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Technical Specification





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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:

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where:

- x the first digit:
  - 1 presented to TSG for information;
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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
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1 Scope

The present document covers the assessment of Base Station (BS) and ancillary equipment in respect of Electromagnetic Compatibility (EMC).

The present document specifies the applicable test conditions, performance assessment and performance criteria for base stations and associated ancillary equipment in the following categories:

- BS equipped with antenna connectors or *TAB connectors* which are possible to be terminated during EMC testing, meeting the *BS type 1-C* and *BS type 1-H* RF requirements of TS 38.104 [2], with conformance demonstrated by compliance to TS 38.141-1 [3].

- BS not equipped with antenna connectors nor *TAB connectors*, i.e. with antenna elements radiating during the EMC testing, meeting the *BS type 1-O* and *BS type 2-O* RF requirements of TS 38.104 [2], with conformance demonstrated by compliance to TS 38.141-2 [4].

The scope of the present document is twofold:

- Requirements, procedures and values of a BS with antenna connectors or *TAB connectors*,

- Requirements, procedures and values of a BS without antenna connectors, nor *TAB connectors*.

The environment classification used in the present document refers to the residential, commercial and light industrial environment classification used in IEC 61000-6-1 [7] and IEC 61000-6-3 [8].

The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus at residential, commercial and light industrial environments. The levels, however, do not cover extreme cases which may occur in any location but with low probability of occurrence.

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] 3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception"

[3] 3GPP TS 38.141-1: "NR; Base Station (BS) conformance testing Part 1: Conducted conformance testing"

[4] 3GPP TS 38.141-2: "NR; Base Station (BS) conformance testing Part 2: Radiated conformance testing"

[5] 3GPP TS 37.113: "E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) Electromagnetic Compatibility (EMC)"

[6] 3GPP TS 37.114: "Active Antenna System (AAS) Base Station (BS) Electromagnetic Compatibility (EMC)"

[7] IEC 61000-6-1: "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 1: Immunity for residential, commercial and light-industrial environments"

[8] IEC 61000-6-3: "Electromagnetic compatibility (EMC) - Part 6: Generic standards - Section 3: Emission standard for residential, commercial and light industrial environments"

[9] IEC 60050(161): "International Electrotechnical Vocabulary - Chapter 161: Electromagnetic compatibility"

[10] 3GPP TR 38.817-2 "NR: General aspect for BS RF to NR"

[11] CISPR 32: "Electromagnetic compatibility of multimedia equipment - Emission requirements"

[12] void

[13] IEC 61000-3-2: "Electromagnetic compatibility (EMC) - Part 3: Limits - Section 2: Limits for harmonic current emissions (equipment input current ≤ 16 A)"

[14] IEC 61000-3-12: "Electromagnetic compatibility (EMC) - Part 3-12: Limits- Limits for harmonic current produced by equipment connected to public low-voltage system with input current >16 A and ≤ 75 A"

[15] IEC 61000-3-3: "Electromagnetic compatibility (EMC) - Part 3: Limits - Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A"

[16] IEC 61000-3-11: "Electromagnetic compatibility (EMC) - Part 3-11: Limits –Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 75 A and subject to conditional connections"

[17] IEC 61000-4-2: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test"

[18] IEC 61000-4-3: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency electromagnetic field immunity test"

[19] IEC 61000-4-4: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test"

[20] IEC 61000-4-5: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 5: Surge immunity test"

[21] IEC 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 6: Immunity to contacted disturbances, induced by radio frequency fields"

[22] IEC 61000-4-11: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 11: Voltage dips, short interruptions and voltage variations. Immunity tests"

[23] ETSI EN 301 489-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements"

[24] Recommendation ITU-R SM.329-12: "Unwanted emissions in the spurious domain"

[25] 3GPP TS 37.105: "Active Antenna System (AAS) Base Station (BS) transmission and reception"

[26] Recommendation ITU-R SM.1539-1: "Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329"

[27] 3GPP TS 38.101-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements"

[28] ETSI EN 301 489-50: "Electromagnetic compatibility (EMC) standard for radio equipment and services; Part 50: Specific conditions for cellular communication base station (BS), repeater and ancillary equipment; Harmonised standard covering the essential requirements of article 3.1(b) of the Directive 2014/53/EU

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 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 TR 21.905 [1].

ancillary equipment: electrical or electronic equipment, that is intended to be used with a receiver or transmitter

NOTE: It is considered as an ancillary equipment if:

- the equipment is intended for use with a receiver or transmitter to provide additional operational and/or control features to the radio equipment, (e.g. to extend control to another position or location); and
- the equipment cannot be used on a stand alone basis to provide user functions independently of a receiver or transmitter; and
- the receiver or transmitter, to which it is connected, is capable of providing some intended operation such as transmitting and/or receiving without the ancillary equipment (i.e. it is not a sub-unit of the main equipment essential to the main equipment basic functions).

antenna port: for EMC purposes, port for connection of an antenna used for intentional transmission and/or reception of radiated RF energy, equivalent to an RF antenna connector/*TAB connector* in TS 37.105 [25]

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 bandwidth: the RF bandwidth supporting a single NR RF carrier with the transmission bandwidth configured in the uplink or downlink of a cell. The *channel bandwidth* is measured in MHz and is used as a reference for transmitter and receiver RF requirements

continuous phenomena: electromagnetic disturbance, the effects of which on a particular device or equipment cannot be resolved into a succession of distinct effects (IEC 60050-161 [9])

enclosure port: physical boundary of the equipment through which electromagnetic fields may radiate or impinge

NOTE: In the case of *integral antenna* equipment, this port is inseparable from the antenna port.

exclusion band: frequency range(s) not subject to test or assessment

integral antenna: antenna designed for permanent connection to the equipment and considered part of the enclosure port

NOTE: An *integral antenna* may be fitted internally or externally.

lower RF bandwidth edge: the frequency of the lower edge of the Base Station RF bandwidth, used as a frequency reference point for transmitter and receiver requirements

operating band: frequency range in which NR operates (paired or unpaired), that is defined with a specific set of technical requirements

port: particular interface of EUT used for EMC requirements testing purposes

NOTE: Any connection point on EUT intended for connection of cables to or from EUT during the EMC testing is considered as a port.

EXAMPLE 1: Examples of ports for *BS type 1-C* and *BS type 1-H* are as presented in figure 3.1-1:

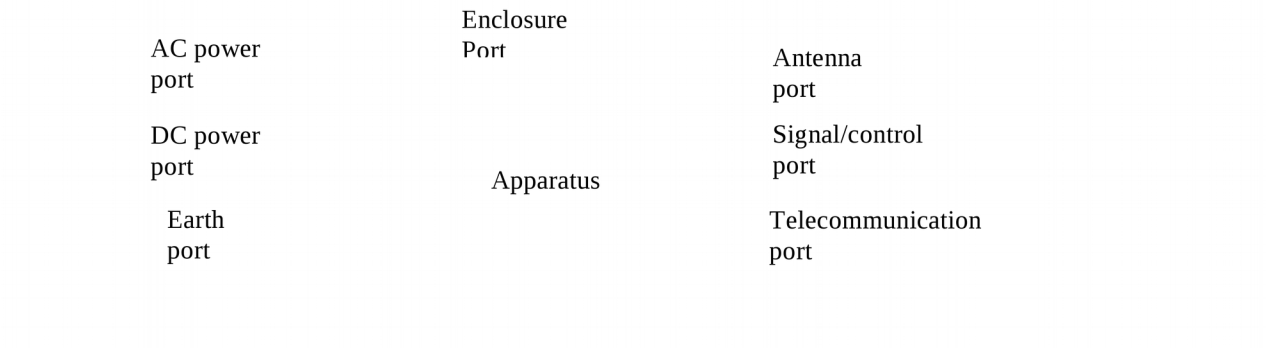


Figure 3.1-1: Examples of *port*s for *BS type 1-C* and *BS type 1-H*

EXAMPLE 2: Examples of ports for *BS type 1-O* and *BS type 2-O* (i.e. with no *antenna ports*) are as presented in figure 3.1-2:

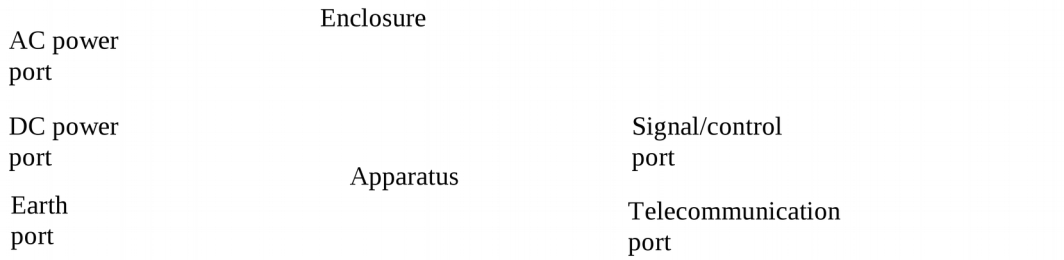


Figure 3.1-2: Examples of *port*s for *BS type 1-O* and *BS type 2-O*

receiver exclusion band: band of frequencies over which no tests of radiated immunity of a receiver are made, and expressed relative to the BS receive band

signal port: port intended for the interconnection of components of an EUT, or between an EUT and associated equipment and used in accordance with relevant functional specifications (for example for the maximum length of cable connected to it)

TAB connector: *transceiver array boundary* connector

transceiver array boundary: conducted interface between the *transceiver unit* array and the composite antenna

transceiver unit: active unit consisting of transmitter and/or receiver which transmits and/or receives radio signals, and which may include passive RF filters

telecommunication port: ports which are intended to be connected to telecommunication networks (e.g. public switched telecommunication networks, integrated services digital networks), local area networks (e.g. Ethernet, Token Ring) and similar networks

NOTE: *Telecommunication port* is called "wired network port" in ETSI EN 301 489-1 [23]

transient phenomena: pertaining to or designating a phenomena or a quantity which varies between two consecutive steady states during a time interval short compared with the time-scale of interest (IEC 60050-161 [9])

transmitter exclusion band: band of frequencies over which no tests of radiated immunity of a transmitter are made and is expressed relative to the carrier frequencies used (the carrier frequencies of the base stations activated transmitter(s))

upper RF bandwidth edge: the frequency of the upper edge of the Base Station RF bandwidth, used as a frequency reference point for transmitter and receiver requirements

3.2 Symbols

For the purposes of the present document, the following symbols apply:

β	Bandwidth
BWChannel	Channel bandwidth
Δf_{OBUE}	Maximum offset of the *operating band* unwanted emissions mask from the downlink *operating band* edge
Δf_{OOB}	Maximum offset of the out-of-band boundary from the uplink *operating band* edge
$F_{DL,low}$	The lowest frequency of the downlink *operating band*
$F_{DL,high}$	The highest frequency of the downlink *operating band*
$F_{UL,low}$	The lowest frequency of the uplink *operating band*
$F_{UL,high}$	The highest frequency of the uplink *operating band*
$\Delta f_{RIexclusion}$	Maximum offset of the Radiated Immunity exclusion band from the uplink operating band edge for test without spatial exclusion

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

AC	Alternating Current
AMN	Artificial Mains Network
BC	Band Category
CDN	Coupling/Decoupling Network
CS	Capability Set
DC	Direct Current
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
EUT	Equipment Under Test
FR	Frequency Range
FRC	Fixed Reference Channel
NRTC	NR Test Configuration
NTC	Test Configuration for Non-contiguous operation
RAT	Radio Access Technology
RF	Radio Frequency
RIB	Radiated Interface Boundary
rms	root mean square
SDL	Supplementary Downlink
TC	Test Configuration

4 Test conditions

4.1 General

Requirements throughout the EMC specifications are in some cases defined separately for different frequency ranges (FR). The frequency ranges FR1 and FR2 are defined in subclause 5.1 of TS 38.104 [2].

The equipment shall be tested in normal test environment defined in the corresponding BS conformance testing specification TS 38.141-1 [3] for BS type 1-C and BS type 1-H, or TS 38.141-2 [4] for BS type 1-O and BS type 2-O. The test conditions shall be recorded in the test report.

For BS capable of multi-band operation, the requirements in the present document apply for each supported *operating band* unless otherwise stated. *Operating bands* shall be activated according to the test configuration in subclause 4.5. Tests shall be performed relating to each type of port and all *operating bands* shall be assessed during the tests.

The manufacturer shall declare the supported *operating band(s)* according to the list of NR *operating bands* defined in TS 38.104 [2].

NOTE 1: NR *operating bands* for *BS type 1-C* and *BS type 1-H*, are declared by the manufacturer according to the declarations specified in TS 38.141-1 [3], subclause 4.6.

NOTE 2: NR *operating bands* for *BS type 1-O* and *BS type 2-O*, are declared by the manufacturer according to the declarations specified in TS 38.141-2 [4], subclause 4.6.

4.2 Arrangements for establishing a communication link

The wanted RF input signal nominal frequency shall be selected by setting the NR Absolute Radio Frequency Channel Number (NR-ARFCN) to an appropriate number.

A communication link shall be set up with a suitable test system capable of evaluating the required performance criteria (hereafter called "the test system") at the radio interface and *telecommunication port/ports* (the NG interface). The test system shall be located outside of the test environment.

When the EUT is required to be in the transmit/receive mode, the following conditions shall be met:

- For the *BS type 1-C* and *BS type 1-H* testing, the EUT shall be commanded to operate at rated transmit power;
- For the *BS type 1-O* and *BS type 2-O* testing, the EUT transmit power shall be configured as stated in subclause 8.1 for emission test and subclause 9.1 for immunity test accordingly
- Adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment;
- The wanted input signal level shall be set to a level where the performance is not limited by the receiver noise floor or strong signal effects.

NOTE: 15 dB above the conducted reference sensitivity level has been used as an example of wanted input signal level in legacy 3GPP EMC specifications for establishing a communication link.

For immunity tests subclause 4.3 shall apply and the conditions shall be as follows.

4.3 Narrow band responses on receivers

Responses on receivers or duplex transceivers occurring during the immunity test at discrete frequencies which are narrow band responses (spurious responses), are identified by the following method:

- if during an immunity test the quantity being monitored goes outside the specified tolerances (clause 6), it is necessary to establish whether the deviation is due to a narrow band response or to a wide band (EMC) phenomenon. Therefore, the test shall be repeated with the unwanted signal frequency increased, and then decreased by 2 x $BW_{Channel}$ MHz, where $BW_{Channel}$ is the channel bandwidth as defined in TS 38.104 [2], subclause 5.3;
- if the deviation disappears in either one or both of the above MHz offset cases, then the response is considered as a narrow band response;
- if the deviation does not disappear, this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrow band response. Under these circumstances the procedure is repeated with the increase and decrease of the frequency of the unwanted signal set to 2.5 x $BW_{Channel}$ MHz;
- if the deviation does not disappear with the increased and/or decreased frequency, the phenomenon is considered wide band and therefore an EMC problem and the equipment fails the test.

For immunity test narrow band responses are disregarded.

For BS capable of multi-band operation, all supported *operating bands* shall be considered for narrowband responses.

4.4 Exclusion bands

4.4.1 Transmitter exclusion band

For testing of radiated immunity there is no *transmitter exclusion band*.

4.4.2 Receiver exclusion band

The *receiver exclusion band* for BS is the frequency range over which no tests of radiated immunity of a receiver are made.

The *receiver exclusion band* is defined as:

$$F_{UL_low} - \Delta f_{OOB} < f < F_{UL_high} + \Delta f_{OOB}$$

Where:

Values of F_{UL_low} and F_{UL_high} are defined for each *operating band* in TS 38.104 [2], subclause 5.2.

The value of Δf_{OOB} is derived considering the width of the *operating band*, and is defined in TS 38.104 [2], subclause 7.4.2.2.

In case the spatial exclusion (as discussed in subclause 9.2.2 and depicted in figure 9.2.2-1) is not used during the EMC RI testing, the receiver exclusion band for BS Type 1-O is defined as:

$$F_{UL_low} - \Delta f_{RIexclusion} < f < F_{UL_high} + \Delta f_{RIexclusion}$$

Where the values of $\Delta f_{RIexclusion}$ are defined in table 4.4.2-1.

Table 4.4.2-1: Maximum $\Delta f_{RIexclusion}$ offset outside the uplink operating band

***Operating band* characteristics**	**$\Delta f_{RIexclusion}$ (MHz)**
100 MHz ≥ $F_{UL_high} - F_{UL_low}$	60
100 MHz < $F_{UL_high} - F_{UL_low}$	200

For BS capable of multi-band operation, the total *receiver exclusion band* is a combination of the *exclusion bands* for each *operating band* supported by BS.

NOTE 1: The *receiver exclusion bands* do not apply for SDL bands.

NOTE 2: As the radiated immunity testing is defined in the frequency range 80 MHz to 6 GHz, there is no *receiver exclusion band* defined for *BS type 2-O*.

4.5 BS test configurations

The present subclause defines the BS test configurations that shall be used for demonstrating conformance. A single NR carrier shall be used for testing of single-carrier capable BS.

Single carrier configuration (SC) tests shall be performed using signal with narrowest supported *BS channel bandwidth* with the smallest supported subcarrier spacing declared per *operating band* in TS 38.141-1 [3] subclause 4.6, and TS 38.141-2 [4] subclause 4.6.

For other NR base stations, the test configurations in table 4.5-1 and table 4.5-2 shall be used. The NR test configurations (NRTCx) are defined in TS 38.141-1 [3], subclause 4.7 for *BS type 1-C* and *BS type 1-H* and TS 38.141-2 [4], subclause 4.8 for *BS type 1-O* and *BS type 2-O*.

Table 4.5-1: Test configurations for *BS type 1-C* and *BS type 1-H*

BS test case	BS with *single-band connector* capable of contiguous spectrum in single band only	BS with *single-band connector* capable of both contiguous and non-contiguous spectrum in single band	BS with *single-band connector* capable of multi-band operation	BS with *Multi-band connector* capable of multi-band operation
Emission tests	NRTC1	NRTC3 or NRTC1/3 (Note1)	NRCT1/3(Note 2), NRTC 5	NRCT1/3(Note 2), NRTC 5
Immunity tests	NRTC1	NRTC3 or NRTC1/3 (Note1)	NRCT1/3(Note 2), NRTC 5	NRCT1/3(Note 2), NRTC 5
NOTE 1: When parameters in the manufacture's declaration according toTS 38.141-1 [3] subclause 4.6 are identical for contiguous (C) and non-contiguous (NC), NRTC 3 is used, otherwise, NRTC1/3 shall be used. NOTE 2: NRTC1 or NRTC3 shall be applied in each supported operating band.				

Table 4.5-2: Test configurations for *BS type 1-O*

BS test case	BS with *single-band RIB* capable of contiguous spectrum in single band only	BS with *single-band RIB* capable of both contiguous and non-contiguous spectrum in single band	BS with *single-band RIB* capable of multi-band operation	BS with*Multi-band RIB* capable of multi-band operation
Emission tests	NRTC1	NRTC3 or NRTC1/3 (Note1)	NRCT1/3(Note 2), NRTC 5	NRCT1/3(Note 2), NRTC 5
Immunity tests	NRTC1	NRTC3 or NRTC1/3 (Note1)	NRCT1/3(Note 2), NRTC 5	NRCT1/3(Note 2), NRTC 5
NOTE 1: When parameters in the manufacture's declaration according to TS 38.141-2 [4] subclause 4.6 are identical for contiguous (C) and non-contiguous (NC), NRTC 3 is used, otherwise, NRTC1/3 shall be used. NOTE 2: NRTC1 or NRTC3 shall be applied in each supported operating band.				

***Table 4.5-3: Test configurations for BS* type 2-O**

BS test case	BS with *single-band RIB* capable of contiguous spectrum in single band only	BS with *single-band RIB* capable of both contiguous and non-contiguous spectrum in single band
Emission tests	NRTC1	NRTC3 or NRTC1/3 (Note1)
Immunity tests	NRTC1	NRTC3 or NRTC1/3 (Note1)
NOTE 1: When parameters in the manufacture's declaration according to TS 38.141-2 [4] subclause 4.6 are identical for contiguous (C) and non-contiguous (NC), NRTC 3 is used, otherwise, NRTC1/3 shall be used.		

5 Performance assessment

5.1 General

The following information shall be recorded in or annexed to the test report:

- the primary functions of the radio equipment to be tested during and after the EMC testing;
- the intended functions of the radio equipment which shall be in accordance with the documentation accompanying the equipment;
- the method to be used to verify that a communications link is established and maintained;
- the user-control functions and stored data that are required for normal operation and the method to be used to assess whether these have been lost after EMC stress;

- the *ancillary equipment* to be combined with the radio equipment for testing (where applicable);
- the information about *ancillary equipment* intended to be used with the radio equipment;
- information about the common and/or band-specific active RF components and other HW blocks for a communication link in BS capable of multi-band operation;
- an exhaustive list of ports (and *RIBs*), classified as either power or signal/control. Power ports shall further be classified as AC or DC power.

Performance assessment of a BS with multiple enclosures may be done separately for the BS part with the Radio digital unit and the Radio unit respectively, according to the manufacturer's choice.

A communication link used by more than one *operating band*, shall be assessed on all *operating band*s. Communication link(s) and/or radio performance parameters for the *operating band*s can during the test be assessed simultaneously or separately for each band, depending on the test environment capability.

5.2 Assessment of throughput in Downlink

A communication link shall be established between the transmitter (via port for the *BS type 1-C* and *BS type 1-H*, or via RIB for the *BS type 1-O* and *BS type 2-O*) and the test equipment. Test equipment shall meet the requirements for the throughput assessment defined in TS 38.101-4 [27] for the bearer used in the immunity tests. The level of the signal supplied to the equipment should be within the range for which the assessment of throughput is not impaired. Power control shall be off during the immunity testing.

5.3 Assessment of throughput in Uplink

The value of the throughput at the output of the receiver shall be monitored at NG interface by using suitable test equipment.

5.4 Ancillary equipment

At the manufacturer's discretion the test may be performed on the *ancillary equipment* separately or on a representative configuration of the combination of radio and *ancillary equipment*. In each case EUT is tested against all applicable immunity and emission clauses of the present document and in each case, compliance enables the *ancillary equipment* to be used with different radio equipment.

6 Performance criteria

6.1 Performance criteria for continuous phenomena for BS

The test should, where possible, be performed using a bearer with the characteristics of data rate and throughput defined in table 6.1-1 and table 6.1-2 . If the test is not performed using one of these bearers (for example, of none of them are supported by the BS), the characteristics of the bearer used shall be recorded in the test report.

The throughput in table 6.1-1 and table 6.1-2 is stated relative to the maximum throughput of the FRC.

The BS uplink and downlink paths shall each meet the performance criteria defined in table 6.1-1 and table 6.1-2 during the test. If the uplink and downlink paths are evaluated as a one loop then the criteria is two times the throughput reduction shown in table 6.1-1 and table 6.1-2 (i.e. throughput > 90 % instead of throughput > 95 %). After each test case BS shall operate as intended with no loss of user control function, stored data and the communication link shall be maintained.

Table 6.1-1: FR1 performance criteria for continuous phenomena for BS

NRchannel bandwidth [MHz]	Sub-carrier spacing [kHz]	Bearer information data rate	Performance criteria (Note 1, Note 2)
5, 10, 15	15	G-FR1-A1-1 in Annex a.1 in TS 38.104 [2]	Throughput > 95 %, no loss of service
10, 15	30	G-FR1-A1-2 in Annex a.1 in TS 38.104 [2]	
10, 15	60	G-FR1-A1-3 in Annex a.1 in TS 38.104 [2]	
20, 25, 30, 40, 50	15	G-FR1-A1-4 in Annex a.1 in TS 38.104 [2]	
20, 25, 30, 40, 50, 60, 70, 80, 90, 100	30	G-FR1-A1-5 in Annex a.1 in TS 38.104 [2]	
20, 25, 30, 40, 50, 60, 70, 80, 90, 100	60	G-FR1-A1-6 in Annex a.1 in TS 38.104 [2]	
NOTE 1: The performance criteria, throughput > 95 %, no loss of service, applies also if a bearer with another characteristics is used in the test. NOTE 2: The performance criteria, throughput > 90 %, no loss of service, applies instead if the uplink and downlink paths are evaluated as a one loop.			

Table 6.1-2: FR2 performance criteria for continuous phenomena for BS

NR channel bandwidth [MHz]	Sub-carrier spacing [kHz]	Bearer information data rate	Performance criteria (Note 1, Note 2)
50, 100, 200	60	G-FR2-A1-1 in Annex a.1 in TS 38.104 [2]	Throughput > 95 %, no loss of service
50	120	G-FR2-A1-2 in Annex a.1 in TS 38.104 [2]	
100, 200, 400	120	G-FR2-A1-3 in Annex a.1 in TS 38.104 [2]	
NOTE 1: The performance criteria, throughput > 95 %, no loss of service, applies also if a bearer with another characteristics is used in the test. NOTE 2: The performance criteria, throughput > 90 %, no loss of service, applies instead if the uplink and downlink paths are evaluated as a one loop.			

6.2 Performance criteria for transient phenomena for BS

The test should be, where possible, performed using a bearer with the characteristics of data rate and throughput defined in table 6.2-1 and table 6.2-2. If the test is not performed using one of these bearers (for example, of none of them are supported by the BS), the characteristics of the bearer used shall be recorded.

The throughput in table 6.2-1 and table 6.2-2 is stated relative to the maximum throughput of the FRC.

The BS uplink and downlink paths shall each meet the performance criteria defined in table 6.2-1 and table 6.2-2 during the test. If the uplink and downlink paths are evaluated as a one loop then the criteria is two times the throughput reduction shown in table 6.2-1 and table 6.2-2 (i.e. throughput <90 % temporarily instead of throughput < 95 % temporarily). After each test case BS shall operate as intended with no loss of user control function, stored data and the communication link shall be maintained.

Table 6.2-1: FR1 performance criteria for transient phenomena for BS

NR channel bandwidth [MHz]	Sub-carrier spacing [kHz]	Bearer information data rate	Performance criteria (Note 1, Note 2)
5, 10, 15	15	G-FR1-A1-1 in Annex a.1 in TS 38.104 [2]	Throughput < 95 % temporarily, however the communication link shall be maintained
10, 15	30	G-FR1-A1-2 in Annex a.1 in TS 38.104 [2]	
10, 15	60	G-FR1-A1-3 in Annex a.1 in TS 38.104 [2]	
20, 25, 30, 40, 50	15	G-FR1-A1-4 in Annex a.1 in TS 38.104 [2]	
20, 25, 30, 40, 50, 60, 70, 80, 90, 100	30	G-FR1-A1-5 in Annex a.1 in TS 38.104 [2]	
20, 25, 30, 40, 50, 60, 70, 80, 90, 100	60	G-FR1-A1-6 in Annex a.1 in TS 38.104 [2]	
NOTE 1: The performance criteria, Throughput < 95 % temporarily, however the communication link shall be maintained, applies also if a bearer with another characteristics is used in the test. NOTE 2: The performance criteria, Throughput < 90 % temporarily, however the communication link shall be maintained, applies instead if the uplink and downlink paths are evaluated as a one loop.			

Table 6.2-2: FR2 performance criteria for transient phenomena for BS

NR channel bandwidth [MHz]	Sub-carrier spacing [kHz]	Bearer information data rate	Performance criteria (Note 1, Note 2)
50, 100, 200	60	G-FR2-A1-1 in Annex a.1 in TS 38.104 [2]	Throughput < 95 % temporarily, however the communication link shall be maintained
50	120	G-FR2-A1-2 in Annex a.1 in TS 38.104 [2]	
100, 200, 400	120	G-FR2-A1-3 in Annex a.1 in TS 38.104 [2]	
NOTE 1: The performance criteria, Throughput < 95 % temporarily, however the communication link shall be maintained, applies also if a bearer with another characteristics is used in the test. NOTE 2: The performance criteria, Throughput < 90 % temporarily, however the communication link shall be maintained, applies instead if the uplink and downlink paths are evaluated as a one loop.			

6.3 Performance criteria for continuous phenomena for Ancillary equipment

The apparatus shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below the performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible performance loss. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

6.4 Performance criteria for transient phenomena for Ancillary equipment

The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below the performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible performance loss. During the test, degradation of performance is however allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

7 Applicability overview

7.1 Emission

Table 7.1-1: Emission requirements applicability

Phenomenon	Application	Equipment test requirement		Reference subclause in the present document	Reference Standard
		BS equipment	Ancillary equipment		
Radiated emission	Enclosure	applicable for *BS type 1-C* and *BS type 1-H* (Note)	not applicable	8.2.1	ITU-R SM.329 [24]
Radiated emission	Enclosure of *ancillary equipment*	not applicable]	applicable	8.2.2	CISPR 32 [11]
Conducted emission	DC power input/output port	applicable	applicable	8.3	CISPR 32 [11]
Conducted emission	AC mains input/output port	applicable	applicable	8.4	CISPR 32 [11]
Conducted emission	*Telecommunication port*	applicable	applicable	8.5	CISPR 32 [11]
Harmonic current emissions	AC mains input port	applicable	applicable	8.6	IEC 61000-3-2 [13] or IEC 61000-3-12 [14]
Voltage fluctuations and flicker	AC mains input port	applicable	applicable	8.7	IEC 61000-3-3 [15]] or IEC 61000-3-11 [16]
NOTE: Radiated emission requirements for *BS type 1-O* and *BS type 2-O* are described in subclause 8.2.1.					

7.2 Immunity

Table 7.2-1: Immunity requirements applicability

Phenomenon	Application	Equipment test requirement		Reference subclause in the present document	Reference standard
		BS equipment	Ancillary equipment		
RF electromagnetic field (80 – 6000 MHz)	Enclosure	applicable	applicable	9.2	IEC 61000-4-3 [18]
Electrostatic discharge	Enclosure	applicable	applicable	9.3	IEC 61000-4-2 [17]
Fast transients common mode	Signal, telecommunications and control ports, DC and AC power input ports	applicable	applicable	9.4	IEC 61000-4-4 [19]
RF common mode 0.15 - 80 MHz	Signal, telecommunications and control ports, DC and AC power input ports	applicable	applicable	9.5	IEC 61000-4-6 [21]
Voltage dips and interruptions	AC mains power input *port*s	applicable	applicable	9.6	IEC 61000-4-11 [22]
Surges, common and differential mode	AC power input *port*s and *telecommunications port*	applicable	applicable	9.7	IEC 61000-4-5 [20]

8 Emission

8.1 Test configurations

This subclause defines the configurations for emission tests as follows:

- The equipment shall be tested under normal test conditions as specified in the functional standards;
- The test configuration shall be as close to normal intended use as possible;
- If the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment while connected to the minimum configuration of *ancillary equipment* necessary to exercise the ports;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operation conditions and to ensure that all the different types of termination are tested;
- The test conditions, test configuration and mode of operation shall be recorded in the test report;
- Ports which in normal operation are connected shall be connected to an *ancillary equipment* or to a representative piece of cable correctly terminated to simulate the input/output characteristics of the *ancillary equipment*; in case of *BS type 1-H*, *antenna port*s shall be correctly terminated;
- For *BS type 1-O* and *BS type 2-O* without *antenna ports* but intentionally radiating through the *antenna array*, the equipment shall be placed in a test setup suitable for the radiated power;
- Ports which are not connected to cables during normal operation, e.g. service connectors, programming connectors, temporary connectors etc. shall not be connected to any cables for the purpose of EMC testing. Where cables have to be connected to these ports, or interconnecting cables have to be extended in length in order to exercise the EUT, precautions shall be taken to ensure that the evaluation of the EUT is not affected by the addition or extension of these cables;
- The test arrangements for transmitter and receiver sections of the transceiver are described separately for the sake of clarity. However, where possible the test of the transmitter section and receiver section of the EUT may be carried out simultaneously to reduce test time.

8.1.1 (Void)

8.1.2 (Void)

8.1.3 (Void)

8.1.4 (Void)

8.1.5 (Void)

8.2 Radiated emission

8.2.1 Radiated emission, BS

This test is applicable to *BS type 1-C* and *BS type 1-H*. This test shall be performed on a representative configuration of BS.

For *BS type 1-O* and *BS type 2-O*, the radiated emission is covered by radiated spurious emission requirement in TS 38.104 [2], conforming to the test requirement in TS 38.141-2 [4].

8.2.1.1 Definition

This test assesses the ability of BS to limit unwanted emission from the *enclosure port*.

8.2.1.2 Test method

a) A test site fulfilling the requirements of ITU-R SM. 329 [24] shall be used. The BS shall be placed on a non-conducting support and shall be operated from a power source via a RF filter to avoid radiation from the power leads.

   Mean power of any spurious components shall be detected by the test antenna and measuring receiver (e.g. a spectrum analyser). At each frequency at which a component is detected, the BS shall be rotated and the height of the test antenna adjusted to obtain maximum response, and the effective radiated power (e.r.p.) of that component determined by a substitution measurement. The measurement shall be repeated with the test antenna in the orthogonal polarization plane.

NOTE: Effective radiated power (e.r.p.) refers to the radiation of a half wave tuned dipole instead of an isotropic antenna. There is a constant difference of 2.15 dB between e.i.r.p. and e.r.p.

$$\text{e.r.p. (dBm)} = \text{e.i.r.p. (dBm)} - 2.15$$ Ref: ITU-R SM.329 ANNEX 1 [24].

b) The BS shall transmit with maximum power declared by the manufacturer with all transmitters active. Set the base station to transmit a signal as stated in subclause 4.5.

c) The received power shall be measured over the frequency range from 30 MHz to $F_{DL,low} - \Delta f_{OBUE}$ and from $F_{DL,high} + \Delta f_{OBUE}$ up to 12750 MHz. The video bandwidth shall be approximately three times the resolution bandwidth. If this video bandwidth is not available on the measuring receiver, it shall be the maximum available and at least 1 MHz. Unless otherwise stated, all measurements are done as mean power (RMS).

8.2.1.3 Limits

The frequency boundary and reference bandwidths for the detailed transitions of the limits between the requirements for out of band emissions and spurious emissions are based on ITU-R Recommendations SM.329 [24] and SM.1539 [26].

The *BS type 1-C* and *BS type 1-H* shall meet the limits below:

Table 8.2.1.3-1: Limits for radiated emissions from BS

Frequency range	Minimum requirement (e.r.p.) / Reference bandwidth
30 MHz ≤ f < 1000 MHz	-36 dBm/ 100 kHz
1 GHz ≤ f < 12.75 GHz	-30 dBm/ 1 MHz
$F_{DL,low} - \Delta f_{OBUE} < f < F_{DL,high} + \Delta f_{OBUE}$ (Note 1, Note 2)]	Not defined
NOTE 1: For BS capable of multi-band operation, the frequency ranges relating to the RF bandwidths of all supported *operating bands* apply.	
NOTE 2: Δf_{OBUE} is defined in subclause 6.6.1 of TS 38.104 [2]	

8.2.1.4 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the radiated emission measurements described in the present document shall be as follows:

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document;

- the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report;

- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in Table 8.2.1-4-1 for BS.

Table 8.2.1.4-1 specifies the maximum measurement uncertainty of the test system. The test system shall enable the equipment under test to be measured with an uncertainty not exceeding the specified values. All tolerances and uncertainties are absolute values, and are valid for a confidence level of 95 %, unless otherwise stated.

A confidence level of 95% is the measurement uncertainty tolerance interval for a specific measurement that contains 95% of the performance of a population of test equipment.

Table 8.2.1.4-1: Maximum measurement uncertainty (BS)

Parameter	Uncertainty for EUT dimension ≤ 1 m	Uncertainty for EUT dimension >1 m
Effective radiated RF power between 30 MHz to 180 MHz	±6 dB	±6 dB
Effective radiated RF power between 180 MHz to 4 GHz	±4 dB	±6 dB
Effective radiated RF power between 4 GHz to 12,75 GHz	±6 dB	±9 dB (NOTE)
NOTE: This value may be reduced to ±6 dB when further information on the potential radiation characteristic of the EUT is available.		

NOTE: If the Test System for a test is known to have a measurement uncertainty greater than that specified in table 8.2.1.4-1, this equipment can still be used, provided that an adjustment is made follows:

Any additional uncertainty in the Test System over and above that specified in table 8.2.1.4-1 is used to tighten the test requirements - making the test harder to pass.

This procedure will ensure that a test system not compliant with Table 8.2.1.4-1 does not increase the probability of passing an EUT that would otherwise have failed a test if a test system compliant with table 8.2.1.4-1 had been used.

8.2.2 Radiated emission, ancillary equipment

This test is only applicable to *ancillary equipment* not incorporated in the radio equipment and intended to be measured on a stand-alone basis, as declared by the manufacturer. This test shall be performed on a representative configuration of the *ancillary equipment*.

This test is not applicable for *ancillary equipment* incorporated in the radio equipment, or for *ancillary equipment* intended to be measured in combination with the radio equipment. In these cases the requirements of the relevant product standard for the effective use of the radio spectrum shall apply.

8.2.2.1 Definition

This test assesses the ability of *ancillary equipment* to limit unwanted emission from the *enclosure port*.

8.2.2.2 Test method

The test method shall be in accordance with CISPR 32 [11].

8.2.2.3 Limits

The *ancillary equipment* shall meet the limits according to CISPR 32 [11] table A.4 and table A.5.

For the referred limit values, the following shall apply:

Where the limits value varies over a given frequency range, it changes linearly with respect to the logarithm of the frequency.

Where there is a step in the relevant limit, the lower value shall be applied at the transition frequency.

Table 8.2.2.3-1: (Void)

Table 8.2.2.3-2: (Void)

8.3 Conducted emission DC power input/output port

This test is applicable to equipment which may have DC cables longer than 3 m.

If the DC power cable of the radio equipment is intended to be less than 3 m in length, and intended only for direct connection to a dedicated AC to DC power supply, then the measurement shall be performed only on the AC power input of that power supply as specified in subclause 8.4.

This test shall be performed on a representative configuration of the radio equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

8.3.1 Definition

This test assesses the ability of radio equipment and *ancillary equipment* to limit internal noise from the DC power input/output ports.

8.3.2 Test method

The test method shall be in accordance with CISPR 32 [11] and the Artificial Mains Network (AMN) shall be connected to a DC power source.

In the case of DC output ports, the ports shall be connected via an AMN to a load drawing the rated current of the source.

A measuring receiver shall be connected to each AMN measurement port in turn and the conducted emission recorded.

The equipment shall be installed with a ground plane as defined in CISPR 32 [11]. The reference earth point of the AMN shall be connected to the reference ground plane with a conductor as short as possible.

8.3.3 Limits

The equipment shall meet the limits according to CISPR 32[11] table A.9, which are defined for average detector receiver and for quasi-peak detector receiver. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector receiver is not necessary.

Where there is a step in the referred limit values, the lower value shall be applied at the transition frequency.

Table 8.3.3-1: (Void)

8.4 Conducted emissions, AC mains power input/output port

This test is applicable to equipment powered by the AC mains.

This test is not applicable to AC output ports which are connected directly (or via a circuit breaker) to the AC power port of the EUT.

This test shall be performed on a representative configuration of the radio equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

8.4.1 Definition

This test assesses the ability of radio equipment and *ancillary equipment* to limit internal noise from the AC mains power input/output ports.

8.4.2 Test method

The test method shall be in accordance with CISPR 32 [11].

8.4.3 Limits

The equipment shall meet the limits according to CISPR 32 [11] table A.10, which are defined for the average detector receiver and for quasi-peak detector receiver. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector receiver is not necessary.

For the referred limit values following shall apply:

Where the limits value varies over a given frequency range, it changes linearly with respect to the logarithm of the frequency.

Where there is a step in the relevant limit, the lower value shall be applied at the transition frequency.

Table 8.4.3-1: (Void)

Alternatively, for equipment intended to be used in telecommunication centres the limits given in CISPR 32 [11] table A.9 shall be used.

Table 8.4.3-2: (Void)

8.5 Conducted emissions, telecommunication port

This test is applicable for radio equipment and/or *ancillary equipment* for fixed use which have *telecommunication ports*.

This test shall be performed on a representative configuration of radio equipment, the associated *ancillary equipment*, or a representative configuration of the combination of radio and *ancillary equipment*.

8.5.1 Definition

This test assesses the EUT unwanted emission present at the *telecommunication ports*.

8.5.2 Test method

The test method shall be in accordance with CISPR 32 [11].

8.5.3 Limits

The *telecommunication po*rts shall meet the limits according to CISPR 32 [11] table A.12.

For the referred limit values, following shall apply:

Where the limits value varies over a given frequency range, it changes linearly with respect to the logarithm of the frequency.

Where there is a step in the relevant limit, the lower value shall be applied at the transition frequency.

Table 8.5.3-1: (Void)

Alternatively, for equipment intended to be used in telecommunication centres only, the limits given in CISPR 32 [11] table A.11 may be used.

Table 8.5.3-2: (Void)

8.6 Harmonic Current emissions (AC mains input port)

The requirements of IEC 61000-3-2 [13] for harmonic current emission apply for equipment covered by the scope of the present document. For equipment with an input current of greater than 16 A per phase, IEC 61000-3-12 [14] applies.

8.7 Voltage fluctuations and flicker (AC mains input port)

The requirements of IEC 61000-3-3 [15] for voltage fluctuations and flicker apply for equipment covered by the scope of the present document. For equipment with an input current of greater than 16 A per phase, IEC 61000-3-11 [16] applies.

9 Immunity

9.1 Test configurations

This subclause defines the configurations for immunity tests as follows:

- the equipment shall be tested under normal test conditions as specified in the functional standards;
- during the test, the RF output power may be reduced to a power level sufficient for establishing and maintaining the required communication link;
- the test configuration shall be as close to normal intended use as possible;
- if the equipment is part of a system, or can be connected to *ancillary equipment*, then it shall be acceptable to test the equipment while connected to the minimum configuration of *ancillary equipment* necessary to exercise the ports;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operation conditions and to ensure that all the different types of termination are tested;
- the test conditions, test configuration and mode of operation shall be recorded in the test report;
- ports which in normal operation are connected shall be connected to an *ancillary equipment* or to a representative piece of cable correctly terminated to simulate the input/output characteristics of the *ancillary equipment*. In case of *BS type 1-C and BS type 1-H*, *antenna ports* shall be correctly terminated.
- ports which are not connected to cables during normal operation, e.g. service connectors, programming connectors, temporary connectors etc. shall not be connected to any cables for the purpose of EMC testing. Where cables have to be connected to these ports, or interconnecting cables have to be extended in length in order to exercise the EUT, precautions shall be taken to ensure that the evaluation of the EUT is not affected by the addition or extension of these cables;
- immunity tests on the entire NR BS shall be performed by establishing communication links at the radio interface (e.g. with the mobile simulator) and the NG interface (e.g. with an NGC simulator) and evaluating the throughput (see figures 9.1-1 and 9.1-2);
- immunity tests shall be performed on both the uplink and downlink paths. The tests shall also include both the radio interface and the NG interface. Throughput evaluation may be carried out at either interface, where appropriate, and the measurements for the uplink and downlink paths may be carried out as a single path looped at either the radio interface or NG interface. In case of looping is used care have to be taken that the throughput information doesn't change due to looping;

- for NR BS capable of multi-band operation, communication links shall be established in such a way that all *operating band*(s) are activated during the test according to the applicable test configurations in subclause 4.5. Performance assessment may be done separately for each *operating band*.

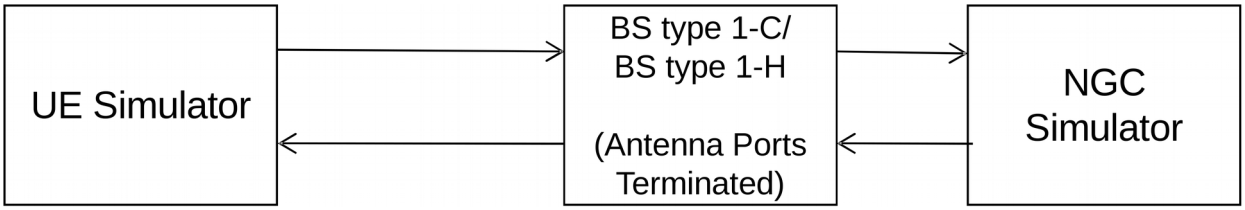


Figure 9.1-1: Communication link set up for *BS type 1-C*/*BS type 1-H* immunity measurement

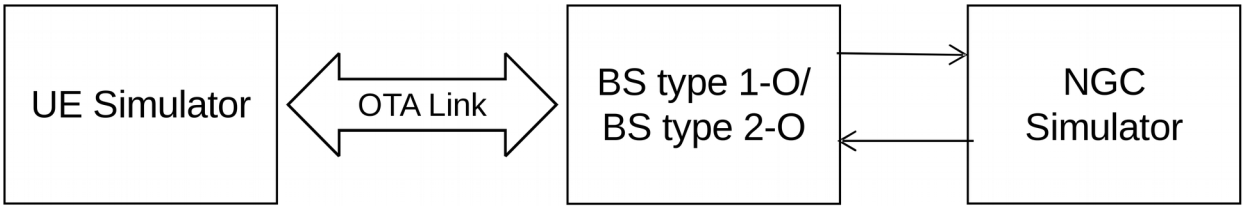


Figure 9.1-2: Communication link set up for *BS type 1-O*/*BS type 2-O* immunity measurement

9.1.1 (Void)

9.1.2 (Void)

9.1.3 (Void)

9.1.4 (Void)

9.1.5 (Void)

9.2 RF electromagnetic field (80 MHz to 6000 MHz)

The test shall be performed on a representative configuration of the equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

9.2.1 Definition

This test assesses the ability of radio equipment and *ancillary equipment* to operate as intended in the presence of a radio frequency electromagnetic field disturbance at the enclosure.

9.2.2 Test method and level

The test method shall be in accordance with IEC 61000-4-3 [18]:

- For transmitters, receivers and transceivers the following requirements shall apply:
- The test level shall be 3 V/m amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;
- The stepped frequency increments shall be 1 % of the momentary frequency;
- The test shall be performed over the frequency range 80 MHz - 6000 MHz; with the exception of the exclusion band for receivers (see subclause 4.4);

- Responses in stand-alone receivers or receivers which are part of transceivers occurring at discrete frequencies which are narrow band responses, shall be disregarded, see subclause 4.3;
- The frequencies selected during the test shall be recorded in the test report.
- In the range of angles except the operational range of angles of the BS Type 1-O and 2-O antenna (i.e. except for the half sphere around the EUT radiating direction as depicted on figure 9.2.2-1) and for the frequency range above 690 MHz (according to the test method in ETSI EN 301 489-50 [28]), the EMC RF electromagnetic field immunity requirement applies.

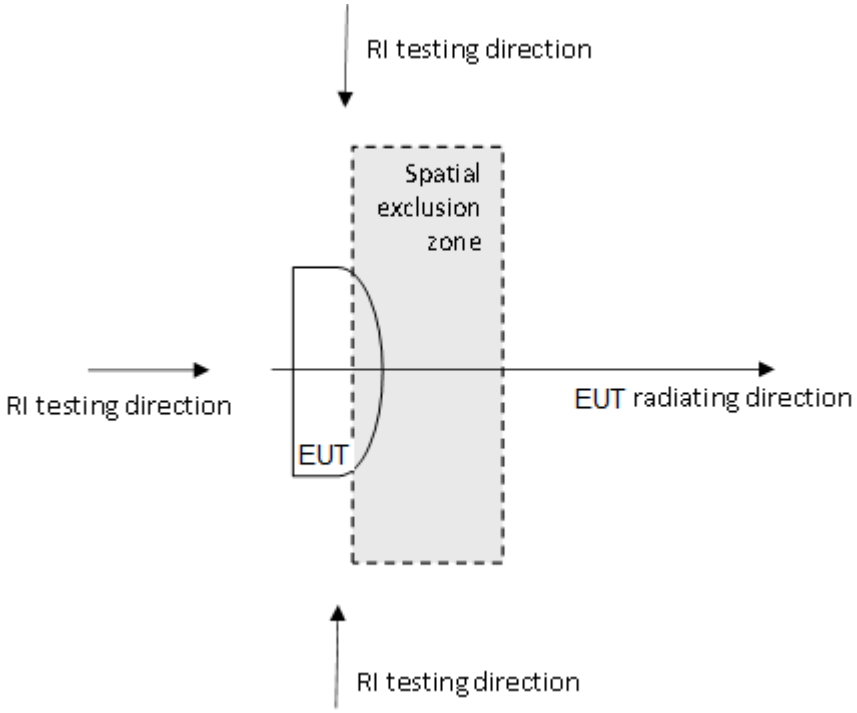


Figure 9.2.2-1: EMC RF electromagnetic field immunity requirement testing directions for 1-O and 2-O BS (horizontal plane depicted)

9.2.3 Performance criteria

Base station:

The performance criteria of subclause 6.1 shall apply.

Ancillary equipment:

The performance criteria of subclause 6.3 shall apply.

9.3 Electrostatic discharge

The test shall be performed on a representative configuration of the radio equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

9.3.1 Definition

This test assesses the ability of radio equipment and *ancillary equipment* to operate as intended in the event of an electrostatic discharge.

9.3.2 Test method and level

The test method shall be in accordance with IEC 61000-4-2 [17]:

- for contact discharge, the equipment shall pass at ±4 kV;
- for air discharge shall pass at ±8 kV;
- electrostatic discharge shall be applied to all exposed surfaces of the EUT except where the user documentation specially indicates a requirement for appropriate protective measures.

NOTE: Ensure that the EUT is fully discharged between each ESD exposure.

9.3.3 Performance criteria

Base station:

The performance criteria of subclause 6.2 shall apply.

Ancillary equipment:

The performance criteria of subclause 6.4 shall apply.

9.4 Fast transients common mode

The test shall be performed on AC mains power input ports.

This test shall be performed on *signal ports*, *telecommunication ports*, *control ports* and DC power input/output ports if the cables may be longer than 3 m.

Where this test is not carried out on a port or any other ports because the manufacturer declares that it is not intended to be used with cables longer than 3 m, a list of ports which were not tested for this reason shall be included in the test report.

This test shall be performed on a representative configuration of the equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

9.4.1 Definition

This test assesses the ability of radio equipment and *ancillary equipment* to operate as intended in the event of fast transients present on one of the input/output ports.

9.4.2 Test method and level

The test method shall be in accordance with IEC 61000-4-4 [19]:

- The test level for *signal ports*, *telecommunication ports* and *control ports* shall be 0.5 kV open circuit voltage as given in IEC 61000-4-4 [19];
- The test level for DC power input/output ports shall be 0.5 kV open circuit voltage as given in IEC 61000-4-4 [19];
- The test level for AC mains power input ports shall be 1 kV open circuit voltage as given in IEC 61000-4-4 [19].

For AC and DC power input ports the transients shall be applied (in parallel) to all the conductors in the cable with reference to the cabinet reference earth (true common mode) and the source impedance shall be 50 Ω.

9.4.3 Performance criteria

Base station:

The performance criteria of subclause 6.2 shall apply.

Ancillary equipment:

The performance criteria of subclause 6.4 shall apply.

9.5 RF common mode (0.15 MHz - 80 MHz)

The test shall be performed on AC mains power input/output ports.

This test shall be performed on *signal ports*, telecommunication *port*s, control and DC power input/output ports, which may have cables longer than 3 m.

Where this test is not carried out on a port or any other ports because the manufacturer declares that it is not intended to be used with cables longer than stated above, a list of ports which were not tested shall be included in the test report.

This test shall be performed on a representative configuration of the equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

NOTE: This test can also be performed using the intrusive method, where appropriate, see IEC 61000-4-6 [21].

9.5.1 Definition

This test assesses the ability of radio equipment and *ancillary equipment* to operate as intended in the presence of a radio frequency electromagnetic disturbance.

9.5.2 Test method and level

The test method shall be in accordance with IEC 61000-4-6 [21]:

- The test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 kHz;
- The stepped frequency increments shall be 50 kHz in the frequency range 150 kHz to 5 MHz and 1% frequency increment of the momentary frequency in the frequency range 5 MHz to 80 MHz;
- The test level shall be severity level 2 as given in IEC 61000-4-6 [21] corresponding to 3 V rms, at a transfer impedance of 150 Ω;
- The test shall be performed over the frequency range 150 kHz - 80 MHz;
- The injection method to be used shall be selected according to the basic standard IEC 61000-4-6 [21];
- Responses of stand-alone receivers or receivers which are part of transceivers occurring at discrete frequencies which are narrow band responses, shall be disregarded, see subclause 4.3;
- The frequencies of the immunity test signal selected and used during the test shall be recorded in the test report.

9.5.3 Performance criteria

Base station:

The performance criteria of subclause 6.1 shall apply.

Ancillary equipment:

The performance criteria of subclause 6.3 shall apply.

9.6 Voltage dips and interruptions

The tests shall be performed on AC mains power input ports.

These tests shall be performed on a representative configuration of the equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

9.6.1 Definition

These tests assess the ability of radio equipment and *ancillary equipment* to operate as intended in the event of voltage dips and interruptions present on the AC mains power input ports.

9.6.2 Test method and level

The following requirements shall apply.

The test method shall be in accordance with IEC 61000-4-11 [22].

The test levels shall be:

- Voltage dip: 0 % residual voltage for 0.5 cycle;
- Voltage dip: 0 % residual voltage for 1 cycle;
- Voltage dip: 70 % residual voltage for 25/30 cycles (at 50/60 Hz);
- Voltage interruption: 0 % residual voltage for 250/300 cycles (at 50/60 Hz).

9.6.3 Performance criteria

For a voltage dip the performance criteria for transient phenomena shall be applied:

- Criteria 6.2 for base station
- Criteria 6.4 for *ancillary equipment*

For a voltage interruption, the following applies:

1. In the case where the equipment is fitted with or connected to a battery back-up, the following performance criteria shall be applied:
   - Criteria 6.2 for base station
   - Criteria 6.4 for *ancillary equipment*
2. In the case where the equipment is powered solely from the AC mains supply (without the use of a parallel battery back-up) volatile user data may have been lost and if applicable the communication link need not to be maintained and lost functions should be recoverable by user or operator:
   - No unintentional responses shall occur at the end of the test
   - In the event of loss of communications link or in the event of loss of user data, this fact shall be recorded in the test report.

9.7 Surges, common and differential mode

The tests shall be performed on AC mains power input ports.

This test shall be additionally performed on *telecommunication port*s.

These tests shall be performed on a representative configuration of the equipment, the associated *ancillary equipment*, or representative configuration of the combination of radio and *ancillary equipment*.

9.7.1 Definition

These tests assess the ability of radio equipment and *ancillary equipment* to operate as intended in the event of surges being present at the AC mains power input ports and *telecommunication ports*.

9.7.2 Test method and level

The test method shall be in accordance with IEC 61000-4-5 [20].

The requirements and evaluation of test results given in subclause 9.7.2.1 (t*elecommunication port*s, outdoor cables), subclause 9.7.2.2 (*telecommunication port*s, indoor cables) and subclause 9.7.2.3 (AC power ports) shall apply, but no test shall be required where normal functioning cannot be achieved, because of the impact of the CDN on the EUT.

9.7.2.1 Test method for telecommunication ports directly connected to outdoor cables

The test level for t*elecommunications port*s, intended to be directly connected to the telecommunications network via outdoor cables, shall be 1 kV line to ground as given in IEC 61000-4-5 [20]. In this case the total output impedance of the surge generator shall be in accordance with the basic standard IEC 61000-4-5 [20].

The test generator shall provide the 1.2/50 μs pulse as defined in IEC 61000-4-5 [20].

9.7.2.2 Test method for telecommunication ports connected to indoor cables

The test level for telecommunication *port*s, intended to be connected to indoor cables (longer than 10 m) shall be 0.5 kV line to ground. In this case the total output impedance of the surge generator shall be in accordance with the basic standard IEC 61000-4-5 [20].

The test generator shall provide the 1.2/50 μs pulse as defined in IEC 61000-4-5 [20].

9.7.2.3 Test method for AC power ports

The test level for AC power input *port*s shall be 2 kV line to ground, and 1 kV line to line, with the output impedance of the surge generator as given in IEC 61000-4-5 [20].

In telecommunication centres 1 kV line to ground and 0.5 kV line to line shall be used.

The test generator shall provide the 1.2/50 μs pulse as defined in IEC 61000-4-5 [20].

9.7.3 Performance criteria

Base station:

The performance criteria of subclause 6.2 shall apply.

Ancillary equipment:

The performance criteria of subclause 6.4 shall apply.

Annex A (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2017-08	RAN4#84	R4-1708861				Specification Skeleton	0.0.1
2017-10	RAN4#84 bis	R4-1711984				Capture TPs approved in RAN4#84bis: R4-1711815, "Draft TS 38.113 v0.0.1" R4-1711828, "TP to TS 38.113: antenna ports for EMC" R4-1711829, "TP to TS 38.113 Section 2 (References)" R4-1711830, "TP to TS 38.113 Section 3 (Definitions, symbols and abbreviations)" R4-1711831, "TP to TS 38.113 Section 7 (Applicability Overview)" R4-1711832, "TP to TS 38.113 Section 8 (Emmision)" R4-1711833, "TP to TS 38.113 Section 9 (Immunity)"	0.0.2
2017-12	RAN4#85	R4-1714545				Capture TPs approved in RAN4#85: R4-1714297,"TP to TS 38.113 ESD test level" R4-1714299,"TP to TS 38.113 section 2 ,3 and 7" R4-1714429,"TP to Section 4.4 in TS 38.113 (NR) Receiver exclusion bands (radiated immunity)" R4-1714301,"TP to Section 8.2 (Radiated Emission Limits) of TS 38.113" R4-1712749,"TP for TS 38.113 introduction of band n71"	0.1.0
2017-12	RAN#78	RP-172420				v1.0.0 submitted for plenary approval	1.0.0
2017-12	RAN#78					Approved by plenary – Rel-15 spec under change control	15.0.0
2018-03	RAN#79	RP-180264	0002		F	CR to TS 38.113 Cat.F draftCRs R4-1801258 Draft CR to TS 38.113 Symbol(clause 3.2) R4-1803309 [NR] DraftCR 38113 Rx exclusion (4.4.2) R4-1803313 DraftCR to TS 38.113 subclause 5.1 and 5.4 R4-1803314 DraftCR to TS 38.113 subclause 8.2.1.2 radiated emission test method_v2 R4-1803315 DraftCR to TS 38.113 subclause 9.1.1_v3	15.1.0
2018-03	RAN#79	RP-180264	0003		B	CR to TS 38.113 Cat.B draftCRs R4-1802055 - Draft CR to Section 6.3 in TS 38.113 (NR) Performance criteria for continuous phenomena for Ancillary equipment R4-1802056 - Draft CR to Section 6.4 in TS 38.113 (NR) Performance criteria for transient phenomena for Ancillary equipment R4-1802057 - Draft CR to Section 8.4 in TS 38.113 (NR) Test method for conducted emissions AC mains power input output port R4-1803318 [NR] DraftCR 38113 Test conditions (4)	15.1.0
2018-06	RAN#80	RP-181076	0004		F	CR to TS 38.113 Implementation of endorsed draft CRs from RAN4 #86bis and RAN4 #87	15.2.0
2018-09	RAN#81	RP-181896	0005		F	CR to TS 38.113: Implementation of endorsed draft CRs from RAN4#88	15.3.0
2018-12	RAN#82	RP-182361	0008	1	F	CR to TS 38.113	15.4.0
2019-03	RAN#83	RP-190403	0009		F	CR to TS 38.113 Implementation of endorsed draftCRs in RAN4#90: R4-1900565 - Draft CR to TS 38.113subclause 9.2.2, ZTE R4-1900566 - Draft CR to TS 38.113subclause 9.7.2.1, ZTE R4-1902330 - Draft CR to TS 38.113 Symbol (subclause 3 and 8.2.1), ZTE R4-1902332 - Draft CR to TS 38.113subclause 7.1 and 8.3.2, ZTE R4-1902334 - Draft CR to TS 38.113 Exclusion Bands for Radiated Immunity Test, Ericsson R4-1902340 - Draft CR to TS 38.113 on FR1 and FR2 definitions, Ericsson R4-1902331 - draft CR to 38.113 - NR BS EMC_v1, Nokia	15.5.0