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**Digital cellular telecommunications system (Phase 2+) (GSM);
Universal Mobile Telecommunications System (UMTS);
LTE;
E-UTRA, UTRA and GSM/EDGE;
Multi-Standard Radio (MSR) Base Station (BS)
Electromagnetic Compatibility (EMC)
(3GPP TS 37.113 version 13.4.0 Release 13)**

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Contents

Foreword

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1 Scope

The present document covers the assessment of E-UTRA, UTRA, GSM/EDGE and NB-IoT Multi-Standard Radio (MSR) Base Stations and associated ancillary equipment in respect of Electromagnetic Compatibility (EMC).

The present document specifies the applicable test conditions, performance assessment and performance criteria for E-UTRA, UTRA, GSM/EDGE and NB-IoT Base Stations and associated ancillary equipment in one of the following categories:

- Multi-Standard Radio (MSR) Base Stations for E-UTRA, UTRA and GSM/EDGE meeting the requirements of TS 37.104 [6], with conformance demonstrated by compliance to TS 37.141 [11].
- Base Stations for E-UTRA meeting the requirements of TS 36.104 [4], with conformance demonstrated by compliance to TS 36.141 [9].
- Base Stations for UTRA FDD meeting the requirements of TS 25.104 [2], with conformance demonstrated by compliance to TS 25.141 [7].
- Base Stations for UTRA TDD meeting the requirements of TS 25.105 [3], with conformance demonstrated by compliance to TS 25.142 [8].
- Base Stations for GSM/EDGE meeting the requirements of TS 45.005 [5], with conformance demonstrated by compliance to TS 51.021 [10].
- Base Stations for NB-IoT meeting the requirements of TS 36.104 [4], with conformance demonstrated by compliance to TS 36.141 [9].

In addition to MSR base stations, the present document covers other BS supporting more than one RAT.

Technical requirements related to the antenna port of Base Stations are not included in the present document. These are found in the relevant product standards [2-11].

The environment classification used in the present document refers to the residential, commercial, and light industrial environment classification used in IEC 61000-6-1 [12] and IEC 61000-6-3 [13].

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 25.104: "Base Station (BS) radio transmission and reception (FDD)".

[3] 3GPP TS 25.105: "Base Station (BS) radio transmission and reception (TDD)".

[4] 3GPP TS 36.104: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception ".

[5] 3GPP TS 45.005: "Radio transmission and reception".

[6] 3GPP TS 37.104: "E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) radio transmission and reception".

[7] 3GPP TS 25.141: "Base Station (BS) conformance testing (FDD)".

[8] 3GPP TS 25.142: "Base Station (BS) conformance testing (TDD)".

[9] 3GPP TS 36.141: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing".

[10] 3GPP TS 51.021: "Base Station System (BSS) equipment specification; Radio aspects".

[11] 3GPP TS 37.141: "E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) conformance testing"

[12] IEC 61000-6-1: 2005: "Electromagnetic compatibility (EMC) - Part 6: Generic standards – Section 1: Immunity for residential, commercial and light-industrial environments".

[13] IEC 61000-6-3: 2006/AMD1:2010: "Electromagnetic compatibility (EMC) - Part 6: Generic standards – Section 3: Emission standard for residential, commercial and light industrial environments".

[14] IEC 60050-161: "International Electrotechnical Vocabulary - Chapter 161: Electromagnetic compatibility".

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

[16] ITU-R Recommendation SM.1539 (2001): "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".

[17] CISPR 22: "Limits and methods of measurement of radio disturbance characteristics of information technology equipment".

[18] CISPR 16-1-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Measuring apparatus".

[19] IEC 61000-3-2 (2004): "Electromagnetic compatibility (EMC) - Part 3: Limits - Section 2: Limits for harmonic current emissions (equipment input current ≤ 16 A)".

[20] IEC 61000-3-12 (2005): "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".

[21] IEC 61000-3-3 (2002): "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".

[22] IEC 61000-3-11 (2000): "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".

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

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

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

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

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

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

[29] 3GPP TS 25.101: "User Equipment (UE) radio transmission and reception (FDD) ".

[30] 3GPP TS 25.102: "User Equipment (UE) radio transmission and reception (TDD)".

[31] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

[32] 3GPP TS 45.008: "Radio subsystem link control".

[33] 3GPP TS 51.010-1: " Mobile Station (MS) conformance specification; Part 1: Conformance specification".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [x] 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: Equipment (apparatus), used in connection with a receiver, transmitter or transceiver is considered as an ancillary equipment (apparatus) if:

- the equipment is intended for use in conjunction with a receiver, transmitter or transceiver 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, transmitter or transceiver; and
- the receiver, transmitter or transceiver 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).

Base Station equipment: Radio and/or ancillary equipment intended for operation at a fixed location and powered directly or indirectly (e.g. via an AC/DC converter or power supply) by AC mains network, or an extended local DC mains network.

Base Station RF bandwidth: The bandwidth in which a Base Station transmits and/or receives multiple carriers and/or RATs simultaneously

Base Station RF bandwidth edge: The frequency of one of the edges of the Base Station RF bandwidth

Channel bandwidth: The RF bandwidth supporting a single E-UTRA 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 (continuous disturbance): Electromagnetic disturbance, the effects of which on a particular device or equipment cannot be resolved into a succession of distinct effects (IEC 60050-161 [14]).

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

Maximum Base Station RF bandwidth: The maximum RF bandwidth supported by a BS within an operating band.

Maximum throughput: The maximum achievable throughput for a reference measurement channel.

MB-MSR Base Station: MSR Base Station characterized by the ability of its transmitter and/or receiver to process two or more carriers in common active RF components simultaneously, where at least one carrier is configured at a different non-overlapping operating band than the other carrier(s).

MSR Base station: Base Station characterized by the ability of its receiver and transmitter to process two or more carriers in common active RF components simultaneously in a declared RF bandwidth, where at least one carrier is of a different RAT than the other carrier(s).

NOTE: A Base Station where receiver or transmitter processes carriers of different RATs simultaneously, but not through common active RF components, is not an MSR BS according to the above definition. Such a BS is in the present specification referred to as "other BS supporting more than one RAT".

NB-IoT In-band operation: NB-IoT is operating in-band when it utilizes the resource block(s) within a normal E-UTRA carrier

NB-IoT guard band operation: NB-IoT is operating in guard band when it utilizes the unused resource block(s) within a E-UTRA carrier's guard-band.

NB-IoT standalone operation: NB-IoT is operating standalone when it utilizes its own spectrum, for example the spectrum currently being used by GERAN systems as a replacement of one or more GSM carriers, as well as scattered spectrum for potential IoT deployment.

Radio communications equipment : Telecommunications equipment which includes one or more transmitters and/or receivers and/or parts thereof for use in a fixed, mobile or portable application. It can be operated with ancillary equipment but if so, is not dependent on it for basic functionality.

Radio equipment: Equipment which contains Radio digital unit and Radio unit.

Radio digital unit: Equipment which contains base band and functionality for controlling Radio unit.

Radio unit: Equipment which contains transmitter and/or receiver.

Port: A particular interface, of the specified equipment (apparatus), with the electromagnetic environment. For example, any connection point on an equipment intended for connection of cables to or from that equipment is considered as a port (see Figure 3.1.1).

Receiver exclusion band: The receiver exclusion band is the band of frequencies over which no tests of radiated immunity of a receiver are made. The exclusion band for receivers is expressed relative to the base station receive band.

Signal and control: Port which carries information or control signals, excluding antenna ports.

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.

Throughput: The number of payload bits successfully received per second for a reference measurement channel in a specified reference condition.

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 [14]).

Transmitter exclusion band: The transmitter exclusion band is the band of frequencies over which no tests of radiated immunity of a transmitter are made. The exclusion band for transmitters 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

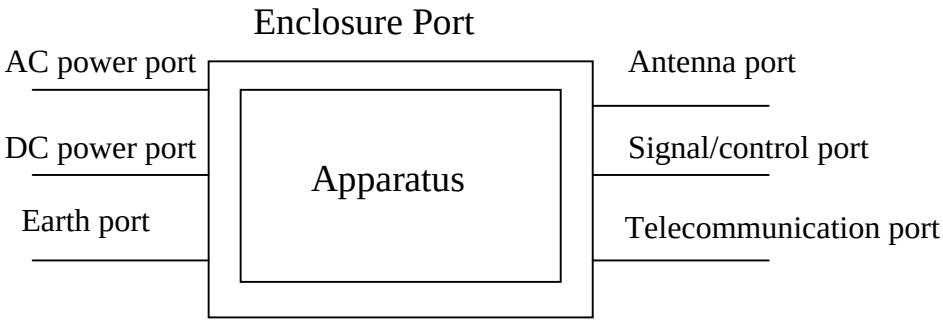

Figure 3.1-1: Examples of ports

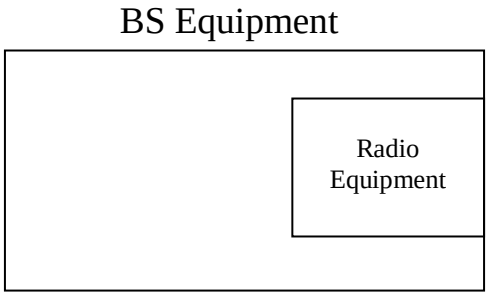

Figure 3.1-2: BS with single enclosure solution

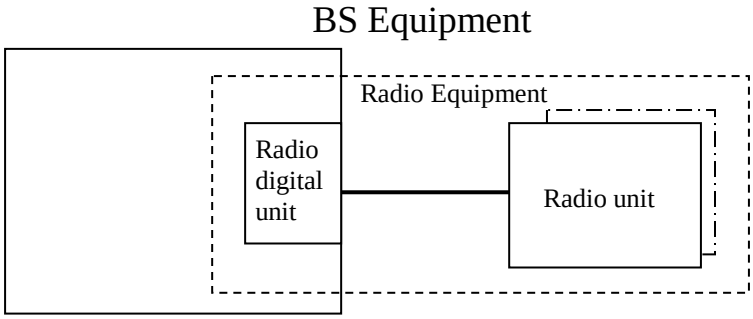

Figure 3.1-3: BS with multiple enclosure solution

3.2 Symbols

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

$BW_{Channel}$	Channel bandwidth
f_{offset}	Frequency offset used for discovering narrowband response for receivers

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
BER	Bit Error Ratio
BLER	Block Error Ratio

CDN	Coupling/Decoupling Network
CS	Capability Set
DC	Direct Current
E-UTRA	Evolved Universal Terrestrial Radio Access
EMC	Electromagnetic Compatibility
EPC	Evolved Packet Core
ESD	Electrostatic discharge
EUT	Equipment Under Test
$F_{BW\ RF,high}$	Upper RF bandwidth edge, where $F_{BW\ RF,high} = F_{C,high} + F_{offset,\ RAT}$
$F_{BW\ RF,low}$	Lower RF bandwidth edge, where $F_{BW\ RF,low} = F_{C,low} - F_{offset,\ RAT}$
$F_{C,high}$	Center frequency of the highest transmitted/received carrier.
$F_{C,low}$	Center frequency of the lowest transmitted/received carrier.
$F_{offset,\ RAT}$	Frequency offset from $F_{C,high}$ to the *upper RF bandwidth edge* or $F_{C,low}$ to the *lower RF bandwidth edge* for a specific *RAT*.
FRC	Fixed Reference Channel
MB-MSR	Multi-Band Multi-Standard Radio
MSR	Multi-Standard Radio
NB-IoT	Narrowband – Internet of Things
NTC	Test Configuration for Non-contiguous operation
RAT	Radio Access Technology
RF	Radio frequency
rms	root mean square
TC	Test Configuration
UTRA	Universal Terrestrial Radio Access

4 Test conditions

4.1 General

The equipment shall be tested in normal test environment defined in base station conformance testing specification TS 37.141 [11]. The test conditions shall be recorded in the test report.

For an EUT which contains more than one BS, it is sufficient to perform tests relating to each type of port of each representative type of the BS forming part of the EUT. For an MSR BS or other BS supporting more than one RAT, tests shall be performed with RATs activated according to the test configuration in subclause 4.5. Tests shall be performed relating to each type of port, and need not be repeated for each RAT if operating RATs are assessed simultaneously during the test. For other BS supporting more than one RAT however (other than MSR BS), tests relating to the antenna port(s) shall always be performed for each supported RAT.

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

The manufacturer shall declare the supported operating band(s) according to subclause 4.4 of TS 37.141 [11]. Requirements apply only for the declared operating band and corresponding Band Category.

The manufacturer shall declare the supported capability set(s) according to subclause 4.7 of TS 37.141 [11]. Tests performed on a Base Station according to a declared Capability Set cover all single RAT and multi-RAT configurations included in the declared Capability Set.

4.2 Arrangements for establishing a communication link

The wanted RF signal nominal frequency shall be selected by setting the channel number according to the following:

- The Absolute Radio Frequency Channel Number (EARFCN) for E-UTRA carrier
- The Absolute Radio Frequency Channel Number (UARFCN) for UTRA carrier

- The Absolute Radio Frequency Channel Number (ARFCN) for GSM/EDGE carrier
- The Absolute Radio Frequency Channel Number (EARFCN) and the Offset of NB-IoT Channel Number to EARFCN for NB-IoT carrier.

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 S1/Iub/Abis 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:

- The EUT shall be commanded to operate at maximum rated transmit power;
- Adequate measures shall be taken to avoid the effect of the unwanted signal on the measuring equipment;
- The wanted RF input signal level shall be set to a level where the performance is not limited by the receiver noise floor or strong signal effects.
  - For E-UTRA, the wanted signal can be set e.g. 15 dB above the reference sensitivity level as defined in TS 36.141 [9] to provide a stable communication link.
  - For UTRA FDD and TDD, the wanted signal can be set e.g. 15 dB above the reference sensitivity level as defined in TS 25.141 [7] or TS 25.142 [8] respectively, to provide a stable communication link.
  - For GSM/EDGE the wanted receiver input signal level shall be set to a nominal value of -47 dBm.
  - For NB-IoT, the wanted signal can be set e.g. 15 dB above the reference sensitivity level as defined in TS 36.141 [9] to provide a stable communication link.

For immunity tests subclause 4.3 shall additionally apply.

4.2.1 Multiple enclosure BS solution

For a BS with multiple enclosures, the BS part with Radio digital unit and the Radio unit may be tested separately. Communication link shall be set up in the same way as if they are in single BS enclosure. The Radio Digital unit and the Radio unit shall communicate over an interface enabling establishment of a communication link.

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 first increased, and then decreased by an offset f_{offset}, where
  - For E-UTRA, $f_{offset} = 2 \times BW_{Channel}$, where $BW_{Channel}$ is the channel bandwidth as defined in TS 36.104 [9];
  - For UTRA, $f_{offset} = 10$ MHz
  - For GSM/EDGE, $f_{offset} = 400$ kHz
  - For NB-IoT, foffset = 400 kHz
- if the deviation disappears in either or both of the above 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 $1.25 \times f_{offset}$;
- 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.

Narrow band responses are disregarded.

For an MSR BS or other BS supporting more than one RAT, the method above shall be applied for each RAT supported. For BS capable of multi-band operation, all supported operating bands shall be considered for narrowband responses.

4.4 Exclusion bands

An exclusion band is a band of frequencies over which no tests of radiated immunity are made.

4.4.1 Transmitter exclusion band

For testing of radiated immunity there shall be no transmitter exclusion band.

4.4.2 Receiver exclusion band

The receiver exclusion band for base stations extends from the lower frequency of the Base Station receive band minus 20 MHz to the upper frequency of the Base Station receive band plus 20 MHz. The exclusion bands for the MSR, E-UTRA, UTRA and GSM/EDGE paired and unpaired operating bands are as set out in Tables 4.4-2 and 4.4-3 respectively.

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

Table 4.4-2: Receiver exclusion band for base stations (paired bands).

MSR and E-UTRA Band number	UTRA Band number	GSM/EDGE Band designation	Receiver exclusion band
1	I	-	1900 MHz – 2000 MHz
2	II	PCS 1900	1830 MHz – 1930 MHz
3	III	DCS 1800	1690 MHz – 1805 MHz
4	IV	-	1690 MHz – 1775 MHz
5	V	GSM 850	804 MHz – 869 MHz
6(1)	VI	-	810 MHz – 860 MHz
7	VII	-	2480 MHz – 2590 MHz
8	VIII	E-GSM	860 MHz – 935 MHz
9	IX	-	1729.9 MHz – 1804.9 MHz
10	X	-	1690 MHz – 1790 MHz
11	XI	-	1407.9 MHz – 1467.9 MHz
12	XII	-	679 MHz – 736 MHz
13	XIII	-	757 MHz – 807 MHz
14	XIV	-	768 MHz – 818 MHz
15	XV	-	Reserved
16	XVI	-	Reserved
17	-	-	684 MHz – 736 MHz
18	-	-	795 MHz – 850 MHz
19	XIX	-	810 MHz – 865 MHz
20	XX	-	812 MHz – 882 MHz
21	XXI	-	1427.9 MHz – 1482.9 MHz
22	XXII	-	3390 MHz – 3510 MHz
23	-	-	1980 MHz – 2040 MHz
24	-	-	1606.5 MHz – 1680.5 MHz
25	XXV	-	1830 MHz – 1935 MHz
26	XXVI	-	794 MHz – 869 MHz
27	-	-	787 MHz – 844 MHz
28	-	-	683 MHz – 768 MHz
29	-	-	N/A
30	-		2285 MHz – 2335 MHz
31	-	-	432.5 MHz – 477.5 MHz
32	XXXII	-	N/A
65	-	-	1900 MHz – 2030 MHz
66	-	-	1690 MHz – 1800 MHz
67	-	-	N/A
68	-	-	678 MHz – 748 MHz

NOTE 1: The band is for UTRA only.

Table 4.4-3: Receiver exclusion band for base stations (unpaired bands)

MSR and E-UTRA Band number	UTRA Band number	Receiver exclusion band
33	a)	1880 MHz – 1940 MHz
34	a)	1990 MHz – 2045 MHz
35	b)	1830 MHz – 1930 MHz
36	b)	1910 MHz – 2010 MHz
37	c)	1890 MHz – 1950 MHz
38	d)	2550 MHz – 2640 MHz
39	f)	1860 MHz – 1940 MHz
40	e)	2280 MHz – 2420 MHz
41	-	2476 MHz – 2710 MHz
42	-	3380 MHz – 3620 MHz
43	-	3580 MHz – 3820 MHz
44	-	683 MHz – 823 MHz
45	-	1427 MHz – 1487 MHz

4.5 BS test configurations

The present clause defines the BS test configurations that shall be used for demonstrating conformance. This is specified in Table 4.5-1, 4.5-1a and 4.5-1b for multi-RAT capable MSR Base Stations, in Table 4.5-2 for single-RAT capable BS and in Table 4.5-3 for multi-band capable BS. For other BS supporting more than one RAT (other than MSR BS), Table 4.5-2 applies separately for each RAT supported.

The Test configurations apply according to the declared RAT Capability Set (CS) of the MSR Base Station according to subclause 4.7 of TS 37.141 [11] and the Band Category of the declared operating band (BC1, BC2 or BC3), as listed in the heading of each table.

The test configurations (TCx) are defined in TS 37.141 [11], subclause 4.8.

For a BS declared to be capable of contiguous operation only, the test configuration(s) in Tables 4.5-1 and 4.5-2 denoted by a “C” shall be used for testing.

For a BS declared to be capable of contiguous and non-contiguous operation and where the parameters in the manufacture’s declaration according to subclause 4.7.2 of TS 37.141 [11] are identical for contiguous and non-contiguous operation, the test configurations denoted by “CNC” shall be used.

For a BS declared to be capable of contiguous and non-contiguous operation and where the parameters in the manufacture’s declaration according to subclause 4.7.2 of TS 37.141 [11] are not identical for contiguous and non-contiguous operation, the test configurations denoted by “C/NC” shall be used for testing.

For a BS declared to support NB-IoT operating in-band, the test configuration(s) in Table 4.5-1 and 4.5-2 denoted by “NI” shall be used for testing.

For a BS declared to support NB-IoT operating in guard band, the test configuration(s) in Table 4.5-1 and 4.5-2 denoted by “NG” shall be used for testing.

For a BS declared to support NB-IoT operating in guard band and in-band, the test configuration(s) in Table 4.5-1 and 4.5-2 denoted by “NG” or/and “NI” shall be used for testing.

For a BS declared to support NB-IoT standalone, the test configuration(s) in Table 4.5-1a, 4.5-1b and 4.5-2 and entries that refer to single-RAT specifications shall be used for testing.

For immunity tests

- The communication link for the RAT(s) listed in the table shall be established according to subclause 4.2
- Tests for ports relating to the RAT(s) supported shall be performed according to clause 4.1.

Table 4.5-1: Test configurations for single-band Multi-RAT capable MSR BS CS(3-6)

Capability Set	**UTRA + E-UTRA, NB-IoT in-band** Note 2, NB-IoT guard band Note 3 **(CS 3)**			**GSM+ UTRA (CS 4)**	**GSM + E-UTRA, NB-IoT in-band** Note 2, NB-IoT guard band Note 3 **(CS 5)**	**GSM + UTRA + E-UTRA, (CS 6)**
BS test case	**BC1**	**BC2**	**BC3**	**BC2**	**BC2**	**BC2**
Emission tests	C: TC3a CNC: NTC3a C/NC: TC3a and NTC3a NI: TC16 NG: TC19	C: TC3a CNC: NTC3a C/NC: TC3a and NTC3a NI: TC16 NG: TC19	C: TC3b	C: TC4a CNC: NTC4a C/NC: TC4a and NTC4a	C: TC4b CNC: NTC4b C/NC: TC4b and NTC4b NI: TC16 NG: TC19	C: TC4c CNC: NTC4c C/NC: TC4c and NTC4c NI: TC16 NG: TC19
Immunity tests (Note 1)	TC3a NI: TC16 NG: TC19	TC3a NI: TC16 NG: TC19	TC3b	TC4a	TC4b NI: TC16 NG: TC19	TC4c NI: TC16 NG: TC19

NOTE 1: The test configuration identified for immunity tests are intended for transmitter tests in TS 37.141 [11], but are here applied both for BS transmitter and receiver.
NOTE 2: The support of NB-IoT in-band operation is optional and declared by the manufacturer. If not supported, the test configurations denoted by "NI" shall not be used for testing.
NOTE 3: The support of NB-IoT guard band operation is optional and declared by the manufacturer. If not supported, the test configurations denoted by "NG" shall not be used for testing.

Table 4.5-1a: Test configurations for single-band Multi-RAT capable MSR BS (CS9-13)

Capability Set	**GSM+NB-IoT standalone (CS 9)**	**UTRA + NB-IoT standalone (CS 10)**		**E-UTRA + NB-IoT standalone (CS 11)**		**GSM+UTRA+ NB-IoT standalone (CS 12)**	**GSM+ E-UTRA+NB-IoT standalone (CS 13)**
BS test case	**BC2**	**BC1**	**BC2**	**BC1**	**BC2**	**BC2**	**BC2**
Emission tests	TC9	TC10	TC10	TC11	TC11	TC12	TC13
Immunity tests (Note 1)	TC9	TC10	TC10	TC11	TC11	TC12	TC13

NOTE 1: The test configuration identified for immunity tests are intended for transmitter tests in TS 37.141 [11], but are here applied both for BS transmitter and receiver.

Table 4.5-1b: Test configurations for single-band Multi-RAT capable MSR BS (CS14-15)

Capability Set	**UTRA + E-UTRA + NB-IoT standalone (CS 14)**		**GSM + UTRA + E-UTRA + NB-IoT standalone (CS 15)**
BS test case	**BC1**	**BC2**	**BC2**
Emission tests	TC14	TC14	TC13
Immunity tests (Note 1)	TC14	TC14	TC13

NOTE 1: The test configuration identified for immunity tests are intended for transmitter tests in TS 37.141 [11], but are here applied both for BS transmitter and receiver.

Table 4.5-2: Test configurations for single-band Single-RAT multi-carrier capable BS

Capability Set	UTRA (MC) capable BS (CS1)			E-UTRA (MC) capable BS (CS2) NB-IoT in-band Note 2, NB-IoT guard band Note 3			NB-IoT (MC) capable BS (CS8)	
BS test case	**BC1**	**BC2**	**BC3**	**BC1**	**BC2**	**BC3**	**BC1**	**BC2**
Emission tests	C: TC1a CNC: NTC1a C/NC: TC1a and NTC1a	C: TC1a CNC: NTC1a C/NC: TC1a and NTC1a	C: TC1b	C: TC2 CNC: NTC2 C/NC: TC2 and NTC2	C: TC2 CNC: NTC2 C/NC: TC2 and NTC2	C: TC2 CNC: NTC2 C/NC: TC2 and NTC2	TC8	TC8
Immunity tests (Note 1)	TC1a	TC1a	TC1b	TC2	TC2	TC2	TC8	TC8
NOTE 1: The test configuration identified for immunity tests are intended for transmitter tests in TS 37.141 [11], but are here applied both for BS transmitter and receiver. NOTE 2: The support of NB-IoT in-band operation is optional and declared by the manufacturer. If not supported, the test configurations denoted by "NI" shall not be used for testing. NOTE 3: The support of NB-IoT guard band operation is optional and declared by the manufacturer. If not supported, the test configurations denoted by "NG" shall not be used for testing.								

Table 4.5-3: Test configurations for multi-band capable BS (CS1-6)

Capability Set	Multi-band testing	
BS test case	**BC1/BC2**	**BC3**
Emission tests	TC7b	TC7b
Immunity tests (Note 1)	TC7a	TC7a
NOTE 1: The test configuration identified for immunity tests are intended for transmitter tests in TS 37.141 [11], but are here applied both for BS transmitter and receiver.		

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 RAT-specific active RF components and other HW blocks for a communication link in MSR BS or other BS supporting more than one RAT
- 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, 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 RAT or more than one operating band, shall be assessed on all RATs and operating bands. Communication link(s) and/or radio performance parameters for the RATs and operating bands can during the test be assessed simultaneously or separately for each RAT and band, depending on the test environment capability.

5.2 Assessment of performance in Downlink

In the immunity tests, the output of the transmitter shall be connected to equipment which meets the requirements for the performance assessment of RAT and bearer used in the immunity tests according to the following:

- Throughput assessment in TS 36.101 [31] in case of E-UTRA
- BLER assessment in TS25.101 [29] in case of UTRA FDD
- BLER assessment in TS25.102 [30] in case of UTRA TDD
- BER assessment in Annex A.1 in case of GSM/EDGE
- Throughput assessment in TS 36.101 [31] in case of NB-IoT

Power control shall be off during the immunity testing.

5.3 Assessment of performance in Uplink

In the immunity tests, the performance in the uplink shall be monitored at a telecommunications port(s) by using suitable test equipment according to the following:

- The value of the throughput shall be monitored in case of E-UTRA
- The value of the BLER shall be monitored in case of UTRA FDD and UTRA TDD
- The value of the BER shall be monitored in case of GSM/EDGE (see Annex A.2)
- The value of the throughput shall be monitored in case of NB-IoT

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

The test should, where possible, be performed using a bearer with the characteristics of data rate and performance criteria defined for E-UTRA, UTRA, GSM/EDGE and NB.IoT below. If the test is not performed using one of these bearers (for example, if none of them are supported by the BS) the characteristics of the bearer used shall be recorded in the test report.

6.1 Performance criteria for continuous phenomena for BS

6.1.1 E-UTRA performance criteria

The throughput in Table 6.1.1-1 is stated relative to the maximum throughput of the FRC. The maximum throughput for an FRC is equal to the payload size * the number of uplink subframes per second.

The BS Uplink and Downlink paths shall each meet the performance criteria defined in Table 6.1.1-1 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 6.1.1-1. 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 6.1.1-1: E-UTRA BS Performance criteria for continuous phenomena for BS

E-UTRA Channel Bandwidth [MHz]	Bearer Information Data Rate	Performance Criteria [1,2]
1.4	FRC A1-1 in Annex A.1 in TS 36.104 [2]	Throughput > 95 % No loss of service
3	FRC A1-2 in Annex A.1 in TS 36.104 [2]	Throughput > 95 % No loss of service
3	FRC A1-6 in Annex A.1 in TS 36.104 [2] for E-UTRA with NB-IoT in-band operation	Throughput > 95 % No loss of service
5	FRC A1-3 in Annex A.1 in TS 36.104 [2]	Throughput > 95 % No loss of service
5	FRC A1-7 in Annex A.1 in TS 36.104 [2] for E-UTRA with NB-IoT in-band operation	Throughput > 95 % No loss of service
10	FRC A1-3 in Annex A.1 in TS 36.104 [2] [3]	Throughput > 95 % No loss of service
15	FRC A1-3 in Annex A.1 in TS 36.104 [2] [3]	Throughput > 95 % No loss of service
20	FRC A1-3 in Annex A.1 in TS 36.104 [2] [3]	Throughput > 95 % No loss of service

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.

NOTE 3: This is the information data rate of a single instance of the bearer mapped to 25 resource blocks. The performance criteria shall be met for each consecutive application of a single instance of the bearer mapped to disjoint frequency ranges with a width of 25 resource blocks each.

6.1.2 UTRA performance criteria

The BS Uplink and Downlink paths shall each meet the performance criteria defined in Table 6.1.2-1 during the test. If the Uplink and Downlink paths are evaluated as a one loop then the criteria is two times the value shown in Table 6.1.2-1.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 6.1.2-1: UTRA BS Performance criteria for continuous phenomena for BS

Bearer Information Data Rate	Performance Criteria
12.2 kbps	BLER < 10^{-2} No loss of service
64 kbps	BLER < 10^{-2} No loss of service
144 kbps	BLER < 10^{-2} No loss of service
384 kbps	BLER < 10^{-2} No loss of service

NOTE: The performance criteria, "BLER < 10^{-2} / No loss of service", applies also if a bearer with another characteristics is used in the test.

6.1.3 GSM/EDGE performance criteria

6.1.3.1 GSM/EDGE downlink

The BER of the downlink shall be assessed during the test according to one of the test methods of Annex A.1.

If the test method of Annex A.1.1 is used, the measured BER of the class 2 bits of TCH/FS shall not exceed 1,6 % during the test.

NOTE: This BER is the upper limit in TS 45.008 [32] for RXQUAL = 3.

If the test method of Annex A.1.2 is used, the value of RXQUAL shall not exceed 3 during the test.

At the conclusion of the test the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained.

6.1.3.1 GSM/EDGE uplnik

The BER of the uplink shall be assessed during the test according to one of the test methods of Annex A.2.

If the test method of Annex A.2.1 is used, the value of RXQUAL shall not exceed 3 during the test.

If the test method of Annex A.2.2 is used, the measured BER of the class 2 bits of TCH/FS shall not exceed 1,6 % during the test.

NOTE: This BER is the upper limit in TS 45.008 [32] for RXQUAL = 3.

For a base station, the RXQUAL of the uplink shall not exceed three (3) measured during the test sequence.

At the conclusion of the test the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained.

6.1.4 NB-IoT performance criteria

The throughput in Table 6.1.4-1 is stated relative to the maximum throughput of the FRC. The Maximum throughput for an FRC equals the Payload size / (Number of Resource Unit * time to send one Resource Unit).

The BS Uplink and Downlink paths shall each meet the performance criteria defined in Table 6.1.4-1 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 6.1.4-1. 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 6.1.4-1: NB-IoT BS Performance criteria for continuous phenomena for BS

NB-IoT Sub-carrier spacing [kHz]	Reference measurement channel	Performance Criteria [1,2]
15	FRC A14-1 in Annex A.14 in TS 36.104 [2]	Throughput > 95 % No loss of service
3.75	FRC A14-2 in Annex A.14 in TS 36.104 [2]	Throughput > 95 % No loss of service

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

At the conclusion of each exposure the EUT shall operate with no user noticeable loss of the communication link.

At the conclusion of the total test comprising the series of individual exposures the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the communication link shall have been maintained.

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 applicability

Phenomenon	Application	Equipment test requirement		Reference subclause in the present document	Reference Standard
		BS equipment	Ancillary equipment		
Radiated emission (NOTE 1)	Enclosure	applicable		8.2.1	ITU-R SM.329 [15]
Radiated emission	Enclosure		applicable	8.2.2	CISPR 22 [17]
Conducted emission	DC power input/output port	applicable	applicable	8.3	CISPR 22 [17], CISPR 16-1-1 [18]
Conducted emission	AC mains input/output port	applicable	applicable	8.4	CISPR 22 [17]
Harmonic current emissions	AC mains input port	applicable	applicable	8.5	IEC 61000-3-2 [19] or IEC 61000-3-12 [20]
Voltage fluctuations and flicker	AC mains input port	applicable	applicable	8.6	IEC 61000-3-3 [21]] or IEC 61000-3-11 [22]
Conducted emission	Telecommunica-tion port	applicable	applicable	8.7	CISPR 22 [17]

NOTE 1: The radiated emissions requirement for the BS equipment covers radiated emissions in the spurious domain. For GSM/EDGE, it corresponds to the “Radiated spurious emissions” requirement in TS 51.021 [10] for radio aspects.

7.2 Immunity

Table 7.2-1: Immunity applicability

Phenomenon	Application	Equipment test requirement		Reference subclause in the present document	Reference Standard
		BS equipment	Ancillary equipment		
RF electromagnetic field (80 - 2700 MHz)	Enclosure	applicable	applicable	9.2	IEC 61000-4-3 [23]
Electrostatic discharge	Enclosure	applicable	applicable	9.3	IEC 61000-4-2 [24]
Fast transients common mode	Signal, telecommunications and control ports, DC and AC power input ports	applicable	applicable	9.4	IEC 61000-4-4 [25]
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 [26]
Voltage dips and interruptions	AC mains power input ports	applicable	applicable	9.6	IEC 61000-4-11 [27]
Surges, common and differential mode	AC power input ports and telecommunications port	applicable	applicable	9.7	IEC 61000-4-5 [28]

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, Radio Frequency (RF) input/output 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;

- 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.

8.2 Radiated emission from Base Station and ancillary equipment

8.2.1 Radiated emission for Base Stations

This test is applicable to Base stations, except for BS that are only single-RAT GSM/EDGE capable. This test shall be performed on a representative configuration of the Base station.

For Base Stations that are only single-RAT GSM/EDGE capable, the test method and limits in clause 8 of TS 51.021 [10] apply.

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 [15] 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 [15].

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 30 MHz to 12.75 GHz, excluding 10 MHz below the lower RF bandwidth edge to 10 MHz above the upper RF bandwidth edge The measurement bandwidth shall be 100 kHz between 30 MHz and 1 GHz and 1 MHz above 1 GHz as given in ITU-R SM.329 [15]. 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 [10] and SM.1539 [23].

The BS 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/ 1MHz
$F_{BW\ RF,low}$ - 10 MHz < f < $F_{BW\ RF,high}$ + 10 MHz (Note 1)	Not defined
NOTE 1: For BS capable of multi-band operation, the frequency ranges relating to the RF bandwidths of all supported bands apply.	

Key:

$F_{BW\ RF,high}$: Upper RF bandwidth edge
$F_{BW\ RF,low}$: Lower RF bandwidth edge

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 8.2.2 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: 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 8.2.2, 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 2 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 applicable to ancillary equipment. This test shall be performed on a representative configuration of the ancillary equipment.

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 22 [17].

8.2.2.3 Limits

The ancillary equipment shall meet the limits according to CISPR 22 [17] shown in Table 8.2.2.3-1 and Table Table 8.2.2.3-2.

Table 8.2.2.3-1: Limits for radiated emissions from ancillary equipment, measured on a stand-alone basis (10 m measuring distance)

Frequency range	Quasi-peak
30 MHz-230 MHz	30 dBµV/m
230 MHz-1000 MHz	37 dBµV/m

Table 8.2.2.3-2: Limits for radiated emissions from ancillary equipment, measured on a stand-alone basis (3 m measuring distance)

Frequency range GHz	Average limit dBµV/m	Peak limit dBµV/m
1 to 3	50	70
3 to 6	54	74
NOTE: The lower limit applies at the transition frequency.		

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 22 [17] 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 a 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 22 [17]. The reference earth point of the AMNs shall be connected to the reference ground plane with a conductor as short as possible.

The measurement receiver shall be in accordance with the requirements of section one of CISPR 16-1-1 [18].

8.3.3 Limits

The equipment shall meet the limits below (including the average limit and the quasi-peak limit) when using, respectively, an average detector receiver and a quasi-peak detector receiver and measured in accordance with the method described in subclause 8.3.2 above. 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.

The equipment shall meet the limits given in Table 8.3.3-1.

Table 8.3.3-1: Limits for conducted emissions

Frequency range	Quasi-peak	Average
>0,15-0,5MHz	79dBµV	66dBµV
>0,5-30 MHz	73dBµV	60dBµV

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 CISPSR 22 [17].

Mains connected ancillary equipment which is not part of the EUT shall be connected to the mains via a separate AMN. According to CISPR 16-1-1 [18], the Protective Earth (PE) conductor shall also be terminated by a 50 Ω/50 µH common mode RF impedance.

8.4.3 Limits

The equipment shall meet the limits in Table 8.4.3-1 below (including the average limit and the quasi-peak limit) when using, respectively, an average detector receiver and a quasi-peak detector receiver and measured in accordance with

the method described in subclause 8.4.2 above. 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.

Table 8.4.3-1: Limits for conducted emissions

Frequency range	Quasi-peak	Average
> 0,15-0,5 MHz	66 - 56 dBµV	56 - 46 dBµV
> 0.5- 5 MHz	56 dBµV	46 dBµV
> 5-30 MHz	60 dBµV	50 dBµV
NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.		

Alternatively, for equipment intended to be used in telecommunication centres the limits given in Table 8.4.3-2 shall be used.

Table 8.4.3-2: Limits for conducted emissions

Frequency range	Quasi-peak	Average
>0,15-0,5MHz	79dBµV	66dBµV
>0,5-30 MHz	73dBµV	60dBµV

8.5 Harmonic current emissions (AC mains input port)

The requirements of IEC 61000-3-2 [19] 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 [20] applies.

8.6 Voltage fluctuations and flicker (AC mains input port)

The requirements of IEC 61000-3-3 [21] 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 61000-3-12 [20] applies.

8.7 Telecommunication ports

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.

8.7.1 Definition

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

8.7.2 Test method

The test method shall be in accordance with CISPR 22 [17].

The measurement frequency range extends from 150 kHz to 30 MHz.

8.7.3 Limits

The telecommunication ports shall meet the limits according to CISPR 22 [17] shown in Table 8.7.3-1.

Table 8.7.3-1: Limits for conducted emissions from telecommunication ports

Frequency range	Voltage limits dB (µV)		Current limits dB (µA)	
MHz	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,5	84 to 74	74 to 64	40 to 30	30 to 20
0,5 to 30	74	64	30	20

NOTE 1: The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.

NOTE 2: The current and voltage disturbance limits are derived for use with an impedance stabilization network (ISN) which presents a common mode (asymmetric mode) impedance of 150 Ω to the telecommunication port under test (conversion factor is 20 $\log_{10}$ 150/I = 44 dB).

Alternatively, for equipment intended to be used in telecommunication centres only, the limits given in Table 8.7.3-2 may be used.

Table 8.7.3-2: Limits for conducted emissions from telecommunication ports of equipment intended for use in telecommunication centres only

Frequency range	Voltage limits dB (µV)		Current limits dB (µA)	
MHz	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,5	97 to 87	84 to 74	53 to 43	40 to 30
0,5 to 30	87	74	43	30

NOTE 1: The limits decrease linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.

NOTE 2: The current and voltage disturbance limits are derived for use with an impedance stabilization network (ISN), which presents a common mode (asymmetric mode) impedance of 150 Ω to the telecommunication port under test (conversion factor is 20 $\log_{10}$ 150/I = 44 dB).

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;
- 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, Radio Frequency (RF) input/output 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 base station shall be performed by establishing communication links at the radio interface (e.g. with the mobile simulator) and the S1/Iub/ Abis interface (e.g. with an RNC/EPC/BSC simulator) and evaluating the BLER/throughput/BER (see Figure 9.1-1);
- Immunity tests shall be performed on both the Uplink and Downlink paths. The tests shall also include both the radio interface and the S1/Iub/ Abis interface. BLER/throughput/BER 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 S1/Iub/ Abis interface. In case of looping is used care have to be taken that the BLER/throughput/BER information doesn't change due to looping.
- For BS capable of multi-RAT and/or multi-band operation, communication links shall be established in such a way that all RATs and 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 RAT and/or operating band.

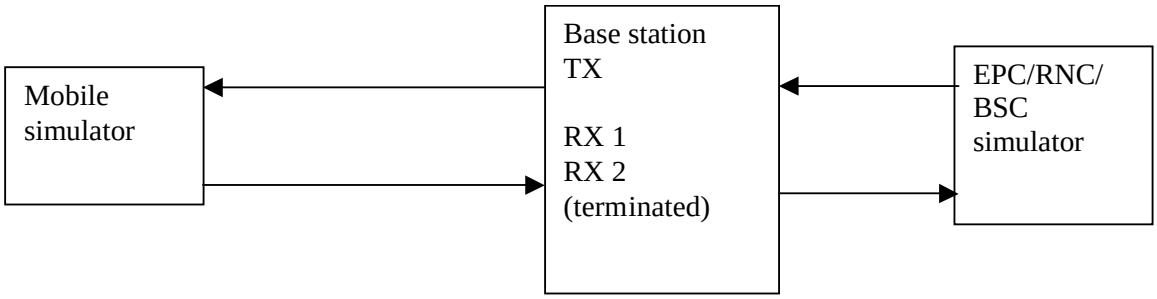

Figure 9.1-1: Communication link set up for BS immunity measurement

9.2 RF electromagnetic field (80 MHz - 1000 MHz, 1400 MHz to 2700 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 [23]:

- 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 - 1 000 MHz and 1400 MHz - 2700 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.

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 [24]:

- for contact discharge, the equipment shall pass at ±2 kV and ±4 kV;
- for air discharge shall pass at ±2 kV, ±4 kV and ±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 [25]:

- 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 [25];
- the test level for DC power input/output ports shall be 0.5 kV open circuit voltage as given in IEC 61000-4-4 [25];
- the test level for AC mains power input ports shall be 1 kV open circuit voltage as given in IEC 61000-4-4 [25].

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 ports, 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 [26].

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 [26]:

- 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 [26] 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 [26];
- 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 [27].

The test levels shall be:

- a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms;
- a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms;
- a voltage interruption corresponding to a reduction of the supply voltage of > 95 % for 5 000 ms.

9.6.3 Performance criteria

For a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms the performance criteria for transient phenomena shall be applied:

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

For a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms and/or a voltage interruption corresponding to a reduction of the supply voltage of > 95 % for 5 000 ms, 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 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.

9.7.1 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 [28].

The requirements and evaluation of test results given in subclause 9.7.2.1 (telecommunication ports, outdoor cables), subclause 9.7.2.2 (telecommunication ports, 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 telecommunications ports, 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 [28], however, in telecommunications centres 0,5 kV line to ground shall be used. In this case the total output impedance of the surge generator shall be in accordance with the basic standard IEC 61000-4-5 [28].

The test generator shall provide the 1,2/50 μs pulse as defined in IEC 61000-4-5 [28].

9.7.2.2 Test method for telecommunication ports connected to indoor cables

The test level for telecommunication ports, 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 [28].

The test generator shall provide the 1,2/50 μs pulse as defined in IEC 61000-4-5 [28].

9.7.2.3 Test method for AC power ports

The test level for AC power input ports 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 [28].

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 [28].

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 (normative): BER assessment for GSM/EDGE

A.1 Assessment of BER at the output of a transmitter

The BER at the output of the transmitter may be assessed using either of the techniques described below.

A.1.1 Assessment of BER using static layer 1 functions

The transmitter under test shall be operated according to the test case of TS 51.021 [10], subclause 6.1.2.

The bit sequence from the output of the transmitter shall be monitored by the test system according to the test case of TS 51.021 [10], subclause 7.1.2, and the BER of the class 2 bits for TCH/FS assessed. The BER shall not exceed the values specified in subclause 6.1 of the present document.

If the EUT does not support TCH/FS, the manufacturer shall declare the logical channel for which the performance shall be assessed, and the corresponding performance criteria.

A.1.2 Assessment of BER using RXQUAL

The output of the transmitter shall be connected to an equipment which meets the requirements of TS 51.010-1 [33] for the assessment of RXQUAL. The level of the signal supplied to the equipment should be within the range for which the assessment of RXQUAL is not impaired. The RXQUAL shall be monitored during the test. The RXQUAL shall not exceed the values specified in subclause 6.1 of the present document.

NOTE: This equipment can be a GSM mobile station with suitable provision for the monitoring of RXQUAL.

A.2 Assessment of BER at the output of a receiver

The BER at the output of the receiver may be assessed using either of the techniques described below.

A.2.1 Assessment of BER using RXQUAL

The value of the RXQUAL reported by the BTS or BSS shall be monitored using suitable test equipment.

A.2.2 Assessment of BER using reported BER

The BER of the class 2 bits at the output of the receiver shall be assessed using suitable test equipment.

If the EUT does not support TCH/FS, the manufacturer shall declare the logical channel for which the performance shall be assessed, and the corresponding performance criteria.

NOTE: This can be performed by a "test loopback" which uses the transmitter of the BTS to return the data which has been decoded by the receiver back to the test equipment which generated the bit sequence. For immunity tests of signal ports, the "test loopback" includes an external connection between signal ports.

Annex B (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2010-02	R4#54	R4-100572				Specification skeleton	0.0.1
2010-04	R4#55	R4-101577				E-mail approved Text Proposals after RAN4 AH#2: **R4-101189**, "TS 37.113: TP on References, Definitions, symbols and abbreviations (TS ch 2 and 3) " **R4-101190**, "TS 37.113: TP on Test conditions (TS ch 4)" **R4-101191**, "TS 37.113: TP on Performance assessment (TS ch 5)" **R4-101192**, "TS 37.113: TP on Performance Criteria (TS ch 6)" **R4-101193**, "TS 37.113: TP on Applicability overview (TS ch 7)" **R4-101194**, "TS 37.113: TP on Emission (TS ch 8)" **R4-101195**, "TS 37.113: TP on Immunity (TS ch 9)"	0.1.0
2010-06	RP#48	RP-100581				Presentation to TSG RAN.	1.0.0
2010-06	RP#48	RP-100581				Approval by TSG RAN.	9.0.0
2010-09	RP-49	RP-100923	002	1		EMC updates for multi-RAT operation	9.1.0
2010-09	RP-49	RP-100923	003			Clarification of radiated emissions requirement	9.1.0
2010-09	RP-49	RP-100927	001			CR LTE_TDD_2600_US spectrum band definition additions for MSR BS to TS 37.113	10.0.0
2010-12	RP-50	RP-101345	010			Band XII/12 frequency range	10.1.0
2010-12	RP-50	RP-101346	006			MSR test configuration for EMC	10.1.0
2010-12	RP-50	RP-101346	008			Correction of CR implementation in clause 6.2 of TS 37.113	10.1.0
2010-12	RP-50	RP-101356	004	1		Band 42 and 43 parameters for UMTS/LTE 3500 (TDD) for TS 37.113	10.1.0
2011-06	RP-52	RP-110812	014	1		Add 2GHz S-Band (Band 23) in 37.113	10.2.0
2011-09	RP-53	RP-111255	017			Add Band 22/XXII for LTE/UMTS 3500 (FDD) to TS 37.113	10.3.0
2011-12	RP-54	RP-111734	018	1		Removal of references to operating bands i) and h)	10.4.0
2011-12	RP-54	RP-111735	019	1		EMC requirements for MSR-NC	10.4.0
2012-03	RP-55	RP-120305	020			Add Extending 850 MHz Upper Band (814 - 849 MHz) to TS37.113	11.0.0
2012-06	RP-56	RP-120793	023			Introduction of APAC700(FDD) into TS 37.113	11.1.0
2012-06	RP-56	RP-120793	024			Introduction of APAC700(TDD) into TS 37.113	11.1.0
2012-06	RP-56	RP-120791	025			Introduction of e850_LB (Band 27) to TS 37.113	11.1.0
2013-06	RP-60	RP-130792	026			Introduction of Band 30 in TS 37.113	12.0.0
2013-06	RP-60	RP-130790	027			Introduction of LTE 450 into TS 37.113	12.0.0
2014-06	RP-64	RP-140914	033			Introduction of band 29 in TS 37.113	12.1.0
2014-06	RP-64	RP-140926	029			Introduction of Band 32/XXXII in TS 37.113	12.1.0
2014-09	RP-65	RP-141562	0036	1		Update of definitions to support supplemental DL in TS37.113	12.2.0
2014-12	RP-66	RP-142146	038			EMC testing of multi-band operation for MSR BS	12.3.0
2015-12	RP-70	RP-152171	0039			Introduction of Band 65	13.0.0
2015-12	RP-70	RP-152172	0040			Introduction of Band 66	13.0.0
2015-12	RP-70	RP-152157	0041			Introduction of Band 67	13.0.0
2015-12	RP-70	RP-152173	0042			Introduction of 1447-1467MHz Band into 37.113	13.0.0
2016-03	RP-71	RP-160483	0043		B	Introduction of Band 68 into 37.113	13.1.0
2016-03	RP-71	RP-160490	0044		F	Introduction of Band 46 in TS 37.113	13.1.0

2016-06	RP-72	RP-161142	0047	-	F	Clarification in EMC environmental conditions references	13.2.0
2016-06	RP-72	RP-161141	0052	-	F	Necessary updates in 37.113 on receiver exclusion bands	13.2.0
2016-12	RP-74	RP-162380	0053	1	B	CR to TS 37.113 – Introduction of NB-IoT	13.3.0
2017-06	RP-76	RP-171285	0067	1	F	CR on LAA BS for TS 37.113	13.4.0

History

Document history		
V13.0.0	January 2016	Publication
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