

ETSI TS 138 101-1 v16.14.0 (2023-01)



iTeh STANDA~~NDAR~~ PREVIEW
5G;
NR;
User Equipment (UE) radio transmission and reception;
Part 1: Range 1 Standalone
(3GPP TS 38.101-1 version 16.14.0 Release 16)

<https://standards.iteh.ai/catalog/standards/sist/5cf14421-e450-4f1b-8e56-b3521ce42187/etsi-ts-138-101-1-v16-14-0-2023-01>



Reference
RTS/TSGR-0438101-1vge0
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 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 2023.
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	26
5.2A.2.1 Inter-band CA (two bands).....	27
5.2A.2.2 Inter-band CA (three bands).....	28
5.2A.2.3 Inter-band CA (four bands).....	29
5.2B Operating bands for DC	29
5.2C Operating band combination for SUL	30
5.2D Operating bands for UL MIMO	30
5.2E Operating band for V2X.....	31
5.2E.1 V2X operating bands	31
5.2E.2 V2X operating bands for con-current operation	31
5.3 UE channel bandwidth	32
5.3.1 General.....	32
5.3.2 Maximum transmission bandwidth configuration	32
5.3.3 Minimum guardband and transmission bandwidth configuration.....	32
5.3.4 RB alignment.....	34
5.3.5 UE channel bandwidth per operating band	35
5.3.6 Asymmetric channel bandwidths	37
5.3A UE channel bandwidth for CA	38
5.3A.1 General.....	38
5.3A.2 Maximum transmission bandwidth configuration for CA	38
5.3A.3 Minimum guardband and transmission bandwidth configuration for CA	39
5.3A.4 Void	40
5.3A.5 UE channel bandwidth per operating band for CA	40
5.3E Channel bandwidth for V2X	41
5.3E.1 General.....	41
5.3E.2 Channel bandwidth for V2X concurrent operation	42
5.4 Channel arrangement.....	42
5.4.1 Channel spacing	42
5.4.1.1 Channel spacing for adjacent NR carriers	42
5.4.2 Channel raster	42
5.4.2.1 NR-ARFCN and channel raster	42
5.4.2.2 Channel raster to resource element mapping.....	43
5.4.2.3 Channel raster entries for each operating band	43

5.4.3	Synchronization raster	46
5.4.3.1	Synchronization raster and numbering	46
5.4.3.3	Synchronization raster entries for each operating band	46
5.4.4	TX-RX frequency separation	47
5.4A	Channel arrangement for CA	48
5.4A.1	Channel spacing for CA	48
5.4A.2	Channel raster for CA	49
5.4A.3	Synchronization raster for CA	49
5.4A.4	Tx-Rx frequency separation for CA	49
5.4B	Reserved	49
5.4C	Reserved	49
5.4D	Reserved	49
5.4E	Channel arrangement for V2X	49
5.4E.1	Channel spacing	49
5.4E.2	Channel raster	49
5.4E.2.1	NR-ARFCN and channel raster	49
5.4E.2.2	Channel raster to resource element mapping	50
5.4E.2.3	Channel raster entries for each operating band	50
5.4E.3	Synchronization raster for V2X	50
5.5	Void	50
5.5A	Configurations for CA	50
5.5A.0	General	50
5.5A.1	Configurations for intra-band contiguous CA	50
5.5A.2	Configurations for intra-band non-contiguous CA	52
5.5A.3	Configurations for inter-band CA	53
5.5A.3.1	Configurations for inter-band CA (two bands)	53
5.5A.3.2	Configurations for inter-band CA (three bands)	63
5.5A.3.3	Configurations for inter-band CA (four bands)	69
5.5B	Configurations for DC	72
5.5C	Configurations for SUL	72
6	Transmitter characteristics	74
6.1	General	74
6.1A	General	74
6.1F	General	74
6.2	Transmitter power	74
6.2.1	UE maximum output power	74
6.2.2	UE maximum output power reduction	76
6.2.3	UE additional maximum output power reduction	78
6.2.3.1	General	78
6.2.3.2	A-MPR for NS_04	81
6.2.3.3	A-MPR for NS_10	82
6.2.3.4	A-MPR for NS_05 and NS_05U	82
6.2.3.5	A-MPR for NS_40	84
6.2.3.6	A-MPR for NS_43 and NS_43U	85
6.2.3.7	A-MPR for NS_03 and NS_03U	86
6.2.3.8	A-MPR for NS_37	86
6.2.3.9	A-MPR for NS_38	87
6.2.3.10	A-MPR for NS_39	87
6.2.3.11	A-MPR for NS_41	87
6.2.3.12	A-MPR for NS_42	88
6.2.3.13	A-MPR for NS_18	88
6.2.3.14	A-MPR for NS_21	89
6.2.3.15	A-MPR for NS_24	89
6.2.3.16	A-MPR for NS_27	90
6.2.3.17	A-MPR for NS_46	91
6.2.3.18	A-MPR for NS_47	92
6.2.3.19	A-MPR for NS_50	92
6.2.3.20	A-MPR for NS_44	93
6.2.3.21	A-MPR for NS_12	93
6.2.3.22	A-MPR for NS_13	94
6.2.3.23	A-MPR for NS_14	94

6.2.3.24	A-MPR for NS_15	95
6.2.3.25	A-MPR for NS_45	95
6.2.3.26	A-MPR for NS_48	96
6.2.3.27	A-MPR for NS_49	96
6.2.3.28	A-MPR for NS_51	97
6.2.4	Configured transmitted power	98
6.2A	Transmitter power for CA	100
6.2A.1	UE maximum output power for CA	100
6.2A.1.1	UE maximum output power for Intra-band contiguous CA	100
6.2A.1.2	UE maximum output power for Intra-band non-contiguous CA	100
6.2A.1.3	UE maximum output power for Inter-band CA	100
6.2A.1.4	Void	102
6.2A.1.5	Void	102
6.2A.2	UE maximum output power reduction for CA	102
6.2A.2.1	UE maximum output power reduction for Intra-band contiguous CA	102
6.2A.2.2	UE maximum output power reduction for Intra-band non-contiguous CA	104
6.2A.2.2.0	General	104
6.2A.2.2.1	MPR to meet -30dBm/MHz	105
6.2A.2.2.2	MPR to meet -13dBm/MHz	105
6.2A.2.3	UE maximum output power reduction for Inter-band CA	105
6.2A.2.4	Void	106
6.2A.3	UE additional maximum output power reduction for CA	106
6.2A.3.1.1	UE additional maximum output power reduction for Intra-band contiguous CA	106
6.2A.3.1.1.1	A-MPR for CA_NS_04	106
6.2A.3.1.2	UE additional maximum output power reduction for Intra-band non-contiguous CA	112
6.2A.3.1.3	UE additional maximum output power reduction for Inter-band CA	114
6.2A.4	Configured output power for CA	116
6.2A.4.1	Configured transmitted power level	116
6.2A.4.1.1	Configured transmitted power for Intra-band contiguous CA	116
6.2A.4.1.2	Configured transmitted power for Intra-band non-contiguous CA	118
6.2A.4.1.3	Configured transmitted power for Inter-band CA	120
6.2A.4.1.4	Void	122
6.2A.4.2	$\Delta T_{IB,c}$ for CA	122
6.2A.4.2.1	$\Delta T_{IB,c}$ for NR-DC	123
6.2A.4.2.2	Void	123
6.2A.4.2.3	$\Delta T_{IB,c}$ for Inter-band CA (two bands)	123
6.2A.4.2.4	$\Delta T_{IB,c}$ for Inter-band CA (three bands)	125
6.2A.4.2.5	$\Delta T_{IB,c}$ for Inter-band CA (four bands)	127
6.2B	Transmitter power for NR-DC	128
6.2B.0	General	128
6.2B.1	UE maximum output power for NR-DC	128
6.2B.2	UE maximum output power reduction for NR-DC	128
6.2B.3	UE additional maximum output power reduction for NR-DC	128
6.2B.4	Configured output power for NR-DC	129
6.2B.4.1	Configured transmitted power level for NR-DC	129
6.2B.4.2	$\Delta T_{IB,c}$ for NR-DC	132
6.2C	Transmitter power for SUL	132
6.2C.1	Configured transmitted power for SUL	132
6.2C.2	$\Delta T_{IB,c}$	132
6.2D	Transmitter power for UL MIMO	133
6.2D.1	UE maximum output power for UL MIMO	133
6.2D.2	UE maximum output power reduction for UL MIMO	134
6.2D.3	UE additional maximum output power reduction for UL MIMO	134
6.2D.4	Configured transmitted power for UL MIMO	134
6.2E	Transmitter power for V2X	135
6.2E.1	UE maximum output power for V2X	135
6.2E.1.1	General	135
6.2E.1.2	UE maximum output power for V2X con-current operation	136
6.2E.2	UE maximum output power reduction for V2X	136
6.2E.2.1	General	136
6.2E.2.2	MPR for Power class 3 V2X UE	136
6.2E.2.3	MPR for Power class 3 V2X con-current operation	137

6.2E.3	UE additional maximum output power reduction for V2X.....	138
6.2E.3.1	General.....	138
6.2E.3.2	A-MPR for Power class 3 V2X UE by NS_33	138
6.2E.3.3	A-MPR for Power class 3 V2X UE by NS_52	140
6.2E.3.4	A-MPR for power class 3 V2X con-current operation.....	141
6.2E.4	Configured transmitted power for V2X	141
6.2E.4.1	General.....	141
6.2E.4.2	Configured transmitted power for V2X con-current operation.....	142
6.2F	Transmitter power for shared spectrum channel access	143
6.2F.1	UE maximum output power.....	143
6.2F.1A	UE maximum output power for CA.....	144
6.2F.1A.1	UE maximum output power for inter-band CA.....	144
6.2F.2	UE maximum output power reduction.....	144
6.2F.2A	UE maximum output power reduction for CA.....	145
6.2F.2A.1	UE maximum output power reduction for inter-band CA.....	145
6.2F.3	UE additional maximum output power reduction.....	145
6.2F.3.1	General.....	145
6.2F.3.2	A-MPR for NS_28	146
6.2F.3.3	A-MPR for NS_29	146
6.2F.3.4	A-MPR for NS_30	147
6.2F.3.5	A-MPR for NS_31	147
6.2F.3.6	A-MPR for NS_53	148
6.2F.3.7	A-MPR for NS_54	148
6.2F.3A	UE additional maximum output power reduction for CA.....	149
6.2F.3A.1	UE additional maximum output power reduction for inter-band CA.....	149
6.2F.4	Configured transmitted power	149
6.3	Output power dynamics.....	149
6.3.1	Minimum output power	149
6.3.2	Transmit OFF power.....	150
6.3.3	Transmit ON/OFF time mask	150
6.3.3.1	General.....	150
6.3.3.2	General ON/OFF time mask	151
6.3.3.3	Transmit power time mask for slot and short or long subslot boundaries.....	151
6.3.3.4	PRACH time mask.....	151
6.3.3.5	Void.....	152
6.3.3.6	SRS time mask	152
6.3.3.7	PUSCH-PUCCH and PUSCH-SRS time masks	154
6.3.3.8	Transmit power time mask for consecutive slot or long subslot transmission and short subslot transmission boundaries	155
6.3.3.9	Transmit power time mask for consecutive short subslot transmissions boundaries	155
6.3.4	Power control.....	156
6.3.4.1	General.....	156
6.3.4.2	Absolute power tolerance.....	156
6.3.4.3	Relative power tolerance.....	157
6.3.4.4	Aggregate power tolerance.....	157
6.3A	Output power dynamics for CA	158
6.3A.1	Minimum output power for CA	158
6.3A.1.1	Minimum output power for intra-band contiguous CA.....	158
6.3A.1.2	Minimum output power for intra-band non-contiguous CA	158
6.3A.1.3	Minimum output power for inter-band CA	158
6.3A.1.4	Void.....	158
6.3A.2	Transmit OFF power for CA.....	158
6.3A.2.1	Transmit OFF power for intra-band contiguous CA	158
6.3A.2.2	Transmit OFF power for intra-band non-contiguous CA	158
6.3A.2.3	Transmit OFF power for inter-band CA.....	158
6.3A.2.4	Void.....	159
6.3A.3	Transmit ON/OFF time mask for CA	159
6.3A.3.1	Transmit ON/OFF time mask for intra-band contiguous CA.....	159
6.3A.3.2	Transmit ON/OFF time mask for intra-band non-contiguous CA	159
6.3A.3.3	Transmit ON/OFF time mask for inter-band CA	159
6.3A.3.3.1	General	159
6.3A.3.3.2	Time mask for switching between two uplink carriers	159

6.3A.3.4	Void.....	160
6.3A.4	Power control for CA.....	160
6.3A.4.1	Power control for intra-band contiguous CA	160
6.3A.4.1.1	Absolute power tolerance	160
6.3A.4.1.2	Relative power tolerance	160
6.3A.4.1.3	Aggregate power control tolerance.....	161
6.3A.4.2	Power control for intra-band non-contiguous CA	161
6.3A.4.2.1	Absolute power tolerance.....	161
6.3A.4.2.1.1	Minimum requirements	161
6.3A.4.2.2	Relative power tolerance.....	161
6.3A.4.2.2.1	Minimum requirements	161
6.3A.4.2.3	Aggregate power control tolerance	162
6.3A.4.3	Power control for inter-band CA.....	162
6.3A.4.4	Void.....	162
6.3B	Output power dynamics for NR-DC.....	162
6.3C	Output power dynamics for SUL	162
6.3C.1	Void	162
6.3C.2	Void	162
6.3C.3	Transmit ON/OFF time mask for SUL	162
6.3C.3.1	Time mask for switching between two uplink carriers.....	162
6.3D	Output power dynamics for UL MIMO	163
6.3D.1	Minimum output power for UL MIMO	163
6.3D.2	Transmit OFF power for UL MIMO.....	163
6.3D.3	Transmit ON/OFF time mask for UL MIMO	163
6.3D.4	Power control for UL MIMO.....	163
6.3E	Output power dynamics for V2X	164
6.3E.1	Minimum output power for V2X.....	164
6.3E.1.1	General.....	164
6.3E.1.2	Minimum output power for V2X con-current operation.....	164
6.3E.2	Transmit OFF power for V2X	164
6.3E.2.1	General.....	164
6.3E.2.2	Transmit OFF power for V2X con-current operation	165
6.3E.3	Transmit ON/OFF time mask for V2X	165
6.3E.3.1	General.....	165
6.3E.3.2	General time mask.....	165
6.3E.3.3	S-SSB time mask	165
6.3E.3.4	Transmit ON/OFF time mask for V2X con-current operation	166
6.3E.4	Power control for V2X	166
6.3E.4.1	General.....	166
6.3E.4.2	Absolute power tolerance.....	166
6.3E.4.3	Power control for V2X con-current operation.....	166
6.3F	Output power dynamics for shared spectrum channel access.....	167
6.3F.1	Minimum output power	167
6.3F.2	Transmit OFF power.....	167
6.3F.3	Transmit ON/OFF time mask	167
6.3F.3.1	General	167
6.3F.3.2	General ON/OFF time mask	167
6.3F.3A	General ON/OFF mask for CA	167
6.3F.3A.1	General ON/OFF mask for inter-band CA	167
6.3F.4	Power control.....	168
6.3F.4.1	General.....	168
6.3F.4.2	Absolute power tolerance.....	168
6.3F.4.3	Relative power tolerance.....	168
6.3F.4.4	Aggregate power tolerance.....	168
6.4	Transmit signal quality	168
6.4.1	Frequency error.....	168
6.4.2	Transmit modulation quality	168
6.4.2.0	General.....	168
6.4.2.1	Error Vector Magnitude	168
6.4.2.1a	Error Vector Magnitude including symbols with transient period	169
6.4.2.2	Carrier leakage	170
6.4.2.3	In-band emissions	170

6.4.2.4	EVM equalizer spectrum flatness	171
6.4.2.4.1	Requirements for Pi/2 BPSK modulation.....	172
6.4A	Transmit signal quality for CA.....	173
6.4A.1	Frequency error for CA.....	173
6.4A.1.1	Frequency error for intra-band contiguous CA	173
6.4A.1.2	Frequency error for intra-band non-contiguous CA	173
6.4A.1.3	Frequency error for inter-band CA.....	173
6.4A.1.4	Void.....	174
6.4A.2	Transmit modulation quality for CA.....	174
6.4A.2.1	Transmit modulation quality for intra-band contiguous CA	174
6.4A.2.1.0	General	174
6.4A.2.1.1	Error Vector Magnitude.....	174
6.4A.2.1.2	In-band emissions.....	174
6.4A.2.1.3	Carrier leakage.....	176
6.4A.2.2	Transmit modulation quality for intra-band non-contiguous CA	177
6.4A.2.2.0	General	177
6.4A.2.2.1	Error Vector Magnitude.....	177
6.4A.2.2.2	In-band emissions.....	177
6.4A.2.2.3	Carrier leakage.....	177
6.4A.2.3	Transmit modulation quality for inter-band CA.....	178
6.4A.2.4	Void.....	178
6.4B	Transmit signal quality for NR-DC.....	178
6.4D	Transmit signal quality for UL MIMO.....	178
6.4D.0	General.....	178
6.4D.1	Frequency error for UL MIMO.....	178
6.4D.2	Transmit modulation quality for UL MIMO.....	178
6.4D.2.0	General.....	178
6.4D.2.1	Error Vector Magnitude	179
6.4D.2.2	Carrier leakage	179
6.4D.2.3	In-band emissions	179
6.4D.2.4	EVM equalizer spectrum flatness for UL MIMO	179
6.4D.3	Time alignment error for UL MIMO	179
6.4D.4	Requirements for coherent UL MIMO	179
6.4E	Transmit signal quality for V2X.....	180
6.4E.1	Frequency error for V2X.....	180
6.4E.1.1	General	180
6.4E.1.2	Frequency error for V2X con-current operation	180
6.4E.2	Transmit modulation quality for V2X	180
6.4E.2.1	General	180
6.4E.2.2	Error Vector Magnitude for V2X	181
6.4E.2.3	Carrier leakage for V2X.....	181
6.4E.2.4	In-band emissions for V2X	181
6.4E.2.5	EVM equalizer spectrum flatness for V2X	181
6.4E.2.6	Transmit modulation quality for V2X con-current operation	181
6.4F	Transmit signal quality for shared spectrum channel access.....	181
6.4F.1	Frequency error.....	181
6.4F.2	Transmit modulation quality.....	181
6.4F.2.0	General	181
6.4F.2.1	Error Vector Magnitude	182
6.4F.2.2	Carrier leakage	182
6.4F.2.3	In-band emissions	182
6.4F.2.4	EVM equalizer spectrum flatness	183
6.4F.2A	Transmit modulation quality for CA.....	183
6.4F.2A.1	Transmit modulation quality for inter-band CA.....	183
6.5	Output RF spectrum emissions.....	183
6.5.1	Occupied bandwidth	183
6.5.2	Out of band emission	183
6.5.2.1	General	183
6.5.2.2	Spectrum emission mask	183
6.5.2.3	Additional spectrum emission mask	184
6.5.2.3.1	Requirements for network signalling value "NS_35"	184
6.5.2.3.2	Requirements for network signalling value "NS_04"	185

6.5.2.3.3	Requirements for network signalling values "NS_03", "NS_03U", and "NS_21"	185
6.5.2.3.4	Requirements for network signalling value "NS_06"	186
6.5.2.3.5	Void	187
6.5.2.3.6	Void	187
6.5.2.3.7	Void	187
6.5.2.3.8	Requirements for network signalling value "NS_27"	187
6.5.2.4	Adjacent channel leakage ratio	187
6.5.2.4.1	NR ACLR	187
6.5.2.4.2	UTRA ACLR	188
6.5.3	Spurious emissions	188
6.5.3.0	General	188
6.5.3.1	General spurious emissions	189
6.5.3.2	Spurious emissions for UE co-existence	189
6.5.3.3	Additional spurious emissions	195
6.5.3.3.1	Requirement for network signalling value "NS_04"	195
6.5.3.3.2	Requirement for network signalling value "NS_17"	196
6.5.3.3.3	Requirement for network signalling value "NS_18"	196
6.5.3.3.4	Requirement for network signalling values "NS_05" and "NS_05U"	196
6.5.3.3.5	Requirement for network signalling values "NS_43" and "NS_43U"	196
6.5.3.3.6	Requirement for network signalling value "NS_37"	197
6.5.3.3.7	Requirement for network signalling value "NS_38"	197
6.5.3.3.8	Requirement for network signalling value "NS_39"	197
6.5.3.3.9	Requirement for network signalling value "NS_40"	197
6.5.3.3.10	Requirement for network signalling value "NS_41"	198
6.5.3.3.11	Requirement for network signalling value "NS_42"	198
6.5.3.3.12	Requirement for network signalling value "NS_21"	198
6.5.3.3.13	Requirement for network signalling value "NS_24"	198
6.5.3.3.14	Requirement for network signalling value "NS_27"	199
6.5.3.3.15	Requirement for network signalling value "NS_47"	199
6.5.3.3.16	Requirement for network signalling value "NS_50"	199
6.5.3.3.17	Requirement for network signalling value "NS_12"	200
6.5.3.3.18	Requirement for network signalling value "NS_13"	200
6.5.3.3.19	Requirement for network signalling value "NS_14"	200
6.5.3.3.20	Requirement for network signalling value "NS_15"	200
6.5.3.3.21	Requirement for network signalling value "NS_45"	201
6.5.3.3.22	Requirement for network signalling values "NS_48" and "NS_51"	201
6.5.3.3.23	Requirement for network signalling value "NS_49"	201
6.5.3.3.24	Requirement for network signalling value "NS_44"	202
6.5.3.3.25	Requirement for network signalling value "NS_46"	202
6.5.4	Transmit intermodulation	202
6.5A	Output RF spectrum emissions for CA	203
6.5A.0	General	203
6.5A.1	Occupied bandwidth for CA	203
6.5A.1.1	Void	203
6.5A.1.1a	Occupied bandwidth for Intra-band contiguous CA	203
6.5A.1.2	Occupied bandwidth for Intra-band non-contiguous CA	203
6.5A.1.3	Occupied bandwidth for Inter-band CA	203
6.5A.2	Out of band emission for CA	203
6.5A.2.1	General	203
6.5A.2.2	Spectrum emission mask	203
6.5A.2.2.1	Spectrum emission mask for intra-band contiguous CA	203
6.5A.2.2.2	Spectrum emission mask for intra-band non-contiguous CA	204
6.5A.2.2.3	Spectrum emission mask for Inter-band CA	204
6.5A.2.2.4	Void	204
6.5A.2.3	Additional spectrum emission mask for CA	204
6.5A.2.3.1	Additional spectrum emission mask for intra-band contiguous CA	204
6.5A.2.3.1	Void	205
6.5A.2.3.2	Additional spectrum emission mask for Intra-band non-contiguous CA	205
6.5A.2.3.2.1	Minimum requirement (network signalling value "CA_NC_NS_04")	205
6.5A.2.3.3	Additional spectrum emission mask for Inter-band CA	205
6.5A.2.4	Adjacent channel leakage ratio	205
6.5A.2.4.1	NR ACLR	205

6.5A.2.4.2	UTRA ACLR	206
6.5A.3	Spurious emission for CA	207
6.5A.3.1	General spurious emissions	207
6.5A.3.2	Spurious emissions for UE co-existence	207
6.5A.3.2.1	Spurious emissions for UE co-existence for intra-band contiguous CA	207
6.5A.3.2.2	Spurious emissions for UE co-existence for intra-band non-contiguous CA	208
6.5A.3.2.3	Spurious emissions for UE co-existence for Inter-band CA	209
6.5A.3.2.4	Void	218
6.5A.3.2.5	Void	218
6.5A.3.2.6	Void	218
6.5A.3.3	Additional spurious emissions for CA	218
6.5A.3.3.1	Additional spurious emissions for intra-band contiguous CA	218
6.5A.3.3.2	Additional spurious emissions for intra-band non-contiguous CA	219
6.5A.4	Transmit intermodulation for CA	219
6.5A.4.2.1	Transmit intermodulation for intra-band contiguous CA	219
6.5A.4.2.2	Void	219
6.5B	Output RF spectrum emissions for NR-DC	219
6.5D	Output RF spectrum emissions for UL MIMO	219
6.5D.1	Occupied bandwidth for UL MIMO	219
6.5D.2	Out of band emission for UL MIMO	220
6.5D.3	Spurious emission for UL MIMO	220
6.5D.4	Transmit intermodulation for UL MIMO	220
6.5E	Output RF spectrum emissions for V2X	220
6.5E.1	Occupied bandwidth for V2X	220
6.5E.1.1	General	220
6.5E.1.2	Occupied bandwidth for V2X con-current operation	221
6.5E.2	Out of band emission for V2X	221
6.5E.2.1	General	221
6.5E.2.2	Spectrum emission mask	221
6.5E.2.2.1	General	221
6.5E.2.2.2	Spectrum emission mask for V2X con-current operation	221
6.5E.2.3	Additional Spectrum emission mask	221
6.5E.2.3.1	Requirements for network signalling value "NS_33"	221
6.5E.2.3.2	Requirements for network signalling value "NS_52"	222
6.5E.2.4	Adjacent channel leakage ratio	222
6.5E.2.4.1	General	222
6.5E.2.4.2	ACLR for V2X con-current operation	223
6.5E.3	Spurious emissions for V2X	223
6.5E.3.1	General spurious emissions	223
6.5E.3.2	Spurious emissions for UE co-existence	223
6.5E.3.3	Spurious emissions for UE co-existence for V2X con-current operation	223
6.5E.3.4	Additional spurious emissions requirements for V2X	224
6.5E.3.4.1	General	224
6.5E.3.4.2	Requirements for network signalling value "NS_33"	224
6.5E.3.4.3	Void	224
6.5E.4	Transmit intermodulation	224
6.5E.4.1	General	224
6.5E.4.2	Transmit intermodulation for V2X con-current operation	224
6.5F	Output RF spectrum emissions	225
6.5F.1	Occupied bandwidth	225
6.5F.2	Out of band emission	225
6.5F.2.1	General	225
6.5F.2.2	Spectrum emission mask for operation with shared spectrum channel access	225
6.5F.2.2.0	General	225
6.5F.2.2.1	Spectrum emission mask for non-transmitted channels	226
6.5F.2.3	Additional spectrum emission mask	226
6.5F.2.4	Adjacent channel leakage ratio	226
6.5F.2.4.0	General	226
6.5F.2.4.1	Shared spectrum channel access ACLR	226
6.5F.2.4.2	Additional requirement for network signaled value "NS_29"	226
6.5F.3	Spurious emissions	227
6.5F.3.0	General	227

6.5F.3.1	General spurious emissions	227
6.5F.3.2	Spurious emissions for UE co-existence	227
6.5F.3.3	Additional spurious emissions	227
6.5F.3.0	General	227
6.5F.3.3.1	Requirement for network signalling value "NS_28"	227
6.5F.3.3.2	Requirement for network signalling value "NS_29"	228
6.5F.3.3.3	Requirement for network signalling value "NS_30"	229
6.5F.3.3.4	Requirement for network signalling value "NS_31"	230
6.5F.3.3.5	Requirements for network signalling value "NS_53" or "NS_54"	231
6.5F.4	Transmit intermodulation	231
6.6	Void.....	231
6.6E	Time alignment error.....	231
7	Receiver characteristics.....	232
7.1	General	232
7.1A	General	232
7.1F	General	233
7.2	Diversity characteristics	233
7.3	Reference sensitivity	233
7.3.1	General.....	233
7.3.2	Reference sensitivity power level	233
7.3.3	$\Delta R_{IB,c}$	240
7.3A	Reference sensitivity for CA	241
7.3A.1	General.....	241
7.3A.2	Reference sensitivity power level for CA	241
7.3A.2.1	Reference sensitivity power level for Intra-band contiguous CA	241
7.3A.2.2	Reference sensitivity power level for Intra-band non-contiguous CA	241
7.3A.2.3	Reference sensitivity power level for Inter-band CA	242
7.3A.2.4	Void.....	242
7.3A.3	$\Delta R_{IB,c}$ for CA	242
7.3A.3.1	General.....	242
7.3A.3.2	$\Delta R_{IB,c}$ for Inter-band CA.....	242
7.3A.3.2.1	$\Delta R_{IB,c}$ for two bands	243
7.3A.3.2.2	Void.....	244
7.3A.3.2.3	$\Delta R_{IB,c}$ for three bands	244
7.3A.3.2.4	$\Delta R_{IB,c}$ for four bands	246
7.3A.4	Reference sensitivity exceptions due to UL harmonic interference for CA.....	247
7.3A.5	Reference sensitivity exceptions due to intermodulation interference due to 2UL CA	250
7.3A.6	Reference sensitivity exceptions due to cross band isolation for CA	253
7.3B	Reference sensitivity for NR-DC	254
7.3C	Reference sensitivity for SUL	254
7.3C.1	General.....	254
7.3C.2	Reference sensitivity power level for SUL	254
7.3C.3	$\Delta R_{IB,c}$ for SUL	257
7.3C.3.1	General.....	257
7.3C.3.2	SUL band combination	257
7.3C.3.2.1	$\Delta R_{IB,c}$ for two bands	257
7.3D	Reference sensitivity for UL MIMO	258
7.3E	Reference sensitivity for V2X	258
7.3E.1	General.....	258
7.3E.2	Minimum requirements	258
7.3F	Reference sensitivity for shared spectrum channel access	260
7.3F.1	General.....	260
7.3F.2	Reference sensitivity power level	260
7.3F.3	$\Delta R_{IB,c}$	261
7.3F.4	Intra-band contiguous shared spectrum channel access CA	261
7.3F.5	Inter-band CA with shared spectrum channel access.....	261
7.3F.5.1	Reference sensitivity exceptions due to UL harmonic interference	261
7.3F.5.2	Reference sensitivity exceptions due to receiver harmonic mixing	262
7.3F.5.3	Reference sensitivity exceptions due to cross band isolation	262
7.4	Maximum input level	263
7.4A	Maximum input level for CA	263

7.4A.1	Maximum input level for Intra-band contiguous CA.....	263
7.4A.2	Maximum input level for Intra-band non-contiguous CA	263
7.4A.3	Maximum input level for Inter-band CA	264
7.4B	Maximum input level for NR-DC	264
7.4D	Maximum input level for UL MIMO	264
7.4E	Maximum input level for V2X	264
7.4E.1	General.....	264
7.4E.2	Maximum input level for V2X con-current operation	264
7.5	Adjacent channel selectivity.....	264
7.5A	Adjacent channel selectivity for CA.....	268
7.5A.1	Adjacent channel selectivity for Intra-band contiguous CA	268
7.5A.2	Adjacent channel selectivity Intra-band non-contiguous CA	270
7.5A.3	Adjacent channel selectivity Inter-band CA	270
7.5B	Adjacent channel selectivity for NR-DC.....	271
7.5D	Adjacent channel selectivity for UL MIMO.....	271
7.5E	Adjacent channel selectivity for V2X	271
7.5E.1	General.....	271
7.5E.2	Adjacent channel selectivity for V2X con-current operation.....	272
7.5F	Adjacent channel selectivity.....	272
7.5F.1	General.....	272
7.5F.2	Intra-band contiguous shared spectrum channel access CA	273
7.6	Blocking characteristics	273
7.6.1	General.....	273
7.6.2	In-band blocking	273
7.6.3	Out-of-band blocking.....	276
7.6.4	Narrow band blocking	278
7.6A	Blocking characteristics for CA	279
7.6A.1	General.....	279
7.6A.2	In-band blocking for CA	279
7.6A.2.1	In-band blocking for Intra-band contiguous CA	279
7.6A.2.2	In-band blocking for Intra-band non-contiguous CA	281
7.6A.2.3	In-band blocking for Inter-band CA.....	281
7.6A.3	Out-of-band blocking for CA.....	282
7.6A.3.1	Out-of-band blocking for Intra-band contiguous CA.....	282
7.6A.3.2	Out-of-band blocking for Intra-band non-contiguous CA.....	283
7.6A.3.3	Out-of-band blocking for Inter-band CA	283
7.6A.4	Narrow band blocking for CA	284
7.6A.4.1	Narrow band blocking for Intra-band contiguous CA	284
7.6A.4.2	Narrow band blocking for Intra-band non-contiguous CA	285
7.6A.4.3	Narrow band blocking for Inter-band CA	285
7.6B	Blocking characteristics for NR-DC.....	285
7.6C	Blocking characteristics for SUL	286
7.6C.1	General.....	286
7.6C.2	In-band blocking for SUL.....	286
7.6C.3	Out-of-band blocking for SUL.....	286
7.6C.4	Narrow band blocking for SUL	286
7.6D	Blocking characteristics for UL MIMO	286
7.6E	Blocking characteristics for V2X	287
7.6E.1	General.....	287
7.6E.2	In-band blocking	287
7.6E.2.1	General.....	287
7.6E.2.2	In-band blocking for V2X con-current operation.....	287
7.6E.3	Out-of-band blocking	288
7.6E.3.1	General.....	288
7.6E.3.2	Out-of-band blocking for V2X con-current operation	288
7.6F	Blocking characteristics	288
7.6F.1	General.....	288
7.6F.2	In-band blocking	288
7.6F.2.1	General	288
7.6F.2.2	Intra-band contiguous shared spectrum channel access CA.....	289
7.6F.3	Out-of-band blocking.....	290
7.6F.3.1	General	290

7.6F.3.2	Intra-band contiguous shared spectrum channel access CA.....	291
7.7	Spurious response.....	291
7.7A	Spurious response for CA.....	293
7.7A.1	Spurious response for Intra-band contiguous CA	293
7.7A.2	Spurious response for Intra-band non-contiguous CA.....	293
7.7A.3	Spurious response for Inter-band CA.....	293
7.7B	Spurious response for NR-DC.....	294
7.7D	Spurious response for UL MIMO.....	294
7.7E	Spurious response for V2X	294
7.7E.1	General.....	294
7.7E.2	Spurious response for V2X con-current operation.....	294
7.7F	Spurious response for shared spectrum channel access.....	294
7.7F.1	General.....	294
7.7F.2	Intra-band contiguous shared spectrum channel access CA	295
7.8	Intermodulation characteristics	295
7.8.1	General.....	295
7.8.2	Wide band Intermodulation	295
7.8A	Intermodulation characteristics for CA	297
7.8A.1	General.....	297
7.8A.2	Wide band intermodulation for CA	297
7.8A.2.1	Wide band intermodulation for Intra-band contiguous CA	297
7.8A.2.2	Wide band intermodulation for Intra-band non-contiguous CA.....	298
7.8A.2.3	Wide band intermodulation for Inter-band CA	298
7.8B	Intermodulation characteristics for NR-DC	298
7.8D	Intermodulation characteristics for UL MIMO	298
7.8E	Intermodulation characteristics for V2X	299
7.8E.1	General.....	299
7.8E.2	Wide band Intermodulation	299
7.8E.2.1	General.....	299
7.8E.2.2	Wide band Intermodulation for V2X con-current operation	299
7.8F	Intermodulation characteristics for shared spectrum channel access	299
7.8F.1	General.....	299
7.8F.2	Wide band Intermodulation	299
7.9	Spurious emissions	300
7.9A	Spurious emissions for CA	301
7.9A.1	Void	301
7.9A.2	Void	301
7.9A.3	Spurious emissions for Inter-band CA.....	301
7.9B	Spurious emissions for NR-DC	301

Annex A (normative): Measurement channels 302

A.1	General	302
A.2	UL reference measurement channels	302
A.2.1	General	302
A.2.2	Reference measurement channels.....	303
A.2.2.1	DFT-s-OFDM Pi/2-BPSK	303
A.2.2.2	DFT-s-OFDM QPSK.....	304
A.2.2.3	DFT-s-OFDM 16QAM.....	305
A.2.2.4	DFT-s-OFDM 64QAM.....	306
A.2.2.5	DFT-s-OFDM 256QAM.....	307
A.2.2.6	CP-OFDM QPSK	308
A.2.2.7	CP-OFDM 16QAM	310
A.2.2.8	CP-OFDM 64QAM	312
A.2.2.9	CP-OFDM 256QAM	314
A.2.3	Reference measurement channels for TDD	316
A.2.3.1	DFT-s-OFDM Pi/2-BPSK	316
A.2.3.2	DFT-s-OFDM QPSK.....	316
A.2.3.3	DFT-s-OFDM 16QAM.....	316
A.2.3.4	DFT-s-OFDM 64QAM.....	316
A.2.3.5	DFT-s-OFDM 256QAM.....	317
A.2.3.6	CP-OFDM QPSK	317

A.2.3.7	CP-OFDM 16QAM	317
A.2.3.8	CP-OFDM 64QAM	317
A.2.3.9	CP-OFDM 256QAM	318
A.3	DL reference measurement channels	319
A.3.1	General	319
A.3.2	DL reference measurement channels for FDD	320
A.3.2.1	General.....	320
A.3.2.2	FRC for receiver requirements for QPSK.....	320
A.3.2.3	FRC for maximum input level for 64QAM	322
A.3.2.4	FRC for maximum input level for 256 QAM	325
A.3.3	DL reference measurement channels for TDD	328
A.3.3.1	General.....	328
A.3.3.2	FRC for receiver requirements for QPSK.....	328
A.3.3.3	FRC for maximum input level for 64QAM	332
A.3.3.4	FRC for maximum input level for 256 QAM	335
A.4	CSI reference measurement channels.....	338
A.5	OFDMA Channel Noise Generator (OCNG).....	338
A.5.1	OCNG Patterns for FDD	338
A.5.1.1	OCNG FDD pattern 1: Generic OCNG FDD Pattern for all unused REs.....	338
A.5.2	OCNG Patterns for TDD.....	338
A.5.2.1	OCNG TDD pattern 1: Generic OCNG TDD Pattern for all unused REs	338
A.6	Void.....	339
A.7	V2X reference measurement channels	339
A.7.1	General	339
A.7.2	FRC for V2X receiver requirements for QPSK.....	339
A.7.3	FRC for maximum input level for 64QAM	341
A.7.4	FRC for maximum input level for 256QAM	342
Annex B (informative):	Void	344
Annex C (informative):	Downlink physical channels	345
C.1	General	345
C.2	Setup.....	345
C.3	Connection	345
C.3.1	Measurement of Receiver Characteristics	345
Annex D (normative):	Characteristics of the interfering signal	346
D.1	General.....	346
D.2	Interference signals.....	346
Annex E (normative):	Environmental conditions	348
E.1	General	348
E.2	Environmental	348
E.2.1	Temperature	348
E.2.2	Voltage	348
E.2.3	Vibration.....	349
Annex F (normative):	Transmit modulation	350
F.0	General	350
F.1	Measurement Point.....	350
F.2	Basic Error Vector Magnitude measurement	350
F.3	Basic in-band emissions measurement	351