|  |  |
| --- | --- |
| 3GPP TS 38.521-5 V18.1.0 (2024-03) | |
| Technical Specification | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Network;  NR;  User Equipment (UE) conformance specification;  Radio transmission and reception;  Part 5: Satellite access Radio Frequency (RF) and performance  (Release 18) | |
|  | |
|  |  |
|  | |
| The present document has been developed within the 3rd Generation Partnership Project (3GPP TM) and may be further elaborated for the purposes of 3GPP. The present document has not been subject to any approval process by the 3GPPOrganizational Partners and shall not be implemented. This Specification is provided for future development work within 3GPPonly. The Organizational Partners accept no liability for any use of this Specification. Specifications and Reports for implementation of the 3GPP TM system should be obtained via the 3GPP Organizational Partners' Publications Offices. | |

|  |
| --- |
|  |
| ***3GPP***  Postal address  3GPP support office address  650 Route des Lucioles - Sophia Antipolis  Valbonne - FRANCE  Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16  Internet  https://www.3gpp.org |
| ***Copyright Notification***  No part may be reproduced except as authorized by written permission. The copyright and the foregoing restriction extend to reproduction in all media.  © 2024, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).  All rights reserved.  UMTS™ is a Trade Mark of ETSI registered for the benefit of its members  3GPP™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners LTE™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners  GSM® and the GSM logo are registered and owned by the GSM Association |

Contents

Foreword 10

1 Scope 12

2 References 12

3 Definitions of terms, symbols and abbreviations 13

3.1 Terms 13

3.2 Symbols 13

3.3 Abbreviations 13

4 General 15

4.1 Relationship between minimum requirements and test requirements 15

4.2 Applicability of minimum requirements 15

4.3 Specification suffix information 15

4.4 Relationship with core specifications 16

5 Operating bands and channel arrangement 16

5.1 General 16

5.2 Operating bands 16

5.2.1 General 16

5.2.2 Operating bands with conducted requirements 16

5.2.3 reserved (for radiated requirements) 16

5.3 UE channel bandwidth 17

5.3.1 General 17

5.3.2 Maximum transmission bandwidth configuration 17

5.3.3 Minimum guardband and transmission bandwidth configuration 17

5.3.4 RB alignment 19

5.3.5 UE channel bandwidth per operating band 19

5.4 Channel arrangement 19

5.4.1 Channel spacing 19

5.4.1.1 Channel spacing for adjacent NTN satellite carriers 19

5.4.2 Channel raster 20

5.4.2.1 NR-ARFCN and channel raster 20

5.4.2.2 Channel raster to resource element mapping 20

5.4.2.3 Channel raster entries for each operating band 20

5.4.3 Synchronization raster 21

5.4.3.1 Synchronization raster and numbering 21

5.4.3.2 Synchronization raster to synchronization block resource element mapping 21

5.4.3.3 Synchronization raster entries for each operating band 21

5.4.4 TX–RX frequency separation 21

6 Transmitter characteristics 22

6.1 General 22

6.2 Transmitter power 22

6.2.1 UE maximum output power 22

6.2.1.1 Test purpose 23

6.2.1.2 Test applicability 23

6.2.1.3 Minimum conformance requirements 23

6.2.1.4 Test description 23

6.2.1.4.1 Initial conditions 23

6.2.1.4.2 Test procedure 24

6.2.1.4.3 Message contents 24

6.2.1.5 Test requirement 25

6.2.2 UE maximum output power reduction 25

6.2.2.1 Test purpose 25

6.2.2.2 Test applicability 25

6.2.2.3 Minimum conformance requirements 25

6.2.2.4 Test description 26

6.2.2.4.1 Initial conditions 26

6.2.2.4.2 Test procedure 28

6.2.2.4.3 Message contents 28

6.2.2.5 Test requirement 29

6.2.3 UE additional maximum output power reduction 30

6.2.3.1 Test purpose 30

6.2.3.2 Test applicability 30

6.2.3.3 Minimum conformance requirements 30

6.2.3.3.1 General 30

6.2.3.3.2 A-MPR for NS\_24 31

6.2.3.4 Test description 32

6.2.3.4.1 Initial conditions 32

6.2.3.4.2 Test procedure 40

6.2.3.4.3 Message contents 40

6.2.3.5 Test requirement 40

6.2.4 Configured transmitted power 43

6.2.4.1 Test purpose 43

6.2.4.2 Test applicability 43

6.2.4.3 Minimum conformance requirements 43

6.2.4.4 Test description 43

6.2.4.4.1 Initial condition 43

6.2.4.4.2 Test procedure 44

6.2.4.4.3 Message contents 44

6.2.4.5 Test requirement 45

6.3 Output power dynamics 46

6.3.1 Minimum output power 46

6.3.1.1 Test purpose 46

6.3.1.2 Test applicability 46

6.3.1.3 Minimum conformance requirements 46

6.3.1.4 Test description 46

6.3.1.4.1 Initial condition 46

6.3.1.4.2 Test procedure 47

6.3.1.4.3 Message contents 47

6.3.1.5 Test requirement 48

6.3.2 Transmit OFF power 48

6.3.2.1 Test purpose 48

6.3.2.2 Test applicability 48

6.3.2.3 Minimum conformance requirements 48

6.3.2.4 Test description 49

6.3.2.5 Test requirement 49

6.3.3 Transmit on/off time mask 49

6.3.3.1 Test purpose 49

6.3.3.2 Test applicability 49

6.3.3.3 Minimum conformance requirements 49

6.3.3.4 Test description 50

6.3.3.4.1 Initial conditions 50

6.3.3.4.2 Test procedure 51

6.3.3.4.3 Message contents 51

6.3.3.5 Test requirement 52

6.4 Transmit signal quality 53

6.4.1 Frequency error 53

6.4.1\_1 Frequency error with GSO ephemeris 53

6.4.1\_1.1 Test purpose 53

6.4.1\_1.2 Test applicability 53

6.4.1\_1.3 Minimum conformance requirements 53

6.4.1\_1.4 Test description 53

6.4.1\_1.4.1 Initial condition 53

6.4.1\_1.4.2 Test procedure 54

6.4.1\_1.4.3 Message contents 55

6.4.1\_1.5 Test requirement 58

6.4.1\_2 Frequency error with NGSO ephemeris 58

6.4.1\_2.1 Test purpose 58

6.4.1\_2.2 Test applicability 58

6.4.1\_2.3 Minimum conformance requirements 58

6.4.1\_2.4 Test description 58

6.4.1\_2.4.1 Initial condition 58

6.4.1\_2.4.2 Test procedure 59

6.4.1\_2.4.3 Message contents 59

6.4.1\_2.5 Test requirement 60

6.5 Output RF spectrum emissions 60

6.5.1 Occupied bandwidth 60

6.5.2 Out of band emission 60

6.5.2.1 [to be updated] 60

6.5.2.2 Spectrum emission mask 60

6.5.2.2.1 Test purpose 60

6.5.2.2.2 Test applicability 60

6.5.2.2.3 Minimum conformance requirements 61

6.5.2.2.4 Test description 61

6.5.2.2.5 Test requirement 64

6.5.2.3 [to be updated] 65

6.5.2.4 Adjacent channel leakage ratio 65

6.5.2.4.0 General 65

6.5.2.4.1 NR Adjacent channel leakage ratio 65

6.5.2.4.2 UTRA Adjacent channel leakage ratio 68

6.5.3 Spurious emission 70

6.5.3.0 General 70

6.5.3.1 General spurious emissions 70

6.5.3.1.1 Test purpose 71

6.5.3.1.2 Test applicability 71

6.5.3.1.3 Minimum conformance requirements 71

6.5.3.1.4 Test description 71

6.5.3.1.5 Test requirement 73

6.5.3.2 Spurious emissions for UE co-existence 73

6.5.3.2.1 Test purpose 73

6.5.3.2.2 Test applicability 73

6.5.3.2.3 Minimum conformance requirements 73

6.5.3.2.4 Test description 74

6.5.3.2.5 Test requirement 76

6.5.3.3 Additional Spurious emissions 76

6.5.3.3.1 Test purpose 77

6.5.3.3.2 Test applicability 77

6.5.3.3.3 Minimum conformance requirements 77

6.5.3.3.4 Test description 77

6.5.3.3.5 Test requirement 79

6.5.4 Transmit intermodulation 79

6.5.4.1 Test purpose 80

6.5.4.2 Test applicability 80

6.5.4.3 Minimum conformance requirements 80

6.5.4.4 Test description 80

6.5.4.4.1 Initial conditions 80

6.5.4.4.2 Test procedure 81

6.5.4.4.3 Message contents 82

6.5.4.5 Test requirement 82

7 Receiver characteristics 82

7.1 General 82

7.2 Diversity characteristics 83

7.3 Reference sensitivity 83

7.3.1 General 83

7.3.2 Reference sensitivity power level 83

7.3.2.1 Test purpose 83

7.3.2.2 Test applicability 83

7.3.2.3 Minimum conformance requirements 83

7.3.2.4 Test description 84

7.3.2.4.1 Initial conditions 84

7.3.2.4.2 Test procedure. 86

7.3.2.4.3 Message contents 86

7.3.2.5 Test requirement 86

7.4 Maximum input level 1744

7.4.1 Test purpose 1744

7.4.2 Test applicability 1744

7.4.3 Minimum conformance requirements 1744

7.4.4 Test description 1745

7.4.4.1 Initial conditions 1745

7.4.4.2 Test procedure 1745

7.4.4.3 Message contents 1746

7.4.5 Test requirement 1746

7.5 Adjacent channel selectivity 1747

7.5.1 Test purpose 1747

7.5.2 Test applicability 1747

7.5.3 Minimum conformance requirements 1747

7.5.4 Test description 1748

7.5.4.1 Initial conditions 1748

7.5.4.2 Test procedure 1749

7.5.4.3 Message contents 1750

7.5.5 Test requirement 1750

7.6 Blocking characteristics 1751

7.6.1 General 1751

7.6.2 In-band blocking 1751

7.6.3 Out of Band Blocking 1751

7.6.3.1 Test purpose 1751

7.6.3.2 Test applicability 1752

7.6.3.3 Minimum conformance requirements 1752

7.6.3.4 Test description 1753

7.6.3.4.1 Initial conditions 1753

7.6.3.4.2 Test procedure 1753

7.6.3.4.3 Message contents 1753

7.6.3.5 Test requirement 1753

7.6.4 Narrow band blocking 1753

7.7 Spurious response 1754

7.7.1 Test Purpose 1754

7.7.2 Test Applicability 1754

7.7.3 Minimum Conformance Requirements 1754

7.7.4 Test Description 1754

7.7.4.1 Initial Conditions 1754

7.7.4.2 Test Procedure 1754

7.7.4.3 Message Contents 1755

7.7.5 Test Requirement 1755

7.8 Intermodulation characteristics 1756

7.8.1 General 1756

7.8.2 Wide band Intermodulation 1756

7.8.2.1 Test purpose 1756

7.8.2.2 Test applicability 1756

7.8.2.3 Minimum conformance requirements 1756

7.8.2.4 Test description 1757

7.8.2.4.1 Initial conditions 1757

7.8.2.4.2 Test procedure 1758

7.8.2.4.3 Message contents 1759

7.8.2.5 Test requirement 1759

7.9 Spurious emissions 1760

7.9.1 Test purpose 1760

7.9.2 Test applicability 1760

7.9.3 Minimum conformance requirements 1760

7.9.4 Test description 1761

7.9.4.1 Initial conditions 1761

7.9.4.2 Test procedure 1762

7.9.4.3 Message contents 1762

7.9.5 Test requirement 1762

8 Conducted performance requirements 1762

8.0 General 1762

8.1.1 Relationship between minimum requirements and test requirements 1762

8.1.2 Applicability of minimum requirements 1763

8.1.3 Conducted requirements 1763

8.1.3.1 Introduction 1763

8.1.3.2 Reference point 1763

8.1.3.3 SNR definition 1763

8.1.3.4 Noc 1764

8.1.3.4.1 Introduction 1764

8.1.3.4.2 Noc for NR operating bands in FR1 1764

8.2 Demodulation performance requirements 1764

8.2.1 General 1764

8.2.1.1 Applicability of requirements 1764

8.2.1.1.1 General 1764

8.2.1.1.2 Applicability of requirements for optional UE features 1765

8.2.1.2.0 PDSCH demodulation requirements 1765

8.2.1.2.1 1RX requirements 1768

8.2.1.2.2 2RX requirements 1768

Annex A: (normative): Measurement channels 1773

A.1 General 1773

A.1.1 Throughput definition 1773

A.2 UL reference measurement channels 1773

A.2.1 General 1773

A.2.2 Reference measurement channels for FDD 1774

A.2.2.1 DFT-s-OFDM Pi/2-BPSK 1774

A.2.2.2 DFT-s-OFDM QPSK 1775

A.2.2.3 DFT-s-OFDM 16QAM 1776

A.2.2.4 DFT-s-OFDM 64QAM 1777

A.2.2.5 DFT-s-OFDM 256QAM 1778

A.2.2.6 CP-OFDM QPSK 1779

A.2.2.7 CP-OFDM 16QAM 1780

A.2.2.8 CP-OFDM 64QAM 1782

A.2.2.9 CP-OFDM 256QAM 1783

A.3 DL reference measurement channels 1785

A.3.1 General 1785

A.3.2 Reference measurement channels for PDSCH performance requirements 1785

A.3.2.0 General 1785

A.3.2.1 FDD 1786

A.3.2.1.1 Reference measurement channels for SCS 15 kHz FR1 1786

A.4 Testing related to Satellite Access 1788

A.4.1 General 1788

A.4.2 Test condition for transmitter characteristics 1788

A.4.3 Test condition for receiver characteristics 1788

A.4.4 Test condition for performance requirements 1788

Annex B: (normative): Propagation conditions 1789

B.0 No interference 1789

B.1 Static propagation condition 1789

B.1.1 UE Receiver with 1Rx 1789

B.1.2 UE Receiver with 2Rx 1789

B.2 Multi-path fading propagation conditions 1789

B.2.0 General 1789

B.2.1 Delay profiles 1790

B.2.2 Combinations of channel model parameters 1790

B.2.3 MIMO Channel Correlation Matrices 1790

B.2.3.0 General 1790

B.2.3.1 MIMO Correlation Matrices using Uniform Linear Array (ULA) 1791

B.2.3.1.0 General 1791

B.2.3.1.1 Definition of MIMO Correlation Matrices 1791

B.2.3.1.2 MIMO Correlation Matrices at High, Medium and Low Level 1791

Annex C (normative): Downlink physical channels 1792

C.1 General 1792

C.2 Setup (Conducted) 1792

C.3 Connection (Conducted) 1792

C.3.0 General 1792

C.3.1 Measurement of Performance requirements 1792

Annex D (normative): Characteristics of the interfering signal 1794

D.1 General 1794

D.2 Interference signals 1794

Annex F (normative): Measurement uncertainties and Test Tolerances 1795

F.1 Acceptable uncertainty of Test System (normative) 1795

F.1.0 General 1795

F.1.1 Measurement of test environments 1795

F.1.2 Measurement of transmitter 1796

F.1.3 Measurement of receiver 1796

F.1.4 Measurement of Demod Performance requirements 1796

F.2 Interpretation of measurement results (normative) 1797

F.3 Test Tolerance and Derivation of Test Requirements (informative) 1797

F.3.0 General 1797

F.3.1 Measurement of test environments 1797

F.3.2 Measurement of transmitter 1798

F.3.3 Measurement of receiver 1798

F.3.4 Measurement of Demod Performance requirements 1799

F.4 Uplink power window 1799

F.4.1 Introduction 1799

F.4.2 Setting the power window above a requirement 1799

F.4.3 Setting the power window below a requirement 1800

F.4.4 Setting the power window centred on a target value 1801

Annex H (normative): Statistical Testing 1803

H.1 General 1803

H.2 Statistical testing of receiver characteristics 1803

H.2.1 General 1803

H.2.2 Mapping throughput to error ratio 1803

H.2.3 Design of the test 1804

H.2.4 Numerical definition of the pass fail limits 1805

H.2.5 Pass fail decision rules 1805

H.2.6 Theory to derive the pass fail limits (Informative) 1806

H.2.6.1 Numerical definition of the pass-fail limits 1806

H.2.6.2 Simulation to derive the pass-fail limits for testing 95% throughput 1807

Annex I (informative): Change history 1808

# Foreword

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

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

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

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.329-10, “Unwanted emissions in the spurious domain”

[16] 3GPP TS 38.214: "NR; Physical layer procedures for data".

# 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].

**Geosynchronous Earth Orbit:** Earth-centered 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.

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

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

**Satellite:** A space-borne vehicle embarking a bent pipe 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:** see definition in TS 38.108 [4].

**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:

ΔFGlobal Granularity of the global frequency raster

ΔFRaster Band dependent channel raster granularity

BWChannel Channel bandwidth

BWinterferer Bandwidth of the interferer

FDL\_low The lowest frequency of the downlink *operating band*

FDL\_high The highest frequency of the downlink *operating band*

FUL\_low The lowest frequency of the uplink *operating band*

FUL\_high The highest frequency of the uplink *operating band*

FInterferer Frequency of the interferer

FInterferer (offset) Frequency offset of the interferer (between the center frequency of the interferer and the carrier frequency of the carrier measured)

FIoffset Frequency offset of the interferer (between the center frequency of the interferer and the closest edge of the carrier measured)

FOOB The boundary between the NR out of band emission and spurious emission domains

FREF RF reference frequency

FREF-Offs Offset used for calculating FREF

Fuw (offset) The frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer

NRB Transmission bandwidth configuration, expressed in units of resource blocks

NREF NR Absolute Radio Frequency Channel Number (NR-ARFCN)

NREF-Offs Offset used for calculating NREF

PInterferer Modulated mean power of the interferer

Puw Power of an unwanted DL signal

## 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

MEO Medium Earth Orbiting

MOP Maximum Output Power

MPR Allowed maximum power reduction

MSD Maximum Sensitivity Degradation

NGEO Non-Geostationary Earth Orbiting

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 frequency ranges

|  |  |
| --- | --- |
| Frequency range designation | Corresponding frequency range |
| FR1 | 410 MHz – 7,125 MHz |

The present specification covers FR1 operating bands.

## 5.2 Operating bands

### 5.2.1 General

NTN satellite covers FR1 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 satellite operating band | Uplink (UL) operating band Satellite Access Node receive / UE transmit  FUL,low – FUL,high | Downlink (DL) operating band Satellite Access Node transmit / UE receive  FDL,low – FDL,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 |
| NOTE: NTN satellite bands are numbered in descending order from n256. | | | |

### 5.2.3 reserved (for radiated requirements)

[To be updated]

## 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 NRB for each UE channel bandwidth and subcarrier spacing is specified in Table 5.3.2-1.

Table 5.3.2-1: Maximum transmission bandwidth configuration NRB

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SCS (kHz) | 5  MHz | 10  MHz | 15  MHz | 20  MHz |
| NRB | NRB | NRB | NRB |
| 15 | 25 | 52 | 79 | 106 |
| 30 | 11 | 24 | 38 | 51 |
| 60 | N/A | 11 | 18 | 24 |

### 5.3.3 Minimum guardband and transmission bandwidth configuration

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

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SCS (kHz) | 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 |

NOTE: The minimum guardbands have been calculated using the following equation: (BWChannel x 1,000 (kHz) - NRB x SCS x 12) / 2 - SCS/2, where NRB are from Table 5.3.2-1.

Figure 5.3.3-1: Void

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

Chart, diagram

Description automatically generated

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 UEchannel bandwidth for the numerology that is transmitted/received immediately adjacent to the guard band.

A black background with a black square

Description automatically generated with medium confidence

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 refers to NR RB alignments as specified in 3GPP TS 38.101‑1 [5] 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. The transmission bandwidth configuration in Table 5.3.2-1 shall be supported for each of the specified channel bandwidths. The channel bandwidths are specified for both the TX and RX path.

Table 5.3.5-1: Channel bandwidths for each NTN satellite band

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

## 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 refers to the NR channel spacing as specified in TS 38.101-1 [5] 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 FREF. 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 ΔFGlobal.

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 FREF in MHz is given by the following equation, where FREF-Offs and NREF-Offs are given in Table 5.4.2.1-1 and NREF is the NR-ARFCN.

FREF = FREF-Offs + ΔFGlobal (NREF – NREF-Offs)

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Frequency range (MHz) | ΔFGlobal (kHz) | FREF-Offs (MHz) | NREF-Offs | Range of NREF |
| 0 – 3,000 | 5 | 0 | 0 | 0 – 599,999 |

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 ΔFRaster, which may be equal to or larger than ΔFGlobal.

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 refers to the NR requirements specified in 3GPP TS 38.101‑1 [5] 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, ΔFRaster = 20 × ΔFGlobal. 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

|  |  |  |  |
| --- | --- | --- | --- |
| NTN satellite operating band | ΔFRaster  (kHz) | Uplink  Range of NREF  (First – <Step size> – Last) | Downlink  Range of NREF  (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 |
| 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. | | | |

### 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 SSREF with corresponding number GSCN. The parameters defining the SSREF 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 SSREF 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.

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

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range | SS Block frequency position SSREF | GSCN | Range of GSCN |
| 0 – 3,000 MHz | N \* 1,200 kHz + M \* 50 kHz,  N=1:2,499, M ϵ {1,3,5}1 | 3N + (M-3)/2 | 2 – 7,498 |
| 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 refers to 3GPP TS 38.101‑1 [5] 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. The distance between applicable GSCN entries is given by the <Step size> indicated in Table 5.4.3.3-1.

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

|  |  |  |  |
| --- | --- | --- | --- |
| NTN satellite operating band | SS Block SCS | SS Block pattern1 | 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 |
| NOTE : SS Block pattern is defined in clause 4.1 in 3GPP 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.

Table 5.4.4-1: UE TX-RX frequency separation

| NTN Satellite Operating Band | TX – RX  carrier centre frequency separation |
| --- | --- |
| n256 | 190 MHz |
| n255 | -101.5 MHz |

# 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@21 | 1@1 | 1@9 |
| CP | 2@0 | 2@9 | 1@0 | 1@10 | 11@0 | 5@21 | 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@191 | 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@121 | 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 LCRB is ceil(NRB/2) -1 in order to meet Inner RB allocation definition (RBStart,Low ≤ RBStart ≤ RBStart,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: 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

- Verification of UE frequency pre-compensation is to be updated

#### 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 |
| NOTE 1: PPowerClass is the maximum UE power specified without taking into account the tolerance  NOTE 2: Powerclass 3 is default power class unless otherwise stated | | |

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 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 | Modulation (NOTE 2) | RB allocation (NOTE 1) |
| 1 | power test case | 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 Zero Doppler conditions in service link and Common TA delay according to SIB19 configuration in TS 38.508-1 [12].

8. 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 PUMAX 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

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

Table 6.2.1.4.3-1: *PUSCH-Config*

|  |
| --- |
| Derivation Path: TS 38.508-1 [12], Table 4.6.3-118 with condition TRANSFORM\_PRECODER\_ENABLED |

#### 6.2.1.5 Test requirement

The maximum output power, derived in step 3 shall be within the range prescribed by the nominal maximum output power and tolerance in Table 6.2.1.5-1 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 | ±(2+TT) |
| n255 | 23 | ±(2+TT) |
| NOTE 1: PPowerClass 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)

[to be updated]

### 6.2.2 UE maximum output power reduction

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

- 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

- Annex F MU/TT is to be updated

- Verification of UE frequency pre-compensation is to be updated

#### 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 ∆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 | | |
| 256 QAM | ≤ 4.5 | | |
| CP-OFDM | QPSK | ≤ 3 | | ≤ 1.5 |
| 16 QAM | ≤ 3 | | ≤ 2 |
| 64 QAM | ≤ 3.5 | | |
| 256 QAM | ≤ 6.5 | | |

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 | |
|  |  |  | Modulation (NOTE 2) | RB allocation (NOTE 1) |
| 1 | Default | N/A for Maximum Power | DFT-s-OFDM Pi/2 BPSK | Inner Full |
| 2 | Low | Reduction (MPR) test case | DFT-s-OFDM Pi/2 BPSK | Edge\_1RB\_Left |
| 3 | High |  | DFT-s-OFDM Pi/2 BPSK | Edge\_1RB\_Right |
| 4 | Default |  | DFT-s-OFDM Pi/2 BPSK | Outer Full |
| 5 | Default |  | DFT-s-OFDM QPSK | Inner Full |
| 6 | Low |  | DFT-s-OFDM QPSK | Edge\_1RB\_Left |
| 7 | High |  | DFT-s-OFDM QPSK | Edge\_1RB\_Right |
| 8 | Default |  | DFT-s-OFDM QPSK | Outer Full |
| 9 | Default |  | DFT-s-OFDM 16 QAM | Inner Full |
| 10 | Low |  | DFT-s-OFDM 16 QAM | Edge\_1RB\_Left |
| 11 | High |  | DFT-s-OFDM 16 QAM | Edge\_1RB\_Right |
| 12 | Default |  | DFT-s-OFDM 16 QAM | Outer Full |
| 13 | Low |  | DFT-s-OFDM 64 QAM | Edge\_1RB\_Left |
| 14 | High |  | DFT-s-OFDM 64 QAM | Edge\_1RB\_Right |
| 15 | Default |  | DFT-s-OFDM 64 QAM | Outer Full |
| 16 | Low |  | DFT-s-OFDM 256 QAM | Edge\_1RB\_Left |
| 17 | High |  | DFT-s-OFDM 256 QAM | Edge\_1RB\_Right |
| 18 | Default |  | DFT-s-OFDM 256 QAM | Outer Full |
| 19 | Default |  | CP-OFDM QPSK | Inner Full |
| 20 | Low |  | CP-OFDM QPSK | Edge\_1RB\_Left |
| 21 | High |  | CP-OFDM QPSK | Edge\_1RB\_Right |
| 22 | Default |  | CP-OFDM QPSK | Outer Full |
| 23 | Default |  | CP-OFDM 16 QAM | Inner Full |
| 24 | Low |  | CP-OFDM 16 QAM | Edge\_1RB\_Left |
| 25 | High |  | CP-OFDM 16 QAM | Edge\_1RB\_Right |
| 26 | Default |  | CP-OFDM 16 QAM | Outer Full |
| 27 | Low |  | CP-OFDM 64 QAM | Edge\_1RB\_Left |
| 28 | High |  | CP-OFDM 64 QAM | Edge\_1RB\_Right |
| 29 | Default |  | CP-OFDM 64 QAM | Outer Full |
| 30 | Low |  | CP-OFDM 256 QAM | Edge\_1RB\_Left |
| 31 | High |  | CP-OFDM 256 QAM | Edge\_1RB\_Right |
| 32 | Default |  | CP-OFDM 256 QAM | Outer Full |
| 333 | Low |  | DFT-s-OFDM Pi/2 BPSK w Pi/2 BPSK DMRS | Edge\_1RB\_Left |
| 343 | High |  | DFT-s-OFDM Pi/2 BPSK w Pi/2 BPSK DMRS | Edge\_1RB\_Right |
| 353 | 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 *lowPAPR-DMRS-PUSCHwithPrecoding-r16*. | | | | |

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 Zero Doppler conditions in service link and Common TA delay according to SIB19 configuration in TS 38.508-1 [12].

8. 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 PUMAX 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 | PPowerClass  (dBm) | ΔPPowerClass  (dB) | MPR (dB) | ΔTC,c (dB) | PCMAX\_L,f,c (dBm) | T(PCMAX\_L,f,c) (dB) | TL,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 | 4.5 | 0 | 18.5 | 4.0 | 2 | 25.0 + TT | 14.5 - TT |
| 17 | 23 | 0 | 4.5 | 0 | 18.5 | 4.0 | 2 | 25.0 + TT | 14.5 - TT |
| 18 | 23 | 0 | 4.5 | 0 | 18.5 | 4.0 | 2 | 25.0 + TT | 14.5 - TT |
| 19 | 23 | 0 | 1.5 | 0 | 21.5 | 2.0 | 2 | 25.0 + TT | 19.5 - TT |
| 20 | 23 | 0 | 3 | 0 | 20.0 | 2.5 | 2 | 25.0 + TT | 17.5 - 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 | 2 | 0 | 21.0 | 2.0 | 2 | 25.0 + TT | 19.0 - TT |
| 24 | 23 | 0 | 3 | 0 | 20.0 | 2.5 | 2 | 25.0 + TT | 17.5 - TT |
| 25 | 23 | 0 | 3 | 0 | 20.0 | 2.5 | 2 | 25.0 + TT | 17.5 - TT |
| 26 | 23 | 0 | 3 | 0 | 20.0 | 2.5 | 2 | 25.0 + TT | 17.5 - TT |
| 27 | 23 | 0 | 3.5 | 0 | 19.5 | 3.5 | 2 | 25.0 + TT | 16.0 - TT |
| 28 | 23 | 0 | 3.5 | 0 | 19.5 | 3.5 | 2 | 25.0 + TT | 16.0 - TT |
| 29 | 23 | 0 | 3.5 | 0 | 19.5 | 3.5 | 2 | 25.0 + TT | 16.0 - TT |
| 30 | 23 | 0 | 6.5 | 0 | 16.5 | 5.0 | 2 | 25.0 + TT | 11.5 - TT |
| 31 | 23 | 0 | 6.5 | 0 | 16.5 | 5.0 | 2 | 25.0 + TT | 11.5 - TT |
| 32 | 23 | 0 | 6.5 | 0 | 16.5 | 5.0 | 2 | 25.0 + TT | 11.5 - TT |
| 33 | 23 | 0 | 0.5 | 0 | 22.5 | 2.0 | 2 | 25.0 + TT | 20.5 - TT |
| 34 | 23 | 0 | 0.5 | 0 | 22.5 | 2.0 | 2 | 25.0 + TT | 20.5 - TT |
| 35 | 23 | 0 | 0 | 0 | 23 | 2.0 | 2 | 25.0 + TT | 21.0 - TT |
| NOTE 1: PPowerClass 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))

[to be updated]

### 6.2.3 UE additional maximum output power reduction

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

#### 6.2.3.1 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. Unless stated otherwise, the total reduction to UE maximum output power is max(MPR, A-MPR) where MPR is defined in clause 6.2.2. Outer and inner allocation notation used in clause 6.2.3 is defined in clause 6.2.2. In absence of modulation and waveform types the A-MPR applies to all modulation and waveform types.

#### 6.2.3.2 Test applicability

[to be updated]

#### 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 | 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] | n2561 |  |  | Table  6.2.3.1-2 in 3GPP TS 38.101-1 [5] |
| NOTE 1: This NS can be signalled for NR 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. | | | | | |

[The NS\_01 label with the field *additionalPmax* [8] absent is default for all NTN satellite bands.]

Table 6.2.3.3.1-2: Mapping of network signalling label

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR satellite band | Value of additionalSpectrumEmission | | | | | | | |
|  | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| n256 | NS\_01 | NS\_24 | NS\_100 |  |  |  |  |  |
| n255 | NS\_01 | NS\_02N |  |  |  |  |  |  |
| 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 |
|  | 256 QAM | ≤ 4.5 |
| CP-OFDM | QPSK | ≤ 4 |
|  | 16 QAM | ≤ 4 |
|  | 64 QAM | ≤ 4 |
|  | 256 QAM | ≤ 6.5 |

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

##### 6.2.3.3.2 A-MPR for NS\_24

Table 6.2.3.3.2-1: A-MPR regions for NS\_24

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Channel Bandwidth, MHz | Carrier Centre Frequency, Fc, MHz | Region A | | Region B | | Region C | |
| RBend\*12\*SCS  MHz | LCRB\*12\*SCS  MHz | RBend\*12\*SCS  MHz | LCRB\*12\*SCS  MHz | RBend\*12\*SCS  MHz | LCRB\*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 6.2.3.3.2-2: 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 |  |
|  | 256 QAM | ≤ 5.5 |  |
| CP-OFDM | QPSK | ≤ 4 |  |
|  | 16 QAM | ≤ 4 |  |
|  | 64 QAM | ≤ 4.5 |  |
|  | 256 QAM | ≤ 7.5 |  |

#### 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 | 256 QAM | Edge\_1RB\_Left |
| 14 | High | Default | Default | 256 QAM | Edge\_1RB\_Right |
| 15 | Default | Default | Default | 256 QAM | Outer\_Full |
| 16 | Low | Default | Default | CP-s OFDM | QPSK | Edge\_1RB\_Left |
| 17 | High | Default | Default | QPSK | Edge\_1RB\_Right |
| 18 | Default | Default | Default | QPSK | Outer\_Full |
| 19 | Low | Default | Default | 16 QAM | Edge\_1RB\_Left |
| 20 | High | Default | Default | 16 QAM | Edge\_1RB\_Right |
| 21 | Default | Default | Default | 16 QAM | Outer\_Full |
| 22 | Low | Default | Default | 64 QAM | Edge\_1RB\_Left |
| 23 | High | Default | Default | 64 QAM | Edge\_1RB\_Right |
| 24 | Default | Default | Default | 64 QAM | Outer\_Full |
| 25 | Low | Default | Default | 256 QAM | Edge\_1RB\_Left |
| 26 | High | Default | Default | 256 QAM | Edge\_1RB\_Right |
| 27 | Default | Default | Default | 256 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 (Fc) 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 | Fc  (MHz) | ChBw (MHz) | SCS | Downlink Configuration | Uplink Configuration | | | | |
| Modulation  (NOTE 2, 3) | | RB allocation (Note 1) | | |
| Region A | Region B | Region C |
| 1-5 | 1,992.5 | 5 | Default | N/A for A-MPR testing | DFT-s OFDM | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 6-10 | 1,997.5 | 5 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 11-25 | 2,002.5 | 5 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | Edge\_1RB\_Right | Edge\_1RB\_Left |
| 26-30 | 1,985 | 10 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Edge\_1RB\_Right | N/A | N/A |
| 31-35 | 1,985 | 10 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 36-50 | 1,995 | 10 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | Edge\_1RB\_Right | Edge\_1RB\_Left |
| 51-65 | 2,000 | 10 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Edge\_1RB\_Right | Edge\_1RB\_Left | 36@0 |
| 66-70 | 2,000 | 10 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 71-85 | 1,987.5 | 15 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | Edge\_1RB\_Right | Edge\_1RB\_Left |
| 86-100 | 1,997.5 | 15 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Edge\_1RB\_Right | Edge\_1RB\_Left | 50@0 |
| 101-105 | 1,997.5 | 15 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 106-120 | 1,990 | 20 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Edge\_1RB\_Right | Edge\_1RB\_Left | 74@0 |
| 121-125 | 1,990 | 20 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 126-140 | 1,995 | 20 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Edge\_1RB\_Right | Edge\_1RB\_Left | 69@0 |
| 141-145 | 1,995 | 20 | Default | Pi/2 BPSK  QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 146-149 | 1,992.5 | 5 | Default | CP-OFDM | QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 150-153 | 1,997.5 | 5 | Default | QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 154-165 | 2,002.5 | 5 | Default | QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | Edge\_1RB\_Right | Edge\_1RB\_Left |
| 166-169 | 1,985 | 10 | Default | QPSK  16 QAM  64 QAM  256 QAM | Edge\_1RB\_Right | N/A | N/A |
| 170-173 | 1,985 | 10 | Default | QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 174-185 | 1,995 | 10 | Default | QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | Edge\_1RB\_Right | Edge\_1RB\_Left |
| 186-197 | 2,000 | 10 | Default | QPSK  16 QAM  64 QAM  256 QAM | Edge\_1RB\_Right | Edge\_1RB\_Left | 37@0 |
| 198-201 | 2,000 | 10 | Default | QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 202-213 | 1,987.5 | 15 | Default | QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | Edge\_1RB\_Right | Edge\_1RB\_Left |
| 214-225 | 1,997.5 | 15 | Default | QPSK  16 QAM  64 QAM  256 QAM | Edge\_1RB\_Right | Edge\_1RB\_Left | 51@0 |
| 226-229 | 1,997.5 | 15 | Default | QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 230-241 | 1,990 | 20 | Default | QPSK  16 QAM  64 QAM  256 QAM | Edge\_1RB\_Right | Edge\_1RB\_Left | 74@0 |
| 242-245 | 1,990 | 20 | Default | QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 246-257 | 1,995 | 20 | Default | QPSK  16 QAM  64 QAM  256 QAM | Edge\_1RB\_Right | Edge\_1RB\_Left | 69@0 |
| 258-261 | 1,995 | 20 | Default | QPSK  16 QAM  64 QAM  256 QAM | Outer\_Full | N/A | N/A |
| 262 | 1,992.5 | 5 | Default | QPSK | Edge\_1RB\_Right | N/A | N/A |
| 263 | 1,997.5 | 5 | Default | 16 QAM | Edge\_1RB\_Right | N/A | N/A |
| 264 | 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. | | | | | | | | | |

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. 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 PUMAX 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) |  |  |

#### 6.2.3.5 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)

[to be updated]

Table 6.2.3.5-2: UE Power Class 3 test requirements (NS\_100) for n256

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test ID | PPowerClass (dBm) | MPR (dB) | A-MPR (dB) | ΔTC,c (dB) | PCMAX\_L,c (dBm) | T(PCMAX\_L,c) (dB) | TL,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 | 4.5 | 4.5 | 0 | 18.5 | 4 | 2 | 25+TT | 14.5-TT |
| 15 | 23 | 4.5 | 4.5 | 0 | 18.5 | 4 | 2 | 25+TT | 14.5-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 | 4 | 0 | 19 | 3.5 | 2 | 25+TT | 15.5-TT |
| 21 | 23 | 3 | 4 | 0 | 19 | 3.5 | 2 | 25+TT | 15.5-TT |
| 22, 23 | 23 | 3.5 | 4 | 0 | 19 | 3.5 | 2 | 25+TT | 15.5-TT |
| 24 | 23 | 3.5 | 4 | 0 | 19 | 3.5 | 2 | 25+TT | 15.5-TT |
| 25, 26 | 23 | 6.5 | 6.5 | 0 | 16.5 | 5 | 2 | 25+TT | 11.5-TT |
| 27 | 23 | 6.5 | 6.5 | 0 | 16.5 | 5 | 2 | 25+TT | 11.5-TT |
| NOTE 1: PPowerClass 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 | PPowerClass  (dBm) | MPR  (dB) | A-MPR  (dB) | ΔTC,c  (dB) | PCMAX\_L,c  (dBm) | T(PCMAX\_L,c)  (dB) | TL,c  (dB) | Upper limit  (dBm) | Lower limit  (dBm) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1, 6, 11-13, 26, 31, 36-38, 51-53, 66, 71-73, 86-88, 101, 106-108, 121, 126-128, 141 | 23 | N/A | 1.5 | 0 | 21.5 | 2 | 2 | 25+TT | 19.5-TT |
| 2, 7, 14-16, 27, 32, 39-41, 54-56, 67, 74-76, 89-91, 102, 109-111, 122, 129-131, 142 | 23 | N/A | 2.0 | 0 | 21 | 2 | 2 | 25+TT | 19-TT |
| 3, 8, 17-19, 28, 33, 42-44, 57-59, 68, 77-79, 92-94, 103, 112-114, 123, 132-134, 143 | 23 | N/A | 3.0 | 0 | 20 | 2.5 | 2 | 25+TT | 17.5-TT |
| 4, 9, 20-22, 29, 34, 45-47, 60-62, 69, 80-82, 95-97, 104, 115-117, 124, 135-137, 144 | 23 | N/A | 3.5 | 0 | 19.5 | 3.5 | 2 | 25+TT | 16-TT |
| 5, 10, 23-25, 30, 35, 48-50, 63-65, 70, 83-85, 98-100, 105, 118-120, 125, 138-140, 145 | 23 | N/A | 5.5 | 0 | 17.5 | 5 | 2 | 25+TT | 12.5-TT |
| 146-147, 150-151, 154-159, 166-167, 170-171, 174-179, 186-191, 198-199, 202-207, 214-219, 226-227, 230-235, 242-243, 246-251, 258-259, 262-264 | 23 | N/A | 4 | 0 | 19 | 3.5 | 2 | 25+TT | 15.5-TT |
| 148, 152, 160-162, 168, 172, 180-182, 192-194, 200, 208-210, 220-222, 228, 236-238, 244, 252-254, 260 | 23 | N/A | 4.5 | 0 | 18.5 | 4 | 2 | 25+TT | 14.5-TT |
| 149, 153, 163-165, 169, 173, 183-185, 195-197, 201, 211-213, 223-225, 229, 239-241, 245, 255-257, 261 | 23 | N/A | 7.5 | 0 | 15.5 | 5 | 2 | 25+TT | 10.5-TT |
| NOTE 1: PPowerClass 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. | | | | | | | | | |

### 6.2.4 Configured transmitted power

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

#### 6.2.4.1 Test purpose

To verify the measured UE configured maximum output power PUMAX,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 Zero Doppler conditions in service link and Common TA delay according to SIB19 configuration in TS 38.508-1 [12].

8. 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 Pumax level of the test point.

3. Measure the mean power of the UE in the channel bandwidth for each test point in table 6.2.4.5-1 according to the test configuration from table 6.2.4.4.1-1. The period of measurement shall be at least the continuous duration of one active slot and in the uplink symbols. For TDD slots with transient periods are not under test.

##### 6.2.4.4.3 Message contents

Message contents are according to TS 38.508-1 [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: PCMAX 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) |
| 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)

[to be updated]

## 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\*NRB+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

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

- Annex F MU/TT is to be updated

#### 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 for15 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 PUMAX 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 µs in the end of the slot.

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

##### 6.3.3.4.3 Message contents

Message contents are according to TS 38.508-1 [12] subclause 4.6with 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 { | 2 entries |  |  |
| PUSCH-TimeDomainResourceAllocation[1] SEQUENCE { |  |  |  |
| k2 | 4 |  | FR1\_15kHz,FR1\_30kHz |
| 6 |  | FR1\_60kHz |
| mappingType | typeA |  |  |
| startSymbolAndLength | 27 | Start symbol(S)=0, Length(L)=14 |  |
| } |  |  |  |
| PUSCH-TimeDomainResourceAllocation[2] SEQUENCE { |  | Addressed by Msg3 PUSCH time resource allocation field of the Random Access Response acc. to TS 38.213 [7] Table 8.2-1. |  |
| k2 | 2 | K2+ Δ=4 acc. to TS 38.214 [16] Table 6.1.2.1.1-5  (NOTE 1) | FR1\_15kHz |
| 6 | K2+ Δ=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 | ≤ -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 ≤ 3.0GHz** |
| **BW ≤ 40MHz** | [to be updated] |

## 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] Annexe 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 PUMAX 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 PUMAX 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 { |  |  |  |
| cellSpecificKoffset-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 { |  |  |  | |
| cellSpecificKoffset-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 { |  |  |  |
| cellSpecificKoffset-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: EphemerisInfo -NR NTN Ephemeris Information for NGSO (LEO-600)  satellites (maximum positive Doppler/2)

|  |  |  |  |
| --- | --- | --- | --- |
| Derivation Path: TS 38.598-1, Table 4.6.3-56C | | | |
| 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\_1.5 Test requirement

The frequency error Δf shall fulfil the test requirement:

|Δf| ≤ (0.1 PPM + [15 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 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:

|Δf| ≤ (0.1 PPM + [15 Hz])

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

## 6.5 Output RF spectrum emissions

[to be updated]

### 6.5.1 Occupied bandwidth

[to be updated]

### 6.5.2 Out of band emission

#### 6.5.2.1 [to be updated]

#### 6.5.2.2 Spectrum emission mask

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

- Annex F MU/TT is to be updated

##### 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 (ΔfOOB) starting from the ± edge of the assigned NR channel bandwidth. For frequencies offset greater than ΔfOOB, 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

|  |  |  |  |
| --- | --- | --- | --- |
| ΔfOOB  (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 | 1 MHz |
| ± 5-6 | -13 |  |
| ± 6-10 | -25 |  |
| ± 5-BWChannel |  | -13 |
| ± BWChannel-(BWChannel+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)** |
| 14 | Low |  |  |  | DFT-s-OFDM Pi/2 BPSK | Edge\_1RB\_Left |
| 24 | High |  |  |  | DFT-s-OFDM Pi/2 BPSK | Edge\_1RB\_Right |
| 34 | Default |  |  |  | DFT-s-OFDM Pi/2 BPSK | Outer\_Full |
| 4 | Low |  |  |  | DFT-s-OFDM QPSK | Edger\_1RB\_Left |
| 5 | High |  |  | DFT-s-OFDM QPSK | Edge\_1RB\_Right |
| 6 | Default |  |  | DFT-s-OFDM QPSK | Outer\_Full |
| 7 | Low |  |  | DFT-s-OFDM 16 QAM | Edge\_1RB\_Left |
| 8 | High |  |  | DFT-s-OFDM 16 QAM | Edge\_1RB\_Right |
| 9 | Default |  |  | DFT-s-OFDM 16 QAM | Outer\_Full |
| 10 | Low |  |  | DFT-s-OFDM 64 QAM | Edge\_1RB\_Left |
| 11 | High |  |  | DFT-s-OFDM 64 QAM | Edge\_1RB\_Right |
| 12 | Default |  |  | DFT-s-OFDM 64 QAM | Outer\_Full |
| 13 | Low |  |  | DFT-s-OFDM 256 QAM | Edge\_1RB\_Left |
| 14 | High |  |  | DFT-s-OFDM 256 QAM | Edge\_1RB\_Right |
| 15 | Default |  |  | DFT-s-OFDM 256 QAM | Outer\_Full |
| 16 | Low |  |  | CP-OFDM QPSK | Edge\_1RB\_Left |
| 17 | High |  |  | CP-OFDM QPSK | Edge\_1RB\_Right |
| 18 | Default |  |  | CP-OFDM QPSK | Outer\_Full |
| 19 | Low |  |  | CP-OFDM 16 QAM | Edge\_1RB\_Left |
| 20 | High |  |  | CP-OFDM 16 QAM | Edge\_1RB\_Right |
| 21 | Default |  |  | CP-OFDM 16 QAM | Outer\_Full |
| 22 | Low |  |  | CP-OFDM 64 QAM | Edge\_1RB\_Left |
| 23 | High |  |  | CP-OFDM 64 QAM | Edge\_1RB\_Right |
| 24 | Default |  |  | CP-OFDM 64 QAM | Outer\_Full |
| 25 | Low |  |  | CP-OFDM 256 QAM | Edge\_1RB\_Left |
| 26 | High |  |  | CP-OFDM 256 QAM | Edge\_1RB\_Right |
| 27 | Default |  |  | CP-OFDM 256 QAM | Outer\_Full |
| 285,6 | Low |  |  |  | DFT-s-OFDM Pi/2 BPSK w Pi/2 BPSK DMRS | Edge\_1RB\_Left |
| 295,6 | High |  |  |  | DFT-s-OFDM Pi/2 BPSK w Pi/2 BPSK DMRS | Edge\_1RB\_Right |
| 305,6 | Default |  |  |  | DFT-s-OFDM Pi/2 BPSK w Pi/2 BPSK DMRS | Outer Full |
| NOTE 1: The specific configuration of each RF allocation is defined in Table 6.1-1.  NOTE 2: DFT-s-OFDM Pi/2 BPSK test applies only for UEs which supports Pi/2 BPSK in FR1.  NOTE 3: VOID  NOTE 4: UE operating in FDD mode, or in TDD mode in bands other than n40, n41, n77, n78 and n79, or in TDD mode the IE *powerBoostPi2BPSK* is set to 0 for bands n40, n41, n77, n78 and n79.  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 *powerBoostPi2BPSK* is set to 0 for bands n40, n77, n78 and n79.  NOTE 6: Applicable to UEs indicating support for UE capability *lowPAPR-DMRS-PUSCHwithPrecoding-r16*. | | | | | | |

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

|  |  |  |  |
| --- | --- | --- | --- |
| ΔfOOB  (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-BWChannel |  | -13+TT |
| ± BWChannel-(BWChannel+5) |  | -25+TT |

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

[to be updated]

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

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

- Annex F MU/TT is to be updated

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 (NRACLR) 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 NRACLR 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\*NRB+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 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, 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\*NRB+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)

[to be updated]

##### 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 (UTRAACLR) 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.

UTRAACLR is specified for the first adjacent UTRA channel (UTRAACLR1) which center frequency is ± 2.5 MHz from NR channel edge and for the 2nd adjacent UTRA channel (UTRAACLR2) 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 = 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 UTRAACLR1 and UTRAACLR2 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 |
| UTRAACLR1 | 33 dB |
| UTRAACLR2 | 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 FOOB (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 (NRB) 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 FOOB (MHz) |
| BWChannel | BWChannel + 5 |

Table 6.5.3.1.3-2: Requirement for general spurious emissions limits

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | Maximum Level | Measurement bandwidth | NOTE |
| 9 kHz ≤ f < 150 kHz | -36 dBm | 1 kHz |  |
| 150 kHz ≤ f < 30 MHz | -36 dBm | 10 kHz |  |
| 30 MHz ≤ f < 1,000 MHz | -36 dBm | 100 kHz |  |
| 1 GHz ≤ f < 5th 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 PUMAX 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 FOOB (MHz) in Table 6.5.3.1.3-1 from the edge of the channel bandwidth. The spurious emission limits in Table 6.5.3.1.5-1 apply for all transmitter band configurations (NRB) and channel bandwidths.

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

Table 6.5.3.1.5-1: General spurious emissions test requirements

|  |  |  |  |
| --- | --- | --- | --- |
| frequency Range | Maximum Level | Measurement bandwidth | NOTE |
| 9 kHz ≤ f < 150 kHz | -36 dBm | 1 kHz |  |
| 150 kHz ≤ f < 30 MHz | -36 dBm | 10 kHz |  |
| 30 MHz ≤ f < 1,000 MHz | -36 dBm | 100 kHz |  |
| 1 GHz ≤ f < 5th 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 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n77, n78, n79 | FDL\_low | - | FDL\_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 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 33, 35 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n77 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| NR Band n2, n25, n70 | FDL\_low | - | FDL\_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]. FDL\_low and FDL\_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 LCRB x RBsize 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) |
| 1 |  | CP-OFDM QPSK | Outer\_Full |
| 2 |  | CP-OFDM QPSK | Edge\_1RB\_Left |
| 3 |  | CP-OFDM QPSK | Edge\_1RB\_Right |
| NOTE 1: The specific configuration of each RB allocation is defined in Table 6.1-1 Common UL configuration. | | | |

1. Connect the SS to the UE antenna connectors as shown in TS 38.508-1 [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 PUMAX 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 FOOB (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 (NRB) and channel bandwidths.

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

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 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n77, n78, n79 | FDL\_low | - | FDL\_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 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 33, 35, 54 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| NR Band n77 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| NR Band n2, n25, n70 | FDL\_low | - | FDL\_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]. FDL\_low and FDL\_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 LCRB x RBsize 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

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

- Test configuration is to be updated and test configuration in [Table 6.2.3.4.1-3] is TBD

- Relative power TC Table 6.3.4.3.3-1 is to be updated

##### 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 FOOB (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 band  (MHz) | Channel bandwidth / Spectrum emission limit1 (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. | | | |

##### 6.5.3.3.4 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 6.2.3.4.1-3] 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)

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 6.5.3.1.4.3.

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 PUMAX 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 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 -MU to -(MU + 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 [Table 6.3.4.3.3-1] 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.

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: A*dditional 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) |  |  |

##### 6.5.3.3.5 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 FOOB (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 band  (MHz) | Channel bandwidth / Spectrum emission limit1 (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. | | | |

### 6.5.4 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 | BWChannel | |
| Interference signal  frequency offset from channel center | BWChannel | 2\*BWChannel |
| 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 | BWChannel and 2\*BWChannel | 2\*BWChannel and 4\*BWChannel |

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 PUMAX 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 |

#### 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 | BWChannel | |
| Interference signal  frequency offset from channel center | BWChannel | 2\*BWChannel |
| 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 | BWChannel and 2\*BWChannel | 2\*BWChannel and 4\*BWChannel |
| 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.

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

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

#### 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 | -93.8 |
| 30 |  | -96.6 | -94.6 | -94.0 |
| 60 |  | -97.0 | -94.9 | -94.2 |
| n255 | 15 | -100.0 | -96.8 | -95.0 | -93.8 |
| 30 |  | -97.1 | -95.1 | -94.0 |
| 60 |  | -97.5 | -95.4 | -94.2 |
| NOTE：The transmitter shall be set to PUMAX 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.

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 |
|  | 15 | 25 | 50 | 75 | 100 |  |
| n256 | 30 |  | 24 | 36 | 50 | FDD |
|  | 60 |  | 10 | 18 | 24 |  |
|  | 15 | 25 | 50 | 75 | [75] |  |
| n255 | 30 |  | 24 | 36 | [36] | FDD |
|  | 60 |  | 10 | 18 | [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. | | | | | | |

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] subclause4.3.1 | | | 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) | LCRBmax | Outer RB allocation / Normal RB allocation |
| 5MHz | 15 | 25 | 25@0 |
| 30 | 11 | 11@0 |
| 60 | N/A | N/A |
| 10MHz | 15 | 52 | 52@0 |
| 30 | 24 | 24@0 |
| 60 | 11 | 11@0 |
| 15MHz | 15 | 79 | 79@0 |
| 30 | 38 | 38@0 |
| 60 | 18 | 18@0 |
| 20MHz | 15 | 106 | 106@0 |
| 30 | 51 | 51@0 |
| 60 | 24 | 24@0 |
| 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, LCRB @ RBstart 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] |

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 ≥ 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.



Table 7.3.2.5-1: Two antenna port Reference sensitivity QPSK PREFSENS for FDD bands for PC3

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Operating band / SCS / Channel bandwidth / Duplex-mode | | | | | | |
| Operating Band | SCS kHz | 5  MHz (dBm) | 10  MHz (dBm) | 15  MHz (dBm) | 20  MHz (dBm) | Duplex Mode |
| n256 | 15 | -99.5 +TT | -96.3 +TT | -94.5 +TT | -93.8 +TT | FDD |
| 30 |  | -96.6 +TT | -94.6 +TT | -94.0 +TT |
| 60 |  | -97.0 +TT | -94.9 +TT | -94.2 +TT |
| n255 | 15 | -100.0 +TT | -96.8 +TT | -95.0 +TT | -93.8 +TT | FDD |
| 30 |  | -97.1 +TT | -95.1 +TT | -94.0 +TT |
| 60 |  | -97.5 +TT | -95.4 +TT | -94.2 +TT |
| 30 |  | -96.63 +TT | -94.63 +TT | -93.53 +TT |
| 60 |  | -97.03 +TT | -94.93 +TT | -93.73 +TT |
| NOTE 1: Void.  NOTE 2: The transmitter shall be set to PUMAX as defined in subclause 6.2.4  NOTE 3: 3 indicates that the requirement is modified by -0.5 dB when the assigned NR channel bandwidth is confined within 1475.9-1510.9 MHz.  NOTE 4: Void  NOTE 5: Void  NOTE 6: TT for each frequency and 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 |

## 7.4 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 ≥ 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 Configuration3 | dBm | -402 |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum uplink configuration specified in Table 7.3.2.3-2 with PCMAX\_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 -MU to -(MU + 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 ≥ 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 Configuration3 | dBm | -402 -TT |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum uplink configuration specified in Table 7.3.2.3-2 with PCMAX\_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 ≤ 3.0GHz |
| 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 FDL\_high < 2700 MHz and FUL\_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 FDL\_high < 2,700 MHz and FUL\_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 FDL\_high < 2,700 MHz and FUL\_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 | | |
| Pinterferer4 | dBm | REFSENS + 45.5 dB | REFSENS + 42.5 dB | REFSENS + 39.5 |
| BWinterferer | MHz | 5 | | |
| Finterferer (offset)2 | MHz | BWChannel /2 + 2.5  /  -(BWChannel /2 + 2.5) | | |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in clause 7.3.2 with PCMAX\_L,f,c defined in clause 6.2.4.  NOTE 2: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. 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: Pinterferer shall be rounded to the next higher 0.5dB value. | | | | |

Table 7.5.3-3: Test parameters for NR bands with   
FDL\_high < 2,700 MHz and FUL\_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 |
| Pinterferer | dBm | -40 | | |
| BWinterferer | MHz | 5 | | |
| Finterferer (offset) | MHz | BWChannel /2 + 2.5  /  -(BWChannel /2 + 2.5) | | |
| NOTE 1: The transmitter shall be set to 24 dB below PCMAX\_L,f,c at the minimum UL configuration specified in clause 7.3.2 with PCMAX\_L,f,c defined in clause 6.2.4.  NOTE 2: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. 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: Pinterferer 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 -MU to -(MU + 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 -MU to -(MU + 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 FDL\_high < 2,700 MHz and FUL\_high < 2,700 MHz, the throughput measurement derived in test procedure 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 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 FDL\_high < 2,700 MHz and FUL\_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 FDL\_high < 2,700 MHz and FUL\_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 | | |
| Pinterferer4 | dBm | REFSENS + 45.5 dB | REFSENS + 42.5 dB | REFSENS + 39.5 |
| BWinterferer | MHz | 5 | | |
| Finterferer (offset)2 | MHz | BWChannel /2 + 2.5  /  -(BWChannel /2 + 2.5) | | |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in clause 7.3.2 with PCMAX\_L,f,c defined in clause 6.2.4.  NOTE 2: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. 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: Pinterferer shall be rounded to the next higher 0.5dB value. | | | | |

Table 7.5.5-3: Test parameters for NR bands with   
FDL\_high < 2,700 MHz and FUL\_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 |
| Pinterferer | dBm | -40 | | |
| BWinterferer | MHz | 5 | | |
| Finterferer (offset) | MHz | BWChannel /2 + 2.5  /  -(BWChannel /2 + 2.5) | | |
| NOTE 1: The transmitter shall be set to 24 dB below PCMAX\_L,f,c at the minimum UL configuration specified in clause 7.3.2 with PCMAX\_L,f,c defined in clause 6.2.4.  NOTE 2: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. 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: Pinterferer 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

[to be updated]

### 7.6.3 Out of Band Blocking

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

#### 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 FDL\_high < 2,700 MHz and FUL\_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 FDL\_high < 2,700 MHz and FUL\_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 ≥ 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   
FDL\_high < 2,700 MHz and FUL\_high < 2,700 MHz

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **RX parameter** | **Units** | **Channel bandwidth (MHz)** | | |
|  |  | **5, 10** | **15** | **20** |
| Power in transmission bandwidth configuration2 | dBm | REFSENS + 6 dB | REFSENS + 7 dB | REFSENS + 9 dB |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in clause 7.3.2 with PCMAX\_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   
FDL\_high < 2,700 MHz and FUL\_high < 2,700 MHz

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Operating Band | Parameter | Unit | Range 1 | Range 2 | Range 3 |
|  | Pinterferer | dBm | -44 | -30 | -15 |
| n255 | Finterferer (CW) | MHz | -60 < f – FDL\_low < -15  or  15 < f – FDL\_high < 60 | -85 < f – FDL\_low ≤ -60  or  60 ≤ f – FDL\_high < 85 | 1 ≤ f ≤ FDL\_low – 85  or  FDL\_high + 85 ≤ f  ≤ 12750 |
| n2561 | Finterferer (CW) | MHz | -100 < f – FDL\_low < -15  or  15 < f – FDL\_high < 60 | -145 < f – FDL\_low ≤ -100  or  60 ≤ f – FDL\_high < 85 | 1 ≤ f ≤ FDL\_low – 145  or  FDL\_high + 85 ≤ f  ≤ 12750 |
| NOTE 1: Band n256 lower frequency ranges are modified to enable specific implementations  NOTE 2: void  NOTE 3: void  NOTE 4: void | | | | | |

For interferer frequencies across ranges 1, 2 and 3 in Table 7.6.3-1, a maximum of



exceptions are allowed for spurious response frequencies in each assigned frequency channel when measured using a step size of MHz withthe number of resource blocks in the downlink transmission bandwidth configuration, BWChannelthe 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 reference measurement channels (RMCs) are specified in TS 38.521-1 [2] clause A.2. 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

[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 TS 38.521-1 [2] Annex C.0, C.1, C.2, and uplink signals according to TS 38.521-1 [2] Annex G.0, G.1, G.2, G.3.0.

4. The UL Reference Measurement Channel is set according to Table 6.2.2.4.1-1.

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

6. 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 Zero Doppler conditions in service link and Common TA delay according to SIB19 configuration in TS 38.508-1 [12].

8. 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 7.6.3.4.3.

##### 7.6.3.4.2 Test procedure

[to be updated]

##### 7.6.3.4.3 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]

#### 7.6.3.5 Test requirement

[to be updated]

### 7.6.4 Narrow band blocking

[to be updated]

## 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 ≥ 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 FDL\_high < 2700 MHz and FUL\_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 FDL\_high < 2,700 MHz and FUL\_high < 2,700 MHz

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **RX parameter** | **Units** | **Channel bandwidth (MHz)** | | |
|  |  | **5, 10** | **15** | **20** |
| Power in transmission bandwidth configuration2 | dBm | REFSENS + 6 dB | REFSENS +  7 dB | REFSENS + 9 dB |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in Table 7.3.2.3-3 with PCMAX\_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 |
| PInterferer (CW) | dBm | -44 |
| FInterferer | 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 + 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 ≥ 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 FDL\_high < 2,700 MHz and FUL\_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 FDL\_high < 2,700 MHz and FUL\_high < 2,700 MHz

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **RX parameter** | **Units** | **Channel bandwidth (MHz)** | | |
|  |  | **5, 10** | **15** | **20** |
| Power in transmission bandwidth configuration2 | dBm | REFSENS + 6 dB | REFSENS +  7 dB | REFSENS + 9 dB |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in Table 7.3.2.3-3 with PCMAX\_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 |
| PInterferer (CW) | dBm | -44 |
| FInterferer | 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 ≥ 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 FDL\_high < 2,700 MHz and FUL\_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 FDL\_high < 2,700 MHz and FUL\_high < 2,700 MHz

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Rx parameter | Units | Channel bandwidth (MHz) | | |
|  |  | 5, 10 | 15 | 20 |
| Pw in Transmission Bandwidth Configuration, per CC5 | dBm | REFSENS + 6 dB | REFSENS + 7 dB | REFSENS + (9 + 10log10(BWChannel /20)) dB |
| PInterferer 1 (CW) | dBm | -46 | | |
| PInterferer 2 (Modulated) | dBm | -46 | | |
| BWInterferer 2 | MHz | 5 | | |
| FInterferer 1 (Offset) | MHz | -BWchannel/2 – 7.5  /  +BWchannel/2 + 7.5 | | |
| FInterferer 2 (Offset) | MHz | 2\*FInterferer 1 | | |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in Table 7.3.2.3-3 with PCMAX\_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] Annexe 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 Finterferer 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 Finterferer 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: 10log10(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 -MU to -(MU + 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 ≥ 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 FDL\_high < 2,700 MHz and FUL\_high < 2,700 MHz

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Rx parameter | Units | Channel bandwidth (MHz) | | |
|  |  | 5, 10 | 15 | 20 |
| Pw in Transmission Bandwidth Configuration, per CC5 | dBm | REFSENS + 6 dB | REFSENS + 7 dB | REFSENS + (9 + 10log10(BWChannel /20)) dB |
| PInterferer 1 (CW) | dBm | -46 | | |
| PInterferer 2 (Modulated) | dBm | -46 | | |
| BWInterferer 2 | MHz | 5 | | |
| FInterferer 1 (Offset) | MHz | -BWchannel/2 – 7.5  /  +BWchannel/2 + 7.5 | | |
| FInterferer 2 (Offset) | MHz | 2\*FInterferer 1 | | |
| NOTE 1: The transmitter shall be set to 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in Table 7.3.2.3-3 with PCMAX\_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 Finterferer 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 Finterferer 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: 10log10(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 MHz ≤ f < 1 GHz | 100 kHz | -57 dBm |  |
| 1 GHz ≤ f ≤ 12.75 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 MHz ≤ f < 1 GHz | 100 kHz | -57 dBm |  |
| 1 GHz ≤ f ≤ 12.75 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 Es is transmitted.

- External white noise source with power spectral density Noc is used.

- *Es* and *Noc* 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, Es and Noc 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:

Where

- NRX 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:

NocBand\_X, SCS\_Y, CBW\_Z = REFSENSBand\_X, SCS\_Y, CBW\_Z – 10\*log10(12\*SCS\_Y\*nPRB) + D – SNRREFSENS + ∆thermal

where

- REFSENSBand\_X, SCS\_Y, 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

- nPRB 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

- SNRREFSENS = -1 dB is the SNR used for simulation of REFSENS

- ∆thermal is the amount of dB that the wanted noise is set above UE thermal noise, giving a defined rise in total noise. ∆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 *ntn-ScenarioSupport-r17* 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 i1, i2 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 | |  | k0=0 for CSI-RS resource 1,2,3,4 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 6 for CSI-RS resource 1 and 3  l0 = 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 = ceil(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 | |  | k0 = 0 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 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 = ceil(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 | |  | k0 = 4 |
| First OFDM symbol in the PRB used for CSI-RS | |  | l0 = 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 = ceil(BWP size/4)\*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 i1, i2 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

[to be updated]

##### 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

Editor's Note: This test cases is incomplete in following aspects:

* Annex G Minimum test time

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

This test applies to all types of NTN UE release 17 and forward supporting satellite access.

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 5.6.2.1-1 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 duringthe 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 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.

SIB19 contents as TS 38.508-1 [12] clause 5.6.2.1.

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) |  |  |
| } |  |  |  |

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 |

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.

## 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 (LCRB) | 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 LCRB ≤ NRB. | | | | | | | | | | |

### 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 (LCRB) | 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 LCRB ≤ NRB. | | | | | | | | | | |

### 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 (LCRB) | 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 LCRB ≤ NRB. | | | | | | | | | | |

### 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 (LCRB) | 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 LCRB ≤ NRB. | | | | | | | | | | |

### A.2.2.5 DFT-s-OFDM 256QAM

Table A.2.2.5-1: Reference Channels for DFT-s-OFDM 256QAM

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Allocated resource blocks (LCRB) | 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 | 256QAM | 20 | 704 | 16 | 2 | 1 | 1056 | 132 |
|  | 5 | 11 | 256QAM | 20 | 3496 | 16 | 2 | 1 | 5280 | 660 |
|  | 9 | 11 | 256QAM | 20 | 6272 | 24 | 1 | 1 | 9504 | 1188 |
|  | 10 | 11 | 256QAM | 20 | 7040 | 24 | 1 | 1 | 10560 | 1320 |
|  | 12 | 11 | 256QAM | 20 | 8456 | 24 | 1 | 2 | 12672 | 1584 |
|  | 15 | 11 | 256QAM | 20 | 10504 | 24 | 1 | 2 | 15840 | 1980 |
|  | 18 | 11 | 256QAM | 20 | 12552 | 24 | 1 | 2 | 19008 | 2376 |
|  | 24 | 11 | 256QAM | 20 | 16896 | 24 | 1 | 3 | 25344 | 3168 |
|  | 25 | 11 | 256QAM | 20 | 17424 | 24 | 1 | 3 | 26400 | 3300 |
|  | 30 | 11 | 256QAM | 20 | 21000 | 24 | 1 | 3 | 31680 | 3960 |
|  | 32 | 11 | 256QAM | 20 | 22536 | 24 | 1 | 3 | 33792 | 4224 |
|  | 36 | 11 | 256QAM | 20 | 25104 | 24 | 1 | 3 | 38016 | 4752 |
|  | 45 | 11 | 256QAM | 20 | 31752 | 24 | 1 | 4 | 47520 | 5940 |
|  | 50 | 11 | 256QAM | 20 | 34816 | 24 | 1 | 5 | 52800 | 6600 |
|  | 60 | 11 | 256QAM | 20 | 42016 | 24 | 1 | 5 | 63360 | 7920 |
|  | 64 | 11 | 256QAM | 20 | 45096 | 24 | 1 | 6 | 67584 | 8448 |
|  | 75 | 11 | 256QAM | 20 | 53288 | 24 | 1 | 7 | 79200 | 9900 |
|  | 80 | 11 | 256QAM | 20 | 56368 | 24 | 1 | 7 | 84480 | 10560 |
|  | 81 | 11 | 256QAM | 20 | 57376 | 24 | 1 | 7 | 85536 | 10692 |
|  | 90 | 11 | 256QAM | 20 | 63528 | 24 | 1 | 8 | 95040 | 11880 |
|  | 100 | 11 | 256QAM | 20 | 69672 | 24 | 1 | 9 | 105600 | 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 5.1.3.1-2 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 LCRB ≤ NRB. | | | | | | | | | | |

### A.2.2.6 CP-OFDM QPSK

Table A.2.2.6-1: Reference Channels for CP-OFDM QPSK

| Parameter | Allocated resource blocks (LCRB) | 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 |
|  | 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 LCRB ≤ NRB. | | | | | | | | | | |

### A.2.2.7 CP-OFDM 16QAM

Table A.2.2.7-1: Reference Channels for CP-OFDM 16QAM

| Parameter | Allocated resource blocks (LCRB) | 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 |
|  | 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 LCRB ≤ NRB. | | | | | | | | | | |

### A.2.2.8 CP-OFDM 64QAM

Table A.2.2.8-1: Reference Channels for CP-OFDM 64QAM

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Allocated resource blocks (LCRB) | 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 LCRB ≤ NRB. | | | | | | | | | | |

### A.2.2.9 CP-OFDM 256QAM

Table A.2.2.9-1: Reference Channels for CP-OFDM 256QAM

| Parameter | Allocated resource blocks (LCRB) | 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 | 256QAM | 20 | 704 | 16 | 2 | 1 | 1056 | 132 |
|  | 5 | 11 | 256QAM | 20 | 3496 | 16 | 2 | 1 | 5280 | 660 |
|  | 9 | 11 | 256QAM | 20 | 6272 | 24 | 1 | 1 | 9504 | 1188 |
|  | 10 | 11 | 256QAM | 20 | 7040 | 24 | 1 | 1 | 10560 | 1320 |
|  | 11 | 11 | 256QAM | 20 | 7680 | 24 | 1 | 1 | 11616 | 1452 |
|  | 12 | 11 | 256QAM | 20 | 8456 | 24 | 1 | 2 | 12672 | 1584 |
|  | 13 | 11 | 256QAM | 20 | 9224 | 24 | 1 | 2 | 13728 | 1716 |
|  | 15 | 11 | 256QAM | 20 | 10504 | 24 | 1 | 2 | 15840 | 1980 |
|  | 18 | 11 | 256QAM | 20 | 12552 | 24 | 1 | 2 | 19008 | 2376 |
|  | 19 | 11 | 256QAM | 20 | 13320 | 24 | 1 | 2 | 20064 | 2508 |
|  | 24 | 11 | 256QAM | 20 | 16896 | 24 | 1 | 3 | 25344 | 3168 |
|  | 25 | 11 | 256QAM | 20 | 17424 | 24 | 1 | 3 | 26400 | 3300 |
|  | 26 | 11 | 256QAM | 20 | 18432 | 24 | 1 | 3 | 27456 | 3432 |
|  | 31 | 11 | 256QAM | 20 | 22032 | 24 | 1 | 3 | 32736 | 4092 |
|  | 33 | 11 | 256QAM | 20 | 23040 | 24 | 1 | 3 | 34848 | 4356 |
|  | 38 | 11 | 256QAM | 20 | 26632 | 24 | 1 | 4 | 40128 | 5016 |
|  | 39 | 11 | 256QAM | 20 | 27656 | 24 | 1 | 4 | 41184 | 5148 |
|  | 47 | 11 | 256QAM | 20 | 32776 | 24 | 1 | 4 | 49632 | 6204 |
|  | 51 | 11 | 256QAM | 20 | 35856 | 24 | 1 | 5 | 53856 | 6732 |
|  | 52 | 11 | 256QAM | 20 | 36896 | 24 | 1 | 5 | 54912 | 6864 |
|  | 53 | 11 | 256QAM | 20 | 36896 | 24 | 1 | 5 | 55968 | 6996 |
|  | 61 | 11 | 256QAM | 20 | 43032 | 24 | 1 | 6 | 64416 | 8052 |
|  | 65 | 11 | 256QAM | 20 | 46104 | 24 | 1 | 6 | 68640 | 8580 |
|  | 67 | 11 | 256QAM | 20 | 47112 | 24 | 1 | 6 | 70752 | 8844 |
|  | 78 | 11 | 256QAM | 20 | 55304 | 24 | 1 | 7 | 82368 | 10296 |
|  | 79 | 11 | 256QAM | 20 | 55304 | 24 | 1 | 7 | 83424 | 10428 |
|  | 80 | 11 | 256QAM | 20 | 56368 | 24 | 1 | 7 | 84480 | 10560 |
|  | 81 | 11 | 256QAM | 20 | 57376 | 24 | 1 | 7 | 85536 | 10692 |
|  | 93 | 11 | 256QAM | 20 | 65576 | 24 | 1 | 8 | 98208 | 12276 |
|  | 95 | 11 | 256QAM | 20 | 67584 | 24 | 1 | 8 | 100320 | 12540 |
|  | 106 | 11 | 256QAM | 20 | 73776 | 24 | 1 | 9 | 111936 | 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 5.1.3.1-2 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 LCRB ≤ NRB. | | | | | | | | | | |

# 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 [12].

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,…, 19 | Bits | 4,096 |  |  |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A |  |  |  |  |
| For Slots i = 1,…, 19 | Bits | 24 |  |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |
| For Slot i = 0 | CBs | N/A |  |  |  |  |
| For Slots i = 1,…, 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,…, 9, 12, …, 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,…, 19 | Bits | 13,064 |  |  |  |  |  |
| Transport block CRC per Slot |  |  |  |  |  |  |  |
| For Slot i = 0 | Bits | N/A |  |  |  |  |  |
| For Slots i = 1,…, 19 | Bits | 24 |  |  |  |  |  |
| Number of Code Blocks per Slot |  |  |  |  |  |  |  |
| For Slot i = 0 | CBs | N/A |  |  |  |  |  |
| For Slots i = 1,…, 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,…, 9, 12, …, 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.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

.

## B.1.2 UE Receiver with 2Rx

For 1 port transmission the channel matrix is defined in the frequency domain by

.

For 2 port transmission the channel matrix is defined in the frequency domain by

.

# 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 [x] 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 |

## 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 |  |  |

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 |  |  |

Table B.2.3.1.1-3 defines the channel spatial correlation matrix. The parameters, *α* and *β* in Table B.2.3.1-3 defines the spatial correlation between the antennas at the gNB and UE.

Table B.2.3.1.1-3: correlation matrices

|  |  |
| --- | --- |
| 1x2 case |  |
| 2x1 case |  |
| 2x2 case |  |

#### 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 |  |
| 2x1 case |  |
| 2x2 case |  |
| NOTE: **I**d is the *d*×*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\*log10(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 [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:  is the CDM group size of NZP CSI-RS specified for each test.  Note 4: It is only applicable to LTE-NR coexistence tests. | | |

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 FDL\_high < 2,700 MHz and FUL\_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 FDL\_high < 2,700 MHz and FUL\_high < 2,700 MHz

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Channel bandwidth** | | | |
|  | 5 MHz | 10MHz | 15 MHz | 20 MHz |
| RB | NOTE 1 | | | |
| BWInterferer | 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 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 |
| 6.3.1 Minimum output power | Same as clause 6.3.1 in TS 38.521-1 [2] for FDD band with f ≤ 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 ≤ 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 ≤ 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 ≤ 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 ≤ 3 GHz. |  |
| 7.5 Adjacent channel selectivity7.5 Adjacent channel selectivity | Same as clause 7.5 in TS 38.521-1 [2] for FDD band with "f ≤ 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 ≤ 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 ≤ 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 ≤ 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 ≤ 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 ≤ 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.1does not increase the chance of passing a device under test where that device would otherwise have failed the test if a Test System compliant with clause F.1 had been used.

# F.3 Test Tolerance and Derivation of Test Requirements (informative)

## 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 |
| 6.3.1 Minimum output power | Same as clause 6.3.1 in TS 38.521-1 [2] for FDD band with f ≤ 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 ≤ 3 GHz. | Minimum requirement + 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 ≤ 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 ≤ 3 GHz. | Modulated carrier frequency:  Upper limit + TT, Lower limit – TT  DL power:  REFSENS + 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 ≤ 3GHz. | 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 ≤ 3 GHz and BW ≤ 40 MHz and taking an example where the target value is 0dBm (lower end of a UE Core requirement side condition range of 0 dBm ≤ Output power ≤ 10 dBm):

A diagram of a power system

Description automatically generated

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 **.**

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 ΔP ≤ 1 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 ≤ 3 GHz and BW ≤ 40 MHz and taking an example where the target value is 4 dB below PCMAX\_L (UE Core requirement side condition):

A diagram of a power line

Description automatically generated

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 ****.

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 ΔP ≤ 1 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 ≤ 3 GHz and BW ≤ 40 MHz and taking an example where the target value is +10 dBm:

A diagram of a power system

Description automatically generated

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 **.**

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 ΔP ≤ 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 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 (NACK + statDTX)/(NACK+ statDTX + ACK)is the Error Ratio (ER). Taking into account the time consumed by the ACK, NACK, and DTX-TTIs (regular and statistical), ER can be mapped unambiguously to throughput for any single reference measurement channel test.

## H.2.3 Design of the test

The test is defined by the following design principles (see clause H.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 | nsp | nsf | ne | nsp | nsf | ne | nsp | nsf | ne | nsp | nsf |
| 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 (nsp, ns=Number of Samples= number of NACK + statDTX + ACK).

NOTE 3: The third column is the number of samples for the fail limit (nsf).

NOTE 4: The UE could be decided as early pass/fail when at least 67 samples are received. The nsf 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 95+ otherwise continue

Having observed 2 errors, pass the test at 119+ samples, otherwise continue

etc.

Having observed 14645 errors, pass the test at 23642349+ samples, fail the test at 2345- samples, otherwise continue

Having observed 152 errors, pass the test at + 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 (ε→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.



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.

- df is the wrong decision probability of a single (ne, ns) co-ordinate for the fail limit.  
It is found by simulation to be df = 0.006.

- clp is the confidence level of a single (ne, ns) co-ordinate for the pass limit.  
It is found by simulation to be clp = 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.

- clp and df 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\*0.05 is decided against the same pass and fail limits.

- clp and df 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 | Rev | 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 |
| 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 comformance 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 |