145	2349	2345
35	683	445	72	1260	1059	109	1817	1703	146	2364	2363
36	699	461	73	1275	1076	110	1832	1721	*) 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).

NOTE 4: The UE could be decided as early pass/fail when at least 67 samples are received. The ns_f is set to NA for ne less than 9.

H.2.5 Pass fail decision rules

The pass fail decision rules apply for a single measurement. A test case is passed only when all the measurements in the test case are passed.

Having observed 0 errors, pass the test at 67+ samples, otherwise continue

Having observed 1 error, pass the test at 67+ samples, otherwise continue

Having observed 2 errors, pass the test at 95+ samples, otherwise continue

etc.

Having observed 145 errors, pass the test at 2349+ samples, fail the test at 2345- samples, otherwise continue

Having observed 146 errors, pass the test at 2364+ samples, fail the test at 2363- 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 2364 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.

H.2.6 Theory to derive the pass fail limits (Informative)

Editor's note: This clause of the Annex H is for information only and it describes the background theory and information for statistical testing.

H.2.6.1 Numerical definition of the pass-fail limits

A statistical test is characterized by test time, selectivity and confidence level. The outcome of the statistical test is a decision. This decision may be correct, i.e., DUTs whose throughput is less than 95% maximum throughput being declared to fail, and DUTs whose throughput is higher or equal to 95% being declared to pass, or in-correct with opposite decision. The Confidence Level (CL) describes the probability that the decision is a correct one. The complement is the wrong decision probability (risk) $D = 1 - CL$.

As described in H.2.2, the measurement of throughput could be mapped to ER (Error Ratio). When testing ER, transport blocks or "samples" are observed and the number of correctly and erroneously received blocks are recorded. For a "standard" test, a pre-defined number of samples are observed, and a pass/fail decision is made based on the number of observed errors being above/below a threshold. This threshold is based on the targeted throughput or BLER and the design target CL. There is always some risk of a statistical variation leading to an incorrect pass/fail decision. The greater the number of samples that are recorded, the lower is the risk of such an error. The number of samples that are observed in a standard test is dimensioned to achieve an acceptable low risk of error (i.e., an acceptable high confidence level) for DUTs that just meet the specified limit.

The standard test works well where the target ER level is relatively high and confidence level relatively low (both are chosen to be on a comparable order of magnitude). However, for relatively low ER testing the length of time required for observing sufficient samples to achieve a 95% confidence level is excessive. In many cases, the DUTs will in fact have a much lower true ER level than the target ER level, (in which case, the number of samples needed to achieve high confidence that the true ER level is lower than the limit is much smaller). On the other hand, a bad DUT which is expected to fail the requirement might have a much higher true ER level (in which case, errors occur more frequently and it can be demonstrated that the DUT is above the target ER limit with fewer samples).

To avoid long test time, an alternative test method called early pass/fail is adopted. With the early pass/fail, each time a block error is encountered, a decision is made on whether the DUT can be passed/failed with 95% CL or the test needs to continue until another error is encountered. In the case of very good DUTs, the test can also be passed, when the number of samples permissible for one error event is reached and no error event is recorded. Pass/Fail is decided based on the total number of observed samples and errors, and a statistical calculation based on an inverse binomial cumulative distribution. The calculation involves one parameter, one variable and the result:

- Parameter: d (per step decision probability).
- Variable: ne (number of observed errors).
- Result: ns (number of expected samples for pass/fail, depending on which one is calculated).

The per step decision probability risk, d , expresses the probability of making an incorrect pass/fail decision in the current step (i.e., for the current decision coordinate). d is determined by simulation such that the overall risk of making a wrong decision over all steps of each test of a large number of tests on a large number of DUTs that exactly meet the target ER limit is $D=5\%$ (and hence the CL 95%).

It should be noted that d is determined separately considering early pass and early fail testing.

For a marginal DUT (i.e., a DUT almost exactly meeting the target ER level), the unmodified early pass/early fail approach is unable to distinguish whether the DUT has just passed or just failed the BLER ($\varepsilon \rightarrow 0$), and can thus terminate with an "undecided" result. To avoid this undecided result and provide selectivity, a so-called "bad device factor" (M) is introduced into the early pass calculation. This factor biases the decision towards avoiding failing good DUT.

H.2.6.2 Simulation to derive the pass-fail limits for testing 95% throughput

As per the description in clause H.2.2, the 95% throughput measurement is mapped to $ER=0.05$, where ER is $(NACK + statDTX)/(NACK + statDTX + ACK)$.

The binomial distribution and its inverse are used to design the pass and fail limits. Note that this method is not unique and that other methods exist.

$$fail(ne, d_f) := \frac{ne}{ns_f} = \frac{ne}{(ne + qnbinom(d_f, ne, ER))}$$

$$pass(ne, cl_p, M) := \frac{ne}{ns_p} = \frac{ne}{(ne + qnbinom(cl_p, ne, ER \cdot M))}$$

Where

- fail(..) is the error ratio for the fail limit.
- pass(..) is the error ratio for the pass limit.
- ER is the specified error ratio 5%.
- ne is the number of bad results. This is the variable in both equations.
- M is the Bad DUT factor $M=1.5$.
- d_f is the wrong decision probability of a single (ne, ns) co-ordinate for the fail limit. It is found by simulation to be $d_f = 0.006$.
- cl_p is the confidence level of a single (ne, ns) co-ordinate for the pass limit. It is found by simulation to be $cl_p = 0.9945$.
- $qnbinom(..)$: The inverse cumulative function of the negative binomial distribution.

The simulation works as follows:

- A large population of limit DUTs with true $ER = 0.05$ is decided against the pass and fail limits.
- cl_p and d_f are tuned such that CL (95 %) of the population passes and D (5 %) of the population fails.
- A population of Bad DUTs with true $ER = M \cdot 0.05$ is decided against the same pass and fail limits.
- cl_p and d_f are tuned such that CL (95 %) of the population fails and D (5 %) of the population passes.
- The number of DUTs decrease during the simulation, as the decided DUTs leave the population. That number decreases with an approximately exponential characteristics. After 146 bad results all DUTs of the population are decided.

NOTE: The exponential decrease of the population is an optimal design goal for the decision co-ordinates (ne, ns), which can be achieved with other formulas or methods as well.

Annex I (informative): Change history

Change history							
Date	Meeting	TDoc	CR	R ev	Cat	Subject/Comment	New version
2022-11	RAN5#97	R5-226639	-	-	-	TP to add clause 1-3 to TS 38.521-5	0.0.0
2022-11	RAN5#97	R5-226640	-	-	-	TP to add clause 4 to TS 38.521-5	0.0.0
2022-11	RAN5#97	R5-226641	-	-	-	TP to add clause 5 to TS 38.521-5	0.0.0
2022-11	RAN5#97	R5-227885	-	-	-	Text proposal for section 6, 6.1 and 6.2.1 in TS 38.521-5	0.0.0
2022-11	RAN5#97	R5-227886	-	-	-	Text proposal for section 6.2.2 in TS 38.521-5	0.0.0
2023-03	RAN5#98	R5-231738	-	-	-	Definition of NTN minimum output power test case 6.3.1	0.0.1
2023-03	RAN5#98	R5-231739	-	-	-	Definition of NTN transmit OFF power test case 6.3.2	0.0.1
2023-03	RAN5#98	R5-231740	-	-	-	Introduction of new test case 7.9 Spurious emissions and addition of main structure of section 7	0.0.1
2023-03	RAN5#98	R5-231741	-	-	-	Introduction of general sections for demodulation performance test cases for NTN capable Ues	0.0.1
2023-03	RAN5#98	R5-231742	-	-	-	Introduction of demodulation performance test cases for NTN capable Ues	0.0.1
2023-03	RAN5#98	R5-230877	-	-	-	Introduction of 6.5.3.1 for TS38.521-5	0.0.1
2023-03	RAN5#98	R5-230878	-	-	-	Introduction of 7.1 7.2 and 7.3 for TS38.521-5	0.0.1
2023-03	RAN5#98	R5-230879	-	-	-	Introduction of 6.5.3.2 for TS38.521-5	0.0.1
2023-03	RAN5#98	R5-231854	-	-	-	Text configurations and requirements for section 6.2.1 and 6.2.2	0.0.1
2023-03	RAN5#98	R5-231367	-	-	-	Introduction of NTN TC 6.3.3 on Tx on-off time mask	0.0.1
2023-03	RAN5#98	R5-231368	-	-	-	Introduction of NTN TC 6.5.2.2 on Spectrum emission mask	0.0.1
2023-03	RAN5#98	R5-231369	-	-	-	Introduction of NTN TC 6.5.2.4 on ACLR	0.0.1
2023-03	RAN5#98	R5-231383	-	-	-	Introduction of NTN TC 7.6.3 on out of band blocking	0.0.1
2023-06	RAN5#99	R5-232346	-	-	-	Definition of NTN maximum input level test case 7.4	0.1.0
2023-06	RAN5#99	R5-233567	-	-	-	Introduction of new test case 7.5 Adjacent channel selectivity	0.1.0
2023-06	RAN5#99	R5-232372	-	-	-	Correction of referenced Annexes for test case 7.9 Spurious emissions	0.1.0
2023-06	RAN5#99	R5-233568	-	-	-	Introduction of new Annexes	0.1.0
2023-06	RAN5#99	R5-233569	-	-	-	Introduction of NTN AMPR tests	0.1.0
2023-06	RAN5#99	R5-232519	-	-	-	Introduction of NTN configured transmission power tests	0.1.0
2023-06	RAN5#99	R5-233570	-	-	-	TP to add 2Rx PDSCH mapping type A test case for NTN UE	0.1.0
2023-06	RAN5#99	R5-233158	-	-	-	Update General SE for NTN	0.1.0
2023-06	RAN5#99	R5-233571	-	-	-	Updates to NTN TC 6.3.3 on Tx on-off time mask	0.1.0
2023-06	RAN5#99	R5-233572	-	-	-	Updates to NTN TC 6.5.2.2 on Spectrum emission mask	0.1.0
2023-06	RAN5#99	R5-233573	-	-	-	Updates to NTN TC 6.5.2.4 on ACLR	0.1.0
2023-09	RAN5#100	R5-235824	-	-	-	MU and TT definition for NR NTN Min power and Off power test cases	1.0.0
2023-09	RAN5#100	R5-235825	-	-	-	MU and TT definition for NR NTN Maximum Input level test case	1.0.0
2023-09	RAN5#100	R5-234627	-	-	-	NTN AMPR test configurations and requirements	1.0.0
2023-09	RAN5#100	R5-234628	-	-	-	Editorial change to move 6.2.4 in 38.521-5	1.0.0
2023-09	RAN5#100	R5-235866	-	-	-	Update Ref sensitivity for NTN	1.0.0
2023-09	RAN5#100	R5-235826	-	-	-	Update TX Intermodulation for NTN	1.0.0
2023-09	RAN5#100	R5-235827	-	-	-	Update TX Spur co-exist for NTN	1.0.0
2023-09	RAN5#100	R5-235456	-	-	-	Clarifications to 38.521-5	1.0.0
2023-09	RAN5#100	R5-235186	-	-	-	Initial conditions update for multiple test cases	1.0.0
2023-09	RAN5#100	R5-235679	-	-	-	Updates to NTN TC 6.3.3 on Tx on-off time mask	1.0.0
2023-09	RAN5#100	R5-235683	-	-	-	Updates to NTN TC 6.5.2.2 on Spectrum emission mask	1.0.0
2023-09	RAN5#100	R5-235681	-	-	-	Updates to NTN TC 6.5.2.4 on ACLR	1.0.0
2023-12	RAN5#101	R5-237874	-	-	-	Addition of test configuration and error correction for 7.5 Adjacent channel selectivity	1.1.0
2023-12	RAN5#101	R5-237834	-	-	-	Introduction of new test cases 7.7 Spurious response	1.1.0
2023-12	RAN5#101	R5-237835	-	-	-	Introduction of new test cases 7.8 Intermodulation characteristics	1.1.0
2023-12	RAN5#101	R5-237836	-	-	-	Addition of test configuration and error correction for 7.9 Spurious emissions	1.1.0
2023-12	RAN5#101	R5-236147	-	-	-	Introduction of Annex B.0	1.1.0
2023-12	RAN5#101	R5-236148	-	-	-	Introduction of Annex D Characteristics of the interfering signal	1.1.0

Change history							
Date	Meeting	TDoc	CR	R ev	Cat	Subject/Comment	New version
2023-12	RAN5#101	R5-236149	-	-	-	Introduction of measurement uncertainties and test tolerances for test cases from 7.5 to 7.9	1.1.0
2023-12	RAN5#101	R5-236150	-	-	-	Introduction of Annex F.4 Uplink power window	1.1.0
2023-12	RAN5#101	R5-236151	-	-	-	Introduction of Annex H Statistical Testing	1.1.0
2023-12	RAN5#101	R5-236291	-	-	-	Further clarification on NR NTN conformance requirement specifications	1.1.0
2023-12	RAN5#101	R5-237690	-	-	-	Adding Additional Spurious Emission TC for NTN	1.1.0
2023-12	RAN5#101	R5-237875	-	-	-	Adding Frequency Error TC for NTN	1.1.0
2023-12	RAN5#101	R5-237864	-	-	-	Core requirements alignment for NR NTN test cases	1.1.0
2023-12	RAN5#101	R5-237876	-	-	-	Update to Refsens test case 7.3.2 for NTN	1.1.0
2023-12	RAN5#101	R5-237877	-	-	-	Update to PDSCH demodulation test cases for NTN	1.1.0
2023-12	RAN#102	RP-233928	-	-	-	presented at RAN#102 for approval	2.0.0
2023-12	RAN#102	-	-	-	-	put under revision control as v17.0.0 with small editorial changes	17.0.0
2023-12	RAN#102	RP-232785	0001	-	F	Updates to spurious emissions UE coexistence test cases as part of introduction of Band 54	18.0.0
2024-03	RAN#103	R5-240840	0003	-	F	Corrections on 5.3.3 for minimum guardband and transmission bandwidth configuration	18.1.0
2024-03	RAN#103	R5-240841	0004	-	F	Corrections on 6.2.2 for maximum output power reduction	18.1.0
2024-03	RAN#103	R5-240843	0006	-	F	Corrections on 6.3.2 for Transmit OFF power	18.1.0
2024-03	RAN#103	R5-240846	0009	-	F	Corrections on 6.5.2 for out of band emission	18.1.0
2024-03	RAN#103	R5-240850	0013	-	F	Corrections on 7.4 for maximum input level	18.1.0
2024-03	RAN#103	R5-240851	0014	-	F	Corrections on 7.5 for adjacent channel selectivity	18.1.0
2024-03	RAN#103	R5-240852	0015	-	F	Corrections on 7.6 for blocking characteristics	18.1.0
2024-03	RAN#103	R5-240853	0016	-	F	Corrections on A.3.2.1.1 for the reference channel for NTN PDSCH requirement	18.1.0
2024-03	RAN#103	R5-240854	0017	-	F	Update of 6.2.1 for maximum output power	18.1.0
2024-03	RAN#103	R5-241148	0026	-	F	Update to PDSCH Mapping Type A test case for Satellite Access	18.1.0
2024-03	RAN#103	R5-241149	0027	-	F	General updates to RF NTN clauses	18.1.0
2024-03	RAN#103	R5-241396	0031	-	F	Updates to NR NTN Minimum output power test	18.1.0
2024-03	RAN#103	R5-241397	0032	-	F	Updates to NR NTN Transmit OFF power test	18.1.0
2024-03	RAN#103	R5-241398	0033	-	F	Updates to NR NTN Maximum Input Level test	18.1.0
2024-03	RAN#103	R5-241440	0034	-	F	Updates to NTN TC 6.3.3 on Tx on-off time mask	18.1.0
2024-03	RAN#103	R5-241441	0035	-	F	Updates to NTN TC 6.5.2.2 on Spectrum emission mask	18.1.0
2024-03	RAN#103	R5-241442	0036	-	F	Updates to NTN TC 6.5.2.4 on ACLR	18.1.0
2024-03	RAN#103	R5-241805	0005	1	F	Corrections on 6.2.3 for additional maximum output power reduction	18.1.0
2024-03	RAN#103	R5-241806	0007	1	F	Corrections on 6.3.3 for Transmit ON OFF time mask	18.1.0
2024-03	RAN#103	R5-241807	0010	1	F	Corrections on 6.5.3 for spurious emission	18.1.0
2024-03	RAN#103	R5-241810	0018	1	F	Update of chapter 4 for RF general description	18.1.0
2024-03	RAN#103	R5-241877	0012	1	F	Corrections on 7.3.2 for Reference sensitivity power level	18.1.0
2024-03	RAN#103	R5-242008	0020	1	F	Update to NTN Add Spurious Emission TC	18.1.0
2024-03	RAN#103	R5-242009	0021	1	F	Update to NTN General Spurious emission TC	18.1.0
2024-03	RAN#103	R5-242010	0022	1	F	Updates to NTN Spur emission UE Coex	18.1.0
2024-03	RAN#103	R5-242011	0023	1	F	Update to NTN Tx Intermod TC	18.1.0
2024-03	RAN#103	R5-242012	0025	1	F	Update to NTN Annex F MU TT	18.1.0
2024-03	RAN#103	R5-242013	0028	1	F	Splitting the NR NTN frequency error test case	18.1.0
2024-03	RAN#103	R5-242018	0029	1	F	UL RMCs updates for NR NTN	18.1.0
2024-06	RAN#104	R5-242500	0038	-	F	Introduction of new NR NTN test case - 6.5.1 Occupied bandwidth	18.2.0
2024-06	RAN#104	R5-242501	0039	-	F	Introduction of new NR NTN test case - 6.4.2.1 Error Vector Magnitude	18.2.0
2024-06	RAN#104	R5-242506	0044	-	F	Introduction of new NR NTN test case - 6.4.2.5 EVM equalizer spectrum flatness for Pi2 BPSK	18.2.0
2024-06	RAN#104	R5-242508	0046	-	F	Update of NR NTN test case - 6.2.2 UE maximum output power reduction	18.2.0
2024-06	RAN#104	R5-242510	0048	-	F	Update of NR NTN test case - 6.2.4 Configured transmitted power	18.2.0
2024-06	RAN#104	R5-242947	0051	-	F	Updates to additional spurious emissions TC 6.5.3.3	18.2.0
2024-06	RAN#104	R5-243288	0053	-	F	Corrections on 5.1 for NTN FR1 frequency range designation	18.2.0
2024-06	RAN#104	R5-243289	0054	-	F	Corrections on 6.2.3 for NTN UE additional maximum output power reduction	18.2.0
2024-06	RAN#104	R5-243290	0055	-	F	Corrections on 6.5.3.3 for NTN UE additional spurious emissions	18.2.0
2024-06	RAN#104	R5-243417	0059	-	F	Annex F updates for NTN RF test on ACLR	18.2.0
2024-06	RAN#104	R5-243422	0063	-	F	REFSENS requirements updates related to NTN band n254	18.2.0
2024-06	RAN#104	R5-243673	0041	1	F	Introduction of new NR NTN test case - 6.4.2.2 Carrier leakage	18.2.0
2024-06	RAN#104	R5-243674	0042	1	F	Introduction of new NR NTN test case - 6.4.2.3 In-band emissions	18.2.0
2024-06	RAN#104	R5-243675	0043	1	F	Introduction of new NR NTN test case - 6.4.2.4 EVM equalizer spectrum flatness	18.2.0
2024-06	RAN#104	R5-243676	0045	1	F	Update of NR NTN test case - 6.2.1 UE maximum output power	18.2.0
2024-06	RAN#104	R5-243677	0047	1	F	Update of NR NTN test case - 6.2.3 UE additional maximum output power reduction	18.2.0

Change history							
Date	Meeting	TDoc	CR	R ev	Cat	Subject/Comment	New version
2024-06	RAN#104	R5-243678	0049	1	F	Update MU and TT for NR NTN test cases	18.2.0
2024-06	RAN#104	R5-243679	0052	1	F	Adding new NTN test case 6.3.4 Power control	18.2.0
2024-06	RAN#104	R5-243680	0056	1	F	Updates on Annex for satellite access conformance test	18.2.0
2024-06	RAN#104	R5-243681	0057	1	F	Annex F updates for NTN RF test on Tx on-off time mask	18.2.0
2024-06	RAN#104	R5-243683	0061	1	F	MOP requirement updates related to NTN band n254	18.2.0
2024-06	RAN#104	R5-243684	0062	1	F	A-MPR requirements updates related to NTN band n254	18.2.0
2024-06	RAN#104	R5-243685	0064	1	F	IBB requirements updates related to NTN band n254	18.2.0
2024-06	RAN#104	R5-243814	0058	1	F	Annex F updates for NTN RF test on Spectrum emission mask	18.2.0
2024-06	RAN#104	R5-243896	0040	1	F	Introduction of new NR NTN test case - 6.4.2.1a Error Vector Magnitude including symbols with transient period	18.2.0
2024-06	RAN#104	R5-243899	0065	1	F	Update to nrn-ntn pdsch demod test case to update min test time	18.2.0
2024-06	RAN#104	R5-243987	0060	2	F	Common clause updates related to NTN band n254	18.2.0
2024-09	RAN#105	R5-244933	0066	-	F	Corrections on 7.3.2 for REFSSENS requirements for NTN band n256	18.3.0
2024-09	RAN#105	R5-245098	0067	-	F	Updates to Tx power control MU TT values	18.3.0
2024-09	RAN#105	R5-245854	0071	1	F	min test time update for nr-ntn pdsch demod test cases	18.3.0
2024-09	RAN#105	R5-245856	0073	1	F	Update to Clause 7.6.2 In-band blocking	18.3.0
2024-09	RAN#105	R5-245857	0074	1	F	Update to Clause 7.6.4 Narrow band blocking	18.3.0
2024-09	RAN#105	R5-245858	0075	1	F	Updates to NTN Out of band blocking RF test	18.3.0
2024-09	RAN#105	R5-245863	0076	1	F	Common clause updates related to NTN band n254	18.3.0
2024-09	RAN#105	R5-245864	0077	1	F	A-MPR requirements updates related to NTN band n254	18.3.0
2024-12	RAN#106	R5-246434	0079	-	F	NTN A-Spurious test - corrections for NS 02N	18.4.0
2024-12	RAN#106	R5-247152	0082	-	F	Addition of common clauses for NR-NTN enhancements	18.4.0
2024-12	RAN#106	R5-247153	0083	-	F	Addition of radiated demodulation clauses for NR-NTN enhancements	18.4.0
2024-12	RAN#106	R5-247263	0085	-	F	Adding receiver requirements for band n254	18.4.0
2024-12	RAN#106	R5-247785	0080	1	F	Updating the test description in NTN performance test case	18.4.0
2024-12	RAN#106	R5-247787	0081	1	F	addition of subtest selection criteria for DEMOD NR-NTN test case	18.4.0
2024-12	RAN#106	R5-247800	0086	1	F	Updates on definition of NTN terms and abbreviations	18.4.0
2024-12	RAN#106	R5-247970	0084	1	F	Adding transmitter requirements for band n254	18.4.0
2025-03	RAN#107	R5-250291	0087	-	F	NR NTN - Core specs alignment in common clauses	18.5.0
2025-03	RAN#107	R5-250632	0088	-	F	Update of test conditions for NR NTN out-of-band blocking test case	18.5.0
2025-03	RAN#107	R5-250948	0089	-	F	Correction of statistical testing of receiver characteristics for NR NTN	18.5.0
2025-03	RAN#107	R5-251085	0090	-	F	Corrections on 6.2.3.3.1 for clause number for NS_03N NS_04N and NS_05N	18.5.0
2025-06	RAN#108	R5-253237	0098	1	F	Rearrangement of RMC tables for FR2 NTN	18.6.0
2025-06	RAN#108	R5-252850	0099	-	F	Corrections on clause 5 for FR2-NTN frequency range	18.6.0
2025-06	RAN#108	R5-253006	0101	-	F	Editorial update to NTN RF test case	18.6.0
2025-06	RAN#108	R5-253473	0092	1	F	NR NTN - Out of band blocking test - Frequency range update	18.6.0
2025-06	RAN#108	R5-253474	0094	1	F	Correction of test case 6.4.2.1a	18.6.0
2025-06	RAN#108	R5-253475	0096	1	F	Cleaning up for NR NTN clause 8.2.1.2	18.6.0
2025-06	RAN#108	R5-253603	0093	1	F	NR NTN - Removing 256QAM - Core specs alignment	18.6.0
2025-06	RAN#108	R5-253612	0095	1	F	Addition of reference sensitivity test cases with variable Tx-Rx spacing for NR NTN bands	18.6.0
2025-06	RAN#108	R5-253235	0097	2	F	Addition of active UL slots and RMC for RF tests of FR1 NTN	18.6.0

History

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