

ETSI TS 138 101-1 V17.6.0 (2022-08)



**5G;
NR;
User Equipment (UE) radio transmission and reception;
Part 1: Range 1 Standalone
(3GPP TS 38.101-1 version 17.6.0 Release 17)**

<https://standards.iteh.ai/catalog/standards/sist/5c3d0111-bb03-443a-ac5e-402ad8d88e32/etsi-ts-138-101-1-v17-6-0-2022-08>



Reference

RTS/TSGR-0438101-1vh60

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://standards-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

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.....	18
1 Scope	20
2 References	20
3 Definitions, symbols and abbreviations	21
3.1 Definitions	21
3.2 Symbols.....	22
3.3 Abbreviations	24
4 General	25
4.1 Relationship between minimum requirements and test requirements	25
4.2 Applicability of minimum requirements	25
4.3 Specification suffix information.....	25
5 Operating bands and channel arrangement.....	26
5.1 General	26
5.2 Operating bands.....	27
5.2A Operating bands for CA	29
5.2A.0 General.....	29
5.2A.1 Intra-band CA	29
5.2A.2 Inter-band CA	30
5.2A.2.1 Inter-band CA (two bands).....	31
5.2A.2.2 Inter-band CA (three bands).....	37
5.2A.2.3 Inter-band CA (four bands)	42
5.2A.2.4 Inter-band CA (five bands)	44
5.2B Operating bands for DC	44
5.2C Operating band combination for SUL	44
5.2D Operating bands for UL MIMO	46
5.2E Operating band for V2X.....	47
5.2E.1 V2X operating bands	47
5.2E.2 V2X operating bands for con-current operation	47
5.3 UE channel bandwidth	48
5.3.1 General.....	48
5.3.2 Maximum transmission bandwidth configuration	50
5.3.3 Minimum guardband and transmission bandwidth configuration.....	50
5.3.4 RB alignment.....	52
5.3.5 UE channel bandwidth per operating band	52
5.3.6 Asymmetric channel bandwidths	56
5.3A UE channel bandwidth for CA	57
5.3A.1 General.....	57
5.3A.2 Maximum transmission bandwidth configuration for CA	58
5.3A.3 Minimum guardband and transmission bandwidth configuration for CA	58
5.3A.4 Void	59
5.3A.5 UE channel bandwidth per operating band for CA	59
5.3E Channel bandwidth for V2X	60
5.3E.1 General.....	60
5.3E.2 Channel bandwidth for V2X concurrent operation.....	62
5.3I Channel bandwidth for RedCap	63
5.4 Channel arrangement.....	63
5.4.1 Channel spacing.....	63
5.4.1.1 Channel spacing for adjacent NR carriers.....	63
5.4.2 Channel raster	63
5.4.2.1 NR-ARFCN and channel raster.....	63

5.4.2.2	Channel raster to resource element mapping.....	64
5.4.2.3	Channel raster entries for each operating band	64
5.4.3	Synchronization raster	68
5.4.3.1	Synchronization raster and numbering.....	68
5.4.3.3	Synchronization raster entries for each operating band.....	69
5.4.4	TX–RX frequency separation	72
5.4A	Channel arrangement for CA.....	73
5.4A.1	Channel spacing for CA.....	73
5.4A.2	Channel raster for CA	74
5.4A.3	Synchronization raster for CA	74
5.4A.4	Tx-Rx frequency separation for CA.....	74
5.4B	Reserved	74
5.4C	Reserved	74
5.4D	Reserved	74
5.4E	Channel arrangement for V2X	74
5.4E.1	Channel spacing.....	74
5.4E.2	Channel raster	75
5.4E.2.1	NR-ARFCN and channel raster.....	75
5.4E.2.2	Channel raster to resource element mapping.....	75
5.4E.2.3	Channel raster entries for each operating band	75
5.4E.3	Synchronization raster for V2X	75
5.5	Void.....	75
5.5A	Configurations for CA.....	75
5.5A.0	General.....	75
5.5A.1	Configurations for intra-band contiguous CA.....	76
5.5A.2	Configurations for intra-band non-contiguous CA	81
5.5A.3	Configurations for inter-band CA	85
5.5A.3.1	Configurations for inter-band CA (two bands)	85
5.5A.3.2	Configurations for inter-band CA (three bands)	120
5.5A.3.3	Configurations for inter-band CA (four bands).....	182
5.5A.3.4	Configurations for inter-band CA (five bands)	216
5.5B	Configurations for DC.....	219
5.5C	Configurations for SUL.....	225
6	Transmitter characteristics	232
6.1	General	232
6.1A	General	232
6.1F	General	232
6.2	Transmitter power	232
6.2.1	UE maximum output power.....	232
6.2.1I	Maximum output power for RedCap UE.....	234
6.2.2	UE maximum output power reduction.....	234
6.2.3	UE additional maximum output power reduction.....	237
6.2.3.1	General	237
6.2.3.2	A-MPR for NS_04	242
6.2.3.3	A-MPR for NS_10	243
6.2.3.4	A-MPR for NS_05 and NS_05U.....	243
6.2.3.5	A-MPR for NS_40	247
6.2.3.6	A-MPR for NS_43 and NS_43U.....	248
6.2.3.7	A-MPR for NS_03 and NS_03U.....	249
6.2.3.8	A-MPR for NS_37	249
6.2.3.9	A-MPR for NS_38	250
6.2.3.10	A-MPR for NS_39	250
6.2.3.11	A-MPR for NS_41	251
6.2.3.12	A-MPR for NS_42	251
6.2.3.13	A-MPR for NS_18	252
6.2.3.14	A-MPR for NS_21	253
6.2.3.15	A-MPR for NS_24	254
6.2.3.16	A-MPR for NS_27	255
6.2.3.17	A-MPR for NS_46	256
6.2.3.18	A-MPR for NS_47	257
6.2.3.19	A-MPR for NS_50	258

6.2.3.20	A-MPR for NS_44	260
6.2.3.21	A-MPR for NS_12	260
6.2.3.22	A-MPR for NS_13	261
6.2.3.23	A-MPR for NS_14	261
6.2.3.24	A-MPR for NS_15	262
6.2.3.25	A-MPR for NS_45	263
6.2.3.26	A-MPR for NS_48	263
6.2.3.27	A-MPR for NS_49	265
6.2.3.28	A-MPR for NS_51	267
6.2.3.29	A-MPR for NS_07	267
6.2.3.30	A-MPR for NS_56	268
6.2.4	Configured transmitted power	269
6.2A	Transmitter power for CA	271
6.2A.1	UE maximum output power for CA	271
6.2A.1.1	UE maximum output power for Intra-band contiguous CA	271
6.2A.1.2	UE maximum output power for Intra-band non-contiguous CA	272
6.2A.1.3	UE maximum output power for Inter-band CA	272
6.2A.1.4	Void	277
6.2A.1.5	Void	277
6.2A.2	UE maximum output power reduction for CA	277
6.2A.2.1	UE maximum output power reduction for Intra-band contiguous CA	277
6.2A.2.2	UE maximum output power reduction for Intra-band non-contiguous CA	280
6.2A.2.2.0	General	280
6.2A.2.2.1	MPR to meet -30dBm/MHz	281
6.2A.2.2.1.1	PC3 with indicating dualPA-Architecture supported	281
6.2A.2.2.1.2	PC2 with indicating dualPA-Architecture supported	282
6.2A.2.2.1.3	PC3 without indicating dualPA-Architecture supported	282
6.2A.2.2.1.4	PC2 without indicating dualPA-Architecture supported	282
6.2A.2.2.2	MPR to meet -13dBm/MHz	283
6.2A.2.2.2.1	PC3 with indicating dualPA-Architecture supported	283
6.2A.2.2.2.2	PC2 with indicating dualPA-Architecture supported	283
6.2A.2.2.2.3	PC3 without indicating dualPA-Architecture supported	283
6.2A.2.2.2.4	PC2 without indicating dualPA-Architecture supported	284
6.2A.2.3	UE maximum output power reduction for Inter-band CA	284
6.2A.2.4	Void	284
6.2A.3	UE additional maximum output power reduction for CA	284
6.2A.3.1.1	UE additional maximum output power reduction for Intra-band contiguous CA	284
6.2A.3.1.1.1	A-MPR for CA_NS_04	285
6.2A.3.1.2	UE additional maximum output power reduction for Intra-band non-contiguous CA	291
6.2A.3.1.3	UE additional maximum output power reduction for Inter-band CA	294
6.2A.4	Configured output power for CA	297
6.2A.4.1	Configured transmitted power level	297
6.2A.4.1.1	Configured transmitted power for Intra-band contiguous CA	297
6.2A.4.1.2	Configured transmitted power for Intra-band non-contiguous CA	299
6.2A.4.1.3	Configured transmitted power for Inter-band CA	302
6.2A.4.1.4	Void	305
6.2A.4.2	$\Delta T_{IB,c}$ for CA	305
6.2A.4.2.1	Void	305
6.2A.4.2.2	Void	305
6.2A.4.2.3	$\Delta T_{IB,c}$ for Inter-band CA (two bands)	305
6.2A.4.2.4	$\Delta T_{IB,c}$ for Inter-band CA (three bands)	313
6.2A.4.2.5	$\Delta T_{IB,c}$ for Inter-band CA (four bands)	325
6.2A.4.2.6	$\Delta T_{IB,c}$ for Inter-band CA (five bands)	331
6.2B	Transmitter power for NR-DC	331
6.2B.0	General	331
6.2B.1	UE maximum output power for NR-DC	331
6.2B.2	UE maximum output power reduction for NR-DC	332
6.2B.3	UE additional maximum output power reduction for NR-DC	332
6.2B.4.1	Configured transmitted power level for NR-DC	333
6.2B.4.2	$\Delta T_{IB,c}$ for NR-DC	337
6.2C	Transmitter power for SUL	337
6.2C.1	Configured transmitted power for SUL	337

6.2C.2	$\Delta T_{IB,c}$	338
6.2D	Transmitter power for UL MIMO	340
6.2D.1	UE maximum output power for UL MIMO.....	340
6.2D.2	UE maximum output power reduction for UL MIMO.....	341
6.2D.3	UE additional maximum output power reduction for UL MIMO.....	342
6.2D.4	Configured transmitted power for UL MIMO	343
6.2E	Transmitter power for V2X	343
6.2E.1	UE maximum output power for V2X	343
6.2E.1.1	General	343
6.2E.1.2	UE maximum output power for V2X con-current operation	344
6.2E.2	UE maximum output power reduction for V2X	345
6.2E.2.1	General	345
6.2E.2.2	MPR for Power class 2 and Power class 3 V2X UE	345
6.2E.2.3	MPR for Power class 2 and Power class 3 V2X con-current operation	347
6.2E.2.4	MPR for Power class 1 UE in n14	350
6.2E.3	UE additional maximum output power reduction for V2X.....	350
6.2E.3.1	General	350
6.2E.3.2	A-MPR for V2X UE by NS_33	351
6.2E.3.3	A-MPR for Power class 3 V2X UE by NS_52	354
6.2E.3.4	A-MPR for V2X con-current operation	355
6.2E.4	Configured transmitted power for V2X.....	356
6.2E.4.1	General	356
6.2E.4.2	Configured transmitted power for inter-band V2X con-current operation.....	356
6.2E.4.3	Configured transmitted power for intra-band V2X con-current operation.....	357
6.2F	Transmitter power for shared spectrum channel access	359
6.2F.1	UE maximum output power.....	359
6.2F.1A	UE maximum output power for CA.....	360
6.2F.1A.1	UE maximum output power for inter-band CA.....	360
6.2F.1D	UE maximum output power for UL MIMO.....	361
6.2F.2	UE maximum output power reduction.....	361
6.2F.2A	UE maximum output power reduction for CA.....	362
6.2F.2A.1	UE maximum output power reduction for inter-band CA.....	362
6.2F.2A.2	UE maximum output power reduction for intra-band contiguous CA	362
6.2F.2D	UE maximum output power reduction for UL MIMO.....	364
6.2F.3	UE additional maximum output power reduction	365
6.2F.3.1	General	365
6.2F.3.2	A-MPR for NS_28	365
6.2F.3.3	A-MPR for NS_29	366
6.2F.3.4	A-MPR for NS_30	366
6.2F.3.5	A-MPR for NS_31	367
6.2F.3.6	A-MPR for NS_53	367
6.2F.3.7	A-MPR for NS_54	368
6.2F.3.8	A-MPR for NS_58	368
6.2F.3.9	A-MPR for NS_59	369
6.2F.3.10	A-MPR for NS_60	370
6.2F.3.11	A-MPR for NS_61	370
6.2F.3A	UE additional maximum output power reduction for CA.....	371
6.2F.3A.1	UE additional maximum output power reduction for inter-band CA.....	371
6.2F.3D	UE additional maximum output power reduction for UL MIMO.....	371
6.2F.4	Configured transmitted power	371
6.2F.4D	Configured transmitted power UL MIMO.....	371
6.2G	Transmitter power for Tx Diversity.....	372
6.2G.1	UE maximum output power for Tx Diversity	372
6.2G.2	UE maximum output power reduction for Tx Diversity	372
6.2G.3	UE additional maximum output power reduction for Tx Diversity	372
6.2G.4	Configured transmitted power for Tx Diversity.....	372
6.2H	Transmitter power for CA with UL MIMO.....	373
6.2H.1	Transmitter power for intra-band UL contiguous CA for UL MIMO	373
6.2H.1.1	UE maximum output power for intra-band UL contiguous CA for UL MIMO.....	373
6.2H.1.2	UE maximum output power reduction for intra-band UL contiguous CA for UL MIMO.....	373
6.2H.1.3	UE additional maximum output power reduction for intra-band UL contiguous CA for UL MIMO	374

6.2H.1.4	Configured transmitted power for intra-band UL contiguous CA for UL MIMO	374
6.3	Output power dynamics.....	374
6.3.1	Minimum output power	374
6.3.2	Transmit OFF power.....	375
6.3.3	Transmit ON/OFF time mask	375
6.3.3.1	General	375
6.3.3.2	General ON/OFF time mask	376
6.3.3.3	Transmit power time mask for slot and short or long subslot boundaries.....	376
6.3.3.4	PRACH time mask.....	376
6.3.3.5	Void.....	378
6.3.3.6	SRS time mask	378
6.3.3.7	PUSCH-PUCCH and PUSCH-SRS time masks	379
6.3.3.8	Transmit power time mask for consecutive slot or long subslot transmission and short subslot transmission boundaries	380
6.3.3.9	Transmit power time mask for consecutive short subslot transmissions boundaries	381
6.3.4	Power control.....	382
6.3.4.1	General	382
6.3.4.2	Absolute power tolerance.....	382
6.3.4.3	Relative power tolerance	382
6.3.4.4	Aggregate power tolerance.....	383
6.3A	Output power dynamics for CA	383
6.3A.1	Minimum output power for CA 6.3A.1.1..... Minimum output power for intra-band contiguous CA	383
6.3A.1.2	Minimum output power for intra-band non-contiguous CA	383
6.3A.1.3	Minimum output power for inter-band CA	383
6.3A.1.4	Void.....	384
6.3A.2	Transmit OFF power for CA.....	384
6.3A.2.1	Transmit OFF power for intra-band contiguous CA	384
6.3A.2.2	Transmit OFF power for intra-band non-contiguous CA	384
6.3A.2.3	Transmit OFF power for inter-band CA	384
6.3A.2.4	Void.....	384
6.3A.3	Transmit ON/OFF time mask for CA	384
6.3A.3.1	Transmit ON/OFF time mask for intra-band contiguous CA	384
6.3A.3.2	Transmit ON/OFF time mask for intra-band non-contiguous CA	385
6.3A.3.3	Transmit ON/OFF time mask for inter-band CA	385
6.3A.3.3.1	General	385
6.3A.3.3.2	Time mask for switching between two uplink carriers	385
6.3A.3.3.3	Time mask for switching between two uplink carriers with two transmit antenna connectors	386
6.3A.3.3.4	Time mask for switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors.....	387
6.3A.3.3.5	Time mask for switching between two uplink bands with two transmit antenna connectors	388
6.3A.3.4	Void.....	389
6.3A.4	Power control for CA.....	389
6.3A.4.1	Power control for intra-band contiguous CA	389
6.3A.4.1.1	Absolute power tolerance	389
6.3A.4.1.2	Relative power tolerance	389
6.3A.4.1.3	Aggregate power control tolerance.....	390
6.3A.4.2	Power control for intra-band non-contiguous CA	390
6.3A.4.2.1	Absolute power tolerance.....	390
6.3A.4.2.1.1	Minimum requirements	390
6.3A.4.2.2	Relative power tolerance	390
6.3A.4.2.2.1	Minimum requirements	390
6.3A.4.2.3	Aggregate power control tolerance	390
6.3A.4.3	Power control for inter-band CA.....	390
6.3A.4.4	Void.....	390
6.3B	Output power dynamics for NR-DC.....	390
6.3C	Output power dynamics for SUL	391
6.3C.1	Void	391
6.3C.2	Void	391
6.3C.3	Transmit ON/OFF time mask for SUL	391
6.3C.3.1	Time mask for switching between two uplink carriers.....	391
6.3C.3.2	Time mask for switching between two uplink carriers with two transmit antenna connectors.....	392

6.3C.3.3	Time mask for switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors	392
6.3C.3.4	Time mask for switching between two uplink bands with two transmit antenna connectors.....	393
6.3D	Output power dynamics for UL MIMO	394
6.3D.1	Minimum output power for UL MIMO.....	394
6.3D.2	Transmit OFF power for UL MIMO.....	394
6.3D.3	Transmit ON/OFF time mask for UL MIMO	394
6.3D.4	Power control for UL MIMO.....	395
6.3E	Output power dynamics for V2X	395
6.3E.1	Minimum output power for V2X	395
6.3E.1.1	General	395
6.3E.1.2	Minimum output power for V2X con-current operation	395
6.3E.2	Transmit OFF power for V2X	396
6.3E.2.1	General	396
6.3E.2.2	Transmit OFF power for V2X con-current operation	396
6.3E.3	Transmit ON/OFF time mask for V2X.....	396
6.3E.3.1	General	396
6.3E.3.2	General time mask.....	396
6.3E.3.3	S-SSB time mask	397
6.3E.3.4	Transmit ON/OFF time mask for V2X con-current operation	397
6.3E.4	Power control for V2X	398
6.3E.4.1	General	398
6.3E.4.2	Absolute power tolerance.....	399
6.3E.4.3	Power control for V2X con-current operation.....	399
6.3F	Output power dynamics for shared spectrum channel access.....	399
6.3F.1	Minimum output power	399
6.3F.2	Transmit OFF power.....	399
6.3F.3	Transmit ON/OFF time mask	399
6.3F.3.1	General	399
6.3F.3.2	General ON/OFF time mask	399
6.3F.3A	General ON/OFF mask for CA	400
6.3F.3A.1	General ON/OFF mask for inter-band CA	400
6.3F.4	Power control.....	400
6.3F.4.1	General	400
6.3F.4.2	Absolute power tolerance.....	400
6.3F.4.3	Relative power tolerance.....	400
6.3F.4.4	Aggregate power tolerance.....	400
6.3G	Output power dynamics for Tx Diversity.....	400
6.3G.1	Minimum output power for Tx Diversity	400
6.3G.2	Transmit OFF power for Tx Diversity.....	401
6.3G.3	Transmit ON/OFF time mask for Tx Diversity	401
6.3G.4	Power control for Tx Diversity	401
6.3H	Output power dynamics for intra-band UL contiguous CA for UL MIMO	401
6.3H.1	Minimum output power for intra-band UL contiguous CA for UL MIMO	401
6.3H.2	Transmit OFF power for intra-band UL contiguous CA for UL MIMO	401
6.3H.3	Transmit ON/OFF time mask for intra-band UL contiguous CA for UL MIMO	401
6.3H.4	Power control for intra-band UL contiguous CA for UL MIMO.....	401
6.4	Transmit signal quality	402
6.4.1	Frequency error.....	402
6.4.2	Transmit modulation quality.....	402
6.4.2.1	Error Vector Magnitude	402
6.4.2.1a	Error Vector Magnitude including symbols with transient period	403
6.4.2.2	Carrier leakage	404
6.4.2.3	In-band emissions	404
6.4.2.4	EVM equalizer spectrum flatness	405
6.4.2.4.1	Requirements for Pi/2 BPSK modulation.....	406
6.4.2.5	Phase continuity requirements for DMRS bundling	407
6.4A	Transmit signal quality for CA.....	408
6.4A.1	Frequency error for CA.....	408
6.4A.1.1	Frequency error for intra-band contiguous CA	408
6.4A.1.2	Frequency error for intra-band non-contiguous CA.....	409
6.4A.1.3	Frequency error for inter-band CA.....	409

6.4A.1.4	Void.....	409
6.4A.2	Transmit modulation quality for CA.....	409
6.4A.2.1	Transmit modulation quality for intra-band contiguous CA	409
6.4A.2.1.0	General	409
6.4A.2.1.1	Error Vector Magnitude.....	409
6.4A.2.1.2	In-band emissions	410
6.4A.2.1.3	Carrier leakage.....	413
6.4A.2.2	Transmit modulation quality for intra-band non-contiguous CA	413
6.4A.2.2.0	General	413
6.4A.2.2.1	Error Vector Magnitude	413
6.4A.2.2.2	In-band emissions	414
6.4A.2.2.3	Carrier leakage.....	414
6.4A.2.3	Transmit modulation quality for inter-band CA.....	414
6.4A.2.4	Void.....	414
6.4B	Transmit signal quality for NR-DC.....	414
6.4D	Transmit signal quality for UL MIMO.....	415
6.4D.1	Frequency error for UL MIMO.....	415
6.4D.2	Transmit modulation quality for UL MIMO.....	415
6.4D.2.1	Error Vector Magnitude	415
6.4D.2.2	Carrier leakage	415
6.4D.2.3	In-band emissions	415
6.4D.2.4	EVM equalizer spectrum flatness for UL MIMO	415
6.4D.3	Time alignment error for UL MIMO	416
6.4D.4	Requirements for coherent UL MIMO	416
6.4E	Transmit signal quality for V2X.....	416
6.4E.1	Frequency error for V2X	416
6.4E.1.1	General	416
6.4E.1.2	Frequency error for V2X con-current operation	417
6.4E.2	Transmit modulation quality for V2X	417
6.4E.2.1	General	417
6.4E.2.2	Error Vector Magnitude for V2X.....	417
6.4E.2.3	Carrier leakage for V2X.....	417
6.4E.2.4	In-band emissions for V2X	417
6.4E.2.5	EVM equalizer spectrum flatness for V2X	417
6.4E.2.6	Transmit modulation quality for V2X con-current operation	417
6.4F	Transmit signal quality for shared spectrum channel access.....	418
6.4F.1	Frequency error.....	418
6.4F.2	Transmit modulation quality.....	418
6.4F.2.1	Error Vector Magnitude	418
6.4F.2.2	Carrier leakage	418
6.4F.2.3	In-band emissions	418
6.4F.2.4	EVM equalizer spectrum flatness	419
6.4F.2A	Transmit modulation quality for CA.....	419
6.4F.2A.1	Transmit modulation quality for inter-band CA.....	419
6.4G	Transmit signal quality for Tx Diversity	420
6.4G.1	Frequency error for Tx Diversity	420
6.4G.2	Transmit modulation quality for Tx Diversity	420
6.4H	Transmit signal quality for CA with UL MIMO	421
6.4H.1	Transmit signal quality for intra-band UL contiguous CA for UL MIMO	421
6.4H.1.1	Frequency error for intra-band UL contiguous CA for UL MIMO.....	421
6.4H.1.2	Transmit modulation quality for intra-band UL contiguous CA for UL MIMO.....	421
6.4H.1.2.1	Error Vector Magnitude.....	421
6.4H.1.2.2	Carrier leakage.....	421
6.4H.1.2.3	In-band emissions	421
6.4H.1.3	Time alignment error for intra-band UL contiguous CA for UL MIMO	421
6.4H.1.4	Coherent UL MIMO requirement for intra-band UL contiguous CA for UL MIMO	421
6.5	Output RF spectrum emissions.....	422
6.5.1	Occupied bandwidth	422
6.5.2	Out of band emission	422
6.5.2.1	General.....	422
6.5.2.2	Spectrum emission mask.....	422
6.5.2.3	Additional spectrum emission mask	423

6.5.2.3.1	Requirements for network signalling value "NS_35"	423
6.5.2.3.2	Requirements for network signalling value "NS_04"	423
6.5.2.3.3	Requirements for network signalling value "NS_03"	424
6.5.2.3.4	Requirements for network signalling value "NS_06" or "NS_07"	424
6.5.2.3.5	Void	425
6.5.2.3.6	Void	425
6.5.2.3.7	Void	425
6.5.2.3.8	Requirements for network signalling value "NS_27"	425
6.5.2.3.9	Requirements for network signalling value "NS_21"	426
6.5.2.4	Adjacent channel leakage ratio	426
6.5.2.4.1	NR ACLR	426
6.5.2.4.2	UTRA ACLR	427
6.5.3	Spurious emissions	427
6.5.3.1	General spurious emissions	427
6.5.3.2	Spurious emissions for UE co-existence	428
6.5.3.3	Additional spurious emissions	436
6.5.3.3.1	Requirement for network signalling value "NS_04"	436
6.5.3.3.2	Requirement for network signalling value "NS_17"	437
6.5.3.3.3	Requirement for network signalling value "NS_18"	437
6.5.3.3.4	Requirement for network signalling value "NS_05"	437
6.5.3.3.5	Requirement for network signalling value "NS_43"	437
6.5.3.3.6	Requirement for network signalling value "NS_37"	438
6.5.3.3.7	Requirement for network signalling value "NS_38"	438
6.5.3.3.8	Requirement for network signalling value "NS_39"	438
6.5.3.3.9	Requirement for network signalling value "NS_40"	438
6.5.3.3.10	Requirement for network signalling value "NS_41"	439
6.5.3.3.11	Requirement for network signalling value "NS_42"	439
6.5.3.3.12	Requirement for network signalling value "NS_21"	439
6.5.3.3.13	Requirement for network signalling value "NS_24"	440
6.5.3.3.14	Requirement for network signalling value "NS_27"	440
6.5.3.3.15	Requirement for network signalling value "NS_47"	440
6.5.3.3.16	Requirement for network signalling value "NS_50"	441
6.5.3.3.17	Requirement for network signalling value "NS_12"	441
6.5.3.3.18	Requirement for network signalling value "NS_13"	441
6.5.3.3.19	Requirement for network signalling value "NS_14"	442
6.5.3.3.20	Requirement for network signalling value "NS_15"	442
6.5.3.3.21	Requirement for network signalling value "NS_45"	442
6.5.3.3.22	Requirement for network signalling values "NS_48" and "NS_51"	443
6.5.3.3.23	Requirement for network signalling value "NS_49"	443
6.5.3.3.24	Requirement for network signalling value "NS_44"	443
6.5.3.3.25	Requirement for network signalling value "NS_46"	444
6.5.3.3.26	Requirement for network signalling value "NS_07"	444
6.5.3.3.27	Requirement for network signalling value "NS_56"	444
6.5.4	Transmit intermodulation	445
6.5A	Output RF spectrum emissions for CA	445
6.5A.1	Occupied bandwidth for CA	446
6.5A.1.1	Void	446
6.5A.1.1a	Occupied bandwidth for Intra-band contiguous CA	446
6.5A.1.2	Occupied bandwidth for Intra-band non-contiguous CA	446
6.5A.1.3	Occupied bandwidth for Inter-band CA	446
6.5A.2	Out of band emission for CA	446
6.5A.2.1	General	446
6.5A.2.2	Spectrum emission mask	446
6.5A.2.2.1	Spectrum emission mask for intra-band contiguous CA	446
6.5A.2.2.2	Spectrum emission mask for intra-band non-contiguous CA	447
6.5A.2.2.3	Spectrum emission mask for Inter-band CA	447
6.5A.2.2.4	Void	447
6.5A.2.3	Additional spectrum emission mask for CA	447
6.5A.2.3.1	Additional spectrum emission mask for intra-band contiguous CA	447
6.5A.2.3.2	Additional spectrum emission mask for Intra-band non-contiguous CA	448
6.5A.2.3.3	Additional spectrum emission mask for Inter-band CA	448
6.5A.2.4	Adjacent channel leakage ratio	448

6.5A.2.4.1	NR ACLR.....	448
6.5A.2.4.2	UTRA ACLR	450
6.5A.3	Spurious emission for CA.....	450
6.5A.3.1	General spurious emissions.....	450
6.5A.3.2	Spurious emissions for UE co-existence.....	451
6.5A.3.2.1	Spurious emissions for UE co-existence for intra-band contiguous CA.....	451
6.5A.3.2.2	Spurious emissions for UE co-existence for intra-band non-contiguous CA	453
6.5A.3.2.3	Spurious emissions for UE co-existence for Inter-band CA.....	453
6.5A.3.2.4	Void.....	474
6.5A.3.2.5	Void.....	474
6.5A.3.2.6	Void.....	474
6.5A.3.3	Additional spurious emissions for CA	474
6.5A.3.3.1	Additional spurious emissions for intra-band contiguous CA.....	474
6.5A.3.3.2	Additional spurious emissions for intra-band non-contiguous CA.....	475
6.5A.4	Transmit intermodulation for CA	475
6.5A.4.2.1	Transmit intermodulation for intra-band contiguous CA	475
6.5A.4.2.2	Void.....	475
6.5B	Output RF spectrum emissions for NR-DC.....	476
6.5D	Output RF spectrum emissions for UL MIMO.....	476
6.5D.1	Occupied bandwidth for UL MIMO	476
6.5D.2	Out of band emission for UL MIMO	476
6.5D.3	Spurious emission for UL MIMO.....	476
6.5D.4	Transmit intermodulation for UL MIMO	477
6.5E	Output RF spectrum emissions for V2X	477
6.5E.1	Occupied bandwidth for V2X.....	477
6.5E.1.1	General	477
6.5E.1.2	Occupied bandwidth for V2X con-current operation.....	477
6.5E.2	Out of band emission for V2X.....	477
6.5E.2.1	General	477
6.5E.2.2	Spectrum emission mask	478
6.5E.2.2.1	General	478
6.5E.2.2.2	Spectrum emission mask for V2X con-current operation.....	478
6.5E.2.3	Additional Spectrum emission mask.....	478
6.5E.2.3.1	Requirements for network signalling value "NS_33".....	478
6.5E.2.3.2	Requirements for network signalling value "NS_52".....	478
6.5E.2.3.3	Requirements for network signalling value "NS_06".....	479
6.5E.2.4	Adjacent channel leakage ratio	479
6.5E.2.4.1	General	479
6.5E.2.4.2	ACLR for V2X con-current operation.....	479
6.5E.3	Spurious emissions for V2X.....	480
6.5E.3.1	General spurious emissions.....	480
6.5E.3.2	Spurious emissions for UE co-existence.....	480
6.5E.3.3	Spurious emissions for UE co-existence for V2X con-current operation	480
6.5E.3.4	Additional spurious emissions requirements for V2X	482
6.5E.3.4.1	General	482
6.5E.3.4.2	Requirements for network signalling value "NS_33".....	482
6.5E.3.4.3	Void.....	482
6.5E.4	Transmit intermodulation	482
6.5E.4.1	General	482
6.5E.4.2	Transmit intermodulation for V2X con-current operation	482
6.5F	Output RF spectrum emissions.....	483
6.5F.1	Occupied bandwidth	483
6.5F.2	Out of band emission	483
6.5F.2.1	General	483
6.5F.2.2	Spectrum emission mask for operation with shared spectrum channel access.....	483
6.5F.2.2.1	Spectrum emission mask for non-transmitted channels.....	484
6.5F.2.3	Additional spectrum emission mask	484
6.5F.2.4	Adjacent channel leakage ratio	484
6.5F.2.4.1	Shared spectrum channel access ACLR	484
6.5F.2.4.2	Additional requirement for network signaled value "NS_29"	484
6.5F.3	Spurious emissions	484
6.5F.3.1	General spurious emissions.....	485

6.5F.3.2	Spurious emissions for UE co-existence	485
6.5F.3.3	Additional spurious emissions	485
6.5F.3.3.1	Requirement for network signalling value "NS_28"	485
6.5F.3.3.2	Requirement for network signalling value "NS_29"	485
6.5F.3.3.3	Requirement for network signalling value "NS_30"	487
6.5F.3.3.4	Requirement for network signalling value "NS_31"	488
6.5F.3.3.5	Requirements for network signalling value "NS_53" or "NS_54" or "NS_60"	489
6.5F.3.3.6	Requirements for network signalling value "NS_58"	489
6.5F.3.3.7	Requirements for network signalling value "NS_61"	489
6.5F.4	Transmit intermodulation	489
6.5G	Output RF spectrum emissions for Tx Diversity	490
6.5G.1	Occupied bandwidth for Tx Diversity	490
6.5G.2	Out of band emission for Tx Diversity	490
6.5G.3	Spurious emission for Tx Diversity	490
6.5G.4	Transmit intermodulation for Tx Diversity	490
6.5H	Output RF spectrum emissions for CA with UL MIMO	490
6.5H.1	Output RF spectrum emissions for intra-band UL contiguous CA for UL MIMO	490
6.5H.1.1	Occupied bandwidth for intra-band UL contiguous CA for UL MIMO	490
6.5H.1.2	Out of band emission for intra-band UL contiguous CA for UL MIMO	490
6.5H.1.3	Spurious emission for intra-band UL contiguous CA for UL MIMO	491
6.5H.1.4	Transmit intermodulation for intra-band UL contiguous CA for UL MIMO	491
6.6	Void	491
6.6E	Time alignment error	491
7	Receiver characteristics	492
7.1	General	492
7.1A	General	492
7.1F	General	493
7.1I	General	493
7.2	Diversity characteristics	493
7.3	Reference sensitivity	493
7.3.1	General	493
7.3.2	Reference sensitivity power level	493
7.3.3	$\Delta R_{IB,c}$	503
7.3A	Reference sensitivity for CA	503
7.3A.1	General	503
7.3A.2	Reference sensitivity power level for CA	503
7.3A.2.1	Reference sensitivity power level for Intra-band contiguous CA	503
7.3A.2.2	Reference sensitivity power level for Intra-band non-contiguous CA	504
7.3A.2.3	Reference sensitivity power level for Inter-band CA	505
7.3A.2.4	Void	505
7.3A.3	$\Delta R_{IB,c}$ for CA	506
7.3A.3.1	General	506
7.3A.3.2	$\Delta R_{IB,c}$ for Inter-band CA	506
7.3A.3.2.1	$\Delta R_{IB,c}$ for two bands	507
7.3A.3.2.2	Void	511
7.3A.3.2.3	$\Delta R_{IB,c}$ for three bands	511
7.3A.3.2.4	$\Delta R_{IB,c}$ for four bands	520
7.3A.3.2.5	$\Delta R_{IB,c}$ for five bands	526
7.3A.3.3	$\Delta R_{IB,c}$ for Intra-band CA	526
7.3A.4	Reference sensitivity exceptions due to UL harmonic interference for CA	526
7.3A.5	Reference sensitivity exceptions due to intermodulation interference due to 2UL CA	534
7.3A.6	Reference sensitivity exceptions due to cross band isolation for CA	561
7.3B	Reference sensitivity for NR-DC	565
7.3C	Reference sensitivity for SUL	565
7.3C.1	General	565
7.3C.2	Reference sensitivity power level for SUL	565
7.3C.3	$\Delta R_{IB,c}$ for SUL	569
7.3C.3.1	General	569
7.3C.3.2	SUL band combination	569
7.3C.3.2.1	$\Delta R_{IB,c}$ for two bands	569
7.3C.3.2.2	$\Delta R_{IB,c}$ for three bands	570

7.3C.3.2.3	$\Delta R_{IB,c}$ for four bands.....	570
7.3D	Reference sensitivity for UL MIMO	570
7.3E	Reference sensitivity for V2X	571
7.3E.1	General.....	571
7.3E.2	Minimum requirements.....	571
7.3E.3	Reference sensitivity power level for V2X con-current operation.....	572
7.3F	Reference sensitivity for shared spectrum channel access	574
7.3F.1	General.....	574
7.3F.2	Reference sensitivity power level	574
7.3F.3	$\Delta R_{IB,c}$	575
7.3F.4	Intra-band contiguous shared spectrum channel access CA	576
7.3G	Reference sensitivity for Tx Diversity.....	576
7.3G.5	Inter-band CA with shared spectrum channel access.....	576
7.3G.5.1	Reference sensitivity exceptions due to UL harmonic interference	576
7.3G.5.2	Reference sensitivity exceptions due to receiver harmonic mixing	576
7.3G.5.3	Reference sensitivity exceptions due to cross band isolation.....	577
7.3I	Reference sensitivity for RedCap	578
7.3I.1	General.....	578
7.3I.2	Reference sensitivity power level	578
7.4	Maximum input level	584
7.4A	Maximum input level for CA	584
7.4A.1	Maximum input level for Intra-band contiguous CA.....	584
7.4A.2	Maximum input level for Intra-band non-contiguous CA	584
7.4A.3	Maximum input level for Inter-band CA	585
7.4B	Maximum input level for NR-DC	585
7.4D	Maximum input level for UL MIMO	585
7.4E	Maximum input level for V2X.....	585
7.4E.1	General.....	585
7.4E.2	Maximum input level for V2X con-current operation	585
7.5	Adjacent channel selectivity.....	586
7.5A	Adjacent channel selectivity for CA.....	588
7.5A.1	Adjacent channel selectivity for Intra-band contiguous CA	588
7.5A.2	Adjacent channel selectivity Intra-band non-contiguous CA	590
7.5A.3	Adjacent channel selectivity Inter-band CA	591
7.5B	Adjacent channel selectivity for NR-DC.....	591
7.5D	Adjacent channel selectivity for UL MIMO.....	591
7.5E	Adjacent channel selectivity for V2X	591
7.5E.1	General.....	591
7.5E.2	Adjacent channel selectivity for V2X con-current operation.....	593
7.5F	Adjacent channel selectivity.....	593
7.5F.1	General.....	593
7.5F.2	Intra-band contiguous shared spectrum channel access CA	594
7.6	Blocking characteristics	595
7.6.1	General.....	595
7.6.2	In-band blocking.....	595
7.6.3	Out-of-band blocking.....	597
7.6.4	Narrow band blocking	600
7.6A	Blocking characteristics for CA	601
7.6A.1	General.....	601
7.6A.2	In-band blocking for CA.....	601
7.6A.2.1	In-band blocking for Intra-band contiguous CA	601
7.6A.2.2	In-band blocking for Intra-band non-contiguous CA	603
7.6A.2.3	In-band blocking for Inter-band CA.....	603
7.6A.3	Out-of-band blocking for CA.....	604
7.6A.3.1	Out-of-band blocking for Intra-band contiguous CA.....	604
7.6A.3.2	Out-of-band blocking for Intra-band non-contiguous CA.....	605
7.6A.3.3	Out-of-band blocking for Inter-band CA	605
7.6A.4	Narrow band blocking for CA	607
7.6A.4.1	Narrow band blocking for Intra-band contiguous CA.....	607
7.6A.4.2	Narrow band blocking for Intra-band non-contiguous CA	607
7.6A.4.3	Narrow band blocking for Inter-band CA	607
7.6B	Blocking characteristics for NR-DC.....	608

7.6C	Blocking characteristics for SUL	608
7.6C.1	General.....	608
7.6C.2	In-band blocking for SUL.....	608
7.6C.3	Out-of-band blocking for SUL.....	608
7.6C.4	Narrow band blocking for SUL	609
7.6D	Blocking characteristics for UL MIMO	609
7.6E	Blocking characteristics for V2X	609
7.6E.1	General.....	609
7.6E.2	In-band blocking.....	609
7.6E.2.1	General	609
7.6E.2.2	In-band blocking for V2X con-current operation.....	610
7.6E.3	Out-of-band blocking.....	610
7.6E.3.1	General	610
7.6E.3.2	Out-of-band blocking for V2X con-current operation	611
7.6F	Blocking characteristics	611
7.6F.1	General.....	611
7.6F.2	In-band blocking	611
7.6F.2.1	General	611
7.6F.2.2	Intra-band contiguous shared spectrum channel access CA.....	612
7.6F.3	Out-of-band blocking.....	613
7.6F.3.1	General	613
7.6F.3.2	Intra-band contiguous shared spectrum channel access CA.....	614
7.7	Spurious response.....	615
7.7A	Spurious response for CA.....	616
7.7A.1	Spurious response for Intra-band contiguous CA	616
7.7A.2	Spurious response for Intra-band non-contiguous CA	616
7.7A.3	Spurious response for Inter-band CA.....	616
7.7B	Spurious response for NR-DC.....	616
7.7D	Spurious response for UL MIMO.....	617
7.7E	Spurious response for V2X	617
7.7E.1	General.....	617
7.7E.2	Spurious response for V2X con-current operation.....	617
7.7F	Spurious response for shared spectrum channel access	617
7.7F.1	General.....	617
7.7F.2	Intra-band contiguous shared spectrum channel access CA	618
7.8	Intermodulation characteristics	618
7.8.1	General.....	618
7.8.2	Wide band Intermodulation	618
7.8A	Intermodulation characteristics for CA	621
7.8A.1	General.....	621
7.8A.2	Wide band intermodulation for CA	621
7.8A.2.1	Wide band intermodulation for Intra-band contiguous CA.....	621
7.8A.2.2	Wide band intermodulation for Intra-band non-contiguous CA.....	622
7.8A.2.3	Wide band intermodulation for Inter-band CA	622
7.8B	Intermodulation characteristics for NR-DC	622
7.8D	Intermodulation characteristics for UL MIMO	623
7.8E	Intermodulation characteristics for V2X	623
7.8E.1	General.....	623
7.8E.2	Wide band Intermodulation	623
7.8E.2.1	General	623
7.8E.2.2	Wide band Intermodulation for V2X con-current operation.....	624
7.8F	Intermodulation characteristics for shared spectrum channel access	624
7.8F.1	General.....	624
7.8F.2	Wide band Intermodulation	624
7.9	Spurious emissions	625
7.9A	Spurious emissions for CA.....	625
7.9A.1	Void	625
7.9A.2	Void	625
7.9A.3	Spurious emissions for Inter-band CA.....	625
7.9B	Spurious emissions for NR-DC	626
Annex A (normative):	Measurement channels.....	627