

ETSI TS 138 101-1 V16.10.0 (2022-04)



**5G;
NR;**

**User Equipment (UE) radio transmission and reception;
Part 1: Range 1 Standalone
(3GPP TS 38.101-1 version 16.10.0 Release 16)**

<https://standards.iteh.ai/catalog/standards/sist/c0bc4559-7acc-47a7-b1dd-df96d7011d73/etsi-ts-138-101-1-v16-10-0-2022-04>



Reference

RTS/TSGR-0438101-1vga0

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:

<http://www.etsi.org/standards-search>

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 at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommitteeSupportStaff.aspx>

If you find a security vulnerability in the present document, please report it through our

Coordinated Vulnerability Disclosure Program:

<https://www.etsi.org/standards/coordinated-vulnerability-disclosure>

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 2022.
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 Web server (<https://ipr.etsi.org/>).

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™** and **LTE™** 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

(standards.iteh.ai)

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 under <http://webapp.etsi.org/key/queryform.asp>.

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	16
1 Scope	18
2 References	18
3 Definitions, symbols and abbreviations	18
3.1 Definitions	18
3.2 Symbols	19
3.3 Abbreviations	21
4 General	23
4.1 Relationship between minimum requirements and test requirements	23
4.2 Applicability of minimum requirements	23
4.3 Specification suffix information	23
5 Operating bands and channel arrangement	24
5.1 General	24
5.2 Operating bands	24
5.2A Operating bands for CA	26
5.2A.0 General	26
5.2A.1 Intra-band CA	26
5.2A.2 Inter-band CA	27
5.2A.2.1 Inter-band CA (two bands)	27
5.2A.2.2 Inter-band CA (three bands)	31
5.2A.2.3 Inter-band CA (four bands)	32
5.2B Operating bands for DC	32
5.2C Operating band combination for SUL	32
5.2D Operating bands for UL MIMO	33
5.2E Operating band for V2X	33
5.2E.1 V2X operating bands	33
5.2E.2 V2X operating bands for con-current operation	34
5.3 UE channel bandwidth	34
5.3.1 General	34
5.3.2 Maximum transmission bandwidth configuration	35
5.3.3 Minimum guardband and transmission bandwidth configuration	35
5.3.4 RB alignment	37
5.3.5 UE channel bandwidth per operating band	37
5.3.6 Asymmetric channel bandwidths	40
5.3A UE channel bandwidth for CA	41
5.3A.1 General	41
5.3A.2 Maximum transmission bandwidth configuration for CA	41
5.3A.3 Minimum guardband and transmission bandwidth configuration for CA	41
5.3A.4 Void	43
5.3A.5 UE channel bandwidth per operating band for CA	43
5.3E Channel bandwidth for V2X	44
5.3E.1 General	44
5.3E.2 Channel bandwidth for V2X concurrent operation	45
5.4 Channel arrangement	45
5.4.1 Channel spacing	45
5.4.1.1 Channel spacing for adjacent NR carriers	45
5.4.2 Channel raster	45
5.4.2.1 NR-ARFCN and channel raster	45
5.4.2.2 Channel raster to resource element mapping	46
5.4.2.3 Channel raster entries for each operating band	46

5.4.3	Synchronization raster	48
5.4.3.1	Synchronization raster and numbering.....	48
5.4.3.3	Synchronization raster entries for each operating band.....	49
5.4.4	TX–RX frequency separation	52
5.4A	Channel arrangement for CA.....	52
5.4A.1	Channel spacing for CA.....	52
5.4A.2	Channel raster for CA	53
5.4A.3	Synchronization raster for CA	53
5.4A.4	Tx-Rx frequency separation for CA.....	53
5.4B	Reserved	53
5.4C	Reserved	53
5.4D	Reserved	53
5.4E	Channel arrangement for V2X	53
5.4E.1	Channel spacing.....	53
5.4E.2	Channel raster	54
5.4E.2.1	NR-ARFCN and channel raster.....	54
5.4E.2.2	Channel raster to resource element mapping.....	54
5.4E.2.3	Channel raster entries for each operating band	54
5.4E.3	Synchronization raster for V2X.....	54
5.5	Void.....	54
5.5A	Configurations for CA.....	54
5.5A.0	General.....	54
5.5A.1	Configurations for intra-band contiguous CA.....	55
5.5A.2	Configurations for intra-band non-contiguous CA	58
5.5A.3	Configurations for inter-band CA	58
5.5A.3.1	Configurations for inter-band CA (two bands)	58
5.5A.3.2	Configurations for inter-band CA (three bands).....	67
5.5A.3.3	Configurations for inter-band CA (four bands).....	74
5.5B	Configurations for DC.....	76
5.5C	Configurations for SUL.....	77
6	Transmitter characteristics	79
6.1	General	79
6.1A	General	79
6.1F	General	79
6.2	Transmitter power.....	79
6.2.1	UE maximum output power	79
6.2.2	UE maximum output power reduction.....	81
6.2.3	UE additional maximum output power reduction.....	84
6.2.3.1	General	84
6.2.3.2	A-MPR for NS_04	89
6.2.3.3	A-MPR for NS_10	90
6.2.3.4	A-MPR for NS_05 and NS_05U.....	90
6.2.3.5	A-MPR for NS_40	93
6.2.3.6	A-MPR for NS_43 and NS_43U.....	93
6.2.3.7	A-MPR for NS_03 and NS_03U.....	94
6.2.3.8	A-MPR for NS_37	95
6.2.3.9	A-MPR for NS_38	95
6.2.3.10	A-MPR for NS_39	96
6.2.3.11	A-MPR for NS_41	96
6.2.3.12	A-MPR for NS_42	97
6.2.3.13	A-MPR for NS_18	97
6.2.3.14	A-MPR for NS_21	98
6.2.3.15	A-MPR for NS_24	98
6.2.3.16	A-MPR for NS_27	99
6.2.3.17	A-MPR for NS_46	100
6.2.3.18	A-MPR for NS_47	101
6.2.3.19	A-MPR for NS_50	102
6.2.3.20	A-MPR for NS_44	102
6.2.3.21	A-MPR for NS_12	103
6.2.3.22	A-MPR for NS_13	103
6.2.3.23	A-MPR for NS_14	104

6.2.3.24	A-MPR for NS_15	105
6.2.3.25	A-MPR for NS_45	105
6.2.3.26	A-MPR for NS_48	106
6.2.3.27	A-MPR for NS_49	106
6.2.3.28	A-MPR for NS_51	107
6.2.4	Configured transmitted power	108
6.2A	Transmitter power for CA	110
6.2A.1	UE maximum output power for CA	110
6.2A.1.1	UE maximum output power for Intra-band contiguous CA	110
6.2A.1.2	UE maximum output power for Intra-band non-contiguous CA	110
6.2A.1.3	UE maximum output power for Inter-band CA	111
6.2A.1.4	Void	114
6.2A.1.5	Void	114
6.2A.2	UE maximum output power reduction for CA	114
6.2A.2.1	UE maximum output power reduction for Intra-band contiguous CA	114
6.2A.2.2	UE maximum output power reduction for Intra-band non-contiguous CA	116
6.2A.2.2.1	MPR _{IM3} to meet -30dBm/MHz	116
6.2A.2.2.2	MPR _{IM3} to meet -13dBm/MHz	117
6.2A.2.3	UE maximum output power reduction for Inter-band CA	117
6.2A.2.4	Void	117
6.2A.3	UE additional maximum output power reduction for CA	117
6.2A.3.1.1	UE additional maximum output power reduction for Intra-band contiguous CA	117
6.2A.3.1.1.1	A-MPR for CA_NS_04	118
6.2A.3.1.2	UE additional maximum output power reduction for Intra-band non-contiguous CA	124
6.2A.3.1.3	UE additional maximum output power reduction for Inter-band CA	126
6.2A.4	Configured output power for CA	128
6.2A.4.1	Configured transmitted power level	128
6.2A.4.1.1	Configured transmitted power for Intra-band contiguous CA	128
6.2A.4.1.2	Configured transmitted power for Intra-band non-contiguous CA	130
6.2A.4.1.3	Configured transmitted power for Inter-band CA	132
6.2A.4.1.4	Void	134
6.2A.4.2	$\Delta T_{IB,c}$ for CA	134
6.2A.4.2.1	Void	134
6.2A.4.2.2	Void	134
6.2A.4.2.3	$\Delta T_{IB,c}$ for Inter-band CA (two bands)	134
6.2A.4.2.4	$\Delta T_{IB,c}$ for Inter-band CA (three bands)	139
6.2A.4.2.5	$\Delta T_{IB,c}$ for Inter-band CA (four bands)	142
6.2B	Transmitter power for NR-DC	142
6.2B.0	General	142
6.2B.1	UE maximum output power for NR-DC	142
6.2B.2	UE maximum output power reduction for NR-DC	143
6.2B.3	UE additional maximum output power reduction for NR-DC	143
6.2B.4	Configured output power for NR-DC	143
6.2B.4.1	Configured transmitted power level for NR-DC	143
6.2B.4.2	$\Delta T_{IB,c}$ for NR-DC	146
6.2C	Transmitter power for SUL	146
6.2C.1	Configured transmitted power for SUL	146
6.2C.2	$\Delta T_{IB,c}$	146
6.2D	Transmitter power for UL MIMO	147
6.2D.1	UE maximum output power for UL MIMO	147
6.2D.2	UE maximum output power reduction for UL MIMO	148
6.2D.3	UE additional maximum output power reduction for UL MIMO	149
6.2D.4	Configured transmitted power for UL MIMO	149
6.2E	Transmitter power for V2X	150
6.2E.1	UE maximum output power for V2X	150
6.2E.1.1	General	150
6.2E.1.2	UE maximum output power for V2X con-current operation	150
6.2E.2	UE maximum output power reduction for V2X	151
6.2E.2.1	General	151
6.2E.2.2	MPR for Power class 3 V2X UE	151
6.2E.2.3	MPR for Power class 3 V2X con-current operation	152
6.2E.3	UE additional maximum output power reduction for V2X	152

6.2E.3.1	General	152
6.2E.3.2	A-MPR for Power class 3 V2X UE by NS_33	153
6.2E.3.3	A-MPR for Power class 3 V2X UE by NS_52	155
6.2E.3.4	A-MPR for power class 3 V2X con-current operation.....	156
6.2E.4	Configured transmitted power for V2X	156
6.2E.4.1	General	156
6.2E.4.2	Configured transmitted power for V2X con-current operation	157
6.2F	Transmitter power for shared spectrum channel access	158
6.2F.1	UE maximum output power	158
6.2F.1A	UE maximum output power for CA.....	159
6.2F.1A.1	UE maximum output power for inter-band CA.....	159
6.2F.2	UE maximum output power reduction.....	159
6.2F.2A	UE maximum output power reduction for CA.....	160
6.2F.2A.1	UE maximum output power reduction for inter-band CA.....	160
6.2F.3	UE additional maximum output power reduction.....	160
6.2F.3.1	General	160
6.2F.3.2	A-MPR for NS_28	161
6.2F.3.3	A-MPR for NS_29	162
6.2F.3.4	A-MPR for NS_30	162
6.2F.3.5	A-MPR for NS_31	163
6.2F.3.6	A-MPR for NS_53	163
6.2F.3.7	A-MPR for NS_54	164
6.2F.3A	UE additional maximum output power reduction for CA.....	164
6.2F.3A.1	UE additional maximum output power reduction for inter-band CA.....	164
6.2F.4	Configured transmitted power.....	165
6.3	Output power dynamics.....	165
6.3.1	Minimum output power	165
6.3.2	Transmit OFF power.....	165
6.3.3	Transmit ON/OFF time mask	166
6.3.3.1	General	166
6.3.3.2	General ON/OFF time mask	166
6.3.3.3	Transmit power time mask for slot and short or long subslot boundaries.....	166
6.3.3.4	PRACH time mask.....	167
6.3.3.5	Void.....	168
6.3.3.6	SRS time mask	168
6.3.3.7	PUSCH-PUCCH and PUSCH-SRS time masks	169
6.3.3.8	Transmit power time mask for consecutive slot or long subslot transmission and short subslot transmission boundaries	171
6.3.3.9	Transmit power time mask for consecutive short subslot transmissions boundaries	171
6.3.4	Power control.....	172
6.3.4.1	General	172
6.3.4.2	Absolute power tolerance.....	172
6.3.4.3	Relative power tolerance	172
6.3.4.4	Aggregate power tolerance.....	173
6.3A	Output power dynamics for CA	173
6.3A.1	Minimum output power for CA	173
6.3A.1.1	Minimum output power for intra-band contiguous CA.....	173
6.3A.1.2	Minimum output power for intra-band non-contiguous CA	173
6.3A.1.3	Minimum output power for inter-band CA	174
6.3A.1.4	Void.....	174
6.3A.2	Transmit OFF power for CA.....	174
6.3A.2.1	Transmit OFF power for intra-band contiguous CA	174
6.3A.2.2	Transmit OFF power for intra-band non-contiguous CA	174
6.3A.2.3	Transmit OFF power for inter-band CA.....	174
6.3A.2.4	Void.....	174
6.3A.3	Transmit ON/OFF time mask for CA	174
6.3A.3.1	Transmit ON/OFF time mask for intra-band contiguous CA.....	174
6.3A.3.2	Transmit ON/OFF time mask for intra-band non-contiguous CA	174
6.3A.3.3	Transmit ON/OFF time mask for inter-band CA	175
6.3A.3.3.1	General	175
6.3A.3.3.2	Time mask for switching between two uplink carriers	175
6.3A.3.4	Void.....	176

6.3A.4	Power control for CA.....	176
6.3A.4.1	Power control for intra-band contiguous CA	176
6.3A.4.1.1	Absolute power tolerance	176
6.3A.4.1.2	Relative power tolerance	176
6.3A.4.1.3	Aggregate power control tolerance.....	176
6.3A.4.2	Power control for intra-band non-contiguous CA	176
6.3A.4.2.1	Absolute power tolerance.....	176
6.3A.4.2.1.1	Minimum requirements	177
6.3A.4.2.2	Relative power tolerance	177
6.3A.4.2.2.1	Minimum requirements	177
6.3A.4.2.3	Aggregate power control tolerance	177
6.3A.4.3	Power control for inter-band CA.....	177
6.3A.4.4	Void.....	177
6.3B	Output power dynamics for NR-DC.....	177
6.3C	Output power dynamics for SUL	177
6.3C.1	Void.....	177
6.3C.2	Void.....	177
6.3C.3	Transmit ON/OFF time mask for SUL	177
6.3C.3.1	Time mask for switching between two uplink carriers.....	177
6.3D	Output power dynamics for UL MIMO	178
6.3D.1	Minimum output power for UL MIMO	178
6.3D.2	Transmit OFF power for UL MIMO.....	178
6.3D.3	Transmit ON/OFF time mask for UL MIMO	179
6.3D.4	Power control for UL MIMO.....	179
6.3E	Output power dynamics for V2X.....	179
6.3E.1	Minimum output power for V2X.....	179
6.3E.1.1	General.....	179
6.3E.1.2	Minimum output power for V2X con-current operation.....	179
6.3E.2	Transmit OFF power for V2X	180
6.3E.2.1	General.....	180
6.3E.2.2	Transmit OFF power for V2X con-current operation	180
6.3E.3	Transmit ON/OFF time mask for V2X.....	180
6.3E.3.1	General.....	180
6.3E.3.2	General time mask.....	180
6.3E.3.3	S-SSB time mask.....	181
6.3E.3.4	Transmit ON/OFF time mask for V2X con-current operation.....	181
6.3E.4	Power control for V2X	181
6.3E.4.1	General.....	181
6.3E.4.2	Absolute power tolerance.....	181
6.3E.4.3	Power control for V2X con-current operation.....	181
6.3F	Output power dynamics for shared spectrum channel access.....	182
6.3F.1	Minimum output power	182
6.3F.2	Transmit OFF power.....	182
6.3F.3	Transmit ON/OFF time mask	182
6.3F.3.1	General	182
6.3F.3.2	General ON/OFF time mask	182
6.3F.3A	General ON/OFF mask for CA	182
6.3F.3A.1	General ON/OFF mask for inter-band CA	182
6.3F.4	Power control.....	183
6.3F.4.1	General	183
6.3F.4.2	Absolute power tolerance.....	183
6.3F.4.3	Relative power tolerance.....	183
6.3F.4.4	Aggregate power tolerance.....	183
6.4	Transmit signal quality.....	183
6.4.1	Frequency error.....	183
6.4.2	Transmit modulation quality.....	183
6.4.2.1	Error Vector Magnitude	183
6.4.2.1a	Error Vector Magnitude including symbols with transient period	184
6.4.2.2	Carrier leakage	185
6.4.2.3	In-band emissions	185
6.4.2.4	EVM equalizer spectrum flatness	186
6.4.2.4.1	Requirements for Pi/2 BPSK modulation.....	187

6.4A	Transmit signal quality for CA.....	188
6.4A.1	Frequency error for CA.....	188
6.4A.1.1	Frequency error for intra-band contiguous CA	188
6.4A.1.2	Frequency error for intra-band non-contiguous CA.....	188
6.4A.1.3	Frequency error for inter-band CA.....	188
6.4A.1.4	Void.....	189
6.4A.2	Transmit modulation quality for CA.....	189
6.4A.2.1	Transmit modulation quality for intra-band contiguous CA	189
6.4A.2.1.1	Error Vector Magnitude.....	189
6.4A.2.1.2	In-band emissions	189
6.4A.2.1.3	Carrier leakage.....	192
6.4A.2.2	Transmit modulation quality for intra-band non-contiguous CA	192
6.4A.2.2.1	Error Vector Magnitude	192
6.4A.2.2.2	In-band emissions	192
6.4A.2.3	Transmit modulation quality for inter-band CA.....	193
6.4A.2.4	Void.....	193
6.4B	Transmit signal quality for NR-DC.....	193
6.4D	Transmit signal quality for UL MIMO.....	193
6.4D.1	Frequency error for UL MIMO.....	193
6.4D.2	Transmit modulation quality for UL MIMO.....	193
6.4D.2.1	Error Vector Magnitude	194
6.4D.2.2	Carrier leakage	194
6.4D.2.3	In-band emissions	194
6.4D.2.4	EVM equalizer spectrum flatness for UL MIMO	194
6.4D.3	Time alignment error for UL MIMO.....	194
6.4D.4	Requirements for coherent UL MIMO.....	194
6.4E	Transmit signal quality for V2X.....	195
6.4E.1	Frequency error for V2X	195
6.4E.1.1	General	195
6.4E.1.2	Frequency error for V2X con-current operation	195
6.4E.2	Transmit modulation quality for V2X	195
6.4E.2.1	General	195
6.4E.2.2	Error Vector Magnitude for V2X.....	195
6.4E.2.3	Carrier leakage for V2X.....	196
6.4E.2.4	In-band emissions for V2X	196
6.4E.2.5	EVM equalizer spectrum flatness for V2X	196
6.4E.2.6	Transmit modulation quality for V2X con-current operation	196
6.4F	Transmit signal quality for shared spectrum channel access.....	196
6.4F.1	Frequency error.....	196
6.4F.2	Transmit modulation quality.....	196
6.4F.2.1	Error Vector Magnitude	196
6.4F.2.2	Carrier leakage	196
6.4F.2.3	In-band emissions	197
6.4F.2.4	EVM equalizer spectrum flatness	197
6.4F.2A	Transmit modulation quality for CA.....	198
6.4F.2A.1	Transmit modulation quality for inter-band CA.....	198
6.5	Output RF spectrum emissions.....	198
6.5.1	Occupied bandwidth	198
6.5.2	Out of band emission	198
6.5.2.1	General	198
6.5.2.2	Spectrum emission mask.....	198
6.5.2.3	Additional spectrum emission mask	199
6.5.2.3.1	Requirements for network signalling value "NS_35".....	199
6.5.2.3.2	Requirements for network signalling value "NS_04".....	200
6.5.2.3.3	Requirements for network signalling value "NS_03" and "NS_21"	200
6.5.2.3.4	Requirements for network signalling value "NS_06".....	201
6.5.2.3.5	Void.....	202
6.5.2.3.6	Void.....	202
6.5.2.3.7	Void.....	202
6.5.2.3.8	Requirements for network signalling value "NS_27"	202
6.5.2.4	Adjacent channel leakage ratio	202
6.5.2.4.1	NR ACLR.....	202

6.5.2.4.2	UTRA ACLR	203
6.5.3	Spurious emissions	203
6.5.3.1	General spurious emissions	204
6.5.3.2	Spurious emissions for UE co-existence	204
6.5.3.3	Additional spurious emissions	212
6.5.3.3.1	Requirement for network signalling value "NS_04"	212
6.5.3.3.2	Requirement for network signalling value "NS_17"	213
6.5.3.3.3	Requirement for network signalling value "NS_18"	213
6.5.3.3.4	Requirement for network signalling value "NS_05"	213
6.5.3.3.5	Requirement for network signalling value "NS_43"	213
6.5.3.3.6	Requirement for network signalling value "NS_37"	214
6.5.3.3.7	Requirement for network signalling value "NS_38"	214
6.5.3.3.8	Requirement for network signalling value "NS_39"	214
6.5.3.3.9	Requirement for network signalling value "NS_40"	214
6.5.3.3.10	Requirement for network signalling value "NS_41"	215
6.5.3.3.11	Requirement for network signalling value "NS_42"	215
6.5.3.3.12	Requirement for network signalling value "NS_21"	215
6.5.3.3.13	Requirement for network signalling value "NS_24"	215
6.5.3.3.14	Requirement for network signalling value "NS_27"	216
6.5.3.3.15	Requirement for network signalling value "NS_47"	216
6.5.3.3.16	Requirement for network signalling value "NS_50"	216
6.5.3.3.17	Requirement for network signalling value "NS_12"	217
6.5.3.3.18	Requirement for network signalling value "NS_13"	217
6.5.3.3.19	Requirement for network signalling value "NS_14"	217
6.5.3.3.20	Requirement for network signalling value "NS_15"	217
6.5.3.3.21	Requirement for network signalling value "NS_45"	218
6.5.3.3.22	Requirement for network signalling values "NS_48" and "NS_51"	218
6.5.3.3.23	Requirement for network signalling value "NS_49"	218
6.5.3.3.24	Requirement for network signalling value "NS_44"	219
6.5.3.3.25	Requirement for network signalling value "NS_46"	219
6.5.4	Transmit intermodulation	219
6.5A	Output RF spectrum emissions for CA	220
6.5A.1	Occupied bandwidth for CA	220
6.5A.1.1	Void	220
6.5A.1.1a	Occupied bandwidth for Intra-band contiguous CA	220
6.5A.1.2	Occupied bandwidth for Intra-band non-contiguous CA	220
6.5A.1.3	Occupied bandwidth for Inter-band CA	220
6.5A.2	Out of band emission for CA	220
6.5A.2.1	General	220
6.5A.2.2	Spectrum emission mask	221
6.5A.2.2.1	Spectrum emission mask for intra-band contiguous C	221
6.5A.2.2.2	Spectrum emission mask for intra-band non-contiguous CA	221
6.5A.2.2.3	Spectrum emission mask for Inter-band CA	221
6.5A.2.2.4	Void	222
6.5A.2.3	Additional spectrum emission mask for CA	222
6.5A.2.3.1	Additional spectrum emission mask for intra-band contiguous CA	222
6.5A.2.3.1	Void	222
6.5A.2.3.2	Additional spectrum emission mask for Intra-band non-contiguous CA	222
6.5A.2.3.2.1	Minimum requirement (network signalling value "CA_NC_NS_04")	222
6.5A.2.3.3	Additional spectrum emission mask for Inter-band CA	223
6.5A.2.4	Adjacent channel leakage ratio	223
6.5A.2.4.1	NR ACLR	223
6.5A.2.4.2	UTRA ACLR	224
6.5A.3	Spurious emission for CA	224
6.5A.3.1	General spurious emissions	224
6.5A.3.2	Spurious emissions for UE co-existence	225
6.5A.3.2.1	Spurious emissions for UE co-existence for intra-band contiguous CA	225
6.5A.3.2.2	Spurious emissions for UE co-existence for intra-band non-contiguous CA	226
6.5A.3.2.3	Spurious emissions for UE co-existence for Inter-band CA	227
6.5A.3.2.4	Void	237
6.5A.3.2.5	Void	237
6.5A.3.2.6	Void	237

6.5A.3.3	Additional spurious emissions for CA	237
6.5A.3.3.1	Additional spurious emissions for intra-band contiguous CA	237
6.5A.4	Transmit intermodulation for CA	238
6.5A.4.2.1	Transmit intermodulation for intra-band contiguous CA	238
6.5A.4.2.2	Void	238
6.5B	Output RF spectrum emissions for NR-DC	238
6.5D	Output RF spectrum emissions for UL MIMO	238
6.5D.1	Occupied bandwidth for UL MIMO	238
6.5D.2	Out of band emission for UL MIMO	239
6.5D.3	Spurious emission for UL MIMO	239
6.5D.4	Transmit intermodulation for UL MIMO	239
6.5E	Output RF spectrum emissions for V2X	239
6.5E.1	Occupied bandwidth for V2X	239
6.5E.1.1	General	239
6.5E.1.2	Occupied bandwidth for V2X con-current operation	240
6.5E.2	Out of band emission for V2X	240
6.5E.2.1	General	240
6.5E.2.2	Spectrum emission mask	240
6.5E.2.2.1	General	240
6.5E.2.2.2	Spectrum emission mask for V2X con-current operation	240
6.5E.2.3	Additional Spectrum emission mask	240
6.5E.2.3.1	Requirements for network signalling value "NS_33"	240
6.5E.2.3.2	Requirements for network signalling value "NS_52"	241
6.5E.2.4	Adjacent channel leakage ratio	241
6.5E.2.4.1	General	241
6.5E.2.4.2	ACLR for V2X con-current operation	241
6.5E.3	Spurious emissions for V2X	242
6.5E.3.1	General spurious emissions	242
6.5E.3.2	Spurious emissions for UE co-existence	242
6.5E.3.3	Spurious emissions for UE co-existence for V2X con-current operation	242
6.5E.3.4	Additional spurious emissions requirements for V2X	242
6.5E.3.4.1	General	242
6.5E.3.4.2	Requirements for network signalling value "NS_33"	243
6.5E.3.4.3	Void	243
6.5E.4	Transmit intermodulation	243
6.5E.4.1	General	243
6.5E.4.2	Transmit intermodulation for V2X con-current operation	243
6.5F	Output RF spectrum emissions	243
6.5F.1	Occupied bandwidth	243
6.5F.2	Out of band emission	244
6.5F.2.1	General	244
6.5F.2.2	Spectrum emission mask for operation with shared spectrum channel access	244
6.5F.2.2.1	Spectrum emission mask for non-transmitted channels	244
6.5F.2.3	Additional spectrum emission mask	245
6.5F.2.4	Adjacent channel leakage ratio	245
6.5F.2.4.1	Shared spectrum channel access ACLR	245
6.5F.2.4.2	Additional requirement for network signaled value "NS_29"	245
6.5F.3	Spurious emissions	245
6.5F.3.1	General spurious emissions	246
6.5F.3.2	Spurious emissions for UE co-existence	246
6.5F.3.3	Additional spurious emissions	246
6.5F.3.3.1	Requirement for network signalling value "NS_28"	246
6.5F.3.3.2	Requirement for network signalling value "NS_29"	246
6.5F.3.3.3	Requirement for network signalling value "NS_30"	248
6.5F.3.3.4	Requirement for network signalling value "NS_31"	249
6.5F.3.3.5	Requirements for network signalling value "NS_53" or "NS_54"	250
6.5F.4	Transmit intermodulation	250
6.6	Void	250
6.6E	Time alignment error	250
7	Receiver characteristics	251
7.1	General	251

7.1A	General	251
7.1F	General	252
7.2	Diversity characteristics	252
7.3	Reference sensitivity	252
7.3.1	General.....	252
7.3.2	Reference sensitivity power level	252
7.3.3	$\Delta R_{IB,c}$	259
7.3A	Reference sensitivity for CA	260
7.3A.1	General.....	260
7.3A.2	Reference sensitivity power level for CA	260
7.3A.2.1	Reference sensitivity power level for Intra-band contiguous CA	260
7.3A.2.2	Reference sensitivity power level for Intra-band non-contiguous CA	260
7.3A.2.3	Reference sensitivity power level for Inter-band CA	261
7.3A.2.4	Void.....	261
7.3A.3	$\Delta R_{IB,c}$ for CA	261
7.3A.3.1	General.....	261
7.3A.3.2	$\Delta R_{IB,c}$ for Inter-band CA.....	261
7.3A.3.2.1	$\Delta R_{IB,c}$ for two bands	263
7.3A.3.2.2	Void.....	266
7.3A.3.2.3	$\Delta R_{IB,c}$ for three bands	266
7.3A.3.2.4	$\Delta R_{IB,c}$ for four bands.....	269
7.3A.4	Reference sensitivity exceptions due to UL harmonic interference for CA.....	269
7.3A.5	Reference sensitivity exceptions due to intermodulation interference due to 2UL CA	274
7.3A.6	Reference sensitivity exceptions due to cross band isolation for CA	280
7.3B	Reference sensitivity for NR-DC.....	281
7.3C	Reference sensitivity for SUL	281
7.3C.1	General.....	281
7.3C.2	Reference sensitivity power level for SUL.....	281
7.3C.3	$\Delta R_{IB,c}$ for SUL	284
7.3C.3.1	General.....	284
7.3C.3.2	SUL band combination	284
7.3C.3.2.1	$\Delta R_{IB,c}$ for two bands	285
7.3D	Reference sensitivity for UL MIMO	285
7.3E	Reference sensitivity for V2X	285
7.3E.1	General.....	285
7.3E.2	Minimum requirements	285
7.3F	Reference sensitivity for shared spectrum channel access.....	287
7.3F.1	General.....	287
7.3F.2	Reference sensitivity power level	287
7.3F.3	$\Delta R_{IB,c}$	288
7.3F.4	Intra-band contiguous shared spectrum channel access CA	288
7.3F.5	Inter-band CA with shared spectrum channel access.....	289
7.3F.5.1	Reference sensitivity exceptions due to UL harmonic interference	289
7.3F.5.2	Reference sensitivity exceptions due to receiver harmonic mixing	289
7.3F.5.3	Reference sensitivity exceptions due to cross band isolation.....	290
7.4	Maximum input level	290
7.4A	Maximum input level for CA	291
7.4A.1	Maximum input level for Intra-band contiguous CA.....	291
7.4A.2	Maximum input level for Intra-band non-contiguous CA	291
7.4A.3	Maximum input level for Inter-band CA	291
7.4B	Maximum input level for NR-DC	291
7.4D	Maximum input level for UL MIMO	292
7.4E	Maximum input level for V2X	292
7.4E.1	General.....	292
7.4E.2	Maximum input level for V2X con-current operation	292
7.5	Adjacent channel selectivity.....	292
7.5A	Adjacent channel selectivity for CA.....	297
7.5A.1	Adjacent channel selectivity for Intra-band contiguous CA	297
7.5A.2	Adjacent channel selectivity Intra-band non-contiguous CA	299
7.5A.3	Adjacent channel selectivity Inter-band CA	300
7.5B	Adjacent channel selectivity for NR-DC.....	300
7.5D	Adjacent channel selectivity for UL MIMO.....	300

7.5E	Adjacent channel selectivity for V2X	300
7.5E.1	General.....	300
7.5E.2	Adjacent channel selectivity for V2X con-current operation.....	301
7.5F	Adjacent channel selectivity.....	301
7.5F.1	General.....	301
7.5F.2	Intra-band contiguous shared spectrum channel access CA	302
7.6	Blocking characteristics	303
7.6.1	General.....	303
7.6.2	In-band blocking.....	303
7.6.3	Out-of-band blocking.....	307
7.6.4	Narrow band blocking	310
7.6A	Blocking characteristics for CA	311
7.6A.1	General.....	311
7.6A.2	In-band blocking for CA.....	311
7.6A.2.1	In-band blocking for Intra-band contiguous CA	311
7.6A.2.2	In-band blocking for Intra-band non-contiguous CA.....	312
7.6A.2.3	In-band blocking for Inter-band CA.....	312
7.6A.3	Out-of-band blocking for CA.....	313
7.6A.3.1	Out-of-band blocking for Intra-band contiguous CA	313
7.6A.3.2	Out-of-band blocking for Intra-band non-contiguous CA.....	314
7.6A.3.3	Out-of-band blocking for Inter-band CA	314
7.6A.4	Narrow band blocking for CA	316
7.6A.4.1	Narrow band blocking for Intra-band contiguous CA.....	316
7.6A.4.2	Narrow band blocking for Intra-band non-contiguous CA	316
7.6A.4.3	Narrow band blocking for Inter-band CA	316
7.6B	Blocking characteristics for NR-DC.....	317
7.6C	Blocking characteristics for SUL	317
7.6C.1	General.....	317
7.6C.2	In-band blocking for SUL.....	317
7.6C.3	Out-of-band blocking for SUL.....	317
7.6C.4	Narrow band blocking for SUL	318
7.6D	Blocking characteristics for UL MIMO	318
7.6E	Blocking characteristics for V2X.....	318
7.6E.1	General.....	318
7.6E.2	In-band blocking.....	318
7.6E.2.1	General	318
7.6E.2.2	In-band blocking for V2X con-current operation	319
7.6E.3	Out-of-band blocking.....	319
7.6E.3.1	General	319
7.6E.3.2	Out-of-band blocking for V2X con-current operation	320
7.6F	Blocking characteristics	320
7.6F.1	General.....	320
7.6F.2	In-band blocking.....	320
7.6F.2.1	General	320
7.6F.2.2	Intra-band contiguous shared spectrum channel access CA.....	321
7.6F.3	Out-of-band blocking.....	322
7.6F.3.1	General	322
7.6F.3.2	Intra-band contiguous shared spectrum channel access CA.....	323
7.7	Spurious response.....	323
7.7A	Spurious response for CA.....	325
7.7A.1	Spurious response for Intra-band contiguous CA	325
7.7A.2	Spurious response for Intra-band non-contiguous CA.....	325
7.7A.3	Spurious response for Inter-band CA.....	325
7.7B	Spurious response for NR-DC.....	325
7.7D	Spurious response for UL MIMO.....	326
7.7E	Spurious response for V2X	326
7.7E.1	General.....	326
7.7E.2	Spurious response for V2X con-current operation.....	326
7.7F	Spurious response for shared spectrum channel access.....	326
7.7F.1	General.....	326
7.7F.2	Intra-band contiguous shared spectrum channel access CA	327
7.8	Intermodulation characteristics	327

7.8.1	General.....	327
7.8.2	Wide band Intermodulation	327
7.8A	Intermodulation characteristics for CA	330
7.8A.1	General.....	330
7.8A.2	Wide band intermodulation for CA	330
7.8A.2.1	Wide band intermodulation for Intra-band contiguous CA.....	330
7.8A.2.2	Wide band intermodulation for Intra-band non-contiguous CA.....	331
7.8A.2.3	Wide band intermodulation for Inter-band CA	331
7.8B	Intermodulation characteristics for NR-DC	331
7.8D	Intermodulation characteristics for UL MIMO	332
7.8E	Intermodulation characteristics for V2X	332
7.8E.1	General.....	332
7.8E.2	Wide band Intermodulation	332
7.8E.3	Intermodulation for V2X con-current operation	332
7.8F	Intermodulation characteristics for shared spectrum channel access	332
7.8F.1	General.....	332
7.8F.2	Wide band Intermodulation	333
7.9	Spurious emissions	333
7.9A	Spurious emissions for CA.....	334
7.9A.1	Void	334
7.9A.2	Void	334
7.9A.3	Spurious emissions for Inter-band CA.....	334
7.9B	Spurious emissions for NR-DC	334
Annex A (normative):	Measurement channels.....	335
A.1	General	335
A.2	UL reference measurement channels.....	335
A.2.1	General	335
A.2.2	Reference measurement channels.....	336
A.2.2.1	DFT-s-OFDM Pi/2-BPSK	336
A.2.2.2	DFT-s-OFDM QPSK.....	337
A.2.2.3	DFT-s-OFDM 16QAM.....	338
A.2.2.4	DFT-s-OFDM 64QAM.....	339
A.2.2.5	DFT-s-OFDM 256QAM.....	340
A.2.2.6	CP-OFDM QPSK	341
A.2.2.7	CP-OFDM 16QAM	343
A.2.2.8	CP-OFDM 64QAM	345
A.2.2.9	CP-OFDM 256QAM	346
A.2.3	Reference measurement channels for TDD.....	347
A.2.3.1	DFT-s-OFDM Pi/2-BPSK	347
A.2.3.2	DFT-s-OFDM QPSK.....	347
A.2.3.3	DFT-s-OFDM 16QAM.....	347
A.2.3.4	DFT-s-OFDM 64QAM.....	347
A.2.3.5	DFT-s-OFDM 256QAM.....	348
A.2.3.6	CP-OFDM QPSK	348
A.2.3.7	CP-OFDM 16QAM	348
A.2.3.8	CP-OFDM 64QAM	348
A.2.3.9	CP-OFDM 256QAM	349
A.3	DL reference measurement channels	350
A.3.1	General	350
A.3.2	DL reference measurement channels for FDD	351
A.3.2.1	General.....	351
A.3.2.2	FRC for receiver requirements for QPSK.....	351
A.3.2.3	FRC for maximum input level for 64QAM	353
A.3.2.4	FRC for maximum input level for 256 QAM	356
A.3.3	DL reference measurement channels for TDD.....	359
A.3.3.1	General.....	359
A.3.3.2	FRC for receiver requirements for QPSK.....	360
A.3.3.3	FRC for maximum input level for 64QAM	363
A.3.3.4	FRC for maximum input level for 256 QAM	366

A.4	CSI reference measurement channels.....	369
A.5	OFDMA Channel Noise Generator (OCNG)	369
A.5.1	OCNG Patterns for FDD	369
A.5.1.1	OCNG FDD pattern 1: Generic OCNG FDD Pattern for all unused REs.....	369
A.5.2	OCNG Patterns for TDD	369
A.5.2.1	OCNG TDD pattern 1: Generic OCNG TDD Pattern for all unused REs	369
A.6	Void.....	370
A.7	V2X reference measurement channels.....	370
A.7.1	General	370
A.7.2	FRC for V2X receiver requirements for QPSK.....	370
A.7.3	FRC for maximum input level for 64QAM.....	372
A.7.4	FRC for maximum input level for 256QAM.....	373
Annex B (informative):	Void	376
Annex C (informative):	Downlink physical channels.....	377
C.1	General	377
C.2	Setup.....	377
C.3	Connection	377
C.3.1	Measurement of Receiver Characteristics	377
Annex D (normative):	Characteristics of the interfering signal	378
D.1	General.....	378
D.2	Interference signals.....	378
Annex E (normative):	Environmental conditions	380
E.1	General	380
E.2	Environmental	380
E.2.1	Temperature	380
E.2.2	Voltage	380
E.2.3	Vibration.....	381
Annex F (normative):	Transmit modulation.....	382
F.0	General	382
F.1	Measurement Point.....	382
F.2	Basic Error Vector Magnitude measurement	382
F.3	Basic in-band emissions measurement.....	383
F.4	Modified signal under test.....	383
F.5	Window length	386
F.5.1	Timing offset	386
F.5.2	Window length	386
F.5.3	Window length for normal CP	386
F.5.4	Window length for Extended CP.....	387
F.5.5	Window length for PRACH	388
F.6	Averaged EVM	389
F.7	Spectrum Flatness	390
Annex G (informative):	Void	391
Annex H (informative):	Void	392