

ETSI TS 138 104 V15.15.0 (2021-10)



**5G;
NR;
Base Station (BS) radio transmission and reception
(3GPP TS 38.104 version 15.15.0 Release 15)**

<https://standards.iteh.ai/catalog/standards/sist/7d9081e0-1d24-48b5-856e-ccf0df258a38/etsi-ts-138-104-v15-15-0-2021-10>



ReferenceRTS/TSGR-0438104vff0

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

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Important notice

<https://standards.iteh.ai/catalog/standards/sist/7d9081e0-1d24-48b5-856e-c60025843801/38-104-v15-15-0-2021-10>
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 2021.
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 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>.

<https://standards.iteh.ai/catalog/standards/sist/7d9081e0-1d24-48b5-856e-cc0d258a38/etsi-ts-138-104-v15-15-0-2021-10>

Modal verbs terminology

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

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

Contents

Intellectual Property Rights	2
Legal Notice	2
Modal verbs terminology.....	2
Foreword.....	11
1 Scope	12
2 References	12
3 Definitions, symbols and abbreviations	13
3.1 Definitions	13
3.2 Symbols.....	17
3.3 Abbreviations	19
4 General	21
4.1 Relationship with other core specifications.....	21
4.2 Relationship between minimum requirements and test requirements	21
4.3 Conducted and radiated requirement reference points	21
4.3.1 BS type 1-C	21
4.3.2 BS type 1-H	22
4.3.3 BS type 1-O and BS type 2-O	23
4.4 Base station classes	23
4.5 Regional requirements.....	24
4.6 Applicability of requirements.....	25
4.7 Requirements for contiguous and non-contiguous spectrum.....	26
4.8 Requirements for BS capable of multi-band operation	26
4.9 OTA co-location with other base stations	28
5 Operating bands and channel arrangement.....	29
5.1 General	29
5.2 Operating bands	29
5.3 BS channel bandwidth	30
5.3.1 General.....	30
5.3.2 Transmission bandwidth configuration	31
5.3.3 Minimum guardband and transmission bandwidth configuration	31
5.3.4 RB alignment.....	33
5.3A BS channel bandwidth for CA.....	37
5.3A.1 Transmission bandwidth configuration for CA	37
5.3A.2 Minimum guardband and transmission bandwidth configuration for CA	37
5.4 Channel arrangement.....	39
5.4.1 Channel spacing.....	39
5.4.1.1 Channel spacing for adjacent NR carriers	39
5.4.1.2 Channel spacing for CA	39
5.4.2 Channel raster	40
5.4.2.1 NR-ARFCN and channel raster.....	40
5.4.2.2 Channel raster to resource element mapping.....	40
5.4.2.3 Channel raster entries for each operating band.....	41
5.4.3 Synchronization raster	42
5.4.3.1 Synchronization raster and numbering.....	42
5.4.3.2 Synchronization raster to synchronization block resource element mapping.....	43
5.4.3.3 Synchronization raster entries for each operating band.....	43
6 Conducted transmitter characteristics	45
6.1 General	45
6.2 Base station output power	45
6.2.1 General.....	45
6.2.2 Minimum requirement for BS type 1-C.....	46
6.2.3 Minimum requirement for BS type 1-H	46

6.2.4	Additional requirements (regional).....	46
6.3	Output power dynamics.....	46
6.3.1	General.....	46
6.3.2	RE power control dynamic range	46
6.3.2.1	General	46
6.3.2.2	Minimum requirement for <i>BS type 1-C</i> and <i>BS type 1-H</i>	46
6.3.3	Total power dynamic range	47
6.3.3.1	General	47
6.3.3.2	Minimum requirement for <i>BS type 1-C</i> and <i>BS type 1-H</i>	47
6.4	Transmit ON/OFF power	48
6.4.1	Transmitter OFF power	48
6.4.1.1	General	48
6.4.1.2	Minimum requirement for <i>BS type 1-C</i>	48
6.4.1.3	Minimum requirement for <i>BS type 1-H</i>	48
6.4.2	Transmitter transient period	48
6.4.2.1	General	48
6.4.2.2	Minimum requirement for <i>BS type 1-C</i> and <i>BS type 1-H</i>	49
6.4.2.3	Void.....	49
6.5	Transmitted signal quality	49
6.5.1	Frequency error.....	49
6.5.1.1	General	49
6.5.1.2	Minimum requirement for <i>BS type 1-C</i> and <i>BS type 1-H</i>	50
6.5.2	Modulation quality.....	50
6.5.2.1	General	50
6.5.2.2	Minimum Requirement for <i>BS type 1-C</i> and <i>BS type 1-H</i>	50
6.5.2.3	EVM frame structure for measurement.....	50
6.5.3	Time alignment error.....	50
6.5.3.1	General	50
6.5.3.2	Minimum requirement for <i>BS type 1-C</i> and <i>BS type 1-H</i>	51
6.6	Unwanted emissions.....	51
6.6.1	General.....	51
6.6.2	Occupied bandwidth	52
6.6.2.1	General	52
6.6.2.2	Minimum requirement for <i>BS type 1-C</i> and <i>BS type 1-H</i>	52
6.6.3	Adjacent Channel Leakage Power Ratio	52
6.6.3.1	General	52
6.6.3.2	Limits and <i>Basic limits</i>	52
6.6.3.3	Minimum requirement for <i>BS type 1-C</i>	55
6.6.3.4	Minimum requirement for <i>BS type 1-H</i>	56
6.6.4	Operating band unwanted emissions	56
6.6.4.1	General	56
6.6.4.2	<i>Basic limits</i>	58
6.6.4.2.1	<i>Basic limits</i> for Wide Area BS (Category A)	58
6.6.4.2.2	<i>Basic limits</i> for Wide Area BS (Category B).....	58
6.6.4.2.2.1	Category B requirements (Option 1).....	58
6.6.4.2.2.2	Category B requirements (Option 2).....	60
6.6.4.2.3	<i>Basic limits</i> for Medium Range BS (Category A and B).....	60
6.6.4.2.4	<i>Basic limits</i> for Local Area BS (Category A and B).....	61
6.6.4.2.5	<i>Basic limits</i> for additional requirements	61
6.6.4.2.5.1	Limits in FCC Title 47.....	61
6.6.4.2.5.2	Protection of DTT.....	61
6.6.4.3	Minimum requirements for <i>BS type 1-C</i>	62
6.6.4.4	Minimum requirements for <i>BS type 1-H</i>	62
6.6.5	Transmitter spurious emissions.....	62
6.6.5.1	General	62
6.6.5.2	<i>Basic limits</i>	63
6.6.5.2.1	General transmitter spurious emissions requirements	63
6.6.5.2.2	Protection of the BS receiver of own or different BS	63
6.6.5.2.3	Additional spurious emissions requirements	64
6.6.5.2.4	Co-location with other base stations.....	71
6.6.5.3	Minimum requirements for <i>BS type 1-C</i>	76
6.6.5.4	Minimum requirements for <i>BS type 1-H</i>	76

6.7	Transmitter intermodulation.....	76
6.7.1	General.....	76
6.7.2	Minimum requirements for <i>BS type 1-C</i>	77
6.7.2.1	Co-location minimum requirements.....	77
6.7.2.2	Additional requirements.....	77
6.7.3	Minimum requirements for <i>BS type 1-H</i>	78
6.7.3.1	Co-location minimum requirements.....	78
6.7.3.2	Intra-system minimum requirements.....	78
6.7.3.3	Additional requirements.....	79
7	Conducted receiver characteristics.....	80
7.1	General.....	80
7.2	Reference sensitivity level.....	80
7.2.1	General.....	80
7.2.2	Minimum requirements for <i>BS type 1-C</i> and <i>BS type 1-H</i>	81
7.3	Dynamic range.....	82
7.3.1	General.....	82
7.3.2	Minimum requirement for <i>BS type 1-C</i> and <i>BS type 1-H</i>	82
7.4	In-band selectivity and blocking.....	85
7.4.1	Adjacent Channel Selectivity (ACS).....	85
7.4.1.1	General.....	85
7.4.1.2	Minimum requirement for <i>BS type 1-C</i> and <i>BS type 1-H</i>	85
7.4.1.3	Void.....	87
7.4.1.4	Void.....	87
7.4.2	In-band blocking.....	87
7.4.2.1	General.....	87
7.4.2.2	Minimum requirement for <i>BS type 1-C</i> and <i>BS type 1-H</i>	87
7.4.2.3	Void.....	89
7.4.2.4	Void.....	89
7.5	Out-of-band blocking.....	89
7.5.1	General.....	89
7.5.2	Minimum requirement for <i>BS type 1-C</i> and <i>BS type 1-H</i>	89
7.5.3	Co-location minimum requirements for <i>BS type 1-C</i> and <i>BS type 1-H</i>	90
7.5.4	Void.....	91
7.6	Receiver spurious emissions.....	91
7.6.1	General.....	91
7.6.2	<i>Basic limits</i>	91
7.6.3	Minimum requirement for <i>BS type 1-C</i>	92
7.6.4	Minimum requirement for <i>BS type 1-H</i>	92
7.7	Receiver intermodulation.....	92
7.7.1	General.....	92
7.7.2	Minimum requirement for <i>BS type 1-C</i> and <i>BS type 1-H</i>	92
7.8	In-channel selectivity.....	97
7.8.1	General.....	97
7.8.2	Minimum requirement for <i>BS type 1-C</i> and <i>BS type 1-H</i>	97
8	Conducted performance requirements.....	100
8.1	General.....	100
8.1.1	Scope and definitions.....	100
8.1.2	Void.....	100
8.2	Performance requirements for PUSCH.....	100
8.2.1	Requirements for PUSCH with transform precoding disabled.....	100
8.2.1.1	General.....	100
8.2.1.2	Minimum requirements.....	101
8.2.2	Requirements for PUSCH with transform precoding enabled.....	108
8.2.2.1	General.....	108
8.2.2.2	Minimum requirements.....	109
8.2.3	Requirements for UCI multiplexed on PUSCH.....	110
8.2.3.1	General.....	110
8.2.3.2	Minimum requirements.....	111
8.3	Performance requirements for PUCCH.....	112
8.3.1	DTX to ACK probability.....	112

8.3.1.1	General	112
8.3.1.2	Minimum requirement	112
8.3.2	Performance requirements for PUCCH format 0	112
8.3.2.1	General	112
8.3.2.2	Minimum requirements	113
8.3.3	Performance requirements for PUCCH format 1	113
8.3.3.1	NACK to ACK requirements	113
8.3.3.1.1	General	113
8.3.3.1.2	Minimum requirements	114
8.3.3.2	ACK missed detection requirements	115
8.3.3.2.1	General	115
8.3.3.2.2	Minimum requirements	115
8.3.4	Performance requirements for PUCCH format 2	116
8.3.4.1	ACK missed detection requirements	116
8.3.4.1.1	General	116
8.3.4.1.2	Minimum requirements	116
8.3.4.2	UCI BLER performance requirements	117
8.3.4.2.1	General	117
8.3.4.2.2	Minimum requirements	117
8.3.5	Performance requirements for PUCCH format 3	117
8.3.5.1	General	117
8.3.5.2	Minimum requirements	118
8.3.6	Performance requirements for PUCCH format 4	119
8.3.6.1	General	119
8.3.6.2	Minimum requirement	120
8.3.7	Performance requirements for multi-slot PUCCH	120
8.3.7.1	General	120
8.3.7.2	Performance requirements for multi-slot PUCCH format 1	120
8.3.7.2.1	NACK to ACK requirements	120
8.3.7.2.1.1	General	120
8.3.7.2.1.2	Minimum requirements	121
8.3.7.2.2	ACK missed detection requirements	121
8.3.7.2.2.1	General	121
8.3.7.2.2.2	Minimum requirements	121
8.4	Performance requirements for PRACH	122
8.4.1	PRACH False alarm probability	122
8.4.1.1	General	122
8.4.1.2	Minimum requirement	122
8.4.2	PRACH detection requirements	122
8.4.2.1	General	122
8.4.2.2	Minimum requirements	122
9	Radiated transmitter characteristics	124
9.1	General	124
9.2	Radiated transmit power	124
9.2.1	General	124
9.2.2	Minimum requirement for <i>BS type 1-H</i> and <i>BS type 1-O</i>	124
9.2.3	Minimum requirement for <i>BS type 2-O</i>	125
9.3	OTA base station output power	125
9.3.1	General	125
9.3.2	Minimum requirement for <i>BS type 1-O</i>	125
9.3.3	Minimum requirement for <i>BS type 2-O</i>	126
9.3.4	Additional requirements (regional)	126
9.4	OTA output power dynamics	126
9.4.1	General	126
9.4.2	OTA RE power control dynamic range	126
9.4.2.1	General	126
9.4.2.2	Minimum requirement for <i>BS type 1-O</i>	126
9.4.3	OTA total power dynamic range	126
9.4.3.1	General	126
9.4.3.2	Minimum requirement for <i>BS type 1-O</i>	126
9.4.3.3	Minimum requirement for <i>BS type 2-O</i>	127

9.5	OTA transmit ON/OFF power.....	127
9.5.1	General.....	127
9.5.2	OTA transmitter OFF power.....	127
9.5.2.1	General.....	127
9.5.2.2	Minimum requirement for <i>BS type 1-O</i>	127
9.5.2.3	Minimum requirement for <i>BS type 2-O</i>	127
9.5.3	OTA transient period.....	127
9.5.3.1	General.....	127
9.5.3.2	Minimum requirement for <i>BS type 1-O</i>	128
9.5.3.3	Minimum requirement for <i>BS type 2-O</i>	128
9.6	OTA transmitted signal quality.....	128
9.6.1	OTA frequency error.....	128
9.6.1.1	General.....	128
9.6.1.2	Minimum requirement for <i>BS type 1-O</i>	128
9.6.1.3	Minimum requirement for <i>BS type 2-O</i>	128
9.6.2	OTA modulation quality.....	129
9.6.2.1	General.....	129
9.6.2.2	Minimum Requirement for <i>BS type 1-O</i>	129
9.6.2.3	Minimum Requirement for <i>BS type 2-O</i>	129
9.6.2.3.1	EVM frame structure for measurement.....	129
9.6.3	OTA time alignment error.....	129
9.6.3.1	General.....	129
9.6.3.2	Minimum requirement for <i>BS type 1-O</i>	129
9.6.3.3	Minimum requirement for <i>BS type 2-O</i>	130
9.7	OTA unwanted emissions.....	130
9.7.1	General.....	130
9.7.2	OTA occupied bandwidth.....	131
9.7.2.1	General.....	131
9.7.2.2	Minimum requirement for <i>BS type 1-O</i> and <i>BS type 2-O</i>	131
9.7.3	OTA Adjacent Channel Leakage Power Ratio (ACLR).....	131
9.7.3.1	General.....	131
9.7.3.2	Minimum requirement for <i>BS type 1-O</i>	131
9.7.3.3	Minimum requirement for <i>BS type 2-O</i>	131
9.7.4	OTA operating band unwanted emissions.....	133
9.7.4.1	General.....	133
9.7.4.2	Minimum requirement for <i>BS type 1-O</i>	133
9.7.4.2.1	Additional requirements.....	134
9.7.4.2.1.1	Protection of DTT.....	134
9.7.4.2.1.2	Limits in FCC Title 47.....	134
9.7.4.3	Minimum requirement for <i>BS type 2-O</i>	134
9.7.4.3.1	General.....	134
9.7.4.3.2	OTA operating band unwanted emission limits (Category A).....	135
9.7.4.3.3	OTA operating band unwanted emission limits (Category B).....	136
9.7.4.3.4	Additional OTA operating band unwanted emission requirements.....	136
9.7.4.3.4.1	Protection of Earth Exploration Satellite Service.....	136
9.7.5	OTA transmitter spurious emissions.....	137
9.7.5.1	General.....	137
9.7.5.2	Minimum requirement for <i>BS type 1-O</i>	137
9.7.5.2.1	General.....	137
9.7.5.2.2	General OTA transmitter spurious emissions requirements.....	137
9.7.5.2.3	Protection of the BS receiver of own or different BS.....	137
9.7.5.2.4	Additional spurious emissions requirements.....	137
9.7.5.2.5	Co-location with other base stations.....	138
9.7.5.3	Minimum requirement for <i>BS type 2-O</i>	138
9.7.5.3.1	General.....	138
9.7.5.3.2	General OTA transmitter spurious emissions requirements.....	138
9.7.5.3.2.1	General.....	138
9.7.5.3.2.2	OTA transmitter spurious emissions (Category A).....	138
9.7.5.3.2.3	OTA transmitter spurious emissions (Category B).....	139
9.7.5.3.3	Additional OTA transmitter spurious emissions requirements.....	139
9.7.5.3.3.1	Limits for protection of Earth Exploration Satellite Service.....	139
9.8	OTA transmitter intermodulation.....	140

9.8.1	General.....	140
9.8.2	Minimum requirement for <i>BS type 1-O</i>	140
10	Radiated receiver characteristics	141
10.1	General	141
10.2	OTA sensitivity	142
10.2.1	<i>BS type 1-H</i> and <i>BS type 1-O</i>	142
10.2.1.1	General	142
10.2.1.2	Minimum requirement	142
10.2.2	<i>BS type 2-O</i>	142
10.3	OTA reference sensitivity level	143
10.3.1	General.....	143
10.3.2	Minimum requirement for <i>BS type 1-O</i>	143
10.3.3	Minimum requirement for <i>BS type 2-O</i>	144
10.4	OTA dynamic range	145
10.4.1	General.....	145
10.4.2	Minimum requirement for <i>BS type 1-O</i>	145
10.5	OTA in-band selectivity and blocking.....	154
10.5.1	OTA adjacent channel selectivity	154
10.5.1.1	General	154
10.5.1.2	Minimum requirement for <i>BS type 1-O</i>	154
10.5.1.3	Minimum requirement for <i>BS type 2-O</i>	155
10.5.2	OTA in-band blocking.....	156
10.5.2.1	General	156
10.5.2.2	Minimum requirement for <i>BS type 1-O</i>	156
10.5.2.3	Minimum requirement for <i>BS type 2-O</i>	159
10.6	OTA out-of-band blocking	159
10.6.1	General.....	159
10.6.2	Minimum requirement for <i>BS type 1-O</i>	159
10.6.2.1	General minimum requirement	159
10.6.2.2	Co-location minimum requirement	160
10.6.3	Minimum requirement for <i>BS type 2-O</i>	161
10.6.3.1	General minimum requirement	161
10.7	OTA receiver spurious emissions	161
10.7.1	General.....	161
10.7.2	Minimum requirement for <i>BS type 1-O</i>	161
10.7.3	Minimum requirement for <i>BS type 2-O</i>	162
10.8	OTA receiver intermodulation	163
10.8.1	General.....	163
10.8.2	Minimum requirement for <i>BS type 1-O</i>	163
10.8.3	Minimum requirement for <i>BS type 2-O</i>	167
10.9	OTA in-channel selectivity.....	168
10.9.1	General.....	168
10.9.2	Minimum requirement for <i>BS type 1-O</i>	168
10.9.3	Minimum requirement for <i>BS type 2-O</i>	171
11	Radiated performance requirements.....	173
11.1	General	173
11.1.1	Scope and definitions.....	173
11.1.2	OTA demodulation branches	173
11.1.3	Void	174
11.2	Performance requirements for PUSCH	174
11.2.1	Requirements for <i>BS type 1-O</i>	174
11.2.1.1	Requirements for PUSCH with transform precoding disabled	174
11.2.1.2	Requirements for PUSCH with transform precoding enabled	174
11.2.1.3	Requirements for UCI multiplexed on PUSCH	174
11.2.2	Requirements for <i>BS type 2-O</i>	174
11.2.2.1	Requirements for PUSCH with transform precoding disabled	174
11.2.2.1.1	General	174
11.2.2.1.2	Minimum requirements	175
11.2.2.2	Requirements for PUSCH with transform precoding enabled	177
11.2.2.2.1	General	177

11.2.2.2.2	Minimum requirements	177
11.2.2.3	Requirements for UCI multiplexed on PUSCH	178
11.2.2.3.1	General	178
11.2.2.3.2	Minimum requirements	179
11.3	Performance requirements for PUCCH	180
11.3.1	Requirements for <i>BS type 1-O</i>	180
11.3.1.1	DTX to ACK probability	180
11.3.1.2	Performance requirements for PUCCH format 0	181
11.3.1.3	Performance requirements for PUCCH format 1	181
11.3.1.4	Performance requirements for PUCCH format 2	181
11.3.1.5	Performance requirements for PUCCH format 3	181
11.3.1.6	Performance requirements for PUCCH format 4	181
11.3.2	Requirements for <i>BS type 2-O</i>	181
11.3.2.1	DTX to ACK probability	181
11.3.2.2	Performance requirements for PUCCH format 0	181
11.3.2.2.1	General	181
11.3.2.2.2	Minimum requirements	182
11.3.2.3	Performance requirements for PUCCH format 1	182
11.3.2.3.1	NACK to ACK requirements	182
11.3.2.3.1.1	General	182
11.3.2.3.1.2	Minimum requirements	183
11.3.2.3.2	ACK missed detection requirements	183
11.3.2.3.2.1	General	183
11.3.2.3.2.2	Minimum requirements	183
11.3.2.4	Performance requirements for PUCCH format 2	184
11.3.2.4.1	ACK missed detection requirements	184
11.3.2.4.1.1	General	184
11.3.2.4.2	UCI BLER performance requirements	185
11.3.2.4.2.1	General	185
11.3.2.4.2.2	Minimum requirements	185
11.3.2.5	Performance requirements for PUCCH format 3	186
11.3.2.5.1	General	186
11.3.2.5.2	Minimum requirements	186
11.3.2.6	Performance requirements for PUCCH format 4	187
11.3.2.6.1	General	187
11.3.2.6.2	Minimum requirements	187
11.4	Performance requirements for PRACH	188
11.4.1	Requirements for <i>BS type 1-O</i>	188
11.4.1.1	PRACH False alarm probability	188
11.4.1.2	PRACH detection requirements	188
11.4.2	Requirements for <i>BS type 2-O</i>	188
11.4.2.1	PRACH False alarm probability	188
11.4.2.1.1	General	188
11.4.2.1.2	Minimum requirement	188
11.4.2.2	PRACH detection requirements	188
11.4.2.2.1	General	188
11.4.2.2.2	Minimum requirements	189
Annex A (normative):	Reference measurement channels	190
A.1	Fixed Reference Channels for reference sensitivity level, ACS, in-band blocking, out-of-band blocking, receiver intermodulation and in-channel selectivity (QPSK, R=1/3)	190
A.2	Fixed Reference Channels for dynamic range (16QAM, R=2/3)	191
A.3	Fixed Reference Channels for performance requirements (QPSK, R=193/1024)	191
A.4	Fixed Reference Channels for performance requirements (16QAM, R=658/1024)	196
A.5	Fixed Reference Channels for performance requirements (64QAM, R=567/1024)	200
A.6	PRACH Test preambles	202
Annex B (normative):	Error Vector Magnitude (FR1)	203
B.1	Reference point for measurement	203

B.2	Basic unit of measurement	203
B.3	Modified signal under test	204
B.4	Estimation of frequency offset	204
B.5	Estimation of time offset	204
B.5.1	General	204
B.5.2	Window length	205
B.6	Estimation of TX chain amplitude and frequency response parameters	206
B.7	Averaged EVM	207
Annex C (normative):	Error Vector Magnitude (FR2)	209
C.1	Reference point for measurement	209
C.2	Basic unit of measurement	209
C.3	Modified signal under test	210
C.4	Estimation of frequency offset	210
C.5	Estimation of time offset	210
C.5.1	General	210
C.5.2	Window length	211
C.6	Estimation of TX chain amplitude and frequency response parameters	211
C.7	Averaged EVM	213
Annex D (normative):	Characteristics of the interfering signals	215
Annex E:	Void	216
Annex F (normative):	Relationship between EIRP based regulatory requirements and 3GPP requirements	217
F.1	General	217
F.2	Relationship between EIRP based regulatory requirements and conducted requirements	217
F.3	Relationship between EIRP based regulatory requirements and OTA requirements	218
Annex G (Normative):	Propagation conditions	219
G.1	Static propagation condition	219
G.2	Multi-path fading propagation conditions	219
G.2.1	Delay profiles	219
G.2.1.1	Delay profiles for FR1	220
G.2.1.2	Delay profiles for FR2	221
G.2.2	Combinations of channel model parameters	222
G.2.3	MIMO Channel Correlation Matrices	223
G.2.3.1	MIMO Correlation Matrices using Uniform Linear Array (ULA)	223
G.2.3.1.1	Definition of MIMO Correlation Matrices	223
G.2.3.1.2	MIMO Correlation Matrices at High, Medium and Low Level	227
G.2.3.2	Multi-Antenna channel models using cross polarized antennas	229
G.2.3.2.1	Definition of MIMO Correlation Matrices using cross polarized antennas	230
G.2.3.2.2	Spatial Correlation Matrices at UE and gNB sides	230
G.2.3.2.2.1	Spatial Correlation Matrices at UE side	230
G.2.3.2.2.2	Spatial Correlation Matrices at gNB side	231
G.2.3.2.3	MIMO Correlation Matrices using cross polarized antennas	231
Annex H (informative):	Change history	232
History		241

Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
 - 1 presented to TSG for information;
 - 2 presented to TSG for approval;
 - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ETSI TS 138 104 V15.15.0 \(2021-10\)](https://standards.iteh.ai/catalog/standards/sist/7d9081e0-1d24-48b5-856e-ccf0df258a38/etsi-ts-138-104-v15-15-0-2021-10)

<https://standards.iteh.ai/catalog/standards/sist/7d9081e0-1d24-48b5-856e-ccf0df258a38/etsi-ts-138-104-v15-15-0-2021-10>

1 Scope

The present document establishes the minimum RF characteristics and minimum performance requirements of NR Base Station (BS).

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] ITU-R Recommendation SM.329: "Unwanted emissions in the spurious domain".
- [3] Recommendation ITU-R SM.328: "Spectra and bandwidth of emissions".
- [4] 3GPP TR 25.942: "RF system scenarios".
- [5] 3GPP TS 38.141-1: "NR; Base Station (BS) conformance testing; Part 1: Conducted conformance testing".
- [6] 3GPP TS 38.141-2: "NR; Base Station (BS) conformance testing; Part 2: Radiated conformance testing".
- [7] Recommendation ITU-R M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".
- [8] "Title 47 of the Code of Federal Regulations (CFR)", Federal Communications Commission.
- [9] 3GPP TS 38.211: "NR; Physical channels and modulation".
- [10] 3GPP TS 38.213: "NR; Physical layer procedures for control".
- [11] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".
- [12] ECC/DEC/(17)06: "The harmonised use of the frequency bands 1427-1452 MHz and 1492-1518 MHz for Mobile/Fixed Communications Networks Supplemental Downlink (MFCN SDL)".
- [13] 3GPP TS 36.104: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception".
- [14] 3GPP TS 37.105: "Active Antenna System (AAS) Base Station (BS) transmission and reception".
- [15] 3GPP TS 38.212: "NR; Multiplexing and channel coding".
- [16] 3GPP TR 38.901: "Study on channel model for frequencies from 0.5 to 100 GHz".
- [17] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".
- [18] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".
- [19] ERC Recommendation 74-01, "Unwanted emissions in the spurious domain".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Aggregated BS Channel Bandwidth: The RF bandwidth in which a Base Station transmits and receives multiple contiguously aggregated carriers. The *aggregated BS channel bandwidth* is measured in MHz.

antenna connector: connector at the conducted interface of the *BS type 1-C*

active transmitter unit: transmitter unit which is ON, and has the ability to send modulated data streams that are parallel and distinct to those sent from other transmitter units to a *BS type 1-C antenna connector*, or to one or more *BS type 1-H TAB connectors* at the *transceiver array boundary*

Base Station RF Bandwidth: RF bandwidth in which a base station transmits and/or receives single or multiple carrier(s) within a supported *operating band*

NOTE: In single carrier operation, the *Base Station RF Bandwidth* is equal to the *BS channel bandwidth*.

Base Station RF Bandwidth edge: frequency of one of the edges of the *Base Station RF Bandwidth*.

basic limit: emissions limit relating to the power supplied by a single transmitter to a single antenna transmission line in ITU-R SM.329 [2] used for the formulation of unwanted emission requirements for FR1

beam: beam (of the antenna) is the main lobe of the radiation pattern of an *antenna array*

NOTE: For certain *BS antenna array*, there may be more than one *beam*.

beam centre direction: direction equal to the geometric centre of the half-power contour of the *beam*

beam direction pair: data set consisting of the *beam centre direction* and the related *beam peak direction*

beam peak direction: direction where the maximum EIRP is found

beamwidth: *beam* which has a half-power contour that is essentially elliptical, the half-power *beamwidths* in the two pattern cuts that respectively contain the major and minor axis of the ellipse

BS channel bandwidth: RF bandwidth supporting a single NR RF carrier with the transmission bandwidth configured in the uplink or downlink

NOTE 1: The *BS channel bandwidth* is measured in MHz and is used as a reference for transmitter and receiver RF requirements.

NOTE 2: It is possible for the BS to transmit to and/or receive from one or more UE bandwidth parts that are smaller than or equal to the *BS transmission bandwidth configuration*, in any part of the *BS transmission bandwidth configuration*.

BS transmission bandwidth configuration: set of resource blocks located within the *BS channel bandwidth* which may be used for transmitting or receiving by the BS

BS type 1-C: NR base station operating at FR1 with requirements set consisting only of conducted requirements defined at individual *antenna connectors*

BS type 1-H: NR base station operating at FR1 with a *requirement set* consisting of conducted requirements defined at individual *TAB connectors* and OTA requirements defined at RIB

BS type 1-O: NR base station operating at FR1 with a *requirement set* consisting only of OTA requirements defined at the RIB

BS type 2-O: NR base station operating at FR2 with a *requirement set* consisting only of OTA requirements defined at the RIB

Channel edge: lowest or highest frequency of the NR carrier, separated by the *BS channel bandwidth*.

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

Carrier aggregation configuration: a set of one or more *operating bands* across which the BS aggregates carriers with a specific set of technical requirements

co-location reference antenna: a passive antenna used as reference for base station to base station co-location requirements

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

Contiguous spectrum: spectrum consisting of a contiguous block of spectrum with no *sub-block gap(s)*.

directional requirement: requirement which is applied in a specific direction within the *OTA coverage range* for the Tx and when the AoA of the incident wave of a received signal is within the *OTA REFSENS RoAoA* or the *minSENS RoAoA* as appropriate for the receiver

equivalent isotropic radiated power: equivalent power radiated from an isotropic directivity device producing the same field intensity at a point of observation as the field intensity radiated in the direction of the same point of observation by the discussed device

NOTE: Isotropic directivity is equal in all directions (i.e. 0 dBi).

equivalent isotropic sensitivity: sensitivity for an isotropic directivity device equivalent to the sensitivity of the discussed device exposed to an incoming wave from a defined AoA

NOTE 1: The sensitivity is the minimum received power level at which specific requirement is met.

NOTE 2: Isotropic directivity is equal in all directions (i.e. 0 dBi).

fractional bandwidth: fractional bandwidth FBW is defined as $FBW = 200 \cdot \frac{F_{FBWhigh} - F_{FBWlow}}{F_{FBWhigh} + F_{FBWlow}} \%$

<https://standards.iteh.ai/catalog/standards/sist/7d9081e0-1d24-48b5-856e-1c3810474153/etsi-ts-138-104-v15-15-0-2021-10>

Highest Carrier: The carrier with the highest carrier frequency transmitted/received in a specified frequency band.

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

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

Inter-band gap: The frequency gap between two supported consecutive *operating bands*.

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

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

Inter RF Bandwidth gap: frequency gap between two consecutive *Base Station RF Bandwidths* that are placed within two supported *operating bands*

Lowest Carrier: The carrier with the lowest carrier frequency transmitted/received in a specified frequency band.

Lower sub-block edge: frequency at the lower edge of one *sub-block*.

NOTE: It is used as a frequency reference point for both transmitter and receiver requirements.

maximum carrier output power: mean power level measured per carrier at the indicated interface, during the *transmitter ON period* in a specified reference condition

maximum carrier TRP output power: mean power level measured per RIB during the *transmitter ON period* for a specific carrier in a specified reference condition and corresponding to the declared *rated carrier TRP output power* ($P_{rated,c,TRP}$)

maximum total output power: mean power level measured within the *operating band* at the indicated interface, during the *transmitter ON period* in a specified reference condition