

# ETSI TS 138 141-2 v17.6.0 (2022-08)



**iTeh STANDA~~RD~~ PREVIEW**  
5G ;  
NR;  
**Base Station (BS) conformance testing Part 2: Radiated  
conformance testing**  
**(3GPP TS 38.141-2 version 17.6.0 Release 17)**  
<https://standards.iteh.ai/catalog/standards/sist/4e995dbc-e13b-41fe-9825-8befeb3628d/etsi-ts-138-141-2-v17-6-0-2022-08>



---

Reference

RTS/TSGR-0438141-2vH60

---

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](http://www.etsi.org/deliver).

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

Information on the current status of this and other ETSI documents is available at  
<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:  
<https://portal.etsi.org/People/CommitteeSupportStaff.aspx>

If you find a security vulnerability in the present document, please report it through our  
Coordinated Vulnerability Disclosure Program:  
<https://www.etsi.org/standards/coordinated-vulnerability-disclosure>

---

**Notice of disclaimer & limitation of liability**

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness for any particular purpose or against infringement of intellectual property rights.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use or inability to use the software.

---

**Copyright Notification**

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.  
The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2022.  
All rights reserved.

---

# Intellectual Property Rights

## Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

## Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

**DECT™, PLUGTESTS™, UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™** and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM®** and the **GSM** logo are trademarks registered and owned by the **GSM Association**.

---

## Legal Notice

(standards.iteh.ai)

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

The present document may refer to technical specifications or reports using their 3GPP identities. These shall be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between 3GPP and ETSI identities can be found under <http://webapp.etsi.org/key/queryform.asp>.

---

## Modal verbs terminology

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

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

---

## Contents

Intellectual Property Rights .....	2
Legal Notice .....	2
Modal verbs terminology.....	2
Foreword.....	16
1    Scope .....	18
2    References .....	18
3    Definitions, symbols and abbreviations .....	20
3.1    Definitions.....	20
3.2    Symbols.....	23
3.3    Abbreviations .....	25
4    General radiated test conditions and declarations .....	27
4.1    Measurement uncertainties and test requirements .....	27
4.1.1    General.....	27
4.1.2    Acceptable uncertainty of OTA Test System .....	29
4.1.2.1    General .....	29
4.1.2.2    Measurement of transmitter .....	30
4.1.2.3    Measurement of receiver .....	33
4.1.2.4    Measurement of performance requirement .....	35
4.1.3    Interpretation of measurement results.....	36
4.2    Radiated requirement reference points .....	36
4.3    Base station classes .....	38
4.4    Regional requirements.....	38
4.5    BS configurations .....	39
4.5.1    Transmit configurations .....	39
4.5.2    Receive configurations .....	40
4.5.3    Power supply options.....	41
4.5.4    BS with integrated Iuant BS modem .....	42
4.6    Manufacturer's declarations.....	42
4.7    Test configurations .....	52
4.7.1    General.....	52
4.7.2    Test signal configurations .....	52
4.7.2.1    Test signal used to build Test Configurations .....	52
4.7.2.2    NRTC1: Contiguous spectrum operation .....	53
4.7.2.2.1    NRTC1 generation.....	53
4.7.2.2.2    NRTC1 power allocation.....	53
4.7.2.3    NRTC2: Contiguous CA occupied bandwidth .....	54
4.7.2.3.1    NRTC2 generation.....	54
4.7.2.3.2    NRTC2 power allocation.....	54
4.7.2.4    NRTC3: Non-contiguous spectrum operation .....	54
4.7.2.4.1    NRTC3 generation.....	54
4.7.2.4.2    NRTC3 power allocation.....	55
4.7.2.5    NRTC4: Multi-band test configuration for full carrier allocation .....	55
4.7.2.5.1    NRTC4 generation.....	55
4.7.2.5.2    NRTC4 power allocation.....	56
4.7.2.6    NRTC5: Multi-band test configuration with high PSD per carrier .....	56
4.7.2.6.1    NRTC5 generation.....	56
4.7.2.6.2    NRTC5 power allocation.....	56
4.8    Applicability of requirements .....	57
4.8.1    Requirement set applicability .....	57
4.8.2    Applicability of test configurations for <i>single-band RIB</i> .....	57
4.8.3    Applicability of test configurations for <i>multi-band RIB</i> .....	58
4.9    RF channels and test models .....	59
4.9.1    RF channels .....	59
4.9.2    Test models .....	60

4.9.2.1	General .....	60
4.9.2.2	NR FR2 test models .....	60
4.9.2.2.1	NR FR2 test model 1.1 (NR-FR2-TM1.1).....	61
4.9.2.2.2	NR FR2 test model 2 (NR-FR2-TM2).....	62
4.9.2.2.2a	NR FR2 test model 2a (NR-FR2-TM2a).....	62
4.9.2.2.3	NR FR2 test model 3.1 (NR-FR2-TM3.1).....	63
4.9.2.2.4	NR FR2 test model 3.1a (NR-FR2-TM3.1a).....	63
4.9.2.3	Data content of physical channels and signals for NR-FR2-TM.....	63
4.9.2.3.1	PDCCH.....	64
4.9.2.3.2	PDSCH .....	64
4.10	Requirements for contiguous and non-contiguous spectrum.....	65
4.11	Requirements for BS capable of multi-band operation .....	65
4.12	Co-location requirements .....	66
4.12.1	General.....	66
4.12.2	Co-location test antenna.....	66
4.12.2.1	General .....	66
4.12.2.2	Co-location test antenna characteristics .....	66
4.12.2.3	Co-location test antenna alignment .....	67
4.13	Format and interpretation of tests .....	68
4.14	Reference coordinate system.....	69
5	Operating bands and channel arrangement.....	71
6	Radiated transmitter characteristics.....	72
6.1	General .....	72
6.2	Radiated transmit power.....	72
6.2.1	Definition and applicability .....	72
6.2.2	Minimum requirement .....	73
6.2.3	Test purpose.....	73
6.2.4	Method of test .....	73
6.2.4.1	Initial conditions .....	73
6.2.4.2	Procedure .....	73
6.2.5	Test requirement .....	74
6.3	OTA base station output power .....	74
6.3.1	Definition and applicability .....	74
6.3.2	Minimum requirement .....	75
6.3.3	Test purpose.....	75
6.3.4	Method of test .....	75
6.3.4.1	Initial conditions .....	75
6.3.4.2	Procedure .....	75
6.3.5	Test requirement .....	76
6.3.5.1	<i>BS type 1-O</i> .....	76
6.3.5.2	<i>BS type 2-O</i> .....	76
6.4	OTA output power dynamics .....	76
6.4.1	General.....	76
6.4.2	OTA RE power control dynamic range .....	76
6.4.2.1	Definition and applicability.....	76
6.4.2.2	Minimum requirement .....	76
6.4.2.3	Method of test .....	77
6.4.3	OTA total power dynamic range .....	77
6.4.3.1	Definition and applicability.....	77
6.4.3.2	Minimum requirement .....	77
6.4.3.3	Test purpose .....	77
6.4.3.4	Method of test .....	77
6.4.3.4.1	Initial conditions .....	77
6.4.3.4.2	Procedure .....	77
6.4.3.5	Test requirement .....	78
6.4.3.5.1	<i>BS type 1-O</i> .....	78
6.4.3.5.2	<i>BS type 2-O</i> .....	79
6.5	OTA transmit ON/OFF power .....	79
6.5.1	OTA transmitter OFF power.....	79
6.5.1.1	Definition and applicability.....	79

6.5.1.2	Minimum requirement .....	80
6.5.1.3	Test purpose .....	80
6.5.1.4	Method of test .....	80
6.5.1.5	Test requirements .....	80
6.5.2	OTA transmitter transient period .....	80
6.5.2.1	Definition and applicability.....	80
6.5.2.2	Minimum requirement .....	81
6.5.2.3	Test purpose .....	81
6.5.2.4	Method of test .....	81
6.5.2.4.1	Initial conditions.....	81
6.5.2.4.2	Procedure.....	81
6.5.2.5	Test requirements .....	82
6.5.2.5.1	<i>BS type 1-O</i> .....	82
6.5.2.5.2	<i>BS type 2-O</i> .....	82
6.6	OTA transmitted signal quality .....	83
6.6.1	General.....	83
6.6.2	OTA frequency error .....	83
6.6.2.1	Definition and applicability.....	83
6.6.2.2	Minimum Requirement .....	83
6.6.2.3	Test purpose .....	83
6.6.2.4	Method of test .....	83
6.6.2.4.1	Initial conditions.....	83
6.6.2.5	Test Requirements.....	83
6.6.3	OTA modulation quality .....	83
6.6.3.1	Definition and applicability.....	83
6.6.3.2	Minimum Requirement .....	84
6.6.3.3	Test purpose .....	84
6.6.3.4	Method of test .....	84
6.6.3.4.1	Initial conditions.....	84
6.6.3.4.2	Procedure.....	84
6.6.3.5	Test requirements .....	86
6.6.3.5.1	<i>BS type 1-O</i> .....	86
6.6.3.5.2	<i>BS type 2-O</i> .....	87
6.6.4	OTA time alignment error .....	88
6.6.4.1	Definition and applicability.....	88
6.6.4.2	Minimum requirement .....	88
6.6.4.3	Test purpose .....	88
6.6.4.4	Method of test .....	88
6.6.4.4.1	Initial conditions.....	88
6.6.4.4.2	Procedure.....	89
6.6.4.5	Test Requirement .....	89
6.6.4.5.1	<i>BS type 1-O</i> .....	89
6.6.4.5.2	<i>BS type 2-O</i> .....	90
6.7	OTA unwanted emissions .....	90
6.7.1	General.....	90
6.7.2	OTA occupied bandwidth .....	90
6.7.2.1	Definition and applicability.....	90
6.7.2.2	Minimum requirement .....	91
6.7.2.3	Test purpose .....	91
6.7.2.4	Method of test .....	91
6.7.2.4.1	Initial conditions.....	91
6.7.2.4.2	Procedure.....	91
6.7.2.5	Test requirement .....	92
6.7.2.5.1	<i>BS type 1-O</i> .....	92
6.7.2.5.2	<i>BS type 2-O</i> .....	92
6.7.3	OTA Adjacent Channel Leakage Power Ratio (ACLR) .....	93
6.7.3.1	Definition and applicability.....	93
6.7.3.2	Minimum requirement .....	93
6.7.3.3	Test purpose .....	93
6.7.3.4	Method of test .....	93
6.7.3.4.1	Initial conditions.....	93
6.7.3.4.2	Procedure.....	93

6.7.3.5	Test requirements.....	94
6.7.3.5.1	<i>BS type 1-O</i> .....	94
6.7.3.5.2	<i>BS type 2-O</i> .....	97
6.7.4	OTA operating band unwanted emissions .....	100
6.7.4.1	Definition and applicability.....	100
6.7.4.2	Minimum requirement .....	100
6.7.4.3	Test purpose .....	100
6.7.4.4	Method of test .....	100
6.7.4.4.1	Initial conditions.....	100
6.7.4.4.2	Procedure.....	101
6.7.4.5	Test requirements .....	101
6.7.4.5.1	<i>BS type 1-O</i> .....	101
6.7.4.5.2	<i>BS type 2-O</i> .....	113
6.7.5	OTA transmitter spurious emissions.....	115
6.7.5.1	General.....	115
6.7.5.2	General OTA transmitter spurious emissions requirements.....	116
6.7.5.2.1	Definition and applicability.....	116
6.7.5.2.2	Minimum requirement.....	116
6.7.5.2.3	Test purpose .....	116
6.7.5.2.4	Method of test.....	116
6.7.5.2.5	Test requirement.....	118
6.7.5.3	Protection of the BS receiver of own or different BS .....	119
6.7.5.3.1	Definition and applicability.....	119
6.7.5.3.2	Minimum requirements .....	120
6.7.5.3.3	Test purpose .....	120
6.7.5.3.4	Method of test.....	120
6.7.5.3.5	Test requirements .....	121
6.7.5.4	Additional spurious emissions requirements.....	121
6.7.5.4.1	Definition and applicability.....	121
6.7.5.4.2	Minimum Requirement .....	121
6.7.5.4.3	Test purpose .....	122
6.7.5.4.4	Method of test.....	122
6.7.5.4.5	Test requirement.....	123
6.7.5.5	Co-location requirements ( <a href="https://catalog.etsi.org/standards/sust/4e995dbc-e13b-41fe-9825-1">https://catalog.etsi.org/standards/sust/4e995dbc-e13b-41fe-9825-1</a> ) .....	133
6.7.5.5.1	Definition and applicability .....	133
6.7.5.5.2	Minimum requirements .....	133
6.7.5.5.3	Test purpose .....	133
6.7.5.5.4	Method of test.....	133
6.7.5.5.5	Test requirements .....	134
6.8	OTA transmitter intermodulation.....	139
6.8.1	Definition and applicability .....	139
6.8.2	Minimum requirement .....	139
6.8.3	Test purpose.....	139
6.8.4	Method of test .....	140
6.8.4.1	Initial conditions .....	140
6.8.4.2	Procedure .....	140
6.8.5	Test requirements.....	141
6.8.5.1	Requirement for BS type 1-O.....	141
7	Radiated receiver characteristics .....	143
7.1	General .....	143
7.2	OTA sensitivity .....	143
7.2.1	Definition and applicability .....	143
7.2.2	Minimum requirement .....	144
7.2.3	Test Purpose.....	144
7.2.4	Method of test .....	144
7.2.4.1	Initial conditions .....	144
7.2.4.2	Procedure .....	145
7.2.5	Test requirements.....	145
7.2.5.1	General .....	145
7.2.5.2	Test requirements for <i>BS type 1-H</i> and <i>BS type 1-O</i> .....	145
7.2.5.3	Test requirements for <i>BS type 2-O</i> .....	147

7.3	OTA reference sensitivity level .....	147
7.3.1	Definition and applicability .....	147
7.3.2	Minimum requirement .....	147
7.3.3	Test Purpose .....	147
7.3.4	Method of test .....	148
7.3.4.1	Initial conditions .....	148
7.3.4.2	Procedure .....	148
7.3.5	Test requirements .....	148
7.3.5.1	General .....	148
7.3.5.2	Test requirements for <i>BS type 1-O</i> .....	148
7.3.5.3	Test requirements for <i>BS type 2-O</i> .....	150
7.4	OTA dynamic range .....	151
7.4.1	Definition and applicability .....	151
7.4.2	Minimum requirement .....	151
7.4.3	Test purpose .....	151
7.4.4	Method of test .....	152
7.4.4.1	Initial conditions .....	152
7.4.4.2	Procedure .....	152
7.4.5	Test requirement .....	152
7.4.5.1	General .....	152
7.4.5.2	Test requirements for <i>BS type 1-O</i> .....	152
7.5	OTA in-band selectivity and blocking .....	161
7.5.1	OTA adjacent channel selectivity .....	161
7.5.1.1	Definition and applicability .....	161
7.5.1.2	Minimum requirement .....	161
7.5.1.3	Test purpose .....	161
7.5.1.4	Method of test .....	161
7.5.1.4.1	Initial conditions .....	161
7.5.1.4.2	Procedure .....	162
7.5.1.5	Test requirement .....	162
7.5.1.5.1	General .....	162
7.5.1.5.2	Test requirements for <i>BS type 1-O</i> .....	162
7.5.1.5.3	Test requirements for <i>BS type 2-O</i> .....	163
7.5.2	OTA in-band blocking .....	164
7.5.2.1	Definition and applicability .....	164
7.5.2.2	Minimum requirement .....	164
7.5.2.3	Test purpose .....	164
7.5.2.4	Method of test .....	164
7.5.2.4.1	Initial conditions .....	164
7.5.2.4.2	Procedure .....	165
7.5.2.5	Test requirement .....	166
7.5.2.5.1	General .....	166
7.5.2.5.2	Test requirements for <i>BS type 1-O</i> .....	166
7.5.2.5.3	Test requirements for <i>BS type 2-O</i> .....	169
7.6	OTA out-of-band blocking .....	170
7.6.1	Definition and applicability .....	170
7.6.2	Minimum requirement .....	170
7.6.3	Test purpose .....	170
7.6.4	Method of test .....	170
7.6.4.1	Initial conditions .....	170
7.6.4.2	Procedure .....	171
7.6.4.2.1	<i>BS type 1-O</i> procedure for out-of-band blocking .....	171
7.6.4.2.2	<i>BS type 1-O</i> procedure for co-location blocking .....	171
7.6.4.2.3	<i>BS type 2-O</i> procedure for out-of-band blocking .....	172
7.6.5	Test requirements .....	173
7.6.5.1	Requirement for <i>BS type 1-O</i> .....	173
7.6.5.1.1	General .....	173
7.6.5.1.2	Co-location requirement .....	173
7.6.5.2	Requirement for <i>BS type 2-O</i> .....	174
7.6.5.2.1	General requirement .....	174
7.7	OTA receiver spurious emissions .....	174
7.7.1	Definition and applicability .....	174

7.7.2	Minimum requirement .....	175
7.7.3	Test purpose.....	175
7.7.4	Method of test .....	175
7.7.4.1	Initial conditions .....	175
7.7.4.2	Procedure .....	176
7.7.5	Test requirement .....	176
7.7.5.1	Test requirement for <i>BS type 1-O</i> .....	176
7.7.5.2	Test requirement for <i>BS type 2-O</i> .....	177
7.8	OTA receiver intermodulation .....	178
7.8.1	Definition and applicability .....	178
7.8.2	Minimum requirement .....	178
7.8.3	Test purpose.....	178
7.8.4	Method of test .....	178
7.8.4.1	Initial conditions .....	178
7.8.4.2	Procedure .....	179
7.8.5	Test requirement .....	179
7.8.5.1	<i>BS type 1-O</i> .....	179
7.8.5.2	<i>BS type 2-O</i> .....	185
7.9	OTA in-channel selectivity .....	185
7.9.1	Definition and applicability .....	185
7.9.2	Minimum requirement .....	186
7.9.3	Test purpose.....	186
7.9.4	Method of test .....	186
7.9.4.1	Initial conditions .....	186
7.9.4.2	Procedure .....	186
7.9.5	Test requirement .....	187
7.9.5.1	<i>BS type 1-O</i> .....	187
7.9.5.2	<i>BS type 2-O</i> .....	189
8	Radiated performance requirements.....	191
8.1	General .....	191
8.1.0	Scope and definitions.....	191
8.1.1	OTA demodulation branches <a href="#">TS 138 141-2 V17.6.0 (2022-08)</a> .....	191
8.1.2	Applicability rule .....	192
8.1.2.0	General .....	192
8.1.2.1	Applicability of PUSCH performance requirements .....	192
8.1.2.1.1	Applicability of requirements for different subcarrier spacings .....	192
8.1.2.1.2	Applicability of requirements for different channel bandwidths .....	192
8.1.2.1.3	Applicability of requirements for different configurations.....	192
8.1.2.1.4	Applicability of requirements for uplink carrier aggregation .....	192
8.1.2.1.5	Applicability of requirements for TDD with different UL-DL patterns .....	192
8.1.2.1.7	Applicability of 2-step RA type requirements for different subcarrier spacings .....	193
8.1.2.2	Applicability of PUCCH performance requirements .....	193
8.1.2.2.1	Applicability of requirements for different formats.....	193
8.1.2.2.2	Applicability of requirements for different subcarrier spacings .....	193
8.1.2.2.3	Applicability of requirements for different channel bandwidths .....	193
8.1.2.2.4	Applicability of requirements for different configurations.....	193
8.1.2.2.5	Applicability of requirements for multi-slot PUCCH.....	193
8.1.2.3	Applicability of PRACH performance requirements .....	193
8.1.2.3.1	Applicability of requirements for different formats.....	193
8.1.2.3.2	Applicability of requirements for different subcarrier spacings .....	194
8.1.2.3.3	Applicability of requirements for different channel bandwidths .....	194
8.1.2.3.4	Applicability of requirements for different restricted set types of long PRACH format 0 .....	194
8.1.2.4	Applicability of PUSCH for high speed train performance requirements .....	194
8.1.2.4.1	Applicability of requirements for different speeds.....	194
8.1.2.4.2	Applicability of requirements for 1T1R .....	194
8.1.2.4.3	Applicability of requirements for different channel bandwidths .....	194
8.1.2.4.4	Applicability of requirements for different DM-RS configurations .....	194
8.1.2.5	Applicability of interleaved PUSCH performance requirements .....	195
8.1.2.5.1	General applicability of interleaved PUSCH performance requirements .....	195
8.1.2.5.2	Applicability of requirements for different subcarrier spacings .....	195
8.1.2.5.3	Applicability of requirements for different channel bandwidths .....	195

8.1.2.5.4	Applicability of requirements for different configurations.....	195
8.1.2.5.5	Applicability of CG-UCI multiplexed on PUSCH requirements.....	195
8.1.2.6	Applicability of interlaced PUCCH performance requirements.....	195
8.1.2.6.1	General applicability of interlaced PUCCH performance requirements.....	195
8.1.2.6.2	Applicability of requirements for different formats.....	195
8.1.2.6.3	Applicability of requirements for different subcarrier spacings .....	195
8.1.2.6.4	Applicability of requirements for different channel bandwidths .....	195
8.1.2.7	Applicability of performance requirements for PRACH with $L_{RA} = 1151$ and $L_{RA} = 571$ .....	196
8.1.2.7.1	Applicability of requirements for different formats.....	196
8.1.2.7.2	Applicability of requirements for different subcarrier spacings .....	196
8.1.2.7.3	Applicability of requirements for different channel bandwidths .....	196
8.2	OTA performance requirements for PUSCH .....	196
8.2.1	Performance requirements for PUSCH with transform precoding disabled .....	196
8.2.1.1	Definition and applicability.....	196
8.2.1.2	Minimum Requirement .....	196
8.2.1.3	Test purpose .....	196
8.2.1.4	Method of test .....	196
8.2.1.4.1	Initial conditions.....	196
8.2.1.4.2	Procedure.....	197
8.2.1.5	Test Requirement .....	198
8.2.1.5.1	Test requirement for <i>BS type 1-O</i> .....	198
8.2.1.5.2	Test requirement for <i>BS type 2-O</i> .....	203
8.2.2	Performance requirements for PUSCH with transform precoding enabled .....	206
8.2.2.1	Definition and applicability.....	206
8.2.2.2	Minimum Requirement .....	206
8.2.2.3	Test Purpose .....	206
8.2.2.4	Method of test .....	206
8.2.2.4.1	Initial Conditions .....	206
8.2.2.4.2	Procedure.....	206
8.2.2.5	Test Requirement .....	208
8.2.2.5.1	Test requirement for <i>BS type 1-O</i> .....	208
8.2.2.5.2	Test requirement for <i>BS type 2-O</i> .....	209
8.2.3	Performance requirements for UCI multiplexed on PUSCH .....	209
8.2.3.1	Definition and applicability.....	209
8.2.3.2	Minimum Requirement .....	210
8.2.3.3	Test purpose .....	210
8.2.3.4	Method of test .....	210
8.2.3.4.1	Initial conditions.....	210
8.2.3.4.2	Procedure.....	210
8.2.3.5	Test Requirement .....	212
8.2.3.5.1	Test requirement for <i>BS type 1-O</i> .....	212
8.2.3.5.2	Test requirement for <i>BS type 2-O</i> .....	213
8.2.4	Performance requirements for PUSCH for high speed train .....	214
8.2.4.1	Definition and applicability.....	214
8.2.4.2	Minimum Requirement .....	214
8.2.4.3	Test Purpose .....	214
8.2.4.4	Method of test .....	214
8.2.4.4.1	Initial Conditions .....	214
8.2.4.4.2	Procedure.....	215
8.2.4.5	Test Requirement for <i>BS Type 1-O</i> .....	217
8.2.4.6	Test Requirement for <i>BS Type 2-O</i> .....	219
8.2.5	Performance requirements for UL timing adjustment.....	219
8.2.5.1	Definition and applicability.....	219
8.2.5.2	Minimum Requirement .....	220
8.2.5.3	Test Purpose .....	220
8.2.5.4	Method of test .....	220
8.2.5.4.1	Initial Conditions .....	220
8.2.5.4.2	Procedure.....	220
8.2.5.5	Test Requirement for High Speed Train for <i>BS type 1-O</i> .....	223
8.2.5.6	Test Requirement for Normal Mode .....	224
8.2.5.5a	Test Requirement for High Speed Train for <i>BS type 2-O</i> .....	224
8.2.6	Performance requirements for PUSCH with 0.001% BLER .....	224

8.2.6.1	Definition and applicability.....	224
8.2.6.2	Minimum Requirement .....	225
8.2.6.3	Test Purpose .....	225
8.2.6.4	Method of test .....	225
8.2.6.4.1	Initial Conditions .....	225
8.2.6.4.2	Procedure.....	225
8.2.6.5	Test requirement .....	226
8.2.6.5.1	Test requirement for <i>BS type 1-O</i> .....	226
8.2.7	Performance requirements for PUSCH repetition Type A.....	228
8.2.7.1	Definition and applicability.....	228
8.2.7.2	Minimum Requirement .....	228
8.2.7.3	Test purpose .....	228
8.2.7.4	Method of test .....	228
8.2.7.4.1	Initial conditions.....	228
8.2.7.4.2	Procedure.....	228
8.2.7.5	Test Requirement .....	230
8.2.7.5.1	Test requirement for <i>BS type 1-O</i> .....	230
8.2.7.5.2	Test requirement for <i>BS type 2-O</i> .....	232
8.2.8.1	Definition and applicability.....	232
8.2.8.2	Minimum Requirement .....	233
8.2.8.3	Test purpose .....	233
8.2.8.4	Method of test .....	233
8.2.8.4.1	Initial conditions.....	233
8.2.8.4.2	Procedure.....	233
8.2.8.5	Test Requirement .....	235
8.2.8.5.1	Test requirement for <i>BS type 1-O</i> .....	235
8.2.8.5.2	Test requirement for <i>BS type 2-O</i> .....	236
8.2.9	Performance requirements for MsgA PUSCH.....	237
8.2.9.1	Definition and applicability.....	237
8.2.9.2	Minimum Requirement .....	237
8.2.9.3	Test Purpose .....	237
8.2.9.4	Method of test .....	237
8.2.9.4.1	Initial Conditions .....	237
8.2.9.4.2	Procedure.....	237
8.2.9.5	Test Requirement .....	240
8.2.9.5.1	Test Requirement for <i>BS type 1-O</i> .....	240
8.2.9.5.2	Test Requirement for <i>BS type 2-O</i> .....	241
8.2.10	Requirements for interlaced PUSCH .....	242
8.2.10.1	Definition and applicability.....	242
8.2.10.2	Minimum Requirement .....	242
8.2.10.3	Test Purpose .....	242
8.2.10.4	Method of test .....	242
8.2.10.4.1	Initial Conditions .....	242
8.2.10.4.2	Procedure.....	243
8.2.10.5	Test Requirement .....	244
8.2.10.5.1	Test requirement for <i>BS type 1-O</i> .....	244
8.2.11	Performance requirements for CG-UCI multiplexed on interlaced PUSCH.....	245
8.2.11.1	Definition and applicability.....	245
8.2.11.2	Minimum Requirement .....	245
8.2.11.3	Test purpose .....	245
8.2.11.4	Method of test .....	245
8.2.11.4.1	Initial conditions.....	245
8.2.11.4.2	Procedure.....	245
8.2.11.5	Test Requirement .....	247
8.2.11.5.1	Test requirement for <i>BS type 1-O</i> .....	247
8.3	OTA performance requirements for PUCCH .....	247
8.3.1	Performance requirements for PUCCH format 0.....	247
8.3.1.1	Definition and applicability.....	247
8.3.1.2	Minimum Requirement .....	248
8.3.1.3	Test purpose .....	248
8.3.1.4	Method of test .....	248
8.3.1.4.1	Initial conditions.....	248

8.3.1.4.2	Procedure .....	248
8.3.1.5	Test Requirement .....	250
8.3.1.5.1	Test requirement for <i>BS type 1-O</i> .....	250
8.3.1.5.2	Test requirement for <i>BS type 2-O</i> .....	250
8.3.2	Performance requirements for PUCCH format 1 .....	251
8.3.2.1	NACK to ACK detection .....	251
8.3.2.1.1	Definition and applicability .....	251
8.3.2.1.2	Minimum Requirement .....	251
8.3.2.1.3	Test purpose .....	251
8.3.2.1.4	Method of test .....	251
8.3.2.1.5	Test Requirement .....	253
8.3.2.2	ACK missed detection .....	254
8.3.2.2.1	Definition and applicability .....	254
8.3.2.2.2	Minimum Requirement .....	254
8.3.2.2.3	Test purpose .....	254
8.3.2.2.4	Method of test .....	255
8.3.2.2.5	Test Requirement .....	256
8.3.3	Performance requirements for PUCCH format 2 .....	257
8.3.3.1	ACK missed detection performance requirements .....	257
8.3.3.1.1	Definition and applicability .....	257
8.3.3.1.2	Minimum Requirement .....	257
8.3.3.1.3	Test Purpose .....	258
8.3.3.1.4	Method of test .....	258
8.3.3.1.5	Test requirement .....	259
8.3.3.2	UCI BLER performance requirements .....	260
8.3.3.2.1	Definition and applicability .....	260
8.3.3.2.2	Minimum Requirement .....	260
8.3.3.2.3	Test Purpose .....	260
8.3.3.2.4	Method of test .....	260
8.3.3.2.5	Test requirement .....	262
8.3.4	Performance requirements for PUCCH format 3 .....	263
8.3.4.1	Definition and applicability .....	263
8.3.4.2	Minimum requirement .....	263
8.3.4.3	Test purpose .....	263
8.3.4.4	Method of test .....	263
8.3.4.4.1	Initial conditions .....	263
8.3.4.4.2	Procedure .....	264
8.3.4.5	Test requirement .....	265
8.3.4.5.1	Test requirement for <i>BS type 1-O</i> .....	265
8.3.4.5.2	Test requirement for <i>BS type 2-O</i> .....	266
8.3.5	Performance requirements for PUCCH format 4 .....	266
8.3.5.1	Definition and applicability .....	266
8.3.5.2	Minimum requirement .....	267
8.3.5.3	Test purpose .....	267
8.3.5.4	Method of test .....	267
8.3.5.4.1	Initial conditions .....	267
8.3.5.4.2	Procedure .....	267
8.3.5.5	Test requirement .....	268
8.3.5.5.1	Test requirement for <i>BS type 1-O</i> .....	268
8.3.5.5.2	Test requirement for <i>BS type 2-O</i> .....	269
8.3.6	Performance requirements for multi-slot PUCCH format .....	269
8.3.6.1	Performance requirements for multi-slot PUCCH format 1 .....	269
8.3.6.1.1	NACK to ACK detection .....	269
8.3.6.1.2	ACK missed detection .....	271
8.3.7	Performance requirements for interlaced PUCCH format 0 .....	273
8.3.7.1	Definition and applicability .....	273
8.3.7.2	Minimum Requirement .....	274
8.3.7.3	Test purpose .....	274
8.3.7.4	Method of test .....	274
8.3.7.4.1	Initial conditions .....	274
8.3.7.4.2	Procedure .....	274
8.3.7.5	Test Requirement .....	275

8.3.7.5.1	Test requirement for <i>BS type 1-O</i> .....	275
8.3.8	Performance requirements for interlaced PUCCH format 1 .....	275
8.3.8.1	NACK to ACK detection .....	275
8.3.8.1.1	Definition and applicability.....	275
8.3.8.1.2	Minimum Requirement .....	276
8.3.8.1.3	Test purpose .....	276
8.3.8.1.4	Method of test.....	276
8.3.8.1.5	Test Requirement.....	277
8.3.8.2	ACK missed detection.....	277
8.3.8.2.1	Definition and applicability.....	277
8.3.8.2.2	Minimum Requirement .....	278
8.3.8.2.3	Test purpose .....	278
8.3.8.2.4	Method of test.....	278
8.3.8.2.5	Test Requirement.....	279
8.3.9	Performance requirements for interlaced PUCCH format 2 .....	280
8.3.9.1	Definition and applicability.....	280
8.3.9.2	Minimum Requirement .....	280
8.3.9.3	Test Purpose .....	280
8.3.9.4	Method of test .....	280
8.3.9.4.1	Initial conditions.....	280
8.3.9.4.2	Procedure.....	280
8.3.9.5	Test requirement .....	281
8.3.10	Performance requirements for interlaced PUCCH format 3 .....	282
8.3.10.1	Definition and applicability.....	282
8.3.10.2	Minimum Requirement .....	282
8.3.10.3	Test Purpose .....	282
8.3.10.4	Method of test .....	282
8.3.10.4.1	Initial conditions.....	282
8.3.10.4.2	Procedure.....	282
8.3.10.5	Test requirement .....	283
8.4	OTA performance requirements for PRACH .....	284
8.4.1	PRACH false alarm probability and missed detection.....	284
8.4.1.1	Definition and applicability.....	284
8.4.1.2	Minimum requirement .....	285
8.4.1.3	Test purpose .....	285
8.4.1.4	Method of test .....	285
8.4.1.4.1	Initial conditions.....	285
8.4.1.4.2	Procedure.....	285
8.4.1.5	Test requirement for Normal Mode.....	287
8.4.1.5.1	Test requirement for <i>BS type 1-O</i> .....	287
8.4.1.5.2	Test requirement for <i>BS type 2-O</i> .....	288
8.4.1.6	Test requirement for high speed train.....	289
8.4.1.6.1	Test requirement for <i>BS type 1-O</i> .....	289
8.4.1.6.2	Test requirement for <i>BS type 2-O</i> .....	289
8.4.1.7	Test requirement for PRACH with $L_{RA}=1151$ and $L_{RA}=571$ .....	290
8.4.1.7.1	Test requirement for <i>BS type 1-O</i> .....	290
<b>Annex A (normative):</b>	<b>Reference measurement channels .....</b>	<b>290</b>
A.1	Fixed Reference Channels for OTA sensitivity, OTA reference sensitivity level, OTA ACS, OTA in-band blocking, OTA out-of-band blocking, OTA receiver intermodulation and OTA in-channel selectivity (QPSK, R=1/3).....	290
A.2	Fixed Reference Channels for OTA dynamic range (16QAM, R=2/3) .....	293
A.3	Fixed Reference Channels for performance requirements (QPSK, R=193/1024) .....	293
A.3A	Fixed Reference Channels for performance requirements (QPSK, R=99/1024) .....	299
A.3B	Fixed Reference Channels for performance requirements (QPSK, R=308/1024) .....	301
A.4	Fixed Reference Channels for performance requirements (16QAM, R=658/1024) .....	302
A.5	Fixed Reference Channels for performance requirements (64QAM, R=567/1024) .....	306

A.6	PRACH Test preambles .....	309
A.7	Fixed Reference Channels for performance requirements (16QAM, R=434/1024) .....	309
A.8	Fixed Reference Channels for performance requirements (QPSK, R=157/1024) .....	310
A.9	Fixed Reference Channels for performance requirements (256QAM, R=682.5/1024) .....	311
A.10	Fixed Reference Channels for performance requirements (64QAM, R=517/1024) .....	312
<b>Annex B (normative):</b>	<b>Environmental requirements for the BS equipment .....</b>	<b>315</b>
B.1	General .....	315
B.2	Normal test environment.....	315
B.3	Extreme test environment.....	315
B.3.1	Extreme temperature .....	315
B.4	Vibration.....	316
B.5	Power supply .....	316
B.6	Measurement of test environments.....	316
B.7	OTA extreme test methods.....	317
B.7.1	Direct far field method .....	317
B.7.2	Relative method.....	317
<b>Annex C (informative):</b>	<b>Test tolerances and derivation of test requirements.....</b>	<b>319</b>
C.1	Measurement of transmitter.....	320
C.2	Measurement of receiver .....	326
C.3	Measurement of performance requirements .....	327
<b>Annex D (normative):</b>	<b>Calibration.....</b>	<b>330</b>
<b>Annex E (informative):</b>	<b>OTA measurement system set-up.....</b>	<b>331</b>
E.1	Transmitter .....	331
E.1.1	Radiated transmit power, OTA output power dynamics, OTA transmitted signal quality, OTA occupied bandwidth, and OTA transmit ON/OFF power ( <i>BS type 2-O</i> ) .....	331
E.1.2	OTA base station output power, OTA ACLR, OTA operating band unwanted emissions .....	332
E.1.3	OTA spurious emissions .....	332
E.1.4	OTA co-location emissions, OTA transmit ON/OFF power ( <i>BS type 1-O</i> ) .....	333
E.1.5	OTA transmitter intermodulation .....	334
E.2	Receiver.....	335
E.2.1	OTA sensitivity and OTA reference sensitivity level.....	335
E.2.2	OTA dynamic range .....	335
E.2.3	OTA adjacent channel selectivity, general OTA blocking, and OTA narrowband blocking .....	336
E.2.4	OTA blocking.....	337
E.2.4.1	General OTA out-of-band blocking.....	337
E.2.4.2	OTA co-location blocking .....	337
E.2.5	OTA receiver spurious emissions.....	338
E.2.6	OTA receiver intermodulation .....	338
E.2.7	OTA in-channel selectivity.....	339
E.3	Performance requirements.....	339
<b>Annex F (normative):</b>	<b>Void .....</b>	<b>340</b>
<b>Annex G (informative):</b>	<b>Transmitter spatial emissions declaration.....</b>	<b>341</b>
G.1	General .....	341
G.2	Declarations.....	342

<b>Annex H (normative):</b>	<b>Characteristics of the interfering signals .....</b>	<b>343</b>
<b>Annex I (normative):</b>	<b>TRP measurement procedures .....</b>	<b>344</b>
I.1	General .....	344
I.2	Spherical equal angle grid .....	344
I.2.1	General .....	344
I.2.2	Reference angular step criteria .....	344
I.3	Spherical equal area grid .....	346
I.4	Spherical Fibonacci grid.....	347
I.5	Orthogonal cut grid .....	347
I.5.1	General .....	347
I.5.2	Operating band unwanted emissions .....	348
I.5.3	Spurious unwanted emissions.....	348
I.6	Wave vector space grid .....	349
I.7	Void.....	349
I.8	Void.....	349
I.9	Full sphere with sparse sampling .....	349
I.10	Beam-based directions .....	350
I.11	Peak method .....	350
I.12	Equal sector with peak average .....	350
I.13	Pre-scan .....	351
<b>Annex J (normative):</b>	<b>Propagation conditions.....</b>	<b>352</b>
J.1	Static propagation condition.....	352
J.2	Multi-path fading propagation conditions.....	352
J.2.1	Delay profiles .....	352
J.2.1.1	Delay profiles for FR1 .....	353
J.2.1.2	Delay profiles for FR2 .....	354
J.2.2	Combinations of channel model parameters .....	355
J.2.3	MIMO channel correlation matrices.....	355
J.2.3.1	MIMO correlation matrices using Uniform Linear Array .....	355
J.2.3.1.1	Definition of MIMO correlation matrices .....	355
J.2.3.1.2	MIMO correlation matrices at high, medium and low level .....	357
J.2.3.2	Multi-antenna channel models using cross polarized antennas.....	359
J.2.3.2.1	Definition of MIMO correlation matrices using cross polarized antennas .....	359
J.2.3.2.2	Spatial correlation matrices at UE and gNB sides.....	360
J.2.3.2.2.1	Spatial correlation matrices at UE side.....	360
J.2.3.2.2.2	Spatial correlation matrices at gNB side .....	360
J.2.3.2.3	MIMO correlation matrices using cross polarized antennas .....	360
J.3	High speed train condition .....	361
J.4	Moving propagation conditions.....	365
<b>Annex K (informative):</b>	<b>Measuring noise close to noise-floor.....</b>	<b>367</b>
<b>Annex L (normative):</b>	<b>In-channel TX tests.....</b>	<b>368</b>
L.1	General .....	368
L.2	Basic principles .....	368
L.2.1	Output signal of the TX under test .....	368
L.2.2	Ideal signal .....	368
L.2.3	Measurement results.....	369