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Foreword

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1 Scope

The present document summarizes the studies of radio requirements for the Base Station (BS) radio transmission and reception as part of the work item on Evolved Universal Terrestrial Radio Access (E-UTRA).

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 TS 25.104 V7.3.0 (2006-03), “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Base Station (BS) radio transmission and reception (FDD) (Release 7)”.

[2] Recommendation ITU-R M.1580-1, “Generic unwanted emission characteristics of base stations using the terrestrial radio interfaces of IMT-2000”.

[3] Recommendation ITU-R SM.328-10, “Spectra and Bandwidth of Emissions”.

[4] Recommendation ITU-R SM.329-10, “Unwanted emissions in the spurious domain”

[5] “International Telecommunications Union Radio Regulations”, Edition 2004, Volume 1 – Articles, ITU, December 2004.

[6] “Title 47 of the Code of Federal Regulations (CFR)”, Federal Communications Commission.

[7] “Adjacent Band Compatibility between UMTS and Other Services in the 2 GHz Band”, ERC Report 65, Menton, May 1999, revised in Helsinki, November 1999.

[8] “Sharing and Adjacent Band Compatibility between UMTS/IMT-2000 in the Band 2500-2690 MHz and Other Services”, ECC Report 045, Granada, February 2004.

[9] “Compatibility Study For UMTS Operating within the GSM 900 And GSM 1800 Frequency Bands”), Draft ECC Report 082, ECC PT1(05)053 ANNEX 22.

[10] Report ITU-R M.2039, “Characteristics of terrestrial IMT-2000 systems for frequency sharing/interference analyses”.

[11] ETSI EN 301 908-3 V2.2.1 (2003-10), “Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS), Repeaters and User Equipment (UE) for IMT-2000 Third-Generation cellular networks; Part 3: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (BS) covering essential requirements of article 3.2 of the R&TTE Directive”.

[12] Recommendation ITU-R SM.1541, “Unwanted emissions in the out-of-band domain”.

[13] 3GPP TR 25.942 V7.0.0 (2007-03), “3rd Generation Partnership Project; Technical Specification Group Radio Access Networks; Radio Frequency (RF) system scenarios (Release 7)”.

[14] R4-070264, "Proposal on LTE ACLR requirements for Node B" (NTT DoCoMo).

[15] 3GPP TS 25.105 V7.4.0 (2006-12), “Technical Specification 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Base Station (BS) radio transmission and reception (TDD) (Release 7)”.

[16] R4-060738, Methodology for deriving E-UTRA EVM BS requirements, Nokia

[17] R4-060740, E-UTRA EVM Requirements for the BS, Nokia

[18] R4-060853, Reserved sub-carriers for LTE, Ericsson

[19] R4-061170, 64QAM for LTE, Ericsson

[20] R4-061171, Modulation quality for LTE, Ericsson

[21] R4-061172, Reserved sub-carriers for LTE, Ericsson

[22] R4-070124, System simulation results for derivation of E-UTRA BS EVM requirements, Nokia

[23] R4-070082, EVM for equal throughput LTE BS – Simulation and Analysis based, Siemens

[24] 3GPP TS 25.141 v7.6.0 (2006-12), "Base Station (BS) conformance testing (FDD) (Release 7)".

[25] R4-061253, "TP for definition of E-UTRA EVM for the BS", Nokia.

[26] R4-070376, "Recommendations on E-UTRA BS EVM definition and measurement methodology", Alcatel-Lucent.

[27] 3GPP TS 36.211 v1.0.0 (2007-03), "Physical Channels and Modulation".

[28] R4-070337, "Impact of second adjacent channel ACLR/ACS on ACIR" (Nokia Siemens Networks).

[29] R4-070430, "UE ACS and BS ACLRs" (Fujitsu).

[30] R4-070898, "Further E-UTRA base station intermodulation simulation results" (Nokia Siemens Networks), RAN4#43bis.

[31] R4-070226, "LTE EVM time offset definition" (Qualcomm Europe).

[32] R4-070366, "LTE eNB EVM time offset" (Qualcomm Europe).

[33] 3GPP TR 21.905, "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Vocabulary for 3GPP Specifications (Release 8)"

[34] R4-071870, "LTE BS dynamic range," NTT DoCoMo

[35] 3GPP TR 36.803, "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception; (Release 8)"

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [33] 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 [33].

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.

Channel edge: The lowest and highest frequency of the carrier, separated by the channel bandwidth.

Maximum output Power: The mean power level per carrier of the base station measured at the antenna connector in a specified reference condition.

Mean power: When applied to E-UTRA transmission this is the power measured in the channel bandwidth of the carrier. The period of measurement shall be at least one subframe (1ms), unless otherwise stated.

Necessary bandwidth: The width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions (as defined in [3]). For E-UTRA, the necessary bandwidth is equal to the channel bandwidth.

Occupied bandwidth: The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage β/2 of the total mean power of a given emission.

Output power: The mean power of one carrier of the base station, delivered to a load with resistance equal to the nominal load impedance of the transmitter.

Rated output power: Rated output power of the base station is the mean power level per carrier that the manufacturer has declared to be available at the antenna connector.

Reference bandwidth: The bandwidth in which an emission level is specified.

Transmission bandwidth: Bandwidth of an instantaneous transmission from a UE or BS, measured in Resource Block units.

Transmission bandwidth configuration: The highest transmission bandwidth allowed for uplink or downlink in a given channel bandwidth, measured in Resource Block units.

3.2 Symbols

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

$BW_{Channel}$	Channel bandwidth
Δf	Separation between the channel edge frequency and the nominal -3dB point of the measuring filter closest to the carrier frequency
Δf_{max}	The extreme value of Δf used for defining the requirement
f_offset	Separation between the channel edge frequency and the centre of the measuring filter
f_offset_{max}	The extreme value of f_offset used for defining the requirement
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
N_{RB}	Transmission bandwidth configuration, expressed in units of resource blocks
REFSENS	Reference Sensitivity level

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [33] 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 [33].

ACI	Adjacent Channel Interference
ACL	Adjacent Channel Leakage
ACLR	Adjacent Channel Leakage Ratio
ACP	Adjacent Channel Power
ACS	Adjacent Channel Selectivity
AWGN	Additive White Gaussian Noise
CEPT	European Conference of Postal and Telecommunications Administrations
CW	Continuous Wave
EARFCN	E- UTRA Absolute Radio Frequency Channel Number
ECC	Electronic Communications Committee
ERC	European Radiocommunications Committee
EVM	Error Vector Magnitude
FCC	Federal Communications Commission
FIR	Finite Impulse Response

FRC	Fixed Reference Channel
GMSK	Gaussian Minimum Shift Keying
ITU	International Telecommunications Union
MCS	Modulation and Coding Scheme
OOB	Out-of-band
PA	Power Amplifier
RRC	Root Raised Cosine
SEM	Spectrum Emissions Mask
SNR	Signal-to-Noise Ratio
ZF	Zero-Forcing

4 General

4.1 Relationship between Minimum Requirements and Test Requirements

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4.2 Base station classes

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4.3 Regional requirements

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4.4 Environmental requirements for the BS equipment

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5 Frequency bands and channel arrangement

5.1 Channel bandwidth

Requirements in present document are specified for the channel bandwidths listed in Table 5.1-1.

Note: Other channel bandwidths may be considered in future releases.

Table 5.1-1 Transmission bandwidth configuration N_{RB} in E-UTRA channel bandwidths

Channel bandwidth $BW_{Channel}$ [MHz]	1.4	3	5	10	15	20
Transmission bandwidth configuration N_{RB}	6	15	25	50	75	100

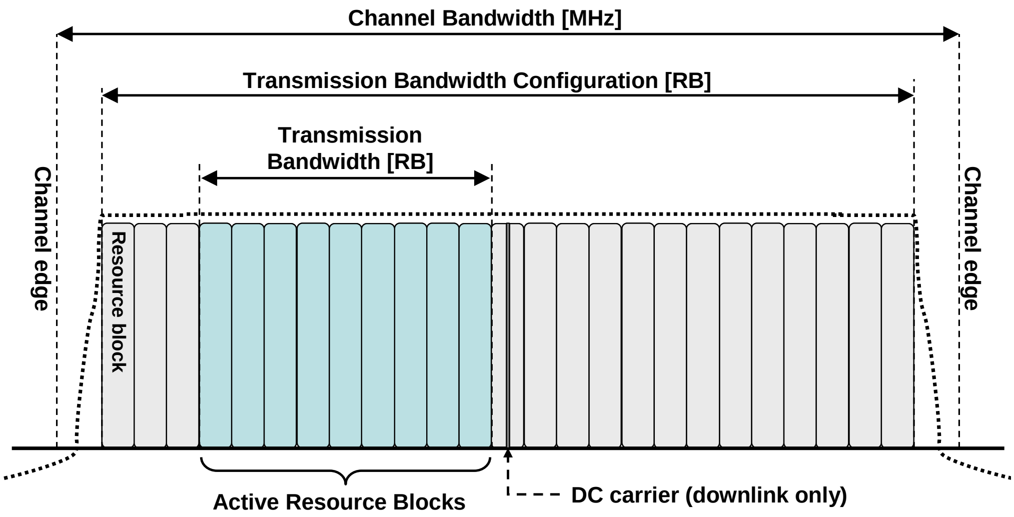

Figure 5.1-1 Definition of Channel Bandwidth and Transmission Bandwidth Configuration.

5.2 Frequency bands

Table 5.2-1 E-UTRA frequency bands

E-UTRA Band	Uplink (UL) eNode B receive UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) eNode B transmit UE receive F_{DL_low} – F_{DL_high}	UL-DL Band separation F_{DL_low} - F_{UL_high}	Duplex Mode
1	1920 MHz – 1980 MHz	2110 MHz – 2170 MHz	130 MHz	FDD
2	1850 MHz – 1910 MHz	1930 MHz – 1990 MHz	20 MHz	FDD
3	1710 MHz – 1785 MHz	1805 MHz – 1880 MHz	20 MHz	FDD
4	1710 MHz – 1755 MHz	2110 MHz – 2155 MHz	355 MHz	FDD
5	824 MHz – 849 MHz	869 MHz – 894MHz	20 MHz	FDD
6	830 MHz – 840 MHz	875 MHz – 885 MHz	35 MHz	FDD
7	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	50 MHz	FDD
8	880 MHz – 915 MHz	925 MHz – 960 MHz	10 MHz	FDD
9	1749.9 MHz – 1784.9 MHz	1844.9 MHz – 1879.9 MHz	60 MHz	FDD
10	1710 MHz – 1770 MHz	2110 MHz – 2170 MHz	340 MHz	FDD
11	1427.9 MHz – 1452.9 MHz	1475.9 MHz – 1500.9 MHz	23 MHz	FDD
12	[TBD] – [TBD]	[TBD] – [TBD]	[TBD]	FDD
13	[TBD] – [TBD]	[TBD] – [TBD]	[TBD]	FDD
14	[TBD] – [TBD]	[TBD] – [TBD]	[TBD]	FDD
...				
33	1900 MHz – 1920 MHz	1900 MHz – 1920 MHz	N/A	TDD
34	2010 MHz – 2025 MHz	2010 MHz – 2025 MHz	N/A	TDD
35	1850 MHz – 1910 MHz	1850 MHz – 1910 MHz	N/A	TDD
36	1930 MHz – 1990 MHz	1930 MHz – 1990 MHz	N/A	TDD
37	1910 MHz – 1930 MHz	1910 MHz – 1930 MHz	N/A	TDD
38	2570 MHz – 2620 MHz	2570 MHz – 2620 MHz	N/A	TDD
39	1880 MHz - 1920 MHz	1880 MHz - 1920 MHz	N/A	TDD
40	2300 MHz - 2400 MHz	2300 MHz - 2400 MHz	N/A	TDD

5.3 Channel arrangement

<Text will be added.>

5.3.1 Channel spacing

The channel spacing between any two LTE carriers is defined as following:

Nominal Channel spacing = (Channel BW1 + Channel BW 2)/2 but this can be adjusted to optimize performance in a particular deployment scenario.

5.3.2 Channel raster and spacing

The channel raster is 100 kHz for all bands, which means that the carrier centre frequency must be an integer multiple of 100 kHz. The spacing between carriers will depend on the deployment scenario, the size of the frequency block available and the channel bandwidths.

5.3.3 Channel number

The carrier frequency in MHz for the downlink is given by the following equation where F_{DL_low} and $N_{OFFS\text{-}DL}$ are given in table 5.3.3-1.

$F_{DL} = F_{DL\_low} + 0.1(N_{DL} – N_{OFFS\text{-}DL})$

The carrier frequency in MHz for the uplink is given by the following equation where F_{UL_low} and $N_{OFFS\text{-}UL}$ are given in table 5.3.3-1.

$F_{UL} = F_{UL\_low} + 0.1(N_{UL} – N_{OFFS\text{-}UL})$

Table 5.3.3-1 E-UTRA channel numbers

Band	Downlink			Uplink		
	F_{DL_low}	$N_{OFFS-DL}$	Range of N_{DL}	F_{UL_low}	$N_{OFFS-UL}$	Range of N_{UL}
1	2110	0	0 – 599	1920	13000	13000 – 13599
2	1930	600	600 – 1199	1850	13600	13600 – 14199
3	1805	1200	1200 – 1949	1710	14200	14200 – 14949
4	2110	1950	1950 – 2399	1710	14950	14950 – 15399
5	869	2400	2400 – 2649	824	15400	15400 – 15649
6	875	2650	2650 – 2749	830	15650	15650 – 15749
7	2620	2750	2750 – 3449	2500	15750	15750 – 16449
8	925	3450	3450 – 3799	880	16450	16450 – 16799
9	1844.9	3800	3800 – 4149	1749.9	16800	16800 – 17149
10	2110	4150	4150 – 4749	1710	17150	17150 – 17749
11	1475.9	4750	4750 – 4999	1427.9	17750	17750 – 17999
…						
33	1900	26000	26000 – 26199	1900	26000	26000 – 26199
34	2010	26200	26200 – 26349	2010	26200	26200 – 26349
35	1850	26350	26350 – 26949	1850	26350	26350 – 26949
36	1930	26950	26950 – 27549	1930	26950	26950 – 27549
37	1910	27550	27550 – 27749	1910	27550	27550 – 27749
38	2570	27750	26200 – 26349	2570	27750	27750 – 28249
39	1880	28250	28250 – 28649	1880	28250	28250 – 28649
40	2300	28650	28650 – 29649	2300	28650	28650 – 29649

5.3.4 EARFCN

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6 Transmitter characteristics

6.1 General

Unless otherwise stated, the requirements in Section 6 assume transmission with a single transmit antenna. In case of multiple transmit antennas the requirements apply to each antenna connector separately, with the other one(s) terminated. Unless otherwise stated, the requirements remain unchanged.

Unless otherwise stated, the transmitter characteristics are specified at the BS antenna connector (test port A) with a full complement of transceivers for the configuration in normal operating conditions. If any external apparatus such as a TX amplifier, a filter or the combination of such devices is used, requirements apply at the far end antenna connector (test port B).

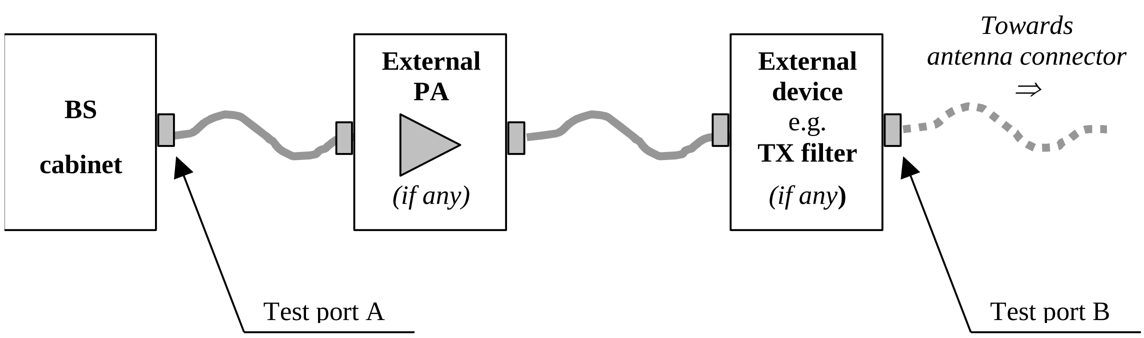

Figure 6.1: Transmitter test ports

6.2 Base station output power

There is no upper limit specified for the maximum output power for the general purpose BS. Limits for maximum output power of other BS classes are ffs. The manufacturer shall declare the rated output power.

In normal conditions, the base station maximum output power shall remain within +2 dB and -2 dB of the rated output power declared by the manufacturer.

In extreme conditions, the base station maximum output power shall remain within +2.5 dB and -2.5 dB of the rated output power declared by the manufacturer.

In certain regions, the minimum requirement for normal conditions may apply also for some conditions outside the range of conditions defined as normal.

6.3 Frequency error

Frequency error is the measure of the difference between the actual BS transmit frequency and the assigned frequency. The same source shall be used for RF frequency and data clock generation.

6.3.1 Minimum requirement

The modulated carrier frequency of the BS shall be accurate to within ±0.05 ppm observed over a period of one subframe (1ms).

Table 6.3-1: Void. 6.4 Output power dynamics

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6.5 Transmit ON/OFF power

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6.6 Output RF spectrum emissions

Unwanted emissions are divided into "Out-of-band emission" and "Spurious emissions" in 3GPP RF specifications. This notation is in line with ITU-R recommendations such as SM.329 [4] and the Radio Regulations [5]. ITU defines:

Out-of-band emission = Emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions.

Spurious emission = Emission on a frequency, or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products but exclude out-of-band emissions.

Unwanted emissions = Consist of spurious emissions and out-of-band emissions.

6.6.1 Occupied bandwidth

6.6.1.1 Background for occupied bandwidth requirement in UTRA

Occupied band width is one way of specifying out-of-band emissions as described in Clause 6.6.2.1. The occupied bandwidth is defined in ITU-R SM.328 [3] and ITU-R Radio Regulations [5]:

Occupied bandwidth = The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage $\beta/2$ of the total mean power of a given emission. Unless otherwise specified by the Radiocommunication Assembly for the appropriate class of emission, the value of $\beta/2$ should be taken as 0.5%. [3] [5]

Occupied bandwidth is used in some regions as a regulatory requirement. It is not defined as a regulatory requirement by the FCC or CEPT/ECC and it is not used as input to any compatibility studies. It is today a mandatory requirement for the BS in RAN4 specifications.

6.6.1.2 Occupied bandwidth requirement for E-UTRA

The occupied bandwidth for E-UTRA is defined in the same way as for UTRA in clause 6.6.1.1, based on $\beta/2 = 0.5\%$.

The occupied bandwidth shall be less than the channel bandwidth as defined in Table 5.1-1.

6.6.2 Out of band emission

6.6.2.1 Background for BS out-of-band emission requirements in UTRA

The core requirements for out-of band emissions are specified for the BS in TS 25.104 [1] and TS 25.105 [15]. The corresponding test requirements are in TS 25.141and TS 25.142. There are several ways of specifying Out-of-band emissions. Three ways are used in RAN4 specifications, namely Occupied Bandwidth, Spectrum emission mask and Adjacent Channel Leakage Ratio (ACLR).

References for the Out-of-band emission requirements are summarised in Table 6.6.2.2-1 for the BS. The tables give references to RAN4 core specs, to where the term is defined and to some relevant regulatory references. These regulatory references have either defined the limit value in 3GPP or they have used it as a basis for studies or recommendations.

Table 6.6.2.2-1 Summary of regulatory references for BS requirements

Requirement	**RAN4** TS 25.104 [1]	**Definition**	**Some relevant regulatory references**
Occupied bandwidth	6.6.1	ITU-R SM.328 (1.13) [3]	ITU Radio Regulations No. S1.153 [5]
Spectrum emission mask	6.6.2.1	ITU-R SM.1541 [12] Limits defined in 3GPP [1]	ITU-R. M.1580 (Annex 1.2) [2]: Band I limits included. FCC Title 47 part 24.238 [6]: Band II limits. FCC Title 47 part 27.53 [6]: Band IV and X limits. FCC Title 47 part 22.917 [6]: Band V limits. ERC Report 65 [7]: Based on Band I limits. ECC Report 045 [8]: Based on Band VII limits. ECC Report 082 [9]: Based on Band III and VIII limits. ETSI EN 301 908-3 [11]: Limits included.
ACLR	6.6.2.2	ITU-R SM.1541 [12] Limits defined in 3GPP [1]	ITU-R M.1580 (Annex 1.3) [2]: Band I limits included. ITU-R M.2039 [10]: ACLR limits included. ERC Report 65 [7]: Based on Band I limits. ECC Report 045 [8]: Based on Band VII limits. ECC Report 082 [9]: Based on Band III and VIII limits. ETSI EN 301 908-3 [11]: Limits included.

6.6.2.1.1 BS Spectrum emission mask as specified in UTRA

ITU-R SM.328 [3] and SM.1541 [12] define “Permissible out-of-band spectrum (of an emission)” as the power density of emissions above and below the necessary bandwidth. The spectrum emission masks defined for the BS in RAN4 specifications specify such limits of emissions, based on a necessary bandwidth for UTRA. No limits are specified inside the necessary bandwidth.

For Band I the masks are also included in the ITU-R recommendation M.1580 [2] on IMT-2000 unwanted emissions. The spectrum masks were mostly based on studies of the spectrum shape of UTRA emissions in early stages of RAN4 work. The masks are also limited by FCC regulations [6] for Bands II, IV, V and X.

The masks were used for several 3GPP co-existence studies as input parameters. In regulatory bodies, CEPT/ECC used the masks as input to several reports studying co-existence and adjacent channel compatibility for IMT-2000 [7] [8] [9]. These reports were partly developed in co-operation with 3GPP.

As an example based on 5MHZ UTRA, the BS mask [1] is defined from 2.5 MHz to a point which is either the operating band edge or 12.5 MHz from the BS carrier centre frequency, whichever is further away. This means that the mask limits emissions in the whole operating band in addition to the +/-12.5 MHz from the carrier centre. Also here, 12.5 MHz is 250% of the necessary bandwidth [4] and the mask is defined with a 30 kHz resolution in the first MHz and a 1 MHz resolution beyond that point. The limits of the mask vary in definition with the BS output power, but have fixed limits for BS powers above 43 dBm or below 31 dBm.

The background of the emission limits for the UTRA mask is described in clause 14.2.1 of TR 25.942 [13]. The main inputs for the UTRA mask limits were

- The ACLR values of 45 dB and 50 dB for the first and second adjacent channel respectively that set a relative limit.
- The FCC limits from [6] (for band II) that set absolute upper limits.
- A mask shape in the first MHz adjacent to the carrier, taking into account imperfections in baseband. A slope is taken from 200 kHz to 1 MHz from the channel edge to more accurately reflect PA behaviour.
- A variation of the mask levels (below FCC limits) that is proportional to the BS output power and with a “floor” for 31 dBm base stations where the absolute limits are low compared to spurious emission limits.

The BS spectrum mask is not mandatory in all regions and is listed as a regional requirement.

6.6.2.1.2 ACLR as specified in UTRA

ITU-R SM.1541 [12] defines Adjacent Channel Power as one way of defining limits on Out-of-band emissions. The term ACLR was defined by RAN4, to avoid confusion regarding related terms such as ACI, ACP and ACL:

Adjacent Channel Leakage power Ratio (ACLR) = The ratio of the RRC filtered mean power centred on the assigned channel frequency to the RRC filtered mean power centred on an adjacent channel frequency.

In combination with the corresponding receiver requirement on Adjacent Channel Selectivity (ACS), ACLR has been an extremely useful tool in co-existence and co-existence studies, both in 3GPP and in CEPT/ECC [7] [8] [9]. For Band I, ACLR is also included in the ITU-R recommendations M.1580 [2] on IMT-2000 unwanted emissions. It is also included in ITU-R report M.2039 [10] that defines parameters to be used in co-existence studies for all IMT-2000 systems.

Together with ACS, the ACLR defines the Adjacent Channel Interference Ratio (ACIR) as

$$ACIR = \frac{1}{\frac{1}{ACLR} + \frac{1}{ACS}}$$

This relation and its application rely on identical assumed reference bandwidths in the ACLR and ACS definitions. If aggressor and victim have different reference bandwidths, both ACLR and ACS definitions have to account for exactly those bandwidths. This is not a problem for co-existence between two UTRA system, but it becomes more complex when there are different systems involved or the bandwidth of a system is flexible as in E-UTRA.

6.6.2.2 Operating band unwanted emission requirements for E-UTRA (spectrum emissions mask)

E-UTRA should have a spectrum emissions mask requirements (SEM) defined, based on the following prerequisites.

- SEM should be defined with a reference bandwidth of 100 kHz. It would have to be verified if this number will be suitable also for matching the mask in the first adjacent MHz as defined in ERC Report 65.

- The SEM limit should also be set to allow some variations due to varying power allocation between resource blocks.
- FCC requirements [6] which apply mainly in Region 2 should be defined separately as an absolute limit and may need a smaller reference bandwidth in some cases.
- In UTRA, the spectrum emissions mask is not only defined in the OOB domain, but also across the spurious domain inside the operating band. This can also be the case for the E-UTRA mask, as long as the limits in the spurious domain are consistent with recommended spurious limits in SM.329 [4]. The “unified” in-band OOB + spurious emissions for E-UTRA can be named *“unwanted emissions”* which is the agreed terminology [6] that encompasses both OOB and spurious emissions.
- The SEM limit should apply for both single and multicarrier BS.
- FCC requirements as defined in [6] apply for bands 2, 4, 5, 10, 35 and 36 as additional limits.

6.6.2.2.1 Operating band unwanted emission requirement specification

The Operating band unwanted emission limits are defined as a “mask” that stretches from 10 MHz below the lowest frequency of the BS transmitter operating band up to 10 MHz above the highest frequency of the BS transmitter operating band, as shown in Figure 6.6.2.2-1. Parts of the mask will be in the out-of-band domain (within +/-2.5 times the necessary bandwidth of the carrier) and parts will be in the spurious domain. As a working assumption, the limits are expressed in one single table per channel bandwidth, with each table being valid for all BS powers and all operating bands.

The unwanted emission limit in the part of the operating band that falls in the spurious domain must be consistent with SM.329 [4]. Based on the Category B spurious emission limits in [4] a level of -25 dBm in 100 kHz (-15 dBm in 1 MHz) is selected as the lower bound for the unwanted emission limits. This is consistent with the level used for UTRA as spurious emission limit inside the operating band. Further details on the spurious emission limits and their interpretation for UTRA (and E-UTRA) are given in TR 25.942, clause 14.2

For E-UTRA Bands 2, 4, 5, 10, 35, 36, an additional Unwanted emission limit is derived from FCC Title 47 [6] Parts 22, 24 and 27, see also Table 6.6.2-1. The requirement stated in [6] is interpreted as -13 dBm in a measurement bandwidth defined as 1% of the "-26 dB modulation bandwidth". For the E-UTRA channel bandwidths, the following additional requirements are defined:

- **1.4 MHz channel bandwidth**: -14 dBm in 10 kHz, which assumes that the "-26 dB modulation bandwidth" is < 1.26 MHz.
- **3 MHz channel bandwidth**: -13 dBm in 30 kHz, which assumes that the "-26 dB modulation bandwidth" is < 3.0 MHz.
- **5 MHz channel bandwidth**: -15 dBm in 30 kHz, which assumes that the "-26 dB modulation bandwidth" is < 4.75 MHz.
- **10 MHz channel bandwidth**: -13 dBm in 100 kHz, which assumes that the "-26 dB modulation bandwidth" is < 10 MHz.
- **15 MHz channel bandwidth**: -15 dBm in 100 kHz, which assumes that the "-26 dB modulation bandwidth" is < 15.8 MHz.
- **20 MHz channel bandwidth**: -16 dBm in 100 kHz, which assumes that the "-26 dB modulation bandwidth" is < 20 MHz.

The additional limit outside the first MHz adjacent to the channel bandwidth, for all channel bandwidths, is -13dBm/100kHz for E-UTRA Band 5, and -13dBm/1MHz for E-UTRA Bands 2, 4, 10, 35 and 36.

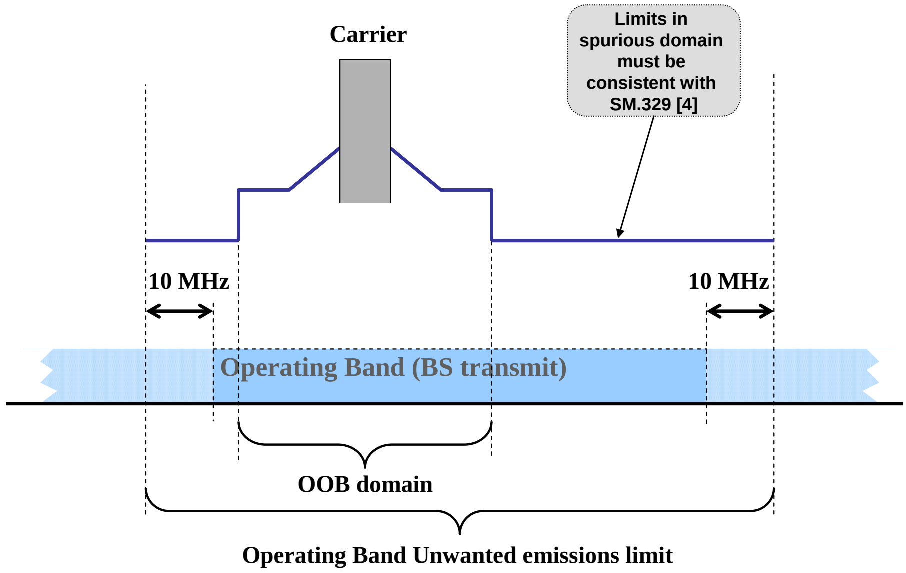

Figure 6.6.2.2-1 Defined frequency range for Operating band unwanted emissions with an example RF carrier and related mask shape (actual limits are TBD).

The requirements shall apply whatever the type of transmitter considered (single carrier or multi-carrier). It applies for all transmission modes foreseen by the manufacturer's specification.

Emissions shall not exceed the maximum level specified in the tables below for [any] BS maximum output power, where:

- Δf is the separation between the channel edge frequency and the nominal -3dB point of the measuring filter closest to the carrier frequency.
- f_offset is the separation between the channel edge frequency and the centre of the measuring filter.
- f_offset_{max} is the offset to the frequency 10 MHz outside the operating band edge.
- Δf_{max} is equal to f_offset_{max} minus half of the bandwidth of the measuring filter.

6.6.2.2.1.1 Minimum requirements for Category A

The minimum requirements for Operating band unwanted emissions are shown in Tables 6.6.2.2-2 to 6.6.2.2-6 and Table 6.6.2.2-8 to 6.6.12.2-12 and are also illustrated in Figure 6.6.2.2-2 for E-UTRA bands >1 GHz. The additional minimum requirements for E-UTRA Bands 2, 4, 5, 10, 35, 36 and 37 are shown in Tables 6.6.2.2-7 and 6.6.2.2-13.

Table 6.6.2.2-2: General operating band unwanted emission limits for 1.4 MHz channel bandwidth, E-UTRA bands <1GHz for Category A

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
0 MHz ≤ Δf < 1.4 MHz	0.05 MHz ≤ f_offset < 1.45 MHz	$-1dBm - \frac{10}{1.4} \cdot \left(\frac{f\_offset}{MHz} - 0.05 \right) dB$	100 kHz
1.4 MHz ≤ Δf < 2.8 MHz	1.45 MHz ≤ f_offset < 2.85 MHz	-11 dBm	100 kHz
2.8 MHz ≤ Δf ≤ Δf_{max}	2.85 MHz ≤ f_offset < f_offset_{max}	-13 dBm (Note 2)	100 kHz

Table 6.6.2.2-3: Void.

Table 6.6.2.2-4: General operating band unwanted emission limits for 3 MHz channel bandwidth, E-UTRA bands <1GHz for Category A

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
0 MHz ≤ Δf < 3 MHz	0.05 MHz ≤ f_offset < 3.05 MHz	$-4.5dBm - \frac{10}{3}\cdot\left(\frac{f\_offset}{MHz} - 0.05\right)dB$	100 kHz
3 MHz ≤ Δf ≤ Δf_{max}	3.05 MHz ≤ f_offset < f_offset_{max}	-13 dBm (Note 2)	100 kHz

Table 6.6.2.2-5: Void.

Table 6.6.2.2-6: General operating band unwanted emission limits for 5, 10, 15 and 20 MHz channel bandwidth, E-UTRA bands <1GHz for Category A

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
0 MHz ≤ Δf < 5 MHz	0.05 MHz ≤ f_offset < 5.05 MHz	$-7dBm - \frac{7}{5}\cdot\left(\frac{f\_offset}{MHz} - 0.05\right)dB$	100 kHz
5 MHz ≤ Δf < 10 MHz	5.05 MHz ≤ f_offset < 10.05 MHz	-14 dBm	100 kHz
10 MHz ≤ Δf ≤ Δf_{max}	10.05 MHz ≤ f_offset < f_offset_{max}	-13 dBm (Note 2)	100 kHz

Table 6.6.2.2-7: General operating band unwanted emission limits for 1.4 MHz channel bandwidth, E-UTRA bands >1GHz for Category A

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
0 MHz ≤ Δf < 1.4 MHz	0.05 MHz ≤ f_offset < 1.45 MHz	$-1dBm - \frac{10}{1.4}\cdot\left(\frac{f\_offset}{MHz} - 0.05\right)dB$	100 kHz
1.4 MHz ≤ Δf < 2.8 MHz	1.45 MHz ≤ f_offset < 2.85 MHz	-11 dBm	100 kHz
2.8 MHz ≤ Δf ≤ Δf_{max}	3.3 MHz ≤ f_offset < f_offset_{max}	-13 dBm (Note 2)	1MHz

Table 6.6.2.2-8: Void.

Table 6.6.2.2-9: General operating band unwanted emission limits for 3 MHz channel bandwidth, E-UTRA bands >1GHz for Category A

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
0 MHz ≤ Δf < 3 MHz	0.05 MHz ≤ f_offset < 3.05 MHz	$-5dBm - \frac{10}{3}\cdot\left(\frac{f\_offset}{MHz} - 0.05\right)dB$	100 kHz
3 MHz ≤ Δf < 6 MHz	3.05 MHz ≤ f_offset < 6.05 MHz	-15 dBm	100 kHz
6 MHz ≤ Δf ≤ Δf_{max}	6.5 MHz ≤ f_offset < f_offset_{max}	-13 dBm (Note 2)	1MHz

Table 6.6.2.2-10: Void.

Table 6.6.2.2-11: General operating band unwanted emission limits for 5, 10, 15 and 20 MHz channel bandwidth, E-UTRA bands >1GHz for Category A

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
0 MHz ≤ Δf < 5 MHz	0.05 MHz ≤ f_offset < 5.05 MHz	$-7dBm-\frac{7}{5}\cdot\left(\frac{f\_offset}{MHz}-0.05\right)dB$	100 kHz
5 MHz ≤ Δf < 10 MHz	5.05 MHz ≤ f_offset < 10.05 MHz	-14 dBm	100 kHz
10 MHz ≤ Δf ≤ Δf_{max}	10.5 MHz ≤ f_offset < f_offset_{max}	-13 dBm (Note 2)	1MHz

Note for Tables 6.6.2.2-2 to 6.6.2.2-11:

NOTE 1 As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth can be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

NOTE2 Since the limit -13 dBm is a regulatory requirement taken from Category A spurious emissions, the Test requirement shall also be -13dBm, i.e. the test tolerance shall be zero when deriving the test limit.

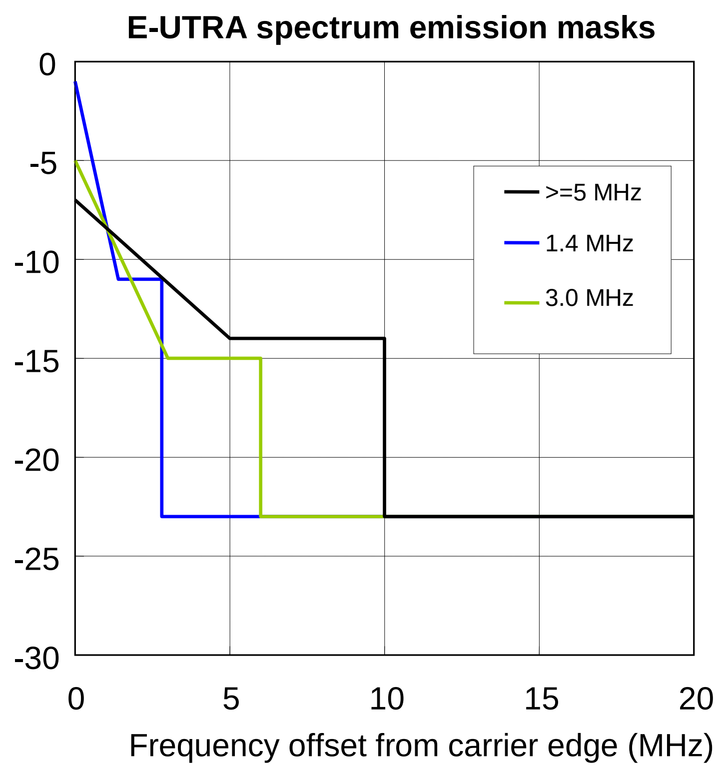

Figure 6.6.2.2-2: Operating band unwanted emission requirements levels relative to channel edge (E-UTRA bands >1GHz). for Category A

6.6.2.2.1.2 Minimum requirements for Category B

The minimum requirements for Operating band unwanted emissions are shown in Tables 6.6.2.2-12 to 6.6.2.2-16 and Table 6.6.2.2-18 to 6.6.12.2-22 and are also illustrated in Figure 6.6.2.2-3 for E-UTRA bands >1 GHz. The additional minimum requirements for E-UTRA Bands 2, 4, 5, 10, 35, 36 and 37 are shown in Tables 6.6.2.2-17 and 6.6.2.2-23.

Table 6.6.2.2-12: General operating band unwanted emission limits for 1.4 MHz channel bandwidth, E-UTRA bands <1GHz for Category B

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
0 MHz ≤ Δf < 1.4 MHz	0.05 MHz ≤ f_offset < 1.45 MHz	$-1dBm-\frac{10}{1.4}\cdot\left(\frac{f\_offset}{MHz}-0.05\right)dB$	100 kHz
1.4 MHz ≤ Δf < 2.8 MHz	1.45 MHz ≤ f_offset < 2.85 MHz	-11 dBm	100 kHz
2.8 MHz ≤ Δf ≤ Δf_{max}	2.85 MHz ≤ f_offset < f_offset_{max}	-16 dBm (Note 2)	100 kHz

Table 6.6.2.2-13: Void.

Table 6.6.2.2-14: General operating band unwanted emission limits for 3 MHz channel bandwidth, E-UTRA bands <1GHz for Category B

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
0 MHz ≤ Δf < 3 MHz	0.05 MHz ≤ f_offset < 3.05 MHz	$-5dBm-\frac{10}{3}\cdot\left(\frac{f\_offset}{MHz}-0.05\right)dB$	100 kHz
3 MHz ≤ Δf < 6 MHz	3.05 MHz ≤ f_offset < 6.05 MHz	-15 dBm	100 kHz
6 MHz ≤ Δf ≤ Δf_{max}	6.05 MHz ≤ f_offset < f_offset_{max}	-16 dBm (Note 2)	100 kHz

Table 6.6.2.2-15: Void.

Table 6.6.2.2-16: General operating band unwanted emission limits for 5, 10, 15 and 20 MHz channel bandwidth, E-UTRA bands <1GHz for Category B

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
0 MHz ≤ Δf < 5 MHz	0.05 MHz ≤ f_offset < 5.05 MHz	$-7dBm-\frac{7}{5}\cdot\left(\frac{f\_offset}{MHz}-0.05\right)dB$	100 kHz
5 MHz ≤ Δf < 10 MHz	5.05 MHz ≤ f_offset < 10.05 MHz	-14 dBm	100 kHz
10 MHz ≤ Δf ≤ Δf_{max}	10.05 MHz ≤ f_offset < f_offset_{max}	-16 dBm (Note 2)	100 kHz

Table 6.6.2.2-17: Additional operating band unwanted emission limits for E-UTRA bands <1GHz

Channel bandwidth	Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
1.4 MHz	0 MHz ≤ Δf < 1 MHz	0.005 MHz ≤ f_offset < 0.995 MHz	-14 dBm	10 kHz
3 MHz	0 MHz ≤ Δf < 1 MHz	0.015 MHz ≤ f_offset < 0.985 MHz	-13 dBm	30 kHz
5 MHz	0 MHz ≤ Δf < 1 MHz	0.015 MHz ≤ f_offset < 0.985 MHz	-15 dBm	30 kHz
10 MHz	0 MHz ≤ Δf < 1 MHz	0.05 MHz ≤ f_offset < 0.95 MHz	-13 dBm	100 kHz
15 MHz	0 MHz ≤ Δf < 1 MHz	0.05 MHz ≤ f_offset < 0.95 MHz	-15 dBm	100 kHz
20 MHz	0 MHz ≤ Δf < 1 MHz	0.05 MHz ≤ f_offset < 0.95 MHz	-16 dBm	100 kHz
1.4 MHz 1.6 MHz 3 MHz 3.2 MHz 5 MHz 10 MHz 15 MHz 20 MHz	1 MHz ≤ Δf < Δf_{max}	1.05 MHz ≤ f_offset < f_offset_{max}	-13 dBm	100 kHz

Table 6.6.2.2-18: General operating band unwanted emission limits for 1.4 MHz channel bandwidth, E-UTRA bands >1GHz for Category B

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
0 MHz ≤ Δf < 1.4 MHz	0.05 MHz ≤ f_offset < 1.45 MHz	$-1dBm - \frac{10}{1.4} \cdot \left(\frac{f\_offset}{MHz} - 0.05 \right) dB$	100 kHz
1.4 MHz ≤ Δf < 2.8 MHz	1.45 MHz ≤ f_offset < 2.85 MHz	-11 dBm	100 kHz
2.8 MHz ≤ Δf ≤ Δf_{max}	3.3 MHz ≤ f_offset < f_offset_{max}	-15 dBm (Note 2)	1MHz

Table 6.6.2.2-19: Void.

Table 6.6.2.2-20: General operating band unwanted emission limits for 3 MHz channel bandwidth, E-UTRA bands >1GHz for Category B

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
0 MHz ≤ Δf < 3 MHz	0.05 MHz ≤ f_offset < 3.05 MHz	$-5dBm - \frac{10}{3} \cdot \left(\frac{f\_offset}{MHz} - 0.05 \right) dB$	100 kHz
3 MHz ≤ Δf < 6 MHz	3.05 MHz ≤ f_offset < 6.05 MHz	-15 dBm	100 kHz
6 MHz ≤ Δf ≤ Δf_{max}	6.5 MHz ≤ f_offset < f_offset_{max}	-15 dBm (Note 2)	1MHz

Table 6.6.2.2-21: Void.

Table 6.6.2.2-22: General operating band unwanted emission limits for 5, 10, 15 and 20 MHz channel bandwidth, E-UTRA bands >1GHz for Category B

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
0 MHz ≤ Δf < 5 MHz	0.05 MHz ≤ f_offset < 5.05 MHz	$-7dBm - \frac{7}{5} \cdot \left(\frac{f\_offset}{MHz} - 0.05 \right) dB$	100 kHz
5 MHz ≤ Δf < 10 MHz	5.05 MHz ≤ f_offset < 10.05 MHz	-14 dBm	100 kHz
10 MHz ≤ Δf ≤ Δf_{max}	10.5 MHz ≤ f_offset < f_offset_{max}	-15 dBm (Note 2)	1MHz

Table 6.6.2.2-23: Additional operating band unwanted emission limits for E-UTRA bands 2, 4, 10, 35, 36 and 37 >1GHz

Channel bandwidth	Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note 1)
1.4 MHz	0 MHz ≤ Δf < 1 MHz	0.005 MHz ≤ f_offset < 0.995 MHz	-14 dBm	10 kHz
3 MHz	0 MHz ≤ Δf < 1 MHz	0.015 MHz ≤ f_offset < 0.985 MHz	-13 dBm	30 kHz
5 MHz	0 MHz ≤ Δf < 1 MHz	0.015 MHz ≤ f_offset < 0.985 MHz	-15 dBm	30 kHz
10 MHz	0 MHz ≤ Δf < 1 MHz	0.05 MHz ≤ f_offset < 0.95 MHz	-13 dBm	100 kHz
15 MHz	0 MHz ≤ Δf < 1 MHz	0.05 MHz ≤ f_offset < 0.95 MHz	-15 dBm	100 kHz
20 MHz	0 MHz ≤ Δf < 1 MHz	0.05 MHz ≤ f_offset < 0.95 MHz	-16 dBm	100 kHz
1.4 MHz 1.6 MHz 3 MHz 3.2 MHz 5 MHz 10 MHz 15 MHz 20 MHz	1 MHz ≤ Δf < Δf_{max}	1.5 MHz ≤ f_offset < f_offset_{max}	-13 dBm	1 MHz

Note for Tables 6.6.2.2-12 to 6.6.2.2-23:

NOTE 1 As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth can be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

NOTE2 Since the limit -16 and -15 dBm dBm are regulatory requirements taken from Category B spurious emissions, the Test requirement shall also be -16 dBm and -15 dBm respectively, i.e. the test tolerance shall be zero when deriving the test limit.

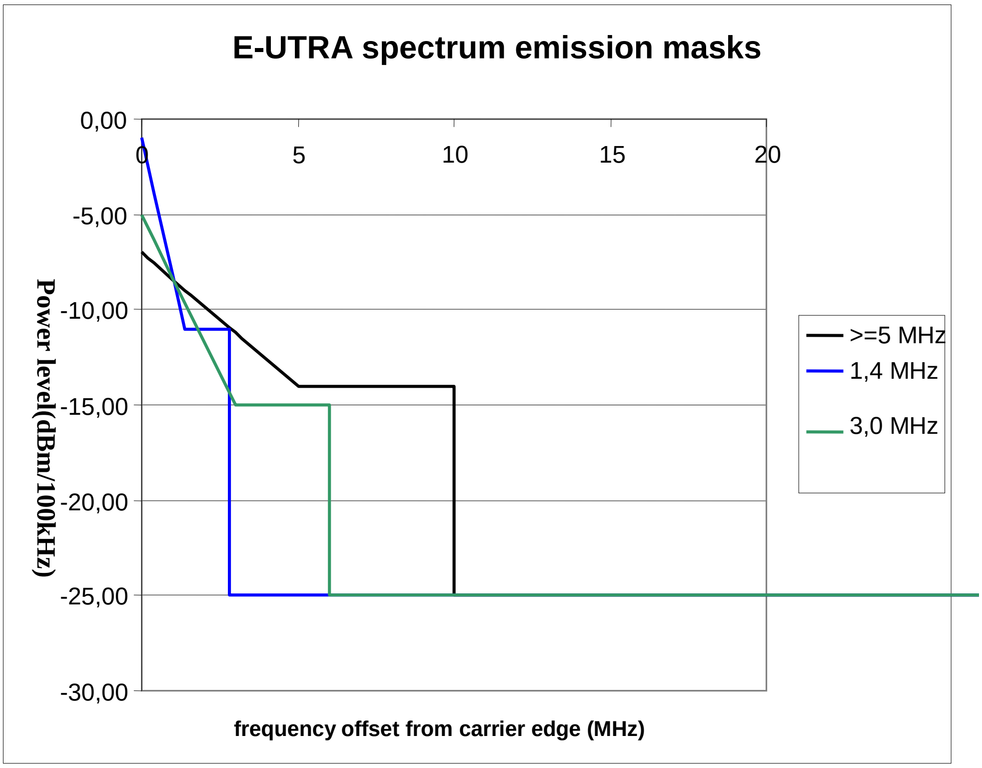

Figure 6.6.2.2-3: Operating band unwanted emission requirements levels relative to channel edge (E-UTRA bands >1GHz).

6.6.2.3 ACLR requirements for E-UTRA

If there is to be both an ACLR-type requirement with carrier-wide reference bandwidth and a mask (SEM) with much narrower reference bandwidth, the ACLR limit should be somewhat stricter than the integrated SEM. In this way, the ACLR can capture the "average" behaviour over a carrier, while the SEM can take into account the variations in the spectrum emissions resulting from variations in power allocations.

Since it is important to assess sharing properties both with adjacent UTRA systems and with E-UTRA carriers the ACLR is defined with different bandwidths:

- ACLR/UTRA in a 1st and 2nd adjacent channel with 5 MHz and/or 1.6 MHz reference bandwidth depending on paired or unpaired spectrum.
- ACLR/E-UTRA (reference bandwidth equal to E-UTRA channel bandwidth) in a 1st and 2nd adjacent channel.
- For carriers with channel bandwidth larger than 5 MHz positioned close to or adjacent to the band edge, the 1st or 2nd adjacent channel that define the ACLR/E-UTRA may fall partly or fully outside the point 10 MHz from the band edge. If it is fully outside, it should not be defined. If it is partly outside it can still be defined, but may not be limiting compared to the unwanted emission limits defined by SEM and spurious emissions.
- ACLR should apply for both single and multicarrier BS.

ACLR measured in other reference bandwidths (smaller or larger) than the E-UTRA carrier or 5 MHz are indirectly defined by the mask.

6.6.2.3.1 ACLR requirement specification

ACLR is defined for two cases as shown in Figure 6.6.2.3-1, i.e. for 1st and 2nd adjacent E-UTRA carriers of the same bandwidth and for 1st and 2nd adjacent UTRA carriers. Separate limits are defined for each channel bandwidth. The requirements can be stated with two tables, one for adjacent E-UTRA and one for adjacent UTRA.

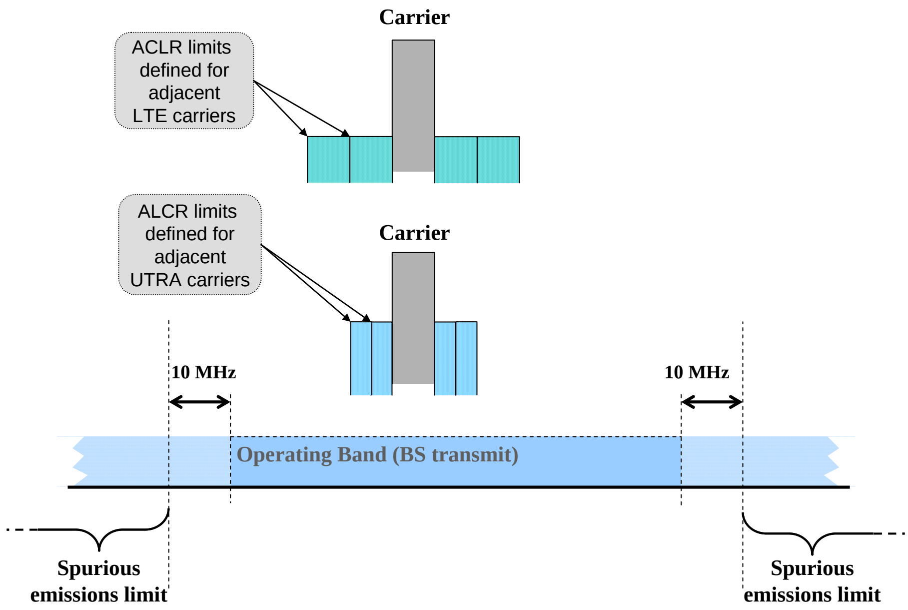

Figure 6.6.2.3-1 The two defined ACLR measures, one for 1st and 2nd adjacent E-UTRA carriers and one for 1st and 2nd adjacent UTRA carrier.

The current working assumptions for BS ACLR are captured in the Table 6.6.2.3-1 for E-UTRA operating in paired spectrum and in Table 6.6.2.3-2 in unpaired spectrum. For Category A, either the limits in the tables or the absolute limit of [-13dBm/MHz] (Note 2) apply, whatever is less stringent. For Category B, the numbers are based on the co-existence simulations outlined in TR 36.942. Either the limits in the tables or the absolute limit of [-15dBm/MHz] apply, whatever is less stringent.

NOTE: Whether the absolute limit is applicable to other base station classes is ffs.

NOTE2 Since the limits -13 dBm and -15 dBm are regulatory requirements taken from Category A and B spurious emissions respectively, the test requirement shall also be -13dBm and -15 dBm respectively, i.e. the test tolerance shall be zero when deriving the test limit.

Table 6.6.2.3-1: Working assumption for BS ACLR for adjacent E-UTRA carriers (paired spectrum)

E-UTRA Channel BW (MHz) [2]	ACLR limit for 1st and 2nd Adjacent channel relative to assigned channel frequency [dB]							
		UTRA[1] 5.0 MHz	E-UTRA[2] 1.4 MHz	E-UTRA[2] 3 MHz	E-UTRA[2] 5.0 MHz	E-UTRA[2] 10 MHz	E-UTRA[2] 15 MHz	E-UTRA[2] 20 MHz
1.4	ACLR 1	[45]	[45]	-	-	-	-	-
	ACLR 2	[45]	[45]	-	-	-	-	-
3	ACLR 1	[45]	-	[45]	-	-	-	-
	ACLR 2	[45]	-	[45]	-	-	-	-
5	ACLR 1	[45]	-	-	[45]	-	-	-
	ACLR 2	[45]	-	-	[45]	-	-	-
10	ACLR 1	[45]	-	-	-	[45]	-	-
	ACLR 2	[45]	-	-	-	[45]	-	-
15	ACLR 1	[45]	-	-	-	-	[45]	-
	ACLR 2	[45]	-	-	-	-	[45]	-
20	ACLR 1	[45]	-	-	-	-	-	[45]
	ACLR 2	[45]	-	-	-	-	-	[45]

NOTES: [1] Measured with a 3.84 MHz bandwidth RRC filter with roll-off factor α =0.22 centered on the adjacent channel.

[2] Measured with a rectangular filter with a bandwidth equal to the transmission bandwidth configuration $N_{RB} \cdot 180$ kHz centered on the 1st or 2nd adjacent channel

Table 6.6.2.3-2: Working assumption for BS ACLR for adjacent E-UTRA carriers (unpaired spectrum assuming synchronized operation)

E-UTRA Channel BW (MHz) [2]	ACLR limit for 1st and 2nd Adjacent channel relative to assigned channel frequency [dB]									
		UTRA[1] 7.68 Mcps	UTRA[1] 3.84 Mcps	UTRA[1] 1.28 Mcps	E-UTRA[2] 1.6 MHz	E-UTRA[2] 3.2 MHz	E-UTRA[2] 5 MHz	E-UTRA[2] 10 MHz	E-UTRA[2] 15 MHz	E-UTRA[2] 20 MHz
1.4	ACLR1	-[3]	-[3]	[45]	[45]		-	-	-	-
	ACLR2			[45]	[45]		-	-	-	-
3	ACLR1	-[3]	-[3]	[45]		[45]				
	ACLR2			[45]		[45]				
5	ACLR1	[45]	[45]	[45]	-		[45]	-	-	-
	ACLR2	[45]	[45]	[45]	-		[45]	-	-	-
10	ACLR1	[45]	[45]	[45]	-		-	[45]	-	-
	ACLR2	[45]	[45]	[45]	-		-	[45]	-	-
15	ACLR1	[45]	[45]	[45]	-		-	-	[45]	-
	ACLR2	[45]	[45]	[45]	-		-	-	[45]	-
20	ACLR1	[45]	[45]	[45]	-		-	-	-	[45]
	ACLR2	[45]	[45]	[45]	-		-	-	-	[45]

NOTES: [1] Measured with a 7.68 MHz, 3.84 MHz or 1.28 MHz bandwidth RRC filter respectively, with roll-off factor α =0.22 centered on the adjacent channel.

[2] Measured with a rectangular filter with a bandwidth equal to the transmission bandwidth configuration $N_{RB} \cdot 180$ kHz centered on the 1st or 2nd adjacent channel

[3] Operation in adjacent channels not possible with synchronized operation in unpaired spectrum due to different time slot structures.

The ACLR2 for the UTRA is set to be the same as ACLR1. It was revealed in [28] and [29] that the second adjacent channel interference contributes only little to overall ACIR because ACLR/ACS in the second adjacent channel is significantly higher than the UTRA UE ACS1.

It was pointed out in [14] that an E-UTRA BSs must not cause larger interference (in terms of absolute power) to the co-existing UTRA system than the one allowed in the current 3GPP requirements, irrespective of its channel bandwidth.

For the deployment in Japan, additional spurious emission requirement to protect co-existing (domestic) wireless systems may be required for certain bands (i.e. E-UTRA Band 1, 6, 9, and 11) in order to limit the ACI in 10, 15, and 20 MHz Channel BW options.

The measurement filter for the transmitted E-UTRA carrier and the adjacent E-UTRA carrier is a rectangular filter with a bandwidth equal to the transmission bandwidth configuration $N_{RB} \cdot 180$ kHz. For ACLR/UTRA, the power of the adjacent carrier is measured using an RRC filter with roll-off factor α =0.22.

Adjacent Channel Leakage power Ratio (ACLR) is the ratio of the filtered mean power centered on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency.

The requirements shall apply whatever the type of transmitter considered (single carrier or multi-carrier). It applies for all transmission modes foreseen by the manufacturer's specification.

6.6.3 Spurious emissions

Spurious emissions are defined in ITU-R Radio Regulations [5] and SM.329 [4].

The core requirements for spurious emissions are specified for the BS in TS 25.104 [1]. The corresponding test requirements are in TS 34.121 and TS 25.141.

References for the spurious emissions requirements are summarised in Table 6.6.3-1 for the BS. The tables give references to RAN4 core specs, to where the term is defined and to some relevant regulatory references. These regulatory references have either defined the limit value in 3GPP or they have used it as a basis for studies or recommendations.

Table 6.6.3-1 Summary of regulatory references for BS spurious emissions limits.

Spurious emissions requirement	**RAN4** TS 25.104 [1]	**Definition**	**Some relevant regulatory references**
General	6.6.3.1	ITU-R SM.329 [4]	ITU-R M.1580 (Annex 1.4) [2]: Band I limits included. ITU-R SM.329[4]: 1.4 Necessary bandwidth 4.1 Reference bandwidths 4.2 Category A limits 4.3 Category B limits Annex 7. Reference BW (Cat. B) ITU-R M.2039 [10]: Limits included by reference. ETSI EN 301 908-3 [11]: Category B limits included.
Co-existence with other bands	6.6.3.2 to 6.6.3.7	Developed and defined in 3GPP.	ITU-R M.1580 (Annex 1.4) [2]: Band I limits included. ITU-R. M.2039 [10]: Limits included by reference. ETSI EN 301 908-3 [11]: Limits to protect GSM900 and GSM1800 in the same area included.

6.6.3.1 Mandatory Requirements

6.6.3.1.1 Background for general spurious emissions requirements for UTRA

The general spurious emissions requirements and the corresponding reference bandwidths are taken from ITU-R recommendation SM.329 [4] for both the UE and the BS. The general requirements are considered regional for the BS, since some regions may apply Category A and other Category B. Both are included in the BS specifications.

The spurious emissions requirements in [1] are only applicable for frequencies, which are greater than 12.5 MHz away from the carrier centre frequency. 12.5 MHz is selected as 250% of the necessary bandwidth, as recommended in ITU-R SM.329 [4]. The corresponding limits in [15] are based on the necessary bandwidths for UTRA TDD that also include 1.6 and 10 MHz.

Annex 7 of ITU-R SM.329 [4] allows for a reduced measurement bandwidth to be applied close to the carrier. The reduced measurement bandwidth is in 3GPP interpreted as an increase of the spurious emission limit for the base station in the BS Category B requirements. The interpretation has however been stricter than the ITU-R recommendations when applied in RAN4, since the increased spurious emission limit is only applied in the downlink part of the UMTS operating band plus an additional 10 MHz on each side of the band. This is further described in [13].

The spurious emissions requirements are included in ITU-R recommendations and M.1580 [2] on IMT-2000 unwanted emissions. They are also included in ETSI harmonised standards [11] and referenced from ITU-R report M.2039 [10] that defines parameters to be used in co-existence studies for all IMT-2000 systems.

6.6.3.1.2 General spurious emissions requirements for E-UTRA

As discussed in clause 6.6.2.2, the definition of "Operating band unwanted emissions" for E-UTRA covers not only the OOB domain, but also the spurious domain inside the operating band, including the 10 MHz of spectrum immediately above and below the operating band. For that reason, there is no need to define spurious emission limits inside the operating band as shown in Figure 6.6.3.1-1. The implication is that the rule that spurious emissions start at a point separated from the carrier centre by 250% of the necessary bandwidth is not applied. Note however that since parts of the Operating band unwanted emission limits will fall inside the spurious domain, they are bound by the same regulatory limits that define spurious emissions. The operating band unwanted emission limits are further discussed in Clause 6.6.2.2.

Since the spurious emission limits defined here does not cover the frequency range of the spurious domain inside the operating band, they should be named "Spurious emissions outside the operating band", in order to distinguish them from the definition of spurious emissions in the spurious domain in ITU-R SM.329 [4].

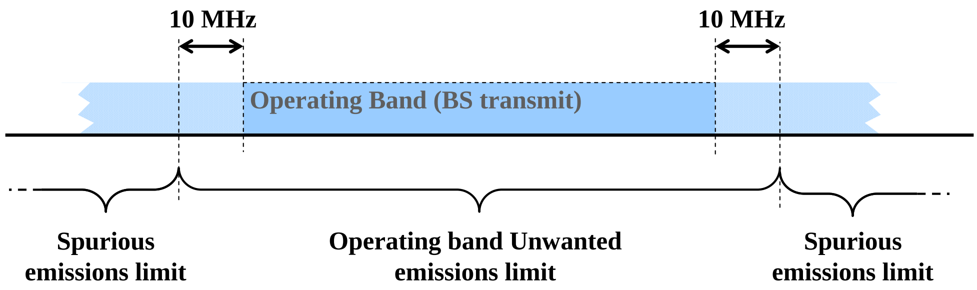

Figure 6.6.3.1-1 Defined frequency ranges for spurious emissions and operating band unwanted emissions

Spurious emission limits as defined in ITU-R SM.329[4] are divided into several Categories, where Category A and B are applied for 3GPP as regional requirements. The Category A and Category B spurious emission limits in Tables 6.6.3-1-1 and 6.6.3.1-2 are in line with ITU-R SM.329[4]. They would apply outside of the region where the limits for “Operating band unwanted emissions” are defined (operating band plus 10 MHz on each side). Further details on the spurious emission limits and their interpretation for UTRA (and E-UTRA) are given in TR 25.942 [13], clause 14.2.

6.6.3.1.3 Specification of Spurious emissions outside the operating band

The spurious emission limits (except the limit in section 6.6.3.5) apply in frequency ranges that are more than 10 MHz below the lowest BS transmitter frequency of the operating band and more than 10 MHz above the highest BS transmitter frequency of the operating band. The requirements shall apply whatever the type of transmitter considered (single carrier or multi-carrier). It applies for all transmission modes foreseen by the manufacturer's specification.

Table 6.6.3.1-1: BS Spurious emission limits outside the operating band, Category A

Band	Maximum level	Measurement Bandwidth	Note
9kHz - 150kHz	-13 dBm	1 kHz	Note 1
150kHz - 30MHz		10 kHz	Note 1
30MHz - 1GHz		100 kHz	Note 1
1GHz - 12.75 GHz		1 MHz	Note 2
NOTE 1: Bandwidth as in ITU-R SM.329 [4] , s4.1 NOTE 2: Bandwidth as in ITU-R SM.329 [4] , s4.1. Upper frequency as in ITU-R SM.329 [4] , s2.5 table 1			

Table 6.6.3.1-2: BS Spurious emissions limits outside the operating band, Category B

Band	Maximum Level	Measurement Bandwidth	Note
9 kHz ↔ 150 kHz	-36 dBm	1 kHz	Note 1
150 kHz ↔ 30 MHz	-36 dBm	10 kHz	Note 1
30 MHz ↔ 1 GHz	-36 dBm	100 kHz	Note 1
1 GHz ↔ 12.75 GHz	-30 dBm	1 MHz	Note 2
NOTE 1: Bandwidth as in ITU-R SM.329 [4] , s4.1 NOTE 2: Bandwidth as in ITU-R SM.329 [4] , s4.1. Upper frequency as in ITU-R SM.329 [4] , s2.5 table 1			

6.6.3.2 Protection of the E-UTRA FDD BS receiver of own or different BS

This requirement is to protect the receivers of the BSs being desensitised by emissions from a BS transmitter. Assuming 30 dB coupling loss between the Tx and Rx antenna ports, 5 dB noise figure and 0.8 dB desensitization (interferer 7 dB below noise floor), the maximum allowed level is -96 dBm.

Table 6.6.3.2-1: BS Spurious emissions limits for protection of the BS receiver

Operating Bands		Maximum Level	Measurement Bandwidth	Note
All		-96 dBm	100 kHz	

6.6.3.3 Co-existence with other systems in the same geographical area

6.6.3.3.1 Background for co-existence requirements for UTRA

The RAN4 specifications define specific BS spurious emission limits for co-existence with a number of systems, including UTRA and GSM in the same and different bands, PHS, TDD and other services in adjacent bands. Co-existence requirements for operation in the same area are regional, but usually mandatory.

Some of the co-existence requirements are referenced or included by external bodies such as ITU-R [2] [10] and ETSI [11] as shown in Table 6.6.3-1.

6.6.3.3.2 Co-existence requirements for E-UTRA

These requirements may be applied for the protection of UE, MS and/or BS operating in other frequency bands in the same geographical area. The requirements may apply in geographic areas in which both E-UTRA BS and a system operating in another frequency band than the E-UTRA operating band are deployed. The system operating in the other frequency band may be GSM900, DCS1800, PCS1900, GSM850, UTRA FDD/TDD and/or E-UTRA .

The power of any spurious emission shall not exceed the limits of Table 6.6.3.3-1 for a BS where requirements for co-existence with the system listed in the first column apply.

Table 6.6.3.3-1: BS Spurious emissions limits for E-UTRA BS in geographic coverage area of systems operating in other frequency bands

System type operating in the same geographical area	Band for co-existence requirement	Maximum Level	Measurement Bandwidth	Note
GSM900	921 - 960 MHz	-57 dBm	100 kHz	This requirement does not apply to E-UTRA BS operating in band 8
	876 - 915 MHz	-61 dBm	100 kHz	For the frequency range 880-915 MHz, this requirement does not apply to E-UTRA BS operating in band 8, since it is already covered by the requirement in sub-clause 6.6.3.2.
DCS1800	1805 - 1880 MHz	-47 dBm	100 kHz	This requirement does not apply to E-UTRA BS operating in band 3
	1710 - 1785 MHz	-61 dBm	100 kHz	This requirement does not apply to E-UTRA BS operating in band 3, since it is already covered by the requirement in sub-clause 6.6.3.2.
PCS1900	1930 - 1990 MHz	-47 dBm	100 kHz	This requirement does not apply to E-UTRA BS operating in frequency band 2 or band 36
	1850 - 1910 MHz	-61 dBm	100 kHz	This requirement does not apply to E-UTRA BS operating in frequency band 2, since it is already covered by the requirement in sub-clause 6.6.3.2. This requirement does not apply to E-UTRA BS operating in frequency band 35.
GSM850	869 - 894 MHz	-57 dBm	100 kHz	This requirement does not apply to E-UTRA BS operating in frequency band 5
	824 - 849 MHz	-61 dBm	100 kHz	This requirement does not apply to E-UTRA BS operating in frequency band 5, since it is already covered by the requirement in sub-clause 6.6.3.2.
UTRA FDD Band I or E-UTRA Band 1	2110 - 2170 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 1,
	1920 - 1980 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 1, since it is already covered by the requirement in sub-clause 6.6.3.2.
UTRA FDD Band II or E-UTRA Band 2	1930 - 1990 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 2
	1850 - 1910 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 2, since it is already covered by the requirement in sub-clause 6.6.3.2.
UTRA FDD Band III or E-UTRA Band 3	1805 - 1880 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 3.
	1710 - 1785 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 3, since it is already covered by the requirement in sub-clause 6.6.3.2.
UTRA FDD Band IV or E-UTRA Band 4	2110 - 2155 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 4
	1710 - 1755 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 4, since it is already covered by the requirement in sub-clause 6.6.3.2.
UTRA FDD Band V or E-UTRA Band 5	869 - 894 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 5
	824 - 849 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 5, since it is already covered by the requirement in sub-clause 6.6.3.2.
UTRA FDD Band VI or E-UTRA Band 6	860 - 895 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 6
	815 - 850 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 6, since it is already covered by the requirement in sub-clause 6.6.3.2.
UTRA FDD Band VII or E-UTRA Band 7	2620 - 2690 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 7.

	2500 - 2570 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 7, since it is already covered by the requirement in sub-clause 6.6.3.2.
UTRA FDD Band VIII or E-UTRA Band 8	925 - 960 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 8.
	880 - 915 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 8, since it is already covered by the requirement in sub-clause 6.6.3.2.
UTRA FDD Band IX or E-UTRA Band 9	1844.9 - 1879.9 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 9.
	1749.9 - 1784.9 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 9, since it is already covered by the requirement in sub-clause 6.6.3.2.
UTRA FDD Band X or E-UTRA Band 10	2110 - 2170 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 10.
	1710 - 1770 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 10, since it is already covered by the requirement in sub-clause 6.6.3.2.
UTRA FDD Band XI or E-UTRA Band 11	1475.9 - 1500.9 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 11.
	1427.9 - 1452.9 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 11, since it is already covered by the requirement in sub-clause 6.6.3.2.
UTRA TDD in Band a) or E-UTRA Band 33	1900 - 1920 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in Band 33
UTRA TDD in Band a) or E-UTRA Band 34	2010 - 2025 MHz	-52 dBm	1 MHz	This requirement does not applyeto E-UTRA BS operating in Band 34
UTRA TDD in Band b) or E-UTRA Band 35	1850 – 1910 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in Band 35
UTRA TDD in Band b) or E-UTRA Band 36	1930 - 1990 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in Band 2 and 36
UTRA TDD in Band c) or E-UTRA Band 37	1910 - 1930 MHz	-52 dBm	1 MHz	This is not applicable to E-UTRA BS operating in Band 37. This unpaired band is defined in ITU-R M.1036, but is pending any future deployment.
UTRA TDD in Band d) or E-UTRA Band 38	2570 – 2620 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in Band 38.
E-UTRA Band 39	1880 – 1920MHz	-52 dBm	1 MHz	This is not applicable to E-UTRA BS operating in Band 39
E-UTRA Band 40	2300 – 2400MHz	-52 dBm	1 MHz	This is not applicable to E-UTRA BS operating in Band 40

NOTE 1: As defined in the scope for spurious emissions in this clause, the co-existence requirements in Table 6.6.3.3-1 do not apply for the 10 MHz frequency range immediately outside the BS transmit frequency range of an operating band (see Table 5.2-1). This is also the case when the transmit frequency range is adjacent to the Band for the co-existence requirement in the table. Emission limits for this excluded frequency range may also be covered by local or regional requirements.

NOTE 2: The table above assumes that two operating bands, where the frequency ranges in Table 5.2-1 would be overlapping, are not deployed in the same geographical area. For such a case of operation with overlapping frequency arrangements in the same geographical area, special co-existence requirements may apply that are not covered by the 3GPP specifications.

6.6.3.4 Co-existence with co-located base stations

These requirements may be applied for the protection of other BS receivers when GSM900, DCS1800, PCS1900, GSM850, UTRA FDD, UTRA TDD and/or E-UTRA BS are co-located with an E-UTRA BS.

The requirements assume a 30 dB coupling loss between transmitter and receiver. If BSs of different classes are co-sited, the coupling loss should be increased by the value as stated in TR 25.942 [13] chapter 10.3 in Table 10.1 and Table 10.2.

NOTE: For co-location with UTRA, the requirements are based on co-location with Wide Area UTRA FDD or TDD base stations.

The power of any spurious emission shall not exceed the limits of Table 6.6.3.4-1 for a BS where requirements for co-location with a BS type listed in the first column apply.

Table 6.6.3.4-1: BS Spurious emissions limits for BS co-located with another BS

Type of co-located BS	Band for co-location requirement	Maximum Level	Measurement Bandwidth	Note
Macro GSM900	876-915 MHz	-98 dBm	100 kHz	
Macro DCS1800	1710 - 1785 MHz	-98 dBm	100 kHz	
Macro PCS1900	1850 - 1910 MHz	-98 dBm	100 kHz	
Macro GSM850	824 - 849 MHz	-98 dBm	100 kHz	
UTRA FDD Band I or E-UTRA Band 1	1920 - 1980 MHz	-96 dBm	100 kHz	
UTRA FDD Band II or E-UTRA Band 2	1850 - 1910 MHz	-96 dBm	100 kHz	
UTRA FDD Band III or E-UTRA Band 3	1710 - 1785 MHz	-96 dBm	100 kHz	
UTRA FDD Band IV or E-UTRA Band 4	1710 - 1755 MHz	-96 dBm	100 kHz	
UTRA FDD Band V or E-UTRA Band 5	824 - 849 MHz	-96 dBm	100 kHz	
UTRA FDD Band VI or E-UTRA Band 6	815 - 850 MHz	-96 dBm	100 kHz	
UTRA FDD Band VII or E-UTRA Band 7	2500 - 2570 MHz	-96 dBm	100 KHz	
UTRA FDD Band VIII or E-UTRA Band 8	880 - 915 MHz	-96 dBm	100 KHz	
UTRA FDD Band IX or E-UTRA Band 9	1749.9 - 1784.9 MHz	-96 dBm	100 KHz	
UTRA FDD Band X or E-UTRA Band 10	1710 - 1770 MHz	-96 dBm	100 kHz	
UTRA FDD Band XI or E-UTRA Band 11	1427.9 - 1452.9 MHz	-96 dBm	100 kHz	
UTRA TDD in Band a) or E-UTRA Band 33	1900 - 1920 MHz	-96 dBm	100 kHz	This is not applicable to E-UTRA BS operating in Band 33
UTRA TDD in Band a) or E-UTRA Band 34	2010 - 2025 MHz	-96 dBm	100 kHz	This is not applicable to E-UTRA BS operating in Band 34
UTRA TDD in Band b) or E-UTRA Band 35	1850 – 1910 MHz	-96 dBm	100 kHz	This is not applicable to E-UTRA BS operating in Band 35
UTRA TDD in Band b) or E-UTRA Band 36	1930 - 1990 MHz	-96 dBm	100 kHz	This is not applicable to E-UTRA BS operating in Band 2 and 36
UTRA TDD in Band c) or E-UTRA Band 37	1910 - 1930 MHz	-96 dBm	100 kHz	This is not applicable to E-UTRA BS operating in Band 37. This unpaired band is defined in ITU-R M.1036, but is pending any future deployment.
UTRA TDD in Band d) or E-UTRA Band 38	2570 – 2620 MHz	-96 dBm	100 kHz	This is not applicable to E-UTRA BS operating in Band 38.
E-UTRA Band 39	1880 – 1920MHz	-96 dBm	100 kHz	This is not applicable to E-UTRA BS operating in Band 33 and 39

E-UTRA Band 40	2300 – 2400MHz	-96 dBm	100 kHz	This is not applicable to E-UTRA BS operating in Band 40

NOTE 1: As defined in the scope for spurious emissions in this clause, the co-location requirements in Table 6.6.3.4-1 do not apply for the 10 MHz frequency range immediately outside the BS transmit frequency range of an operating band (see Table 5.2-1). This is also the case when the transmit frequency range is adjacent to the Band for the co-location requirement in the table. The current state-of-the-art technology does not allow a single generic solution for co-location with other system on adjacent frequencies for 30dB BS-BS minimum coupling loss. However, there are certain site-engineering solutions that can be used. These techniques are addressed in TR 25.942 [13].

NOTE 2: The table above assumes that two operating bands, where the corresponding eNode B transmit and receive frequency ranges in Table 5.2-1 would be overlapping, are not deployed in the same geographical area. For such a case of operation with overlapping frequency arrangements in the same geographical area, special co-location requirements may apply that are not covered by the 3GPP specifications.

NOTE 3: Co-located TDD base stations that are synchronized and using the same operating band can transmit without special co-locations requirements. For unsynchronized base stations, special co-location requirements may apply that are not covered by the 3GPP specifications.

6.6.3.5 Co-existence with PHS

This requirement may be applied for the protection of PHS in geographic areas in which both PHS and E-UTRA are deployed. This requirement is also applicable at specified frequencies falling between 10 MHz below the lowest BS transmitter frequency of the operating band and 10 MHz above the highest BS transmitter frequency of the operating band.

The power of any spurious emission shall not exceed:

Table 6.6.3.5-1: E-UTRA BS Spurious emissions limits for BS in geographic coverage area of PHS

Band	Maximum Level	Measurement Bandwidth	Note
1884.5 - 1919.6 MHz	-41 dBm	300 kHz	

6.7 Transmit intermodulation

The transmit intermodulation requirement is a measure of the capability of the transmitter to inhibit the generation of signals in its non linear elements caused by presence of the own transmit signal and an interfering signal reaching the transmitter via the antenna. Source of interfering signals can be either co-located base stations or other transmitter of the own base station with separated antenna connector.

The transmit intermodulation level is the power of the intermodulation products when a E-UTRA modulated interference signal of 5 MHz bandwidth is injected into the antenna connector at a mean power level of 30 dB lower than that of the mean power of the wanted signal. The wanted signal bandwidth shall be the maximum bandwidth supported by the base station. The centre frequency of the interference signal offset from the subject signal carrier centre frequency shall be plus half of the bandwidth of subject signal +2.5 MHz, +7.5 MHz, +12.5 MHz and minus half of the bandwidth of subject signal -2.5 MHz, -7.5 MHz, -12.5 MHz respectively, but exclude interference frequencies that are partially or complete outside of operating frequency band of the base station.

The transmit intermodulation level shall not exceed the limits of out of band emission or the spurious emission in the presence of a E-UTRA modulated interference signal of 5 MHz bandwidth with a mean power level 30 dB lower than the mean power of the wanted signal. The measurement can be limited to frequencies on which third and fifth order intermodulation products appear, considering the width of these products.

6.8 Transmit modulation

6.8.1 EVM

6.8.1.1 Definition

6.8.1.1.1 Measurement system set-up

The measurement system set-up as currently specified in Annex B.1.2 of [24] for measuring UTRA BS EVM, as depicted in Figure 6.8.1.1-1 below, should be used for measuring E-UTRA BS EVM.

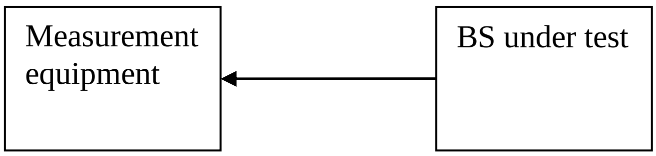

Figure 6.8.1.1-1: Measurement system set up for EVM

6.8.1.1.2 Reference point for measurement

The EVM should be measured at the point after the FFT and a zero-forcing (ZF) equalizer in the receiver, as depicted in Figure 6.8.1.1-2 below [25].

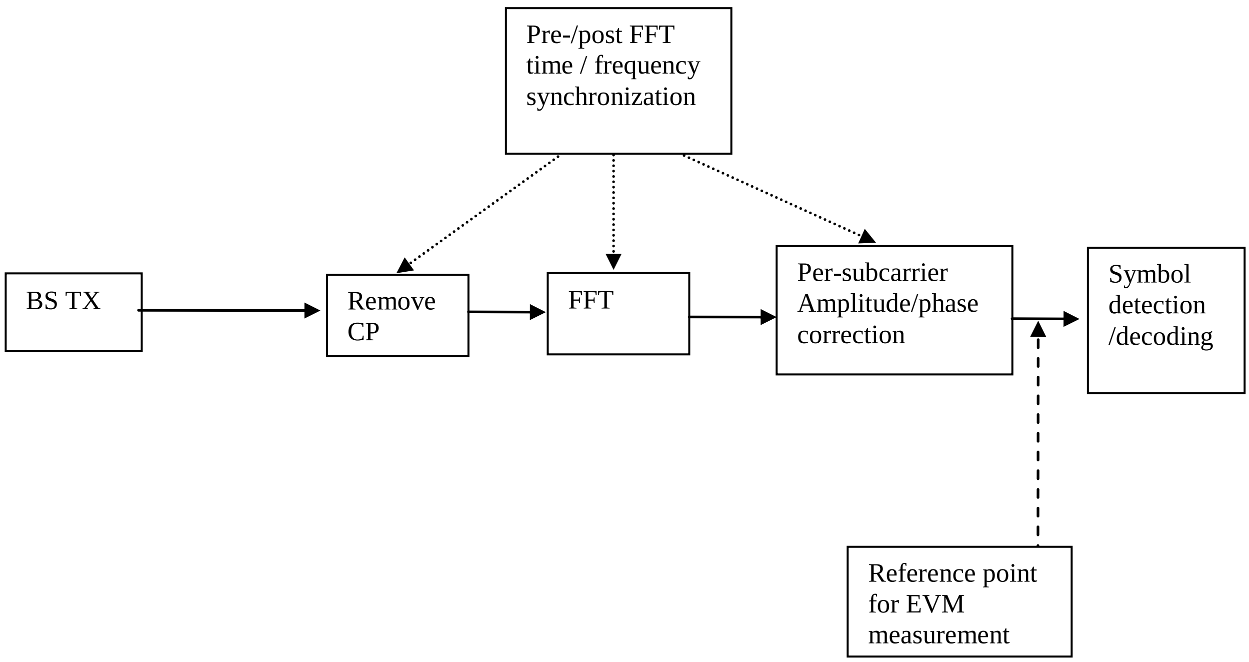

Figure 6.8.1.1-2: Reference point for EVM measurement

6.8.1.1.3 Basic unit of measurement

Separate EVM requirements should be specified for different modulation schemes. The basic unit of EVM measurement is defined over one subframe in the time domain and N_{BW}^{RB} subcarriers (180kHz) in the frequency domain: [25,26,31]

$$EVM = \sqrt{\frac{\sum_{t\in T}\sum_{f\in F(t)}\left|Z'(t,f)-I(t,f)\right|^2}{\sum_{t\in T}\sum_{f\in F(t)}\left|I(t,f)\right|^2}}$$

where

T is the set of symbols with the considered modulation scheme being active within the subframe,

$F(t)$ is the set of subcarriers within the $N_{\mathrm{BW}}^{\mathrm{RB}}$ subcarriers with the considered modulation scheme being active in symbol *t*,

$I(t,f)$ is the ideal signal reconstructed by the measurement equipment in accordance with relevant Tx models,

$Z'(t,f)$ is the modified signal under test defined in 6.8.1.1.4.

Note that a resource block (RB) consists of $N_{symb}^{DL} \times N_{BW}^{RB}$ resource elements, corresponding to one slot (0.5 ms) in the time domain and 180 kHz in the frequency domain [27], i.e. the basic unit of EVM measurement is defined over two temporally consecutive resource blocks.

6.8.1.1.4 Modified signal under test

To minimize the EVM, the signal under test should be modified with respect to a set of parameters following the procedure explained below: [25]

$$Z'(t,f) = \frac{FFT\left\{z(v-\Delta\tilde{t})\cdot e^{-j2\pi\Delta\tilde{f}v}\right\}e^{j2\pi f\Delta\tilde{t}}}{\tilde{a}(t,f)\cdot e^{j\tilde{\varphi}(t,f)}}$$

where

$z(v)$ is the time domain samples of the signal under test.

$\Delta\tilde{t}$ is the sample timing difference between the FFT processing window in relation to nominal timing of the ideal signal.

$\Delta\tilde{f}$ is the RF frequency offset.

$\tilde{\varphi}(t,f)$ is the phase response of the TX chain.

$\tilde{a}(t,f)$ is the amplitude response of the TX chain.

In the following $\Delta\tilde{c}$ represents the middle sample of the EVM window of length W (defined in 6.8.1.1.6) or the last sample of the first window half if W is even.

The EVM analyser shall

- detect the start of each subframe and estimate $\Delta\tilde{t}$ and $\Delta\tilde{f}$,
- determine $\Delta\tilde{c}$ so that the EVM window of length W is centred on the measured cyclic prefix of the considered OFDM symbol. To minimize the estimation error the timing shall be based on the primary synchronization signal and reference signals. To limit time distortion of any transmit filter the reference signals in the [1] outer RBs are not taken into account in the timing estimation.

To determine the other parameters a sample timing offset equal to $\Delta\tilde{c}$ is corrected from the signal under test. The EVM analyser shall then

- correct the RF frequency offset $\Delta\tilde{f}$ for each subframe,

- estimate the TX chain equalizer coefficients $\tilde{a}(t,f)$ and $\tilde{\varphi}(t,f)$ used by the ZF equalizer for all subcarriers by

  1. time averaging at each reference signal subcarrier of the amplitude and phase of the reference symbols, the time-averaging length is 10 subframes This process creates an average amplitude and phase for each reference signal subcarrier (i.e. every third subcarrier with the exception of the reference subcarrier spacing across the DC subcarrier).
  2. smoothing in the frequency of the time averaged amplitude and phase for each reference signal subcarrier domain by applying a moving average filter as described in section 6.8.1.1.8. This will yield equalizer coefficients $\hat{a}(t,f)$ and $\hat{\varphi}(t,f)$ at each reference signal subcarrier
  3. performing linear interpolation from the equalizer coefficients $\hat{a}(t,f)$ and $\hat{\varphi}(t,f)$ to compute coefficients $\tilde{a}(t,f)$, $\tilde{\varphi}(t,f)$ for each subcarrier.
  4. performing linear extrapolation from the equalizer coefficients $\hat{a}(t,f)$ and $\hat{\varphi}(t,f)$ to compute coefficients $\tilde{a}(t,f)$, $\tilde{\varphi}(t,f)$ for any subcarriers that exist beyond the last reference signal subcarrier at the lower and upper end of the channel.

At this stage estimates of $\Delta\tilde{f}$, $\tilde{a}(t,f)$, $\tilde{\varphi}(t,f)$ and $\Delta\tilde{c}$ are available. $\Delta\tilde{t}$ is one of the extremities of the window W, i.e. $\Delta\tilde{t}$ can be $\Delta\tilde{c}+\alpha-\left\lfloor\frac{W}{2}\right\rfloor$ or $\Delta\tilde{c}+\left\lfloor\frac{W}{2}\right\rfloor$, where $\alpha=0$ if W is odd and $\alpha=1$ if W is even. The EVM analyser shall then

- calculate EVM$_l$ with $Z'(t,f)$ set to $$Z'_l(t,f)=\frac{FFT\left\{z\left(v-\left(\Delta\tilde{c}+\alpha-\left\lfloor\frac{W}{2}\right\rfloor\right)\right)\cdot e^{-j2\pi\Delta\tilde{f}v}\right\}.e^{j2\pi f\left(\Delta\tilde{c}+\alpha-\left\lfloor\frac{W}{2}\right\rfloor\right)}}{\tilde{a}(t,f)\cdot e^{j\tilde{\varphi}(t,f)}},$$
- calculate EVM$_h$ with $Z'(t,f)$ set to $$Z'_h(t,f)=\frac{FFT\left\{z\left(v-\left(\Delta\tilde{c}+\left\lfloor\frac{W}{2}\right\rfloor\right)\right)\cdot e^{-j2\pi\Delta\tilde{f}v}\right\}.e^{j2\pi f\left(\Delta\tilde{c}+\left\lfloor\frac{W}{2}\right\rfloor\right)}}{\tilde{a}(t,f)\cdot e^{j\tilde{\varphi}(t,f)}}.$$

6.8.1.1.5 Timing offset

As a result of using a cyclic prefix, there is a range of $\Delta\tilde{t}$, which, at least in the case of perfect Tx signal quality, would give close to minimum error vector magnitude. As a first order approximation, that range should be equal to the length of the cyclic prefix. Any time domain windowing or FIR pulse shaping applied by the transmitter reduces the $\Delta\tilde{t}$ range within which the error vector is close to its minimum.

When the cyclic prefix length varies from symbol to symbol (e.g. time multiplexed MBMS and unicast) then T should be further restricted to the subset of symbols with the considered modulation scheme being active and with the considered cyclic prefix length type.

6.8.1.1.6 Window length

The window length W affects EVM, and could be expressed as a certain percentage of the configured cyclic prefix length. In the case where equalization is present, as with frequency domain EVM computation, the effect of FIR is reduced. This is because the equalization can correct most of the linear distortion introduced by the FIR. However, the time domain windowing effect can't be removed.

6.8.1.1.6.1 Window length for normal CP

The table below specifies EVM window length for channel bandwidths 1.4, 3, 5, 10, 15, 20 MHz [32], for normal CP. . The nominal window length for 3 MHz is rounded down one sample to allow the window to be centered on the symbol.

Table 6.8.1.1-1 EVM window length for normal CP

Channel Bandwidth MHz	Cyclic prefix length N_{cp} for symbol 0	Cyclic prefix length N_{cp} for symbols 1 to 6	Nominal FFT size	Cyclic prefix for symbols 1 to 6 in FFT samples	EVM window length W	Ratio of W to CP for symbols 1 to 6*
1.4	160	144	128	9	[7]	[77.8]
3			256	18	[14]	[77.8]
5			512	36	[32]	[88.9]
10			1024	72	[66]	[91.7]
15			1536	108	[102]	[94.4]
20			2048	144	[136]	[94.4]
* Note: These percentages are informative and apply to symbols 1 through 6. Symbol 0 has a longer CP and therefore a lower percentage.						

6.8.1.1.6.2 Window length for extended CP

The table below specifies the EVM window length at channel bandwidths 1.4, 3, 5, 10, 15, 20 MHz [32], for extended CP. The nominal window lengths for 3 MHz and 15 MHz are rounded down one sample to allow the window to be centered on the symbol.

Table 6.8.1.1-2 EVM window length for extended CP

Channel Bandwidth MHz	Cyclic prefix length N_{cp}	Nominal FFT size	Cyclic prefix in FFT samples	EVM window length W	Ratio of W to CP*

1.4	512	128	32	[30]	[93.8]
3		256	64	[60]	[93.8]
5		512	128	[124]	[96.9]
10		1024	256	[250]	[97.4]
15		1536	384	[374]	[97.4]
20		2048	512	[504]	[98.4]
* Note: These percentages are informative					

6.8.1.1.7 Observation period for sample timing difference and frequency offset

The observation period for determining the sample timing difference $\Delta\tilde{t}$ and frequency offset $\Delta\tilde{f}$ should be specified in the standards to avoid diverging measurement results from different implementations in the measurement equipments. The working assumption is that the observation period should be one subframe (1ms).

6.8.1.1.8 Determination of equalizer coefficients

Constrained equalizer coefficients at the reference signal subcarriers $\hat{a}(t, f)$ and $\hat{\varphi}(t, f)$ are derived from the time averaged values by applying smoothing in the frequency domain. This is done to constrain the amount of BS TX impairments which can be removed by the equalizer, particularly in the centre of the channel.

The equalizer coefficients for amplitude and phase $\hat{a}(t, f)$ and $\hat{\varphi}(t, f)$ are obtained by computing the moving average in the frequency domain of the time-averaged reference signal subcarriers. The moving average window size is 19. For reference subcarriers at or near the edge of the channel the window size is reduced accordingly as per figure 6.8.1.1.8. The use of information other than from the reference symbols to compute the TX chain equalizer coefficients – such as data and control information – is precluded since this information is not readily available to the UE in a real-time receiver.

This constrained equalizer definition is not meant to imply any performance or implementation in the UE and is intended only as a stable reference against which BS TX impairments can be evaluated.

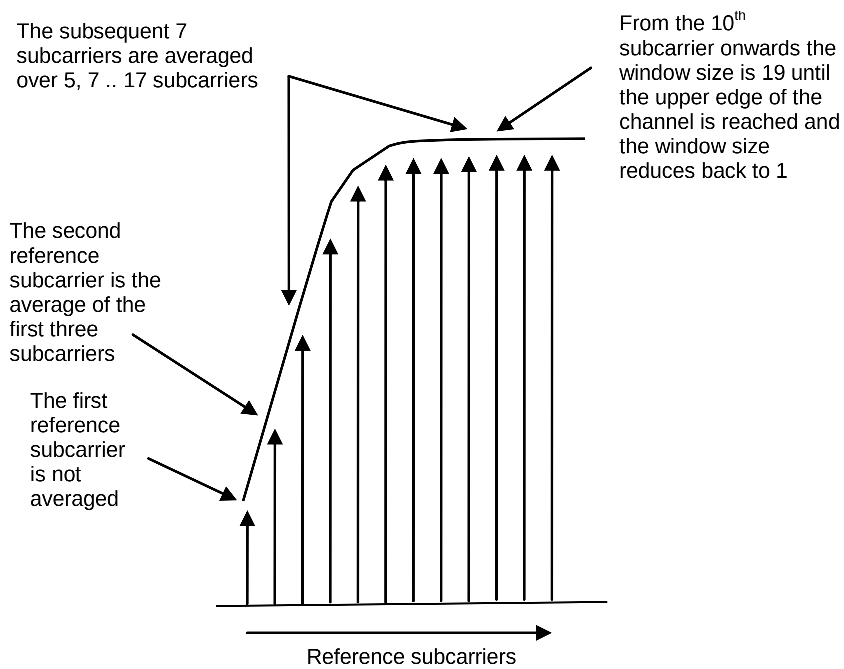

Figure 6.8.1.1-1: Reference subcarrier smoothing in the frequency domain

6.8.1.1.9 EVM requirements

The EVM requirements should be tested against the maximum of the RMS average at the window W extremities of the EVM measurements (i.e. EVM_l and EVM_h) over all allocated resource blocks with the considered modulation scheme in the frequency domain and 10 consecutive downlink subframes (10 ms) in the time domain, i.e. [26]

$$\overline{EVM} = \sqrt{\frac{1}{\sum_{i=1}^{10} Ni} \sum_{i=1}^{10} \sum_{j=1}^{Ni} EVM_{i,j}^2}$$

$$EVM = \max(\overline{\mathrm{EVM}}_l, \overline{\mathrm{EVM}}_h)$$

Where

Ni is the number of resource blocks with the considered modulation scheme in subframe i and x is either l or h. For frame structure type 2, subframes with special fields (DwPTS and GP) are not included in the averaging.

6.8.1.2 EVM Requirement

Regarding EVM levels appropriate for a general minimum performance requirement for modulation accuracy, contribution [16] provided some analysis including 64QAM 8/9 MCS and MIMO and indicated required average EVM levels in the order 6.5 … 8.5 %, depending on the methodology used of deriving the requirement. The semi-analytical analysis in [23] concluded that an average EVM of 7% would be suitable for E-UTRA 64QAM MCS curves based on a S/N in the range of 14dB to 19dB and 5% Tput loss criteria. Further system simulation results were provided in [22] and concluded that 7 % average EVM will limit the Tput loss for 64QAM modulated RBs to ~5 %.

Contributions [19][20] considered potential gains in system performance (user Tput) by using a very low EVM (~4 %) for deployment scenarios with a very high selection probability of 64QAM MCS. One example for such a case is partial system loading with a more favourable C/I distribution [19]. As discussed in [17][18], several methods exist for reducing the EVM in such scenarios, however, they all require some form of mitigation against increasing PAPR, e.g. power reduction on RBs, reserving RBs for enabling TR schemes [8][11], not scheduling 64QAM on all RBs simultaneously, etc.

It is expected that it will not be possible to identify and agree a single “winning” combination of these alternatives which would be optimal for all possible deployment scenarios. The related RAN4 specifications on modulation accuracy for both, a general requirement as well as test specification, would also become very complex if all of the above PAPR related mitigation alternatives would be explicitly supported. This would require e.g. to formulate parameters of the EVM requirements (like EVM % or TX power or # of reserved RBs) as a function of the used 64QAM modulated RBs.

It is believed that such an approach would not be practical, both from the specification complexity as well as the E-UTRA time schedule point of view. Therefore it is proposed that the RAN4 specifications should not mandate a certain PAPR mitigation approach, but instead leave it to the system vendor to optimise the system performance for special scenarios with high selection probability of 64QAM MCS. However, a general minimum performance requirement for modulation accuracy needs to be set so as to ensure a robust baseline performance of the system and it is believed that based on the above mentioned analysis 7 % [-23 dBc] average EVM is an adequate minimum performance requirement.

However, noting that work on the EVM measurement definition is still ongoing and that there remain uncertainties, some margin should be reserved. A range of [7 …8 %] EVM is therefore proposed as a working assumption for 64QAM modulated RBs and is subject to finalising work on the definition of the EVM.

[12.5 %] and [17.5 %] are proposed as minimum performance requirement for 16QAM, respectively QPSK modulated RBs.

When defining UE RX minimum performance demodulation requirements this approach should be taken in to account.

<Text will be added.>

7 Receiver characteristics

7.1 General

The requirements in Section 7 assume reception with a single antenna. In case of multiple receive antennas the requirements apply to each antenna connector separately, with the other one(s) terminated or disabled. Unless otherwise stated, the requirements remain unchanged.

Unless otherwise stated, the receiver characteristics are specified at the BS antenna connector (test port A) with a full complement of transceivers for the configuration in normal operating conditions. If any external apparatus such as a RX amplifier, a filter or the combination of such devices is used, requirements apply at the far end antenna connector (port B).

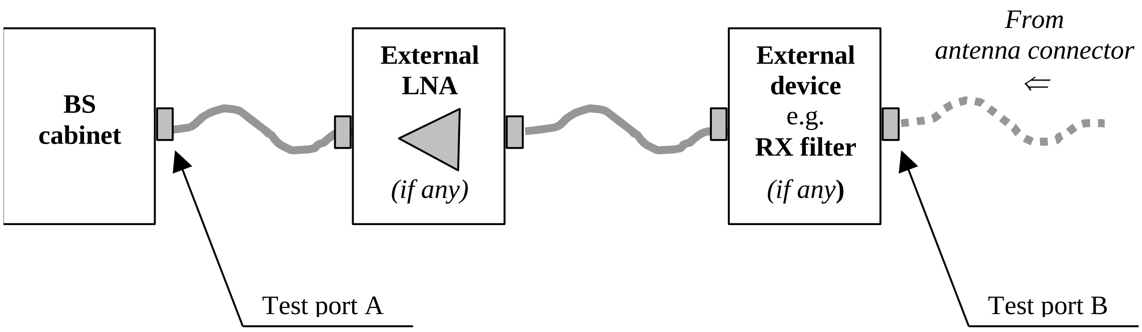

Figure 7.1: Receiver test ports

7.2 Reference sensitivity level

The primary purpose of the reference sensitivity requirement is to verify the receiver noise figure. Other RX impairments such as RX EVM will be included within the receiver dynamic range / demodulation performance requirements at higher SNR points.

A UE may be assigned only a small part of the uplink channel bandwidth, making the transmission more susceptible to narrowband spuriouses that affect only a small number of resource blocks. Putting sensitivity requirements on individual resource blocks will however put unnecessary tough requirements on the analogue receiver parts. It was therefore agreed to select a granularity of 25 resource blocks for the receiver sensitivity definition. This puts the requirement on par with the WCDMA receiver sensitivity.

The reference sensitivity level is calculated on the basis of the base station receiver noise power and predefined SNR operating point. Taking into account EVM testing is left to high throughput reference measurement channel with high SNR operating point, the reference sensitivity testing is left to low throughput reference measurement channel with low SNR operating point. Assuming the base station receiver noise figure of 5dB, SNR operating point equal to 95% relative of nominal throughput with [y]dB implementation margin and 90% bandwidth efficiency (77.14% for 1.4MHz channel bandwidth), the base station reference sensitivity level for different channel bandwidths looks as follows:

Table 7.2-1. E-UTRA BS reference sensitivity level

E-UTRA channel bandwidth (MHz)	Reference measurement channel	BS reference sensitivity level
1.4	FRC A1-1 in Annex A.1	-108.7-0.6+2.0 dBm
3	FRC A1-2 in Annex A.1	-104.7-0.9+2.0 dBm

5	FRC A1-3 in Annex A.1	-102.5-1.1+2.0 dBm
10	FRC A1-3 in Annex A.1*	-102.5-1.1+2.0 dBm
15	FRC A1-3 in Annex A.1*	-102.5-1.1+2.0 dBm
20	FRC A1-3 in Annex A.1*	-102.5-1.1+2.0 dBm
Note*: The requirement shall be met in consecutive application of FRC A1-3 to chunks of 25 resource blocks		

The reference sensitivity level is the minimum mean power received at the antenna connector at which the throughput shall be ≥ 95% of the maximum throughput (see Table A.1-1).

7.3 Dynamic range

The intention of the dynamic range requirement is to ensure that the base station can receive high throughput also in the presence of increased interference and high wanted signal levels. This requirement measures the effects of receiver impairments such as receiver EVM. While measuring these effects, there should be only negligible uncertainty due to the receiver's own thermal noise floor (e.g. 0.1dB impact).

The dynamic range requirement of the E-UTRA system is specified as a measure of the capability of the receiver to receive a wanted signal in the presence of interfering signal in the reception frequency channel at which the throughput shall be ≥ 95% of the maximum throughput (see Table A.2-1). This is shown in Table 7.3-1.

The interfering signal for the E-UTRA base station dynamic range requirement is AWGN signal. The mean power of this signal is equal to the receiver noise floor increased by a certain margin in order to mask the receiver's own noise floor. Based on simulations [34], additional noise of 20 dB should be appropriate. A 20 dB rise of the power of the wanted signal appears to be also a reasonable assumption from a scenario point of view, covering for both, noise rise due to other-cell interference as well as possible UL power control errors of the wanted signal.

The mean power of the wanted signal is equal to the sum of interfering signal power, SNR point and a desensitization margin. In order to make the test sensitive to receiver EVM impairments, the wanted signal is a 16QAM signal and the SNR operating point [x]dB is defined at 95% relative throughput from link level simulations. Implementation margin [y]dB includes base-band demodulation imperfections (e.g. due to channel estimation), receiver impairments (EVM). The same granularity of 25 resource blocks as for the receiver sensitivity definition is agreed.

Table 7.3-1 E-UTRA BS dynamic range requirement, paired spectrum, Wide Area BS

E-UTRA channel bandwidth (MHz)	Reference measurement channel	Wanted signal mean power [dBm]	Interfering signal mean power [dBm] /channel BW	Type of interfering signal
1.4	FRC A.2-1 in Annex A.2	[-88.7+9.4+2.5]	[-88.7]	AWGN
3	FRC A2-2 in Annex A.2	[-84.7+9.3+2.5]	[-84.7]	AWGN
5	FRC A2-3 in Annex A.2	[-82.5+9.2+2.5]	[-82.5]	AWGN
10	FRC A2-3 in Annex A.2*	[-82.5+9.2+2.5]	[-79.5]	AWGN
15	FRC A2-3 in Annex A.2*	[-82.5+9.2+2.5]	[-77.7]	AWGN
20	FRC A2-3 in Annex A.2*	[-82.5+9.2+2.5]	[-76.4]	AWGN
Note*: The requirement shall be met in consecutive application of FRC A2-3 to chunks of 25 resource blocks				

7.4 Adjacent Channel Selectivity (ACS)

7.4.1 ACS as specified for UTRA BS

The Adjacent Channel Selectivity (ACS) for the BS was specified in 3GPP together with the ACLR, based on extensive simulations documented in TR 25.942 [13]. As explained in clause 6.6.2.1.1, the parameters are closely linked from a system performance point of view and have been an effective tool in co-existence studies.

Adjacent Channel Selectivity (ACS) = A measure of the receiver ability to receive a wanted signal at is assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the center frequency of the assigned channel. ACS is the ratio of the receiver filter attenuation on the assigned channel frequency to the receiver filter attenuation on the adjacent channel(s).

ACS cannot be directly measured, but is defined by stating a certain receiver performance (BER = 0.001) at a specified data rate, wanted signal mean power and interfering signal mean power, where the interferer is a UTRA signal located on the adjacent channel at 5 MHz spacing or 1.6MHz spacing. The wanted signal mean power is 6 dB above the reference sensitivity, implying 6 dB degradation ("noise rise") at the receiver. This does not mean that 6 dB degradation is allowed, it is simply a selected test parameter in order to make the interference impact measurable.

The BS ACS is only defined at a single low input level (at 6dB desensitization), while the UE ACS is defined at both a low input level and a second 27 dB higher input level, in order to capture also the dynamic range requirements of the receiver.

The selected set of parameters for UTRA FDD BS in TS 25.104 [1] corresponds to an ACS value of 46 dB, assuming a 5 dB noise figure of the BS receiver.

7.4.2 ACS requirement for E-UTRA BS

An ACS requirement can be defined for E-UTRA in a way similar as for UTRA. The main difference is that E-UTRA is defined with multiple channel bandwidths and there are also interference scenarios with many types of systems with different bandwidths on adjacent channels, in addition to E-UTRA. The scenario for UTRA with narrowband systems on the adjacent channel was covered by a "narrowband blocking requirement" as discussed in clause 7.5.

The ACS requirement (as well as the UTRA narrowband blocking) fundamentally sets the receiver selectivity of the base station. The limiting situation is an adjacent strong signal, while requirements further off are defined by the blocking requirements. The following two signals are used to define the E-UTRA ACS/ narrowband blocking requirement:

- A single resource block signal from an adjacent E-UTRA system with minimum centre frequency offset of the interfering signal to the band edge of a victim system equal to 340kHz (250 and 240kHz for 1.4 and 3MHz channel bandwidth, respectively). This corresponds to the narrowband blocking requirement for UTRA and is shown in Table 7.4.2-1.

- A wideband signal in an adjacent channel position. The wideband signal is a 5 MHz E-UTRA carrier (1.4 and 3MHz E-UTRA carrier for 1.4 and 3MHz channel bandwidth, respectively), independent of the E-UTRA channel bandwidth with minimum centre frequency offset of the interfering signal to the band edge of a victim system equal to 2.5MHz (700kHz and 1.5MHz for 1.4 and 3MHz channel bandwidth, respectively) - see Table 7.4.2-2. For frequency ranges beyond 5 MHz, the selectivity is defined by the blocking requirement. The main reason to have an ACS test with a wider band signal is not to test a wider part of the selectivity curve, but rather to test the selectivity with a modulated signal. It is from this point of view not of high importance if it is a UTRA or an E-UTRA signal that is used to define the requirement.

The mean power of the E-UTRA interfering signal for ACS requirement is equal to -52dBm as for the UTRA system.

The mean power of a single resource block interfering signal is equal to -49dBm.

For ACS requirement, the mean power of wanted signal for channel bandwidths ≥ 5 MHz is defined by the reference sensitivity + 6dB, while it is REFSENS + 8 dB for 3 MHz and REFSENS + 11 dB for 1.4 MHz. All values are based on an ACS level of 46 dB.

For narrowband blocking requirement, the mean power of wanted signal is defined by the reference sensitivity + 6dB.

The same granularity of 25 resource blocks as for the receiver sensitivity definition is proposed.

It is believed that the proposed narrowband blocking requirement (based on an E-UTRA scenario) cover also the relevant GSM scenarios. Taking the proposal for 1.4MHz E-UTRA as an example, the offset of 250 kHz from the nominal channel edge is in line with possible GSM carrier locations (200kHz or 300kHz offset from the band edge). While the proposed E-UTRA interfering signal power is slightly lower compared to the corresponding values in current UTRA specifications, it should be noted that the E-UTRA signal is amplitude modulated signal, so it is a more stringent interferer than the GMSK one used for UTRA.

Table 7.4.2-1 E-UTRA BS narrowband blocking requirement

E-UTRA channel bandwidth (MHz)	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering RB centre frequency offset to the band edge of the wanted carrier [kHz]	Type of interfering signal
1.4	REFSENS + 6dB	-49	250+m*180, m=0, 1, 2, 3, 4, 5	1.4 MHz E-UTRA signal, 1 RB*
3	REFSENS + 6dB	-49	240+m*180, m=0, 1, 2, 3, 4, 7, 10, 13	3 MHz E-UTRA signal, 1 RB*
5	REFSENS + 6dB	-49	340+m*180, m=0, 1, 2, 3, 4, 9, 14, 19, 24	5 MHz E-UTRA signal, 1 RB*
10	REFSENS + 6dB	-49	340+m*180, m=0, 1, 2, 3, 4, 9, 14, 19, 24	5 MHz E-UTRA signal, 1 RB*
15	REFSENS + 6dB	-49	340+m*180, m=0, 1, 2, 3, 4, 9, 14, 19, 24	5 MHz E-UTRA signal, 1 RB*
20	REFSENS + 6dB	-49	340+m*180, m=0, 1, 2, 3, 4, 9, 14, 19, 24	5 MHz E-UTRA signal, 1 RB*
Note*: Interfering signal consisting of one resource block adjacent to the wanted signal's band edge				

Table 7.4.2-2 E-UTRA BS ACS requirement

E-UTRA channel bandwidth (MHz)	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering signal centre frequency offset to the band edge of the wanted carrier [MHz]	Type of interfering signal
1.4	REFSENS + 11dB	-52	0.7	1.4MHz E-UTRA signal
3	REFSENS + 8dB	-52	1.5	3MHz E-UTRA signal
5	REFSENS + 6dB	-52	2.5	5MHz E-UTRA signal
10	REFSENS + 6dB	-52	2.5	5MHz E-UTRA signal
15	REFSENS + 6dB	-52	2.5	5MHz E-UTRA signal
20	REFSENS + 6dB	-52	2.5	5MHz E-UTRA signal

7.5 Blocking characteristics

The blocking performance requirement of the E-UTRA system is specified as a measure of the receiver ability to receive a wanted signal at its assigned channel frequency in the presence of an unwanted interferer – 1.4MHz, 3MHz or 5MHz E-UTRA carrier for in-band blocking, CW signal for out-of-band blocking, on frequencies other than those "close-in" to the wanted channel. The example for operating band: 1, centre frequency of interfering signal: 1900 - 2000MHz is shown in Table 7.5-1. The operating band: 1, centre frequency of interfering signal: 1 - 1900MHz, 2000 - 12750MHz is shown in Table 7.5-2.

For channel bandwidths below 5MHz the E-UTRA interfering signal centre frequency corresponds to the second adjacent channel. For E-UTRA channel bandwidths equal to and higher than 5MHz, the minimum offset between the interfering signal centre frequency and the nominal band edge of the wanted carrier is 7.5MHz.

The mean power of the E-UTRA interfering signal is equal to -43dBm which is a compromise between the 30dBm Maximum Output Power and the 24dBm assumption in 36.942 under worst case MCL conditions.

The mean power of the CW interfering signal is equal to -15dBm as for the UTRA system.

The same granularity of 25 resource blocks as for the receiver sensitivity definition is agreed.

Table 7.5-1 E-UTRA BS blocking requirements, operating band 1 as an example: centre frequency of interfering signal: 1900 – 2000 MHz, paired spectrum

E-UTRA Assigned BW (MHz)	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering signal minimum offset to the band edge of the wanted carrier [MHz]	Type of interfering signal
1.4	REFSENS + 6dB	-43	2.1	1.4MHz E-UTRA signal
3	REFSENS + 6dB	-43	4.5	3MHz E-UTRA signal
5	REFSENS + 6dB	-43	7.5	5MHz E-UTRA signal
10	REFSENS + 6dB	-43	7.5	5MHz E-UTRA signal
15	REFSENS + 6dB	-43	7.5	5MHz E-UTRA signal
20	REFSENS + 6dB	-43	7.5	5MHz E-UTRA signal

Table 7.5-2 E-UTRA BS blocking requirements, operating band 1 as an example: centre frequency of interfering signal: 1 - 1900 MHz, 2000 - 12750 MHz, paired spectrum

E-UTRA Assigned BW (MHz)	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering signal minimum offset to the band edge of the wanted carrier [MHz]	Type of interfering signal
1.4	REFSENS + 6dB	-15	-	CW carrier
3	REFSENS + 6dB	-15	-	CW carrier
5	REFSENS + 6dB	-15	-	CW carrier
10	REFSENS + 6dB	-15	-	CW carrier
15	REFSENS + 6dB	-15	-	CW carrier
20	REFSENS + 6dB	-15	-	CW carrier

Table 7.5-3 E-UTRA BS blocking requirements, operating band 33 as an example: centre frequency of interfering signal: 1880 – 1940 MHz, unpaired spectrum

E-UTRA Assigned BW (MHz)	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering signal minimum offset to the band edge of the wanted carrier [MHz]	Type of interfering signal
1.4	REFSENS + 6dB	-43	2.4	1.6MHz E-UTRA signal
3	REFSENS + 6dB	-43	4.8	3.2MHz E-UTRA signal
5	REFSENS + 6dB	-43	7.5	5MHz E-UTRA signal
10	REFSENS + 6dB	-43	7.5	5MHz E-UTRA signal
15	REFSENS + 6dB	-43	7.5	5MHz E-UTRA signal
20	REFSENS + 6dB	-43	7.5	5MHz E-UTRA signal

Table 7.5-4 E-UTRA BS blocking requirements, operating band 33 as an example: centre frequency of interfering signal: 1 - 1880 MHz, 1940 - 12750 MHz, unpaired spectrum

E-UTRA Assigned BW (MHz)	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering signal minimum offset to the band edge of the wanted carrier [MHz]	Type of interfering signal
1.4	REFSENS + 6dB	-15	-	CW carrier
3	REFSENS + 6dB	-15	-	CW carrier
5	REFSENS + 6dB	-15	-	CW carrier
10	REFSENS + 6dB	-15	-	CW carrier
15	REFSENS + 6dB	-15	-	CW carrier
20	REFSENS + 6dB	-15	-	CW carrier

7.5.1 Blocking requirement for co-location with GSM, UTRA- and E-UTRA operating in different frequency bands

This additional blocking requirement may be applied for the protection of E-UTRA BS receivers when GSM, UTRA or E-UTRA BS operating in a different frequency band are co-located with a E-UTRA BS. The requirement is applicable to all channel bandwidths supported by the E-UTRA BS.

The requirements in this chapter assume a 30 dB coupling loss between transmitter and receiver.

For a E-UTRA BS, the static reference performance as specified for reference sensitivity in section 7.2 shall be met with a wanted and an interfering signal coupled to the BS antenna input using the parameters in Table 7.5.1-1.

Requirements for other BS classes are ffs.

Table 7.5.1-1: Blocking performance requirement for E-UTRA BS when co-located with BS in other frequency bands.

Co-located BS type	Center Frequency of Interfering Signal (MHz)	Interfering Signal mean power (dBm)	Wanted Signal mean power (dBm)	Type of Interfering Signal
Macro GSM850	869 – 894	+16	[REFSENS + [6]dB]	CW carrier
Macro GSM900	921 – 960	+16	[REFSENS + [6]dB]	CW carrier
Macro DCS1800	1805 – 1880	+16	[REFSENS + [6]dB]	CW carrier
Macro PCS1900	1930 – 1990	+16	[REFSENS + [6]dB]	CW carrier
UTRA or E-UTRA – FDD Operating Band I	2110 – 2170	+16	[REFSENS + [6]dB]	CW carrier
UTRA or E-UTRA – FDD Operating Band II	1930 – 1990	+16	[REFSENS + [6]dB]	CW carrier
UTRA or E-UTRA – FDD Operating Band III	1805 – 1880	+16	[REFSENS + [6]dB]	CW carrier
UTRA or E-UTRA – FDD Operating Band IV	2110 – 2155	+16	[REFSENS + [6]dB]	CW carrier
UTRA or E-UTRA – FDD Operating Band V	869 – 894	+16	[REFSENS + [6]dB]	CW carrier
UTRA or E-UTRA – FDD Operating Band VI	875 – 885	+16	[REFSENS + [6]dB]	CW carrier
UTRA or E-UTRA – FDD Operating Band VII	2620 – 2690	+16	[REFSENS + [6]dB]	CW carrier
UTRA or E-UTRA – FDD Operating Band VIII	925 – 960	+16	[REFSENS + [6]dB]	CW carrier
UTRA or E-UTRA – FDD Operating Band IX	1844.9 – 1879.9	+16	[REFSENS + [6]dB]	CW carrier
UTRA or E-UTRA - FDD Operating Band X	2110 – 2170	+16	[REFSENS + [6]dB]	CW carrier
UTRA TDD in Band a)	1900-1920 2010-2025	+16	[REFSENS + [6]dB]	CW carrier
E-UTRA TDD in Band 33	1900-1920	+16	[REFSENS + [6]dB]	CW carrier
E-UTRA TDD in Band 34	2010-2025	+16	[REFSENS + [6]dB]	CW carrier
UTRA TDD in Band b)	1850-1910 1930-1990	+16	[REFSENS + [6]dB]	CW carrier
E-UTRA TDD in Band 35	1850-1910	+16	[REFSENS + [6]dB]	CW carrier
E-UTRA TDD in Band 36	1930-1990	+16	[REFSENS + [6]dB]	CW carrier
UTRA TDD in Band c) or E-UTRA TDD in Band 37	1910-1930	+16	[REFSENS + [6]dB]	CW carrier
UTRA TDD in Band d) or E-UTRA in Band 38	2570-2620	+16	[REFSENS + [6]dB]	CW carrier
Note: REFSENS is related to the channel bandwidth and specified in section 7.2				
NOTE: Some combinations of bands may not be possible to co-site based on the requirements above. The following note is included in TS25.104: "The current state-of-the-art technology does not allow a single generic solution for co-location with UTRA-TDD on adjacent frequencies for 30dB BS-BS minimum coupling loss. However, there are certain site-engineering solutions that can be used. These techniques are addressed in TR 25.942" [13].				

7.6 Intermodulation characteristics

The intermodulation performance requirement of the E-UTRA system is specified as a measure of the capability of the receiver to receive a wanted signal on its assigned channel frequency in the presence of two interfering signals which have a specific frequency relationship to the wanted signal. This is shown in Table 7.6-1 for intermodulation and in Table 7.6-2 for narrowband intermodulation.

The interfering signals for E-UTRA base station intermodulation performance requirement are CW and 5MHz E-UTRA signal (1.4 and 3MHz for 1.4 and 3MHz wanted signal channel bandwidths, respectively). 5MHz E-UTRA signal cover both UTRA modulation formats and other bandwidth E-UTRA interferers. This simplifies the test equipment.

In case of narrowband intermodulation performance requirement the following interference signals are used: CW signal and single resource block transmission from an adjacent E-UTRA system.

The offset between the E-UTRA interfering signal centre frequency and the nominal band edge of the wanted carrier is specified on the basis of the worst case scenario – the intermodulation products fall (almost) on the edge resource blocks of an operating channel bandwidth (77.14% bandwidth efficiency for 1.4MHz channel bandwidth and 90% bandwidth efficiency for other channel bandwidths, the E-UTRA interferer should be on the100 kHz raster).

For narrowband intermodulation performance requirement, the CW signal and interfering single resource block centre frequency offsets to the band edge of a victim system are defined assuming there are fixed centre frequencies of interfering single resource blocks and assuming the CW signal is chosen such that it corresponds approximately to the centre frequency of the closest possible interfering resource block. Undesired intermodulation product will always be produced on the centre frequency of the closest victim resource block to the interfering signal, i.e. this is the edge RB of the victim carrier. These frequency offsets correspond to the worst case in the sense that they are the closest possible to the victim carrier and thus the least amount of RX filtering would be available to mitigate against intermodulation.

It was shown in [30] for the worst case that there is a very low probability (0.1%) that total received power from two E-UTRA interferers generating undesired intermodulation product exceeded -51.7dBm simultaneously. Therefore, the interfering signal mean power of -52dBm is proposed. The same granularity of 25 resource blocks as for the receiver sensitivity definition is proposed.

Table 7.6-1 E-UTRA BS intermodulation performance requirement

E-UTRA channel bandwidth (MHz)	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering signal centre frequency offset to the band edge of the wanted carrier [MHz]	Type of interfering signal
1.4	REFSENS + 6dB	-52	2.1	CW
		-52	4.9	1.4MHz E-UTRA signal
3	REFSENS + 6dB	-52	4.5	CW
		-52	10.5	3MHz E-UTRA signal
5	REFSENS + 6dB	-52	7.5	CW
		-52	17.5	5MHz E-UTRA signal
10	REFSENS + 6dB	-52	7.5	CW
		-52	17.7	5MHz E-UTRA signal
15	REFSENS + 6dB	-52	7.5	CW
		-52	18	5MHz E-UTRA signal
20	REFSENS + 6dB	-52	7.5	CW
		-52	18.2	5MHz E-UTRA signal

Table 7.6-2 E-UTRA BS narrowband intermodulation performance requirement

E-UTRA channel bandwidth (MHz)	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering signal offset to the band edge of the wanted carrier [kHz]	Type of interfering signal
1.4	REFSENS + 6dB	-52	270	CW
		-52	790	1.4 MHz E-UTRA signal, 1 RB*
3	REFSENS + 6dB	-52	275	CW
		-52	790	3 MHz E-UTRA signal, 1 RB*
5	REFSENS + 6dB	-52	360	CW
		-52	1060	5 MHz E-UTRA signal, 1 RB*
10	REFSENS + 6dB	-52	415	CW
		-52	1420	5 MHz E-UTRA signal, 1 RB*
15	REFSENS + 6dB	-52	380	CW
		-52	1600	5MHz E-UTRA signal, 1 RB*

20	REFSENS + 6dB	-52	345	CW
		-52	1780	5MHz E-UTRA signal, 1 RB*
Note*: Interfering signal consisting of one resource block positioned at the stated offset.				

7.7 In-channel selectivity

In-channel selectivity (ICS) is a measure of the receiver ability to receive a wanted signal at its assigned resource block locations in the presence of another in-channel wanted signal received at a much larger power spectral density.

It is proposed to define the UL signal for just 2 users, one being the “wanted” signal and the other one being the “interfering” signal at elevated power. The following wanted/interfering RB allocations are proposed:

Table 7.7-1: Wanted/interfering RB allocations

E-UTRA channel BW [MHz]	RBs	RBs wanted signal	RBs interfering signal
1.4	6	3	3
3	15	9	6
5	25	15	10
10	50	25	25
15	75	25	25
20	100	25	25

In case of 15, 20 MHz the 25 RB allocations of the wanted / interfering signals are proposed to be adjacently around DC in order to be sensitive to the RF impairments of RX image leakage, EVM, IMD3 and LO phase noise.

Regarding the interferer level, it is proposed to conduct this test for a 16QAM “interfering” RB allocation 25 dB above its noise floor, corresponding to a 16 dB interference-over-thermal [4] and a 9 dB C/I assumption. Table 2 summarizes the required level of the interfering signals:

Table 7.7-2: Required level of the 16QAM modulated interfering signal

E-UTRA channel BW [MHz]	RBs wanted signal	RBs interfering signal	Interfering signal level [dBm]
1.4	3	3	-87
3	9	6	-84
5	15	10	-81
10	25	25	-77
15	25	25	-77
20	25	25	-77

For the “wanted” RB allocation no additional interference is assumed (worst case). It is proposed to have a 3 dB desensitisation of the “wanted” RB allocation in the presence of the “interfering” RB allocation. This results in a ~25 dB in-channel selectivity requirement.

The “wanted” signal is a QPSK modulated FRC. To define test criteria, it is sufficient to measure the Tput of the “wanted” signal only.

To summarize, the proposed requirement for in-channel selectivity reads as follows. The required implementation margin *y* and wanted signal C/I requirement *x* for the additional FRCs are still TBD.

Table 7.7-3 E-UTRA BS in-channel selectivity, paired spectrum

E-UTRA channel bandwidth (MHz)	Reference measurement channel	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Type of interfering signal
1.4	A1-4 in Annex A.1	[-111.7 + 0 + 2 +3]	[-87]	1.4 MHz E-UTRA signal, 3 RBs
3	A1-5 in Annex A.1	[-106.9 -0.65 + 2 +3]	[-84]	3 MHz E-UTRA signal, 6 RBs
5	A1-2 in Annex A.1	[-104.7 -0.9 + 2 +3]	[-81]	5 MHz E-UTRA signal, 10 RBs
10	A1-3 in Annex A.1	[-102.5 -1.1 + 2 +3]	[-77]	10 MHz E-UTRA signal, 25 RBs
15	A1-3 in Annex A.1*	[-102.5 -1.1 + 2 +3]	[-77]	15 MHz E-UTRA signal, 25 RBs*
20	A1-3 in Annex A.1*	[-102.5 -1.1 + 2 +3]	[-77]	20 MHz E-UTRA signal, 25 RBs*
Note*: Wanted and interfering signal are placed adjacently around DC				

7.8 Spurious emissions

7.8.1 Background for receiver spurious emissions in UTRA

The UTRA requirement for spurious emissions generated or amplified in a receiver that appear at the BS receiver antenna connector is defined in TS 25.104 [1] clause 7.7. It applies only for BS with separate RX and TX antenna ports, while for all BS with common RX and TX antenna port the transmitter spurious emission requirements apply.

The requirement consist of three parts

- General spurious emissions requirements, based on internationally recognized limits.
- Additional requirements for protection of BS receivers for FDD uplink and TDD bands. These limits for UTRA were originally based on the corresponding Tx spurious emission limits, but are included as separate tables for Rx spurious emissions.
- Co-existence requirements that may apply for co-located base stations are incorporated by reference.

7.8.2 Receiver spurious emissions in E-UTRA

The general spurious emission requirements apply for UTRA in the same way as for E-UTRA. The frequency range in the out-of-band domain is excluded, i.e. out to the outermost carrier centres plus 250% of the necessary bandwidth (= Channel bandwidth). In order to align with the Transmitter spurious emissions requirements in Clause 6.6.3, frequencies that are more than 10 MHz below or above the transmitter operating band are however not excluded from the requirement, even if they are within 2.5 * $BW_{Channel}$ from the carrier.

The additional requirements are based on the corresponding Tx spurious limits and are for this reason be expressed as a direct reference to the additional Tx spurious emission requirements in clause 6.6.3. This avoids duplication of limits and reduces the risk for errors when updating specifications.

7.8.3 E-UTRA receiver spurious emissions requirement

The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the BS receiver antenna connector. The requirements apply to all BS with separate RX and TX antenna ports. The test shall be performed when both TX and RX are on, with the TX port terminated.

For all BS with common RX and TX antenna port the transmitter spurious emission as specified in clause 6.6.3 is valid.

The power of any spurious emission shall not exceed the levels in Table 7.8-1:

Table 7.8-1: General spurious emission minimum requirement

Band	Maximum level	Measurement Bandwidth	Note
30MHz - 1 GHz	-57 dBm	100 kHz	
1 GHz - 12.75 GHz	-47 dBm	1 MHz	
NOTE: The frequency range between 2.5 * $BW_{Channel}$ below the first carrier frequency and 2.5 * $BW_{Channel}$ above the last carrier frequency transmitted by the BS, where $BW_{Channel}$ is the channel bandwidth according to Table 5.1-1, may be excluded from the requirement. However, frequencies that are more than 10 MHz below the lowest frequency of the BS transmitter operating band or more than 10 MHz above the highest frequency of the BS transmitter operating band shall not be excluded from the requirement.			

In addition to the requirements in Table 7.8-1, the power of any spurious emission shall not exceed the levels specified for Protection of the E-UTRA FDD BS receiver of own or different BS in Clause 6.6.3.2 and for Co-existence with other systems in the same geographical area in Clause 6.6.3.3. In addition, the co-existence requirements for co-located base stations specified in subclause 6.6.3.4 may also be applied.

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8 Performance requirement

8.1 Requirements for PUSCH

The bulk of requirements are for the PUSCH. Each Channel requires a separate set of requirements since an eNodeB may only support a single BW. In addition eNodeBs may have 2 or 4 receive antennas.

The performance requirement of PUSCH is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRC (30% or 70%).

There are many combinations of modulation, coding rate, transmission bandwidth and cyclic prefix length that can be tested. In addition this can be done for many different propagation conditions detailed in Annex B. To limit the number of tests only a subset of the possible tests are defined.

8.2 Requirements for PUCCH

For PUCCH the error probability requirements have already been defined by other working groups.

The tuning of the detector is determined by the DTX to ACK error probability. Then the other requirements can be formulated as SNR required for reaching sufficiently low error probabilities for the other cases. Since these are channel dependent there will be an individual requirement for each propagation condition.

8.3 Requirements for PRACH

For PRACH the detector is tuned to reach the target of the false alarm probability.

PRACH supports 4 different bursts formats intended for different uses.

Annex A: Measurement channels

A overview of the encoding process is given in figure A-1. First a CRC is added to the transport block. The transport block is then split into code blocks with a maximum size of 6144 bits. If the transport block is split into 2 or more parts a CRC is added to each code block. The code block is encoded using a rate 1/3 turbo coder. To get the coder back into a known state a few more bits (12) has to be generated, these are know as the trellis termination bits. The coded block is then punctured using a circular buffer to get the correct number of bits to transmit over the channel. Finally the code blocks are concatenated, mapped to constellations and sent in a subframe.

Receiver requirements in the present document are defined with a throughput stated relative to the Maximum throughput of the FRC. The Maximum throughput for an FRC equals the Payload size * the Number of uplink subframes per second.

A.1 Fixed Reference Channels for reference sensitivity (QPSK, R=1/3)

Table A.1-1 FRC parameters for reference sensitivity

Reference channel	A1-1	A1-2	A1-3	A1-4	A1-5
Allocated resource blocks	6	15	25	3	9
DFT-OFDM Symbols per subframe	12	12	12	12	12
Modulation	QPSK	QPSK	QPSK	QPSK	QPSK
Code rate	1/3	1/3	1/3	1/3	1/3
Payload size (bits)	568	1416	2344	288	856
Transport block CRC (bits)	24	24	24	24	24
Code block CRC size (bits)	0	0	0	0	0
Number of code blocks - C	1	1	1	1	1
Coded block size including 12bits trellis termination (bits)	1788	4332	7116	948	2652
Total number of bits per sub-frame	1728	4320	7200	864	2592
Total symbols per sub-frame	864	2160	3600	432	1296

A.2 Fixed Reference Channels for dynamic range (16QAM, R=2/3)

Table A.2-1 FRC parameters for dynamic range

Reference channel	A2-1	A2-2	A2-3
Allocated resource blocks	6	15	25
DFT-OFDM Symbols per subframe	12	12	12
Modulation	16QAM	16QAM	16QAM
Code rate	2/3	2/3	2/3
Payload size (bits)	2280	5736	9528
Transport block CRC (bits)	24	24	24
Code block CRC size (bits)	0	0	24
Number of code blocks - C	1	1	2
Coded block size including 12bits trellis termination (bits)	6924	17292	14412
Total number of bits per sub-frame	3456	8640	14400
Total symbols per sub-frame	864	2160	3600

Annex B:
Propagation conditions

B.1 General

The propagation conditions used for BS performance requirements are fundamentally the same as the ones used for the UE. This Annex lists the propagation conditions that apply for BS performance. The background and derivation of the propagation conditions for LTE are described in more detail in TR 36.803 [35].

B.2 Propagation channels

B.2.1 Static propagation condition

The propagation for the static performance measurement is an Additive White Gaussian Noise (AWGN) environment. No fading or multi-paths exist for this propagation model.

B.2.2 Multi-path fading propagation conditions

B.2.2.1 Delay profiles

Three Multi-path delay profiles are defined for E-UTRA performance requirements as shown in Tables B.2.2.1-1 to B.2.2.1-3. They represent ***low delay spread*** environment (EPA), ***medium delay spread*** environment (EVA) and ***high delay spread*** environment (ETU).

Table B.2.2.1-1 Extended Pedestrian A model (EPA)

Excess tap delay [ns]	Relative power [dB]
0	0.0
30	-1.0
70	-2.0
90	-3.0
110	-8.0
190	-17.2
410	-20.8

Table B.2.2.1-2 Extended Vehicular A model (EVA)

Excess tap delay [ns]	Relative power [dB]
0	0.0
30	-1.5
150	-1.4
310	-3.6
370	-0.6
710	-9.1
1090	-7.0
1730	-12.0
2510	-16.9

Table B.2.2.1-3 Extended Typical Urban model (ETU)

Excess tap delay [ns]	Relative power [dB]
0	-1.0
50	-1.0
120	-1.0
200	0.0
230	0.0
500	0.0
1600	-3.0
2300	-5.0
5000	-7.0

B.2.2.2 Doppler spectrum

The Doppler spectrum is modelled using the well known *Clarke* or *Classical Doppler spectrum* as described in further detail in [35]. Three Doppler frequencies are defined for LTE performance requirement:

- A **low Doppler frequency** of f_D = 5 Hz.
- A **medium Doppler frequency** of f_D = 70 Hz.
- A **high Doppler frequency** of f_D = 300 Hz.

B.2.2.3 Multi-Antenna channel models

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B.2.2.4 Combinations of channel model parameters

<Text will be added.>

B.2.3 High speed train scenario

High speed train conditions are as follows.

Scenario 1: Open space

Scenario 2: Tunnel with leaky cable

Scenario 3: Tunnel for multi-antennas

The high speed train conditions for the test of the baseband performance are two non fading propagation channels (scenario 1 and 3) and one fading propagation channel (scenario 2) with one tap. For BS with Rx diversity defined in scenario 1, the Doppler shift variation is the same between antennas.

For scenario 1 and 3, Doppler shift is given by

$$f_s(t) = f_d \cos\theta(t) \qquad \text{(B.2.3.1)}$$

where $f_s(t)$ is the Doppler shift and f_d is the maximum Doppler frequency. The cosine of angle $\theta(t)$ is given by

$$\cos\theta(t) = \frac{D_s/2 - vt}{\sqrt{D_{\min}{}^2 + (D_s/2 - vt)^2}}, \quad 0 \le t \le D_s/v \qquad \text{(B.2.3.2)}$$

where $D_s/2$ is the initial distance of the train from BS, and $D_{\min}$ is BS-Railway track distance, both in meters; v is the velocity of the train in m/s, t is time in seconds.

In a practical scenario the Doppler shift experienced by the eNodeB will double since the UE will first experience a frequency offset equal to the Doppler frequency. It will then synchronise its oscillator to the carrier frequency plus the doppler offset. The signal will then be shifted another doppler frequency going back from the UE.

For scenario 1 and 3, Doppler shift and cosine angle is given by equation B.2.3.1 and B.2.3.2 where the required input parameters are listed in table B.2.3-1 assuming a carrier frequency f_C = 2690 MHz. The resulting Doppler shift is shown in Figure B.2.3-1 and B.2.3-2.

For scenario 2, Rician fading is considered where Rician factor, K is defined as the ratio between the dominant signal power and the variant of the other weaker signals. Parameters are according to Table B.2.3-1.

Table B.2.3-1: Parameters for high speed train conditions

Parameter	Value		
	Scenario 1	Scenario 2	Scenario 3
D_s	1000 m	Infinity	300 m
D_{min}	50 m	-	2 m
K	-	10 dB	-
v	350 km/h	300 km/h	300 km/h
f_d	1750 Hz	1500 Hz	1500 Hz

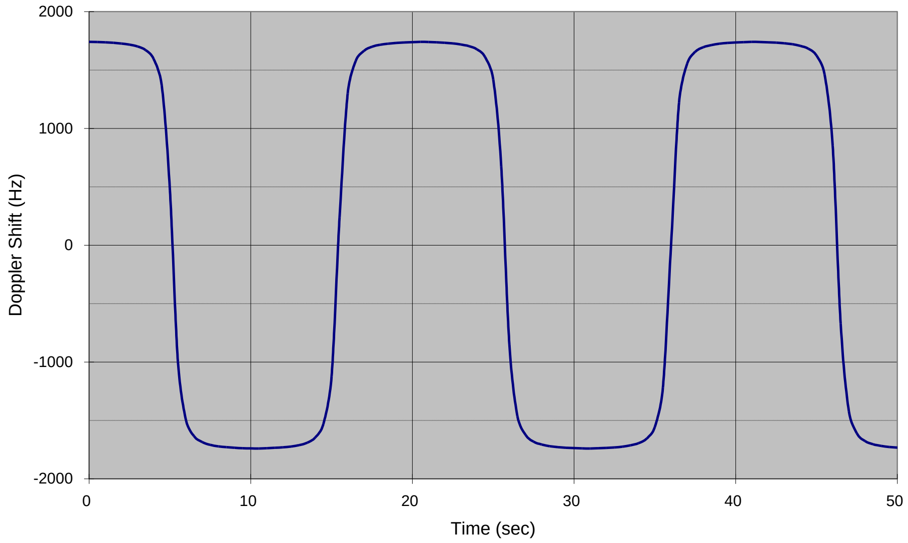

Figure B.2.3-1: Doppler shift trajectory for scenario 1

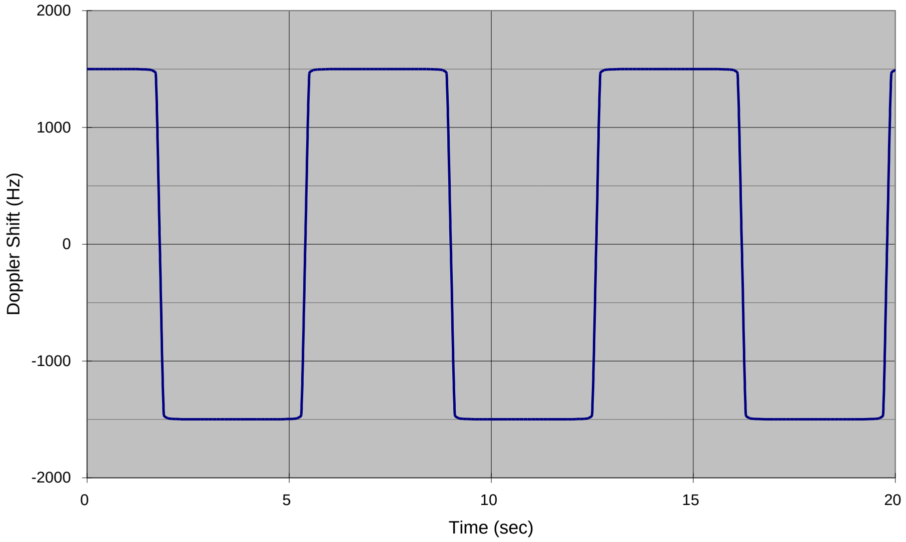

Figure B.2.3-2: Doppler shift trajectory for scenario 3

Annex C: Characteristics of the interference signal

<Text will be added.>

Annex D: Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2007-02	RAN4#42	R4-070252			TR created based on content in **R4-061384**		0.1.0
2007-02	RAN4#42	R4-070313			Agreed TPs in RAN4#42: **R4-070294**, "Text proposal – number of resource blocks in an operating system bandwidth" **R4-070304**, "BS Spurious Emission definition for LTE" **R4-070305**, "E-UTRA base station blocking initial simulation results" **R4-070313**, "TR 36.804 V0.2.0: "Base Station (BS) radio transmission and reception" **R4-070314**, "BS ACS definition for LTE"	0.1.0	0.2.0
2007-03	RAN4#42 bis	R4-070384			Agreed TP in RAN4#42bis: **R4-070306**, "LTE BS EVM Requirement"	0.2.0	0.3.0
2007-04	RAN4#42 bis	R4-070466			Agreed TPs in RAN4#42bis: **R4-070338**, "E-UTRA base station transmit intermodulation" **R4-070351**, "Spectrum emission mask correction" **R4-070453**, "Text proposal to TR 36.804 on BS EVM definition and measurement methodology" **R4-070468**, "Updated ACLR text proposal for TR 36.804"	0.3.0	0.4.0
2007-05	RAN4#43	R4-070828			Agreed TPs in RAN4#43: **R4-070479**, "E-UTRA base station Frequency error requirement" **R4-070531**, "E-UTRA BS output power specification" **R4-070810**, "TP to BS TR on numerology " **R4-070826**, "LTE TDD BS ACLR Text proposal" **R4-070827**, "LTE FDD BS ACLR Text proposal"	0.4.0	0.5.0
2007-06	RAN4#43 bis	R4-071137			Agreed TPs in RAN4#43bis: **R4-070884**, "E-UTRA TDD Base Station Tx EVM Averaging & Text Proposal to TR36.804" **R4-070934**, "On E-UTRA BS blocking requirements for co-location" **R4-071027**, "Text Proposal to TR36.804 on EVM Averaging for TDD frame structure Type 2" **R4-071082**, "TP to BS TR on numerology" **R4-071096**, "LTE Band numbering Text Proposal for TR36.803. **R4-071105,** "LTE Time Domain EVM Text" **R4-071107**, "On E-UTRA bandwidth option definition" **R4-071108**, "E-UTRA operating band unwanted emission limits" **R4-071109**, "FCC Limits for E-UTRA bandwidth options" **R4-071122**, "On definition of E-UTRA base station reference sensitivity level" **R4-071123**, "On definition of E-UTRA base station reference sensitivity level – measurement channels" **R4-071124**, "On definition of E-UTRA base station narrowband blocking and ACS requirements" **R4-071125**, "On definition of E-UTRA base station blocking performance requirement" **R4-071126**, "On E-UTRA base station dynamic range requirement" **R4-071127**, "On E-UTRA base station dynamic range requirement – measurement channels" **R4-071128**, "On E-UTRA base station intermodulation and narrowband intermodulation performance requirements"	0.5.0	0.6.0
2007-08	RAN4#44	R4-071268			Editorial updates and clean-up.	0.6.0	0.6.1
2007-08	RAN4#44	R4-071485			Agreed TPs in RAN4#44: **R4-071221,** "E-UTRA BS spurious emissions, co-existence in the same geographical area" **R4-071222,** "E-UTRA BS spurious emissions, co-existence with co-located base stations" **R4-071223**, "E-UTRA BS spurious emissions, co-existence with PHS" **R4-071264**, "TP for E-UTRA Occupied bandwidth" **R4-071265**, "TP for Operating band unwanted emissions" **R4-071286**, "LTE Channel spacing" **R4-071374**, "ACLR/UTRA 5 MHz limits for 1.4 and 3 MHz E-UTRA FDD eNB" **R4-071445**, "Some receiver characteristics for E-UTRA BS of Frame structure type 2" **R4-071463**, "On open issues for E-UTRA base station ACS and narrowband blocking requirements" **R4-071464**, "TP for ACLR open issues" **R4-071467**, "LTE BS RX Dynamic range " **R4-071468**, "LTE RX static sensitivity simulations" **R4-071504**, "Text proposal to TR36.804 on the LTE eNodeB EVM measurement"	0.6.1	0.7.0
2007-10	RAN4#44 bis	R4-071708			Editorial updates, clean-up and alignment with updates of TR 36.803 v0.5.0 (R4-071515)	0.7.0	0.7.1
2007-10	RAN4#44	R4-071781			Agreed TPs in RAN4#44bis:	0.7.1	0.8.0

	bis				**R4-071536**, “TP for TR36.804 – BS ACLR2” **R4-071678**, “TP 36.804: ACLR for the 2nd adjacent channel” **R4-071738**, "TP for TR 36.804 on channel numbering". **R4-071739**, "Reference points and test ports for E-UTRA RF tests". **R4-071741**, "E-UTRA TDD BS Spurious Emission for Coexistence & Text Proposal to TR36.804". **R4-071746**, "TP 36.804: Rx Spurious emissions". **R4-071751**, "Some receiver characteristics for E-UTRA BS of Frame structure type 2" (CATT). **R4-071754**, "Lower limit for E-UTRA BS ACLR". **R4-071762**, "Proposal for eNB in-channel selectivity requirement". **R4-071763**, "On definition of E-UTRA base station in-channel selectivity measurement channels". **R4-071773**, "TP for updating FRC definitions for reference sensitivity in 36.804".		
2007-11	RAN4#45	R4-072156			Agreed TPs in RAN4#45: **R4-071904**, "On open issues for E-UTRA in-channel selectivity requirement" **R4-071959**, "TR 36.804: TP for High speed train model (BS)" **R4-071961**, "Removal of brackets in TR 36.804" **R4-072096**, "Correction for TR 36.804, Table 6.6.2.2-7, frequency offset" **R4-072099**, "Text Proposal for TR 36.804: BS Rx Dynamic range" **R4-072114**, "TP to BS TR on frequency band for E-UTRA TDD" **R4-072129**, "TR 36.804: TP for Propagation conditions for BS (Annex B)" **R4-072167**, "Text proposal for TR 36.804: Spectrum emission masks and ACLR limit for Category A" **R4-072168**, "Text proposal for TR 36.804: BS ACLR" **R4-072170**, "TP to TR 36.804 on the LTE eNodeB EVM" **R4-072222**, "TP to 36.804 on performance requirements"	0.8.0	0.9.0
2007-11	RAN#38	RP-070976			Presented to TSG RAN for information	0.9.0	1.0.0
2008-03	RAN4#46 bis	R4-080614			Agreed TPs in RAN4#46: **R4-080489**, "TP to TR36.804 on E-UTRA BS Spurious Emissions for E-UTRA/UTRA TDD and FDD Coexistence" Agreed TPs in RAN4#46bis: **R4-080766**, “Text proposal for 36.804 on modifications related to TDD frame structure optimisation”	1.0.0	1.1.0
2008-04	RAN4#46 bis	R4-080833			Agreed TPs in RAN4#46bis: **R4-080615**, "TS 36.804: TP for general updates" **R4-080752**, "TP to TR36.804: LTE eNodeB EVM measurement" **R4-080795**, "TP to 36.104 Clarification of EVM window lengths size for extended CP and for first symbol at normal CP"	1.1.0	1.2.0