

ETSI TS 136 101 V12.24.0 (2020-02)



LTE;
**Evolved Universal Terrestrial Radio Access (E-UTRA);
User Equipment (UE) radio transmission and reception
(3GPP TS 36.101 version 12.24.0 Release 12)**

iTeh STANDARDS PREVIEW
Full standard:
<https://standards.iteh.ai/catalog/standards/etsi-ts-136-101-v12.24.0-2020-02>
4140-8059-1341a5f41fc5/etsi-ts-136-101-v12.24.0-2020-02



Reference

RTS/TSGR-0436101vCO0

Keywords

LTE

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 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

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>

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 2020.
All rights reserved.

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.

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is 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 IPR Policy, no investigation, 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.

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.....	19
1 Scope	20
2 References	20
3 Definitions, symbols and abbreviations	20
3.1 Definitions	20
3.2 Symbols	22
3.3 Abbreviations	24
4 General	26
4.1 Relationship between minimum requirements and test requirements	26
4.2 Applicability of minimum requirements	26
4.3 Void.....	26
4.3A Applicability of minimum requirements (CA, UL-MIMO, ProSe, Dual Connectivity, UE category 0).....	26
4.4 RF requirements in later releases	27
5 Operating bands and channel arrangement.....	27
5.1 General	27
5.2 Void.....	28
5.3 Void.....	28
5.4 Void.....	28
5.5 Operating bands.....	28
5.5A Operating bands for CA	30
5.5B Operating bands for UL-MIMO.....	35
5.5C Operating bands for Dual Connectivity.....	35
5.5D Operating bands for ProSe.....	37
5.5E Operating bands for UE category 0	37
5.6 Channel bandwidth.....	37
5.6.1 Channel bandwidths per operating band.....	38
5.6A Channel bandwidth for CA.....	40
5.6A.1 Channel bandwidths per operating band for CA.....	42
5.6B Channel bandwidth for UL-MIMO	52
5.6B.1 Void	52
5.6C Channel bandwidth for Dual Connectivity	52
5.6C.1 Void	53
5.6D Channel bandwidth for ProSe.....	53
5.6D.1 Channel bandwidths per operating band for ProSe.....	53
5.7 Channel arrangement.....	53
5.7.1 Channel spacing.....	53
5.7.1A Channel spacing for CA.....	53
5.7.2 Channel raster	54
5.7.2A Channel raster for CA	54
5.7.3 Carrier frequency and EARFCN.....	54
5.7.4 TX-RX frequency separation	55
5.7.4A TX-RX frequency separation for CA	56
6 Transmitter characteristics	56
6.1 General	56
6.2 Transmit power	57
6.2.1 Void	57
6.2.2 UE maximum output power.....	57
6.2.2A UE maximum output power for CA.....	58
6.2.2B UE maximum output power for UL-MIMO	60

6.2.3	UE maximum output power for modulation / channel bandwidth.....	62
6.2.3A	UE Maximum Output power for modulation / channel bandwidth for CA	62
6.2.3B	UE maximum output power for modulation / channel bandwidth for UL-MIMO	64
6.2.3D	UE maximum output power for modulation / channel bandwidth for ProSe.....	64
6.2.4	UE maximum output power with additional requirements	64
6.2.4A	UE maximum output power with additional requirements for CA	72
6.2.4A.1	A-MPR for CA_NS_01 for CA_1C	74
6.2.4A.2	A-MPR for CA_NS_02 for CA_1C	74
6.2.4A.3	A-MPR for CA_NS_03 for CA_1C	75
6.2.4A.4	A-MPR for CA_NS_04.....	76
6.2.4A.5	A-MPR for CA_NS_05 for CA_38C	76
6.2.4A.6	A-MPR for CA_NS_06.....	77
6.2.4A.7	A-MPR for CA_NS_07.....	78
6.2.4A.8	A-MPR for CA_NS_08.....	79
6.2.4B	UE maximum output power with additional requirements for UL-MIMO.....	80
6.2.4D	UE maximum output power with additional requirements for ProSe	81
6.2.5	Configured transmitted power	81
6.2.5A	Configured transmitted power for CA	88
6.2.5B	Configured transmitted power for UL-MIMO	90
6.2.5C	Configured transmitted power for Dual Connectivity.....	91
6.2.5D	Configured transmitted power for ProSe	92
6.3	Output power dynamics.....	93
6.3.1	(Void).....	93
6.3.2	Minimum output power	93
6.3.2.1	Minimum requirement	93
6.3.2A	UE Minimum output power for CA	93
6.3.2A.1	Minimum requirement for CA	93
6.3.2B	UE Minimum output power for UL-MIMO	94
6.3.2B.1	Minimum requirement	94
6.3.3	Transmit OFF power.....	94
6.3.3.1.	Minimum requirement	94
6.3.3A	UE Transmit OFF power for CA	95
6.3.3A.1	Minimum requirement for CA	95
6.3.3B	UE Transmit OFF power for UL-MIMO	95
6.3.3B.1	Minimum requirement	95
6.3.3D	Transmit OFF power for ProSe.....	95
6.3.4	ON/OFF time mask.....	96
6.3.4.1	General ON/OFF time mask	96
6.3.4.2	PRACH and SRS time mask	96
6.3.4.2.1	PRACH time mask	96
6.3.4.2.2	SRS time mask	97
6.3.4.3	Slot / Sub frame boundary time mask	98
6.3.4.4	PUCCH / PUSCH / SRS time mask.....	98
6.3.4A	ON/OFF time mask for CA	100
6.3.4B	ON/OFF time mask for UL-MIMO	100
6.3.4D	ON/OFF time mask for ProSe.....	100
6.3.4D.1	General time mask for ProSe	100
6.3.4D.2	PSSS/SSSS time mask	101
6.3.4D.3	PSSS / SSSS / PSBCH time mask.....	102
6.3.4D.4	PSSCH / SRS time mask.....	103
6.3.5	Power Control	103
6.3.5.1	Absolute power tolerance	103
6.3.5.1.1	Minimum requirements	103
6.3.5.2	Relative Power tolerance.....	103
6.3.5.2.1	Minimum requirements	103
6.3.5.3	Aggregate power control tolerance	104
6.3.5.3.1	Minimum requirement.....	104
6.3.5A	Power control for CA.....	105
6.3.5A.1	Absolute power tolerance.....	105
6.3.5A.1.1	Minimum requirements	105
6.3.5A.2	Relative power tolerance	105
6.3.5A.2.1	Minimum requirements	105

6.3.5A.3	Aggregate power control tolerance	106
6.3.5A.3.1	Minimum requirements	106
6.3.5B	Power control for UL-MIMO	106
6.3.5D	Power Control for ProSe	106
6.3.5D.1	Absolute power tolerance	106
6.4	Void	107
6.5	Transmit signal quality	107
6.5.1	Frequency error	107
6.5.1A	Frequency error for CA	107
6.5.1B	Frequency error for UL-MIMO	107
6.5.1D	Frequency error for ProSe	107
6.5.2	Transmit modulation quality	107
6.5.2.1	Error Vector Magnitude	107
6.5.2.1.1	Minimum requirement	108
6.5.2.2	Carrier leakage	108
6.5.2.2.1	Minimum requirements	108
6.5.2.3	In-band emissions	108
6.5.2.3.1	Minimum requirements	109
6.5.2.4	EVM equalizer spectrum flatness	109
6.5.2.4.1	Minimum requirements	109
6.5.2A	Transmit modulation quality for CA	110
6.5.2A.1	Error Vector Magnitude	111
6.5.2A.2	Carrier leakage for CA	111
6.5.2A.2.1	Minimum requirements	111
6.5.2A.3	In-band emissions	111
6.5.2A.3.1	Minimum requirement for CA	111
6.5.2B	Transmit modulation quality for UL-MIMO	113
6.5.2B.1	Error Vector Magnitude	114
6.5.2B.2	Carrier leakage	114
6.5.2B.3	In-band emissions	114
6.5.2B.4	EVM equalizer spectrum flatness for UL-MIMO	114
6.5.2D	Transmit modulation quality for ProSe	114
6.5.2D.1	Error Vector Magnitude	114
6.5.2D.2	Carrier leakage	114
6.5.2D.3	In-band emissions	114
6.5.2D.4	EVM equalizer spectrum flatness for ProSe	115
6.6	Output RF spectrum emissions	115
6.6.1	Occupied bandwidth	115
6.6.1A	Occupied bandwidth for CA	115
6.6.1B	Occupied bandwidth for UL-MIMO	116
6.6.2	Out of band emission	116
6.6.2.1	Spectrum emission mask	116
6.6.2.1.1	Minimum requirement	116
6.6.2.1A	Spectrum emission mask for CA	117
6.6.2.2	Additional spectrum emission mask	117
6.6.2.2.1	Minimum requirement (network signalled value "NS_03", "NS_11", "NS_20", and "NS_21")	117
6.6.2.2.2	Minimum requirement (network signalled value "NS_04")	118
6.6.2.2.3	Minimum requirement (network signalled value "NS_06" or "NS_07")	118
6.6.2.2A	Additional Spectrum Emission Mask for CA	119
6.6.2.2A.1	Minimum requirement (network signalled value "CA_NS_04")	119
6.6.2.3	Adjacent Channel Leakage Ratio	120
6.6.2.3.1	Minimum requirement E-UTRA	120
6.6.2.3.1Aa	Void	121
6.6.2.3.1Aa	Void	121
6.6.2.3.2	Minimum requirements UTRA	121
6.6.2.3.2A	Minimum requirement UTRA for CA	121
6.6.2.3.3A	Minimum requirements for CA E-UTRA	123
6.6.2.4	Void	123
6.6.2.4.1	Void	123
6.6.2A	Void	123
6.6.2B	Out of band emission for UL-MIMO	124
6.6.3	Spurious emissions	124

6.6.3.1	Minimum requirements	124
6.6.3.1A	Minimum requirements for CA.....	125
6.6.3.2	Spurious emission band UE co-existence	125
6.6.3.2A	Spurious emission band UE co-existence for CA	130
6.6.3.3	Additional spurious emissions	136
6.6.3.3.1	Minimum requirement (network signalled value "NS_05").....	136
6.6.3.3.2	Minimum requirement (network signalled value "NS_07").....	136
6.6.3.3.3	Minimum requirement (network signalled value "NS_08").....	137
6.6.3.3.4	Minimum requirement (network signalled value "NS_09").....	137
6.6.3.3.5	Minimum requirement (network signalled value "NS_12").....	137
6.6.3.3.6	Minimum requirement (network signalled value "NS_13").....	137
6.6.3.3.7	Minimum requirement (network signalled value "NS_14").....	138
6.6.3.3.8	Minimum requirement (network signalled value "NS_15").....	138
6.6.3.3.9	Minimum requirement (network signalled value "NS_16").....	138
6.6.3.3.10	Minimum requirement (network signalled value "NS_17").....	139
6.6.3.3.11	Minimum requirement (network signalled value "NS_18").....	139
6.6.3.3.12	Minimum requirement (network signalled value "NS_19").....	139
6.6.3.3.13	Minimum requirement (network signalled value "NS_11").....	139
6.6.3.3.14	Minimum requirement (network signalled value "NS_20").....	140
6.6.3.3.15	Minimum requirement (network signalled value "NS_21").....	140
6.6.3.3.16	Minimum requirement (network signalled value "NS_22").....	140
6.6.3.3.17	Minimum requirement (network signalled value "NS_23").....	141
6.6.3.3.18	Void.....	141
6.6.3.3.19	Minimum requirement (network signalled value "NS_04").....	141
6.6.3.3A	Additional spurious emissions for CA	142
6.6.3.3A.1	Minimum requirement for CA_1C (network signalled value "CA_NS_01").....	142
6.6.3.3A.2	Minimum requirement for CA_1C (network signalled value "CA_NS_02").....	142
6.6.3.3A.3	Minimum requirement for CA_1C (network signalled value "CA_NS_03").....	143
6.6.3.3A.4	Minimum requirement for CA_38C (network signalled value "CA_NS_05").....	143
6.6.3.3A.5	Minimum requirement for CA_7C (network signalled value "CA_NS_06").....	143
6.6.3.3A.6	Minimum requirement for CA_39C (network signalled value "CA_NS_07").....	144
6.6.3.3A.7	Minimum requirement for CA_42C (network signalled value "CA_NS_08").....	144
6.6.3.3A.8	Minimum requirement for CA_41C (network signalled value "CA_NS_04").....	144
6.6.3A	Void	145
6.6.3B	Spurious emission for UL-MIMO	145
6.6A	Void.....	145
6.6B	Void.....	145
6.7	Transmit intermodulation	145
6.7.1	Minimum requirement	145
6.7.1A	Minimum requirement for CA	145
6.7.1B	Minimum requirement for UL-MIMO	146
6.8	Void.....	146
6.8.1	Void	146
6.8A	Void.....	146
6.8B	Time alignment error for UL-MIMO	146
6.8B.1	Minimum Requirements	146
7	Receiver characteristics	147
7.1	General	147
7.2	Diversity characteristics	147
7.3	Reference sensitivity power level.....	148
7.3.1	Minimum requirements (QPSK).....	148
7.3.1A	Minimum requirements (QPSK) for CA.....	158
7.3.1B	Minimum requirements (QPSK) for UL-MIMO	171
7.3.1D	Minimum requirements (QPSK) for ProSe.....	171
7.3.1E	Minimum requirements (QPSK) for UE category 0	172
7.3.2	Void	173
7.4	Maximum input level	173
7.4.1	Minimum requirements	173
7.4.1A	Minimum requirements for CA	174
7.4.1B	Minimum requirements for UL-MIMO	175
7.4.1D	Minimum requirements for ProSe	175

7.4A	Void.....	176
7.4A.1	Void	176
7.5	Adjacent Channel Selectivity (ACS).....	176
7.5.1	Minimum requirements.....	176
7.5.1A	Minimum requirements for CA	177
7.5.1B	Minimum requirements for UL-MIMO	179
7.5.1D	Minimum requirements for ProSe	179
7.6	Blocking characteristics	180
7.6.1	In-band blocking	180
7.6.1.1	Minimum requirements	180
7.6.1.1A	Minimum requirements for CA.....	181
7.6.1.1D	Minimum requirements for ProSe.....	183
7.6.2	Out-of-band blocking.....	184
7.6.2.1	Minimum requirements	184
7.6.2.1A	Minimum requirements for CA.....	185
7.6.2.1D	Minimum requirements for ProSe.....	188
7.6.3	Narrow band blocking	188
7.6.3.1	Minimum requirements	189
7.6.3.1A	Minimum requirements for CA.....	189
7.6.3.1D	Minimum requirements for ProSe.....	190
7.6A	Void.....	191
7.6B	Blocking characteristics for UL-MIMO	191
7.7	Spurious response.....	191
7.7.1	Minimum requirements.....	191
7.7.1A	Minimum requirements for CA	192
7.7.1B	Minimum requirements for UL-MIMO	193
7.7.1D	Minimum requirements for ProSe	193
7.8	Intermodulation characteristics	194
7.8.1	Wide band intermodulation.....	194
7.8.1.1	Minimum requirements	194
7.8.1A	Minimum requirements for CA	194
7.8.1B	Minimum requirements for UL-MIMO	196
7.8.1D	Minimum requirements for ProSe	196
7.8.2	Void	197
7.9	Spurious emissions	197
7.9.1	Minimum requirements	197
7.9.1A	Minimum requirements	197
7.10	Receiver image	197
7.10.1	Void	197
7.10.1A	Minimum requirements for CA	197
8	Performance requirement	199
8.1	General	199
8.1.1	Receiver antenna capability	199
8.1.1.1	Simultaneous unicast and MBMS operations.....	200
8.1.1.2	Dual-antenna receiver capability in idle mode	200
8.1.2	Applicability of requirements	200
8.1.2.1	Applicability of requirements for different channel bandwidths.....	200
8.1.2.2	Definition of CA capability.....	200
8.1.2.2A	Definition of dual connectivity capability.....	201
8.1.2.3	Applicability and test rules for different CA configurations and bandwidth combination sets.....	202
8.1.2.3A	Applicability and test rules for different dual connectivity configuration and bandwidth combination set	204
8.1.2.3B	Applicability and test rules for different TDD-FDD CA configurations and bandwidth combination sets.....	205
8.1.2.4	Test coverage for different number of component carriers	206
8.1.2.5	Applicability of performance requirements for Type B receiver	207
8.1.3	UE category and UE DL category	207
8.2	Demodulation of PDSCH (Cell-Specific Reference Symbols)	207
8.2.1	FDD (Fixed Reference Channel)	207
8.2.1.1	Single-antenna port performance	207
8.2.1.1.1	Minimum Requirement	208

8.2.1.1.2	Void.....	211
8.2.1.1.3	Void.....	211
8.2.1.1.4	Minimum Requirement 1 PRB allocation in presence of MBSFN.....	211
8.2.1.2	Transmit diversity performance	212
8.2.1.2.1	Minimum Requirement 2 Tx Antenna Port	212
8.2.1.2.2	Minimum Requirement 4 Tx Antenna Port	212
8.2.1.2.3	Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)	213
8.2.1.2.3A	Minimum Requirement 2 Tx Antenna Ports (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)	215
8.2.1.2.4	Enhanced Performance Requirement Type A - 2 Tx Antenna Ports with TM3 interference model	217
8.2.1.2.5	Enhanced Performance Requirement Type B - 2 Tx Antenna Ports with TM2 interference model	219
8.2.1.2.6	Enhanced Performance Requirement Type B - 2 Tx Antenna Ports with TM9 interference model	220
8.2.1.3	Open-loop spatial multiplexing performance	221
8.2.1.3.1	Minimum Requirement 2 Tx Antenna Port	221
8.2.1.3.1B	Enhanced Performance Requirement Type C –2Tx Antenna Ports.....	224
8.2.1.3.1C	Enhanced Performance Requirement Type C - 2 Tx Antenna Ports with TM1 interference	225
8.2.1.3.2	Minimum Requirement 4 Tx Antenna Port	226
8.2.1.3.3	Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)	226
8.2.1.3.4	Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)	230
8.2.1.4	Closed-loop spatial multiplexing performance	232
8.2.1.4.1	Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port.....	232
8.2.1.4.1A	Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Port.....	233
8.2.1.4.1B	Enhanced Performance Requirement Type A - Single-Layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model	233
8.2.1.4.1C	Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Ports (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)....	235
8.2.1.4.1D	Enhanced Performance Requirement Type B - Single-layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model	237
8.2.1.4.2	Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port	239
8.2.1.4.2A	Enhanced Performance Requirement Type C – Multi-layer Spatial Multiplexing 2Tx Antenna Ports.....	239
8.2.1.4.3	Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port	240
8.2.1.4.3A	Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port for dual connectivity	243
8.2.1.5	MU-MIMO.....	245
8.2.1.6	[Control channel performance: D-BCH and PCH]	245
8.2.1.7	Carrier aggregation with power imbalance	245
8.2.1.7.1	Minimum Requirement	245
8.2.1.8	Intra-band non-contiguous carrier aggregation with timing offset.....	246
8.2.1.8.1	Minimum Requirement	246
8.2.2	TDD (Fixed Reference Channel)	247
8.2.2.1	Single-antenna port performance	247
8.2.2.1.1	Minimum Requirement	247
8.2.2.1.2	Void.....	251
8.2.2.1.3	Void.....	251
8.2.2.1.4	Minimum Requirement 1 PRB allocation in presence of MBSFN.....	251
8.2.2.2	Transmit diversity performance	252
8.2.2.2.1	Minimum Requirement 2 Tx Antenna Port	252
8.2.2.2.2	Minimum Requirement 4 Tx Antenna Port	252
8.2.2.2.3	Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)	253
8.2.2.2.3A	Minimum Requirement 2 Tx Antenna Ports (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)	255
8.2.2.2.4	Enhanced Performance Requirement Type A – 2 Tx Antenna Ports with TM3 interference model	257

8.2.2.2.5	Minimum Requirement 2 Tx Antenna Port (when <i>EIMTA-MainConfigServCell-r12</i> is configured)	259
8.2.2.2.6	Enhanced Performance Requirement Type B - 2 Tx Antenna Ports with TM2 interference model	259
8.2.2.2.7	Enhanced Performance Requirement Type B - 2 Tx Antenna Ports with TM9 interference model	261
8.2.2.3	Open-loop spatial multiplexing performance	262
8.2.2.3.1	Minimum Requirement 2 Tx Antenna Port	262
8.2.2.3.1A	Soft buffer management test	264
8.2.2.3.1B	Enhanced Performance Requirement Type C - 2Tx Antenna Ports	265
8.2.2.3.1C	Enhanced Performance Requirement Type C - 2 Tx Antenna Ports with TM1 interference	265
8.2.2.3.2	Minimum Requirement 4 Tx Antenna Port	266
8.2.2.3.3	Minimum Requirement 2Tx antenna port (demodulation subframe overlaps with aggressor cell ABS)	267
8.2.2.3.4	Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)	271
8.2.2.4	Closed-loop spatial multiplexing performance	273
8.2.2.4.1	Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Port	273
8.2.2.4.1A	Minimum Requirement Single-Layer Spatial Multiplexing 4 Tx Antenna Port	274
8.2.2.4.1B	Enhanced Performance Requirement Type A – Single-Layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model	274
8.2.2.4.1C	Minimum Requirement Single-Layer Spatial Multiplexing 2 Tx Antenna Ports (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)	276
8.2.2.4.1D	Enhanced Performance Requirement Type B - Single-layer Spatial Multiplexing 2 Tx Antenna Port with TM4 interference model	278
8.2.2.4.2	Minimum Requirement Multi-Layer Spatial Multiplexing 2 Tx Antenna Port	280
8.2.2.4.2A	Enhanced Performance Requirement Type C Multi-Layer Spatial Multiplexing 2 Tx Antenna Port	281
8.2.2.4.3	Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port	281
8.2.2.4.3A	Minimum Requirement Multi-Layer Spatial Multiplexing 4 Tx Antenna Port for dual connectivity	284
8.2.2.4.4	Void	286
8.2.2.5	MU-MIMO	286
8.2.2.6	[Control channel performance: D-BCH and PCH]	286
8.2.2.7	Carrier aggregation with power imbalance	286
8.2.2.7.1	Minimum Requirement	286
8.2.2.8	Intra-band contiguous carrier aggregation with minimum channel spacing	287
8.2.2.8.1	Minimum Requirement	287
8.2.3	TDD FDD CA (Fixed Reference Channel)	288
8.2.3.1	Single-antenna port performance	289
8.2.3.1.1	Minimum Requirement for FDD PCell	289
8.2.3.1.2	Minimum Requirement for TDD PCell	290
8.2.3.2	Open-loop spatial multiplexing performance 2Tx Antenna port	292
8.2.3.2.1	Minimum Requirement for FDD PCell	292
8.2.3.2.1A	Soft buffer management test for FDD PCell	294
8.2.3.2.2	Minimum Requirement for TDD PCell	294
8.2.3.2.2A	Soft buffer management test for TDD PCell	296
8.2.3.3	Closed-loop spatial multiplexing performance 4Tx Antenna Port	297
8.2.3.3.1	Minimum Requirement for FDD PCell	297
8.2.3.3.2	Minimum Requirement for TDD PCell	299
8.3	Demodulation of PDSCH (User-Specific Reference Symbols)	301
8.3.1	FDD	301
8.3.1.1	Single-layer Spatial Multiplexing	302
8.3.1.1A	Enhanced Performance Requirement Type A – Single-layer Spatial Multiplexing with TM9 interference model	304
8.3.1.1B	Single-layer Spatial Multiplexing (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)	306
8.3.1.1C	Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM9 interference model	308
8.3.1.1D	Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with CRS interference model	310

8.3.1.1E	Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM3 interference model.....	311
8.3.1.1F	Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM10 serving cell configuration and TM9 interference model	312
8.3.1.2	Dual-Layer Spatial Multiplexing	314
8.3.1.2A	Enhanced Performance Requirement Type C - Dual-Layer Spatial Multiplexing.....	315
8.3.1.3	Performance requirements for DCI format 2D and non Quasi Co-located Antenna Ports.....	316
8.3.1.3.1	Minimum requirement with Same Cell ID (with single NZP CSI-RS resource).....	316
8.3.1.3.2	Minimum requirements with Same Cell ID (with multiple NZP CSI-RS resources).....	318
8.3.1.3.3	Minimum requirement with Different Cell ID and Colliding CRS (with single NZP CSI-RS resource)	320
8.3.2	TDD	322
8.3.2.1	Single-layer Spatial Multiplexing	322
8.3.2.1A	Single-layer Spatial Multiplexing (with multiple CSI-RS configurations)	324
8.3.2.1B	Enhanced Performance Requirement Type A – Single-layer Spatial Multiplexing with TM9 interference model.....	326
8.3.2.1C	Single-layer Spatial Multiplexing (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)	328
8.3.2.1D	Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM9 interference.....	330
8.3.2.1E	Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with CRS interference model.....	332
8.3.2.1F	Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM3 interference.....	334
8.3.2.1G	Enhanced Performance Requirement Type B – Single-layer Spatial Multiplexing with TM10 serving cell configuration and TM9 interference model	335
8.3.2.2	Dual-Layer Spatial Multiplexing	337
8.3.2.2A	Enhanced Performance Requirement Type C - Dual-Layer Spatial Multiplexing	338
8.3.2.3	Dual-Layer Spatial Multiplexing (with multiple CSI-RS configurations)	339
8.3.2.4	Performance requirements for DCI format 2D and non Quasi Co-located Antenna Ports.....	340
8.3.2.4.1	Minimum requirement with Same Cell ID (with single NZP CSI-RS resource).....	340
8.3.2.4.2	Minimum requirements with Same Cell ID (with multiple NZP CSI-RS resources).....	342
8.3.2.4.3	Minimum requirement with Different Cell ID and Colliding CRS (with single NZP CSI-RS resource)	344
8.4	Demodulation of PDCCH/PCFICH	346
8.4.1	FDD	346
8.4.1.1	Single-antenna port performance	346
8.4.1.2	Transmit diversity performance	346
8.4.1.2.1	Minimum Requirement 2 Tx Antenna Port	346
8.4.1.2.2	Minimum Requirement 4 Tx Antenna Port	347
8.4.1.2.3	Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)	347
8.4.1.2.4	Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)	351
8.4.2	TDD	355
8.4.2.1	Single-antenna port performance	356
8.4.2.2	Transmit diversity performance	356
8.4.2.2.1	Minimum Requirement 2 Tx Antenna Port	356
8.4.2.2.2	Minimum Requirement 4 Tx Antenna Port	357
8.4.2.2.3	Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)	357
8.4.2.2.4	Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)	361
8.5	Demodulation of PHICH.....	365
8.5.1	FDD	365
8.5.1.1	Single-antenna port performance	365
8.5.1.2	Transmit diversity performance	366
8.5.1.2.1	Minimum Requirement 2 Tx Antenna Port	366
8.5.1.2.2	Minimum Requirement 4 Tx Antenna Port	366
8.5.1.2.3	Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)	366

8.5.1.2.4	Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)	368
8.5.2	TDD	370
8.5.2.1	Single-antenna port performance	371
8.5.2.2	Transmit diversity performance	371
8.5.2.2.1	Minimum Requirement 2 Tx Antenna Port	371
8.5.2.2.2	Minimum Requirement 4 Tx Antenna Port	372
8.5.2.2.3	Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS)	372
8.5.2.2.4	Minimum Requirement 2 Tx Antenna Port (demodulation subframe overlaps with aggressor cell ABS and CRS assistance information are configured)	374
8.6	Demodulation of PBCH	376
8.6.1	FDD	376
8.6.1.1	Single-antenna port performance	376
8.6.1.2	Transmit diversity performance	377
8.6.1.2.1	Minimum Requirement 2 Tx Antenna Port	377
8.6.1.2.2	Minimum Requirement 4 Tx Antenna Port	377
8.6.1.2.3	Minimum Requirement 2 Tx Antenna Port under Time Domain Measurement Resource Restriction with CRS Assistance Information	377
8.6.2	TDD	379
8.6.2.1	Single-antenna port performance	379
8.6.2.2	Transmit diversity performance	379
8.6.2.2.1	Minimum Requirement 2 Tx Antenna Port	379
8.6.2.2.2	Minimum Requirement 4 Tx Antenna Port	379
8.6.2.2.3	Minimum Requirement 2 Tx Antenna Port under Time Domain Measurement Resource Restriction with CRS Assistance Information	380
8.7	Sustained downlink data rate provided by lower layers	381
8.7.1	FDD (single carrier and CA).....	381
8.7.2	TDD (single carrier and CA)	386
8.7.3	FDD (EPDCCH scheduling).....	389
8.7.4	TDD (EPDCCH scheduling).....	390
8.7.5	TDD FDD CA.....	392
8.7.5.1	Minimum Requirement FDD PCell	393
8.7.5.2	Minimum Requirement TDD PCell	395
8.7.6	FDD (DC)	396
8.7.7	TDD (DC)	399
8.8	Demodulation of EPDCCH	402
8.8.1	Distributed Transmission	402
8.8.1.1	FDD.....	402
8.8.1.1.1	Void.....	403
8.8.1.2	TDD	403
8.8.1.2.1	Void.....	404
8.8.2	Localized Transmission with TM9	404
8.8.2.1	FDD.....	404
8.8.2.1.1	Void.....	405
8.8.2.1.2	Void.....	405
8.8.2.2	TDD	405
8.8.2.2.1	Void.....	407
8.8.2.2.2	Void.....	407
8.8.3	Localized transmission with TM10 Type B quasi co-location type.....	407
8.8.3.1	FDD.....	407
8.8.3.2	TDD	409
8.9	Demodulation (single receiver antenna)	411
8.9.1	PDSCH	411
8.9.1.1	FDD and half-duplex FDD (Fixed Reference Channel).....	411
8.9.1.1.1	Transmit diversity performance (Cell-Specific Reference Symbols)	412
8.9.1.1.2	Closed-loop spatial multiplexing performance (Cell-Specific Reference Symbols)	412
8.9.1.1.3	Closed-loop spatial multiplexing performance (User-Specific Reference Symbols)	413
8.9.1.2	TDD (Fixed Reference Channel)	414
8.9.1.2.1	Transmit diversity performance (Cell-Specific Reference Symbols)	415
8.9.1.2.2	Closed-loop spatial multiplexing performance (Cell-Specific Reference Symbols)	416
8.9.1.2.3	Closed-loop spatial multiplexing performance (User-Specific Reference Symbols)	416

8.9.2	PHICH	418
8.9.2.1	FDD and half-duplex FDD.....	418
8.9.2.1.1	Transmit diversity performance.....	418
8.9.2.2	TDD	418
8.9.2.2.1	Transmit diversity performance.....	418
8.9.3	PBCH.....	418
8.9.3.1	FDD and half-duplex FDD.....	418
8.9.3.1.1	Transmit diversity performance.....	418
8.9.3.2	TDD	419
8.9.3.2.1	Transmit diversity performance.....	419
9	Reporting of Channel State Information	419
9.1	General	419
9.1.1	Applicability of requirements	419
9.1.1.1	Applicability of requirements for different channel bandwidths.....	419
9.1.1.2	Applicability and test rules for different CA configurations and bandwidth combination sets.....	419
9.1.1.2A	Applicability and test rules for different TDD-FDD CA configurations and bandwidth combination sets.....	420
9.1.1.3	Test coverage for different number of component carriers	421
9.2	CQI reporting definition under AWGN conditions	421
9.2.1	Minimum requirement PUCCH 1-0 (Cell-Specific Reference Symbols)	422
9.2.1.1	FDD.....	422
9.2.1.2	TDD	423
9.2.1.3	FDD (CSI measurements in case two CSI subframe sets are configured)	424
9.2.1.4	TDD (CSI measurements in case two CSI subframe sets are configured)	426
9.2.1.5	FDD (CSI measurements in case two CSI subframe sets are configured and with CRS assistance information)	428
9.2.1.6	TDD (CSI measurements in case two CSI subframe sets are configured and with CRS assistance information)	430
9.2.1.7	FDD (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used)	432
9.2.1.8	TDD (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used)	433
9.2.2	Minimum requirement PUCCH 1-1 (Cell-Specific Reference Symbols)	433
9.2.2.1	FDD.....	433
9.2.2.2	TDD	434
9.2.3	Minimum requirement PUCCH 1-1 (CSI Reference Symbols).....	435
9.2.3.1	FDD.....	435
9.2.3.2	TDD	436
9.2.4	Minimum requirement PUCCH 1-1 (With Single CSI Process).....	437
9.2.4.1	FDD.....	437
9.2.4.2	TDD	440
9.2.5	Minimum requirement PUCCH 1-1 (when <i>csi-SubframeSet-r12</i> and <i>EIMTA-MainConfigServCell-r12</i> are configured)	442
9.3	CQI reporting under fading conditions.....	444
9.3.1	Frequency-selective scheduling mode	444
9.3.1.1	Minimum requirement PUSCH 3-0 (Cell-Specific Reference Symbols).....	444
9.3.1.1.1	FDD	444
9.3.1.1.2	TDD.....	445
9.3.1.1.3	FDD (CSI measurements in case two CSI subframe sets are configured and with CRS assistance information)	446
9.3.1.1.4	TDD (CSI measurements in case two CSI subframe sets are configured and with CRS assistance information)	449
9.3.1.1.5	TDD (when <i>csi-SubframeSet-r12</i> is configured)	451
9.3.1.2	Minimum requirement PUSCH 3-1 (CSI Reference Symbol)	453
9.3.1.2.1	FDD	453
9.3.1.2.2	TDD.....	454
9.3.1.2.3	FDD (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used).....	456
9.3.1.2.4	TDD (Modulation and TBS index Table 2 and 4-bit CQI Table 2 are used).....	457
9.3.1.2.5	Void.....	458
9.3.1.2.6	TDD (when <i>csi-SubframeSet-r12</i> is configured with one CSI process)	458
9.3.2	Frequency non-selective scheduling mode	461
9.3.2.1	Minimum requirement PUCCH 1-0 (Cell-Specific Reference Symbol)	461
9.3.2.1.1	FDD	461