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Technical Specification

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Base Station (BS) radio transmission and reception
(3GPP TS 36.104 version 8.4.0 Release 8)

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Contents

Foreword

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

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1 Scope

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

2 References

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

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

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

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

[3] ITU-R Recommendation M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".

[4] 3GPP TS 36.141: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing".

[5] ITU-R recommendation SM.328: "Spectra and bandwidth of emissions".

[6] 3GPP TS 25.104: "Base Station (BS) radio transmission and reception (FDD)".

[7] 3GPP TS 25.105: "Base Station (BS) radio transmission and reception (TDD)".

[8] 3GPP TR 25.942: "RF system scenarios".

[9] 3GPP TR 36.942: "E-UTRA RF system scenarios".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Base station receive period: The time during which the base station is receiving data subframes or UpPTS.

Carrier: The modulated waveform conveying the E-UTRA or UTRA physical channels

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 E-UTRA carrier, separated by the channel bandwidth.

DL RS power: The resource element power of Downlink Reference Symbol.

Downlink operating band: The part of the operating band designated for downlink.

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

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

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.

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

Multi-carrier transmission configuration: A set of one or more contiguous carriers that a BS is able to transmit simultaneously according to the manufacturer"s specification.

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.

Operating band: A frequency range in which E-UTRA operates (paired or unpaired), that is defined with a specific set of technical requirements**.**

NOTE: The operating band(s) for an E-UTRA BS is declared by the manufacturer according to the designations in table 5.5-1.

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 during the transmitter ON period.

RE power control dynamic range: The difference between the power of a RE and the average RE power for a BS at maximum output power for a specified reference condition.

RRC filtered mean power: The mean power of a UTRA carrier as measured through a root raised cosine filter with roll-off factor α and a bandwidth equal to the chip rate of the radio access mode.

NOTE 1: The RRC filtered mean power of a perfectly modulated UTRA signal is 0.246 dB lower than the mean power of the same signal.

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

Total power dynamic range: The difference between the maximum and the minimum transmit power of an OFDM symbol for a specified reference condition.

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.

Transmitter ON period: The time period during which the BS transmitter is transmitting data and/or reference symbols, i.e. data subframes or DwPTS.

Transmitter OFF period: The time period during which the BS transmitter is not allowed to transmit.

Transmitter transient period: The time period during which the transmitter is changing from the OFF period to the ON period or vice versa.

Uplink operating band: The part of the operating band designated for uplink.

3.2 Symbols

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

α	Roll-off factor
β	Percentage of the mean transmitted power emitted outside the occupied bandwidth on the assigned channel
$BW_{Channel}$	Channel bandwidth
BW_{Config}	Transmission bandwidth configuration, expressed in MHz, where $BW_{Config} = N_{RB}$ x 180 kHz in the uplink and BW_{Config} = 15 kHz + N_{RB} x 180 kHz in the downlink.
f	Frequency
Δf	Separation between the channel edge frequency and the nominal -3dB point of the measuring filter closest to the carrier frequency
Δf_{max}	The largest value of Δf used for defining the requirement
F_C	Carrier centre frequency
f_offset	Separation between the channel edge frequency and the centre of the measuring filter
f_offset_{max}	The maximum 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_{DL}	Downlink EARFCN
$N_{Offs-DL}$	Offset used for calculating downlink EARFCN
$N_{Offs-UL}$	Offset used for calculating uplink EARFCN
N_{CS}	Number of Cyclic shifts for preamble generation in PRACH
N_{RB}	Transmission bandwidth configuration, expressed in units of resource blocks
N_{UL}	Uplink EARFCN
Pmax	Maximum output Power
Pout	Output power
$P_{REFSENS}$	Reference Sensitivity power level

3.3 Abbreviations

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

ACLR	Adjacent Channel Leakage Ratio
ACK	Acknowledgement (in HARQ protocols)
ACS	Adjacent Channel Selectivity
AWGN	Additive White Gaussian Noise
BS	Base Station
CP	Cyclic prefix
CRC	Cyclic Redundancy Check
CW	Continuous Wave
DC	Direct Current
DFT	Discrete Fourier Transformation
DTX	Discontinuous Transmission
DwPTS	Downlink part of the special subframe (for TDD operation)
EARFCN	E-UTRA Absolute Radio Frequency Channel Number
EPA	Extended Pedestrian A model
ETU	Extended Typical Urban model
E-UTRA	Evolved UTRA
EVA	Extended Vehicular A model
EVM	Error Vector Magnitude
FDD	Frequency Division Duplex
FFT	Fast Fourier Transformation
FRC	Fixed Reference Channel
GP	Guard Period (for TDD operation)
HARQ	Hybrid Automatic Repeat Request

ICS	In-Channel Selectivity
ITU-R	Radiocommunication Sector of the ITU
LNA	Low Noise Amplifier
MCS	Modulation and Coding Scheme
OFDM	Orthogonal Frequency Division Multiplex
OOB	Out-of-band
PA	Power Amplifier
PBCH	Physical Broadcast Channel
PDCCH	Physical Downlink Control Channel
PDSCH	Physical Downlink Shared Channel
PUSCH	Physical Uplink Shared Channel
PUCCH	Physical Uplink Control Channel
PRACH	Physical Random Access Channel
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase-Shift Keying
RB	Resource Block
RE	Resource Element
RF	Radio Frequency
RMS	Root Mean Square (value)
RS	Reference Symbol
RX	Receiver
RRC	Root Raised Cosine
SNR	Signal-to-Noise Ratio
TDD	Time Division Duplex
TX	Transmitter
UE	User Equipment

4 General

4.1 Relationship between minimum requirements and test requirements

The Minimum Requirements given in this specification make no allowance for measurement uncertainty. The test specification TS 36.141 [4] Annex G defines Test Tolerances. These Test Tolerances are individually calculated for each test. The Test Tolerances are used to relax the Minimum Requirements in this specification to create Test Requirements.

The measurement results returned by the Test System are compared - without any modification - against the Test Requirements as defined by the shared risk principle.

The Shared Risk principle is defined in ITU-R M.1545 [3].

4.2 Base station classes

The requirements in this specification apply to Base Stations intended for general-purpose applications.

Other base station classes are for further study. The requirements for these may be different than for general-purpose applications.

4.3 Regional requirements

Some requirements in the present document may only apply in certain regions either as optional requirements or set by local and regional regulation as mandatory requirements. It is normally not stated in the 3GPP specifications under what exact circumstances that the requirements apply, since this is defined by local or regional regulation.

Table 4.3-1 lists all requirements that may be applied differently in different regions.

Table 4.3-1: List of regional requirements

Clause number	Requirement	Comments
5.5	Operating bands	Some bands may be applied regionally.
5.6	Channel bandwidth	Some channel bandwidths may be applied regionally.
5.7	Channel arrangement	The requirement is applied according to what operating bands in clause 5.5 that are supported by the BS.
6.2	Base station maximum output power	In certain regions, the minimum requirement for normal conditions may apply also for some conditions outside the range of conditions defined as normal.
6.6.3.1	Operating band unwanted emissions (Category A)	This requirement is mandatory for regions where Category A limits for spurious emissions, as defined in ITU-R Recommendation SM.329 [2] apply.
6.6.3.2	Operating band unwanted emissions (Category B)	This requirement is mandatory for regions where Category B limits for spurious emissions, as defined in ITU-R Recommendation SM.329 [2], apply.
6.6.4.1.1	Spurious emissions (Category A)	This requirement is mandatory for regions where Category A limits for spurious emissions, as defined in ITU-R Recommendation SM.329 [2] apply.
6.6.4.1.2	Spurious emissions (Category B)	This requirement is mandatory for regions where Category B limits for spurious emissions, as defined in ITU-R Recommendation SM.329 [2], apply.
6.6.4.3	Additional spurious emission requirements	These requirements may be applied for the protection of system operating in frequency ranges other than the E-UTRA BS operating band.
6.6.4.4	Co-location with other base stations	These requirements may be applied for the protection of other BS receivers when a BS operating in another frequency band is co-located with an E-UTRA BS.
7.6.2	Co-location with other base stations	These requirements may be applied for the protection of the BS receiver when a BS operating in another frequency band is co-located with an E-UTRA BS.

5 Operating bands and channel arrangement

5.1 General

The channel arrangements presented in this clause are based on the operating bands and channel bandwidths defined in the present release of specifications.

NOTE: Other operating bands and channel bandwidths may be considered in future releases.

5.2 Void

5.3 Void

5.4 Void

5.5 Operating bands

E-UTRA is designed to operate in the operating bands defined in Table 5.5-1.

Table 5.5-1 E-UTRA frequency bands

E-UTRA Operating Band	Uplink (UL) operating band BS receive UE transmit	Downlink (DL) operating band BS transmit UE receive	Duplex Mode
	F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	
1	1920 MHz – 1980 MHz	2110 MHz – 2170 MHz	FDD
2	1850 MHz – 1910 MHz	1930 MHz – 1990 MHz	FDD
3	1710 MHz – 1785 MHz	1805 MHz – 1880 MHz	FDD
4	1710 MHz – 1755 MHz	2110 MHz – 2155 MHz	FDD
5	824 MHz – 849 MHz	869 MHz – 894MHz	FDD
6	830 MHz – 840 MHz	875 MHz – 885 MHz	FDD
7	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	FDD
8	880 MHz – 915 MHz	925 MHz – 960 MHz	FDD
9	1749.9 MHz – 1784.9 MHz	1844.9 MHz – 1879.9 MHz	FDD
10	1710 MHz – 1770 MHz	2110 MHz – 2170 MHz	FDD
11	1427.9 MHz – 1452.9 MHz	1475.9 MHz – 1500.9 MHz	FDD
12	698 MHz – 716 MHz	728 MHz – 746 MHz	FDD
13	777 MHz – 787 MHz	746 MHz – 756 MHz	FDD
14	788 MHz – 798 MHz	758 MHz – 768 MHz	FDD
…			
17	704 MHz – 716 MHz	734 MHz – 746 MHz	FDD
…			
33	1900 MHz – 1920 MHz	1900 MHz – 1920 MHz	TDD
34	2010 MHz – 2025 MHz	2010 MHz – 2025 MHz	TDD
35	1850 MHz – 1910 MHz	1850 MHz – 1910 MHz	TDD
36	1930 MHz – 1990 MHz	1930 MHz – 1990 MHz	TDD
37	1910 MHz – 1930 MHz	1910 MHz – 1930 MHz	TDD
38	2570 MHz – 2620 MHz	2570 MHz – 2620 MHz	TDD
39	1880 MHz – 1920 MHz	1880 MHz – 1920 MHz	TDD
40	2300 MHz – 2400 MHz	2300 MHz – 2400 MHz	TDD

5.6 Channel bandwidth

Requirements in present document are specified for the channel bandwidths listed in Table 5.6-1.

Table 5.6-1 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 5.6-1 shows the relation between the Channel bandwidth ($BW_{Channel}$) and the Transmission bandwidth configuration (N_{RB}). The channel edges are defined as the lowest and highest frequencies of the carrier separated by the channel bandwidth, i.e. at F_C +/- $BW_{Channel}$ /2.

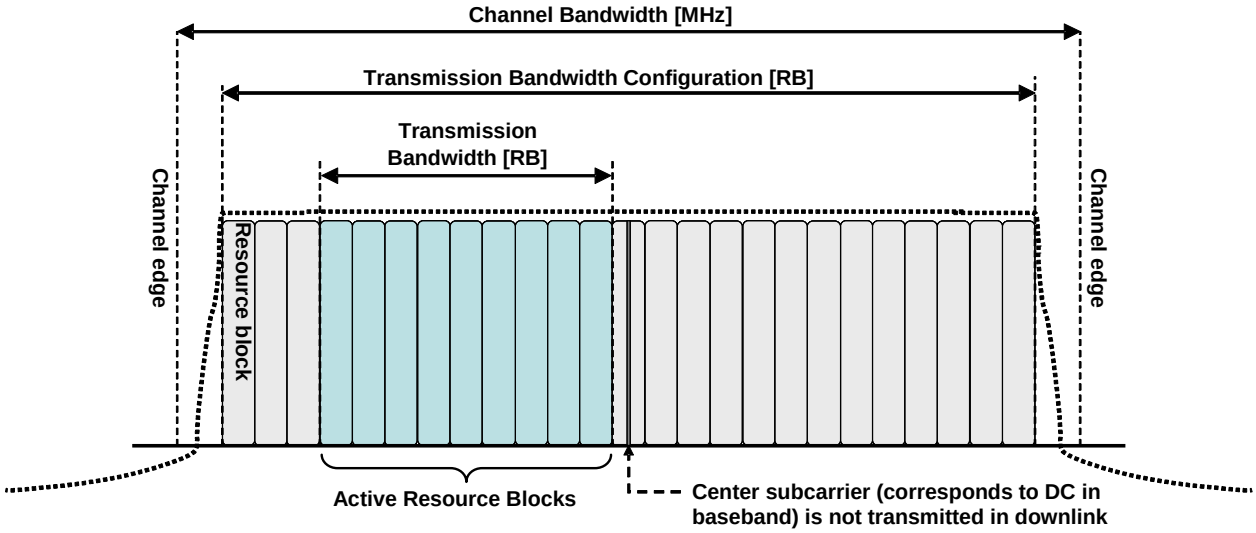

Figure 5.6-1 Definition of Channel Bandwidth and Transmission Bandwidth Configuration for one E-UTRA carrier

5.7 Channel arrangement

5.7.1 Channel spacing

The spacing between carriers will depend on the deployment scenario, the size of the frequency block available and the channel bandwidths. The nominal channel spacing between two adjacent E-UTRA carriers is defined as following:

$$\text{Nominal Channel spacing} = (BW_{Channel(1)} + BW_{Channel(2)})/2$$

where $BW_{Channel(1)}$ and $BW_{Channel(2)}$ are the channel bandwidths of the two respective E-UTRA carriers. The channel spacing can be adjusted to optimize performance in a particular deployment scenario.

5.7.2 Channel raster

The channel raster is 100 kHz for all bands, which means that the carrier centre frequency must be an integer multiple of 100 kHz.

5.7.3 Carrier frequency and EARFCN

The carrier frequency in the uplink and downlink is designated by the E-UTRA Absolute Radio Frequency Channel Number (EARFCN) in the range 0 - 65535. The relation between EARFCN and 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 5.7.3-1 and N_{DL} is the downlink EARFCN.

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

The relation between EARFCN and 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 5.7.3-1 and N_{UL} is the uplink EARFCN.

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

Table 5.7.3-1 E-UTRA channel numbers

E-UTRA Operating Band	F_{DL_low} [MHz]	Downlink $N_{Offs-DL}$	Range of N_{DL}	F_{UL_low} [MHz]	Uplink $N_{Offs-UL}$	Range of N_{UL}
1	2110	0	0 – 599	1920	18000	18000 – 18599
2	1930	600	600 – 1199	1850	18600	18600 – 19199
3	1805	1200	1200 – 1949	1710	19200	19200 – 19949
4	2110	1950	1950 – 2399	1710	19950	19950 – 20399
5	869	2400	2400 – 2649	824	20400	20400 – 20649
6	875	2650	2650 – 2749	830	20650	20650 – 20749
7	2620	2750	2750 – 3449	2500	20750	20750 – 21449
8	925	3450	3450 – 3799	880	21450	21450 – 21799
9	1844.9	3800	3800 – 4149	1749.9	21800	21800 – 22149
10	2110	4150	4150 – 4749	1710	22150	22150 – 22749
11	1475.9	4750	4750 – 4999	1427.9	22750	22750 – 22999
12	728	5000	5000 – 5179	698	23000	23000 – 23179
13	746	5180	5180 – 5279	777	23180	23180 – 23279
14	758	5280	5280 – 5379	788	23280	23280 – 23379
…						
17	734	5730	5730 – 5849	704	23730	23730 – 23849
…						
33	1900	36000	36000 – 36199	1900	36000	36000 – 36199
34	2010	36200	36200 – 36349	2010	36200	36200 – 36349
35	1850	36350	36350 – 36949	1850	36350	36350 – 36949
36	1930	36950	36950 – 37549	1930	36950	36950 – 37549
37	1910	37550	37550 – 37749	1910	37550	37550 – 37749
38	2570	37750	37750 – 38249	2570	37750	37750 – 38249
39	1880	38250	38250 – 38649	1880	38250	38250 – 38649
40	2300	38650	38650 – 39649	2300	38650	38650 – 39649

6 Transmitter characteristics

6.1 General

Unless otherwise stated, the requirements in clause 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 are 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 (port B).

Unless otherwise stated the requirements in clause 6 applies at all times, i.e. during the Transmitter ON period, the Transmitter OFF period and the Transmitter transient period.

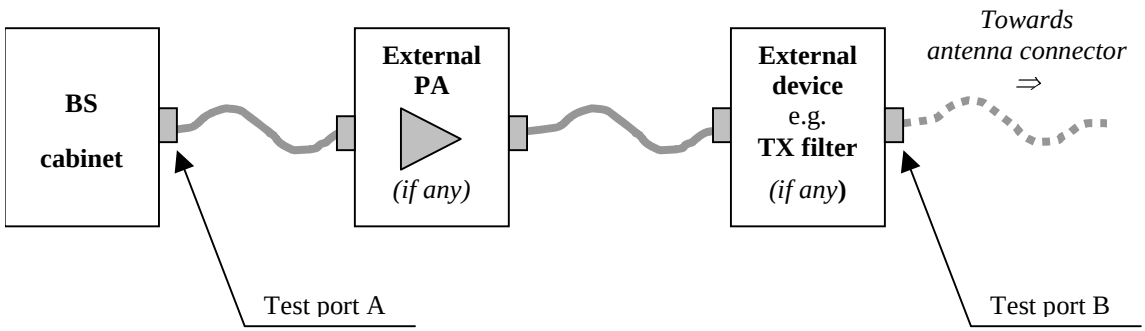

Figure 6.1-1: Transmitter test ports

6.2 Base station output power

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

Maximum output power, Pmax, of the base station is the mean power level per carrier measured at the antenna connector during the transmitter ON period in a specified reference condition.

6.2.1 Minimum requirement

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 Output power dynamics

The requirements in subclause 6.3 apply during the transmitter ON period. Transmit signal quality (as specified in subclause 6.5) shall be maintained for the output power dynamics requirements of this Clause.

Power control is used to limit the interference level.

6.3.1 RE Power control dynamic range

The RE power control dynamic range is the difference between the power of an RE and the average RE power for a BS at maximum output power for a specified reference condition.

6.3.1.1 Minimum requirements

RE power control dynamic range:

Table 6.3.1.1-1 E-UTRA BS RE power control dynamic range

Modulation scheme used on the RE	RE power control dynamic range (dB)	
	(down)	(up)
QPSK (PDCCH)	-6	+4
QPSK (PDSCH)	-6	+3
16QAM (PDSCH)	-3	+3
64QAM (PDSCH)	0	0
NOTE 1: Total TX power shall always be less or equal to maximum BS output power.		

6.3.2 Total power dynamic range

The total power dynamic range is the difference between the maximum and the minimum transmit power of an OFDM symbol for a specified reference condition.

NOTE: The upper limit of the dynamic range is the OFDM symbol power for a BS at maximum output power. The lower limit of the dynamic range is the OFDM symbol power for a BS when one resource block is transmitted. The OFDM symbol shall carry PDSCH and not contain RS, PBCH or synchronisation signals.

6.3.2.1 Minimum requirements

The downlink (DL) total power dynamic range shall be larger than or equal to the level in Table 6.3.2.1-1.

Table 6.3.2.1-1 E-UTRA BS total power dynamic range

E-UTRA channel bandwidth (MHz)	Total power dynamic range (dB)
1.4	7.7
3	11.7
5	13.9
10	16.9
15	18.7
20	20

6.4 Transmit ON/OFF power

The requirements in subclause 6.4 are only applied for E-UTRA TDD BS.

6.4.1 Transmitter OFF power

Transmitter OFF power is defined as the mean power measured over 70 us filtered with a square filter of bandwidth equal to the transmission bandwidth configuration of the BS (BW_{Config}) centred on the assigned channel frequency during the transmitter OFF period.

6.4.1.1 Minimum Requirement

The transmitter OFF power spectral density shall be less than -85dBm/MHz.

6.4.2 Transmitter transient period

The transmitter transient period is the time period during which the transmitter is changing from the OFF period to the ON period or vice versa. The transmitter transient period is illustrated in Figure 6.4.2-1.

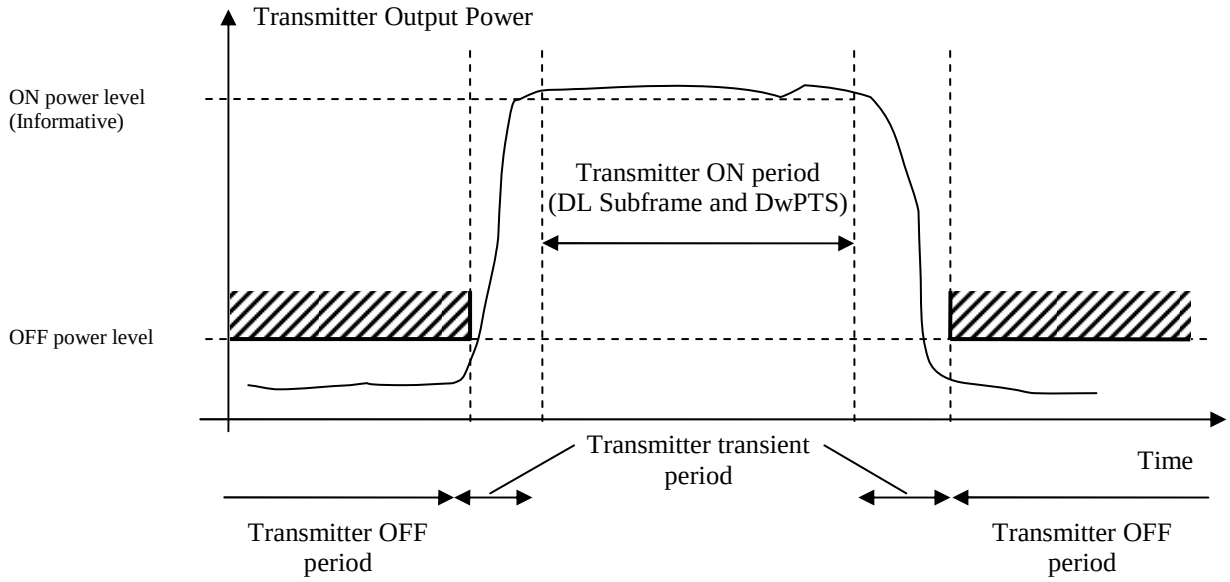

Figure 6.4.2-1 Illustration of the relations of transmitter ON period, transmitter OFF period and transmitter transient period.

6.4.2.1 Minimum requirements

The transmitter transient period shall be shorter than the values listed in Table 6.4.2.1-1.

Table 6.4.2.1-1 Minimum requirements for the transmitter transient period

Transition	Transient period length [us]
OFF to ON	17
ON to OFF	17

6.5 Transmitted signal quality

The requirements in subclause 6.5 apply to the transmitter ON period.

6.5.1 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.

6.5.1.1 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 6.5.1-1: Void

6.5.2 Error Vector Magnitude

The Error Vector Magnitude is a measure of the difference between the ideal symbols and the measured symbols after the equalization. This difference is called the error vector. The equaliser parameters are estimated as defined in Annex E. The EVM result is defined as the square root of the ratio of the mean error vector power to the mean reference power expressed in percent.

For all bandwidths, the EVM measurement shall be performed over all allocated resource blocks and subframes within a frame. The EVM value is then calculated as the mean square root of the measured values. The EVM for different modulation schemes on PDSCH shall be better than the limits in table 6.5.2-1:

Table 6.5.2-1 EVM requirements

Modulation scheme for PDSCH	Required EVM [%]
QPSK	17.5 %
16QAM	12.5 %
64QAM	8 %

6.5.3 Time alignment between transmitter branches

In Tx Diversity and spatial multiplexing, signals are transmitted from two or more antennas. These signals shall be aligned. The time alignment error in Tx Diversity and spatial multiplexing transmission is specified as the delay between the signals from two antennas at the antenna ports.

6.5.3.1 Minimum Requirement

The time alignment error in Tx Diversity or spatial multiplexing for any possible configuration of two transmit antennas shall not exceed 65 ns.

6.5.4 DL RS power

DL RS power is the resource element power of the Downlink Reference Symbol.

The absolute DL RS power is indicated on the BCH. The absolute accuracy is defined as the maximum deviation between the DL RS power indicated on the BCH and the DL RS power at the BS antenna connector.

6.5.4.1 Minimum requirements

DL RS power shall be within ± 2.1 dB of the DL RS power indicated on the BCH

6.6 Unwanted emissions

Unwanted emissions consist of out-of-band emissions and spurious emissions [2]. Out of band emissions are unwanted emissions immediately outside the channel bandwidth resulting from the modulation process and non-linearity in the transmitter but excluding spurious emissions. Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emission, intermodulation products and frequency conversion products, but exclude out of band emissions.

The out-of-band emissions requirement for the BS transmitter is specified both in terms of Adjacent Channel Leakage power Ratio (ACLR) and Operating band unwanted emissions. The Operating band unwanted emissions define all unwanted emissions in the downlink operating band plus the frequency ranges 10 MHz above and 10 MHz below the band. Unwanted emissions outside of this frequency range are limited by a spurious emissions requirement.

There is in addition a requirement for occupied bandwidth.

6.6.1 Occupied bandwidth

The occupied bandwidth is 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 transmitted power. See also ITU-R Recommendation SM.328 [5].

The value of β/2 shall be taken as 0.5%.

The requirement applies during the transmitter ON period.

6.6.1.1 Minimum requirement

The occupied bandwidth shall be less than the channel bandwidth as defined in Table 5.6-1.

6.6.2 Adjacent Channel Leakage power Ratio (ACLR)

Adjacent Channel Leakage power Ratio (ACLR) is the ratio of the filtered mean power centred 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. For a multi-carrier BS, the requirement applies for the adjacent channel frequencies below the lowest carrier frequency transmitted by the BS and above the highest carrier frequency transmitted by the BS for each supported multi-carrier transmission configuration. The requirement applies during the transmitter ON period.

6.6.2.1 Minimum requirement

The ACLR is defined with a square filter of bandwidth equal to the transmission bandwidth configuration of the transmitted signal (BW_{Config}) centred on the assigned channel frequency and a filter centred on the adjacent channel frequency according to the tables below.

For Category A, either the ACLR limits in the tables below or the absolute limit of -13dBm/MHz apply, whichever is less stringent.

For Category B, either the ACLR limits in the tables below or the absolute limit of -15dBm/MHz apply, whichever is less stringent.

For operation in paired spectrum, the ACLR shall be higher than the value specified in Table 6.6.2.1-1.

Table 6.6.2.1-1: Base Station ACLR in paired spectrum

E-UTRA transmitted signal channel bandwidth $BW_{Channel}$ [MHz]	BS adjacent channel centre frequency offset below the first or above the last carrier centre frequency transmitted	Assumed adjacent channel carrier (informative)	Filter on the adjacent channel frequency and corresponding filter bandwidth	ACLR limit
1.4, 3.0, 5, 10, 15, 20	$BW_{Channel}$	E-UTRA of same BW	Square (BW_{Config})	45 dB
	2 x $BW_{Channel}$	E-UTRA of same BW	Square (BW_{Config})	45 dB
	$BW_{Channel}$ /2 + 2.5 MHz	3.84 Mcps UTRA	RRC (3.84 Mcps)	45 dB
	$BW_{Channel}$ /2 + 7.5 MHz	3.84 Mcps UTRA	RRC (3.84 Mcps)	45 dB
NOTE 1: $BW_{Channel}$ and BW_{Config} are the channel bandwidth and transmission bandwidth configuration of the E-UTRA transmitted signal on the assigned channel frequency. NOTE 2: The RRC filter shall be equivalent to the transmit pulse shape filter defined in TS 25.104 [6], with a chip rate as defined in this table.				

For operation in unpaired spectrum, the ACLR shall be higher than the value specified in Table 6.6.2.1-2.

Table 6.6.2.1-2: Base Station ACLR in unpaired spectrum with synchronized operation

E-UTRA transmitted signal channel bandwidth $BW_{Channel}$ [MHz]	BS adjacent channel centre frequency offset below the first or above the last carrier centre frequency transmitted	Assumed adjacent channel carrier (informative)	Filter on the adjacent channel frequency and corresponding filter bandwidth	ACLR limit
1.4, 3	$BW_{Channel}$	E-UTRA of same BW	Square (BW_{Config})	45 dB
	2 x $BW_{Channel}$	E-UTRA of same BW	Square (BW_{Config})	45 dB
	$BW_{Channel}$ /2 + 0.8 MHz	1.28 Mcps UTRA	RRC (1.28 Mcps)	45 dB
	$BW_{Channel}$ /2 + 2.4 MHz	1.28 Mcps UTRA	RRC (1.28 Mcps)	45 dB
5, 10, 15, 20	$BW_{Channel}$	E-UTRA of same BW	Square (BW_{Config})	45 dB
	2 x $BW_{Channel}$	E-UTRA of same BW	Square (BW_{Config})	45 dB
	$BW_{Channel}$ /2 + 0.8 MHz	1.28 Mcps UTRA	RRC (1.28 Mcps)	45 dB
	$BW_{Channel}$ /2 + 2.4 MHz	1.28 Mcps UTRA	RRC (1.28 Mcps)	45 dB
	$BW_{Channel}$ /2 + 2.5 MHz	3.84 Mcps UTRA	RRC (3.84 Mcps)	45 dB
	$BW_{Channel}$ /2 + 7.5 MHz	3.84 Mcps UTRA	RRC (3.84 Mcps)	45 dB
	$BW_{Channel}$ /2 + 5 MHz	7.68 Mcps UTRA	RRC (7.68 Mcps)	45 dB
	$BW_{Channel}$ /2 + 15 MHz	7.68 Mcps UTRA	RRC (7.68 Mcps)	45 dB

NOTE 1: $BW_{Channel}$ and BW_{Config} are the channel bandwidth and transmission bandwidth configuration of the E-UTRA transmitted signal on the assigned channel frequency.
NOTE 2: The RRC filter shall be equivalent to the transmit pulse shape filter defined in TS 25.105 [7], with a chip rate as defined in this table.

6.6.3 Operating band unwanted emissions

The Operating band unwanted emission limits are defined from 10 MHz below the lowest frequency of the downlink operating band up to 10 MHz above the highest frequency of the downlink operating band.

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

The unwanted emission limits in the part of the downlink operating band that falls in the spurious domain are consistent with ITU-R Recommendation SM.329 [2].

Emissions shall not exceed the maximum levels specified in the tables below, 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 downlink operating band.
- Δf_{max} is equal to f_offset_{max} minus half of the bandwidth of the measuring filter.

For a multicarrier E-UTRA BS the definitions above apply to the lower edge of the carrier transmitted at the lowest carrier frequency and the higher edge of the carrier transmitted at the highest carrier frequency.

The requirements of either subclause 6.6.3.1 (Category A limits) or subclause 6.6.3.2 (Category B limits) shall apply. The application of either Category A or Category B limits shall be the same as for Transmitter spurious emissions (Mandatory Requirements) in subclause 6.6.4.1.

6.6.3.1 Minimum requirements (Category A)

For E-UTRA BS operating in Bands 5, 6, 8, 12, 13, 14, 17 emissions shall not exceed the maximum levels specified in Tables 6.6.3.1-1 to 6.6.3.1-3.

Table 6.6.3.1-1: 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	100 kHz

Table 6.6.3.1-2: 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	$-4.5dBm - \frac{10}{3} \left(\frac{f\_offset}{MHz} - 0.05 \right) dB$	100 kHz
3 MHz ≤ Δf ≤ Δf_{max}	3.05 MHz ≤ f_offset < f_offset_{max}	-13 dBm	100 kHz

Table 6.6.3.1-3: 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	100 kHz

For E-UTRA BS operating in Bands 1, 2, 3, 4, 7, 9, 10, 11, 33, 34, 35, 36, 37, 38, 39, 40, emissions shall not exceed the maximum levels specified in Tables 6.6.3.1-4 to 6.6.3.1-6:

Table 6.6.3.1-4: 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	1MHz

Table 6.6.3.1-5: 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	1MHz

Table 6.6.3.1-6: 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}	10.5 MHz ≤ f_offset < f_offset_{max}	-13 dBm	1MHz

6.6.3.2 Minimum requirements (Category B)

For E-UTRA BS operating in Bands 5, 6, 8, 12, 13, 14, 17, emissions shall not exceed the maximum levels specified in Tables 6.6.3.2-1 to 6.6.3.2-3:

Table 6.6.3.2-1: 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	100 kHz

Table 6.6.3.2-2: 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	100 kHz

Table 6.6.3.2-3: 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	100 kHz

For E-UTRA BS operating in Bands 1, 2, 3, 4, 7, 9, 10, 11, 33, 34, 35, 36, 37, 38, 39, 40, emissions shall not exceed the maximum levels specified in Tables 6.6.3.2-4 to 6.6.3.2-6:

Table 6.6.3.2-4: 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	1MHz

Table 6.6.3.2-5: 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	1MHz

Table 6.6.3.2-6: 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	1MHz

6.6.3.3 Additional requirements

In certain regions the following requirement may apply. For E-UTRA BS operating in Band 5, emissions shall not exceed the maximum levels specified in Tables 6.6.3.3-1.

Table 6.6.3.3-1: 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	-13 dBm	100 kHz
20 MHz	0 MHz ≤ Δf < 1 MHz	0.05 MHz ≤ f_offset < 0.95 MHz	-13 dBm	100 kHz
All	1 MHz ≤ Δf < Δf_{max}	1.05 MHz ≤ f_offset < f_offset_{max}	-13 dBm	100 kHz

In certain regions the following requirement may apply. For E-UTRA BS operating in Bands 2, 4, 10, 35, 36, emissions shall not exceed the maximum levels specified in Table 6.6.3.2-2.

Table 6.6.3.3-2: 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
All	1 MHz ≤ Δf < Δf_{max}	1.5 MHz ≤ f_offset < f_offset_{max}	-13 dBm	1 MHz

In certain regions the following requirement may apply. For E-UTRA BS operating in Bands 12, 13, 14, 17, emissions shall not exceed the maximum levels specified in Table 6.6.3.3-3.

Table 6.6.3.3-3: Additional operating band unwanted emission limits for E-UTRA (bands 12, 13 and 14)

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)
All	0 MHz ≤ Δf < 100 kHz	0.015 MHz ≤ f_offset < 0.085 MHz	-13 dBm	30 kHz
All	100 kHz ≤ Δf < Δf_{max}	150 kHz ≤ f_offset < f_offset_{max}	-13 dBm	100 kHz

NOTE 1: As a general rule for the requirements in subclause 6.6.3, 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 may 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.

6.6.4 Transmitter spurious emissions

The transmitter spurious emission limits apply from 9 kHz to 12.75 GHz, excluding the frequency range from 10 MHz below the lowest frequency of the downlink operating band up to 10 MHz above the highest frequency of the downlink operating band. Exceptions are the requirement in Table 6.6.4.3.1-2 and 6.6.4.3.1-3 that apply also closer than 10 MHz from the downlink 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. Unless otherwise stated, all requirements are measured as mean power (RMS).

6.6.4.1 Mandatory Requirements

The requirements of either subclause 6.6.4.1.1 (Category A limits) or subclause 6.6.4.1.2 (Category B limits) shall apply. The application of either Category A or Category B limits shall be the same as for Operating band unwanted emissions in subclause 6.6.3.

6.6.4.1.1 Spurious emissions (Category A)

6.6.4.1.1.1 Minimum Requirement

The power of any spurious emission shall not exceed the limits in Table 6.6.4.1.1.1-1

Table 6.6.4.1.1.1-1: BS Spurious emission limits, Category A

Frequency range	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 [2] , s4.1 NOTE 2: Bandwidth as in ITU-R SM.329 [2] , s4.1. Upper frequency as in ITU-R SM.329 [2] , s2.5 table 1			

6.6.4.1.2 Spurious emissions (Category B)

6.6.4.1.2.1 Minimum Requirement

The power of any spurious emission shall not exceed the limits in Table 6.6.4.1.2.1-1

Table 6.6.4.1.2.1-1: BS Spurious emissions limits, Category B

Frequency range	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 [2] , s4.1 NOTE 2: Bandwidth as in ITU-R SM.329 [2] , s4.1. Upper frequency as in ITU-R SM.329 [2] , s2.5 table 1			

6.6.4.2 Protection of the BS receiver of own or different BS

This requirement shall be applied for E-UTRA FDD operation in order to prevent the receivers of the BSs being desensitised by emissions from a BS transmitter. It is measured at the transmit antenna port for any type of BS which has common or separate Tx/Rx antenna ports.

6.6.4.2.1 Minimum Requirement

The power of any spurious emission shall not exceed the limits in Table 6.6.4.2-1.

Table 6.6.4.2-1: BS Spurious emissions limits for protection of the BS receiver

	Frequency range	Maximum Level	Measurement Bandwidth	Note
	F_{UL_low} – F_{UL_high}	-96 dBm	100 kHz	

6.6.4.3 Additional spurious emissions requirements

These requirements may be applied for the protection of system operating in frequency ranges other than the E-UTRA BS downlink operating band. The limits may apply as an optional protection of such systems that are deployed in the same geographical area as the E-UTRA BS, or they may be set by local or regional regulation as a mandatory requirement for an E-UTRA operating band. It is in some cases not stated in the present document whether a requirement is mandatory or under what exact circumstances that a limit applies, since this is set by local or regional regulation. An overview of regional requirements in the present document is given in subclause 4.3.

Some requirements may apply for the protection of specific equipment (UE, MS and/or BS) or equipment operating in specific systems (GSM, UTRA, E-UTRA, etc.) as listed below.

6.6.4.3.1 Minimum Requirement

The power of any spurious emission shall not exceed the limits of Table 6.6.4.3.1-1 for a BS where requirements for co-existence with the system listed in the first column apply.

Table 6.6.4.3.1-1: BS Spurious emissions limits for E-UTRA BS for co-existence with systems operating in other frequency bands

System type for E-UTRA to co-exist with	Frequency range 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 6.6.4.2.
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 6.6.4.2.
PCS1900	1930 - 1990 MHz	-47 dBm	100 kHz	This requirement does not apply to E-UTRA BS operating in band 2 or band 36.
	1850 - 1910 MHz	-61 dBm	100 kHz	This requirement does not apply to E-UTRA BS operating in band 2, since it is already covered by the requirement in sub-clause 6.6.4.2. This requirement does not apply to E-UTRA BS operating in band 35.
GSM850	869 - 894 MHz	-57 dBm	100 kHz	This requirement does not apply to E-UTRA BS operating in band 5
	824 - 849 MHz	-61 dBm	100 kHz	This requirement does not apply to E-UTRA BS operating in band 5, since it is already covered by the requirement in sub-clause 6.6.4.2.
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 6.6.4.2.
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 6.6.4.2
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 6.6.4.2.
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 6.6.4.2.
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 6.6.4.2.
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 6.6.4.2.

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 6.6.4.2.
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 6.6.4.2.
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 6.6.4.2.
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 6.6.4.2.
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 6.6.4.2.
UTRA FDD Band XII or E-UTRA Band 12	728 - 746 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 12.
	698 - 716 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 12, since it is already covered by the requirement in sub-clause 6.6.4.2.
UTRA FDD Band XIII or E-UTRA Band 13	746 - 756 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 13.
	777 - 787 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 13, since it is already covered by the requirement in sub-clause 6.6.4.2.
UTRA FDD Band XIV or E-UTRA Band 14	758 - 768 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 14.
	788 - 798 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 14, since it is already covered by the requirement in sub-clause 6.6.4.2.
E-UTRA Band 17	734 - 746 MHz	-52 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 17.
	704 - 716 MHz	-49 dBm	1 MHz	This requirement does not apply to E-UTRA BS operating in band 17, since it is already covered by the requirement in subclause 6.6.4.2.
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 apply eto 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 6.6.4.3.1-1 do not apply for the 10 MHz frequency range immediately outside the downlink operating band (see Table 5.5-1). This is also the case when the downlink operating band is adjacent to the Band for the co-existence requirement in the table. Emission limits for this excluded frequency range may be covered by local or regional requirements.

NOTE 2: The table above assumes that two operating bands, where the frequency ranges in Table 5.5-1 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.

The following requirement may be applied for the protection of PHS. This requirement is also applicable at specified frequencies falling between 10 MHz below the lowest BS transmitter frequency of the downlink operating band and 10 MHz above the highest BS transmitter frequency of the downlink operating band.

The power of any spurious emission shall not exceed:

Table 6.6.4.3.1-2: E-UTRA BS Spurious emissions limits for BS for co-existence with PHS

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

The following requirement shall be applied to BS operating in Bands 13 and 14 to ensure that appropriate interference protection is provided to 700 MHz public safety operations. This requirement is also applicable at the frequency range from 10 MHz below the lowest frequency of the BS downlink operating band up to 10 MHz above the highest frequency of the BS downlink operating band.

The power of any spurious emission shall not exceed:

Table 6.6.4.3.1-3: BS Spurious emissions limits for protection of public safety operations

Operating Band	Frequency range	Maximum Level	Measurement Bandwidth	Note
13	763 - 775 MHz	-46 dBm	6.25 kHz	
13	793 - 805 MHz	-46 dBm	6.25 kHz	
14	769 - 775 MHz	-46 dBm	6.25 kHz	
14	799 - 805 MHz	-46 dBm	6.25 kHz	

6.6.4.4 Co-location with other 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.

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

6.6.4.4.1 Minimum Requirement

The power of any spurious emission shall not exceed the limits of Table 6.6.4.4.1-1 for a BS where requirements for co-location with a BS type listed in the first column apply.

Table 6.6.4.4.1-1: BS Spurious emissions limits for BS co-located with another BS

Type of co-located BS	Frequency range 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 FDD Band XII or E-UTRA Band 12	698 - 716 MHz	-96 dBm	100 kHz	
UTRA FDD Band XIII or E-UTRA Band 13	777 - 787 MHz	-96 dBm	100 kHz	
UTRA FDD Band XIV or E-UTRA Band 14	788 - 798 MHz	-96 dBm	100 kHz	
E-UTRA Band 17	704 - 716 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 6.6.4.4.1-1 do not apply for the 10 MHz frequency range immediately outside the BS transmit frequency range of a downlink operating band (see Table 5.5-1). 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 BS transmit and receive frequency ranges in Table 5.5-1 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.

6.7 Transmitter 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. The requirement applies during the transmitter ON period and the transmitter transient period.

6.7.1 Minimum requirement

The transmitter intermodulation level is the power of the intermodulation products when an interfering signal is injected into the antenna connector. The wanted signal channel bandwidth $BW_{Channel}$ shall be the maximum bandwidth supported by the base station. The offset of the interfering signal from the wanted signal shall be as in Table 6.7.1-1.

Table 6.7.1-1 Interfering and wanted signals for the Transmitter intermodulation requirement

Parameter	Value
Wanted signal	E-UTRA signal of maximum channel bandwidth $BW_{Channel}$
Interfering signal type	E-UTRA signal of channel bandwidth 5 MHz
Interfering signal level	Mean power level 30 dB below the mean power of the wanted signal
Interfering signal centre frequency offset from wanted signal carrier centre frequency	$-BW_{Channel}$ /2 - 12.5 MHz $-BW_{Channel}$ /2 - 7.5 MHz $-BW_{Channel}$ /2 - 2.5 MHz $BW_{Channel}$ /2 + 2.5 MHz $BW_{Channel}$ /2 + 7.5 MHz $BW_{Channel}$ /2 + 12.5 MHz
NOTE: Interfering signal positions that are partially or completely outside of the downlink operating band of the base station are excluded from the requirement.	

The transmitter intermodulation level shall not exceed the unwanted emission limits in subclause 6.6 in the presence of an interfering signal according to Table 6.7.1-1. The measurement may be limited to frequencies on which third and fifth order intermodulation products appear, considering the width of these products.

7 Receiver characteristics

7.1 General

The requirements in clause 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).

Unless otherwise stated the requirements in clause 7 apply during the base station receive period.

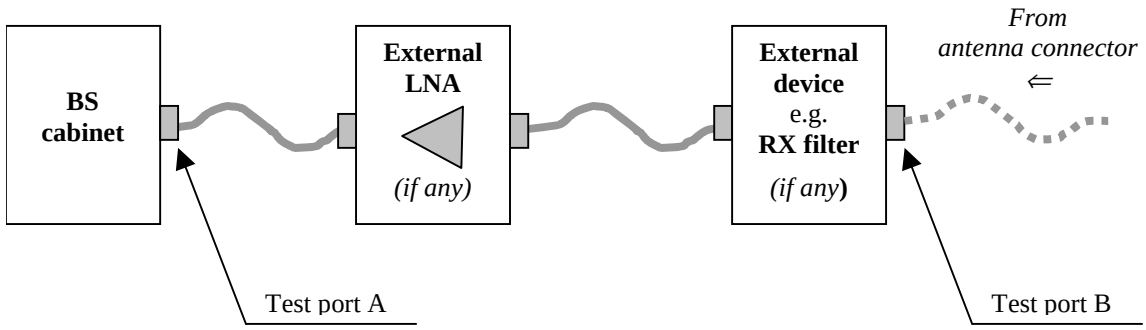

Figure 7.1: Receiver test ports

The throughput requirements defined for the receiver characteristics in this clause do not assume HARQ retransmissions.

7.2 Reference sensitivity level

The reference sensitivity power level $P_{REFSENS}$ is the minimum mean power received at the antenna connector at which a throughput requirement shall be met for a specified reference measurement channel.

7.2.1 Minimum requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in Annex A with parameters specified in Table 7.2.1-1.

Table 7.2.1-1: BS reference sensitivity levels

E-UTRA channel bandwidth [MHz]	Reference measurement channel	Reference sensitivity power level, PREFSENS [dBm]
1.4	FRC A1-1 in Annex A.1	-106.8
3	FRC A1-2 in Annex A.1	-103.0
5	FRC A1-3 in Annex A.1	-101.5
10	FRC A1-3 in Annex A.1*	-101.5
15	FRC A1-3 in Annex A.1*	-101.5
20	FRC A1-3 in Annex A.1*	-101.5

Note*: $P_{REFSENS}$ is the power level of a single instance of the reference measurement channel. This requirement shall be met for each consecutive application of a single instance of FRC A1-3 mapped to disjoint frequency ranges with a width of 25 resource blocks each

7.3 Dynamic range

The dynamic range is specified as a measure of the capability of the receiver to receive a wanted signal in the presence of an interfering signal inside the received channel bandwidth. In this condition a throughput requirement shall be met for a specified reference measurement channel. The interfering signal for the dynamic range requirement is an AWGN signal.

7.3.1 Minimum requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in Annex A with parameters specified in Table 7.3.1-1.

Table 7.3.1-1: Dynamic range

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 A2-1 in Annex A.2	-76.3	-88.7	AWGN
3	FRC A2-2 in Annex A.2	-72.4	-84.7	AWGN
5	FRC A2-3 in Annex A.2	-70.2	-82.5	AWGN
10	FRC A2-3 in Annex A.2*	-70.2	-79.5	AWGN
15	FRC A2-3 in Annex A.2*	-70.2	-77.7	AWGN
20	FRC A2-3 in Annex A.2*	-70.2	-76.4	AWGN

7.4 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 an interfering signal received at a larger power spectral density. In this condition a throughput requirement shall be met for a specified reference measurement channel. The interfering signal shall be an E-UTRA signal as specified in Annex C.

7.4.1 Minimum requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in Annex A with parameters specified in Table 7.4.1-1.

Table 7.4.1-1 E-UTRA BS in-channel selectivity

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	-106.9	-87	1.4 MHz E-UTRA signal, 3 RBs
3	A1-5 in Annex A.1	-102.1	-84	3 MHz E-UTRA signal, 6 RBs
5	A1-2 in Annex A.1	-100.0	-81	5 MHz E-UTRA signal, 10 RBs
10	A1-3 in Annex A.1	-98.5	-77	10 MHz E-UTRA signal, 25 RBs
15	A1-3 in Annex A.1*	-98.5	-77	15 MHz E-UTRA signal, 25 RBs*
20	A1-3 in Annex A.1*	-98.5	-77	20 MHz E-UTRA signal, 25 RBs*

Note*: Wanted and interfering signal are placed adjacently around DC

7.5 Adjacent Channel Selectivity (ACS) and narrow-band blocking

Adjacent channel selectivity (ACS) is a measure of the receiver ability to receive a wanted signal at its assigned channel frequency in the presence of an adjacent channel signal with a specified centre frequency offset of the interfering signal to the band edge of a victim system. The interfering signal shall be an E-UTRA signal as specified in Annex C.

7.5.1 Minimum requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel, with a wanted and an interfering signal coupled to the BS antenna input as specified in Tables 7.5.1-1 and 7.5.1-2 for narrowband blocking and in Table 7.5.1-3 for ACS. The reference measurement channel for the wanted signal is identified in Table 7.2.1-1 for each channel bandwidth and further specified in Annex A.

Table 7.5.1-1: Narrowband blocking requirement

Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Type of interfering signal
$P_{REFSENS}$ + 6dB*	-49	See Table 7.5.1-2
Note*: $P_{REFSENS}$ depends on the channel bandwidth as specified in Table 7.2.1-1.		

Table 7.5.1-2: Interfering signal for Narrowband blocking requirement

E-UTRA Assigned BW [MHz]	Interfering RB centre frequency offset to the channel edge of the wanted signal [kHz]	Type of interfering signal
1.4	250+m*180, m=0, 1, 2, 3, 4, 5	1.4 MHz E-UTRA signal, 1 RB*
3	240+m*180, m=0, 1, 2, 3, 4, 7, 10, 13	3 MHz E-UTRA signal, 1 RB*
5	340+m*180, m=0, 1, 2, 3, 4, 9, 14, 19, 24	5 MHz E-UTRA signal, 1 RB*
10	340+m*180, m=0, 1, 2, 3, 4, 9, 14, 19, 24	5 MHz E-UTRA signal, 1 RB*
15	340+m*180, m=0, 1, 2, 3, 4, 9, 14, 19, 24	5 MHz E-UTRA signal, 1 RB*
20	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

Table 7.5.1-3: Adjacent channel selectivity

E-UTRA channel bandwidth [MHz]	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering signal centre frequency offset from the channel edge of the wanted signal [MHz]	Type of interfering signal
1.4	$P_{REFSENS}$ + 11dB*	-52	0.7	1.4MHz E-UTRA signal
3	$P_{REFSENS}$ + 8dB*	-52	1.5	3MHz E-UTRA signal
5	$P_{REFSENS}$ + 6dB*	-52	2.5	5MHz E-UTRA signal
10	$P_{REFSENS}$ + 6dB*	-52	2.5	5MHz E-UTRA signal
15	$P_{REFSENS}$ + 6dB*	-52	2.5	5MHz E-UTRA signal
20	$P_{REFSENS}$ + 6dB*	-52	2.5	5MHz E-UTRA signal

Note*: $P_{REFSENS}$ depends on the channel bandwidth as specified in Table 7.2.1-1.

7.6 Blocking

7.6.1 General blocking requirement

The blocking characteristics is a measure of the receiver ability to receive a wanted signal at its assigned channel in the presence of an unwanted interferer, which are either a 1.4MHz, 3MHz or 5MHz E-UTRA signal for in-band blocking or a CW signal for out-of-band blocking. The interfering signal shall be an E-UTRA signal as specified in Annex C.

7.6.1.1 Minimum requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel, with a wanted and an interfering signal coupled to BS antenna input using the parameters in Table 7.6.1.1-1 and 7.6.1.1-2. The reference measurement channel for the wanted signal is identified in Table 7.2.1-1 for each channel bandwidth and further specified in Annex A.

Table 7.6.1.1-1: Blocking performance requirement for

Operating Band	Centre Frequency of Interfering Signal [MHz]	Interfering Signal mean power [dBm]	Wanted Signal mean power [dBm]	Interfering signal centre frequency minimum frequency offset from the channel edge of the wanted signal [MHz]	Type of Interfering Signal
1-7, 9-11, 13-14, 33-40	(F_{UL_low} -20) to (F_{UL_high} +20)	-43	$P_{REFSENS}$ +6dB*	See table 7.6.1.1-2	See table 7.6.1.1-2
	1 to (F_{UL_low} -20) (F_{UL_high} +20) to 12750	-15	$P_{REFSENS}$ +6dB*	—	CW carrier
8	(F_{UL_low} -20) to (F_{UL_high} +10)	-43	$P_{REFSENS}$ +6dB*	See table 7.6.1.1-2	See table 7.6.1.1-2
	1 to (F_{UL_low} -20) (F_{UL_high} +10) to 12750	-15	$P_{REFSENS}$ +6dB*	—	CW carrier
12	(F_{UL_low} -20) to (F_{UL_high} +12)	-43	$P_{REFSENS}$ +6dB*	See table 7.6.1.1-2	See table 7.6.1.1-2
	1 to (F_{UL_low} -20) (F_{UL_high} +12) to 12750	-15	$P_{REFSENS}$ +6dB*	—	CW carrier
17	(F_{UL_low} -20) to (F_{UL_high} +18)	-43	$P_{REFSENS}$ +6dB*	See table 7.6.1-2	See table 7.6.1-2
	1 to (F_{UL_low} -20) (F_{UL_high} +18) to 12750	-15	$P_{REFSENS}$ +6dB*	—	CW carrier
Note*: $P_{REFSENS}$ depends on the channel bandwidth as specified in Table 7.2.1-1.					

Table 7.6.1.1-2: Interfering signals for blocking performance requirement for

E-UTRA channel BW [MHz]	Interfering signal centre frequency minimum offset to the channel edge of the wanted signal [MHz]	Type of interfering signal
1.4	2.1	1.4MHz E-UTRA signal
3	4.5	3MHz E-UTRA signal
5	7.5	5MHz E-UTRA signal
10	7.5	5MHz E-UTRA signal
15	7.5	5MHz E-UTRA signal
20	7.5	5MHz E-UTRA signal

7.6.2 Co-location with other base stations

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 an E-UTRA BS. The requirement is applicable to all channel bandwidths supported by the E-UTRA BS.

The requirements in this clause assume a 30 dB coupling loss between interfering transmitter and E-UTRA BS receiver.

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

7.6.2.1 Minimum requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel, with a wanted and an interfering signal coupled to BS antenna input using the parameters in Table 7.6.2.1-1. The reference measurement channel for the wanted signal is identified in Table 7.2.1-1 for each channel bandwidth and further specified in Annex A.

Table 7.6.2.1-1: Blocking performance requirement for E-UTRA BS when co-located with BS in other frequency bands.

Co-located BS type	Centre Frequency of Interfering Signal (MHz)	Interfering Signal mean power (dBm)	Wanted Signal mean power (dBm)	Type of Interfering Signal
Macro GSM850	869 – 894	+16	$P_{REFSENS}$ + 6dB*	CW carrier
Macro GSM900	921 – 960	+16	$P_{REFSENS}$ + 6dB*	CW carrier
Macro DCS1800	1805 – 1880	+16	$P_{REFSENS}$ + 6dB*	CW carrier
Macro PCS1900	1930 – 1990	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band I or E-UTRA Band 1	2110 – 2170	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band II or E-UTRA Band 2	1930 – 1990	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band III or E-UTRA Band 3	1805 – 1880	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band IV or E-UTRA Band 4	2110 – 2155	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band V or E-UTRA Band 5	869 – 894	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band VI or E-UTRA Band 6	875 – 885	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band VII or E-UTRA Band 7	2620 – 2690	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band VIII or E-UTRA Band 8	925 – 960	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band IX or E-UTRA Band 9	1844.9 – 1879.9	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band X or E-UTRA Band 10	2110 – 2170	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band XI or E-UTRA Band 11	1475.9 - 1500.9	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band XII or E-UTRA Band 12	728 - 746	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band XIII or E-UTRA Band 13	746 - 756	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA FDD Band XIV or E-UTRA Band 14	758 - 768	+16	$P_{REFSENS}$ + 6dB*	CW carrier
E-UTRA Band 17	734 - 746	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA TDD in Band a)	1900-1920 2010-2025	+16	$P_{REFSENS}$ + 6dB*	CW carrier
E-UTRA TDD in Band 33	1900-1920	+16	$P_{REFSENS}$ + 6dB*	CW carrier
E-UTRA TDD in Band 34	2010-2025	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA TDD in Band b)	1850-1910 1930-1990	+16	$P_{REFSENS}$ + 6dB*	CW carrier
E-UTRA TDD in Band 35	1850-1910	+16	$P_{REFSENS}$ + 6dB*	CW carrier
E-UTRA TDD in Band 36	1930-1990	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA TDD in Band c) or E-UTRA TDD in Band 37	1910-1930	+16	$P_{REFSENS}$ + 6dB*	CW carrier
UTRA TDD in Band d) or E-UTRA in Band 38	2570-2620	+16	$P_{REFSENS}$ + 6dB*	CW carrier
E-UTRA in Band 39	1880-1920	+16	$P_{REFSENS}$ + 6dB*	CW carrier
E-UTRA in Band 40	2300-2400	+16	$P_{REFSENS}$ + 6dB*	CW carrier
Note*: $P_{REFSENS}$ depends on the channel bandwidth as specified in Table 7.2.1-1.				
NOTE 1: Except for a BS operating in Band 13, these requirements do not apply when the interfering signal falls within the uplink operating band or in the 10 MHz immediately outside the uplink operating band. For a BS operating in band 13 the requirements do not apply when the interfering signal falls within the frequency range 768-797 MHz.				
NOTE 2: Some combinations of bands may not be possible to co-site based on the requirements above. The current state-of-the-art technology does not allow a single generic solution for co-location of UTRA TDD or E-UTRA TDD with E-UTRA FDD 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 [8].				

7.7 Receiver spurious emissions

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. In this case for FDD BS the test shall be performed when both TX and RX are on, with the TX port terminated.

For TDD BS with common RX and TX antenna port the requirement applies during the Transmitter OFF period. For FDD BS with common RX and TX antenna port the transmitter spurious emission as specified in clause 6.6.4 is valid.

7.7.1 Minimum requirement

The power of any spurious emission shall not exceed the levels in Table 7.7.1-1:

Table 7.7.1-1: General spurious emission minimum requirement

Frequency range	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 5.6-1, may be excluded from the requirement. However, frequencies that are more than 10 MHz below the lowest frequency of the BS downlink operating band or more than 10 MHz above the highest frequency of the BS downlink operating band shall not be excluded from the requirement.			

In addition to the requirements in Table 7.7.1-1, 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 subclause 6.6.4.2 and for Co-existence with other systems in the same geographical area in subclause 6.6.4.3. In addition, the co-existence requirements for co-located base stations specified in subclause 6.6.4.4 may also be applied.

7.8 Receiver intermodulation

Third and higher order mixing of the two interfering RF signals can produce an interfering signal in the band of the desired channel. Intermodulation response rejection is 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. Interfering signals shall be a CW signal and an E-UTRA signal as specified in Annex C.

7.8.1 Minimum requirement

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel, with a wanted signal at the assigned channel frequency and two interfering signals coupled to the BS antenna input, with the conditions specified in Tables 7.8.1-1 and 7.8.1-2 for intermodulation performance and in Table 7.8.1-3 for narrowband intermodulation performance. The reference measurement channel for the wanted signal is identified in Table 7.2.1-1 for each channel bandwidth and further specified in Annex A.

Table 7.8.1-1: Intermodulation performance requirement

Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Type of interfering signal
$P_{REFSENS}$ + 6dB*	-52	See Table 7.8.1-2
Note*: $P_{REFSENS}$ depends on the channel bandwidth as specified in Table 7.2.1-1.		

Table 7.8.1-2: Interfering signal for Intermodulation performance requirement

E-UTRA channel bandwidth [MHz]	Interfering signal centre frequency offset from the channel edge of the wanted signal [MHz]	Type of interfering signal
1.4	2.1	CW
	4.9	1.4MHz E-UTRA signal
3	4.5	CW
	10.5	3MHz E-UTRA signal
5	7.5	CW
	17.5	5MHz E-UTRA signal
10	7.5	CW
	17.7	5MHz E-UTRA signal
15	7.5	CW
	18	5MHz E-UTRA signal
20	7.5	CW
	18.2	5MHz E-UTRA signal

Table 7.8.1-3: Narrowband intermodulation performance requirement

E-UTRA channel bandwidth [MHz]	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]	Interfering RB centre frequency offset from the channel edge of the wanted signal [kHz]	Type of interfering signal
1.4	$P_{REFSENS}$ + 6dB*	-52	270	CW
		-52	790	1.4 MHz E-UTRA signal, 1 RB**
3	$P_{REFSENS}$ + 6dB*	-52	275	CW
		-52	790	3.0 MHz E-UTRA signal, 1 RB**
5	$P_{REFSENS}$ + 6dB*	-52	360	CW
		-52	1060	5 MHz E-UTRA signal, 1 RB**
10	$P_{REFSENS}$ + 6dB* (***)	-52	415	CW
		-52	1420	5 MHz E-UTRA signal, 1 RB**
15	$P_{REFSENS}$ + 6dB* (***)	-52	380	CW
		-52	1600	5MHz E-UTRA signal, 1 RB**
20	$P_{REFSENS}$ + 6dB* (***)	-52	345	CW
		-52	1780	5MHz E-UTRA signal, 1 RB**

Note*: $P_{REFSENS}$ is related to the channel bandwidth as specified in Table 7.2.1-1.
Note**: Interfering signal consisting of one resource block positioned at the stated offset.
Note***: This requirement shall apply only for a FRC A1-3 mapped to the frequency range at the channel edge adjacent to the interfering signals

8 Performance requirement

8.1 General

Performance requirements for the BS are specified for the fixed reference channels defined in Annex A and the propagation conditions in Annex B. The requirements only apply to those FRCs that are supported by the base station.

The SNR used in this clause is defined as:

$$SNR = S / N$$

Where:

S is the total signal energy in the subframe on a single antenna port.

N is the noise energy in a bandwidth corresponding to the allocated bandwidth over the duration of a subframe.

8.2 Performance requirements for PUSCH

8.2.1 Requirements in multipath fading propagation conditions

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 FRCs listed in Annex A. The performance requirements assume HARQ retransmissions.

Table 8.2.1-1 Test parameters for testing PUSCH

Parameter	Value
Maximum number of HARQ transmissions	4
RV sequence	0, 2, 3, 1, 0, 2, 3, 1
Uplink-downlink allocation for TDD	Configuration 1 (2:2)

8.2.1.1 Minimum requirements

The throughput shall be equal to or larger than the fraction of maximum throughput stated in the tables 8.2.1.1-1 to 8.2.1.1-6 at the given SNR.

Table 8.2.1.1-1 Minimum requirements for PUSCH, 1.4 MHz Channel Bandwidth

Number of RX antennas	Cyclic prefix	Propagation conditions (Annex B)	FRC (Annex A)	Fraction of maximum throughput	SNR [dB]
2	Normal	EPA 5Hz	A3-2	30%	-4.1
				70%	0.1
			A4-3	70%	10.6
			A5-2	70%	17.7
		EVA 5Hz	A3-1	30%	-2.7
				70%	1.8
			A4-1	30%	4.4
				70%	11.3
			A5-1	70%	18.6
		EVA 70Hz	A3-2	30%	-3.9
				70%	0.7
			A4-3	30%	4.0
				70%	11.9
		ETU 70Hz	A3-1	30%	-2.4
				70%	2.4
		ETU 300Hz	A3-1	30%	-2.2
				70%	2.9
	Extended	ETU 70Hz	A4-2	30%	4.8
				70%	13.5
4	Normal	EPA 5Hz	A3-2	30%	-6.6
				70%	-3.1
			A4-3	70%	7.1
			A5-2	70%	14.4
		EVA 5Hz	A3-1	30%	-5.0
				70%	-1.3
			A4-1	30%	1.3
				70%	7.8
			A5-1	70%	15.4
		EVA 70Hz	A3-2	30%	-6.3
				70%	-2.7
			A4-4	30%	0.8
				70%	8.3
		ETU 70Hz	A3-1	30%	-4.8
				70%	-1.0
		ETU 300Hz	A3-1	30%	-4.6
				70%	-0.6
	Extended	ETU 70Hz	A4-2	30%	1.6
				70%	9.9

Table 8.2.1.1-2 Minimum requirements for PUSCH, 3 MHz Channel Bandwidth

Number of RX antennas	Cyclic prefix	Propagation conditions (Annex B)	FRC (Annex A)	Fraction of maximum throughput	SNR [dB]
2	Normal	EPA 5Hz	A3-3	30%	-4.1
				70%	0.1
			A4-4	70%	10.9
			A5-3	70%	18.1
		EVA 5Hz	A3-1	30%	-2.8
				70%	1.8
			A4-1	30%	4.3
				70%	11.5
			A5-1	70%	18.8
		EVA 70Hz	A3-3	30%	-4.0
				70%	0.6
			A4-4	30%	4.7
				70%	12.5
		ETU 70Hz	A3-1	30%	-2.5
				70%	2.4
		ETU 300Hz	A3-1	30%	-2.2
				70%	2.9
	Extended	ETU 70Hz	A4-2	30%	4.7
				70%	13.5
4	Normal	EPA 5Hz	A3-3	30%	-6.8
				70%	-3.4
			A4-4	70%	7.7
			A5-3	70%	14.4
		EVA 5Hz	A3-1	30%	-5.0
				70%	-1.3
			A4-1	30%	1.2
				70%	7.8
			A5-1	70%	15.4
		EVA 70Hz	A3-3	30%	-6.5
				70%	-2.9
			A4-4	30%	1.6
				70%	8.7
		ETU 70Hz	A3-1	30%	-4.8
				70%	-0.9
		ETU 300Hz	A3-1	30%	-4.6
				70%	-0.6
	Extended	ETU 70Hz	A4-2	30%	1.5
				70%	9.9

Table 8.2.1.1-3 Minimum requirements for PUSCH, 5 MHz Channel Bandwidth

Number of RX antennas	Cyclic prefix	Propagation conditions (Annex B)	FRC (Annex A)	Fraction of maximum throughput	SNR [dB]
2	Normal	EPA 5Hz	A3-4	30%	-4.7
				70%	-0.7
			A4-5	70%	10.4
			A5-4	70%	18.0
		EVA 5Hz	A3-1	30%	-2.7
				70%	1.8
			A4-1	30%	4.3
				70%	11.5
			A5-1	70%	18.6
		EVA 70Hz	A3-4	30%	-4.5
				70%	-0.1
			A4-5	30%	4.3
				70%	12.3
		ETU 70Hz	A3-1	30%	-2.5
				70%	2.4
		ETU 300Hz	A3-1	30%	-2.2
				70%	2.9
	Extended	ETU 70Hz	A4-2	30%	4.8

				70%	13.5
4	Normal	EPA 5Hz	A3-4	30%	-7.1
				70%	-3.8
			A4-5	70%	7.6
			A5-4	70%	14.4
		EVA 5Hz	A3-1	30%	-5.1
				70%	-1.4
			A4-1	30%	1.2
				70%	7.9
			A5-1	70%	15.5
		EVA 70Hz	A3-4	30%	-6.9
				70%	-3.3
			A4-5	30%	1.2
				70%	8.3
		ETU 70Hz	A3-1	30%	-4.8
				70%	-0.9
		ETU 300Hz	A3-1	30%	-4.6
				70%	-0.6
	Extended	ETU 70Hz	A4-2	30%	1.6
				70%	9.9

Table 8.2.1.1-4 Minimum requirements for PUSCH, 10 MHz Channel Bandwidth

Number of RX antennas	Cyclic prefix	Propagation conditions (Annex B)	FRC (Annex A)	Fraction of maximum throughput	SNR [dB]
2	Normal	EPA 5Hz	A3-5	30%	-4.2
				70%	-0.4
			A4-6	70%	10.8
			A5-5	70%	18.3
		EVA 5Hz	A3-1	30%	-2.7
				70%	1.9
			A4-1	30%	4.3
				70%	11.4
			A5-1	70%	18.8
		EVA 70Hz	A3-5	30%	-4.1
				70%	0.1
			A4-6	30%	4.5
				70%	12.6
		ETU 70Hz	A3-1	30%	-2.5
				70%	2.4
		ETU 300Hz	A3-1	30%	-2.2
				70%	2.9
	Extended	ETU 70Hz	A4-2	30%	4.8
				70%	13.6
4	Normal	EPA 5Hz	A3-5	30%	-6.8
				70%	-3.5
			A4-6	70%	7.5
			A5-5	70%	14.7
		EVA 5Hz	A3-1	30%	-5.0
				70%	-1.2
			A4-1	30%	1.2
				70%	7.9
			A5-1	70%	15.5
		EVA 70Hz	A3-5	30%	-6.7
				70%	-2.9
			A4-6	30%	0.7
				70%	8.0
		ETU 70Hz	A3-1	30%	-4.8
				70%	-0.9
		ETU 300Hz	A3-1	30%	-4.6
				70%	-0.6
	Extended	ETU 70Hz	A4-2	30%	1.7
				70%	10.3

Table 8.2.1.1-5 Minimum requirements for PUSCH, 15 MHz Channel Bandwidth

Number of RX antennas	Cyclic prefix	Propagation conditions (Annex B)	FRC (Annex A)	Fraction of maximum throughput	SNR [dB]
2	Normal	EPA 5Hz	A3-6	30%	-4.5
				70%	-0.8
			A4-7	70%	11.3
			A5-6	70%	18.8
		EVA 5Hz	A3-1	30%	-2.8
				70%	1.8
			A4-1	30%	4.2
				70%	11.4
			A5-1	70%	18.7
		EVA 70Hz	A3-6	30%	-4.5
				70%	-0.3
			A4-7	30%	4.2
				70%	12.9
		ETU 70Hz	A3-1	30%	-2.5
				70%	2.4
		ETU 300Hz	A3-1	30%	-2.2
				70%	2.9
	Extended	ETU 70Hz	A4-2	30%	4.9
				70%	13.6
4	Normal	EPA 5Hz	A3-6	30%	-7.2
				70%	-3.8
			A4-7	70%	7.6
			A5-6	70%	15.0
		EVA 5Hz	A3-1	30%	-5.0
				70%	-1.2
			A4-1	30%	1.2
				70%	7.9
			A5-1	70%	15.7
		EVA 70Hz	A3-6	30%	-7.0
				70%	-3.3
			A4-7	30%	0.7
				70%	8.5
		ETU 70Hz	A3-1	30%	-4.8
				70%	-1.0
		ETU 300Hz	A3-1	30%	-4.6
				70%	-0.6
	Extended	ETU 70Hz	A4-2	30%	1.6
				70%	10.1

Table 8.2.1.1-6 Minimum requirements for PUSCH, 20 MHz Channel Bandwidth

Number of RX antennas	Cyclic prefix	Propagation conditions (Annex B)	FRC (Annex A)	Fraction of maximum throughput	SNR [dB]
2	Normal	EPA 5Hz	A3-7	30%	-4.2
				70%	-0.4
			A4-8	70%	11.5
			A5-7	70%	19.7
		EVA 5Hz	A3-1	30%	-2.7
				70%	1.8
			A4-1	30%	4.3
				70%	11.5
			A5-1	70%	18.7
		EVA 70Hz	A3-7	30%	-4.1
				70%	0.2
			A4-8	30%	4.2
				70%	13.0
		ETU 70Hz	A3-1	30%	-2.4
				70%	2.4
		ETU 300Hz	A3-1	30%	-2.1
				70%	2.9
	Extended	ETU 70Hz	A4-2	30%	4.7
				70%	13.6
4	Normal	EPA 5Hz	A3-7	30%	-6.8
				70%	-3.5
			A4-8	70%	7.5
			A5-7	70%	15.9
		EVA 5Hz	A3-1	30%	-5.1
				70%	-1.3
			A4-1	30%	1.2
				70%	7.9
			A5-1	70%	15.6
		EVA 70Hz	A3-7	30%	-6.7
				70%	-2.9
			A4-8	30%	0.7
				70%	8.6
		ETU 70Hz	A3-1	30%	-4.4
				70%	-0.9
		ETU 300Hz	A3-1	30%	-4.6
				70%	-0.7
	Extended	ETU 70Hz	A4-2	30%	1.6
				70%	10.0

8.2.2 Requirements for UL timing adjustment

The performance requirement of UL timing adjustment is determined by a minimum required throughput for a given SNR. The performance requirements assume HARQ retransmissions. The performance requirements for UL timing adjustment scenario 2 defined in Annex B.4 are optional.

In the tests for UL timing adjustment, two signals are configured, one being transmitted by a moving UE and the other being transmitted by a stationary UE. FRC parameters in Table A.7-1 and Table A.8-1 are applied for both UEs. The received power for both UEs is the same. The resource blocks allocated for both UEs are consecutive. In Scenario 2, Doppler shift is not taken into account.

Table 8.2.2-1 Test parameters for testing UL timing adjustment

Parameter	Value
Maximum number of HARQ transmissions	4
RV sequence	0, 2, 3, 1, 0, 2, 3, 1
Uplink-downlink allocation for TDD	Configuration 1 (2:2)
Subframes in which PUSCH is transmitted	subframe #0, #2, #4, #6, and #8 in radio frames
Subframes in which sounding RS is transmitted (Note 1)	subframe #1 in radio frames
Note 1. The configuration of SRS is optional.	

8.2.2.1 Minimum requirements

The throughput shall be ≥ 70% of the maximum throughput of the reference measurement channel as specified in Annex A for the moving UE at the SNR given in table 8.2.2.1-1.

Table 8.2.2.1-1 Minimum requirements for UL timing adjustment.

Number of RX antennas	Cyclic prefix	Channel Bandwidth [MHz]	Moving propagation conditions (Annex B)	FRC (Annex A)	SNR [dB]
2	Normal	1.4	Scenario 1	A7-1	13.1
			Scenario 2	A8-1	-1.9
		3	Scenario 1	A7-2	13.4
			Scenario 2	A8-2	-1.5
		5	Scenario 1	A7-3	13.2
			Scenario 2	A8-3	-1.6
		10	Scenario 1	A7-4	13.8
			Scenario 2	A8-4	-1.8
		15	Scenario 1	A7-5	14.0
			Scenario 2	A8-5	-1.8
		20	Scenario 1	A7-6	13.9
			Scenario 2	A8-6	-1.8

8.2.3 Requirements for high speed train

The performance requirement of PUSCH for high speed train is determined by a minimum required throughput for a given SNR. The required throughput is expressed as a fraction of maximum throughput for the FRCs listed in Annex A. The performance requirements assume HARQ retransmissions. The performance requirements for high speed train are optional.

Table 8.2.3-1 Test parameters for high speed train

Parameter	Value
Maximum number of HARQ transmissions	4
RV sequence	0, 2, 3, 1, 0, 2, 3, 1
Uplink-downlink allocation for TDD	Configuration 1 (2:2)
Subframes in which PUSCH is transmitted	subframe #0 and #8 in radio frames for which SFN mod 4 = 0 subframe #6 in radio frames for which SFN mod 4 = 1 subframe #4 in radio frames for which SFN mod 4 = 2 subframe #2 in radio frames for which SFN mod 4 = 3
Subframes in which PUCCH is transmitted (Note1, Note 2)	subframe #5 in radio frames
Note 1. The configuration of PUCCH (format 2) is optional.Note 2. The SNR values per antenna shall be set to -4.5 dB and -1.5 dB for Scenario 1 and 3, respectively.	

8.2.3.1 Minimum requirements

The throughput shall be equal to or larger than the fraction of maximum throughput stated in table 8.2.3.1-1 at the given SNR.

Table 8.2.3.1-1 Minimum requirements of PUSCH for high speed train

Channel Bandwidth [MHz]	*Cyclic prefix*	*FRC (Annex A)*	*Number of RX antennas*	*Propagation conditions (Annex B)*	*Fraction of maximum throughput*	*SNR [dB]*
1.4	*Normal*	*A3-2*	*1*	*HST Scenario 3*	*30%*	*-1.5*
					70%	*1.9*
			2	*HST Scenario 1*	*30%*	*-3.9*
					70%	*-0.6*
3	*Normal*	*A3-3*	*1*	*HST Scenario 3*	*30%*	*-2.1*
					70%	*1.6*
			2	*HST Scenario 1*	*30%*	*-4.5*
					70%	*-1.0*
5	*Normal*	*A3-4*	*1*	*HST Scenario 3*	*30%*	*-2.6*
					70%	*1.3*
			2	*HST Scenario 1*	*30%*	*-5.1*
					70%	*-1.4*
10	*Normal*	*A3-5*	*1*	*HST Scenario 3*	*30%*	*-2.7*
					70%	*1.2*
			2	*HST Scenario 1*	*30%*	*-5.4*
					70%	*-1.5*
15	*Normal*	*A3-6*	*1*	*HST Scenario 3*	*30%*	*-2.7*
					70%	*1.2*
			2	*HST Scenario 1*	*30%*	*-5.2*
					70%	*-1.4*
20	*Normal*	*A3-7*	*1*	*HST Scenario 3*	*30%*	*-2.7*
					70%	*1.2*
			2	*HST Scenario 1*	*30%*	*-5.3*
					70%	*-1.4*

8.2.4 Requirements for HARQ-ACK multiplexed on PUSCH

Two performance requirements are defined for HARQ-ACK multiplexed on PUSCH: ACK false detection and ACK missed detection requirements.

The ACK false detection probability for PUSCH is the probability that ACK is detected when data only is sent on symbols where HARQ-ACK information can be allocated (i.e. by puncturing data).

The ACK missed detection probability for HARQ-ACK multiplexed on PUSCH is the conditional probability of not detecting an ACK when it was sent on PUSCH resources.

In the tests for ACK missed detection on PUSCH, data is punctured by the control information (i.e. ACK/NAK) in both slots within subframe on symbols as specified in 36.212.

In both tests none of CQI, RI nor SRS is transmitted. Tests are to be performed for one bit HARQ-ACK information (O = 1).

8.2.4.1 Minimum requirement

The ACK false detection probability as well as the ACK missed detection probability for HARQ-ACK multiplexed on PUSCH shall not exceed 1% at PUSCH power settings presented in table 8.2.4.2.1-1.

Table 8.2.4.1-1 Minimum requirements for HARQ-ACK multiplexed on PUSCH

Number of RX antennas	Cyclic Prefix	Propagation conditions (Annex B)	Channel Bandwidth [MHz]	FRC (Annex A)	$I_{offset}^{HARQ-ACK}$	SNR [dB]
2	Normal	ETU70	1.4	A.3-1	[TBD]	[TBD]
				A.4-3	[TBD]	[TBD]
			3	A.3-1	[TBD]	[TBD]
				A.4-4	[TBD]	[TBD]
			5	A.3-1	[TBD]	[TBD]
				A.4-5	[TBD]	[TBD]
			10	A.3-1	[TBD]	[TBD]
				A.4-6	[TBD]	[TBD]
			15	A.3-1	[TBD]	[TBD]
				A.4-7	[TBD]	[TBD]
			20	A.3-1	[TBD]	[TBD]
				A.4-8	[TBD]	[TBD]

8.3 Performance requirements for PUCCH

8.3.1 DTX to ACK performance

The DTX to ACK requirement is valid for any number of receive antennas, for all frame structures and for any channel bandwidth.

The DTX to ACK probability for multi user PUCCH case denotes the probability that ACK is detected when nothing is sent on the wanted signal and the interfering signals are present.

8.3.1.1 Minimum requirement

The DTX to ACK probability, i.e. the probability that ACK is detected when nothing is sent, shall not exceed 1%.

8.3.2 ACK missed detection requirements for single user PUCCH format 1a

The ACK missed detection probability is the probability of not detecting an ACK when an ACK was sent.

8.3.2.1 Minimum requirements

The ACK missed detection probability shall not exceed 1% at the SNR given in table 8.3.2.1-1.

Table 8.3.2.1-1 Minimum requirements for single user PUCCH format 1a

Number of RX antennas	Cyclic Prefix	Propagation Conditions (Annex B)	Channel Bandwidth / SNR [dB] 1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
2	Normal	EPA 5	-2.5	-3.9	-4.8	-5.4	-5.3	-5.1
		EVA 5	-4.5	-5.1	-5.1	-5.0	-5.1	-5.1
		EVA 70	-4.9	-5.2	-5.2	-5.1	-5.2	-5.1
		ETU 300	-5.0	-5.1	-4.9	-5.0	-5.2	-5.2
	Extended	ETU 70	-4.2	-4.3	-4.1	-4.3	-4.2	-4.3
4	Normal	EPA 5	-7.9	-8.4	-8.7	-8.9	-8.9	-9.0
		EVA 5	-8.8	-9.1	-9.1	-8.8	-8.9	-8.9
		EVA 70	-8.9	-9.0	-9.0	-8.8	-9.0	-8.8
		ETU 300	-8.7	-8.9	-8.7	-8.7	-8.9	-8.8
	Extended	ETU 70	-7.9	-8.1	-7.9	-8.1	-8.0	-8.0

8.3.3 CQI missed detection requirements for PUCCH format 2

The CQI missed detection block error probability is defined as the conditional probability of incorrectly receiving the CQI information bits or not detecting the signal at all when the CQI information is sent. The CQI information bit payload per sub-frame is equal to 4 bits.

8.3.3.1 Minimum requirements

The CQI missed detection block error probability shall not exceed 1% at the SNR given in table 8.3.3.1-1.

Table 8.3.3.1-1 Minimum requirements for PUCCH format 2

Number of RX antennas	Cyclic Prefix	Propagation Conditions (Annex B)	Channel Bandwidth / SNR [dB] 1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
2	**Normal**	**ETU 70**	**-3.9**	**-4.4**	**-4.2**	**-4.4**	**-4.4**	**-4.4**

8.3.4 ACK missed detection requirements for multi user PUCCH format 1a

The ACK missed detection probability is the conditional probability of not detecting an ACK on the wanted signal in the presence of the wanted signal and the interfering signals.

Test parameters for multi user PUCCH case are presented in Annex A.9.

8.3.4.1 Minimum requirement

The ACK missed detection probability for multi user PUCCH case shall not exceed 1% at the SNR given in table 8.3.4.1-1.

Table 8.3.4.1-1 Minimum requirements for multi user PUCCH case

Number of RX antennas	Cyclic Prefix	Propagation Conditions (Annex B)	Channel Bandwidth / SNR [dB] 1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
2	Normal	ETU 70	-4.1	-4.4	-4.4	-4.6	-4.6	-4.4

8.4 Performance requirements for PRACH

8.4.1 PRACH False alarm probability

The false alarm requirement is valid for any number of receive antennas, for all frame structures and for any channel bandwidth.

The false alarm probability is the conditional total probability of erroneous detection of the preamble (i.e. the sum of all errors from all detectors) when input is only noise.

8.4.1.1 Minimum requirement

The false alarm probability shall be less than or equal to 0.1%.

8.4.2 PRACH detection requirements

The probability of detection is the conditional probability of correct detection of the preamble when the signal is present. There are several error cases – detecting different preamble than the one that was sent, not detecting a preamble at all or correct preamble detection but with the wrong timing estimation. For AWGN, a timing estimation error occurs if the estimation error of the timing of the strongest path is larger than 1.04us. For ETU70, a timing estimation error occurs if the estimation error of the timing of the strongest path is larger than 2.08us. The strongest path for the timing estimation error refers to the strongest path (i.e. average of the delay of all paths having the same highest gain = 310ns for ETU) in the power delay profile.

The test preambles for normal mode are listed in table A.6-1 and the test preambles for high speed mode are listed in A.6-2.

8.4.2.1 Minimum requirements

The probability of detection shall be equal to or exceed 99% for the SNR levels listed in table 8.4.2.1-1 and 8.4.2.1-2.

The requirements for Burst format 4 are optional and only valid for base stations supporting TDD. The requirements for high speed mode (table 8.4.2.1-2) are only valid for the base stations supporting high speed mode.

Table 8.4.2.1-1 PRACH missed detection requirements for Normal Mode

Number of RX antennas	Propagation conditions (Annex B)	Frequency offset	SNR [dB]				
			Burst format 0	Burst format 1	Burst format 2	Burst format 3	Burst format 4
2	AWGN	0	-14.2	-14.2	-16.4	-16.5	-7.2
	ETU 70	270 Hz	-8.0	-7.8	-10.0	-10.1	-0.1
4	AWGN	0	-16.9	-16.7	-19.0	-18.8	-9.8
	ETU 70	270 Hz	-12.1	-11.7	-14.1	-13.9	-5.1

Table 8.4.2.1-2 PRACH missed detection requirements for High speed Mode

Number of RX antennas	Propagation conditions (Annex B)	Frequency offset	SNR [dB]			
			Burst format 0	Burst format 1	Burst format 2	Burst format 3
2	AWGN	0	-14.1	-14.2	-16.3	-16.6
	ETU 70	270 Hz	-7.4	-7.3	-9.3	-9.5
	AWGN	625 Hz	-12.4	-12.3	-14.4	-14.4
	AWGN	1340 Hz	-13.4	-13.5	-15.5	-15.7
4	AWGN	0	-16.9	-16.6	-18.9	-18.8
	ETU 70	270 Hz	-11.8	-11.4	-13.7	-13.7
	AWGN	625 Hz	-14.9	-14.6	-16.8	-16.8
	AWGN	1340 Hz	-15.9	-15.5	-17.8	-17.8

Annex A (normative): Reference measurement channels

The parameters for the reference measurement channels are specified in clause A.1 for reference sensitivity and in-channel selectivity and in clause A.2 for dynamic range.

A schematic overview of the encoding process for the reference measurement channels is provided in Figure A-1.

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. For FDD, 1000 uplink sub-frames per second are used.

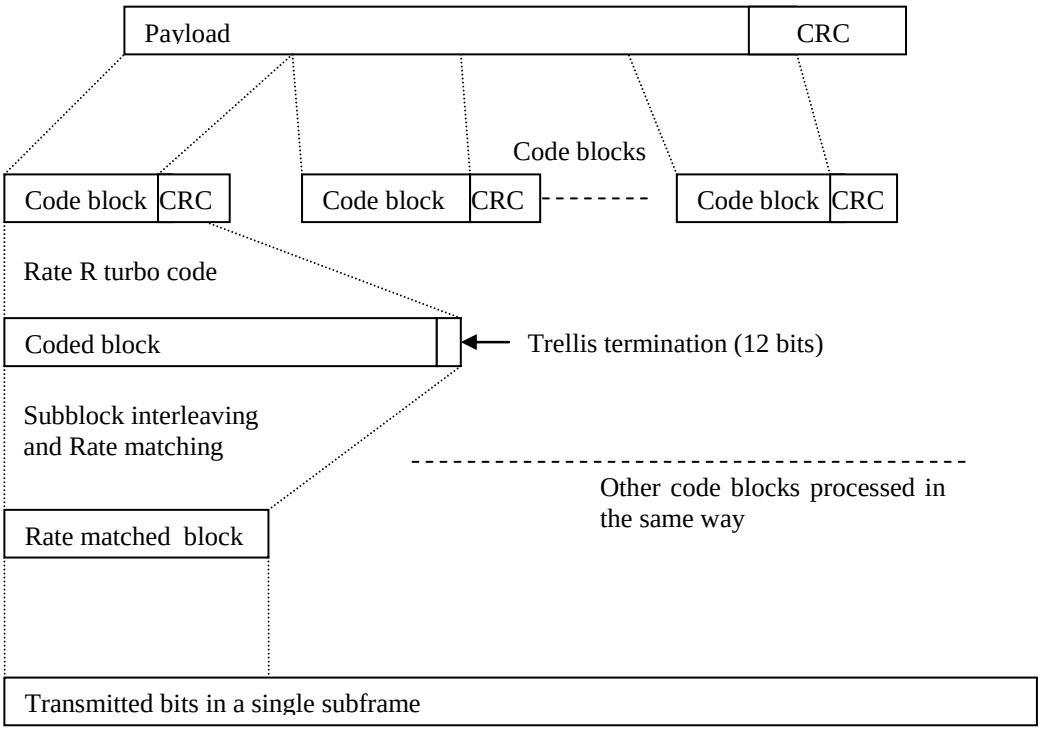

Figure A-1. Schematic overview of the encoding process

A.1 Fixed Reference Channels for reference sensitivity and in-channel selectivity (QPSK, R=1/3)

The parameters for the reference measurement channels are specified in Table A.1-1 for reference sensitivity and in-channel selectivity.

Table A.1-1 FRC parameters for reference sensitivity and in-channel selectivity

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)	600	1544	2216	256	936
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)	1884	4716	6732	852	2892
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)

The parameters for the reference measurement channels are specified in Table A.2-1 for dynamic range.

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)	2344	5992	9912
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)	7116	18060	14988
Total number of bits per sub-frame	3456	8640	14400
Total symbols per sub-frame	864	2160	3600

A.3 Fixed Reference Channels for performance requirements (QPSK 1/3)

Table A.3-1 FRC parameters for performance requirements (QPSK 1/3)

Reference channel	A3-1	A3-2	A3-3	A3-4	A3-5	A3-6	A3-7
Allocated resource blocks	1	6	15	25	50	75	100
DFT-OFDM Symbols per subframe	12	12	12	12	12	12	12
Modulation	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK
Code rate	1/3	1/3	1/3	1/3	1/3	1/3	1/3
Payload size (bits)	104	600	1544	2216	5160	6712	10296
Transport block CRC (bits)	24	24	24	24	24	24	24
Code block CRC size (bits)	0	0	0	0	0	24	24
Number of code blocks - C	1	1	1	1	1	2	2
Coded block size including 12bits trellis termination (bits)	396	1844	4716	6732	15564	10188	15564
Total number of bits per sub-frame	288	1728	4320	7200	14400	21600	28800
Total symbols per sub-frame	144	864	2160	3600	7200	10800	14400

Reference channel	A4-1	A4-2	A4-3	A4-4	A4-5	A4-6	A4-7	A4-8
Allocated resource blocks	1	1	6	15	25	50	75	100
DFT-OFDM Symbols per subframe	12	10	12	12	12	12	12	12
Modulation	16QAM	16QAM	16QAM	16QAM	16QAM	16QAM	16QAM	16QAM
Code rate	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Payload size (bits)	408	376	2600	6456	10680	21384	32856	43816
Transport block CRC (bits)	24	24	24	24	24	24	24	24
Code block CRC size (bits)	0	0	0	24	24	24	24	24
Number of code blocks - C	1	1	1	2	2	4	6	8
Coded block size including 12bits trellis termination (bits)	1308	1212	7884	9804	16140	16140	16524	16524
Total number of bits per sub-frame	576	480	3456	8640	14400	28800	43200	57600
Total symbols per sub-frame	144	120	864	2160	3600	7200	10800	14400

A.4 Fixed Reference Channels for performance requirements (16QAM 3/4)

Table A.4-1 FRC parameters for performance requirements (16QAM 3/4)

A.5 Fixed Reference Channels for performance requirements (64QAM 5/6)

Table A.5-1 FRC parameters for performance requirements (64QAM 5/6)

Reference channel	A5-1	A5-2	A5-3	A5-4	A5-5	A5-6	A5-7
Allocated resource blocks	1	6	15	25	50	75	100
DFT-OFDM Symbols per subframe	12	12	12	12	12	12	12
Modulation	64QAM	64QAM	64QAM	64QAM	64QAM	64QAM	64QAM
Code rate	5/6	5/6	5/6	5/6	5/6	5/6	5/6
Payload size (bits)	712	4392	11064	18336	36696	55056	75376
Transport block CRC (bits)	24	24	24	24	24	24	24
Code block CRC size (bits)	0	0	24	24	24	24	24
Number of code blocks - C	1	1	2	3	6	9	13
Coded block size including 12bits trellis termination (bits)	2220	13260	16716	18444	18444	18444	17484
Total number of bits per sub-frame	864	5184	12960	21600	43200	64800	86400
Total symbols per sub-frame	144	864	2160	3600	7200	10800	14400

A.6 PRACH Test preambles

Table A.6-1 Test preambles for Normal Mode

Burst format	Ncs	Logical sequence index	v
0	13	22	32
1	167	22	2
2	167	22	0
3	0	22	0
4	10	0	0

Table A.6-2 Test preambles for High speed Mode

Burst format	Ncs	Logical sequence index	v
0	15	384	0
1	202	384	0
2	202	384	0
3	237	384	0

A.7 Fixed Reference Channels for UL timing adjustment (Scenario 1)

Table A.7-1 FRC parameters for UL timing adjustment (Scenario 1)

Reference channel	A7-1	A7-2	A7-3	A7-4	A7-5	A7-6
Allocated resource blocks	3	6	12	25	25	25
DFT-OFDM Symbols per subframe	12	12	12	12	12	12
Modulation	16QAM	16QAM	16QAM	16QAM	16QAM	16QAM
Code rate	3/4	3/4	3/4	3/4	3/4	3/4
Payload size (bits)	1288	2600	5160	10680	10680	10680
Transport block CRC (bits)	24	24	24	24	24	24
Code block CRC size (bits)	0	0	0	24	24	24
Number of code blocks - C	1	1	1	2	2	2
Coded block size including 12bits trellis termination (bits)	3948	7884	15564	16140	16140	16140
Total number of bits per sub-frame	1728	3456	6912	14400	14400	14400
Total symbols per sub-frame	432	864	1728	3600	3600	3600
SRS bandwidth configuration (See TS 36.211, 5.5.3) (Note 1)	7	5	3	2	5	2
SRS-Bandwidth b (See TS 36.211, 5.5.3) (Note 1, 2)	0	0	0	0	0	1

NOTE 1. The configuration of SRS is optional
NOTE 2. PUSCH resource blocks shall be included in SRS resource blocks

A.8 Fixed Reference Channels for UL timing adjustment (Scenario 2)

Table A.8-1 FRC parameters for UL timing adjustment (Scenario 2)

Reference channel	A8-1	A8-2	A8-3	A8-4	A8-5	A8-6
Allocated resource blocks	3	6	12	25	25	25
DFT-OFDM Symbols per subframe	12	12	12	12	12	12
Modulation	QPSK	QPSK	QPSK	QPSK	QPSK	QPSK
Code rate	1/3	1/3	1/3	1/3	1/3	1/3
Payload size (bits)	256	600	1224	2216	2216	2216
Transport block CRC (bits)	24	24	24	24	24	24
Code block CRC size (bits)	0	0	0	0	0	0
Number of code blocks - C	1	1	1	1	1	1
Coded block size including 12bits trellis termination (bits)	852	1884	3756	6732	6732	6732
Total number of bits per sub-frame	864	1728	3456	7200	7200	7200
Total symbols per sub-frame	432	864	1728	3600	3600	3600
SRS bandwidth configuration (See TS 36.211, 5.5.3) (Note 1)	7	5	3	2	5	2
SRS-Bandwidth b (See TS 36.211, 5.5.3) (Note 1, 2)	0	0	0	0	0	1

NOTE 1. The configuration of SRS is optional
NOTE 2. PUSCH resource blocks shall be included in SRS resource blocks

A.9 Multi user PUCCH test

Table A.9-1 Test parameters for multi user PUCCH case

	Cyclic shift index (δ =0)	Orthogonal cover index	RS orthogonal cover / ACK/NACK orthogonal cover	Relative power [dB]	Relative timing [ns]
Tested signal	4	0	2	-	-
Interferer 1	2	0	1	0	0
Interferer 2	3	1	7	-3	
Interferer 3	4	2	14	3	

NOTE1: Presented resource index mapping for orthogonal cover and cyclic shift indices are for the first slot of the subframe.

NOTE2: All above listed signals are transmitted on the same PUCCH resources, with different PUCCH channel indices as presented above.

Annex B (normative): Propagation conditions

B.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 Multi-path fading propagation conditions

Table B.2-1 shows multi-path delay profiles that are used for the performance measurements in multi-path fading environment. All taps have classical Doppler spectrum, defined as:

(CLASS) $$S(f) \propto 1/(1-(f/f_D)^2)^{0.5}$$ for $f \in -f_D, f_D$.

Table B.2-1 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 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.2-3 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

A multipath fading propagation condition is defined by a combination of a multi-path delay profile and a maximum Doppler frequency f_D which is either 5, 70 or 300 Hz.

B.3 High speed train condition

High speed train conditions are as follows:

Scenario 1: Open space

Scenario 3: Tunnel for multi-antennas

The high speed train conditions for the test of the baseband performance are two non-fading propagation channels in both scenarios. For BS with Rx diversity defined in scenario 1, the Doppler shift variation is the same between antennas.

Doppler shift for both scenarios is given by:

$$f_s(t) = f_d \cos\theta(t) \tag{B.3.1}$$

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:

$$\cos\theta(t) = \frac{D_s/2 - vt}{\sqrt{D_{\min}{}^2 + (D_s/2 - vt)^2}},\ 0 \le t \le D_s/v \tag{B.3.2}$$

$$\cos\theta(t) = \frac{-1.5D_s + vt}{\sqrt{D_{\min}{}^2 + (-1.5D_s + vt)^2}},\ D_s/v < t \le 2D_s/v \tag{B.3.3}$$

$$\cos\theta(t) = \cos\theta(t \mod (2D_s/v)),\ t > 2D_s/v \tag{B.3.4}$$

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.

Doppler shift and cosine angle is given by equation B.3.1 and B.3.2-B.3.4 respectively, where the required input parameters listed in table B.3-1 and the resulting Doppler shift shown in Figure B.3-1 and B.3-2 are applied for all frequency bands.

Table B.3-1: Parameters for high speed train conditions

Parameter	Value	
	Scenario 1	Scenario 3
D_s	1000 m	300 m
$D_{\min}$	50 m	2 m
v	350 km/h	300 km/h
f_d	1340 Hz	1150 Hz

NOTE1: Parameters for HST conditions in table B.3-1 including f_d and Doppler shift trajectories presented on figures B.3-1 and B.3-2 were derived for Band1.

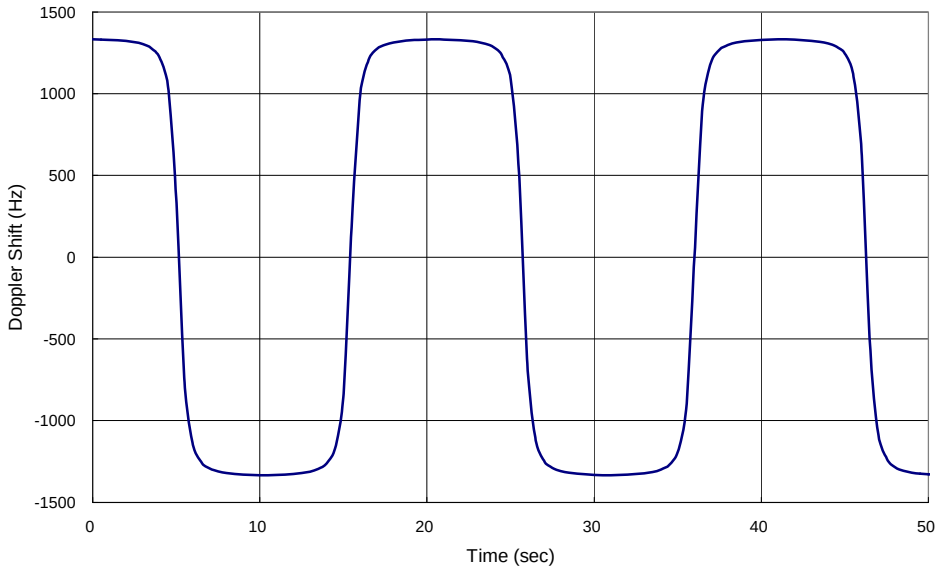

Figure B.3-1: Doppler shift trajectory for scenario 1

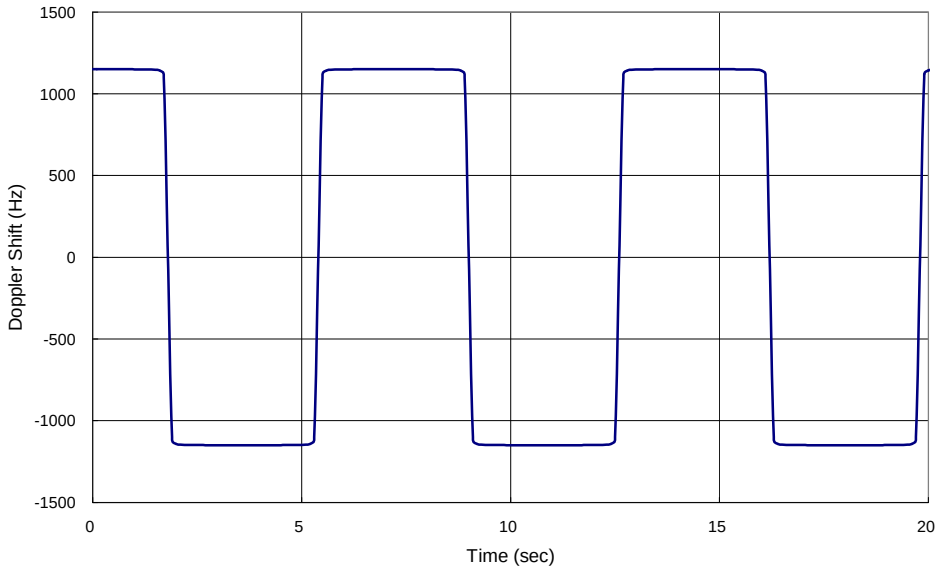

Figure B.3-2: Doppler shift trajectory for scenario 3

B.4 Moving propagation conditions

Figure B.4-1 illustrates the moving propagation conditions for the test of the UL timing adjustment performance. The time difference between the reference timing and the first tap is according Equation (B.4-1). The relative timing among all taps is fixed. The parameters for the moving propagation conditions are shown in Table B.4-1.

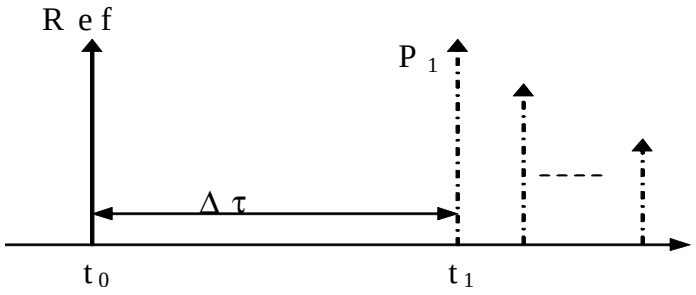

Figure B.4-1: Moving propagation conditions

$$\Delta\tau = \frac{A}{2} \cdot \sin(\Delta\omega \cdot t) \qquad \text{(B.4-1)}$$

Table B.4-1: Parameters for UL timing adjustment

Parameter	Scenario 1	Scenario 2
Channel model	ETU200	AWGN
UE speed	120 km/h	350 km/h
CP length	Normal	Normal
A	10 μs	10 μs
Δω	0.04 s^{-1}	0.13 s^{-1}

Annex C (normative): Characteristics of the interfering signals

The interfering signal shall be a PUSCH containing data and reference symbols. Normal cyclic prefix is used. The data content shall be uncorrelated to the wanted signal and modulated according to clause 5 of TS36.211. Mapping of PUSCH modulation to receiver requirement are specified in table C-1.1.

Table C-1: Modulation of the interfering signal

Receiver requirement	Modulation
In-channel selectivity	16QAM
Adjacent channel selectivity and narrow-band blocking	QPSK
Blocking	QPSK
Receiver intermodulation	QPSK

Annex D (normative): Environmental requirements for the BS equipment

The BS equipment shall fulfil all the requirements in the full range of environmental conditions for the relevant environmental class from the relevant IEC specifications listed below

60 721-3-3 "Stationary use at weather protected locations"

60 721-3-4 "Stationary use at non weather protected locations"

Normally it should be sufficient for all tests to be conducted using normal test conditions except where otherwise stated. For guidance on the use of test conditions to be used in order to show compliance refer to TS 36.141.

Annex E (normative): Error Vector Magnitude

E.1 Reference point for measurement

The EVM shall be measured at the point after the FFT and a zero-forcing (ZF) equalizer in the receiver, as depicted in Figure E.1-1 below.

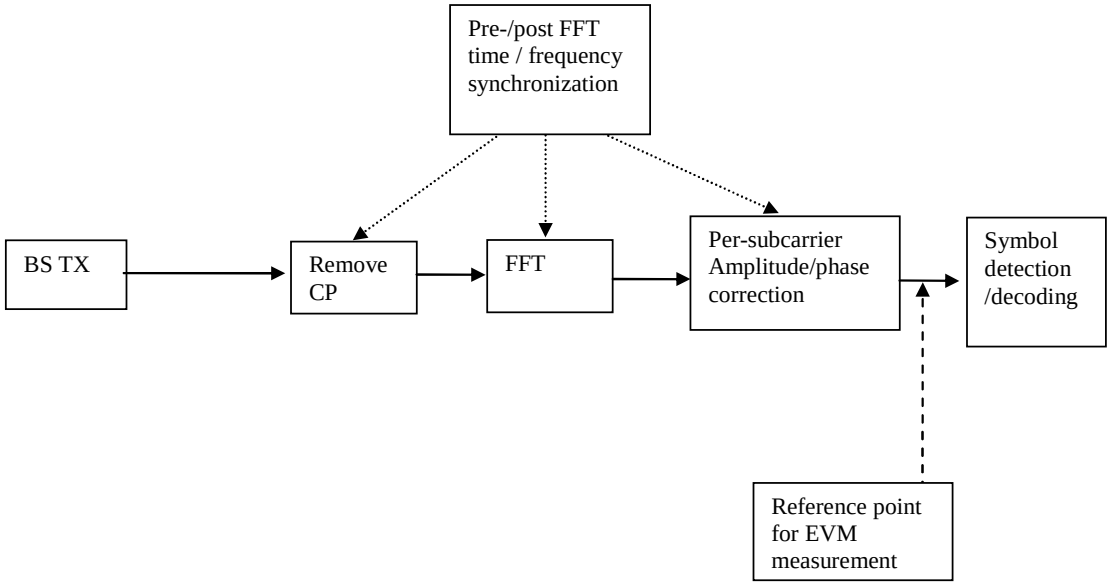

Figure E.1-1: Reference point for EVM measurement

E.2 Basic unit of measurement

The basic unit of EVM measurement is defined over one subframe (1ms) in the time domain and N_{BW}^{RB} subcarriers (180kHz) in the frequency domain:

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

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 E.3.

Note: Although the basic unit of measurement is one subframe, the equalizer is calculated over 10 subframes measurement period to reduce the impact of noise in the reference symbols.

E.3 Modified signal under test

Implicit in the definition of EVM is an assumption that the receiver is able to compensate a number of transmitter impairments. The signal under test is equalised and decoded according to:

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

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. Note that two timing offsets are determined, the corresponding EVM is measured and the maximum used as described in E.7.

$\Delta\tilde{f}$ 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.

E.4 Estimation of frequency offset

The observation period for determining the frequency offset $\Delta\tilde{f}$ shall be 1 ms.

E.5 Estimation of time offset

The observation period for determining the sample timing difference $\Delta\tilde{t}$ shall be 1 ms.

In the following $\Delta\tilde{c}$ represents the middle sample of the EVM window of length W (defined in E.5.1) or the last sample of the first window half if W is even.

$\Delta\tilde{c}$ is estimated 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

Two values for $\Delta\tilde{t}$ are determined:

$\Delta\tilde{t}_l = \Delta\tilde{c} + \alpha - \left\lfloor \frac{W}{2} \right\rfloor$ and

$\Delta\tilde{t}_h = \Delta\tilde{c} + \left\lfloor \frac{W}{2} \right\rfloor$ where $\alpha = 0$ if W is odd and $\alpha = 1$ if W is even.

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

E.5.1 Window length

Table E.5.1-1 below specifies EVM window length (W) for normal CP, the cyclic prefix length N_{cp} is 160 for symbols 0 and 144 for symbols 1-6.

Table E.5.1-2 specifies the EVM window length (W) for extended CP, the cyclic prefix length N_{cp} is 512.

Table E.5.1-1 EVM window length for normal CP

Channel Bandwidth MHz	FFT size	Cyclic prefix length for symbols 0 in FFT samples	Cyclic prefix length for symbols 1-6 in FFT samples	EVM window length *W*	Ratio of *W* to total CP for symbols 1-6* [%]
1.4	128	10	9	5	55.6
3	256	20	18	12	66.7
5	512	40	36	32	88.9
10	1024	80	72	66	91.7
15	1536	120	108	102	94.4
20	2048	160	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.

Table E.5.1-2 EVM window length for extended CP

Channel Bandwidth [MHz]	FFT size	Cyclic prefix in FFT samples	EVM window length *W*	Ratio of *W* to total CP * [%]
1.4	128	32	28	87.5
3	256	64	58	90.6
5	512	128	124	96.9
10	1024	256	250	97.7
15	1536	384	378	98.4
20	2048	512	504	98.4

* Note: These percentages are informative.

E.6 Estimation of TX chain amplitude and frequency response parameters

The equalizer coefficients $\tilde{a}(t, f)$ and $\tilde{\varphi}(t, f)$ are determined as follows:

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. The equalizer coefficients for amplitude and phase $\hat{a}(t, f)$ and $\hat{\varphi}(t, f)$ at the reference signal subcarriers are obtained by computing the moving average in the frequency domain of the time-averaged reference signal subcarriers, i.e. every third subcarrier. 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 E.6-1.

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.

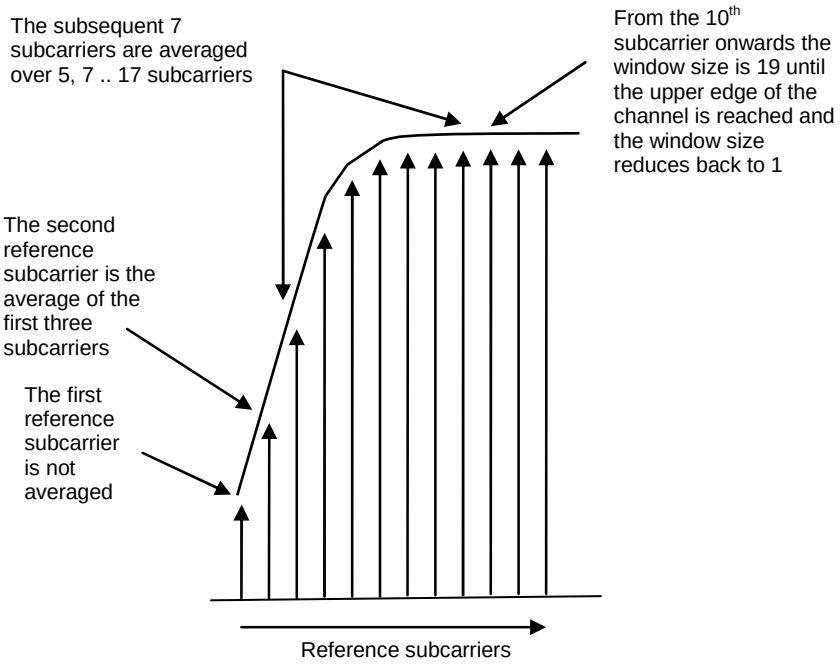

Figure E.6-1: Reference subcarrier smoothing in the frequency domain

E.7 Averaged EVM

EVM is averaged over all allocated downlink resource blocks with the considered modulation scheme in the frequency domain, and a minimum of 10 downlink subframes:

For FDD the averaging in the time domain equals the 10 subframe duration of the 10 subframes measurement period from the equalizer estimation step.

For TDD the averaging in the time domain can be calculated from subframes of different frames and should have a minimum of 10 subframes averaging length. TDD special fields (DwPTS and GP) are not included in the averaging.

$$\overline{EVM_{frame}} = \sqrt{\frac{1}{\sum_{i=1}^{N_{dl}} Ni} \sum_{i=1}^{N_{dl}} \sum_{j=1}^{Ni} EVM_{i,j}^{2}}$$

Where Ni is the number of resource blocks with the considered modulation scheme in subframe i and N_{dl} is the number of allocated downlink subframes in one frame.

The EVM requirements shall be tested against the maximum of the RMS average at the window W extremities of the EVM measurements:

Thus $\overline{\mathrm{EVM}}_{\mathrm{frame},1}$ is calculated using $\Delta\tilde{t} = \Delta\tilde{t}_l$ in the expressions above and $\overline{\mathrm{EVM}}_{frame,h}$ is calculated using $\Delta\tilde{t} = \Delta\tilde{t}_h$ in the $\overline{EVM_{frame}}$ calculation.

Thus we get:

$$EVM_{frame} = \max(\overline{\mathrm{EVM}}_{\mathrm{frame},1}, \overline{\mathrm{EVM}}_{frame,h})$$

The averaged EVM with the minimum averaging length of at least 10 subframes is then achieved by further averaging of the EVM_{frame} results

$$\overline{EVM} = \sqrt{\frac{1}{N_{frame}} \sum_{k=1}^{N_{frame}} EVM_{frame,k}^{2}}\ ,\ N_{frame} = \left\lceil \frac{10}{N_{dl}} \right\rceil$$

Annex F (Informative): Unwanted emission requirements for multi-carrier BS

F.1 General

In subclause 6.6, unwanted emission requirements for single carrier or multi-carrier BS are specified. This multi-carrier BS corresponds to a multi-carrier BS of the same channel bandwidth for E-UTRA. The following two pragmatic scenarios are considered in this annex:

- multi-carrier BS of different E-UTRA channel bandwidths: Only 5 MHz and higher channel bandwidths (less than 5 MHz is FFS)
- multi-carrier BS of E-UTRA and UTRA

Only multi-carrier BS with contiguous carriers are considered. The guidelines below assumes that the power spectral density of the multiple carriers is the same. All other combinations of multiple carriers are ffs.

Note 1: Further information and analysis for these scenarios can be found in TR 36.942 [9].

F.2 Multi-carrier BS of different E-UTRA channel bandwidths

For a multi-carrier E-UTRA BS transmitting a group of carriers of different channel bandwidths (≥5 MHz), the channel bandwidth of the outermost carriers should be considered for ACLR and Operating band unwanted emission requirements. That is, the corresponding requirements for the channel bandwidth of each of the outermost carriers should be applied at the respective side of the group of transmitted carriers.

F.3 Multi-carrier BS of E-UTRA and UTRA

For a multi-carrier BS transmitting a group of carriers of E-UTRA and UTRA, the RAT being used on the outermost carriers should be considered for ACLR and Operating band unwanted emission requirements. That is, the corresponding requirements for the RAT being used on each of the outermost carriers should be applied at the respective side of the group of transmitted carriers.

Annex G (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2007-08	RAN4#44	R4-071465			TS skeleton created from 3GPP TS template.		0.0.1
2007-10	RAN4#44 bis	R4-071709			Agreed TP in RAN4#44: **R4-071466**, "TP Common definitions for TS 36.104"	0.0.1	0.0.2
2007-10	RAN4#44 bis	R4-071782			Agreed TP in RAN4#44bis: **R4-071681**, "TP 36.104: General (6.1)". **R4-071740**, "E-UTRA FDD BS general receiver requirements".	0.0.2	0.1.0
2007-11	RAN4#45	R4-072157			Agreed TP in RAN4#45: **R4-071854**, "E-UTRA FDD BS Reference sensitivity level" **R4-071858**, "E-UTRA FDD BS Receiver intermodulation" **R4-071859**, "E-UTRA FDD BS Fixed Reference Channels" **R4-071860**, "E-UTRA FDD BS In-channel selectivity" **R4-071964**, "TS 36.104: TP for Unwanted emissions (6.6)" **R4-071968**, "TS 36.104: TP for Tx Intermodulation (6.7)" **R4-071969**, "TS 36.104: TP for Rx spurious emissions (7.6)" **R4-072123**, "TS 36.104: TP for General (4)" **R4-072124**, "TS 36.104: TP for Operating band unwanted emissions (6.6.3)" **R4-072126**, "E-UTRA FDD BS Dynamic range" **R4-072127**, "E-UTRA FDD BS Adjacent channel selectivity and narrow band blocking" **R4-072128**, "TS 36.104: TP for Propagation conditions for BS (Annex B)" **R4-072130**, "E-UTRA FDD BS Blocking" **R4-072155**, "TS 36.104: TP for Occupied bandwidth (6.6.1)" **R4-072162**, "TP to 36.104 on performance requirements" **R4-072177**, "TS 36.104: TP for Frequency bands and channel arrangement (5)" **R4-072185**, "TS 36.104: TP for ACLR (6.6.2)" **R4-072205**, " TS 36.104: TP for Transmitter spurious emissions (6.6.4)"	0.1.0	0.2.0
2007-11	RAN#38	RP-070975			Presentation to TSG	0.2.0	1.0.0
2007-11					Approved version at TSG RAN #38	1.0.0	8.0.0
2008-03	RAN#39	RP-080123	3	2	Combined updates of E-UTRA BS RF requirements	8.0.0	8.1.0
2008-05	RAN#40	RP-080325	4		Updates of E-UTRA BS requirements	8.1.0	8.2.0
2008-09	RAN#41	RP-080640	7	2	LTE BS ON-OFF Mask	8.2.0	8.3.0
2008-09	RAN#41	RP-080640	8		Removal of brackets for LTE BS RF requirements	8.2.0	8.3.0
2008-09	RAN#41	RP-080640	14	1	Unwanted emission requirements for multi-carrier BS	8.2.0	8.3.0
2008-09	RAN#41	RP-080640	15	2	Clarification of emission requirements for co-existence	8.2.0	8.3.0
2008-09	RAN#41	RP-080640	17	1	eNB performance requirements for UL timing adjustment	8.2.0	8.3.0
2008-09	RAN#41	RP-080640	18		eNodeB performance requirements for PUCCH format 2	8.2.0	8.3.0
2008-09	RAN#41	RP-080640	21		eNB performance requirements for highs speed train	8.2.0	8.3.0
2008-09	RAN#41	RP-080640	23		Additional band 17	8.2.0	8.3.0
2008-09	RAN#41	RP-080641	5	2	Updates of Fixed Reference Channels	8.2.0	8.3.0
2008-09	RAN#41	RP-080641	9		Removal of brackets and notes related to test requirements	8.2.0	8.3.0
2008-09	RAN#41	RP-080641	10		High Speed Train scenarios modification	8.2.0	8.3.0
2008-09	RAN#41	RP-080641	12		Several modifications for TS36.104	8.2.0	8.3.0
2008-09	RAN#41	RP-080641	13		Removal of notes on frequency offset	8.2.0	8.3.0
2008-09	RAN#41	RP-080641	16	1	LTE Abbreviations update	8.2.0	8.3.0
2008-09	RAN#41	RP-080641	19	1	eNodeB performance requirements for PUSCH and RF requirements	8.2.0	8.3.0
2008-09	RAN#41	RP-080641	20		Clarification on High Speed train model in 36.104	8.2.0	8.3.0
2008-09	RAN#41	RP-080641	22	1	Clarification of ACLR for multi-carrier E-UTRA BS	8.2.0	8.3.0
2008-12	RAN #42	RP-080914	37	1	Editorial updates of TS 36.104	8.3.0	8.4.0
2008-12	RAN #42	RP-080915	30		Correction to the figure with the transmission bandwidth configuration		
2008-12	RAN #42	RP-080916	77		Modification to EARFCN		
2008-12	RAN #42	RP-080917	38	1	Alignement of clause 5 betweeb E-UTRA specs		
2008-12	RAN #42	RP-080918	26		Correction of output power dynamics requirement		
2008-12	RAN #42	RP-080918	27		LTE BS ON-OFF Mask		
2008-12	RAN #42	RP-080918	28		Correction to RE power control dynamic range		
2008-12	RAN #42	RP-080919	29	1	BS RF requirements for Band 17		
2008-12	RAN #42	RP-080920	41		Update of total dynamic range limits		
2008-12	RAN #42	RP-080921	39	1	Update of TDD-FDD coexistance requirements		
2008-12	RAN #42	RP-080922	33	1	eNB performance requirements for Multi User PUCCH		
2008-12	RAN #42	RP-080922	42		PRACH demodulation requirements update		

2008-12	RAN #42	RP-080922	25	1	Updates of Fized Reference Channels and requirements for UL timing adjustment and PUCCH format 2		
2008-12	RAN #42	RP-080922	44		eNB performance requirements for HARQ-ACK multiplexed on PUSCH		
2008-12	RAN #42	RP-080923	43		General updates to Clause 8 and appendix A		
2008-12	RAN #42	RP-080925	24		LTE TDD Update for Annex E of 36.104		
2008-12	RAN #42	RP-080927	32	1	Clarification of eNB HST propagation conditions		
2008-12	RAN #42	RP-080927	31		Corrections of eNB performance requirements for high speed train		

History

Document history		
V8.2.0	November 2008	Publication
V8.3.0	November 2008	Publication
V8.4.0	January 2009	Publication