**3GPP TSG-RAN WG4 Meeting # 109 R4-2321919**

**Chicago, US, November 13 – 17, 2023**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.101-1** | **CR** | **1869** | **rev** | **-** | **Current version:** | **18.3.0** |  |
|  |
| *For* ***[HE](http://www.3gpp.org/3G_Specs/CRs.htm%22%20%5Cl%20%22_blank)******[LP](http://www.3gpp.org/3G_Specs/CRs.htm%22%20%5Cl%20%22_blank)*** *on using this form: comprehensive instructions can be found at <http://www.3gpp.org/Change-Requests>.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

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|  |
| ***Title:***  | Big CR for TS 38.101-1 for NR ATG |
|  |  |
| ***Source to WG:*** | CMCC |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_ATG-Core |  | ***Date:*** | 2023-11-20 |
|  |  |  |  |  |
| ***Category:*** | B |  | ***Release:*** | Rel-18 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | To introduce requirements in clause 2, 3, 4.3, 5.2J, 6.1J, 6.2J, 6.3J, 6.4J,6.5J, 7.1J, 7.2J, 7.3J, 7.4J, 7.5J, 7.6J, 7.7J, 7.8J and 7.9J |
|  |  |
| ***Summary of change:*** | To introduce requirements in clause 2, 3, 4.3, 5.2J, 6.1J, 6.2J, 6.3J, 6.4J,6.5J, 7.1J, 7.2J, 7.3J, 7.4J, 7.5J, 7.6J, 7.7J, 7.8J and 7.9JThis big CR captures following endorsed draft CRs:R4-2321913, R4-2321914, R4-2321915, R4-2321917, R4-2321918, [R4-2318917](file:///D%3A%5C%5CRAN4%23109%5C%5CDocs%5C%5CR4-2318917.zip) and R4-2317792 |
|  |  |
| ***Consequences if not approved:*** | There are no framework for ATG UE RF requirements in current spec. |
|  |  |
| ***Clauses affected:*** | 2, 3, 4.3, 5.2J, 6.1J, 6.2J, 6.3J, 6.4J,6.5J, 7.1J, 7.2J, 7.3J, 7.4J, 7.5J, 7.6J, 7.7J, 7.8J and 7.9J |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS 38.521-1 |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

## **<<Start of Change>>**

# 2 References

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

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

For a specific reference, subsequent revisions do not apply.

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

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

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

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

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

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

[6] 3GPP TS 38.211: "NR; Physical channels and modulation".

[7] 3GPP TS 38.331: "Radio Resource Control (RRC) protocol specification".

[8] 3GPP TS 38.213: "NR; Physical layer procedures for control".

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

[10] 3GPP TS 38.214: "NR; Physical layer procedures for data".

[11] 3GPP TS 36.101: Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception;

[12] ETSI TS 102 792: "Intelligent Transport Systems (ITS); Mitigation techniques to avoid interference between European CEN Dedicated Short Range Communication (CEN DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range".

[13] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".

[14] 3GPP TS 37.213: “Physical layer procedures for shared spectrum channel access”.

[15] 3GPP TS 38.306: “NR; User Equipment (UE) radio access capabilities”.

[16] 3GPP TS 38.104: “NR; Base Station (BS) radio transmission and reception”.

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

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

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

**ATG UE**: The terminals or user equipments which are mounted in aircraft and support ATG feature as defined in clause x.x.x. from TS38.306.

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

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

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

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

**Con-current operation**: The simultaneous transmission and reception of sidelink and Uu interfaces while operation is agnostic of the service used on each interface.

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

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

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

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

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

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

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

**RedCap UE**: The UE with reduced capabilities as defined in clause 4.2.21.1 from TS38.306 [15].

**Sub-band**: For a UE that supports shared spectrum channel access in wideband operation, a sub-band is the set of RBs within an approximately 20 MHz segment of the channel where the wideband channel is uniformly divided into an integer number of 20 MHz sub-bands. Sub-bands may be separately allocated in uplink and downlink.

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

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

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

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

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

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

**Wideband operation:** For a UE that supports shared spectrum channel access, wideband operation refers to operation within a channel larger than 20 MHz in which intra-cell guard bands may be configured to distinguish individual RB-sets

## 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

ΔfOOB Δ Frequency of Out Of Band emission

ΔFTX-RX Maximum deviation to the Tx-Rx carrier center frequency separation for asymmetric uplink/downlink channel bandwidth operation

∆MPRc Allowed Maximum Power Reduction relaxation for serving cell *c*

ΔPPowerClass Adjustment to maximum output power for a given power class

RB The starting frequency offset between the allocated RB and the measured non-allocated RB

ΔRIB,c Allowed reference sensitivity relaxation due to support for inter-band CA operation, for serving cell *c*

ΔRIBC Allowed reference sensitivity relaxation due to support for intra-band contiguous CA operation

ΔRIBNC Allowed reference sensitivity relaxation due to support for intra-band non-contiguous CA operation

ΔRIB,4R Reference sensitivity adjustment due to support for 4 antenna ports

ΔR1RReference sensitivity adjustment due to support for 1 antenna ports

ΔShift Channel raster offset

TC Allowed operating band edge transmission power relaxation

TC,*c*Allowed operating band edge transmission power relaxation for serving cell *c*

ΔTIB,c Allowed maximum configured output power relaxation due to support for inter-band CA operation, inter-band NR-DC operation and due to support for SUL operations, for serving cell *c*

BWChannel Channel bandwidth

BWChannel,block Sub-block bandwidth, expressed in MHz. BWChannel,block= Fedge,block,high- Fedge,block,low

BWChannel\_CA Aggregated channel bandwidth, expressed in MHz

BWChannel,max Maximum channel bandwidth supported among all bands in a release

BWGB max( BWGB,Channel(*k*) )

BWGB,Channel(k) Minimum guard band defined in clause 5.3A.1 of carrier *k*

BWDL Channel bandwidth for DL

BWUL Channel bandwidth for UL

BWinterferer Bandwidth of the interferer

Ceil(x) Rounding upwards; ceil(x) is the smallest integer such that ceil(x) ≥ x

Floor(x) Rounding downwards; floor(x) is the greatest integer such that floor(x) ≤ x

FC *RF reference frequency* on the channel raster, given in table 5.4.2.2-1

FC,block, high Fc of the highest transmitted/received carrier in a *sub-block*

FC,block, low Fc of the lowest transmitted/received carrier in a *sub-block*

FC,low The Fc of the lowest carrier, expressed in MHz

FC,high The Fc of the highest carrier, expressed in MHz

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*

Fedge,block,low The lower *sub-block* edge, where Fedge,block,low = FC,block,low - Foffset, low.

Fedge,block,high The upper *sub-block* edge, where Fedge,block,high = FC,block,high + Foffset, high.

Fedge , low The *lower edge* of *aggregated channel bandwidth*, expressed in MHz. Fedge,low = FC,low - Foffset,low.

Fedge, high The *higher edge* of *aggregated channel bandwidth*, expressed in MHz. Fedge,high = FC,high + Foffset,high.

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

FInterferer Frequency of the interferer

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

Foffset Frequency offset from FC\_high to the *higher edge* or FC\_low to the *lower edge.*

Foffset,high Frequency offset from FC,high to the upper *UE RF Bandwidth edge*, or from FC,block, high to the upper sub-block edge

Foffset,low Frequency offset from FC,low to the lower *UE RF Bandwidth edge*, or from FC,block, low to the lower sub-block edge

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

FREF, shift RF reference frequency for Supplementary Uplink (SUL) bands, the uplink of all FDD bands, and TDD bands

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

GBChannel Minimum guard band defined in clause 5.3.3, expressed in kHz

LCRB Transmission bandwidth which represents the length of a contiguous resource block allocation expressed in units of resources blocks

Max() The largest of given numbers

Min() The smallest of given numbers

 Physical resource block number

NRACLR NR ACLR

NRB Transmission bandwidth configuration, expressed in units of resource blocks

NRB\_agg The number of the aggregated RBs within the fully allocated aggregated channel bandwidth

$N\_{RB\_{\\_agg}}=\sum\_{1}^{j}N\_{RB\_{j}}∗2^{μ\_{j}}$ for carrier 1 to j, where *μ* is defined in TS 38.211 [6]

NRB,c The transmission bandwidth configuration of component carrier c, expressed in units of resource blocks

$N\_{RB,cj}=N\_{RB\_{j}}∗2^{μ\_{j}}$ for carrier j, where *μ* is defined in TS 38.211 [6]

NRB,largest BW The largest transmission bandwidth configuration of the component carriers in the bandwidth combination, expressed in units of resource blocks

NRB,low The transmission bandwidth configurations according to Table 5.3.2-1 for the lowest assigned component carrier in clause 5.3A.1

NRB,high The transmission bandwidth configurations according to Table 5.3.2-1 for the highest assigned component carrier in clause 5.3A.1

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

NREF-Offs Offset used for calculating NREF

PCMAX The configured maximum UE output power

PCMAX, *c* The configured maximum UE output power for serving cell *c*

PCMAX, *f*, *c* The configured maximum UE output power for carrier *f* of serving cell *c* in each slot

PEMAX Maximum allowed UE output power signalled by higher layers

PEMAX, *c* Maximum allowed UE output power signalled by higher layers for serving cell *c*

PInterferer Modulated mean power of the interferer

Plargest BW Power of the largest transmission bandwidth configuration of the component carriers in the bandwidth combination

PMaxOutputPower The rated maximum ATG UE output power at maximum modulation order and full PRB configurations which is indicated by ATG UE capability [*RatedMOPATG*]

PPowerClass The nominal UE power (i.e., no tolerance)

P-MPR*c* Power Management Maximum Power Reduction for serving cell *c*

PRB The transmitted power per allocated RB, measured in dBm

PUMAX The measured configured maximum UE output power

Puw Power of an unwanted DL signal

Pw Power of a wanted DL signal

RBstart The lowest RB index of transmitted resource blocks

RBstart\_CA The lowest RB index of transmitted resource blocks for intra-band contiguous CA

SCSc SCS for the component carrier c, expressed in kHz

SCSlargest BW SCS for the largest transmission bandwidth configuration of the component carriers in the bandwidth combination, expressed in kHz

SCSlow SCS for the lowest assigned component carrier in clause 5.3A.1, expressed in kHz

SCShigh SCS for the highest assigned component carrier in clause 5.3A.1, expressed in kHz

*tp* Transient Period value signalled by the UE

*tpstart* Start position of transient period relative to the symbol boundary

T(PCMAX, *f*, *c*) Tolerance for applicable values of PCMAX, *f*, *c* for configured maximum UE output power for carrier *f* of serving cell *c*

TL,c Absolute value of the lower tolerance for the applicable *operating band* as specified in clause 6.2.1

SSREF SS block reference frequency position

UTRAACLR UTRA ACLR

## 3.3 Abbreviations

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

ACLR Adjacent Channel Leakage Ratio

ACS Adjacent Channel Selectivity

A-MPR Additional Maximum Power Reduction

ATG Air-To-Ground

BS Base Station

BW Bandwidth

BWP Bandwidth Part

CA Carrier Aggregation

CA\_nX-nY Inter-band CA of component carrier(s) in one sub-block within Band nX and component carrier(s) in one sub-block within Band nY where nX and nY are the applicable NR *operating bands*

CC Component Carriers

CG Carrier Group

CP-OFDM Cyclic Prefix-OFDM

CW Continuous Wave

DC Dual Connectivity

DFT-s-OFDM Discrete Fourier Transform-spread-OFDM

DM-RS Demodulation Reference Signal

DTX Discontinuous Transmission

E-UTRA Evolved UTRA

EIRP Equivalent Isotropically Radiated Power

EVM Error Vector Magnitude

FR Frequency Range

FRC Fixed Reference Channel

FWA Fixed Wireless Access

GSCN Global Synchronization Channel Number

IBB In-band Blocking

IDFT Inverse Discrete Fourier Transformation

ITS Intelligent Transportation System

ITU‑R Radiocommunication Sector of the International Telecommunication Union

MBW Measurement bandwidth defined for the protected band

MCG Master Cell Group

MOP Maximum Output Power

MPR Allowed maximum power reduction

MSD Maximum Sensitivity Degradation

NR New Radio

NR-ARFCN NR Absolute Radio Frequency Channel Number

NS Network Signalling

OCNG OFDMA Channel Noise Generator

OOB Out-of-band

P-MPR Power Management Maximum Power Reduction

PRB Physical Resource Block

PS Public Safety

PSCCH Physical Sidelink Control CHannel

PSSCH Physical Sidelink Shared CHannel

QAM Quadrature Amplitude Modulation

RE Resource Element

REFSENS Reference Sensitivity

RedCap Reduced Capability

RF Radio Frequency

RMS Root Mean Square (value)

RSRP Reference Signal Receiving PowerRx Receiver

Rx Receiver

SC Single Carrier

SCG Secondary Cell Group

SCS Subcarrier spacing

SDL Supplementary Downlink

SEM Spectrum Emission Mask

SL Sidelink

SL-MIMO Sidelink-Multiple Antenna transmission

SNR Signal-to-Noise Ratio

SRS Sounding Reference Symbol

SS Synchronization Symbol

SUL Supplementary uplink

TAE Time Alignment Error

TAB Transceiver Array Boundary

TAG Timing Advance Group

Tx Transmitter

TxD Tx Diversity

UL MIMO Uplink Multiple Antenna transmission

ULFPTx Uplink Full Power Transmission

V2X Vehicle to Everything

## **<<Next of Change>>**

## 4.3 Specification suffix information

Unless stated otherwise, the suffixes shown in Table 4.3-1 are used for indicating at 2nd level clause. For shared spectrum channel access, suffices A, B, and D are used for indicating at 3rd level clause.

Table 4.3-1: Definition of suffixes

|  |  |
| --- | --- |
| Clause suffix | Variant |
| None | Single Carrier |
| A | Carrier Aggregation (CA) |
| B | Dual-Connectivity (DC) |
| C | Supplement Uplink (SUL) |
| D | UL MIMO |
| E | V2X |
| F | Shared spectrum channel access |
| G | Tx Diversity (TxD) |
| H | Carrier Aggregation(CA) with UL MIMO |
| I | RedCap |
| J | ATG |

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

A terminal which supports advanced V2X services, public safety services and other commercial use cases related to NR sidelink operation shall meet all of the separate corresponding requirements in suffix E.

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

For a terminal that supports public safety service using sidelink, the minimum requirements are applicable when

- The UE is associated with a serving cell on PS carrier, or

- The UE is not associated with a serving cell on the PS carrier and is provisioned with the preconfigured radio parameters for PS that are associated with known Geographical Area, or

- The UE is associated with a serving cell on a carrier different than the PS carrier, and the radio parameters for PS that are provided by the serving cell, or

- The UE is associated with a serving cell on a carrier different than the PS carrier, and has a non-serving cell selected on the PS carrier with the preconfigured radio parameters.

When the advanced-V2X or PS UE is not associated with a serving cell on the V2X or PS carrier, and the UE does not have knowledge of its geographical area, or is provisioned with preconfigured radio parameters that are not associated with any Geographical Area, V2X or PS UE’ transmissions are not allowed, and the requirements in Section 6.3E.2 apply.

For a terminal that supports operation in shared spectrum, the current version of this specification assumes in the uplink sub-bands within a wideband channel shall be contiguously allocated to the UE. The uplink requirements for one or more non-transmitted sub-bands between two transmitted sub-bands does not form a part of the current version of this specification.

Terminal that supports inter-band NR-DC configuration shall meet the minimum requirements for corresponding CA configuration (suffix A), unless otherwise specified.

## **<<Next of Change>>**

## 5.2J Operating band for ATG

NR operating bands n1, n3, n34, n39, n41, n78, n79, which are defined in Table 5.2-1, can be applied for ATG operation.

## **<<Next of Change>>**

## 6.1J General

Unless otherwise stated, the transmitter characteristics are specified at the antenna connector(s) of the ATG UE with one or multiple omni-directional antenna(s) or at the *transceiver array boundary* (TAB) connectors of the ATG UE with the antenna array. The definition about *transceiver array boundary* (TAB) is specified in clause 4.3.2 of TS 38.104 [16].

For the ATG UE with multiple omni-directional antennas indicating the capability [TBD1], the transmitter RF requirements are defined as the sum of measurement of all antenna connectors.

For the ATG UE with the antenna array indicating the capability [TBD2], the transmitter RF requirements are defined as the sum of measurement of all TAB connectors.

## **<<Next of Change>>**

## 6.2J Transmitter power for ATG

### 6.2J.1 UE maximum output power for ATG

For the ATG UE, the rated maximum output power is declared via UE capability [*RatedMOPATG*] at maximum modulation order reported by ATG UE and full PRB configurations within the channel bandwidth of NR carrier unless otherwise stated. The period of measurement shall be at least one sub frame (1ms). UE capability [*RatedMOPATG*] is an integer value in the range 23 to 40 dBm.

The measured maximum output powershall remain within +2 dB and -2 dB of the *rated maximum output power* declared by the ATG UE.

### 6.2J.2 Configured transmitted power for ATG

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

PCMAX\_L,f,c ≤ PCMAX,f,c ≤ PCMAX\_H,f,c with

PCMAX\_L,f,c = MIN {PEMAX,c, *PMaxOutputPower*}

PCMAX\_H,f,c = PEMAX,c

where

 PEMAX,c is the value given by [either the *p-Max* IE or the field *additionalPmax* of the *NR-NS-PmaxList IE]*, whichever is applicable according to TS 38.331[7];

 *PMaxOutputPower* is the maximum ATG UE output power at maximum modulation order and full PRB configurations which is indicated by ATG UE capability [*RatedMOPATG*];

## **<<Next of Change>>**

6.3J Output power dynamics for ATG

6.3J.1 Minimum output power for ATG

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

The minimum output power is defined as the mean power in at least one sub-frame (1 ms). The minimum output power shall not exceed the values specified in Table 6.3J.1-1for ATG UE with omni-directional antenna and in Table 6.3J.1-2 for ATG UE with antenna array.

**Table 6.3J.1-1: Minimum output power for ATG UE with omni-directional antenna**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channel bandwidth** | **(MHz)** | **5,10,15,20** | **25,30,35,40,45,50** | **60,70,80,90,100** |
| REF\_SCS | (kHz) | 15 | 30 |
| Minimum output power | (dBm) | -15 | -15+10log10 (BWChannel /20) | -15+10log10 (BWChannel /20) |
| Measurement bandwidth | (MHz) | MBW=REF\_SCS\*(12\*NRB+1)/1000 |
| NOTE: The minimum output power value is rounded to the nearest number down to one decimal point. |

**Table 6.3J.1-2: Minimum output power for ATG UE with antenna array**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channel bandwidth** | **(MHz)** | **5,10,15,20** | **25,30,35,40,45,50** | **60,70,80,90,100** |
| REF\_SCS | (kHz) | 15 | 30 |
| Minimum output power | (dBm) | -19 | -19+10log10 (BWChannel /20) | -19+10log10 (BWChannel /20) |
| Measurement bandwidth | (MHz) | MBW=REF\_SCS\*(12\*NRB+1)/1000 |
| NOTE: The minimum output power value is rounded to the nearest number down to one decimal point. |

6.3J.2 Transmit OFF power for ATG

The transmit OFF power requirements as specified in clause 6.3.2 are applicable for ATG UE.

6.3J.3 Transmit ON/OFF time mask for ATG

The transmit ON/OFF time mask requirements as specified in clause 6.3.3 are applicable for ATG UE.

6.3J.4 Power control for ATG

The power control requirements specified in clause 6.3.4 are applicable for ATG UE.

## **<<Next of Change>>**

## 6.4J Transmit signal quality for ATG

### 6.4J.1 Frequency error for ATG

The ATG UE basic measurement interval of modulated carrier frequency is 1 UL slot. The ATG UE pre-compensates the uplink modulated carrier frequency by the estimated Doppler shift. The mean value of basic measurements of ATG 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 1: the ideally pre-compensated reference uplink carrier frequency consists of the UL carrier frequency signalled to the UE by ATG BS and UL precompensated doppler frequency shift.

NOTE 2: UE shall rely on the ATG BS location broadcasted by the [ATG specific SIB] in 38.331.

### 6.4J.2 Transmit modulation quality for ATG

The requirements for transmit modulation quality defined in clause 6.4.2 shall apply for ATG UE except for the phase continuity requirements for DMRS bundling in 6.4.2.5. And the requirements for 256QAM modulation are only applicable to ATG UE indicating support of 256QAM.

## **<<Next of Change>>**

## 6.5J Output RF spectrum emissions for ATG

### 6.5J.1 Occupied bandwidth for ATG

The requirements for occupied bandwidth in clause 6.5.1 apply.

### 6.5J.2 Out of band emission for ATG

#### 6.5J.2.1 General

This clause contains requirements for out of band emissions for ATG UE, the requirement defined in general part of clause 6.5.2.1 should apply.

#### 6.5J.2.2 Spectrum emission mask

If the actual transmission power of ATG UE is less than or equal to 31dBm, the requirements for spectrum emission mask in clause 6.5.2.2 apply; if the actual transmission power of ATG UE is larger than 31dBm, the requirements of spectrum emission mask in clause 6.5.2.2 shall be relaxed with scaling factor equal to (the actual transmission power minus 31) dB.

NOTE: This scaling factor is only applicable to ATG airborne UE.

#### 6.5J.2.3 Adjacent channel leakage ratio

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 6.5J.2.3-1.

If the measured adjacent channel power is greater than –50 dBm then the NRACLR shall be higher than the value 30dBc.

Table 6.5J.2.3-1: NR ACLR measurement bandwidth

|  |  |  |  |
| --- | --- | --- | --- |
| Channel bandwidth | (MHz) | 5,10,15,20,25,30,35,40,45,50 | 60,70,80,90,100 |
| REF\_SCS | (kHz) | 15 | 30 |
| NR ACLR measurement bandwidth | (MHz) | MBW=REF\_SCS\*(12\*NRB+1)/1000 |
| NOTE : “NRB” in the formula is the maximum transmission bandwidth configuration as defined in Table 5.3.2-1. |

### 6.5J.3 Spurious emissions for ATG

The requirements for spurious emission in general part of clause 6.5.3.0 and clause 6.5.3.1 apply.

## **<<Next of Change>>**

## 7.1J General for ATG

Unless otherwise stated, the receiver characteristics are specified at the antenna connector(s) of the ATG UE with one or multiple omni-directional antenna(s) or at the *transceiver array boundary* (TAB) connectors of the ATG UE with the antenna array. The definition about *transceiver array boundary* (TAB) is specified in clause 4.3.2 of TS 38.104 [16].

For the ATG UE with multiple omni-directional antennas, the receiver RF requirements are defined on top of each antenna connector.

For the ATG UE with the antenna array, the receiver RF requirements are defined on top of each TAB connector.

## **<<Next of Change>>**

## 7.2J  Diversity characteristics for ATG

The ATG UE is required to be equipped with a minimum of two Rx antenna ports in all operating bands. ATG UE is required optionally to be equipped with four Rx antenna ports.

##  **<<Next of Change>>**

## 7.3J Reference sensitivity for ATG

### 7.3J.1 General

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

### 7.3J.2 Reference sensitivity power level

For a ATG UE(s) equipped with 2 Rx antenna ports, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2.2 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 7.3.2-1a and Table 7.3.2-1b for the applicable operating bands.

For ATG UE(s) equipped with 4 Rx antenna ports, reference sensitivity for 2Rx antenna ports shall be modified by the amount given in ΔRIB,4R in Table 7.3.2-2 for the applicable operating bands.

The reference sensitivity (REFSENS) requirement for a ATG UE shall be met with uplink transmission bandwidth less than or equal to that specified in Table 7.3.2-3.

## **<<Next of Change>>**

## 7.4J Maximum input level for ATG

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 Annexs A.3.2 and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1) with parameters specified in Table 7.4J-1.

Table 7.4J-1: Maximum input level for ATG

|  |  |  |  |
| --- | --- | --- | --- |
| **Rx Parameter** | **Units** | **ATG UE Types** | **Reference measurement channel** |
| **Omni-directional antenna: receiver characteristics specified at the antenna connector(s)** | **Antenna array: receiver characteristics specified at transceiver array boundary (TAB) connectors** |
| Power in Transmission Bandwidth Configuration | dBm | -42 | -30 | A.3.2.3 or A.3.3.3 for 64 QAM |
|  |  | -44 | -32 | A.3.2.4 or A.3.3.4 for 256 QAM |
| The applicable channel bandwidths | MHz | 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 |
| 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 with PCMAX\_L,f,c as defined in clause 6.2J.2. |

## **<<Next of Change>>**

## 7.5J Adjacent channel selectivity for ATG

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).

The UE shall fulfil the minimum requirements specified in Table 7.5J-1 for NR bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz and the minimum requirements specified in Table 7.5J-2 for NR bands with FDL\_low ≥ 3300 MHz and FUL\_low ≥ 3300 MHz. These requirements apply for all values of an adjacent channel interferer up to -42 dBm with omni-directional antenna and -30dBm with antenna array for any SCS specified for the channel bandwidth of the wanted signal. However, it is not possible to directly measure the ACS; instead the lower and upper range of test parameters are chosen as in Table 7.5J-3 and Table 7.5J-4 for verification of the requirements specified in Table 7.5J-1, and as in Table 7.5J-5 and Table 7.5J-6 for verification of the requirements specified in Table 7.5J-2. For these test parameters, the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.3.2, and A.3.3 (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1).

Table 7.5J-1: ACS for NR bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz

|  |  |  |
| --- | --- | --- |
| RX parameter | Units | Channel bandwidth (MHz) |
| 3, 5, 10 | 15 | 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 |
| ACS | dB | 33 | 30 | 27 – 10log10(BWChannel /20) |
| NOTE1: ACS value is rounded to the next higher 0.5dB value |

Table 7.5J-2: ACS for NR bands with FDL\_low ≥ 3300 MHz and FUL\_low ≥ 3300 MHz

|  |  |  |
| --- | --- | --- |
| RX parameter | Units | Channel bandwidth (MHz) |
| 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 |
| ACS | dB | 33 |

Table 7.5J-3: Test parameters for NR bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz, case 1

|  |  |  |
| --- | --- | --- |
| RX parameter | Units | Channel bandwidth (MHz) |
|  |  | 3 | 5, 10 | 15  | 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 |
| Power in transmission bandwidth configuration | dBm | REFSENS + 14 dB |
| Pinterferer4 | dBm |  | REFSENS + 45.5 dB | REFSENS + 42.5 dB | REFSENS + 39.5 – 10log10(BWChannel /20) |
| BWinterferer | MHz | 3 | 5 |
| Finterferer (offset) | MHz | 3 /- 3 | 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 Table 7.3.2-3 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 Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1.NOTE 4: 10log10(x) is rounded to the next higher 0.5dB value. |

Table 7.5J-4: Test parameters for NR bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz, case 2

|  |  |  |
| --- | --- | --- |
| RX parameter | Units | Channel bandwidth (MHz) |
|  |  | 5, 10 | 15 | 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 |
| Power in transmission bandwidth configuration4 | dBm | -73.55-61.56 | -70.55-58.56 | -67.5 + 10log10(BWChannel /20)5-55.5 + 10log10(BWChannel /20)6 |
| Pinterferer | dBm | -425-306 |
| 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 Table 7.3.2-3 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 RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1NOTE 4: 10log10(x) is rounded to the next higher 0.5dB value.NOTE 5: Pinterferer shall be set to -42dBm for omni-directional antenna.NOTE 6: Pinterferer shall be set to -30dBm for antenna array. |

Table 7.5J-5: Test parameters for NR bands with FDL\_low ≥ 3300 MHz and FUL\_low ≥ 3300 MHz, case 1

|  |  |  |
| --- | --- | --- |
| RX parameter | Units | Channel bandwidth (MHz) |
|  |  | 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 |
| Power in transmission bandwidth configuration | dBm | REFSENS + 14 dB |
| Pinterferer | dBm | REFSENS + 45.5 dB |
| BWinterferer | MHz | BWChannel |
| Finterferer (offset) | MHz | BWChannel/-BWChannel  |
| 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 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 an SCS equal to that of the wanted signal.NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1. |

Table 7.5J-6: Test parameters for NR bands with FDL\_low ≥ 3300 MHz and FUL\_low ≥ 3300 MHz, case 2

|  |  |  |
| --- | --- | --- |
| RX parameter | Units | Channel bandwidth (MHz) |
|  |  | 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100 |
| Power in transmission bandwidth configuration | dBm | -73.54-61.55 |
| Pinterferer | dBm | -424-305 |
| BWinterferer | MHz | BWChannel |
| Finterferer (offset) | MHz | BWChannel/-BWChannel  |
| NOTE 1: The transmitter shall be set to 24 dB below PCMAX\_L,f,c at the minimum UL configuration specified in Table 7.3.2-3 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 an SCS equal to that of the wanted signal.NOTE 3: The interferer consists of the RMC specified in Annexes A.3.2.2 and A.3.3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1. NOTE 4: Pinterferer shall be set to -42dBm for omni-directional antenna.NOTE 5: Pinterferer shall be set to -30dBm for antenna array. |

## **<<Next of Change>>**

7.6J Blocking characteristics for ATG

7.6J.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.

7.6J.2 In-band blocking for ATG

For ATG UE, the in-band blocking requirement defined in clause 7.6.2 applies.

7.6J.3 Out-of-band blocking for ATG

For ATG UE, the out-of-band blocking requirement defined in clause 7.6.3 applies.

NOTE: In 3GPP, the ATG UE out-of-band blocking specification is defined to ensure the telecommunication link and there may be other sources of interference and regulatory issues that need to be considered when designing ATG UE, i.e. avionic equipment.

## **<<Next of Change>>**

7.7J Spurious response for ATG

For ATG UE, the spurious response defined in clause 7.7 applies.

## **<<Next of Change>>**

## 7.8J Intermodulation characteristics for ATG

### 7.8J.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.

### 7.8J.2 Wide band intermodulation for ATG

For ATG UE, the wide band intermodulation requirement defined in clause 7.8.2 applies.

## **<<Next of Change>>**

7.9J Spurious emissions for ATG

For ATG UE, the spurious emissions as specified in clause 7.9 applies.

## **<<End of Change>>**