



TECHNICAL SPECIFICATION

**5G;
NR;
User Equipment (UE) radio transmission and reception;
Part 1: Range 1 Standalone
(3GPP TS 38.101-1 version 15.30.0 Release 15)**



Reference

RTS/TSGR-0438101-1vfu0

Keywords

5G

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

Important notice

The present document can be downloaded from the
[ETSI Search & Browse Standards](#) application.

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format on [ETSI deliver](#) repository.

Users should be aware that the present document may be revised or have its status changed, this information is available in the [Milestones listing](#).

If you find errors in the present document, please send your comments to the relevant service listed under [Committee Support Staff](#).

If you find a security vulnerability in the present document, please report it through our [Coordinated Vulnerability Disclosure \(CVD\)](#) program.

Notice of disclaimer & limitation of liability

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness for any particular purpose or against infringement of intellectual property rights.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2026.
All rights reserved.

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the [ETSI IPR online database](#).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™**, **LTE™** and **5G™** logo are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM®** and the GSM logo are trademarks registered and owned by the GSM Association.

Legal Notice

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

The present document may refer to technical specifications or reports using their 3GPP identities. These shall be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between 3GPP and ETSI identities can be found at [3GPP to ETSI numbering cross-referencing](#).

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Contents

Intellectual Property Rights	2
Legal Notice	2
Modal verbs terminology.....	2
Foreword.....	11
1 Scope	12
2 References	12
3 Definitions, symbols and abbreviations	12
3.1 Definitions	12
3.2 Symbols.....	13
3.3 Abbreviations	15
4 General	16
4.1 Relationship between minimum requirements and test requirements	16
4.2 Applicability of minimum requirements	16
4.3 Specification suffix information.....	16
5 Operating bands and channel arrangement.....	17
5.1 General	17
5.2 Operating bands.....	17
5.2A Operating bands for CA	18
5.2A.1 Intra-band CA	18
5.2A.2 Inter-band CA	18
5.2A.2.1 Inter-band CA (two bands).....	19
5.2B Void.....	19
5.2C Operating band combination for SUL	19
5.3 UE channel bandwidth	20
5.3.1 General.....	20
5.3.2 Maximum transmission bandwidth configuration	20
5.3.3 Minimum guardband and transmission bandwidth configuration.....	21
5.3.4 RB alignment	22
5.3.5 UE channel bandwidth per operating band	22
5.3.6 Asymmetric channel bandwidths	24
5.3A UE channel bandwidth for CA	25
5.3A.1 General.....	25
5.3A.2 Maximum transmission bandwidth configuration for CA	25
5.3A.3 Minimum guardband and transmission bandwidth configuration for CA	25
5.3A.4 Void	27
5.3A.5 UE channel bandwidth per operating band for CA.....	27
5.4 Channel arrangement.....	27
5.4.1 Channel spacing.....	27
5.4.1.1 Channel spacing for adjacent NR carriers	27
5.4.2 Channel raster	28
5.4.2.1 NR-ARFCN and channel raster.....	28
5.4.2.2 Channel raster to resource element mapping.....	28
5.4.2.3 Channel raster entries for each operating band	29
5.4.3 Synchronization raster	30
5.4.3.1 Synchronization raster and numbering.....	30
5.4.3.2 Synchronization raster to synchronization block resource element mapping.....	30
5.4.3.3 Synchronization raster entries for each operating band.....	30
5.4.4 TX–RX frequency separation	31
5.4A Channel arrangement for CA.....	31
5.4A.1 Channel spacing for CA.....	31
5.4A.2 Channel raster for CA.....	32
5.4A.3 Synchronization raster for CA	32
5.4A.4 Tx-Rx frequency separation for CA.....	32

5.5	Void.....	32
5.5A	Configurations for CA.....	32
5.5A.1	Configurations for intra-band contiguous CA.....	32
5.5A.2	Void.....	34
5.5A.3	Configurations for inter-band CA.....	34
5.5A.3.1	Configurations for inter-band CA (two bands).....	34
5.5B	Void.....	36
5.5C	Configurations for SUL.....	36
6	Transmitter characteristics.....	39
6.1	General.....	39
6.2	Transmitter power.....	39
6.2.1	UE maximum output power.....	39
6.2.2	UE maximum output power reduction.....	40
6.2.3	UE additional maximum output power reduction.....	41
6.2.3.1	General.....	41
6.2.3.2	A-MPR for NS_04.....	44
6.2.3.3	A-MPR for NS_10.....	45
6.2.3.4	A-MPR for NS_05 and NS_05U.....	46
6.2.3.5	A-MPR for NS_40.....	48
6.2.3.6	A-MPR for NS_43 and NS_43U.....	48
6.2.3.7	A-MPR for NS_03 and NS_03U.....	49
6.2.3.8	A-MPR for NS_37.....	49
6.2.3.9	A-MPR for NS_38.....	50
6.2.3.10	A-MPR for NS_39.....	50
6.2.3.11	A-MPR for NS_41.....	50
6.2.3.12	A-MPR for NS_42.....	51
6.2.3.13	A-MPR for NS_18.....	51
6.2.4	Configured transmitted power.....	52
6.2A	Transmitter power for CA.....	54
6.2A.1	UE maximum output power for CA.....	54
6.2A.1.1	Void.....	54
6.2A.1.2	Void.....	54
6.2A.1.3	UE maximum output power for Inter-band CA.....	54
6.2A.2	UE maximum output power reduction for CA.....	55
6.2A.2.1	Void.....	55
6.2A.2.2	Void.....	55
6.2A.2.3	UE maximum output power reduction for Inter-band CA.....	55
6.2A.3	UE additional maximum output power reduction for CA.....	55
6.2A.3.1.1	Void.....	55
6.2A.3.1.2	Void.....	55
6.2A.3.1.3	UE additional maximum output power reduction for Inter-band CA.....	55
6.2A.4	Configured output power for CA.....	56
6.2A.4.1	Configured transmitted power level.....	56
6.2A.4.1.1	Void.....	56
6.2A.4.1.2	Void.....	56
6.2A.4.1.3	Configured transmitted power for Inter-band CA.....	56
6.2A.4.2	$\Delta T_{IB,c}$ for CA.....	58
6.2A.4.2.1	Void.....	58
6.2A.4.2.2	Void.....	58
6.2A.4.2.3	$\Delta T_{IB,c}$ for Inter-band CA (two bands).....	58
6.2B	Void.....	59
6.2C	Transmitter power for SUL.....	59
6.2C.1	Configured transmitted power for SUL.....	59
6.2C.2	$\Delta T_{IB,c}$	59
6.2D	Transmitter power for UL MIMO.....	59
6.2D.1	UE maximum output power for UL MIMO.....	59
6.2D.2	UE maximum output power reduction for UL MIMO.....	60
6.2D.3	UE additional maximum output power reduction for UL MIMO.....	60
6.2D.4	Configured transmitted power for UL MIMO.....	60
6.3	Output power dynamics.....	61
6.3.1	Minimum output power.....	61

6.3.2	Transmit OFF power.....	62
6.3.3	Transmit ON/OFF time mask	62
6.3.3.1	General	62
6.3.3.2	General ON/OFF time mask	62
6.3.3.3	Transmit power time mask for slot and short or long subslot boundaries.....	63
6.3.3.4	PRACH time mask.....	63
6.3.3.5	Void.....	64
6.3.3.6	SRS time mask.....	64
6.3.3.7	PUSCH-PUCCH and PUSCH-SRS time masks	65
6.3.3.8	Transmit power time mask for consecutive slot or long subslot transmission and short subslot transmission boundaries	66
6.3.3.9	Transmit power time mask for consecutive short subslot transmissions boundaries	67
6.3.4	Power control.....	67
6.3.4.1	General	67
6.3.4.2	Absolute power tolerance.....	67
6.3.4.3	Relative power tolerance.....	68
6.3.4.4	Aggregate power tolerance.....	68
6.3A	Output power dynamics for CA	68
6.3A.1	Minimum output power for CA	68
6.3A.1.1	Void.....	68
6.3A.1.2	Void.....	68
6.3A.1.3	Minimum output power for inter-band CA	68
6.3A.2	Transmit OFF power for CA.....	69
6.3A.2.1	Void.....	69
6.3A.2.2	Void.....	69
6.3A.2.3	Transmit OFF power for inter-band CA.....	69
6.3A.3	Transmit ON/OFF time mask for CA	69
6.3A.3.1	Void.....	69
6.3A.3.2	Void.....	69
6.3A.3.3	Transmit ON/OFF time mask for inter-band CA	69
6.3A.4	Power control for CA.....	69
6.3A.4.1	Void.....	69
6.3A.4.2	Void.....	69
6.3A.4.3	Power control for inter-band CA	69
6.3D	Output power dynamics for UL MIMO	69
6.3D.1	Minimum output power for UL MIMO	69
6.3D.2	Transmit OFF power for UL MIMO.....	69
6.3D.3	Transmit ON/OFF time mask for UL MIMO	70
6.3D.4	Power control for UL MIMO.....	70
6.4	Transmit signal quality	70
6.4.1	Frequency error.....	70
6.4.2	Transmit modulation quality	70
6.4.2.0	General	70
6.4.2.1	Error Vector Magnitude	70
6.4.2.2	Carrier leakage	71
6.4.2.3	In-band emissions	71
6.4.2.4	EVM equalizer spectrum flatness	72
6.4.2.4.1	Requirements for Pi/2 BPSK modulation.....	73
6.4A	Transmit signal quality for CA.....	74
6.4A.1	Frequency error for CA.....	74
6.4A.1.1	Void.....	74
6.4A.1.2	Void.....	74
6.4A.1.3	Frequency error for inter-band CA.....	74
6.4A.2	Transmit modulation quality for CA.....	74
6.4A.2.1	Void.....	74
6.4A.2.2	Void.....	74
6.4A.2.3	Transmit modulation quality for inter-band CA.....	74
6.4D	Transmit signal quality for UL MIMO.....	75
6.4D.0	General.....	75
6.4D.1	Frequency error for UL MIMO.....	75
6.4D.2	Transmit modulation quality for UL MIMO.....	75
6.4D.2.0	General	75

6.4D.2.1	Error Vector Magnitude	75
6.4D.2.2	Carrier leakage	75
6.4D.2.3	In-band emissions	76
6.4D.2.4	EVM equalizer spectrum flatness for UL MIMO	76
6.4D.3	Time alignment error for UL MIMO	76
6.4D.4	Requirements for coherent UL MIMO	76
6.5	Output RF spectrum emissions.....	76
6.5.1	Occupied bandwidth	76
6.5.2	Out of band emission	77
6.5.2.1	General	77
6.5.2.2	Spectrum emission mask	77
6.5.2.3	Additional spectrum emission mask	78
6.5.2.3.1	Requirements for network signalling value "NS_35"	78
6.5.2.3.2	Requirements for network signalling value "NS_04"	78
6.5.2.3.3	Requirements for network signalling values "NS_03" and "NS_03U"	79
6.5.2.3.4	Requirements for network signalling value "NS_06"	79
6.5.2.3.5	Void	80
6.5.2.3.6	Void	80
6.5.2.3.7	Void	80
6.5.2.4	Adjacent channel leakage ratio	80
6.5.2.4.1	NR ACLR	80
6.5.2.4.2	UTRA ACLR	81
6.5.3	Spurious emissions	81
6.5.3.0	General	81
6.5.3.1	General spurious emissions	81
6.5.3.2	Spurious emissions for UE co-existence	82
6.5.3.3	Additional spurious emissions	87
6.5.3.3.1	Requirement for network signalling value "NS_04"	87
6.5.3.3.2	Requirement for network signalling value "NS_17"	87
6.5.3.3.3	Requirement for network signalling value "NS_18"	87
6.5.3.3.4	Requirement for network signalling values "NS_05" and "NS_05U"	87
6.5.3.3.5	Requirement for network signalling values "NS_43" and "NS_43U"	88
6.5.3.3.6	Requirement for network signalling value "NS_37"	88
6.5.3.3.7	Requirement for network signalling value "NS_38"	88
6.5.3.3.8	Requirement for network signalling value "NS_39"	88
6.5.3.3.9	Requirement for network signalling value "NS_40"	89
6.5.3.3.10	Requirement for network signalling value "NS_41"	89
6.5.3.3.11	Requirement for network signalling value "NS_42"	89
6.5.3.3.12	Void	90
6.5.3.3.13	Void	90
6.5.3.3.14	Void	90
6.5.3.3.15	Void	90
6.5.3.3.16	Requirement for network signalling value "NS_50"	90
6.5.4	Transmit intermodulation	90
6.5A	Output RF spectrum emissions for CA.....	90
6.5A.0	General.....	90
6.5A.1	Occupied bandwidth for CA	91
6.5A.1.1	Void.....	91
6.5A.1.2	Void.....	91
6.5A.1.3	Occupied bandwidth for Inter-band CA.....	91
6.5A.2	Out of band emission for CA	91
6.5A.2.1	General	91
6.5A.2.2	Spectrum emission mask	91
6.5A.2.2.1	Void	91
6.5A.2.2.2	Void	91
6.5A.2.2.3	Spectrum emission mask for Inter-band CA	91
6.5A.2.3	Additional spectrum emission mask	91
6.5A.2.3.1	Void	91
6.5A.2.3.2	Void	91
6.5A.2.3.3	Additional spectrum emission mask for Inter-band CA	91
6.5A.2.4	Adjacent channel leakage ratio	91
6.5A.2.4.1	NR ACLR.....	91

6.5A.2.4.1.1	Void	91
6.5A.2.4.1.2	Void	91
6.5A.2.4.1.3	NR ACLR for Inter-band CA	91
6.5A.2.4.2	UTRA ACLR	92
6.5A.2.4.2.1	Void	92
6.5A.2.4.2.2	Void	92
6.5A.2.4.2.3	UTRA ACLR for Inter-band CA	92
6.5A.3	Spurious emission for CA	92
6.5A.3.1	General spurious emissions	92
6.5A.3.2	Spurious emissions for UE co-existence	92
6.5A.3.2.1	Void	92
6.5A.3.2.2	Void	92
6.5A.3.2.3	Spurious emissions for UE co-existence for Inter-band CA	92
6.5A.4	Transmit intermodulation for CA	93
6.5A.4.1	Void	93
6.5A.4.2	Void	93
6.5A.4.3	Transmit intermodulation for Inter-band CA	93
6.5D	Output RF spectrum emissions for UL MIMO	93
6.5D.1	Occupied bandwidth for UL MIMO	93
6.5D.2	Out of band emission for UL MIMO	93
6.5D.3	Spurious emission for UL MIMO	93
6.5D.4	Transmit intermodulation for UL MIMO	93
7	Receiver characteristics	95
7.1	General	95
7.2	Diversity characteristics	95
7.3	Reference sensitivity	95
7.3.1	General	95
7.3.2	Reference sensitivity power level	95
7.3.3	$\Delta R_{IB,c}$	101
7.3A	Reference sensitivity for CA	101
7.3A.1	General	101
7.3A.2	Reference sensitivity power level for CA	101
7.3A.2.1	Reference sensitivity power level for Intra-band contiguous CA	101
7.3A.2.2	Void	101
7.3A.2.3	Reference sensitivity power level for Inter-band CA	101
7.3A.2.4	Void	101
7.3A.3	$\Delta R_{IB,c}$ for CA	102
7.3A.3.1	General	102
7.3A.3.2	$\Delta R_{IB,c}$ for Inter-band CA	102
7.3A.3.2.1	$\Delta R_{IB,c}$ for two bands	102
7.3A.3.2.2	Void	102
7.3A.4	Reference sensitivity exceptions due to UL harmonic interference for CA	102
7.3A.5	Reference sensitivity exceptions due to intermodulation interference due to 2UL CA	104
7.3A.6	Reference sensitivity exceptions due to cross band isolation for CA	105
7.3B	Void	106
7.3C	Reference sensitivity for SUL	106
7.3C.1	General	106
7.3C.2	Reference sensitivity power level for SUL	106
7.3C.3	$\Delta R_{IB,c}$ for SUL	107
7.3C.3.1	General	107
7.3C.3.2	SUL band combination	107
7.3C.3.2.1	$\Delta R_{IB,c}$ for two bands	108
7.3D	Reference sensitivity for UL MIMO	108
7.4	Maximum input level	108
7.4A	Maximum input level for CA	108
7.4A.1	Maximum input level for Intra-band contiguous CA	108
7.4A.2	Void	109
7.4A.3	Maximum input level for Inter-band CA	109
7.4D	Maximum input level for UL MIMO	109
7.5	Adjacent channel selectivity	109
7.5A	Adjacent channel selectivity for CA	112

7.5A.1	Adjacent channel selectivity for Intra-band contiguous CA	112
7.5A.2	Void	114
7.5A.3	Adjacent channel selectivity Inter-band CA	114
7.5D	Adjacent channel selectivity for UL MIMO.....	114
7.6	Blocking characteristics	114
7.6.1	General.....	114
7.6.2	In-band blocking.....	115
7.6.3	Out-of-band blocking.....	117
7.6.4	Narrow band blocking	120
7.6A	Blocking characteristics for CA	121
7.6A.1	General.....	121
7.6A.2	In-band blocking for CA.....	121
7.6A.2.1	In-band blocking for Intra-band contiguous CA.....	121
7.6A.2.2	Void.....	122
7.6A.2.3	In-band blocking for Inter-band CA.....	122
7.6A.3	Out-of-band blocking for CA.....	122
7.6A.3.1	Out-of-band blocking for Intra-band contiguous CA.....	122
7.6A.3.2	Void.....	123
7.6A.3.3	Out-of-band blocking for Inter-band CA	123
7.6A.4	Narrow band blocking for CA	124
7.6A.4.1	Narrow band blocking for Intra-band contiguous CA.....	124
7.6A.4.2	Void	125
7.6A.4.3	Narrow band blocking for Inter-band CA.....	125
7.6C	Blocking characteristics for SUL	125
7.6C.1	General.....	125
7.6C.2	In-band blocking for SUL.....	125
7.6C.3	Out-of-band blocking for SUL.....	125
7.6C.4	Narrow band blocking for SUL	126
7.6D	Blocking characteristics for UL MIMO	126
7.7	Spurious response.....	126
7.7A	Spurious response for CA.....	127
7.7A.1	Spurious response for Intra-band contiguous CA	127
7.7A.2	Void	127
7.7A.3	Spurious response for Inter-band CA.....	127
7.7D	Spurious response for UL MIMO.....	128
7.8	Intermodulation characteristics	128
7.8.1	General.....	128
7.8.2	Wide band Intermodulation	128
7.8A	Intermodulation characteristics for CA	129
7.8A.1	General.....	129
7.8A.2	Wide band intermodulation for CA	129
7.8A.2.1	Wide band intermodulation for Intra-band contiguous CA.....	129
7.8A.2.2	Void.....	130
7.8A.2.3	Wide band intermodulation for Inter-band CA	130
7.8D	Intermodulation characteristics for UL MIMO	130
7.9	Spurious emissions	131
7.9A	Spurious emissions for CA.....	131
7.9A.1	Void	131
7.9A.2	Void	131
7.9A.3	Spurious emissions for Inter-band CA.....	131
Annex A (normative): Measurement channels.....		132
A.1	General	132
A.2	UL reference measurement channels	132
A.2.1	General	132
A.2.2	Reference measurement channels.....	133
A.2.2.1	DFT-s-OFDM Pi/2-BPSK	133
A.2.2.2	DFT-s-OFDM QPSK.....	134
A.2.2.3	DFT-s-OFDM 16QAM.....	135
A.2.2.4	DFT-s-OFDM 64QAM.....	136
A.2.2.5	DFT-s-OFDM 256QAM.....	137

A.2.2.6	CP-OFDM QPSK	138
A.2.2.7	CP-OFDM 16QAM	140
A.2.2.8	CP-OFDM 64QAM	143
A.2.2.9	CP-OFDM 256QAM	145
A.2.3	Reference measurement channels for TDD	147
A.2.3.1	DFT-s-OFDM Pi/2-BPSK	147
A.2.3.2	DFT-s-OFDM QPSK	147
A.2.3.3	DFT-s-OFDM 16QAM	147
A.2.3.4	DFT-s-OFDM 64QAM	147
A.2.3.5	DFT-s-OFDM 256QAM	147
A.2.3.6	CP-OFDM QPSK	147
A.2.3.7	CP-OFDM 16QAM	148
A.2.3.8	CP-OFDM 64QAM	148
A.2.3.9	CP-OFDM 256QAM	148
A.3	DL reference measurement channels	149
A.3.1	General	149
A.3.2	DL reference measurement channels for FDD	151
A.3.2.1	General	151
A.3.2.2	FRC for receiver requirements for QPSK	151
A.3.2.3	FRC for maximum input level for 64QAM	154
A.3.2.4	FRC for maximum input level for 256 QAM	157
A.3.3	DL reference measurement channels for TDD	160
A.3.3.1	General	160
A.3.3.2	FRC for receiver requirements for QPSK	160
A.3.3.3	FRC for maximum input level for 64QAM	164
A.3.3.4	FRC for maximum input level for 256 QAM	167
A.4	CSI reference measurement channels	170
A.5	OFDMA Channel Noise Generator (OCNG)	170
A.5.1	OCNG Patterns for FDD	170
A.5.1.1	OCNG FDD pattern 1: Generic OCNG FDD Pattern for all unused REs	170
A.5.2	OCNG Patterns for TDD	170
A.5.2.1	OCNG TDD pattern 1: Generic OCNG TDD Pattern for all unused REs	170
A.6	Void	170
Annex B (informative):	Void	171
Annex C (informative):	Downlink physical channels	172
C.1	General	172
C.2	Setup	172
C.3	Connection	172
C.3.1	Measurement of Receiver Characteristics	172
Annex D (normative):	Characteristics of the interfering signal	173
D.1	General	173
D.2	Void	173
Annex E (normative):	Environmental conditions	174
E.1	General	174
E.2	Environmental	174
E.2.1	Temperature	174
E.2.2	Voltage	174
E.2.3	Vibration	174
Annex F (normative):	Transmit modulation	176
F.0	General	176

F.1	Measurement Point.....	176
F.2	Basic Error Vector Magnitude measurement	176
F.3	Basic in-band emissions measurement.....	177
F.4	Modified signal under test.....	177
F.5	Window length	179
F.5.1	Timing offset	179
F.5.2	Window length	179
F.5.3	Window length for normal CP	179
F.5.4	Window length for Extended CP.....	181
F.5.5	Window length for PRACH	181
F.6	Averaged EVM	182
F.7	Spectrum Flatness	183
F.8	183	
F.9	183	
F.10	EVM for UL MIMO.....	183
F10.1	General	183
F10.2	MIMO Equalization	185
F10.3	Layer processing	185
Annex G (normative):		187
G.0	General	187
G.1	Measurement Point.....	187
G.2	Relative Phase Error Measurement	188
G.2.1	Symbols and subcarriers used	188
G.2.2	CFO (carrier frequency offset) correction.....	188
G.2.3	Steps of the measurement method.....	188
Annex H (normative):		ModifiedMPR-Behavior
		190
H.1	Indication of modified MPR behavior.....	190
Annex I (informative):		Void
		191
Annex J (informative):		Void
		192
Annex K (informative):		Void
		193
Annex L (informative):		Change history
		194
History		207

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.

Sample Document

get full document from standards.iteh.ai

1 Scope

The present document establishes the minimum RF requirements for NR User Equipment (UE) operating on frequency Range 1.

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".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.2 Symbols

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

ΔF_{Global}	Granularity of the global frequency raster
ΔF_{Raster}	Band dependent channel raster granularity
Δf_{OOB}	Δ Frequency of Out Of Band emission
$\Delta F_{\text{TX-RX}}$	Δ Frequency of default TX-RX separation of the FDD <i>operating band</i>
$\Delta P_{\text{PowerClass}}$	Adjustment to maximum output power for a given power class
Δ_{RB}	The starting frequency offset between the allocated RB and the measured non-allocated RB
$\Delta R_{\text{IB},c}$	Allowed reference sensitivity relaxation due to support for inter-band CA operation, for serving cell c
$\Delta R_{\text{IB},4R}$	Reference sensitivity adjustment due to support for 4 antenna ports
Δ_{Shift}	Channel raster offset
ΔT_{C}	Allowed operating band edge transmission power relaxation
$\Delta T_{\text{C},c}$	Allowed operating band edge transmission power relaxation for serving cell c
$\Delta T_{\text{IB},c}$	Allowed maximum configured output power relaxation due to support for inter-band CA operation and due to support for SUL operations, for serving cell c
BW_{Channel}	Channel bandwidth
$BW_{\text{Channel,block}}$	Sub-block bandwidth, expressed in MHz. $BW_{\text{Channel,block}} = F_{\text{edge,block,high}} - F_{\text{edge,block,low}}$
$BW_{\text{Channel_CA}}$	Aggregated channel bandwidth, expressed in MHz
$BW_{\text{Channel,max}}$	Maximum channel bandwidth supported among all bands in a release
BW_{GB}	$\max(BW_{\text{GB,Channel}(k)})$
$BW_{\text{GB,Channel}(k)}$	Minimum guard band defined in clause 5.3A.1 of carrier k
BW_{DL}	Channel bandwidth for DL

BW_{UL}	Channel bandwidth for UL
$BW_{interferer}$	Bandwidth of the interferer
$Ceil(x)$	Rounding upwards; $ceil(x)$ is the smallest integer such that $ceil(x) \geq x$
$Floor(x)$	Rounding downwards; $floor(x)$ is the greatest integer such that $floor(x) \leq x$
F_C	Center frequency of a carrier for a numerology defined by the <i>RF reference frequency</i> on the channel raster mapped to the carrier according to sub-clause 5.4.2.2
$F_{C,block, high}$	F_C of the highest transmitted/received carrier in a <i>sub-block</i>
$F_{C,block, low}$	F_C of the lowest transmitted/received carrier in a <i>sub-block</i>
$F_{C,low}$	The F_C of the lowest carrier, expressed in MHz
$F_{C,high}$	The F_C of the highest carrier, expressed in MHz
F_{DL_low}	The lowest frequency of the downlink <i>operating band</i>
F_{DL_high}	The highest frequency of the downlink <i>operating band</i>
F_{UL_low}	The lowest frequency of the uplink <i>operating band</i>
F_{UL_high}	The highest frequency of the uplink <i>operating band</i>
$F_{edge,block,low}$	The lower <i>sub-block edge</i> , where $F_{edge,block,low} = F_{C,block,low} - F_{offset, low}$.
$F_{edge,block,high}$	The upper <i>sub-block edge</i> , where $F_{edge,block,high} = F_{C,block,high} + F_{offset, high}$.
$F_{edge, low}$	The <i>lower edge of aggregated channel bandwidth</i> , expressed in MHz. $F_{edge,low} = F_{C,low} - F_{offset,low}$.
$F_{edge, high}$	The <i>higher edge of aggregated channel bandwidth</i> , expressed in MHz. $F_{edge,high} = F_{C,high} + F_{offset,high}$.
$F_{interferer (offset)}$	Frequency offset of the interferer (between the center frequency of the interferer and the carrier frequency of the carrier measured). For intra-band contiguous CA, the $F_{interferer (offset)}$ is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer
$F_{interferer}$	Frequency of the interferer
$F_{ioffset}$	Frequency offset of the interferer (between the center frequency of the interferer and the closest edge of the carrier measured)
F_{offset}	Frequency offset from $F_{C,high}$ to the <i>higher edge</i> or $F_{C,low}$ to the <i>lower edge</i> .
$F_{offset,high}$	Frequency offset from $F_{C,high}$ to the upper <i>UE RF Bandwidth edge</i> , or from $F_{C,block, high}$ to the upper sub-block edge
$F_{offset,low}$	Frequency offset from $F_{C,low}$ to the lower <i>UE RF Bandwidth edge</i> , or from $F_{C,block, low}$ to the lower sub-block edge
F_{OOB}	The boundary between the NR out of band emission and spurious emission domains
F_{REF}	RF reference frequency
$F_{REF-Offs}$	Offset used for calculating F_{REF}
$F_{REF, shift}$	RF reference frequency for Supplementary Uplink (SUL) bands, the uplink of all FDD bands, and TDD bands
$F_{uw (offset)}$	The frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer
$GB_{channel}$	Minimum guard band defined in clause 5.3.3, expressed in kHz
L_{CRB}	Transmission bandwidth which represents the length of a contiguous resource block allocation expressed in units of resource blocks
$Max()$	The largest of given numbers
$Min()$	The smallest of given numbers
n_{PRB}	Physical resource block number
NR_{ACLR}	NR ACLR
NR_{RB}	Transmission bandwidth configuration, expressed in units of resource blocks
NR_{RB_agg}	The number of the aggregated RBs within the fully allocated aggregated channel bandwidth $N_{RB_agg} = \sum_{i=1}^j N_{RB_i} * 2^{\mu_i}$ for carrier 1 to j, where μ is defined in TS 38.211 [6]
$NR_{RB,c}$	The transmission bandwidth configuration of component carrier c, expressed in units of resource blocks $N_{RB,cj} = N_{RB_j} * 2^{\mu_j}$ for carrier j, where μ is defined in TS 38.211 [6]
$NR_{RB,low}$	The transmission bandwidth configurations according to Table 5.3.2-1 for the lowest assigned component carrier in section 5.3A.1
$NR_{RB,high}$	The transmission bandwidth configurations according to Table 5.3.2-1 for the highest assigned component carrier in section 5.3A.1
N_{REF}	NR Absolute Radio Frequency Channel Number (NR-ARFCN)
$N_{REF-Offs}$	Offset used for calculating N_{REF}
P_{CMAX}	The configured maximum UE output power
$P_{CMAX, c}$	The configured maximum UE output power for serving cell c
$P_{CMAX, f, c}$	The configured maximum UE output power for carrier f of serving cell c in each slot
P_{EMAX}	Maximum allowed UE output power signalled by higher layers
$P_{EMAX, c}$	Maximum allowed UE output power signalled by higher layers for serving cell c